Biosystems Engineering for sustainable agriculture, forestry and food production

International Mid-Term Conference 2019
Italian Association of Agricultural Engineering (AIIA)

Potenza/Matera, University of Basilicata, September 12-13, 2019

Biosystem Engineering for sustainable agriculture, forestry and food production

Conference Proceedings Book

https://sites.google.com/unibas.it/aiiamatera2019

Matera, 12-13 September 2019

Organization

SAFE - School of Agriculture, Forestry, Food and Environmental Sciences - University of Basilicata, with the technical support of Ninetek Innovazioni per l'Agro-industria s.r.l., spin-off company of the University of Basilicata

Presentation

Sustainable development of agriculture, forestry, and food production sectors is closely related to the research developments in the field of biosystems engineering. On one side, biosystems research is oriented to efficiently produce and process biological resources to satisfy the demand of consumers and a wide range of industries for food, feed, bio-energy and bio-based products. At the same time, it provides and develops engineering-based methodologies and decision support tools for management and protection of soil, water and environmental resources; design of structures, facilities, equipment and infrastructures; planning and design of rural areas and landscape; mechanization and technologies for agricultural production; agricultural electrification and energy usage; ergonomics and work organization and safety; computer and communication technologies.

Matera, 12 September 2019

The Organizing Committee

- Antonio Coppola
- Giovanni Carlo Di Renzo
- Giuseppe Altieri
- Paola D'Antonio
- Alessandro Comegna
- Francesco Genovese
- Attilio Matera
- Luciano Scarano
- Luigi Gioviale
- Cosimo Marano

Table of Contents

1 Foreword

The aim of this Conference is to stimulate contributions related to the engineering technological applications to the agriculture, forestry, and agro-food sectors. Researchers involved in activities related to Biosystems and Agricultural Engineering, as well as Agricultural, Forestry and Food Engineers, farm and food company managers are warmly invited to attend the Conference.

The Conference will deal with the following major topic

Innovative biosystems engineering for sustainable agriculture, forestry and food production

The specific subjects will include (but not will be limited to)

- Agricultural hydraulics
- Water resources management in agriculture and forestry ecosystem
- Design and management of Farm and District-Scale Irrigation Systems
- Remote Sensing in agricultural and forestry systems
- Monitoring and modeling of the interactions among soil hydrological, plant and atmosphere processes, and agricultural management practices
- Soil and contaminant hydrology
- Forestry hydraulics and hydraulics protection of agricultural and forestry systems
- Bioengineering Techniques for soil protection and slope stabilization
- Rural buildings, facilities and territory
- Spatial and landscape analysis
- Planning and design of rural areas
- Mechanization and technologies for agricultural production
- Agricultural electrification and energy usage
- Ergonomics and work organization
- Computer and communication technologies
- Machines and facilities for agricultural products and food processing

2 The AIIA Society

President

Giacomo Scarascia Mugnozza

University of Bari

Vice President

Giuseppe Giordano

University of Palermo

The ***Italian Society of Agricultural Engineering*** (AIIA) was founded in 1959, as a national association belonging to the ***Commission Internationale du Génie Rural*** (CIGR). AIIA adheres to the CIGR in all its direct and indirect forms and represents it nationally. AIIA also adheres to the ***European Society of Agricultural Engineers*** (EurAgEng), a European member of the CIGR. Furthermore AIIA, along with other scientific societies pertaining to the agricultural, forestry, agro-industrial and environmental sectors, it is part of the ***Italian Society of Agricultural Scientific Societies*** (AISSA).

The ***Italian Society of Agricultural Engineering*** coordinates and develops initiatives in the field of agricultural engineering, i.e. those scientific and technical disciplines related to engineering works applied to the development of agricultural and forestry systems, favouring the exchange of experiences and research results among sector scholars. AIIA promotes initiatives involving application of engineering principles to the processes that govern territorial phenomena in order to study, model and enhance biological systems for a sustainable development of agriculture, food production, land use and environment safety. AIIA is particularly active in networking between scholars and experts in the various sectors of agricultural engineering and biosystems, with reference to research, innovation, development, technology transfer and training.

AIIA periodically promotes and organizes, also together with other entities and associations, conferences, seminars and meetings involving stakeholders, public and private, with the aim of facilitating the encounter of research and training, innovation and development demand, and to promote the creation and dissemination of new knowledge in the sector.

In particular, the ***Italian Society of Agricultural Engineering*** pursues the following aims:

- bring its technical and scientific contribution to questions of general interest in the field of Agricultural Engineering;
- foster relations between scholars and operators dedicated to Agricultural Engineering;
- promote the development of Agricultural Engineering in its various branches;
- encourage, coordinate and perform - also on behalf of third parties - research in the field of Agricultural Engineering, also by setting up specific centres;
- encourage the training of technicians specialized in Agricultural Engineering by means of teaching courses, scholarships and similar facilities;
- promote activities and events for dealing with historical and cultural issues concerning Agricultural Engineering;
- promote and maintain connections with similar Italian and foreign institutions;

- promote study events for dealing with issues and problems of a scientific and technical nature relevant to Agricultural Engineering.

The ***Journal of Agricultural Engineering***, an international journal with peer review, is the official organ of the Association.

The ***Italian Society of Agricultural Engineering*** is divided into the following Technical Sections:

- ***1st Section - Land and water use;***
- ***2nd Section - Rural buildings, plants and territory;***
- ***3rd Section - Mechanization and technologies for agricultural production;***
- ***4th Section - Agricultural electrification and use of energy;***
- ***5th Section - Ergonomics and work organization;***
- ***6th Section - Machines and plants for processing agricultural production;***
- ***7th Section - Information and communication technologies.***

Members of AIIA are professors and researchers who are part of the main groups active in research and training in the sector in Italy at Universities and Research Institutes, and other scholars and experts, technicians, professionals, companies, institutes and university departments, public bodies and private.

AIIA (*Italian Society of Agricultural Engineering*)

Italian Society of Agricultural Engineering
(Associazione Italiana di Ingegneria Agraria)
Via Venafro, 5
00159 ROMA (RM)
Phone: +39 06 40860027
Fax: +39 06 4076264
info@aiia.it
http://www.aiia.it/

3 AIIA Section 1 - Land and water use

President

Antonio Coppola

University of Basilicata

Vice President

Federico Preti

University of Firenze

3.1 PURPOSE

The 1st Section aims to promote scientific progress in the methods, tools and technologies for the monitoring and management of agro-forestry and environmental systems. Particular importance is given to the aspects of conservation of water and soil resources, to the maintenance or restoration of balanced environmental balances, to the socio-economic implications linked to the use of soil and water. The priority areas of investigation and intervention are those of agricultural areas and rural and forest areas, with an open vision to interactions with near-urban and urban areas, to ensure the integrated and harmonious development of the territory and society as a whole.

3.2 TOPICS OF INTEREST

Specific topics of interest are: agricultural hydraulics and agricultural, forest and soil hydrology; integrated management of water resources, irrigation, drainage, reclamation and water systems for agriculture and the agro-food industry; soil erosion, hydro-geological instability, hydraulic-forest arrangements, soil protection interventions including naturalistic engineering and environmental requalification of water courses; mathematical models and techniques for monitoring and remote sensing of hydrological processes in agro-forestry systems, protection of soil and water from pollution of agricultural origin, as well as purification techniques and the use of unconventional water for irrigation purposes.

4 AIIA Section 1 – Oral Presentations

Oral Presentations

CODE: 021

1a sezione – Oral presentation

4.1 A CHECK OF WATER DROP IMPACT EFFECTS ON SURFACE SOIL SATURATED HYDRAULIC CONDUCTIVITY

Francesca Todisco[1], Vincenzo Bagarello[2], Lorenzo Vergni[1], Alessandra Vinci[1]

[1]University of Perugia, Dep. Scienze Agrarie, Alimentari ed Ambientali DSA3.
[2]University of Palermo, Dep. Dipartimento Scienze Agrarie, Alimentari e Forestali

Abstract

The saturated soil hydraulic conductivity, K_s, may change soon after tillage due to soil structure reorganization processes that can also be influenced, at the soil surface, by rainfall impact. Testing rainfall impact effects on K_s may improve interpretation and simulation of surface soil hydrological processes, especially in agricultural environments.

The post-tillage dynamics of surface soil K_s was studied at the Masse experimental station (central Italy, silty-clay-loam soil). The experiment was performed by rainfall simulation, on two replicated micro-plots (width 1 m, length 0.92 m, slope 16%) established on bare soil, according to the following scheme: tillage, wetting 1 phase (rainfall with low intensity, i.e. 40 mm/h, and low kinetic energy), simulation 1 phase (rainfall with high intensity, i.e. 70 mm/h, and high kinetic energy), suspension for some days, wetting 2 phase, simulation 2 phase, suspension for some days, wetting 3 phase, simulation 3 phase. The experiment was replicated two times on plot 1 and three times on plot 2, with a pause of a few months between two replicated experiments on a plot. The gravimetric soil water content, w, was measured before wetting and both before and after simulation. Runoff was measured at 5 min intervals. The infiltration rate was calculated as the difference between rainfall intensity and runoff rate. Finally, K_s was assumed to be equal to the infiltration rate under the nearly steady conditions reached at the end of each simulation phase. For each individual experiment, the relationship between K_s and the energy, E, dissipated at the soil surface was examined by two alternative scenarios: i) energy of the simulation phase only, E_s; and ii) total energy, i.e. also including the energy dissipated for wetting (E_w).

The ante wetting, w, values were quite low and they increased during wetting, reaching at the end of this phase a value that remained more or less stable during the simulation phase. Consequently, all changes of K_s were expected to be specifically attributable to mechanical modifications of the porous medium occurring as a consequence of raindrop impact.

On average, the decrease of K_s was noticeable in the passage from simulation 1 (25.7 mm/h) to simulation 2 (8.4 mm/h, -67.2%) but it was less pronounced in the passage from simulation 2 to simulation 3 (5.1 mm/h, -39.4%). The variability of K_s was highest for the first simulation (CV = 77%) and it decreased to a nearly constant value for the two subsequent simulations (CV = 41-44%). For each individual experiment, K_s decreased with E. The goodness of the fit was similar for the K_s vs. E_s and K_s vs. E_s+E_w relationships. Therefore, the dissipated energy during the simulation phase of the experiment had a prevalent effect on the K_s dynamics. The best relationships (highest coefficients of determination, R^2) had an exponential or a power shape, depending on the experiment. In some cases, the K_s vs. E relationships were excellent while in other cases they appeared less robust even though the general decreasing trend was always captured.

In conclusion, raindrop impact had a noticeable effect on K_s, with a high reduction of both the average value and its variability, when it occurred on an initially tilled soil. An event with similar perturbative characteristics had a more limited effect on K_s (smaller decrease of the mean value and unchanged variability) when it fell on a surface that was already subjected to a previous disturbance process after tillage.

The developed experimental methodology appears usable to determine raindrop impact effects on the saturated hydraulic conductivity of surface soil in highly controlled field conditions and it could be applied to develop K_s vs. E relationships usable for numerically simulating surface soil hydrological processes.

CODE: 006

Reference topic: Erosione, difesa del suolo e riqualificazione fluviale
I Sezione AIIA - Utilizzazione del suolo e delle acque

4.2 A COMPREHENSIVE CHECK OF USLE-BASED SOIL LOSS PREDICTION MODELS AT THE SPARACIA (SOUTH ITALY) SITE

V. Bagarello[1*], V. Ferro[2], V. Pampalone[1]

[1] Department of Agricultural, Food and Forest Sciences, University of Palermo, Viale delle Scienze, Building 4, 90128 Palermo, Italy
[2] Department of Earth and Marine Science, University of Palermo, Via Archirafi 20, 90123 Palermo, Italy
[*] Corresponding author, e-mail address vincenzo.bagarello@unipa.it

Developing simple and reliable analytical tools to predict event soil erosion rates at the plot scale is necessary in the perspective of a sustainable land management since accelerated soil water erosion affects adversely the natural and anthropogenic environments. Improving empirical models, such as those USLE-based, has still a large interest since these models require few input data. The general definition of the event rainfall-runoff erosivity factor for the USLE-based models is $REF_e = (Q_R)^{b1}(EI_{30})^{b2}$ in which Q_R is the event runoff coefficient, EI_{30} is the single-storm erosion index and b_1 and b_2 are coefficients. The rainfall erosivity factor of the original USLE is obtained for $b_1 = 0$ and $b_2 = 1$. The condition $b_1 = b_2 = 1$ corresponds to the USLE-M. The case $b_1 \neq 1$ and $b_2 = 1$ was named USLE-MB. Another possible case, named USLE-MR, is $b_1 = 1$ and $b_2 \neq 1$. When $b_1 = b_2$ is different from 1, the USLE-MM is obtained. The last possible case is that $b_1 \neq b_2$ and both exponents differ from one (USLE-M2). The different expressions of REF_e have never been tested simultaneously. The general objective of this investigation was to simultaneously check, for the Sparacia (Sicily, Italy) experimental station, all possible expressions of the rainfall-runoff erosivity factor against a database of bare plot soil losses that includes 641 normalized event soil loss, A_{eN}, values obtained on plots varying in length from 11 to 44 m and in steepness from 9% to 26%. As expected, the poorest performances were obtained with the USLE, probably due to the lack of any experimental information on event runoff. The tendency to overestimate small normalized soil losses and underestimate high normalized soil losses was clear for this model but it was greatly reduced by introducing in the soil loss prediction model both the runoff coefficient and an exponent for the erosivity term. A distinction was made among the four power-type models (USLE-MB, USLE-MR, USLE-MM, USLE-M2) since the fitting to the data was poor with the USLE-MR (coefficient of determination, $R^2 = 0.38$) as compared with the other three models, yielding higher and relatively similar R^2 values ($R^2 = 0.63$-0.72). Estimating two distinct exponents (one for EI_{30} and another for Q_R, USLE-M2) instead of one exponent only (USLE-MB, USLE-MR, USLE-MM) did not allow to appreciably improve soil loss prediction. The USLE-MB and the USLE-MM performed similarly in terms of both residuals and prediction errors with reference to both the complete dataset and different sub-datasets, only including small ($A_{eN} \leq 1$ Mg ha^{-1}), intermediate ($10 < A_{eN} \leq 10$ Mg ha^{-1}) and severe ($A_{eN} > 10$ Mg ha^{-1}) erosion events. Therefore, the first conclusion was that including the runoff coefficient in the empirical soil prediction model is important to improve the quality of the event soil loss predictions but a great importance has to be paid to the mathematical structure of the model since very different results can be obtained starting from the same experimental information. Further research should be focused on the USLE-MB and the USLE-MM among the possible alternatives. Both models are expected to yield normally distributed and homoscedastic residuals. The USLE-MM has to be considered since it was characterized by better statistical indices (R^2, root mean square error, bias) than the USLE-MB. The USLE-MB has to be considered since, unlike from the former model, it can theoretically be deduced by applying the dimensional analysis and self-similarity, and the baseline component of soil erodibility, which is representative of the soil intrinsic and quasi-static properties, has the same measurement units of the K factor of the USLE and it can be corrected by an hydrological component which takes into account the effect of the event variability.

CODE: 056

Reference topic: Bioengineering Techniques for soil protection and slope stabilization

4.3 BIODEGRADABLE GEOSYNTHETICS FOR GEOTECHNICAL AND GEO-ENVIRONMENTAL ENGINEERING

Alessio Cislaghi[1,2], Paolo Sala[1], Gigliola Borgonovo[3], Claudio Gandolfi[1], Gian Battista Bischetti[1,2]

[1] Department of Agricultural and Environmental Sciences, University of Milan, Via Celoria 2, 20133 Milan, Italy
[2] Centre of Applied Studies for the Sustainable Management and Protection of Mountain Areas (Ge.S.Di.Mont.), University of Milan, Via Morino 8, 25048 Edolo (Brescia), Italy
[3] Department of Food, Environmental and Nutritional Sciences, University of Milan, Via Mangiagalli 25, 20133 Milan, Italy

Corresponding author
Alessio Cislaghi, Department of Agricultural and Environmental Sciences, University of Milan, Via Celoria 2, 20133 Milan, Italy. Phone: +39 02 503 16903

Abstract
Among the commonly used plastic materials in geotechnical engineering, building and construction sectors, the most significant fraction consists in geosynthetics, which are all products used in contact with soil or rock for stabilizing soil layers. Unfortunately, the application of these products involves environmental risks associated with their degradation, which causes the release of potentially toxic micro-particles in the soil. Hence, a strong interest in testing biodegradable polymers of natural origin has been increasing for taking up the principles of Circular Economy (an economic paradigm developed by the European Community) and for finding alternative materials with adequate mechanical properties for geotechnical and geo-environmental applications.
The main aim of this study is to evaluate chemical and mechanical characteristics of these bioplastic materials for producing geogrids. In particular, it focuses on those materials already on the market and commonly sold as filaments for 3D printers. Among these materials, the most widely known is the poly(lactic acid) or PLA, a biopolymer derived from the fermentation of carbohydrates of vegetable origin. PLA can be produced either in a pure form or combined with processing waste of other vegetable fibers such as hemp, cork and wood.
On several selected materials, laboratory tests were carried out to evaluate the chemical purity of the biodegradable products through the analysis of optical rotary dispersion and the magnetic resonance spectroscopy. Later, the filaments were used to print samples of geogrids with different shapes at 1:5 scale using a professional 3D printer based on FFF (Fused Filament Fabrication) technology. Subsequently, tensile tests were performed on the filaments and on the samples of geogrids.
The chemical analyses showed that these products are composed by at least 80% of PLA, even when combined with other organic materials. Tensile tests measured that the maximum tensile resistance ranges from 2.7 to 25 kN/m. By comparing the tested materials, it can be noticed that PLA in pure form is approximately 30% more resistant than those biopolymers containing other vegetable fibers. Moreover, the mechanical properties of PLA are comparable, but naturally less than those characteristics measured for plastic geogrids commonly present on the market.
Finally, these results are encouraging and can support a possible application of PLA for the production of innovative geosynthetics, which can be used in combination with live plants because of the lower tensile strength resistance.

CODE: 054

Topic: Water resources management in agriculture and forestry ecosystem Proposal: Oral presentation

4.4 CHARACTERIZATION OF CONSTRUCTED WETLAND SUBSTRATES AND EVALUATION OF THEIR HYDRAULIC BEHAVIOR

Feliciana Licciardello[1*], Massimo Iovino[2], Delia Ventura[1], Alessandro Sacco[1], Giuseppe Cirelli[1] and Salvatore Barbagallo[1]

[1] *University of Catania - Department of Agriculture, Food and Environment*

[2] *University of Palermo - Department of Agricultural, Food and Forest Sciences*

Green infrastructures, as constructed wetlands, play an important role in wastewater treatment and reuse particularly in small communities and agro-industrial activities.

As part of the treatment process, filter media of constructed wetlands (CWs) will gradually become clogged due to factors related to influent characteristics, system design and bed activities. The development of clogging can be detected by the appearance of water on the surface of the granular medium and it could reduce the treatment performance. The phenomenon is very variable in space, being generally most severe within the first few meters of the CW but, sometimes, it also occurs close to the outlet area.

Hydraulic behavior of CWs can be investigated *in situ* by means of hydraulic conductivity (K_s) measurements, clog matter characterizations as well as hydrodynamic visualizations. The suitability of available measurement techniques, in terms of accuracy, repeatability as well as time and skill required, can vary depending on the substrate type, system design as well as clogging degree and distribution. In order to investigate the suitability of measurement techniques to assess the spatial and temporal evolution of clogging in pilot and full scale CWs, a monitoring campaign started few years ago. The full scale CW works as secondary wastewater (WW) treatment system of the Ikea®, located in the industrial district of Catania, Eastern Sicily, Italy. The pilot scale CW treats alternatively storm water from the Ikea® parking area and the sequential batch reactor WW produced from the retail store. Hydraulic conductivity measurements were carried out only in the horizontal subsurface CW beds by falling head tests specifically developed to detect high K_s values. In particular, different schemes and equations for the

Lefranc's test were compared employing also a new type of *in situ* permeameter cell. The implemented pervious permeameter used with a calibrated equation was the most suitable method to obtain a K_s estimation that account also for the horizontal component of flow. In order to validate the proposed method, other hydraulic measurement techniques were tested. In particular, tracer tests were carried out by pulse–injecting a sodium chloride solution into the inlet pipe of the hydraulic system and then measuring WW electric conductivity at different sites within the bed to assess the K_s variations.

**Corresponding author:* Feliciana Licciardello, University of Catania - Department of Agriculture, Food and Environment, Via S. Sofia, 100 – 95123, Catania, Italy, Phone: +390957147551, Fax: +390957147600 Email: feliciana.licciardello@unict.it

CODE: 016

Spatial and landscape analysis

4.5 EVALUATING THE EFFECTS OF FOREST COVER CHANGES ON SEDIMENT CONNECTIVITY IN A CATCHMENT AFFECTED BY MULTIPLE WILDFIRES.

Martini L. [1], Faes L. [1], Scalari C. [1], Pellegrini G.[1], Iroumé A. [2], Lenzi M.A.[1] and Picco L. [1,3,4]

[1] University of Padova, Department of Land, Environment, Agriculture and Forestry, Padova, Italy

[2] Universidad Austral de Chile, Faculty of Forest Sciences and Natural Resources, Valdivia, Chile.

[3] Universidad Austral de Chile, Faculty of Engineering, Valdivia, Chile.

[4] Universidad Austral de Chile, Rina – Natural and Anthropogenic Risks Research Center, Valdivia, Chile.

Submitted for oral presentation;

presenting author: lorenzo.martini.2@phd.unipd.it, TESAF dep., viale dell'Università 16, Legnaro (PD).

ABSTRACT

Wildfires occurrence and severity are deeply studied in Mediterrenean catchments but the fire-related impacts on the hydrogeomorphic properties of river basins is scarcely studied in South American sites. Fire affects river systems by altering the forest cover, decreasing the soil infiltration capacity, modifying the sediment yields and channel instability and leading to in-channel wood recruitment. To study the effect of the disturbance in the sediment routing, analysis of sediment connectivity, i.e. the degree of linkage between source and sink areas, has been recently used. The main aim of the present research is to adapt and apply the Index of Connectivity (IC) in a Chilean catchment (Rio Toro, extension 18 km^2) affected by multiple wildfires in 2002 and 2015. Specific objectives involve the derivation of fire severity maps of both wildfires, and the development of a weighting factor, which properly represents the impedance to sediment fluxes. We made use of multi-temporal satellite images (Landsat 4-5 TM; Landsat 8) and sampling plots to carry out the fire severity maps and then the Normalized Difference Vegetation Index (NDVI) for the computation of the weighting factor maps used in the connectivity analysis. Therefore, the multi-temporal analysis of sediment connectivity accounts for changes in land cover due to the impact of wildfires. Preliminary results demonstrated not only the applicability of this approach, which permitted to highlights the changes in IC patterns, but even the predominant changes in forest cover as well as the preferential sources of sediment and large wood within the basin.

CODE: 086

Topic: Water resources management in agriculture and forestry ecosystem; AIIA section: 1°

4.6 GROUNDWATER RECHARGE THROUGH WINTER FLOODING OF RICE AREAS

Arianna Facchi[1]*, Camilla Negri[1], Michele Rienzner[1], Enrico Chiaradia[1], Marco Romani[2]

[1] Dipartimento di Scienze Agrarie e Ambientali – Produzione, Territorio, Agroenergia, Università degli Studi di Milano (DiSAA-UNIMI), via Celoria 2, 20133 Milano
[2] Centro Ricerche Riso, Ente Nazionale Risi (CRR-ENR), strada per Cerretto, Pavia
[*] Author for correspondence: arianna.facchi@unimi.it

Proposal: Oral presentation

Recent researches suggest that groundwater overdraft can be mitigated by diverting flood waters onto agricultural lands for direct groundwater recharge (Bachand et al., 2016; 2014). This technique is often called Ag-MAR (where Ag stays for *Agricultural* and MAR for *Managed Aquifer Recharge*) and is usually carried out during wintertime, when water is abundant since it is not used for irrigation (Niswonger et al., 2017). Recently, Ag-MAR has been adopted in a few areas of the USA, particularly in California. In Europe, the implementation of winter flooding of rice paddies has been promoted since the late nineties; however, in Northern Italy it was introduced as an agro-environment measure in the EU - RDP 2014-2020 and thus it started to be adopted only recently. If a few studies in recent years have focused on the biodiversity maintenance and agronomic effects of winter flooding, no studies have investigated its impacts on the hydrological balance of rice areas in terms of both groundwater recharge and possible increase of irrigation efficiency during summertime (as a consequence of a higher soil water content and/or lower groundwater depth at seeding time).
Starting from October 2017, the hydrological balance of a 36 hectares (9 adjacent paddies) rice area located in the middle of the Lombardy-Piedmont rice basin (PV) has been under investigation. Winter flooding in the area has been practiced since 2004. Flow meters were installed on the irrigation and drainage channels of the pilot area, piezometers were positioned inside and outside the winter flooded area, and soil surveys (traditional and using EMI sensors) were performed. A conceptual hydrological model simulating the water balance at the paddy field scale was developed, calibrated and applied for scenario simulations. Main results show that: (a) irrigation efficiency of the pilot area during the first summer season is well in line with those found for other paddy areas in the region (WUE: 20-30%); (b) higher percolation rates are observed in wintertime compared to summer season: this can be explained by higher water levels within the fields, lower evaporation processes, lower groundwater levels and, probably, also higher paddy soil hydraulic conductivities in wintertime; (c) despite the higher percolation, groundwater level reached in winter season is slightly lower than in summer, and the groundwater depletion after the end of the flooding period is faster (about 1 month) compared to that observed after the summer flooding (2-2.5 months): this is probably due to the larger and more compacted portion of territory flooded during summer months; (d) to maintain higher groundwater levels at the beginning of the cropping season, which would increase the irrigation efficiency, winter flooding should be maintained longer over time and should involve larger paddy areas.

CODE: 101

Reference topic: Water resources management in agriculture and forestry ecosystem
AIIA first section "Utilizzazione del suolo e delle acque"

Proposed for oral presentation

4.7 HOW DOES EVAPOTRANSPIRATION AFFECT STREAMFLOW? ECOHYDROLOGICAL MONITORING AND MODELLING IN TWO FORESTED CATCHMENTS

G. Zuecco[1], A. Errico[2], M. Bottazzi[3], E. Guastini[2], C. Marchina[1], P. Trucchi[2], F. Preti[2], D. Penna[2], M. Borga[1]

[1]Dept. of Land, Environment, Agriculture and Forestry, University of Padua
[2]Dept. of Agriculture, Food, Environment and Forestry, University of Florence
[3]Department of Civil, Environmental and Mechanical Engineering, University of Trento
Presenting author: G. Zuecco, via dell'Università 16, 35020 Legnaro (PD), Italy, giulia.zuecco@unipd.it

Changes in land use can strongly affect the hydrological response and the water budget of small catchments, due to variations in the evapotranspiration rates. Numerous studies have reported the effect of evapotranspiration on the annual water balance at different spatial scales, but detailed ecohydrological monitoring at the small catchment scale is still needed to improve the estimation of evapotranspiration fluxes and runoff response by hydrological models.
In this study, we used hydrometeorological data from two small and mountainous forested catchments in Italy to i) investigate the hydrological response of the two catchments at seasonal and rainfall-runoff event time scale, and ii) analyze the evapotranspiration rates obtained by the application of a hydrological model.

The Ressi catchment (0.02 km^2) is in the Italian pre-Alps and its climate is oceanic, while the Re della Pietra catchment (2.0 km^2) is in the Apennines and the climate is humid sub-tropical. Meteorological, soil moisture and canopy openness data were collected in the two catchments, and these data were used to perform hydrological simulations with the GEOframe-NewAGE system. The modular structure of the hydrological model allowed for testing different methods to compute evapotranspiration rates, i.e. the Penman-Monteith FAO method, the Priestley-Taylor equation and the new Schymanski-Or method.

Preliminary results show that during the growing season, rainfall-runoff events had large rainfall intensities, short duration and small stormflow volumes. In the Ressi catchment, runoff coefficients varied between 0.1 and 96% (155 events, period: August 2012-November 2016), with event runoff coefficients in summer much smaller than during the rest of the year. In the Re della Pietra catchment, event runoff coefficients in the period July-September were also small and varied between 1.2 and 5.1% (8 events). During dry periods, streamflow tended to decrease in both catchments, but with different dynamics. Strong daily streamflow fluctuations were observed in summer in the Re della Pietra catchment, but not in the Ressi catchment. Preliminary simulations performed with the different methods to estimate evapotranspiration were evaluated using the Nash-Sutcliffe and the Kling-Gupta efficiency, showing generally better results using the Schymanski-Or method.

Acknowledgements: This study is part of the research project "SILVA - Water fluxes between soil, vegetation and atmosphere: a comparative analysis in two Italian forested catchments", funded by Premio Florisa Melone 2018 assigned by the Italian Hydrological Society.

CODE: 087

AIIA first section "Utilizzazione del suolo e delle acque"
Reference topic: Water resources management in agriculture and forestry ecosystem
Presentation request: oral

4.8 HOW DOES TREE WATER UPTAKE CHANGE OVER TIME ALONG A HILLSLOPE?

Ginevra Fabiani[1,2], Daniele Penna[1], and Julian Klaus[2]

[1]Department of Agriculture, Food, Environment and Forestry, University of Florence, Florence, Italy
[2]Luxembourg Institute of Science and Technology (LIST), Department Environmental Research and Innovation, Belvaux, Luxembourg

Presenting author: G. Fabiani, via San Bonaventura, 13, 50145, Florence (FI), Italy; 41, rue du Brill - L-4422 Belvaux, Luxembourg; ginevra.fabiani@unifi.it; ginevra.fabiani@list.lu

Trees connect and modulate water flux from the Earth's surface to the atmosphere and provide several hydrological services including water protection, infiltration and soil development, runoff mitigation and thus reduction of potential flooding. Under the current global warming conditions, forest ecosystems are expected to be the strongly affected by temperature increase and water shortage, requiring more effective and careful forest management practices. To inform science-based sustainable forest management, a holistic comprehension of the interactions and feedbacks between vegetation and the water cycle is needed. Water stable isotopes have been widely used to determine tree water uptake sources (i.e., soil water from different depths, shallow groundwater, stream water), but a detailed understanding of the first order controls (i.e., topography, geology, pedology and environmental conditions) on water uptake dynamics is still missing.
In the present study, we investigate the spatio-temporal dynamic of water sources for beech and sessile oak trees along a hillslope in a Luxembourgish catchment taking advantage of the tracer capability of the stable isotopes of hydrogen and oxygen (^{2}H and ^{18}O). The underlying hypotheses are that i) the landscape position (e.g., bottom-hillslope, mid-hillslope, upper hillslope) determines the accessibility of groundwater for tree water uptake, ii) this accessibility is a function of climate variability, and iii) species-specific uptake pattern exists according to plant root architecture.
Fortnightly field campaigns will be carried out over the whole growing season in 2019 to sample water from xylem, soil water at different depths, groundwater, stream water, and precipitation. Soil water will be measured through direct vapour equilibration and xylem water will be extracted via cryogenic distillation. Grab sampling will be performed for the other potential water source. The isotopic composition will be determined through laser spectroscopy and mass spectrometry (for xylem samples). Sap flow will be also measured at selected trees, and hydro-meteorological data are available on site. To determine the most likely proportional contributions of water sources for the different trees of the two species, a multi-source Bayesian mixing model framework will be used.
In this work we present the preliminary results from this three-year project that will show different proportions of water uptake from trees at different hillslope position over the course of the growing season, and will contribute to obtained a better insight on the factors governing the spatio-temporal variability of tree water uptake in forested environments.

CODE: 065

4.9 HOW MUCH DID RIVER RESTORATION PROJECTS IMPROVE MORPHOLOGICAL QUALITY? STUDY CASES IN SOUTH TYROL.

Andreoli A.[1,*], Steinmann A.[1], Fasano F.[1], Moritsch S.[2], Scorpio V.[1], Hecher P.[3] and Comiti F.[1]

[1] *Faculty of Science and Technology, Free University of Bozen-Bolzano, Bolzano, Italy*

[2] *Institute of Hydrobiology and Aquatic Ecosystem Management, University of Natural Resources and Life Sciences, Vienna, Austria*

[3] *Civil Protection Agency, Autonomous Province of Bolzano, Bolzano, Italy*

[*] *Corresponding Author: andrea.andreoli@unibz.it*

Abstract

This work analyzes the river morphology evolution over 70 years in three river reaches of South Tyrol. Mareit, Ahr and the Eisack rivers underwent the typical degradation trajectory of the 20th century: a strong human pressure during the 1960 - 1980 period, characterized by a general floodplain and riverbed narrowing, dramatic reduction of sediment supply and followed by a massive river engineering interventions. In the last 15 years, the three analyzed reaches have been subject to river restoration actions.

In order to assess the effects of restoration actions, pre- and post-restoration conditions were analyzed through photointerpretation of aerial imagery and analysis of morphological units surfaces through the application of the Geomorphic Units Survey and Classification System, GUS (Rinaldi *et al.*, 2015). A set of aerial pictures from 1945, 1954, 1985, 2011, 2014 and 2017 was analyzed by a GIS in order to interpret and classify river morphologies. Moreover, two digital elevation models (DEM) generated from airborne topographic LiDAR (in 2010) and bathymetric LiDAR (in 2016) were consulted in doubtful situations. Total surface of each geomorphic units was calculated for every analyzed year and compared to assess the historical modification trajectory of the three study reaches.

An overall increase in morphological quality after restoration works has been observed; however, as time passes from restoration actions the Geomorphic Units Richness Index (GUSI-R) and the Geomorphic Units Density Index (GUSI-D) slightly decrease due to a natural readjustment of the river to a new equilibrium condition characterized by weakness of sediment transport (especially coarse) and altered flow regime.

Results outlines how river restoration actions needs to be projected in a watershed context, analyzing the limiting factors that characterize the system and promoting extensive action at the watershed scale that aim to improve the overall quality of the river environment.

Keywords: River Morphological Quality, Geomorphic Units Survey and Classification System (GUS), River Restoration.

Proposed for Oral presentation

CODE: 125

AIIA section: I (AGR08)

Topic: Erosione, difesa del suolo e riqualificazione fluviale

Water resources management in agriculture and forestry ecosystem

Type of presentation: Oral/Poster

4.10 MODELING THE EFFECT OF DIFFERENT MANAGEMENT PRACTICES FOR SOIL EROSION CONTROL IN A MEDITERRANEAN WATERSHED

Giovanni Francesco Ricci [1], Anna Maria De Girolamo [2] , and Francesco Gentile [1]

[1] Dipartimento di Scienze Agro-Ambientali e Territoriali, Università di Bari Aldo Moro, via Amendola 165/A, 70126 Bari e-mail autore di riferimento francesco.gentile@uniba.it

[2] Istituto di Ricerca sulle Acque, Consiglio Nazionale delle Ricerche (IRSA-CNR), Bari

Summary

To counteract the threat of soil erosion, the most widespread form of soil degradation, European policies (PAC 2014-2020) incentive the application of Best Management Practices (BMPs). Therefore, European countries are called to identify the areas under a high risk of soil erosion and to adopt conservation measures. In this study, the Soil and Water Assessment Tool (SWAT) was used to quantify the soil erosion rates for the current management options and to identify the critical source areas in the Carapelle watershed, which is an agricultural watershed located in the Puglia region (Southern Italy). The model was calibrated and validated both manually and automatically using SWAT-CUP for runoff and sediment load at daily time scale for a five years period (2007-2011).
The results show that in the Carapelle the average annual sediment load is 6 t ha^{-1} yr^{-1}. A threshold of sediment yield 10 t ha^{-1} yr^{-1} was selected to discretize the high erosion risk areas resulting in 59 HRUs located in the mountainous part of the watershed and characterized by agricultural land use. Different BMPs scenarios, based on the regional policies, were consequently modelled in the study area: contour farming, no tillage, reforestation and a combination of these. No-tillage resulted in the most effective single scenario as soil erosion is reduced from 6.0 to 4.2 t ha^{-1}. The combination between contour farming and reforestation showed good cumulative effects in reducing the sediment load at watershed scale (from 6.0 to 3.7 t ha^{-1}). The methodology applied in this study offer actionable information to policymakers and to water managers in order to discretize the high erosion risk areas, as well as to test and choose the most effective BMPs scenarios for sediment load reduction.

CODE: 127

I sezione AIIA: Utilizzazione del suolo e delle acque

TOPICS: Water resources management in agriculture and forestry ecosystem; Monitoring and modeling of the interactions among soil hydrological, plant and atmosphere processes, and agricultural management practices; Remote Sensing in agricultural and forestry systems

Proposed for ORAL presentation

4.11 MANAGING MICROCLIMATES IN AGROECOSYSTEMS: BUILDING LOCAL RESILIENCE WITH A GLOBAL PERSPECTIVE

Giulio Castelli [1*], Elena Bresci [1], Francesco Sambalino [2], Frank van Steenbergen [2]

[1] Department of Agriculture, Food, Environment and Forestry (DAGRI), Università degli Studi di Firenze

[2] MetaMeta Research, 's Hertogenbosch, the Netherlands

** Presenting author: DAGRI, Università degli Studi di Firenze, Via San Bonaventura, 13, 50145, Firenze, Italy. Mail: giulio.castelli@unifi.it*

Microclimates are the result of the interactions between biophysical aspects of landscapes, regional and global climatic conditions, and human actions. At the landscape level, issues such as soil moisture, air humidity, soil and air temperature and wind speed have a decisive impact on the nature and health of an (agro-)ecosystems. When change is made to a landscape, changes are made to the local micro-climate as well. In the global climate change debate, mitigation and adaptation are dominant concepts, while the management of local climatic conditions is largely unattended. As there is little evidence that humans can modify global climate and temperature in the near future, it is crucial to focus on microclimates. Stable microclimates can buffer exacerbating weather extremes, contributing to the resilience and well-being of ecosystems and productive systems, carbon sequestration and biodiversity. Drafting from experimental results obtained in Ethiopia (Castelli et al., 2019) that demonstrates how landscape restoration and water harvesting, in a semi-arid climate, can regulate dry season temperatures, this work analyses the various components of microclimates that together build ecosystem resilience, and presents a framework for microclimate management. We analyse available literature on the topic, for then discussing a range of interventions that have the potential to improve the microclimatic situations and the ecological functions of landscapes. Five main microclimatic components are identified: air temperature, soil moisture, soil temperature, air humidity, wind direction and speed. Three clusters of management actions are then identified and discussed: water buffering through soil conservation and water harvesting, functional re-greening and microclimate-compatible land use planning. The potential and the effects of each action to manage and improve microclimatic conditions and interactions are analysed, in order to propose a guideline to build investment strategies for landscape restoration and resilience through microclimate improvement, especially in agro-ecosystems. The intervention will also present the Centre for Microclimate Management, a Dutch-Italian foundation aiming to work on that topic in the next years.

Reference: Castelli, G., Castelli, F., & Bresci, E. (2019). Mesoclimate regulation induced by landscape restoration and water harvesting in agroecosystems of the horn of Africa. Agriculture, Ecosystems & Environment, 275, 54–64.

CODE: 085

Reference topic: Forestry hydraulics and hydraulics protection of agricultural and forestry systems
AIIA first section "Utilizzazione del suolo e delle acque"
Preference: oral presentation

4.12 MANAGING RIPARIAN VEGETATION IN ANTHROPIZED ENVIRONMENTS: A MODELING TOOL FOR THE BEST PRACTICE CHOICE

Alessandro Errico[1,4], Simona Francalanci[2,4], Yamuna Giambastiani[3,4], Federico Preti[1,4]

[1]Department of Agricultural, Food, Environmental and Forestry Sciences and Technologies, University of Florence
[2]Department of Civil and Environmental Engineering, University of Florence
[3]National Research Council, Institute of Biometeorology & LaMMA Consortium
[4]WaVe – Water and Vegetation Research Unit, University of Florence

Presenting author: A. Errico, via San Bonaventura 13, 50145 Firenze, Italy, alessandro.errico@unifi.it

Choosing the best management practice of riparian vegetation represents a complex challenge for river managers. Vegetated buffers along natural and artificial streams constitute a fundamental component of the environment, both at the local and at the landscape scale. In anthropized environments, such as intensively-cultivated floodplains and urbanized landscapes, riparian vegetation plays a key role as an ecological corridor on which a large number of plant and animal species rely on for their survival. On the other hand, the presence of vegetation, especially in strongly modified streams, can contribute to increase flood risk, both connected to the increase of bed roughness, and possible source of Large Wood.
The Ombrone river is one of the main tributaries of the Arno river, the largest one of Tuscany region. The Ombrone catchment appears a mosaic of urban and productive settlements, agricultural land, and forest. In the last decades, the stream undertook a severe incision, that caused the partial destabilization of the banks and a progressive reduction of river mobility. As a consequence, riparian vegetation in large stretches assumed the habitus of trees, partially alternated with invasive plant cover such as Arundo donax.
In 2018, the local Land Reclamation Office started a maintenance intervention along the last 4 km of the river, up to the confluence with Arno. The planned practice consisted in the total clearcut of the entire vegetation cover, with no distinction between invasive and autochthonous species, their position within the cross section, the vigor or the presence of peculiar habitats.
The present scientific contribution comes from the collaboration that the WaVe (Water and Vegetation) research unit started with the Land Reclamation Office, to analyse the effect of vegetation along the 3 km-long stretch with a quantitative, scientific approach. For this purpose, detailed field surveys were carried out to describe the vegetation characteristics and distribution along the stretch, in order to obtain in-situ input data to feed hydraulic resistance models available in the literature. Combining resistance models with hydraulic modeling in Unsteady flow conditions, the research Unit was able to provide quantitative evaluation of different management hypothesis. The proposed numerical approach allowed to detect the sections (or portion of these) where vegetation appeared more influent on water flow, distinguishing different areas in order to differentiate cutting intensity.

CODE: 163

Topic: Water resources management in agriculture and forestry ecosystem

Proposal: Oral presentation

4.13 ON THE PERFORMANCE OF A NOVEL HYBRID CONSTRUCTED WETLAND FOR STORMWATER TREATMENT AND IRRIGATION REUSE IN MEDITERRANEAN CLIMATE

Delia Ventura[1*], Simona Consoli[1], Mirco Milani[1], Alessandro Sacco[1], Ruggero Rapisarda[1], Giuseppe Luigi Cirelli[1]

[1]Department of Agriculture, Food and Environment, University of Catania, Via S. Sofia 100, 95123 Catania, Italy

Decentralized water treatment facilities (DWTFs) for effective water management has been clearly described as one of the best practice (BMPs) strategies for promoting the circular economy. The recovery and reuse of natural resources, water *in primis*, can be pursued through different approach and technologies, variously engineered and/or more likely as nature-based solutions (NBS). In the cities of the future, the chance to rely on unconventional and diffuse water source like stormwater runoff is becoming necessary, but more knowledge on stormwater treatment facilities and performances are required. This study investigates the reliability of a pilot hybrid constructed wetland (H-CW) in treating contaminants typically found in stormwater runoff and its feasibility in water reuse for green areas irrigation. The H-CW was constituted by two identical parallel lines, with a common inlet (stabilization pond), and one horizontal flow bed (HF) and a free-surface unit (FWS) for each line. To cope with the uncertainty in performing representative sampling during storm events, particularly in Mediterranean conditions, with increasingly longer periods of drought and short intense precipitations, a receipt for synthetic stormwater has been proposed and tested for documenting the removal efficiency along the length of the treatment train (μgL^{-1} Cd, Cr, Fe, Pb, Cu, Zn, total hydrocabons: 5, 30, 3000, 100, 80, 500, 30000). Intensive monitoring activities were conducted during one month and quality analyses regarded the three matrices of the system: water, biomass (*Canna indica*, *Typha latifolia*) and filtering medium (volcanic gravel, porosity 0.4). First evaluations showed very high removal efficiency for all the metals (84-99%) and the total hydrocarbons (99%), already at the outlet of the HF units. Furthermore, among the analysed macrophytes organs, the hypogeal parts presented higher metal concentrations, generally more prevailing in the roots than in the rhizomes. In addition to biostabilization processes, significant differences in roots biomass evidenced also the accumulation of Cr and Zn in *Canna indica* and only of Zn in *Typha latifolia*. Results on metals concentrations in the sediment did not reveal any retention or release process. These evidences indicated that the disposal and maintenance practices for plant biomass and sediment in CWs management do not require specific operations. Overall, experimental observations on a pilot-scale H-CW are promising and suggest good reliability in the perspective to combine this technology in DWTFs for enhancing the water recovery and reuse, for green area irrigation and toilette flushing, in Mediterranean climate conditions.

**Corresponding author*: Delia Ventura, University of Catania - Department of Agriculture, Food and Environment, Via S. Sofia, 100 – 95123, Catania, Italy, Phone: +390957147546, Fax: +390957147 Email: delia.ventura@unict.it

CODE: 157

4.14 ON THE USE OF CRITICAL RAINFALL THRESHOLDS FOR DEBRIS FLOWS IN EARLY WARNING SYSTEMS: INSIGHTS FROM THE GADRIA CATCHMENT, EASTERN ITALIAN ALPS

Velio Coviello (1), Lorenzo Marchi (2), Francesco Comiti (1), Stefano Crema (2), Marco Cavalli (2), and Pierpaolo Macconi (3)

(1) Free University of Bozen- Bolzano, Faculty of Science and Technology, Italy (velio.coviello@unibz.it), (2) Research Institute for Geo-hydrological Protection, CNR, Italy, (3) Civil Protection Agency, Autonomous Province of Bozen/Bolzano, Italy

Critical rainfall thresholds for debris flows are widely used in early warning systems based on precipitation measurements. However, these systems are affected by large uncertainties due to the practical barriers in measuring the actual triggering rainfall in high-elevation sites and steep terrains. In addition, precipitation is not the only factor involved in debris-flow initiation, which also depend from sediment availability and other climatic factors (e.g., snowmelt). Instrumentl monitoring performed in debris-flow catchments is of paramount relevance for investigating the climatic control on debris-flow initiation. The combination of a high rain gauge density with complementary monitoring data permits reducing the uncertainties related to the spatial representativeness of rainfall measurements. Moreover, the precise knowledge of the time of occurrence enables recognizing which part of the rainstorm actually triggered the debris flow.

In this work, we present the analysis of rainfall-induced debris flows recorded from 2011 to 2018 in the instrumented catchment of Gadria (South Tyrol, Eastern Italian Alps). The Gadria catchment has a drainage area of 6.3 km^2 and ranges in elevation from 1,394 to 2,945 m a.s.l. Steep channels, highly fractured metamorphic rocks and thick Quaternary deposits set the ideal conditions for chronic debris-flow activity. The study area is characterized by dry inner-Alpine climate, with mean annual precipitation of 480 mm in the valley floor. We computed the mean intensity, I (mm/h), and the total duration, D (h), of the triggering rainstorms measured by three rain gauges located inside the catchment. We considered the arrival time at the monitoring station located on the fan apex for the definition of the rainfall duration. In most cases, hourly rainfall totals exceeding about 10 mm are likely to initiate debris flows. However, we observed that significantly lower rainfall intensities (e.g., 1 mm/h on 26 July 2016) could be sufficient for triggering a debris flow. In spite of the small distance between the rain gauges, remarkable differences among the rainfalls measured at the different rain gauges were observed. Finally, most debris flows were triggered by rainfall events comparable with those that only produced debris floods. We argue that rainfall analysis alone does not explain the type of sediment fluxes at the catchment scale and short-period variations in the amounts and location of sediment sources in the headwater channels strongly influence debris-flow initiation. The combination of rainfall thresholds and instrumental detection appears the most promising solution for the development of reliable early warning systems for debris flows.

CODE: 058

PRESENTED FOR SECTION 1 under one of the following topics:

- Water resources management in agriculture and forestry ecosystem
- Design and management of Farm and District-Scale Irrigation Systems
- Remote Sensing in agricultural and forestry systems

4.15 OPERATIONAL MONITORING OF IRRIGATION IN THE CAMPANIA REGION (ITALY) FOR THE COMPLIANCE OF EU WATER DIRECTIVE BY USING SENTINEL-2 DATA

G. D'Urso[1,*], G.B. Chirico[1], C. De Michele[2], S. Falanga Bolognesi[2] and O. R. Belfiore[2]

[1] Department of Agricultural Sciences, University of Napoli Federico II, Via Università 100, 80055, Portici (NA, Italy) * durso@unina.it

[2] Ariespace Spin-off Company of the University of Napoli Federico II, Centro Direzionale Isola A/3, Napoli (Italy)

The lack of accurate and up-to-date data on irrigated areas and water volumes is hampering the full implementation of the Water Framework Directive (WFD) and its compliance especially in Mediterranean regions. In many cases statistical data acquired by means of periodical surveys, while they are able to give a picture at the national scale, they are rather imprecise at regional and local scales, which are the most relevant for the management of water resources in hydrographic basins. The Italian Ministry of Agriculture has adopted specific actions (Decree 31/07/2015) for monitoring irrigation areas and volumes on a regular basis to improve the compliance to the Water Directive. To this end, multispectral Earth Observation data from the Sentinel-2 satellites of the European Space Agency are representing a very valuable source of information for mapping irrigated areas and estimating the corresponding water requirements.

This study illustrates the procedures developed in the context of IRRISAT©, the first satellite-based irrigation advisory service developed in Italy and operating in the Campania region. These procedures exploit the full spectral range of Sentinel-2 data, from visible to shortwave infrared, and temporal domain, thanks to the high revisit time of the two satellites, to monitor the development status of crops. Relatively mature machine learning supervised classification algorithms (support vector machines, single decision trees (DTs), Random Forests, boosted DTs, artificial neural networks, and k-Nearest Neighbours have been extensively tested, including in operational settings for mapping irrigated and non-irrigated areas from dense temporal series of vegetation indexes and surface water status derived from Sentinel-2 bands.

The quantification of irrigation volumes has been carried out by applying the Penman-Monteith equation, with appropriate values of the canopy parameters namely the canopy resistance, crop height and surface albedo. The canopy resistance is calculated from the Leaf Area Index, also derived from Sentinel-2 data, and a stomatal resistance which takes into account the soil and canopy water status as detected from SWIR and NIR reflectances. Results will be presented from case-studies for the irrigation season 2018, where the accuracy assessment of the proposed procedures has been carried out with ground-truth data related to actual irrigated areas and measured irrigation volumes.

CODE: 011

Topic: Water resources management in agriculture and forestry ecosystem

Type of presentation: oral

4.16 REMOVAL EFFICIENCIES OF A SURFACE FLOW CONSTRUCTED WETLAND TREATING AGRICULTURAL DRAINAGE WATER - A CASE STUDY FROM EMILIA-ROMAGNA

Stevo Lavrnić[1]*, Xi Nan[1], Stefano Anconelli[2], Domenico Solimando[2], Attilio Toscano[1]

[1]Alma Mater Studiorum - University of Bologna, Department of Agricultural and Food Sciences, Viale Giuseppe Fanin 50, Bologna 40127, Italy.

[2]Consorzio di Bonifica Canale Emiliano Romagnolo, Via Ernesto Masi 8, Bologna 40137, Italy.

**Presenting author: +39 051 20 96 186; stevo.lavrnic@unibo.it*

Agricultural drainage water is one of the most important non-point sources of pollution. One of the consequences is eutrophication of water ecosystems that occurs due to uncontrolled inflow of nutrients (e.g. nitrogen and phosphorus). Therefore, it is important to treat agricultural drainage water before its discharge to surface water bodies. One of the best treatment technologies are nature-based solutions, in particular constructed wetlands. Their advantages are that they do not require constant maintenance, their ability to deal with varied and not constant flow and low cost operation. It is important to estimate a life span of such a technology, since most of the systems reported in the literature are constructed recently, and there is a possibility that their performance will deteriorate over the years. Therefore, the goal of this study was to monitor performance of a surface flow constructed wetland (SFCW) in operation since 2001, and to estimate its current ability to reduce pollution load from an agricultural farm.

The system monitored is a SFCW located at the village of Budrio, Metropolitan City of Bologna. It is treating drainage water coming from a 12,5 ha experimental farm operated by Land Reclamation Consortium Canale Emiliano Romagnolo. The SFCW has an area of 0.4 ha and a maximum depth of 0.4 m. The results reported here are from an experimental period of 18 months (September 2017 - December 2018), but the system monitoring is still ongoing within the Italian national project GREEN4WATER. The parameters measured were total suspended solids (TSS), total nitrogen (TN) and total phosphorus (TP).

While the total inflow during the monitoring period was 18,181 m^3, the outflow was only 12,293 m^3, meaning that the water volume that exited the system through evapotranspiration and infiltration was quite high (32%). Moreover, the flow was not evenly distributed throughout the year, with inflow of 15,765 m^3 only in March and April, while there was no inflow whatsoever in the period July-December. A high water loss is one of the main characteristics of this kind of systems, therefore concentration of different parameters can be misleading. For example, TN inflow concentration was found to be 7.87 mg L^{-1}, while outflow was at 7.80 mg L^{-1}. However, the removal ability of the SFCW becomes clear if loads are considered - 207 and 122 kg TN $year^{-1}$ for inflow and outflow, respectively. Similarly, TSS load was reduced from 2,549 kg $year^{-1}$ to 928 kg $year^{-1}$. Although it was still quite low, TP load increased from 0.40 to 0.62 kg $year^{-1}$, probably due to the flush out of sediments during high intensity rain events.

Overall, it can be concluded that the monitored SFCW after 17 years of operation still can be considered as a viable option for treatment of agricultural drainage water and consequently one of the measures for preventing surface water bodies pollution.

CODE: 124

4.17 SIRR-MOD - A DECISION SUPPORT SYSTEM FOR IDENTIFYING OPTIMAL IRRIGATION WATER NEEDS AT FIELD AND DISTRICT SCALE

Dragonetti G.[1], Sengouga A.[2], Comegna A.[2], Lamaddalena N[1], Basile A.[3] and Coppola A.[2]

[1] Mediterranean Agronomic Institute (IAMB), Department of Land and Water, Bari, Italy
[2] University of Basilicata, School of Agricultural, Forestry, Food and Environmental Sciences (SAFE),Potenza, Italy
[3] Italian National Research Council (CNR), Institute for Mediterranean Agriculture and Forest Systems (ISAFOM), Ercolano, Italy

Submitted for oral presentation;
presenting author: dragonetti@iamb.it, IAMB, Valenzano (BA).

ABSTRACT

SIRR-MOD is a Decision Support System (DSS) to support the control and planning of irrigation water uses at different spatial scales, under pressurized or open channel irrigation systems and climatic conditions, including climatic uncertainty. SIRR-MOD mainly consists of dynamic modelling tools thought to provide assistance to the different actors involved (farmers, irrigation technicians, irrigation district managers, policy-makers) in managing irrigation water resources to optimize yield, while minimizing water consumption and water quality degradation. Basically, SIRR-MOD platform integrates two numerical tools: 1) A agro-hydrological model (named FLOWS-HAGES) for simulating flow of water and solutes in heterogeneous agri-environmental systems; 2) A model for simulating the hydraulics of the irrigation network (named COPAM).
The FLOWS-HAGES model simulates the daily evolution of: soil water contents and pressure heads in the soil profile; water uptake and actual evapotranspiration; stress periods for each crop; return fluxes to the groundwater and their quality in terms of solute concentrations (e.g. nitraes). For specific input data (LAI, Potential Evapotranspiration…), the model may interact with remote sensing maps. The daily optimal sequence of hydrants opening may be thus established by passing the volumes to be delivered to a model for simulating the hydraulics of the irrigation network (the COPAM model), in order to guarantee that the discharges flowing inside the distribution pipes network are delivered under optimal pressure head distribution.
SIRR-MOD represents a powerful tool in the decision-making process allowing to evaluate the effects of different interventions (changes in management practices, characteristics of the network, irrigation methods, crop types), as well as the response to climate change scenarios.
SIRR-MOD provides a system capable of: i) describing the basic components of the water cycle (including groundwater recharge); ii) balancing the irrigation water supplies with soil evaporation and plant transpiration and describing pollution processes in order to attenuate the impact on water resources availability and quality.
To illustrate the potentiality of the modeling tool, the methodology has been applied to establish irrigation scheduling over the irrigation season for a selected sector of the Irrigation District 10 in the "Sinistra Ofanto" irrigation system (Apulia region, Italy).

CODE: 158

4.18 THE BENEFIT OF CONTINUOUS MODELLING FOR DESIGN HYDROGRAPH ESTIMATION IN SMALL AND UNGAUGED BASINS

S. Grimaldi[1,], A. Petroselli,[2] and F. Tauro[1]*

[1] Department for Innovation in Biological, Agro-food and Forest systems (DIBAF), University of Tuscia, Via San Camillo de Lellis snc, 01100 Viterbo, Italy
salvatore.grimaldi@unitus.it

[2] Department of Economics, Engineering, Society and Enterprise (DEIM), University of Tuscia, Via San Camillo De Lellis snc, 01100 Viterbo, Italy

Abstract The design hydrograph (DH) estimation is a crucial problem in practical hydrology and hydraulics. Reliable DH is particularly challenging in small and ungauged basins due to the lack of observed discharge data that are needed for calibrating advanced models. For such basins, often the modeler is forced to adopt simple and conceptual modelling like the so called event-based approach. It consists in selecting a design rainfall distribution, characterized by an assumed return period, determining the rainfall excess and then the design hydrograph. In the last years, the continuous modeling approach was introduced. It is characterized by a generation of a long synthetic rainfall time series at sub-daily resolution that feeds a continuous rainfall–runoff model producing a discharge time series for which a design hydrograph can be estimated. In this work, we would like to emphasize the added value of continuous approach in providing a more reliable estimation of the hydrograph volume and duration.

Keywords: small basins, ungauged basins, event based modeling, continuous modeling, flood mapping

5 AIIA Section 1 - Posters

POSTERS

CODE: 159

5.1 A MODIFIED CATCHMENT CONNECTIVITY INDEX (MCCI) FOR APPLICATIONS IN MEDITERRANEAN WATERSHEDS

Giuseppe Bombino[1], Carolina Boix-Fayos[2], Maria Francesca Cataldo[1], Daniela D'Agostino[1], Pietro Denisi[1], Joris de Vente[2], Antonino Labate[1], Vincenzo Tamburino[1], Demetrio Antonio Zema[1]

[1] Department "Agraria", "Mediterranea" University of Reggio Calabria - Località Feo di Vito - I-89122 Reggio Calabria (Italy), giuseppe.bombino@unirc.it

[2] Soil Erosion and Conservation Research Group - CEBAS-CSIC - Spanish Research Council - Campus de Espinardo - PO Box 164 - E-30100, Murcia (Spain), cboix@csic.es

Summary

A modification of the Catchment Connectivity Index developed by Quiñonero-Rubio *et al.* (2013) is suggested to evaluate the sediment transfer in the headwater of a Mediterranean basin ("Sant'Agata", Calabria, Southern Italy). In order to understand the influence of both intensive (check-dams) and extensive (reforestation over a large area) restoration works, the *mCCI* was applied considering two different time windows (1955 and 2012), the first *ante-operam* and the latter *post operam*. We assumed that the *equilibrium* conditions of the river system have been established about 50 years after human forcing. Compared to the original version of CCI (which is a combination of TC (Transport Capacity), TE (Trap Efficiency), GF (Geomorphological Factor), SP (Stream Power) and FC (Flow Conditions) factors), the TE, GF and FC factors have been modified (as well as the final index formulation) and adapted to the ephemeral torrents (such the studied headwater is).

In general, the comparison of *mCCI* between 1955 and 2012 has highlighted a decrease in sediment connectivity by 9.4% due to human works, mainly due to the changes in land uses rather than to the check dams influence (about ten times less). As a matter of fact, the expansion of forest cover, leading to a greening-up effect on hillslopes and in channels, increased the resistance of the fluvial system to the effects of rain events, specifically by reducing the highest peak flows. This could also have played a role in decreasing the connectivity of water and sediment flows, reducing input from hillslopes to the channel.

The presence of the check dams has helped the stabilization of longitudinal profile and banks of the active channel. The effect of the control works has been synergetic with the decrease of water and sediment input due to the progressive greening-up of the hillslopes. This led to some changes and adjustments in channel forms, namely the general narrowing between consecutive check dams, local bed aggradation, cross-section expansion and downstream local incision.

The study has demonstrated not only the applicability of the CCI its modified form in the Mediterranean headwaters, but also its usefulness in understanding the effects intensive and extensive restoration works under these geomorphological and climatic conditions.

CODE: 167

Erosione, difesa del suolo e riqualificazione fluviale

5.2 A CONCEPTUAL MODEL FOR THE PREDICTION OF SOIL BULK DENSITY

Mario Palladino*, Paolo Nasta, Nunzio Romano

Department of Agricultural Sciences, AFBE Division, University of Napoli Federico II, Portici (Naples), Italy.

The bulk density of the soil, ρ_s, is strictly correlated to the structural state of the soil. The soil structure characterizes the spatial arrangement of solid particles within the total volume and will therefore influence bulk density. However, the soil structure also addresses the specific distribution of the size of the voids and the variability of the related state as tortuosity and connectivity of the soil. It therefore affects the basic hydraulic, electrical, mechanical and thermal properties of the soil. Consequently, ρ_s should be related to these important properties and influence soil water, heat and gas exchanges.

The development of pedotransfer functions offers a potential to alleviate labor costs associated with ρ_s determinations. As a means of incorporating a priori knowledge into the model-building process, we proposed to conceptualize the prediction of ρ_s from other regularly measured properties. The model considers the soil porosity, derived from bulk density, and use correlation with clay content and organic matter content to derive the minimum values, corresponding to soil with ruined or loose structure. The model residues, known as α, are interpreted as a structural part of the porosity. All models were trained using soil data collected by our research group, with limits set at bulk densities between 0.7 and 1.8 g/cm^3 and containing organic matter levels below 12%. The performance of the conceptual model was comparable to a multiple linear regression model. Further development of the conceptual model should allow the inclusion of soil structural and topographic information to improve bulk-density predictions.

* Corresponding author:
Dr. Mario Palladino
Department of Agricultural Sciences, Division of Agricultural, Forest and Biosystems Engineering
University of Napoli Federico II
Via Università n. 100, Portici (Napoli) - Italy
Tel.: +39-081-2539416; E-mail: mario.palladino@unina.it

CODE: 098

Reference topic: Erosion; Agricultural hydraulics; Water resources management in agriculture and forestry ecosystem; Spatial and landscape analysis
AIIA section: I section
Presentation type: Oral

5.3 A DIAGNOSTIC FRAMEWORK FOR MAPPING AND QUANTIFYING THE GEOMORPHIC IMPACT OF WILD BOARS

Paolo Tarolli[1], Luca Mauri[1], Lorenzo Sallustio[2]

[1] Department of Land, Environment, Agriculture and Forestry, University of Padova, Agripolis, Viale dell'Università 16, 35020 Legnaro (PD), Italy (paolo.tarolli@unipd.it)
[2] University of Molise, Department of Bioscience and Territory, 86090 Pesche (IS), Italy

Among the main invasive species, the wild boar (*Sus scrofa*) is the most responsible for soil degradation in several Italian regions. At the same time, the presence of this species in agricultural areas has induced a conflict with human causing severe economic losses. A clear quantification of the potential damages of this species is however still obscure. The purpose of this research is to analyze the role of wild boars as a geomorphologic agent, presenting a diagnostic framework regarding the geomorphic impact of this species classifying and mapping potential sediment hot-spots and their likely connection to rivers and roads networks. Accordingly, a record of wild boar's damages types is presented, and their possible interaction with hydro-geomorphological processes is described. Then, a case study is presented on mapping and quantifying wild boar damages in a hilly agricultural landscape located in northeast Italy. The wild boar damages were geolocalized through GPS in two years among agricultural fields interested by wild boars' damages. For each damaged area measures of soil erosion depth were taken and surface interested by degradation mapped. The volume of removed soil was then estimated considering the average depth of recorded damages. Finally, the Index of Connectivity was applied to provide a classification of damages based on their connection to the river and roads network. The results indicate that the ongoing uncontrolled wild boar's expansion increases soil erosion, with a potential connection to the hydrographic networks and human infrastructures.

References

Mauri L, Sallustio L, Tarolli P (accepted). The geomorphologic forcing of wild boars. *Earth Surface Processes and Landform*. ISSN:1096-9837.

CODE: 066

Reference topic: Design and management of Farm and District-Scale Irrigation Systems

5.4 COMPARISON OF DIFFERENT METHODS FOR TOPOGRAPHIC RELIEF OF RURAL CANALS FOR THE ASSESSMENT OF FLOW RATE AND STORAGE CAPACITY

Daniele Masseroni[1], Daniele Passoni[2], Livio Pinto[2] and Claudio Gandolfi[1]

[1] Department of Agricultural and Environmental Sciences, University of Milan, Via Celoria 2, 20133 Milan, Italy
[2] Department of Civil and Environmental Engineering, Politecnico of Milan, P.zza Leonardo da Vinci 32, 20133 Milan, Italy.

Corresponding author
Daniele Masseroni, Department of Agricultural and Environmental Sciences, University of Milan, Via Celoria 2, 20133 Milan, Italy. Phone: +39 02 503 16903, Fax: +39 02 503 16900

Abstract (2000 character approx.)
Rural channels in floodplain areas usually compose a ramified network intended to irrigate agrarian lands as well as to drain water from fields and peri-urban areas. The topographic relief of rural canal network, for detecting its drainage and water storage capacity is, therefore, a crucial task to allow a sustainable management and planning of in rural areas and, always more frequently, to control the interactions with urban areas (sewer overflow discharges, in particular). However, to date, datasets of canal and ditch geomorphological characteristics, such as layout, cross-sections, slopes and canal bed characteristics, are almost completely absent, or unreliable.
This work tests the use of three different data sources – two from remote sensing and one from ground survey - for detecting the geometrical characteristics of rural canals at increasingly high resolution, providing cross sections and slopes over a pilot study domain of about two hectares located in south Milan (Italy). Specifically, rural canal geometries were obtained from the processing of: (i) a photogrammetric flight carried out at 2.500 m altitude by an airplane equipped with an UtraCam camera with ground resolution of about 14 cm and vertical error of about 30cm, and (ii) a photogrammetric flight carried out at 30 m altitude through a DJI Mavic 2 Pro unmanned aerial vehicle (UAV) equipped with 20 megapixel camera with ground resolution of about 1cm and vertical error of about 5cm; (iii) a ground-fixed Leica Nova MS60 MultiStation with a ground resolution about 1x1 mm and vertical error of about 2mm. Moreover, GPS spot acquisitions carried out by a GPS GNSS Leica GS14 with horizontal and vertical resolution of about 1.5cm and 2cm, allowed to complete surveys with a further level of detail.
3D models of the rural canals were obtained from the processing of the data of each of the three sources. Results of the comparison of the models are presented, focusing on canal cross sections, slope, and bed characteristics; moreover, the impact of these differences on the flow and storage capacity of the channels will be discussed and, finally, an assessment of the costs of data acquisition and processing is provided.

CODE: 055

Topic: Water resources management in agriculture and forestry ecosystem - AIIA Section:I

Poster/Oral presentation

5.5 DROUGHT VARIABILITY AND TREND OVER LOMBARDY PLAIN FROM METEOROLOGICAL STATION RECORDS (1951–2017)

Gandolfi[1, *], C., Facchi[1], A., Crespi[1], A., Rienzner[1], M., and Maugeri[2], M.

[1] Department of Agricultural and Environmental Sciences, Università degli Studi di Milano, Milan, Italy

[2] Department of Environmental Science and Policy, Università degli Studi di Milano, Milan, Italy

[*] Presenting author: DiSAA, via Celoria 2, 20133 Milan, phone 02 50316910, email claudio.gandolfi@unimi.it

Drought is one of the climate-related natural hazards mostly affecting water resource supply systems, such as agriculture and food sectors. Even though evidences of increasing drought frequency at global scale under warming climate conditions have been provided by several studies, drought behaviour could be highly variable in both space and time, so that local assessments of recent past drought evolution based on meteorological station observations are crucial to analyse local impacts and to plan adaptation strategies.

In this framework, we investigated the spatial and temporal variability of droughts over the period 1951–2017 for a portion of Lombardy plain (Northern Italy), starting from a quality-checked and homogenized database of long precipitation and temperature station records covering the study area. The work aimed at filling the lack of drought studies over Northern Italian plain where agriculture represents one of the most relevant economic sectors. The drought evolution was evaluated by means of two standardized indices: Standardized Precipitation Index (SPI) and Standardized Precipitation-Evapotranspiration Index (SPEI).

In particular, the monthly temperature and precipitation station records over the period 1951–2017 were interpolated onto a 30-arc second resolution grid covering the study domain by means of an anomaly-based procedure and the gridded fields were used to compute the 1951– 2017 SPI and SPEI monthly series at each point of the region. This approach allows to get the climatic information for a number of points that is much greater than that of stations and to reduce biases due to changes in data distribution and availability.

SPI and SPEI trend analysis was performed on annual and seasonal scale at both regional and grid-point level. Theil-Sen test on SPI values highlighted a significant drying tendency (Mann-Kendall p-value < 0.05) for summer only (-0.14 decade^{-1}), while SPEI series exhibited a more negative summer trend (-0.22 decade^{-1}) and significant reductions also in spring and annual values (-0.14 and -0.17 decade^{-1}, respectively), probably suggesting increasing evapotranspiration rates driven by higher temperature.

The trend analysis at grid point level confirmed the regional trends and highlighted for both indicators the most intense drying tendencies occurring over the south-western portion of the domain. In addition, drought events over subsequent decades from 1951 to 2010 were identified for each grid cell from both SPI and SPEI series in order to investigate temporal variations in drought frequency, severity and duration and the main hotspot locations.

CODE: 118

Topic: Forestry hydraulics and hydraulics protection of agricultural and forestry systems

Section 1st: Utilizzazione del suolo e delle acque

Preference: poster presentation

5.6 EFFECTS OF CHANNEL HYDRO-MORPHOLOGY AND VEGETATION COVER ON CHECK DAM FUNCTIONING AND CONSERVATION IN A LARGE RIVER OF MÉXICO

Manuel Esteban Lucas-Borja[1], Demetrio Antonio Zema[2,*], Giuseppe Bombino[2], Pietro Denisi[2], Antonino Labate[2], Yang Yu[3], Xu Xiangzhou[4], Bruno Gianmarco Carrà[2], Mary Nichols[5], Artemi Cerdà[6], Santo Marcello Zimbone[2]

[1] Departamento de Ciencia y Tecnología Agroforestal y Genética, Universidad de Castilla La Mancha, Campus Universitario s/n, E-02071, Albacete, Spain, manuelesteban.lucas@uclm.es

[2] Department "Agraria", University "Mediterranea" of Reggio Calabria, Località Feo di Vito, I-89122 Reggio Calabria, Italy, dzema@unirc.it (* corresponding/presenting author).

[3] Department of Sediment Research, China Institute of Water Resources and Hydropower Research, Beijing 100048, China, theodoreyy@gmail.com.

[4] School of Hydraulic Engineering, Dalian University of Technology, Dalian 116024, China.

[5] Southwest Watershed Research Center, USDA-ARS, 2000 E. Allen Rd., Tucson, AZ, USA.

[6] Soil Erosion and Degradation Research Group. Department of Geografia, University of Valencia, Blasco Ibàñez, 28, E-46010 Valencia, Spain.

Summary

Check dams are widely used around the world for watershed regulation, since these works are able to control water and sediment fluxes along stream channels. However, there is limited information describing the influence of site characteristics (such as channel morphology, check dam geometry and vegetation cover) *post operam* on conditions of these control works and their effectiveness for soil conservation. The effects of channel and check dam size, watershed hydrology, and vegetation characteristics must be investigated as being potentially influencing factors on structural stability and sediment retention capacity at the watershed scale.

To address these issues, a combination of statistical multivariate techniques is applied to a large dataset describing the condition and functioning of check dams in a large regulated watershed (Culiacan, state of Sinaloa) in north-western Mexico. The watershed, with an area of 10368 km^2, is covered by cropland (sorghum and corn), and protective forest and pasture. In the watershed drainage network about 280 check dams were recently built (2011-2015) to slow runoff and retain sediment. Many of these check dams are intact, but many other have failed. The structures were built as part of an "emergency" strategy aiming to retain water and sediment generated by rainstorms on upstream areas with highly erodible soils; thus, it was expected that these control works would start functioning immediately after their installation, and this short-term monitoring activity can assure verify that they are functioning as anticipated. The check dam dataset has been prepared using a combination of field surveys (measuring check dam dimensions as well as upstream and downstream channel morphology and sediment deposition/scouring dynamics) with remotely sensed data (evaluating vegetation cover and watershed morphology), digital terrain models (from which the original and regulated channel profiles were estimated) and simple hydrological models (to estimate the water discharge in the channel).

The use of these techniques has helped to interpret possible cause-effect relationships between sub-watershed characteristics and the failure and efficiency (assessed in terms of sediment storage capacity) of the check dams. The output of these statistical models has allowed us to identify and quantify the dominant factors (channel dimensions and hydrology, vegetation cover, characteristics of the check dams) affecting both the structural condition and their ability to store sediment. These factors must be considered with care in developing the best strategies for soil conservation to improve the functioning of watersheds.

CODE: 115

Topic: Monitoring and modeling of the interactions among soil hydrological, plant and atmosphere processes, and agricultural management practices

Proposal: Poster presentation

5.7 EVALUATION OF GREEN ROOF AGEING EFFECTS ON SUBSTRATE HYDRAULIC CHARACTERISTICS

Alagna V.[1], Bagarello V.[1], Di Prima S.[2], Giordano G.[1], Iovino M.[1*]

[3] *Department of Agricultural, Food and Forest Sciences, University of Palermo*
[4] *Université de Lyon; UMR5023 Ecologie des Hydrosystèmes Naturels et Anthropisés, CNRS, ENTPE, Université Lyon 1*

[*] *Corresponding Author: massimo.iovino@unipa.it*

Green roofs contribute to mitigate urban storm water effects through the retention of rainfall and the detention of runoff. While the water retention capacity of the substrate is mostly influenced by the pore size distribution, the detention performance is largely influenced by hydraulic conductivity, as this property defines the speed with which water can pass through a substrate. The vegetated substrate of green roofs undergoes various chemical and physical changes with time that directly affect hydraulic performances. Indeed, substrate characteristics are influenced by many factors including root system development, organic matter turnover, loss of soil particles and dissolvable substances washed off with water and mechanical consolidation. However, very few studies have addressed the aging effects on green roof hydraulic properties. This partly reflects the scarcity of long-term hydrological records due to complexity but also the fact that methods for the evaluation of hydraulic properties are often destructive resulting in alteration of the very fragile pore space distribution of vegetated substrates. Minidisk infiltrometer (MDI) samples the upper surface layer with a minimum disturbance and thus is potentially valuable for assessing the effects of substrate ageing.

With the aim to evaluate the temporal changes of substrate hydrodynamic properties, MDI infiltration tests were conducted at the prototype extensive green roof test plot established at the University of Palermo. The plot, 3-m-width by 6-m-length by 0.11-m-thick, was built with Mediterranean green roof system (HARPO verdepensile, Trieste, Italy) and planted with Sedum sediforme at a density of 70 plants/m^2. Sampling was repeated four times: before grass planting (Age 0) and then after 4 months (Age 1), 7 months (Age 2) and 10 months (Age 3). A total of 144 infiltration tests were conducted at two pressure heads, $h0$ = - 30 mm and $h0$ = 0 and infiltration data analysed by the Zhang (1997) method and the BEST approach (Lassabatere et al., 2006).

Zhang model underestimated the substrate hydraulic conductivity under both saturated, $K0$, and unsaturated, K-30, conditions but the hydraulic conductivity time evolution was concurrently estimated by the two approaches. From Age 0 to Age 2, the substrate experienced an 4-fold increase in both $K0$ and K-30 values. Thereafter (Age 3), the hydraulic conductivity decreased and approached values two-times higher than the initial ones. The results showed that green roofs may undergo significant modifications of hydraulic properties, even in relatively short time, as consequence of washing off of fine particles and mechanical consolidation due to root development. The observed temporal variations may influence the hydrological performance of the green roof.

CODE: 182

5.8 FIELD EXPERIMENTAL TESTS FOR SOIL EROSION EVALUATION IN THE COPPICES OF MARGANAI (SARDINIA)

F. Giadrossich, I. Murgia, E. Guastini, A. Ganga, M. Pirastru

Università degli Studi di Sassari
Dipartimento di Agraria - Sezione di Ingegneria del Territorio
Viale Italia 39, 07100 Sassari
E-mail: mpirastru@uniss.it

Natural or anthropogenic events can cause a temporary decrease of the protective effect of the tree canopies. Among these, coppice management represents a potential exposure of the soil to the risk of erosion and loss of organic matter. However, regeneration from the stumps limits the potential negative impacts of coppice and the erosion rate depends on the conjunction of several elements such rainfall intensity, slope gradient, the type of soil and silvicultural practices.

This study aims to evaluate the erodibility of Marganai soils in areas subjected to coppice cutting considering the stumps regeneration. The study areas have been characterized from a physical and floristic point of view (slope gradient, vegetation, stoniness, litter). Eight study sites were identified to carry out controlled rain simulation on 16 experimental plots, with and without vegetation, to measure the response in terms of surface runoff, infiltration, amount of sediment and transported organic material. For each test a two 30-minute rain simulation was conducted with an intensity of about 45 mm/h. Soil moisture was assessed at the beginning and end of each test.

The test results showed an extremely low surface runoff due to the high percentage of water infiltration into the soil. The average infiltration calculated does not show any significant differences between plots, both with and without soil cover given by stump shoots. The solid material carried by the surface runoff is lower than literature reference values and we conclude that coppice in the Marganai forest did not reveal problems related to the rill or interril erosion, or rather, erosion rate measured confirmed the lack of erosion observed in the field.

CODE: 123

AIIA section: I (AGR08)

Topic: Erosione, difesa del suolo e riqualificazione fluviale

Water resources management in agriculture and forestry ecosystem

Type of presentation: Poster

5.9 INFLUENCE OF CHECK DAMS ON RIPARIAN VEGETATION COVER THROUGH LAI FIELD MEASUREMENTS AND REMOTE SENSING

Giovanni Romano[1], Giovanni Francesco Ricci and Francesco Gentile

[1] Dipartimento di Scienze Agro-Ambientali e Territoriali, Università di Bari Aldo Moro, via Amendola 165/A, 70126 Bari e-mail autore di riferimento francesco.gentile@uniba.it

Summary

The Cammarota stream is located in Northern Puglia (Southern Italy) and is characterized by the presence of intact and destroyed check dams. Here in-situ measurements of the Leaf Area Index (LAI) were conducted to detect the variability of riparian vegetation along fifty-three riverbed transects. The observed values ranged from 0.26 to 5.71. The lower ones were found in those reaches where destroyed or strongly damaged check dams are located, and, consequently, riverbed erosive processes are present. The higher LAI values were instead found in those reaches with the presence of intact or slightly damaged check dams, characterized by a higher geomorphological stability. LAI measurement were also conducted in a nearby stream, named Vallone della Madonna, with intact check dams and sound riparian vegetation. Here the observed values of LAI ranged between 4.08 and 5.93, which are similar to those found in the Cammarota reaches with good geomorphological conditions.

LAI values from both streams were also retrieved from Landsat 8 satellite images using three different equations to derive LAI values from the corrected Normalized Difference Vegetation Index (NDVIc). Based on their statistical performance, the Lambert-Beer equation better predicted LAI within Cammarota reaches with denser vegetation and in the Vallone della Madonna stream, while their performance was not satisfactory in the Cammarota reaches characterized by enhanced erosive processes. Further developments of this study will deal with the analysis of satellite images with higher resolution, like the Sentinel-2, provided by the Copernicus mission of the European Space Agency (ESA).

CODE: 053

Topic: Gestione dell'irrigazione a scala comprensoriale in Italia e nel Mediterraneo; AIIA section: 1°

5.10 ON THE DESCRIPTION OF SOIL VARIABILITY THROUGH EMI SENSORS AND PEDOLOGICAL SURVEYS IN PRECISION AGRICULTURE

Bianca Ortuani[1]*, Enrico Casati[1], Camilla Negri[1], Arianna Facchi[1]

[1] Dipartimento di Scienze Agrarie e Ambientali – Produzione, Territorio, Agroenergia, Università degli Studi di Milano (DiSAA-UNIMI), via Celoria 2, 20133 Milano

[*] Author for correspondence, bianca.ortuani@unimi.it, tel. ++39 02 50316905

Proposal: Poster

Delineation of homogeneous management zones (MZ) is required in Precision Agriculture to conduct variable rate irrigation and fertilization. MZ delineation is usually based on soil electrical conductivity (EC) measurements acquired by geophysical devices, such as EMI sensors. EC data acquired through EMI sensors are related to physical and chemical properties of the soil profile, but must be considered as average values referred to the soil depth explored by the sensor. Therefore, the following questions arise: how reliable are EC values measured by EMI sensors to describe soil variability, compared to pedological soil mapping? To which extent MZs delineated through EMI surveys correspond to pedological units in a soil map?

In this study, an intensive soil sampling was conducted over an area of 36 ha (9 fields) in a rice farm located in Lomellina (PV). Texture measurements were executed on soil samples collected in 38 points, at three soil depths defined accordingly to the main soil profile features of paddy soils in the area (ERSAL, 1996). Soils were found to be Haplustalfs with an anthraquic sandy-loam epipedon. Deeper layers are characterized by particle size classes ranging from fine-loamy to coarse-loamy and clay contents less than 26%, over a sandy parent material. Four main soil types were recognized, mainly based on the clay content distribution in the soil profile. EC measurements were acquired at increasing soil depths through a multi-frequency EMI sensor. EC maps were elaborated and analyzed through Principal Component Analysis and Cluster Analysis to delineate MZs, which resulted to be four in the study area. MZ and pedological soil maps were compared: they showed similar spatial distributions of soil types, in particular when observed at the field scale. However, at the farm scale, different MZs may correspond to the same soil unit, especially in certain areas. This was principally due to the different soil properties to which the two classifications are mainly sensitive: clay and sand contents respectively in the case of pedological and MZ soil mapping.

Finally, ANOVA (Analysis of Variance) was used to evaluate the statistical significance of differences in: (1) EC values among soil mapping units, and (2) clay contents among MZs. The results showed that the former were significant, while the latter were not significant, confirming that MZ delineation is not influenced by clay content variations within the area.

This study suggests that an integrated approach, considering both EMI and pedological surveys, is required to describe properly soil variability. In that context, a preliminary MZ delineation may be used to optimize soil sampling locations and density.

CODE: 007

Reference topic Water resources management in agriculture and forestry ecosystem
AIIA section: Utilizzazione del suolo e delle acque (Section 1a)
Poster

5.11 RETRIEVING REFERENCE EVAPOTRANSPIRATION FOR IRRIGATION SCHEDULING: FORECAST OR PAST WEATHER DATA?

Vanella, D.[1]*, Intrigliolo, D.S.[2], Consoli, S.[1], Dumitrache, R.C.[3], Matescu, E.[3], Deelstra, J.[4], Longo, G.[1], Barbagallo, S.[1], Lizzio, G.[1], Ramírez-Cuesta, J.M.[2]

[1] Dipartimento di Agricoltura, Alimentazione e Ambiente (Di3A), Università degli Studi di Catania, Via S. Sofia, 100, 95123 Catania, Italy
[2] Centro de Edafología y Biología Aplicada del Segura (CEBAS), Consejo Superior de Investigaciones Científicas (CSIC), Espinardo, 30100 Murcia, Spain
[3] National Meteorological Administration, 97, Soseaua Bucuresti-Ploiesti, sector 1 013686 Bucharest, Romania
[4] Norwegian Institute of Bioeconomy Research, Postboks 115, NO-1431 Ås, Norway

** presenting Author: Daniela Vanella, via S. Sofia 100 95123 Catania (Italy), +390957147554, d.vanella@unict.it*

Nowadays, the increasing availability of numerical weather predictions opens new prospects to retrieve reference evapotranspiration (ET_0) forecasts. The reliability of weather simulations provided by COSMO model in predicting ET_0 was evaluated during the year 2017 in 7 study sites distributed in 4 countries (Italy, Norway, Romania and Spain) covering a wide range of climate conditions. The main objective of the study was to evaluate the optimal scenario for calculating ET_0 by separately assessing the accuracy in the use of past meteorological data and forecasts for estimating irrigation requirements (IR).

The ET_0 estimates were obtained by incorporating the meteorological variables foreseen in the FAO-56 Penman-Monteith equation. Each weather component (air temperature, T_{air}; relative humidity, RH; wind speed, u_2; solar radiation, R_s; rainfall, P) and ET_0 was compared with ground-based observations. Simulated irrigation scheduling was computed every three days using: (i) meteorological data measured during the previous three days and (ii) weather forecast for the next three days; and compared *a posteriori* with IR obtained from the measured meteorological data. Validations were performed by R^2 and RMSE.

Results showed a good agreement between measured and estimated meteorological variables. The best performance was obtained for T_{air} and R_s (R^2, RMSE of 0.97, 1.54°C; and 0.89, 37.33 W m^{-2}, respectively), whereas the worst model performance was obtained for P and u_2 (R^2, RMSE of 0.12, 126.61 mm; and 0.34, 1.20 m s^{-1}, respectively). The comparison between daily ET_0 from the measured and predicted meteorological data showed high performance, with R^2 and RMSE of 0.90 and 0.68 mm, respectively. IR values have been estimated more accurately using forecast meteorological data (1.7% overestimation), rather than using meteorological data from the past (2.6% underestimation).

In conclusion, the use of forecast meteorological data is recommended for the estimation of IR, since the uncertainties due to the weather forecast translate into minor errors compared to those committed when using data from past meteorological conditions.

CODE: 071

Topic: *Forestry hydraulics and hydraulics protection of agricultural and forestry systems*
AIIA Section: *Utilizzazione del Suolo e delle Acque.*

5.12 TWO-DIMENSIONAL NUMERICAL MODELING OF HYDRAULIC EXPERIMENTS IN A DRAINAGE CHANNEL UNDER DIFFERENT RIPARIAN VEGETATION SCENARIOS

G. F. C. Lama[1], A. Errico[2], S. Francalanci[3], G B. Chirico[1], L. Solari[3] and F. Preti[2]

[1] Department of Agricultural Sciences, University of Naples "Federico II"
Via Università 100, 80055, Portici (Italy)
giuseppefrancescocesare.lama@unina.it

[2] Department of Agricultural, Food, Environmental and Forestry Sciences and Technologies, University of Florence
Via San Bonaventura. 13, 50145, Firenze (Italy)
alessandro.errico@unifi.it
federico.preti@unifi.it

[2] Department of Civil and Environmental Engineering, University of Florence
Via Santa Marta. 3, 50139, Firenze (Italy)
simona.francalanci@unifi.it
luca.solari@unifi.it

Presenting Author: Giuseppe Francesco Cesare Lama

Department of Agricultural Sciences, University of Naples "Federico II" Via Università 100, 80055, Portici (Italy) giuseppefrancescocesare.lama@unina.it

Abstract

A two-dimensional numerical model was applied for interpreting the results of hydraulic experiments conducted in a drainage channel covered by mature *Phragmites australis (Cav.) Trin. ex Steud.* (common reed), in the San Rossore-Migliarino-Massacciuccoli Regional Park (Tuscany, Italy).

The model solves the Depth-averaged Dynamic Wave equations, based on a numerical Finite Volume Method (FVM), and in this study was implemented with spatially variable roughness coefficients for describing the impact of different vegetation management scenarios.

The hydraulic experiments were conducted with three different discharges and three vegetation scenarios: A) undisturbed vegetation, with common reed fully covering the drainage channel; B) vegetation removal only in the central portion of the channel, with two lateral buffers of undisturbed vegetation; and C) extensive cut of the whole vegetation cover from the channel and the banks.

The numerical results were compared with the observed water surface elevations and with vertically averaged flow velocities measured by means of an acoustic doppler velocimeter positioned along five verticals of the upstream cross-section of the drainage channel.

The results are discussed for evaluating the impact of the different management scenarios on both channel hydraulic conveyance and riparian vegetation habitat functionality.

CODE: 100

Reference topic: Water resources management in agriculture and forestry ecosystem
AIIA first section "Utilizzazione del suolo e delle acque"
Proposed for oral presentation

5.13 UNDERSTANDING FLOOD GENERATION IN MELTWATER-DOMINATED CATCHMENTS THROUGH STABLE ISOTOPES OF WATER

Giulia Zuecco[1] and Daniele Penna[2]

[1]Dept. of Land, Environment, Agriculture and Forestry, University of Padua
[2]Dept. of Agriculture, Food, Environment and Forestry, University of Florence

Presenting author: G. Zuecco, via dell'Università 16, 35020 Legnaro (PD), Italy, giulia.zuecco@unipd.it

Mountain catchments are fundamental landscape units to study runoff generation processes whose understanding is critical to develop effective measures of flood prevention and mitigation. Particularly, high-elevation and high-latitude catchments, dominated by meltwater inputs (snowmelt and glacier melt), represent important sources of freshwater and are particularly vulnerable to climate change effects. A detailed comprehension of hydrological mechanisms in these environments is therefore of paramount importance both for flood risk assessment and for projection of future water supply and water resources management.
In the last decade, several studies were carried out in meltwater-dominated high-elevation and high-latitude catchments in cold regions around the world, in different physiographic conditions and climatic forcing. Many of these studies were conducted based on an experimental or experimental-modelling methodological approach that took advantage of stable isotopes of hydrogen and oxygen used as tracers to track water flow pathways through the catchment. These works contributed to get more insight into the hydrology of these systems, offering a description of a large variety of mechanistic and sometimes site-specific behaviours. There is therefore the need to summarize these recent findings and organize them in a coherent framework to obtain a comprehensive view of flood generation processes in meltwater-dominated catchments and, at the same time, to identify research gaps.
In this work, we provide an overview on current knowledge derived by recent studies that applied stable isotopes of water in high-elevation and high-latitude catchments. We collected more than 50 papers published between 2015 and 2019 in peer-reviewed journals. We focus and summarize the main findings obtained by these papers around the following key points: quantification of water sources contributing to stream runoff; role of storage on water availability and catchment hydrological response; role of permafrost thawing on meltwater input to stream; results of isotope-aided modelling to predict flood generation and project future runoff dynamics. We, then, highlight current limitations associated to this methodological approach, provide possible solutions to overcome them, and identify research lines that can serve as a guide for future isotope-based studies of hydrological behaviour in meltwater-dominated, high-elevation and high-latitude catchments.

CODE: 128

I sezione AIIA: Utilizzazione del suolo e delle acque

TOPICS: Remote Sensing in agricultural and forestry systems; Agricultural hydraulics

Proposed for POSTER presentation

5.14 VALIDATION OF NORMALIZED DIFFERENCE INFRARED INDEX (NDII) TO ESTIMATE SOIL MOISTURE IN TRADITIONAL OLIVE CULTIVATION SYSTEMS, TUNISIA

Lucas Allan Almeida Oliveira [1,2], Giulio Castelli [2*], Fethi Abdelli [3], Hanen Dhaou[3], Elena Bresci [2], Mohamed Ouessar [2]

[1] Federal University of Viçosa, Viçosa, state of Minas Gerais, Brazil

[2] Department of Agriculture, Food, Environment and Forestry (DAGRI), Università degli Studi di Firenze

[3] Institut des Régions Arides (IRA), Médenine, Tunisia

** Presenting author: DAGRI, Università degli Studi di Firenze, Via San Bonaventura, 13, 50145, Firenze, Italy. Mail: giulio.castelli@unifi.it*

Olive trees are one of the most cultivated plants in the south-eastern Tunisia, characterized by semi-arid to arid climate. In that area, olive trees are grown under rainfed conditions or in areas upstream traditional water harvesting techniques, called *jesr* (plural: *jessour*). Under conditions of water scarcity, having information on soil moisture could be fundamental, since crop productivity is mainly determined by soil water availability. Methods to estimate the soil moisture are mostly based on punctual sampling and demand an intensive field work, thus the use of satellite images can be an effective alternative to estimate the soil moisture on these areas. Sriwongsitanon et al. (2016) have shown that Normalized Difference Infrared Index (NDII) values are strongly correlated with modelled soil moisture in the root zone. The aim of this research is to validate the use of the NDII to estimate the soil moisture in olive tree orchards situated in Tunisia. Time series of NDII values were compared with measured soil water contents, collected at a non-regular time interval between 2009 and 2017, by using the novel Google Earth Engine platform. Soil moisture data was collected on tree olive orchards: Jessour sites Techine and Adbach and rainfed site Dar Dhaoui. We tested the correlation between NDII (8-days composites) and soil moisture at each available depth, by using the 'Landsat 7 Collection 1 Tier 1 8-Day NDWI Composite', using a linear interpolation on the NDII data to find an estimated value on the days we had the soil moisture data. Once the correlation was tested, the data available was used to build equations that allows the estimation of soil moisture using the NDII, for each site. Results show that the soil moisture of the first layer had the best correlation with the NDII for all the tree sites evaluated. The coefficient of determination values (R^2) for Dar Dhaoui, Jesr Adbach and Jesr Techine sites, were respectively 0.67, 0.63 and 0.62. Our analysis represents a confirmation of previous validation of NDII as a proxy of soil moisture. The results allow us to conclude that Landsat 7 NDII values are correlated with the soil moisture for the three study areas. It is possible to infer the soil moisture variations for other points on the study area using NDII values.

6 AIIA Section 2 - Rural buildings, plants and territory

President

Patrizia Tassinari

University of Bologna

Vice President

Giovanni Cascone

University of Catania

6.1 PURPOSE

The 2nd AIIA Section - Rural buildings and agro-forestry - deals with construction in agriculture in relation to the biosystems it contains, the design of structures, technical systems and infrastructures for the agro-forestry area, and the analysis, planning and design of the territory and the rural landscape. Strategic objectives are: innovation and quantitative and qualitative optimization of the efficiency of agricultural and forestry production processes, reduction of environmental and landscape impacts, protection and enhancement of rural environment structural and infrastructural systems related to rural buildings and to the agro-forestry territory. Studies and research, conducted also with interdisciplinary characteristics, incorporate the requirements of competitiveness, sustainability and improvement of the quality of the agricultural sector and the related dynamics, as well as the needs of the community, in line with national and international policies. Design, planning, analysis, modelling and monitoring methods are applied in particular: to buildings for agriculture, animal husbandry, protected crops, forest activities, rural housing, conservation, processing and processing of agricultural products, livestock and forestry, aquaculture, management and treatment of agricultural, zoo-technical and agro-industrial effluents; to the relationship between biosystems and buildings; to land, environmental and agro-forestry landscape resources; to the rural building heritage; to the infrastructure for the green, the territory and the use of the rural landscape.

6.2 TOPICS OF INTEREST

The specific areas of study are: planning of structures and infrastructures for agriculture, animal husbandry and agro-industry; design, functional, technical-construction, plant engineering, energy, environmental, safety, biomaterial aspects, related to rural buildings; savings, energy efficiency and use of renewable energy sources in buildings and technical installations for agriculture; analysis of the environmental performance of buildings and plants for agriculture, recycling and reuse of construction materials; environmental impact of livestock farms, management systems for agricultural and livestock waste; modelling of environmental parameters in farm buildings, in livestock farms and in protected facilities; rural building design with landscape compatibility criteria; study and recovery of historic rural buildings; survey, representation, analysis and modelling of the natural and anthropic resources of the rural area, also with precision techniques; analysis of the built and infrastructural system of the near-urban and rural territory, on the building, settlement and large area scale, with inferential techniques and high efficiency systems; definition of criteria, methods and tools for urban planning, territorial and landscape planning in suburban areas; analysis of the landscape impact of structures and infrastructures in the extra-urban territory; planning of green areas

in urban and extra-urban areas; environmental assessment of plans and interventions in the territory; recovery and redevelopment of the agro-forestry area and degraded areas, also with naturalistic engineering techniques. Members of the 2nd AIIA Section are mainly active in Working Groups attributable to the sector of interest SE (Structures & Environment) of the ***European Society of Agricultural Engineers*** (EurAgEng) as well as in section II (Farm Buildings, Equipment, Structures and Environment) of the ***International Commission of Agricultural and Biosystem Engineering*** (CIGR).

7 AIIA Section 2 – Oral Presentations

Oral Presentations

CODE: 160

Reference topic: Monitoring and modeling of the interactions among soil hydrological, plant and atmosphere processes, and agricultural management practices

AIIA section: 2°

Proposal: oral

7.1 A LIFE CYCLE ASSESSMENT COMPARATIVE STUDY OF DIGESTATE APPLICATION WITH FERTIGATION AND TRADITIONAL TECHNIQUES IN LIFE ARIMEDA PROJECT

***Jacopo Bacenetti*[1], *Viviana Guido*[2], *Elisabetta Riva*[2], *Giorgio Provolo*[2]**

[1]*Department of Environmental Science and Policy, Università degli Studi di Milano, Via Celoria 10, 20133, Milano – Italy.*
[2]*Department of Agricultural and Environmental Science, Università degli Studi di Milano, Via Celoria 2, 20133, Milano – Italy.*

Presenting author: Jacopo Bacenetti. Department of Environmental Science and Policy, Università degli Studi di Milano, Via Celoria 10, 20133, Milano – Italy Jacopo.bacenetti@unimi.it

Abstract

The project LIFE16 ENV/ES/000400 ARIMEDA, aims at developing and demonstrating innovative systems of fertigation in Mediterranean extensive crops using the liquid fraction of slurry and digestate, in order to reduce emissions of ammonia.
In the framework of the project, this study aims to compare the environmental impact related to two different maize cultivation scenarios to produce silage. In the Baseline Scenario (BS), organic fertilizer is applied only in pre-sowing using a conventional slurry tank equipped with a splash-plate system while, in the Alternative Scenario (AS), a pre-sowing application using an umbilical system and six fertigation applications using electrical pumps have been used.
The inventory data regarding the production factors used (fuel, fertilisers, seeds, pesticides, etc.) and the biomass yield (19.2 and 20.4 tons of dry matter for BS and AS, respectively) were directly collected during experimental trials performed in 2018 over a global area of 19.44 ha (7.00 ha for BS and 12.44 ha for AS). Except than for ammonia volatilisation, the emissions of N and P compounds related to fertiliser applications were assessed according the model proposed by Brentrup et al. (2000). The emission of NH_3, measured by passive samplers (CEH ALPHA samplers) and evaluated with Wintrax software, was considerably higher in BS (473 kg/ha vs 213 kg/ha in AS).
The environmental impact was evaluated using the Life Cycle Assessment (LCA) approach considering the following environmental indicators: Climate change (CC), Ozone depletion (OD), Particulate matter (PM), Photochemical ozone formation (POF), Acidification, Terrestrial (TE), Freshwater (FE) and Marine eutrophication (ME) and Mineral, fossil & ren resource depletion (MFRD). Respect to BS, AS performs better for all the impact categories affected by the ammonia emission (i.e., -57% for PM, TA and TE), shows similar results for CC, OD, POF and MFRD and it has a higher impact for ME (+11%, due to higher nitrate leaching).
Although the results should be confirmed by the second year of the project, the use of fertigation, combined with appropriate application techniques of digestate in the pre-sowing period, might be a sustainable technique to reduce ammonia emissions related to the application of animal slurry and digestate.

CODE: 035

Computer communication technologies – AIIA 2nd Section

Proposal for Oral presentation

7.2 A NUMERICAL MODEL QUANTIFYING HEAT STRESS SUSCEPTIBILITY OF INDIVIDUAL DAIRY COWS

Stefano Benni[a], Matti Pastell[b], Filippo Bonora[a], Patrizia Tassinari[a], Daniele Torreggiani[a]

a. Department of Agricultural and Food Sciences, University of Bologna
b. Luke, Natural Resources Institute Finland

Viale Fanin 50, 40127 Bologna, Italy – stefano.benni@unibo.it

Heat stress in dairy cattle farms is one of the most critical issues that can jeopardize animal welfare and production. The global climate change has sharpened the problem in recent years and a further aggravation is considered unavoidable. The current availability of databases of environmental parameters and cow-specific data about behaviour, heath and production, collected through Precision Livestock Farming (PLF) devices, has increasingly enhanced the research aimed to understand the consequences of heat stress in cattle. In this context, the development of numerical models quantifying individual cows' responses to heat stress conditions represents a topical challenge. The aim of the study is the development of a numerical model suitable to analyze the relationship between milk production, animal behavior and environmental parameters for individual cows and to identify different classes of susceptibility to heat stress in the herd.

A typical farm in Bologna plain land equipped with an Automatic Milking System (AMS) was adopted as a study case and indoor climatic data of the barn were monitored and jointly analyzed with cows' production and behavioral parameters recorded through the AMS. A Generalized Addictive Mixed Model (GAMM) was formulated based on the data surveyed, in order to quantify the influence of the thermo-hygrometric index (THI) on milk production trends in time. Each cow has been characterized in terms of the respective response to heat stress conditions and the results led to subdivide the herd into three classes of susceptibility to heat stress. These classes have then been analyzed in terms of productive, behavioral and phenotypic parameters collected by the PLF devices used in the farm. The study provided a model capable to characterize the effects of heat stress conditions on individual animals in relation to the main variables describing their conditions and the relative management choices. Moreover, the results contributed to lend indications about targeted treatments to mitigate heat stress according to each cow's features.

Keywords: Precision Livestock Farming, Dairy Cattle, THI, Numerical Model, Milk Yield

CODE: 122

Reference topic: Planning and design of rural areas.

AIIA section: 2nd Section - Rural buildings and Agroforestry Land.

Proposal for oral presentation.

7.3 ADAPTATION TO CLIMATE CHANGE IN SARDINIA: A SCRUTINY OF REGIONAL PLANS

Antonio Ledda, [1,*]Andrea De Montis,[1,] [2]Elisabetta Anna Di Cesare,[2] Giovanni Satta,[3] Gianluca Cocco, [3] Filippo Arras,[3]Annalisa Congiu, [3]Emanuela Manca [3]

[1,2]Department of Agricultural Science, University of Sassari

[2]Department of Civil and Environmental Engineering and Architecture, University of Cagliari

[3]Regione Autonoma della Sardegna, Direzione generale della Difesa dell'Ambiente, Cagliari

*Presenting author: Department of Agricultural Science, University of Sassari, viale Italia 39, 07100 Sassari, phone and fax: +39079229243; e-mail: antonioledda@uniss.it

ABSTRACT

Climate change has become an increasingly relevant and worrying phenomenon worldwide. Rising of sea level, frequent floods and higher average temperatures than in the past decades are affecting lifestyles and safety of human population, and ecosystems balance. Climate change affects urban, peri-urban and rural areas. As response, in 2013 the Council of Europe adopted the European Union strategy (EU strategy) on adaptation to climate change. The EU strategy aims at making Europe more climate-resilient also in rural areas – i.e. in rural landscapes. Adaptation measures can prevent or minimize the negative effects of climate change in such areas. In 2015 the Italian Ministry of the Environment and Protection of Land and Sea enacted the National Climate Change Adaptation Strategy, and issued a draft of the National Climate Change Adaptation Plan (NCCAP) in 2017. The NCCAP gathers the adaptation measures in three categories: gray, green, and soft measures. Several soft measures fall into the governance field. Governance implies coordination and cooperation among different actors and sectors for effective implementation of adaptation measures.

In 2019, the Autonomous Region of Sardinia adopted the regional strategy for adaptation to climate change (RSACC), which has paved the way for making the region more resilient to extreme weather events. The regional plans should be consistent with the adaptation aims and measures defined by the RSACC. The regional plans are usually drawn up through multi-actor collaboration and could be key as reference framework to define effective adaptation measures at sub regional level, i.e. for drawing up municipal master plans able to make local landscapes and territories more resilient to climate changes.

In this study, we aim at scrutinizing a set of regional plans with respect to a set of criteria proposed in a previous study and included in the RSACC, in order to stress strengths and weaknesses of the plans.

CODE: 084

Reference topic: *Rural buildings, facilities and territory*

7.4 AMMONIA EMISSION REDUCTION WITH INNOVATIVE SLURRY FERTIGATION TECHNIQUES: FIRST RESULTS OF THE PROJECT LIFE ARIMEDA

Guido V., Riva E., Finzi, A., Provolo G.

Presenting author: Guido Viviana. DISAA, Dipartimento di Scienze Agrarie ed Ambientali – via Celoria 2, 20133 Milano, email:viviana.guido@unimi.it

Abstract

The agricultural sector is responsible for most (over 90%) of ammonia emissions into the air, with negative effects on acidification and eutrophication of water. Besides, ammonia can be combined with other substances present in the air (for example, nitrogen and sulfur oxides) constituting a significant proportion of particulate matter.

Ammonia emissions from the livestock sector account for about 60% of the total and are substantially due to the management of livestock manure. Manure spreading is among the operations that can involve high ammonia emissions.

The activity of the project LIFE16 ENV/ES/000400 ARIMEDA aims at demonstrating the reduction potential of ammonia emissions using fertigation techniques with diluted liquid slurries via subsurface drip and low-pressure center pivot irrigation systems, in comparison to surface application. The activities involved two farms and a total surface of 46 ha (5 plots with subsurface drip irrigation and 2 plots with pivot irrigation.

The nitrogen use efficiency, obtained from the ratio between the removed nitrogen and the fertilizer nitrogen has been calculated for each plot. To evaluate ammonia emissions, passive samplers (CEH ALPHA sampler) were used, based on a filter impregnated with citric acid and methanol capable of retaining the ammonia contained in the air.

The overall losses in the case of surface distribution (control plots) were 25% of the total distributed nitrogen (40% of the ammoniacal nitrogen) while with direct incorporation (fertigation plots) were the 6%. Fertigation was carried out for each distribution with an average of 19 kg/ha and 23 kg/ha of nitrogen respectively for drip irrigation and pivot. The digestate was previously filtered with prototypes developed by the project partners in order to remove solids greater than 50 micron (drip irrigation) or 150 micron (pivot).

Fertigation has made it possible to limit the dose distributed in pre-sowing and to split the distribution during the growing season. The expected improvement in nitrogen use is confirmed by the increase in the nitrogen use efficiency which increased by 48% with drip irrigation and by 28% with the pivot. The first results highlight how fertigation with digestate can improve nitrogen use efficiency and reduce ammonia emissions during the application to the soil of animal manures, provided that the separation system is adequately designed.

Preferred presentation: Oral

CODE: 038

Reference topic: Remote Sensing in agricultural and forestry systems

AIIA 2nd Section: Rural buildings, facilities and territory

Proposal for: Oral presentation

7.5 ANALYSIS OF THE EVOLUTION OF PROTECTED AREAS BY IMPLEMENTING SAR GEODATA INTO A GIS ENVIRONMENT

Giuseppe CILLIS[1*], Aimé LAY-EKUAKILLE[2], Vito TELESCA[3], Dina STATUTO[1], Pietro PICUNO[1]

1 *School of Agricultural, Forest, food and Environmental Sciences - SAFE, University of Basilicata, Italy*

2 *Department of Innovation Engineering, University of Salento, Italy*

3 *School of Engineering, University of Basilicata, Italy*

** Corresponding Author: via dell'Ateneo Lucano n.10, 85100 Potenza (PZ), Italy.*

e-mail: giuseppe.cillis@unibas.it

Abstract

In the last decades, the Mediterranean agroforestry landscapes have undergone significant changes, with relevant considerable environmental and socio-economic impacts. These phenomena are often triggered by agricultural abandonment, especially in environmentally-sensitive areas, which are usually located in marginal and less profitable regions. The need to identify dynamics, trends and impacts on these areas - often having a high naturalistic and cultural value, even protected by environmental regulations - is one of the topics most investigated by rural landscape researchers, since some transformations could indeed irremediably compromise the identity and role of these Mediterranean rural landscapes. On the other hand, progressive increase of freely available multi-source geodata allows a greater knowledge of the phenomena in progress. It helps to reconstruct landscapes original structure, so as to avoid negative impacts on biodiversity, naturalness and hydrogeological stability. Hence, thanks to the development of increasingly advanced and interoperable open source GIS tools, it is possible to implement relevant geodata – *e.g.*:archive data; historical and thematic cartography; aerial photos; vector cartography; open data; satellite images;*etc.* - that can be mutually integrated in an increasingly efficient and accurate approach. In this paper the analysis of the process of landscape reshaping pattern is analysed in some protected areas of the Basilicata region (Southern Italy), characterized by natural and semi-natural habitats with a high environmental interest. Starting from the land cover map of 1975, elaborated through thematic cartography and aerial photos, the analysis has been improved through the integration of the remote sensing data processed by means of SAR images, as well to assess the land cover changes up to the present day, then enabling the development of a suitable methodology useful for future planning and management activities.

Keywords: Remote Sensing, SAR, Geographical Information System, Protected area, Rural Landscape

CODE: 117

Reference topic: Planning and design of rural areas.

AIIA section: 2nd Section - Rural buildings and Agroforestry Land.

Proposal for oral presentation.

7.6 ASSESSING RESILIENCE: A COMPARATIVE APPROACH TO ECOLOGICAL NETWORKS

Andrea De Montis[1,*], Amedeo Ganciu[2], Valentina Peddio[1], Matteo Cabras[1], Maurizio Mulas[1], Antonietta Bardi[1], Simone Caschili[3], Chiara Cocco[4], Pierangelo Massa[4]

[1]Department of Agricultural Science, University of Sassari

[2] Research Institute on Terrestrial Ecosystems (IRET) National Research Council (CNR), Roma

[3] LaSalle Investment Management, Chicago, United States of America

[4]Department of Civil and Environmental Engineering and Architecture, University of Cagliari

*Presenting author: Department of Agricultural Science, University of Sassari, viale Italia 39, 07100 Sassari, phone and fax: 079229242; e-mail: andreadm@uniss.it

ABSTRACT

The resilience is an overarching concept concerning the capacity of complex system to react to severe crisis by self-organization, innovation and learning and to attain more robust settings than in the original condition. While the theory on resilience has exploded in the last decades, its operationalization is less practiced. A possible way out is the selection of appropriate variables able to measure the behavior of a system, when it is subject to important stresses. Resilience has been applied to the study of socio-ecological system, including ecological networks. These systems can reconnect fragmented landscapes through a web of patches intertwined by environmental corridors.

In this paper, we aim at assessing the resilience of two ecological networks designed for the towns of Nuoro and Sassari, Italy. The ensembles are built on the ecological properties of two vegetal target species (i.e. *Quercus Ilex* and *Olea Europaea*) and their seed dispersal through the corresponding frugivorous animal vector species. We have studied the behavior of the ecological network under different types of attacks to the patches: at random or according to a deterministic approach to the rule of patch removal. Our method allows to compare the dynamic pattern of resilience (i.e. along the process of elimination of patches) and to observe typical outcomes reported in other cases but also interesting peculiarities.

Keywords: Ecological networks, resilience, random attack, deterministic attack.

CODE: 130

The paper is prepared for Oral presentation. Topic: *Rural buildings, facilities and territory*

AIIA Section II

7.7 CALIBRATED SIMULATION OF A FARM BUILDING FARMSTEAD: DEFINING UNCERTAINTY OF RURAL BUILDINGS ENERGY MODELS

Mansoureh Gholami*, Alberto Barbaresi, Daniele Torreggiani, Patrizia Tassinari

Department of Agricultural and Food Sciences, University of Bologna, Viale Fanin 48, Bologna (Italy)

ABSTRACT:

Rural areas represent 90% of European Union territory and recently have become the central theme in long term energy planning, while modelling energy supply and demand in rural communities is complicated due to lack of measured data and also to the independent supply sources. This paper aims to quantitatively assess energy demand of a rural building complex through a model calibration to minimize the gap between the modelled and the real energy performance of the buildings. The methodology is validated in a building farmstead - used as case study - located in Emilia-Romania Region in Italy. The contribution of this paper will be signifying the importance of calibration modelling as an integrated approach to uncertainty quantification in order to maintain the relevance of the developed energy models. This methodology will create a daily energy planning procedure to match energy production and consumption in rural areas. Result shows that monthly and annually calibration leads to considerably better energy usage intensity fits compared to traditional energy modelling.

Keywords: energy models, rural building stock, uncertainty analysis, building energy, rural planning

***Corresponding author**: Mansoureh Gholami, email: mansoureh.gholami2@unibo.it Viale Giuseppe Fanin 48, 40127 Bologna (Italy)

CODE: 141

AIIA Section II

Topic: Planning and design of rural areas - Oral Presentation

7.8 COMMUNITY LED LOCAL DEVELOPMENT AND PSL, POTENTIALS FOR REFUELLING THE URBAN-RURAL LINKAGE: A CASE IN CENTRAL ITALY

Ernesto Marcheggiani [1,2], Monica Bocci[1], Francesco Paci[1]

1. Dipartimento di scienze Agrarie, Alimentari e Ambientali (D3A), Università Politecnica delle Marche, Via Brecce Bianche 12, 60131 Ancona (Italy)

2. Division of Forest, Nature and Landscape (FNL), University of Leuven, Celestijnenlaan 200e, 3001 Leuven (Belgium)

e.marcheggiani@staff.univpm.it

Urbanisation and economy change resulted in new types of rural-urban interactions in the last decade. Such a challenge compels for a due revitalising revision of territorial policies and governance approaches. New paradigms stemmed by the long route of the European strategy 2020 have funded their ground overall in Europe while new keywords are setting the policy agenda.

Rural territories are not exempt from such a trend, and the Leader agenda for the period 2014 – 2020 has seen a number of different approaches declining the same rules of law across the continent. Moreover this, fresh brand new proposal such as the recall for a multi-governance and convergences for the structural funds have remained unheard in several regions of Europe, a situation which, at the very operational stage of the programming period, is seeing Italy playing the Cinderella's if compared with the governance innovation drawn by other European countries. Whilst some of them are benefitting for a number of the positive effects of their well-planned and sound exploitation of the novelties offered, others stand still laying beyond in old visions. The conundrum of the sustainable and accessible future development of rural districts.

The work put forward a reflection on the challenges risen by the newly branded multi-level forms of governance and the way structural funds are channelled to territories. In the frame of an ongoing action among a wide partnership of local stakeholders, the work depicts the first stages for the implementation of a network operating in the context of rural tourism in the Marche region, in Central Italy. The implementing of the body of the network is inspired to the community lead local development (Clld) approach, as hardly wished by the DG Regional and Urban Policy and DG Agriculture at the European Commission since the beginning of the current programming period. The network gathers a meaningful representative of bodies, from the regional authority to civil society and entrepreneurs active in rural development and agriculture (the LAG and FLAG, sixty Municipalities and the three coastal medium towns, etc.), reaching out for a public of 400'000 people in the region and pushing the regional constituency far beyond the business as usual.

CODE: 050

Reference topic: Rural buildings, facilities and territory

AIIA 2nd Section: Rural buildings, facilities and territory

Proposal for: Oral presentation

7.9 COMPARISON OF THE EFFICIENCY OF PLASTIC NETS FOR SHADING GREENHOUSE IN DIFFERENT CLIMATES

Dina STATUTO[1*], Ahmed M. ABDEL-GHANY[2], Giuseppe STARACE[3], Paolo ARRIGONI[4], Pietro PICUNO[1]

1 *School of Agricultural, Forest, food and Environmental Sciences - SAFE, University of Basilicata, Italy*
2 *Department of Agricultural Engineering, College of Food and Agriculture Sciences, King Saud University - KSU, P.O. Box 2460, Riyadh 11451, Saudi Arabia.*
3 *Department of Engineering for Innovation - University of Salento, via per Monteroni, 73100 Lecce, Italy*
4 *SACHIM s.r.l., via Mastricale 7, 70017 Putignano (BA), Italy*

- *Presenting Author: via dell'Ateneo Lucano n.10, 85100 Potenza (PZ), Italy. e-mail: dina.statuto@unibas.it.*

Abstract

A greenhouse creates ideal cultivation conditions, since it contributes to a better microclimate together with an effective exploitation of the solar radiation, controlling the internal environment while optimizing the use of resources. In order to limit the internal air temperature raise during summer, one common solution utilized by growers is the shading of the greenhouse against excessive solar radiation through the use of plastic shading nets due to their cheaper price and photo-selective properties, as a way to effectively control the micro-climatic conditions inside greenhouse and tunnels. Moreover, thanks to a specific formulation of their chemical and physical properties, plastic nets may also proactively combine the shading effect with some specific features, useful to create more favourable conditions for crop growth.

With the aim to analyze the efficacy of the shading effect of plastic nets in different climates, experimental trials have been carried on some identical small-scale tunnels installed in two different locations, one Mediterranean area (Acerenza - Southern Italy) and one in arid conditions (Riyadh - Saudi Arabia). These tunnels have been covered with an EVAC plastic film and shaded with different types of plastic nets, installed either in contact or at a distance of 20-cm from the external part of the cladding film. The radiometrical characteristics of the plastic film and nets have been determined through laboratory tests, while the internal microclimatic conditions monitored inside these experimental tunnels in both the tested locations. The results obtained enabled to start a comparative analysis of the performances of the tested nets, highlighting the role that a selective filtering of the solar radiation may play on crop protection from high temperatures, as well as on the quality of light arriving to the crops.

CODE: 107

Topic for oral presentation: Rural buildings, facilities and territory - II Section AIIA

7.10 DAMAGES TO RURAL BUILDINGS AND FACILITIES OBSERVED IN THE AFTERMATH OF 2012 EMILIA EARTHQUAKES

Bovo Marco*, Barbaresi Alberto, Torreggiani Daniele, Tassinari Patrizia

Department of Agricultural and Food Sciences – University of Bologna

Viale G. Fanin 48, 40127 Bologna, Italy

* Corresponding author. email: marco.bovo@unibo.it – DISTAL, viale Giuseppe Fanin, 48 – 40127 Bologna (BO) – Italy.

Abstract In May 2012, two strong seismic events hit the Emilia Romagna region, in the north of Italy. Those earthquakes caused strong damages to both historical rural heritage and modern agricultural precast facilities, highlighting the high seismic vulnerability of these structures. In this paper, damages and collapses collected in the aftermath surveys on historical rural and modern agricultural buildings, are presented and commented. It was observed that in the area hit by the earthquakes few recurrent typologies are present, and buildings of the same typology showed similar damage mechanisms. Therefore, in order to define the most typical damages affecting constructions in the agricultural sector, the stock of the historical rural buildings has been classified in different categories, based on plan layout and intended use of each building. The first criterion separates the isolated from the composed buildings. The second splits the structures in dwellings for residential use, stable-haylofts and buildings used for other minor services. Instead, the reinforced concrete precast buildings were classified based on age of construction and main dimensions of principal elements. The outcomes presented in this paper allowed to identify the rural building typologies most vulnerable to earthquakes and to define recurring deficiencies for the various categories. In general, the main reasons of the damages to historical buildings can be ascribed to lack of effective connections between orthogonal walls, poor connections between floor elements and walls, and excessive flexibility of floor diaphragms. The main lacks observed in the precast facilities were the absence of mechanical connections between precast elements and the great flexibility of vertical elements inducing large horizontal displacements and consequent loss of structure stability.

Keywords: rural building; traditional technology; precast facilities; seismic damage; building survey; Emilia earthquake.

CODE: 097

Reference topic: Spatial and landscape analysis or Planning and design of rural areas

II AIIA section

Proposal for Oral presentation

7.11 ECOSYSTEM SERVICES ASSESSMENT FOR ECOLOGICAL CORRIDORS: A STUDY CASE AT LOCAL SCALE IN ITALY

Maurizia Sigura

Department of Agricultural, Food, Environmental and Animal Sciences University of Udine, Via delle scienze 206, 33100 Udine , Italy. Tel.+39+432558658, Fax. +39+432558603 e-mail: maurizia.sigura@uniud.it

Abstract

Ecological networks are considered as effective tools for counteract the effects of fragmentation due to human activities and infrastructures both at european (Natura 2000 site network) and country scale At regional and local scale the principles of ecological connectivity is widely applied both to spatial planning and landscape planning, which represents the areas where ecological networks implementation is now taking place. With the launch of the EU 2020 european biodiversity target and 2050 vision for the sustainabile development the European Commission intoduced the more complex concept of Green Infrastructures (GI) which are defined as " *a strategically planned network of natural and semi-natural areas with other environmental features designed and managed to deliver a wide range of ecosystem service".* The European Strategy recognised GI as a tool for providing ecological, economic and social benefits through natural solutions, putting at the core of this approach issues such as ecosystem services, climate change adaptation and ecological resilience.

In this framework a meta-network approach was developed to study the ecological connectivity as ecosystem service by influence and network diagrams. The first step provides for the identification of the multiple types of nodes (ecological, economic and social factors) ehich take part in the meta-network and interacting with the ES. The second step provides the identification of which ecological network components directly and indirectly contribute to the ecosystem service provision. The third step identifies the relations between the nodes of meta-network finding the links of the network. Analisys of relations between ES and the structure of ecological network (e.g. the impact on connectivity indices), the socioeconomic network (e.g., actors benefit from the service, or interact with it), the drivers and management actions (e.g., landuse change, climat change , rural development, nature conservation) complement the meta-network model.

The proposed approach was used to operationalize a project, aimed to the creation of an ecological corridor, for ecosystem service management in the plane of Friuli Venezia Giulia region, obtaining a new tool for support the spatial planning process and communication.

CODE: 061

Reference topic: Rural buildings, facilities and territory - AIIA 2nd Section - Rural buildings and Agroforestry Land

7.12 EFFECTS OF FEEDING FREQUENCY ON THE BEHAVIOR PATTERNS OF DAIRY COWS IN AN AUTOMATIC FEEDING AND MILKING SYSTEM

Gabriele Mattachini, Alberto Finzi, Elisabetta Riva, and Giorgio Provolo

Department of Agricultural and Environmental Sciences, Università degli Studi di Milano, 20133 Milano, Italy

Presenting author: Gabriele Mattachini. Department of Agricultural and Environmental Sciences, Università degli Studi di Milano, 20133 Milano, Italy, email:mxlelex@libero.it

Feeding systems in modern dairy farms is an important issue in relation to animal welfare moreover the choice between the different types available on the market implies economic and technological consideration. The objective of this study was to determine the effect of feed delivery frequency on the behavior patterns, visits to an automatic milking system (AMS) and on milk production of lactating dairy cows.
The study was conducted on two commercial dairy farms with 93 and 83 lactating cows, respectively. Milking and feeding were carried out automatically. Feeding treatments of mixed ration on both farms consisted of two different frequencies replicated in two periods. On one farm cows were fed 11 times per day (11×) and 6×; on the other farm cows were fed 9× and 6×. Lying behavior of 44 dairy cows (20 on one farm and 24 on the other), randomly selected, was electronically monitored for the last 4 d of each treatment period. All individual-cow milking-related data were automatically collected.
The frequency of feed delivery had no effect on total daily lying time and the lying bouts. High feed delivery frequency (11×) affected the distribution of lying bouts durations. Cows fed 11× compared to those fed 6× had significantly fewer longer bouts (150 to 200 min in duration), and shorter bouts (100 to 150 min). High feeding frequency may disturb the duration of lying bouts and alter the pattern of lying behavior throughout the day, affecting mainly the lying time during the 60 min before and following the provision of fresh feed. Utilization of AMS was not affected by feeding frequency, but, in several hours of the day, the feeding frequency significantly affected the milking and refusal patterns. The results obtained showed that a high feed delivery frequency (11×) compared to a low feed delivery frequency (6×) decreases the number of long-duration lying bouts, which may indicate that a very high feeding frequency disturbs the cows during their resting periods and thus influences both animal comfort and milk production. Based on these results, we recommend delivering feed at a low frequency to allow cows to distribute more evenly their lying time over the course of the day and improve their utilization of an AMS.

Preferred presentation: Oral

CODE: 005

reference topic: Rural buildings, facilities and territory

AIIA section: 2°

proposal for Oral presentation

7.13 EVALUATION OF GREEN-WALLS EFFICIENCY FOR BUILDING ENERGY SAVING

C. Bibbiani[1*], C. Gargari[2], C.A. Campiotti[3] and F. Fantozzi[2]

[1] Department of Veterinary Sciences, University of Pisa, Viale delle Piagge 2, Pisa 56124 (Italy); carlo.bibbiani@unipisa.it

[2] Department of Energy, Systems, Territory and Construction Engineering (DESTEC), University of Pisa, Via Diotisalvi 2, Pisa 56126 (Italy)

[3] ENEA - Italian National Agency for New Technologies, Energy and Sustainable Economic Development - Technical Unit Energy Efficiency - Agriculture Unit, Via Anguillarese 301, 00123 Roma (Italy)

Abstract

The research moves from the processing of thermo-hygrometric data collected through a campaign to monitor energy flows within the rooms of Building F92, with particular reference to the sections of the building facing south-east, south-west, screened by a green wall.

In spring 2018, ENEA installed many sensors to detect parameters such as air temperature, internal and external surface temperature of walls, solar irradiation, wind speed, etc., on the one hand, to validate the reliability of the parameters that can be extrapolated from the critical analysis of the readings, on the other to derive indications for a possible schematization of the contribution offered by the green-wall to the improvement of the conditions of indoor comfort. The research focused on the interpretation of the values measured by the sensors for the validation of simplified calculation models available in the bibliography.

The analysis allowed the extrapolation of data useful for the calculation of the “Kv“ parameter, the so-called "green factor", a synthetic index able to describe the contribution to cooling offered by the green-walls.

The evaluation of the parameter Kv demonstrates the substantial contribution of the green-wall to the reduction of the flow entering the opaque wall.

Keywords: green-wall, building energy saving, green factor.

Dott. Ing. Carlo BIBBIANI

Department of Veterinary Sciences, University of Pisa

Viale delle Piagge 2, 56124 - Pisa (I)

phone: +39 0502216813

Fax: +39 0502210654

mail: carlo.bibbiani@unipi.it

CODE: 014

Reference topic: Monitoring and modeling of the interactions among soil hydrological, plant and atmosphere processes, and agricultural management practices

AIIA section: 2nd Section - Rural buildings, plants and territory
Oral presentation

7.14 HEAT FLUXES IN A GREEN FAÇADE SYSTEM: MATHEMATICAL RELATIONS AND AN EXPERIMENTAL CASE

Fabiana Convertino*, Giacomo Scarascia Mugnozza, Evelia Schettini, Giuliano Vox

Department of Agricultural and Environmental Science DISAAT – University of Bari, via Amendola 165/A, 70126 Bari, Italy – fabiana.convertino@uniba.it

Abstract

The need of greater environmental sustainability in today's living contexts can be significantly coped through the design and implementation of green infrastructures. Their benefits, in terms of climate improvement and comfort conditions, are considerable. Among green infrastructures, vertical greenery systems (VGSs) represent an important application to buildings. VGSs contribute to the energy efficiency of the buildings and, at the same time, to the improvement of outdoor and indoor microclimatic conditions. Green façades, a specific typology of VGSs, allow a considerable energy saving for air conditioning, thanks to the reduction of the buildings' surfaces temperature and the increasing of the envelope thermal insulation. Thus, a realistic description of the functioning of green façades is essential for the comprehension of the real extent of the advantages given by their introduction. This paper aims to provide a first answer to the need of energy simulation models for green façades' thermal behaviour. The paper proposes a theoretical and an experimental approach. Firstly, the main heat fluxes involved into the green façade system are investigated and described, by resorting to a schematic representation. Then, the so defined mathematical relations are applied to data collected during an experiment on a green façade conducted at the University of Bari. This work represents a contribution to the development of a model to forecast the thermal behaviour of green façades and of the microclimate of buildings equipped with them.

Keywords: vertical greenings, heat transfer, energy saving, green layer, evapotranspiration.

**** Presenting author:*** *Fabiana Convertino, Department DISAAT University of Bari, via Amendola 165/A, 70126 Bari, Italy. Telephone: +39 0805443060. Fax +39 0805442977 Email: fabiana.convertino@uniba.it*

CODE: 126

Reference topic: Planning and design of rural areas.

AIIA section: 2nd Section - Rural buildings and Agroforestry Land.

Proposal for oral presentation.

7.15 INDICATOR OF CONNECTIVITY: APPLICATION TO SPECIFIC SARDINIAN CASES

Andrea De Montis[1], Vittorio Serra[2*], Antonio Ledda[1]

[1]*Department of Agricultural Science, University of Sassari*

[2]*Department of Civil and Environmental Engineering and Architecture, University of Cagliari*

*Presenting author: Department of Civil and Environmental Engineering and Architecture, University of Cagliari; e-mail: vittorio.serra1986@gmail.com

ABSTRACT

Landscape fragmentation (LF) is a process largely caused by road infrastructure and urbanised areas. LF consists of dividing a natural environment into several separate fragments and reducing the surface area of the original land. The most obvious effects are: the isolation of animal and plant species, the reduction of biodiversity, and loss of connectivity between natural areas. LF can be considered as one of the main causes that negatively affect landscape quality, because it triggers habitat loss processes, decline of fauna and flora species. Transport and mobility infrastructures and urban settlement have been acknowledged as key factors in catalysing LF processes. On the other hand, connectivity is defined as "the degree to which the landscape facilitates or prevents movement between patches" and can be measured by the probability of movement between all points or areas of intervention of a landscape.

In this work we propose the application of the connectivity indicator for natural areas. The index, which is part of a more complex indicator, the City Biodiversity Index (CBI), or Singapore Index on Cities' Biodiversity Index, is particularly useful for measuring connectivity of natural areas in urban environments. This index can provide answers on the degree of connectivity of a habitat, considering intra and inter patch movement. We apply the indicator to specific case studies located in Sardinia, in the cities of Cagliari and Sassari. The connectivity between the natural areas of the urban context has been evaluated; results provide planners with powerful indications on possible interventions able to limit the effects of LF.

CODE: 036

Reference topic: Rural buildings, plants and territory

AIIA section: 2nd Section - Rural buildings, plants and territory

Oral presentation

7.16 INNOVATIVE TENSILE STRUCTURES FOR PROTECTED CROP FACILITIES

Silvana Fuina, Giacomo Scarascia Mugnozza, Sergio Castellano*

Department of Agricultural and Environmental Science DISAAT – University of Bari, via Amendola 165/A, 70126 Bari, Italy – silvana.fuina@uniba.it

**** Presenting author:** Silvana Fuina, Department DISAAT University of Bari, via Amendola 165/A, 70126 Bari, Italy. Telephone: +39 0805443060. Fax +39 0805442977 Email: silvana.fuina@uniba.it*

Abstract

Greenhouse structures are complex buildings that must meet different needs, such as the microclimate control inside the greenhouse, the strength of structural elements, as well as the radiometric features of roofing materials. The covering system must allow the transmission of solar radiation for crop needs and guarantee resistance performances in relation to external actions, such as wind and snow load. Starting from the main characteristics of agricultural greenhouses and tensile structures, the proposal concerns with an innovative tensile supporting structure designed for the covering of protected crop facilities.

The innovative tensile structural configuration was first studied by means of the selection of the construction materials and the cross sections of the structural components and afterward calculated using the structural analysis software SOFISTIK. The load analysis on the structure was carried out in accordance with the European standards UNI-EN 13031-1: 2004 and the Italian Technical Construction Code of 2018. The main results concern the comparison with the current structural types of commercial greenhouses: analysis of the steel weight of the structure and improvement of the structural response to external actions of the innovative tensile structure.

Keywords: greenhouse structures, load analysis, structural behaviour.

CODE: 047

Reference topic: Computer and communication technology – AIIA Section: II (oral presentation)

7.17 MODELING SOIL THERMAL REGIMES DURING A SOLARIZATION TREATMENT IN CLOSED GREENHOUSE BY MEANS OF SYMBOLIC REGRESSION VIA GENETIC PROGRAMMING

A. D'Emilio[1]

[1]Department of Agriculture, Food, and Environment, University of Catania, via S. Sofia 100, 95123 Catania, Italy; phone: +39-095-7147577; e-mail: ademilio@unict.it

Soil solarization is a non-chemical method for disease controlling that employs only solar radiation to heat moistened soil, mulched with a plastic film, up to temperatures which are lethal for most soil-borne pathogens. The use of this technique in closed greenhouse is more effective and has allowed its spreading in areas characterized by temperate climate, such as the Mediterranean Basin. Modeling soil thermal regimes during a solarization treatment is a relevant topic, as it can be useful to estimate the required duration of the treatment in relation to the climatic conditions, as well as the efficacy of the technique. To this aim, several studies have been carried out, based on two main strategies: modeling the physical processes of the soil-mulch-greenhouse system or applying numerical procedures based on neural networks (NNs). However, the application and reliability of physical models require accurate knowledge of the thermo-physical properties of each component of the system, which are sometimes difficult to measure. On the contrary, NNs have the advantage of not considering the physical properties of the system, but they do not give any symbolic function which can be easily used. Symbolic regression via genetic programming (GP) represents an alternative method for finding a function that best fit a given set of data by applying genetic algorithms. In this paper, a such model is proposed, which use outside air temperature, outside solar radiation flux, and time of day as input variables and provides soil temperatures at different depths as output. The results allowed to obtain an easy to use symbolic function which is able to estimate soil temperature with an accuracy comparable to that one achieved with other simulation models.

CODE: 112

Rural buildings, facilities and territory
AIIA section: 2°
Proposal: oral presentation

7.18 MODELLING DAIRY COW BEHAVIOUR IN FREE STALL BARNS: THE CASE STUDY OF COW OESTRUS DETECTION FROM ACCELEROMETER DATA

Porto S.M. C.[1*], Mancino M.[1], Cascone G[1]., Arcidiacono C.[1]

[1]Department of Agriculture, Food and Environment, University of Catania
Building and Land Engineering Section, via S. Sofia 100, 95123, Catania, Italy;
[*]Presenting author: siporto@unict.it; mob. ++3923031968.

Keywords: PLF; behaviour; statistical analysis; indicator; acceleration components.

In the last decade, application of PLF techniques have provided relevant contribution for intensive livestock farming by improving the efficacy of the farm management processes, enhancing animal welfare in barns and reducing livestock breeding costs for farmers.
In dairy cattle production systems, accurate oestrus detection is required to minimize production costs because it is of key importance to reduce calving interval and the consequent loss of milk production, as well as additional costs related to medical expenses, semen purchase, and daily herd management operations. Although a number of processes of the dairy industry can be automated, oestrus detection is an activity that still requires farmers' experience.
In this case study an accelerometer device was fixed to a hind leg of the cow for a week with the aim of identifying oestrus manifestation. The tri-axial acceleration data, stored using a Raspberry Pi single board computer, was rigorously analysed adopting statistical methods to achieve valid indicators for oestrus detection. Among different indicators based on Signal Magnitude Area (SMA) computed on the different acceleration components, the moving average of the SMA computed on the x acceleration component at a 15-min interval provided good results when used as prediction variable of the cow's heat. This indicator increased when the cow was in standing for a long period, as expected from the results described in the literature which show that the restless behaviour of the cow increases with the onset of oestrus.
The statistical model, reported in this case study, presents different strengths: a low-complexity computation process of the indicators is promising for feasibility of its implementation in a real-time computing system; a frequently refresh of the data, so that every 15-min interval a new value of the variable is calculated and an alarm could be raised; a low-cost hardware and a simple installation needed by the system.
Further studies on a greater number of cows will be conducted for the validation of the proposed statistical method and specific research will also be focused on its implementation on a real-time system.

CODE: 013

Reference topic: Monitoring and modeling of the interactions among soil hydrological, plant and atmosphere processes, and agricultural management practices

AIIA section: 2nd Section - Rural buildings, plants and territory
Oral presentation

7.19 MODELLING OF THE THERMAL EFFECT OF GREEN FAÇADES ON BUILDING SURFACE TEMPERATURE IN MEDITERRANEAN CLIMATE

Ileana Blanco*, Giacomo Scarascia Mugnozza, Giuliano Vox, Evelia Schettini

Department of Agricultural and Environmental Science DISAAT – University of Bari, via Amendola 165/A, 70126 Bari, Italy – ileana.blanco@uniba.it

Abstract

It is foreseen that the Urban Heat Island effect, together with the global warming phenomena, and the ever-increasing intensity, frequency and duration of heat waves will led to increase the thermal discomfort in the urban environment and its surroundings. Urban Green Infrastructures (UGIs) improve the supply of urban ecosystem services. UGIs can provide benefits such as better urban climate conditions and lower temperature of urban air. They can also limit the development of extreme temperatures on buildings surface, in particular in Mediterranean climate areas. Green façades permit the physical shading of the building envelope, produce a cooling effect by means of evapotranspiration in summer, and improve the thermal insulation in winter. It follows a reduction of the thermal flows between exterior and interior and more sustainable buildings.

A three years experimental test was carried out at the University of Bari (Italy) for assessing the thermal performance of two green façades characterized by two different climbing plants (*Pandorea jasminoides variegated* and *Rhyncospermum jasminoides)*. The ambient conditions and several climatic parameters on the walls were monitored during the field test. The temperature on the external surface during summer 2015 was used for fitting a regression model. The model was validated on summer 2016. It can be applied for predicting the two green facades performance in a Mediterranean climate only by using an input dataset on climate conditions.

Keywords: greenery systems, regression model, urban agriculture.

**** Presenting author:*** *Ileana Blanco, Department DISAAT University of Bari, via Amendola 165/A, 70126 Bari, Italy. Telephone: +39 0805443060. Fax +39 0805442977 Email: ileana.blanco@uniba.it*

CODE: 049

TOPIC Rural buildings, facilities and territory

7.20 PERFORMANCES OF A COLLECTIVE INTEGRATED TREATMENT SYSTEM OF LIVESTOCK MANURE FOR ENERGY RECOVERY AND NITROGEN REMOVAL

Alberto Finzi, Gabriele Mattachini, Elisabetta Riva, and Giorgio Provolo

Department of Agricultural and Environmental Sciences, Università degli Studi di Milano, 20133 Milano, Italy
Presenting author: Alberto Finzi, Department of Agricultural and Environmental Sciences, Università degli Studi di Milano, 20133 Milano, Italy. Email:alberto.finzi@unimi.it

Land application of livestock manures supply nutrients to crops but give rise to environmental pollution if their management is not optimal. The introduction of a technical solution might be evaluated by verifying its effects along the whole management chain of the livestock manure. In this framework an integrated multiple treatment can achieve higher overall efficiencies and can be more effective and economically sustainable in a collective management system.
The aim of this study was to evaluate the technical and economic performances of a collective integrated treatment system for bioenergy production and nitrogen removal, over a five years period. The collective treatment plant, located in an intensive livestock area with a high nitrogen surplus designated as vulnerable zone, consists of a biogas plant, a solid-liquid separation system and a biological nitrogen removal process.
The treatment plant involved 12 livestock units (pigs, cows and poultry), located 0.5 to 6 km far away from the plant, for a total daily production of around 280 m^3 of manure. The manure was transported by slurry tankers and pipeline from the nearby farm. At first, manure was processed in a biogas plant for energy production, that consist of two digesters of 2,280 m^3, and a post-digester of 3,185 m^3. Other biomasses (silage) were added around 10 t d^{-1}. The digestate was treated by a solid-liquid separator, at first a screw-press and then by a centrifuge. The solid fraction was sold, while the liquid fraction was treated for biological nitrogen removal in a Sequencing Batch Reactor (SBR) with two reactors of 660 m^3. The effluent was finally stored in two storages and then transported back to the farms.
Daily inputs and outputs of the plant were recorded to define a mass balance of the whole treatment. Samples were collected periodically to determine the performance of each treatment in terms of removal of total solids (TS), volatile solids, total Kjeldahl nitrogen (TKN), ammonium, total phosphorous and metals (Cu and Zn). Economics performance were obtained by evaluating the incomes and expenses referred to the treatment plant and transport costs (farm-plant).
Among the main results, the mass balance and nutrient balance show 52% removal efficiencies for TS and 30% for TKN. The economic balance highlights an economic profit of 1.61 €/t manure treated. The collective integrated treatment system studied can be a sustainable solution from the environmental and economical point of view to reduce nitrogen surplus in intensive livestock area.

Preferred presentation type: Oral

CODE: 030

Presentation: Oral

Section: Rural buildings, facilities and territory

7.21 PHYSICAL PROPERTIES OF PANELS PRODUCED WITH CEMENT AND LIGNOCELLULOSIC MATERIALS

Patrícia Ferreira Ponciano Ferraz[1*], Matheus da Rocha Coutinho Avelino[1], Victor Rezende Carvalho[1], Isabela Moreira Albano da Silva[1], André Luiz de Lima Domingos[1], Rafael Farinassi Mendes[1], Jaqueline de Oliveira Castro[1] Leonardo Conti[2], Giuseppe Rossi[2]

[1]Federal University of Lavras, Campus Universitário, PO Box 3037, Lavras, Minas Gerais, Brazil, CEP 37200-000 E-mail: patrícia.ponciano@ufla.br

[2]Department of Agriculture, Food, Environment and Forestry (DAGRI), Università degli Studi di Firenze.

** Author for correspondence*

Abstract: The use of lignocellulosic materials residues in cement composites have been highlighted in sustainable buildings materials in many countries. Thus, this paper aims to compare the physical properties of panels produced with lignocellulosic raw materials and cement: density, water absorption (WA) and swelling in thickness (ST) after 2 and 24 hours of immersion in water. The following lignocellulosic materials were used to produce the panels: sugarcane bagasse, eucalyptus, banana pseudostem, coconut shell and coffee husk. To make the panels, each material was grinded and then mixed in concrete blender with cement and the additive. Three panels of each material were produced following the methodology proposed by the literature. After making the panels with dimensions of 480 x 480 x 15 mm, 28 days were expected to cure the cement in an air-conditioned environment. Subsequently, each sample was cut with the following dimensions: 150 x 150 x 15 mm. After, each sample was submerged in water for 2 and 24 hours, and it was measured its WA and ST in both conditions. The tests were performed according to the standard recommendations. In relation to the density of the studied panels, a great variation in the densities of the samples of the lignocellulosic panels was found. Coconut and banana pseudostem panels presented the lowest density (0.984g/cm³ and 1.0 g/cm³, respectively) and the coffee panel showed the maximum density (1.2 g/cm³). It is known that lower density of the panels, lower resistance to WA. So, it was observed that coconut and banana panels presented the highest values of WA after 2 h and after 24 h of immersion. But sugarcane panels had the lowest absorption values for 2 and 24 hours of immersion (5.5% and 12.1%, respectively). In relation to ST 2h and 24h, the eucalyptus panels presented the highest ST (2.2% and 6.4%, respectively). On the other hand, the sugarcane panels had the lowest ST at 2 hours (1.0%). Sugar cane panels was the unique panel that was in accordance to the recommended standards related to ST for 2h. ST resistance tends to decrease with the increase in density, so panels produced with smaller and thicker particles tend to be slenderer and present greater resistance to perpendicular traction.

Keywords: cement composites, density, residues, swelling in thickness, water absorption

CODE: 031

Presentation: Oral

Section: Rural buildings, facilities and territory

7.22 PHYSICAL PROPRIETIES OF ALTERNATIVE BEDDING MATERIALS FOR DAIRY CATTLE

Patrícia Ferreira Ponciano Ferraz[1*], Giuseppe Rossi[2], Leonardo Conti[2], Gabriel Araújo e Silva Ferraz[1], Lorenzo Leso[2], Matteo Barbari[2]

[1]Federal University of Lavras, Campus Universitário, PO Box 3037, Lavras, Minas Gerais, Brazil, CEP 37200-000 E-mail: patrícia.ponciano@ufla.br

[2]Department of Agriculture, Food, Environment and Forestry (DAGRI), Università degli Studi di Firenze.

** Author for correspondence*

Abstract: Housing system can affect dairy cow's welfare and performance and the type of bedding used can also affect comfort and hygiene level of the animals. A wide range of different materials can be used in bedding for dairy cattle but their physical proprieties must be analyzed to evaluate their potential. *Miscanthus* can be considered as alternative materials to be used for bedding. *Miscanthus* is a woody grass that requires low input and straw are easily find in many regions. Thus, both materials can be alternatives in order to reduce costs of bedding. Therefore, the aim of this study was to investigate the physical properties of *Miscanthus* in comparation to straw, as affordable alternatives to be used as bedding material in housing systems for dairy cows. Particle size, bulk density, porosity, water holding capacity from *Miscanthus* and straw were measured experimentally in the lab of the Department of Agriculture, Food, Environment and Forestry (DAGRI) of the University of Florence. Particle size was determined by applying 50 g of material (*Miscanthus* and straw) on a shaker with six sieves during 5 min. The mean particle size influences the material mass and the resistance to compaction. Bulk density can be defined as the ratio of weight to volume and is given in kg/m^3. This information is important in order to quantify volumes of products with irregular shapes. Bulk density of *Miscanthus* and straw was determined according to the ASABE Standard S269.4 DEC 91. One of the biggest producers' worries is related to the amount of water in bedding because it can affect microbial activity, thermal insulation, gases emissions, odor emissions and friability. Thus, to determine the water holding capacity and porosity of bedding materials samples Australian Standards were used. Based on these physical properties results, it is expected to demonstrate the good potential to use *Miscanthus* as viable alternatives to straw as a bedding material for dairy cattle.

Keywords: bulk density, dairy cows, *Miscanthus*, porosity, straw, water holding capacity

CODE: 060

Reference topic: Planning and design of rural areas
AIIA 2nd Section: Rural buildings, facilities and territory
Proposal for: Oral presentation

7.23 PLANNING THE FLOWS OF RESIDUAL BIOMASSES PRODUCED IN RURAL AREAS FOR THEIR VALORISATION IN THE FRAMEWORK OF A CIRCULAR BIOECONOMY

Canio Manniello[1]*, Dina Statuto[1], Andrea Di Pasquale[2], Pietro Picuno[1]

[1]SAFE School of Agriculture, Forestry, Food and Environmental Sciences, University of Basilicata, via dell'Ateneo Lucano 10, Potenza 85100, Italy.

[2]INNOVA Consorzio per l'Informatica e la Telematica srl, III Trav. G.B. Pirelli, snc – Z.I. La Martella – 75100 Matera (MT), Italy.

- *Presenting Author: via dell'Ateneo Lucano n.10, 85100 Potenza (PZ), Italy. e-mail: canio.manniello@unibas.it,*

Abstract

The implementation of the circular economy concept is finalised to create a system that allows for the long life, optimal reuse, refurbishment, remanufacturing and recycling of products and materials. In this context, the contribution provided by the valorisation of residual biomass is fundamental for the production of renewable biological resources and the conversion of these resources and waste streams into value-added products, such as food, feed, bio-based products and bioenergy. In this paper, spatially residual biomasses coming from the primary sector were identified and included into a system aimed to the sustainable valorisation of agricultural co-products, by-products and wastes produced in rural areas of the Basilicata Region from agricultural activities and small communities. Different types of by-products - such as cereal straw, pruning of fruit trees, livestock manure and residues from the agro-food industries - have been considered. Their components have been quantitatively assessed and qualitatively classified, in order to find the most rational and convenient solution for their valorisation from a technical, economic and environmental point of view. This, respecting a hierarchical process, which gives priority to the re-balancing of soil fertility, then to their use in other cascading use opportunities offered in the same agricultural sector or in different production chains (*e.g.*, cosmetics, nutraceuticals, *etc.*), finally only at the end valorised for energy purposes. An Internet of Things (IoT) network system applied to these residues would support a constant monitoring of their life cycle as well. From the results which have been obtained, some thematic maps derived from spatial analysis elaborated with a Geographic Information System (GIS) enabled to highlight the areas with the greatest concentration of residues, and to implement possible planning strategies for their management, able to valorise them in the framework of a circular bioeconomy.

CODE: 173

Topic: Planning and design of rural areas

Proposal: Oral presentation

7.24 PROPOSAL OF A WEB-BASED MULTI-CRITERIA SPATIAL DECISION SUPPORT SYSTEM (MC-SDSS) FOR AGRICULTURE

Giuseppe Modica*, Maurizio Pollino**, Luigi La Porta**, Salvatore Di Fazio*

**Dipartimento di Agraria, Università degli Studi Mediterranea di Reggio Calabria, Località Feo di Vito, I-89122 Reggio Calabria, Italy*

***ENEA National Agency for New Technologies, Energy and Sustainable Economic Development, DTE-SEN-APIC Lab, Via Anguillarese, 301 – 00123 Rome, Italy*

Corresponding Author: Giuseppe Modica, giuseppe.modica@unirc.it

Land suitability evaluation (LSE) is a widespread methodology that supports environmental managers and planners in analyzing the interactions between location, development actions, and environmental elements. In the present paper, we discuss on a web-based multi-criteria spatial decision support system (MC-SDSS) implemented to accomplish LSE for olive crops. We propose a MC-SDSS developed on a free open source software for geospatial (FOSS4G) environment, accessible through a user-friendly geographical user interface (GUI) that allows to perform geospatial analyses. To this end, the MC-SDSS has been conceived as a multi-tier architecture, able to manage processes executable via OGC (Open Geospatial Consortium) web processing services (WPSs) and produce output maps and data available via the largely used OGC services: web feature service (WFS), web coverage service (WCS) and web map service (WMS). In this first application, we chose the weighted linear combination (WLC) as decision rule to aggregate data, weighted by judgements provided by experts following the analytical hierarchy process (AHP).

The MC-SDSS here described has been conceived and designed to offer an effective solution, accessible also to non-experts, and based on specific online tools (e.g. web-based processing and multi-criteria assessment). To this end, the WPS has been configured to offer GIS geoprocessing capabilities to clients via web, including access to pre-programmed calculations and/or computation models, operating on geo-referenced data. The data required by the WPS are delivered via web, and the service is targeted at processing both vector and raster data: for the specific purposes of this work, raster data (in GeoTIFF format) have been selected and used as input for the processing tasks implemented. Considering the general framework described and the processing steps outlined, the WebGIS application represent the front-end interface of the MC-SDSS, through which the user is able to access data, perform calculation and assess the results obtained (land suitability maps). Moreover, the WebGIS client is able to manage three different type of users with different level of privileges: guest, expert, and the decision maker.

CODE: 102

Topic for oral presentation: Rural buildings, facilities and territory
Section II

7.25 SHADING SCREENS CHARACTERIZATION BY MEANS OF WIND-TUNNEL EXPERIMENTS AND CFD MODELING

Enrica Santolini[a], Daniele Torreggiani[a], Patrizia Tassinari[a]

[a] Department of Agricultural and Food Sciences, University of Bologna, Italy

The use of shading screens in the protected cultivation sector is widespread, due to the fact they allow both to reduce the heat load and thus to control temperature, and to have lower and uniform levels of light intensity inside greenhouses. An extended selection of shading screens is available on the market, with different colors, material and textures. The choice of the best screen depends on the specific application and needs of the grower. Despite the positive action of the screens, some screens can also negatively affect ventilation and indoor climate, since their porosity can generate extra mass, heat and momentum transfer resistance. A prediction of airflow through porous screens is crucial for their selection, as well as to the manufacture of new screening materials. Most studies have evaluated the screen-related parameters, such as permeability and porosity, and the screen effect on ventilation referring to screens with simple and regular textures, which is not the case of the new screen types. The reliability of the literature models for these parameters' estimation of new type of screens is not certain. In this work, these parameters have been evaluated for three new screen types, available on the market. An experimental approach based on image analysis together with wind tunnel tests and PIV measurements has been set up to yield the porosity, the permeability and the inertial coefficient. The relations of these parameters have been derived from the experimental. A satisfactory description of the airflow through porous screens and a clear methodology of estimation has been performed.

The use of shading screens in the protected cultivation sector is widespread, due to the fact they allow both to reduce the heat load and thus to control temperature, and to have lower and uniform levels of light intensity inside greenhouses. An extended selection of shading screens is available on the market, with different colors, material and textures. The choice of the best screen depends on the specific application and needs of the grower. Despite the positive action of the screens, some screens can also negatively affect ventilation and indoor climate, since their porosity can generate extra mass, heat and momentum transfer resistance. Then, a prediction of airflow through porous screens is important for their selection, as well as to the manufacture of new screening materials. Most studies have evaluated the screen-related parameters, such as permeability and porosity, and the screen effect on ventilation referring to screens with simple and regular textures, which are not characteristics of several new screen types available. In this work, these parameters have been evaluated for three new screen types, available on the market. An experimental approach based on image analysis together with wind tunnel tests and PIV measurements has been set up to yield the porosity, the permeability and the inertial coefficient. The relations of these parameters have been derived from the experimental. A reliable description of the airflow through porous screens and a clear methodology of estimation has been performed.

Presenting author: Enrica Santolini, **e-mail**: enrica.santolini2@unibo.it

CODE: 175

Topic and AIIA section: ***Spatial and landscape analysis****-(Proposal for Oral presentation)*

7.26 SPATIAL MULTICRITERIA DECISION ANALYSIS AND ECOSYSTEM SERVICES IN THE VESUVIUS NATIONAL PARK (SOUTHERN ITALY) AS A TOOL FOR POST-FIRE LANDSCAPE RESTORATION PLANNING

Elena Cervelli[1,*], Antonio Saracino[1], Emilia Allevato[1], Davide Ascoli[1-◊] Paola Conti[2], Guido D'Urso[1], Giovanni Battista Chirico[1], Salvatore Faugno[1], Francesco Giannino[1], Stefano Mazzoleni[1], Antonello Migliozzi[1], Nunzio Romano[1], Luigi Saulino[1], Ester Scotto di Perta[1], Stefania Pindozzi[1]

[1]Department of Agricultural Sciences, Università degli Studi di Napoli Federico II, Via Università 100, 80055 Portici, NA (Italy)
elena.cervelli@unina.it

[2]Vesuvius National Park Authority, Palazzo Mediceo Via Palazzo del Principe, 80044 Ottaviano, NA (Italy)

[◊] Present address: Department of Agricultural, Forest and Food Sciences, Università di Torino, Largo Paolo Braccini 4, 10095 Grugliasco, TO (Italy)

Abstract

In the Mediterranean basin wildfires are becoming increasingly important in scientific and operative context, due to the extent of the burned areas in the last decades, and to the resulting large ecological and socio-economic impacts. Damages assessment, interventions planning to restore burned areas and future fire risks prevention, are some of the implications that affect post-fire landscape management.

Vesuvius is known all around the world for its volcanic nature, cultural geological and landscape heritage. In summer 2017, a large wildfire burned about 3.200 ha of forest stands along the volcano slopes. Very-high and high fires severity effects were observed on 374 and 2147 ha, respectively; in both cases tree mortality exceeded 80%.

The present work provides results of wildfire impacts assessment, in order to support landscape restoration planning. The framework entails the identification of intervention priority areas with respect to fire severity, safety, and ecosystem services. Moreover, an assessment of environmental damages during the early post-fire stages was conducted in terms of Ecosystem services (ESs) loss. Spatial MultiCriteria Decision Analysis (ILWIS module) with support of panel of experts allowed the identification of priority restoration. These areas were overlapped with the fire severity map in order to identify the most critical areas i.e., land surfaces with high degree of change between pre- and post-fire conditions. Intervention priority areas have been identified by overlapping fire severity map with ESs map. Finally, the ESs monetary value loss was assessed by means of GIS-based approach.

About 400 ha, 5% of Vesuvius National Park total area, have been classified as priority intervention areas. For all these areas, the loss of about 50% of the ecosystem services monetary value has been calculated.

This work, carried out in cooperation with agro-forestry landscape planners, foresters, agronomists, botanists and ecologists, highlights the importance of an interdisciplinary approach in landscape management and restoration. Indeed, the definition of priority intervention areas becomes strategic in allocating monetary resources to restore burned areas.

CODE: 082

Planning and design of rural areas – section 2 –oral presentation

7.27 SPATIAL ANALYSIS OF FEEDSTOCK SUPPLY AND LOGISTICS TO LOCALISE NEW BIOGAS PLANTS

Francesca Valenti*[*1], Simona M.C. Porto[1]

[1]Department of Agriculture, Food and Environment, University of Catania,
Via S. Sofia 100, 95123, Catania, Italy;
[*]Presenting author: francesca.valenti@unict.it; mob. +393348066812.

Keywords: by-products; agricultural residues; anaerobic digestion; GIS modelling; spatial index.

Italy is the third largest biogas producer in the world after China and Germany, but the biogas sector in southern Italy, especially in Sicily, is still developing. The objective of this study was to contribute to the sustainable development of the biogas sector in Sicily by developing a method for the localization of geographical areas suitable for biogas production by anaerobic digestion of biomasses, which is a sustainable alternative to energy production from fossil fuels because could contribute to both the reduction of environmental burden and the re-use of by-products and agricultural residues.
The most suitable areas were investigated by combining the results of two different methodological phases. In the first phase, by considering criteria based of the sustainable development of biogas sector (i.e., re-use and valorise agro-industrial by-products and agricultural residues, reduce the amount of dedicated energy crops by promoting double crops and crop rotation, localise biomass availability on the selected area, and minimise transportation costs due to logistics and supply phase of biomasses), a hypothetical regional biogas power generation system based on multiple biomass feedstocks was proposed in a study area located in Sicily by following a three-step approach. In detail, data collection, GIS-based analyses, and techno-economic assessment were carried out by taking into account the amount of available and useable biomass in order to select areas for the development of new biogas plants.
Meanwhile, to develop the second phase of the study, different mixtures of feedstocks were selected by considering biomass availability and were chemically characterized and tested with BMP and semi-continuous AD tests. Among the analysed feedstock mixtures, the most suitable for the enhancement of biogas production in terms of methane content was selected and a GIS-based model was developed in order to compute and map a spatial availability index (i_{fm_a}) of the chosen feedstock-mixture. The results of this second phase of the study made it possible to locate four areas, suitable for the development of biogas plants fed by the most suitable feedstock mixture. Among these four areas, two overlapped those obtained in the first phase of the study that considered for the analyses only criteria based on sustainability issues. Therefore, these two areas could satisfy both the need of reducing environmental burden of biogas plants and the enhancement of biogas quality in terms of methane content.
The methodology proposed in this research could help local authorities to plan a sustainable development of the biogas sector since it allows the selection of geographical areas where locating biogas plants fed with a feedstock mixture which on the one hand valorises by-products and agro-industrial residues on the other hand enhance biogas quality.

CODE: 018

Reference topic: Spatial and landscape analysis

AIIA 2nd Section: Rural buildings, facilities and territory

Proposal for: Oral presentation

7.28 SPATIAL ANALYSIS OF RURAL BUILDINGS IMPACT ON AGRO-FORESTRY LANDSCAPE USING GIS

Giuseppe CILLIS[1]*, Dina STATUTO[1], Pietro PICUNO[1]

[1] School of Agricultural, Forest, Food and Environmental Sciences, University of Basilicata, 85100, Potenza, Italy,

** Corresponding and presenting Author: via dell'Ateneo Lucano n.10, 85100 Potenza (PZ), Italy. e-mail: giuseppe.cillis@unibas.it*

Rural buildings, designed over the centuries in order to fulfil their primary agricultural role, now constitute a widespread heritage that in some cases possesses an irreplaceable architectural value, playing a central role for the sustainability of the rural environment as well constitute a witness of the economic and productive organization of a specific territory. Furthermore, they can have influences on natural and semi-natural habitats, both in terms of structure and biodiversity.

Mostly in some southern European countries - as in the Basilicata region (Southern Italy) – these rural structures have been built based on the agricultural needs and land characteristics. Considering the land abandonment occurred during the last centuries, also historical farm buildings, in most cases, have been abandoned, causing a lost of the historical-cultural heritage of the rural landscape. In this context, it would be fruitful to improve the knowledge about the specific characteristic of farm buildings, considering also their geographic location, in order to analyse the impacts that rural buildings could have on the high naturalistic value and how the land was transformed after their abandonment.

In this paper, the potential of a Geographic Information Systems (GIS) have been explored, with the aim to improve the cataloguing system of the Basilicata region's farm buildings, traditionally known as *"masserie"* and to connect the role that they could have considering the surrounding landscape and agroforestry territory.

A protected area of Basilicata Region is considered as study area and through GIS the geo-localization of rural buildings and the land cover changes over the past 30 years were identified, focusing mainly on the processes of land abandonment and renaturalization. Finally, the trajectories of change have been investigated in order to understand potential negative impact between rural heritage and biodiversity conservation.

Keywords: Rural buildings, Spatial Analysis, Geographical Information System, Agro-forestry landscape.

CODE: 177

Rural buildings, facilities and territory – AIIA 2nd Section -Oral presentation proposal

7.29 STANDARDIZED ASSESSMENT OF THE ENERGY PERFORMANCE OF ANIMAL HOUSES: A CASE STUDY OF TWO GROWING-FINISHING PIG HOUSES

Andrea Costantino[1,2*], Enrico Fabrizio[1], Elio Dinuccio[3], Gianfranco Airoldi[3]

[1]TEBE Research Group, Department of Energy, Politecnico di Torino, Corso Duca degli Abruzzi 24, 10129 Torino, Italy

[2]School of Agricultural Engineering and Environment, Universitat Politécnica de Valéncia, Camino de Vera, s/n, 46022 Valencia, Spain

[3]Department of Agricultural, Forest and Food Science, Università degli studi di Torino, Largo Paolo Braccini 2, 10095, Grugliasco (TO), Italy

*Presenting Author: andrea.costantino@polito.it

In livestock houses for intensive animal farming, climate control plays a fundamental role because it enhances the animal welfare, maximizes the production and minimizes the use of feed. At the same time, climate control represents an energy consumption and a running cost for the farmers. Currently, in literature there are neither reference values nor limitations to this energy consumption that, for instance, in growing-finishing pig houses represents around 50% of electrical energy and 70% of thermal energy uses. It may be therefore important that farmers know this energy consumption and have reference values for improving the production and reducing the running costs of the farm.

Within the EPAnHaus project (2015-2018) a methodological framework for the energy certification scheme for animal houses was developed through numerical and experimental works. In the present paper, this framework is applied to a selected case study to perform the energy certification. The case study is a farmstead where two growing-finishing pig houses are present and around 3000 animals are reared until the target weight of 150 kg. The energy certification is based on a standardized assessment of the energy performance that was carried out through an on-field energy audit (short-term monitoring and data from the energy bills) and through an energy simulation in standardized boundary conditions. The energy uses that are considered in this work are heating and ventilation, both for indoor air quality control and cooling. The results of the energy certification are synthetized using energy performance indicators (specifically developed for animal houses). Based on the results of the energy certification, energy efficiency measures for increasing the energy performance of the animal house are provided.

The methodology that was applied in this work may be extended to other case studies for investigating the average values of energy consumption of the animal houses at a national level with the aim of creating benchmark values.

CODE: 121

Topic for oral presentation: Rural buildings, facilities and territory - II Section AIIA

7.30 THE INCIDENCE OF BUILDING ENVELOPE DESIGN IN THE THERMAL BEHAVIOUR AND ENERGY NEED OF FOOD PROCESSING BUILDINGS

Barbaresi Alberto *, Bovo Marco, Torreggiani Daniele, Tassinari Patrizia

Department of Agricultural and Food Sciences – University of Bologna

Viale G. Fanin 48, 40127 Bologna, Italy

* Corresponding author. email: alberto.barbaresi@unibo.it – DISTAL, viale Giuseppe Fanin, 48 – 40127 Bologna (BO) – Italy.

The introduction of renewable energy sources and the design of energetically high-performance structures are two of the most important features requested to new building generations. Nowadays, these aspects play an important role in the design of new rural buildings but also in the definition of energetic retrofits of the existing constructions. The total energy consumption of food processing buildings is relevant in fact, and often related to food safety and quality. The research of the most promising strategies in order to design an efficient building is then strictly correlated with the choice of dimensions, wall and roof constructions, glazing, orientation and cooling/heating needs. It is important to recall that the energy behaviour of buildings is strongly affected by external factor like weather conditions and under this light the effect of recent climate change increases the complexity to model the building behaviour. In this context the present contribution provides some useful insights into the most important variables of the building envelope in order to limit or contain energy consumptions by means of computer energy simulations. The evaluation is performed by considering a case study building with different intended uses (therefore desired indoor temperature ranges), and different design and material choices throughout two years. The main objective of the paper is to simulate the thermal behaviour of a calibrated case study building and analyse the effects of envelope variables (walls, roof, glazing orientation and weather conditions) in both conditioned and free-running building configurations.

Keywords: Energy efficient, energy saving, rural building, cooling system.

CODE: 026

Rural buildings, facilities and territory-Oral presentation proposal

7.31 THERMAL ENVIRONMENT INSIDE A MECHANICALLY VENTILATED GREENHOUSE: RESULTS FROM A LONG-TERM MONITORING

Andrea Costantino[1,2], Lorenzo Comba[1], Giacomo Sicardi[3], Mauro Bariani[3], Enrico Fabrizio[1*]

[1]TEBE Research Group, Department of Energy, Politecnico di Torino, Corso Duca degli Abruzzi 24, 10129 Torino, Italy

[2]School of Agricultural Engineering and Environment, Universitat Politécnica de Valéncia, Camino de Vera, s/n, 46022 Valencia, Spain

[3]Munters Italy S.p.a., via Strada Piani 2, Chiusavecchia d'Imperia (IM), 18027, Italy

In totally mechanically controlled greenhouses, the main indoor environmental parameters that are needed for the production (e.g. air temperature and relative humidity) should be accurately controlled for maximizing the quantity and the quality of the final products (crops or flowers). Due to the features of this building type (e.g. transparent and low-insulating envelope and free cooling), maintaining the adequate indoor environmental conditions is challenging, especially during the warm and the cool seasons. For these reasons, the indoor environmental conditions can vary significatively within the enclosure and some spots can be characterized by indoor environmental conditions that are not the optimal ones for the production.

In this work, the results from a long-term monitoring campaign that was carried out in a mechanically ventilated greenhouse in North of Italy are presented. The case study (of about 1700 m^2 of useful floor area) was equipped with 18 PT1000 sensors and 5 humistors for monitoring the indoor air temperature and relative humidity (10-minutes time step) in various spots of the greenhouse. Furthermore, the working schedules of the ventilation fans, the evaporative pads, the automated window openings and the solar shadings were monitored (5-minutes time step). The outdoor weather conditions were provided by the climate control unit of the analysed greenhouse and by a third-party weather station. The monitoring campaign lasted about four months during the warm season (July - October 2018).

The acquired data were used to evaluate the indoor environmental conditions concerning air temperature and relative humidity, considering the variation of the boundary conditions during the analysed period (e.g. activation of the evaporative pads or the use of the solar radiation shadings). Furthermore, vertical and horizontal gradients of air temperature were analysed for evaluating the uniformity of the thermal environment.

CODE: 004

Topic: Spatial and landscape design; AIIA section: II

7.32 URBAN AGRICULTURE, CUI PRODEST? SEATTLE'S PICARDO FARM AS SEEN BY ITS GARDENERS

M.E. Menconi[1], P. Borghi[1], and D. Grohmann*[1]

[1] *Department of Agricultural, Food and Environmental Sciences (DSA3), Università degli Studi di Perugia, Borgo xx giugno 76, 06100, Perugia (Italy)*

* *presenting author: david.grohmann@unipg.it*

Abstract (proposal for oral presentation)

The urban green network provides various ecosystem services that are crucial assets in determining cities' sustainability (Cortinovis et. al, 2019). Urban agriculture is a type of urban green space use that is experiencing a growing interest among Institutions (United Nations, 2016; FAO, 2019) and researchers (Bell et al., 2016; Weidner et al., 2019). This paper analyses its benefits, as perceived by the urban gardeners. The case study is a community garden in Seattle, called Picardo farm. This project started in 1973 and represents the community garden in Seattle that has originated the current Municipal P-Patch Community Gardening program (Hou and Grohmann, 2018). Picardo farm covers 1.2 hectares and involves 281 gardeners. The method uses semi-structured interviews for understanding the perceived benefits by gardeners. The results show as the spontaneous appreciation is mainly distributed among these themes (every respondent listed one or more themes): gardening activity (65% of respondents), social interactions (65%), attachment to place (65%), wellbeing (58%), food production (48%), education about food production and consumption (29%), and connection with nature (24%). Generally, these results showed how the citizens involved in community gardens are aware of the variety of values linked with this activity or, in other words, how the community gardens attract or generate aware citizens. Respect to other urban green spaces, the strengths of the community gardens, in addition to the food production, regard the ability to build site-specific cohesive communities. Indeed, the higher values linked to the theme "social interactions" refer the cohesion between gardeners that manage the place, and the higher values linked to the "attachment to place" refer to site-specific characteristics of the place (quality of soil, exposure, water availability, beauty). These considerations show as these communities guarantee constant stewardship of the place where they are located. Finally, the results show as urban agriculture is a complementary form of green space provision with distinctive values.

References

Bell, S., Fox-Kamper, R., Keshavarz, N., Benson, M., Caputo, S., Noori, S., and Voigt, A. (2016). *Urban allotment gardens in Europe*. Routledge.

Cortinovis, C., Haase, D., Zanon B., and Geneletti, D. (2019). Is urban spatial development on the right track? Comparing strategies and trends in the European Union. *Landscape and Urban Planning* 181, 22-37.

FAO. *FAO's role in urban agriculture*. Retrieved from: http://www.fao.org/urban-agriculture/en/ (March, 2019).

Hou, J., and Grohmann, D. (2018). Integrating Community Gardens into Urban Parks: Lessons in Planning, Design and Part-nership from Seattle. *Urban Forestry & Urban Greening* 33, 46-55.

United Nations (2016). New Urban Agenda *Habitat III. United Nations Conference on Housing and Sustainable urban Development*, Oct. 17-20, Quito, Ecuador.

Weidner, T., Yang, A., Hamm, M.W. (2019). Consolidating the current knowledge on urban agriculture in pro-ductive urban food systems: Learnings, gaps and outlook. *Journal of Cleaner Production* 209, 1637-1655.

CODE: 137

Section 2 - Planning and design of rural areas

7.33 USERS' PERCEPTION AND PREFERENCE OF DIFFERENT VEGETATION CONFIGURATION ALONG RURAL GREENWAYS

Natalia Fumagalli e Giulio Senes

Department of Agricultural and Environmental Sciences, University of Milan
via Celoria 2 – 20133 Milan Italy,
natalia.fumagalli@unimi.it giulio.senes@unimi.it

Key words: virtual landscape, greenways, users' preferences

This paper reports the results of a virtual landscapes study which sought to evaluate: (a) the effect that four different configurations of "side vegetation" along a rural greenway have on users' preferences; (b) the potential restorative effect on the users' mental fatigue connected to the different configurations of "side vegetation".

People perception of the surrounding landscape is different if you move by bike along a greenway or if you stand still. To evaluate influences of different vegetation configurations it is necessary to compare greenways that are different only for this aspect.

We considered four different configurations of "side vegetation": no vegetation, only trees, trees and shrubs, shrubs and perennials. These configurations were used to create 4 different virtual runs simulating bikers moving along greenway at 25 km/h.

The people involved, were asked to see one of these videos (1 minute) and to evaluate this virtual experience answering to some questions related to:

- users' preferences, described through sensorial and semiotic aesthetic attributes (Nasar, 1994*);
- users' perceived restoration, trough the Perceived Restorativeness Scale – PRS, (Pasini et al., 2014*).

Personal data (age, sex….) were collected too.

Statistical analysis showed that personal characteristics have no effect on users' preferences and regenerative potential of a greenway while the landscapes surrounding the greenway have a great effect. The presence of some physical-aesthetic attributes, the familiarity with the proposed landscape and its restorative properties, have the major effects on the preference.

Unlike what reported in the literature, users' landscape preference when moving on a greenway is determined by the satisfaction in relation with social impressions and the impact that a greenway has on humans, rather than on its aesthetic aspects linked to the presence of vegetation.

Familiarity plays a more important role on preferences and perceived restorativeness than what indicated in the literature; familiarity increases with the presence of specific features of the landscape.

Finally, we found that a greenway is perceived as more regenerative if:

- it is perceived as a place that facilitates recreational and social activities,
- it presents natural elements, that are sources of "fascination" that spontaneously activates involuntary attention and restores from direct attention.

8 AIIA Section 2 – E-Posters

E-POSTERS

CODE: 178

AIIA II Section: Spatial and landscape analysis

8.1 ASSESSMENT OF CLIMATE CHANGE IMPACT IN A PERI-URBAN WATERSHED OF THE METROPOLITAN AREA OF ROME (ITALY)

Boccia[a] L., Capolupo[c] A., Recanatesi[b] F., Ripa[b] M.N.

a DIARC –University of Naples Federico II - Via Toledo 402 - Napoli Italy
b. Department of Agricultural and Forestry Science (D.A.F.N.E.), Tuscia University, Viterbo, Italy
c. LUPT - Università di Napoli Federico II - Via Toledo 402 - Napoli
Corresponding author: Fabio Recanatesi, Department of Agricultural and Forestry Science (D.A.F.N.E.), Tuscia University, Via S. C. De Lellis snc, Viterbo, Italy, email address fabio.rec@unitus.it fax n. 0761357250

Abstract

Climate change (CC) trend observed in the last decades in Mediterranean area, produce a relevant impact on hydrological regimes due to decreased rainfall, higher evaporation and changes in the entity of runoff. Changes in Land Use (LUC) can deeply affect this impact as a consequence of sealing of surfaces.

By 2006, almost 100,000 km^2 of EU soil (2.3% of the whole territory) had been sealed, with a pro capita quota of 200 m^2 of sealed surface for each EU citizen. Italy, in 2016, recorded a soil sealing rate of 2.8% of the entire territory. The urban expansion which occurred in past decades combined with climate change is considered one of the main causes of the increase in flood frequency and intensity in small catchments, causing both social and financial damage. Moreover change in hydrological regimes can threaten many habitats and exert a heavy impact on biodiversity.

In the present paper, the effects of land use change and of introducing Best Management Practices (BMPs) at urban scale is assessed, with particular regard to the decreasing of flood prone areas, also considering future climate scenarios, based on emission scenarios A1B and A2, provided in the context of the study of Climate Change Impacts Study Committee A suburban watershed of the metropolitan area of Rome has been selected as a case study.

CODE: 046

Reference topic: Planning and design of rural areas– AIIA Section: II

8.2 DEFINITION OF A METHODOLOGY TO SUPPORT PLANNING AND DESIGN OF AGRICULTURAL AREAS WITHIN SUBURBAN PARKS.

P. Russo[1], P. Lanteri[1,2], A. D'Emilio[1]

[1]Department of Agriculture, Food, and Environment, University of Catania.

[2]Presenting author (poster): via S. Sofia 100, 95123 Catania, Italy; phone: +39-095-7147574; e-mail: planteri@unict.it

The changed attitude of today's society towards environmental protection requires a reconsideration of territorial resources management, according to models characterized by an improved sustainability. In this context, particular attention should be pointed to the recovery and redevelopment of the marginal areas located in the suburbs of the cities. Within these zones, the residual agricultural areas can have a relevant function in any land protection actions. Indeed, maintaining the productive function can contribute to support the sale and consumption of farm-to-table agricultural products. On the other hand, the addition of new social and educational functions can help to strengthen the relationship between marginal areas and urban center.

Landscape planning and design can play a key role in achieving these goals, if oriented towards sustainable development and resource valorization, rather than towards a sterile conservation in the current status. For this purpose, it is necessary to set up procedures, methods and techniques, which allow to verify the compatibility of every human intervention with the landscape resources.

In this work some design criteria are defined, which allow the introduction of new activities in periurban areas in respect of the present activities and historical landscapes. Among these activities, those related to the use of agricultural areas are analyzed in the hypothesis of their conversion in public parks. Specifically, in a first phase, the requirements of the areas intended for specific activities are determined (agricultural, on the one hand, and fruition for free time and educational activities, on the other). Subsequently, the functional and technological compatibility between the two models (agricultural and fruition) is verified, in order to allow their coexistence and integration.

CODE: 169

Topic: Rural buildings, facilities and territory
Type of presentation: Poster.

8.3 DESIGN OF CATERING FACILITIES: A META-DESIGN APPROACH

Antonio Paolillo[1]*; *Francesco Barreca[1]*; *Marco Poiana[1]

[1] *Department of AGRARIA, Mediterranean University of Reggio Calabria*
** Author for correspondence*

Abstract:
In Italy, household spending on food services in 2016 was 80.254 million euros in value and 73.141 million euros in business with a real increase of 3.0% compared to 2015. The consumption of meals outside of home in Italy in 2016 was around 35% of total household food consumption, also showing a moderate but steady growth trend. In the 2007-2016 period, household consumption in restaurant and catering services recorded a real increase of 3.5%, equal to 2.4 billion euros. From the point of view of absolute values, Italy is the third largest restaurant market in Europe after the United Kingdom and Spain. (FIPE Annual Report 2017).
The kitchen facilities are fundamental to ensure a sustainable food chain. In fact they have to guarantee the best condition to conduct a hygienic and safe process with environmental respect. The lay-out design of the spaces is strategic not only to food hygiene but also to limit the food contamination of meals for people who have specific food intolerances or allergies. Catering kitchen, which give service to offices, schools and also hospitals which have patients whose diets range from low-fat and low-purine to gluten-free, should guarantee healthy cooked food but also safety to workers without limiting the productivity.
For these reasons is very important to use a methodological approach to design these spaces. In this paper was developed a specific meta-design method to support design of the catering kitchen spaces. In accordance with the UNI 8290 and UNI 10838 the building's organism was divided into environmental and technical system. The environmental systems is determined by means of an analytical process of the aggregation of spaces and functions, they are fundamentally based on knowledge of product and employee needs during production. A specific case study was considered it is a catering facility located at Reggio Calabria in south Italy.

Key words: Catering facilities, sustainability, ready food, meta-design, kitchen.

CODE: 180

Reference topic: Rural buildings, plants and territory

AIIA section: 2nd Section - Rural buildings, plants and territory

8.4 ENHANCEMENT OF THE ROMAN BRIDGE OF CANOSA IN THE OFANTO VALLEY LANDSCAPE

Enrico Liano, Silvana Fuina*, Marcio A. Alberti, Giacomo Scarascia Mugnozza

Department of Agricultural and Environmental Science DISAAT – University of Bari, via Amendola 165/A, 70126 Bari, Italy – silvana.fuina@uniba.it

Abstract

The Roman Bridge is located on the route of the Via Traiana and has favored for many centuries the connection between Canosa and Daunia. On its stones have passed Roman emperors, kings, princesses, armies, merchants and travelers of all kinds and from all over the world.

Its location is about three kilometers from Canosa, with an imposing donkey back structure, resting on a oak wood structure covered with concrete. It is divided into five round arches, supported by piers defended by rostrums. During the Second World War, a concrete passage for crawlers was built at the end of the bridge.

At the State Archives of Foggia, it is noted that the bridge has undergone, over the centuries, numerous interventions of maintenance and restoration at high altitude. These maintenance operations leaving intact the piers, the rostrums and the foundation stalls. From December 2015 with a resolution of the City Council of Canosa the municipal agricultural land along the "Tratturo Regio", in the stretch between the Bridge Roman and the Mausoleum of Bagnoli, was given in concession to voluntary organizations or social cooperatives. The purpose was to promote tourism and culture, mainly pedestrian or cycling, in line with the "Park of the tratturi": the results make again productive an area abandoned for too long time and make accessible the archaeological walks of great historical and tourist importance.

The land on the Tratturo Regio, in the stretch between the Bridge over the Ofanto River and the Mausoleum Bagnoli, are subject to protection, according to the "Municipal Plan of the Tratturi", which qualifies them as “path”, where cattle and herds passed, that retain the original consistency or that can be at the same reintegrated. Aim of the research is the requalification of the study area through analyses, plan and restructure the ancient routes. In this study, the current status of the area is analyzed in detail and the inconsistency of the interventions is highlighted that have followed over time. The project proposal provides for new tourism paths equipped with a cycle/pedestrian tracks and small resting and refreshment areas, intermodal exchange car parks and management structures, allowing the creation of a green tourist-cultural route.

Keywords: roman bridge of Canosa, slow tourism, green tourist-cultural route.

CODE: 142

AIIA Section II

Topic: Computer and communication technologies - Poster section

8.5 GEOTAGGED SOCIAL MEDIA TO CHARACTERIZE TOURIST FLOWS IN RURAL AREAS: A CASE IN SOUTHERN ITALY

Ernesto Marcheggiani [1,2], Alvin Chua[5], Loris Servillo[5], Andrew Vande Moere[5], Roberto Pierdicca[3], Marina Paolanti[4], Andrea Felicetti[4], Adriano Mancini[4], Emanuele Frontoni[4] and Andrea Galli[1],

1. Dipartimento di scienze Agrarie, Alimentari e Ambientali (D3A), Università Politecnica delle Marche, Via Brecce Bianche 12, 60131 Ancona (Italy)
2. Division of Forest, Nature and Landscape (FNL), University of Leuven, Celestijnenlaan 200e, 3001 Leuven , (Belgium)
3. Dipartimento di Ingegneria Civile, Edile e dell'Architettura, Università Politecnica delle Marche (DICEA), Università Politecnica delle Marche, Via Brecce´ Bianche 12, 60131 Ancona (Italy)
4. Dipartimento di Ingegneria dell'Informazione (DII), Università Politecnica delle Marche, Via Brecce Bianche 12, 60131 Ancona (Italy)
5. Department of Architecture, University of Leuven, (Belgium)
e.marcheggiani@staff.univpm.it

The work describes a method based on geotagged social media data (GSMD) from Twitter to characterise spatial, temporal and demographic features of tourist flows. We experimented our methodology in a regional tourist attraction in southern Italy at the regional scale, the Cilento's region. The results demonstrate how the analysis yields more detailed spatial, temporal and demographic information of tourist movements if compared with consolidate techniques such as surveys and marketing operation. Apart from the distinctive advantages mentioned above, Twitter provides freely accessible mechanisms to monitor activities that occur within a specified area and timeframe. However, several technical requirements must be fulfilled in order to perform flow analysis with geotagged tweets.

Our data consisted of 72,031geotagged tweets posted by 3135 unique individuals. On average, there were 193 (SD 2.639) tweets per trajectory. The low standard deviation indicates that the majority of the trajectories contain a relatively similar number of tweets.

Our approach enables relatively sophisticated descriptions of tourist movement, as well as the demographic profiles of tourist groups. However, biases in the data, as well as methodological limitations, should be considered when concluding the analysis of GSMD. Nonetheless, this is the first large-scale observational study of tourist flows that to our knowledge attempt to provide a comprehensive description of tourist profiles and their associated movement.

Apart from the spatial segmentation and mapping features of tourist flux over an area as large as one-third of Campania region, the same dataset of GSMD was used to perform an analysis of the opinions contained in the Tweets by techniques known as Sentiment Analysis. Sentiment analyses relating to tourism is a topic of considerable interest in the economy and the territory. The approach based on machine learning turns out to be remarkably effective: the vast amounts of data let us testing four types of neural networks. For each testing phase, we evaluated the accuracy of the sentiment classification.

The insights obtained from our case study illustrate the potential of the proposed methodology for especially for rural settings where the lack of financial resources and the vastness of territories, often hamper the sound planning of tourism uses. Attention should be paid to biases in the data as well as methodological limitations when drawing conclusions from analytical results.

CODE: 116

Planning and design of rural areas – section 2 –poster

8.6 HEATMAP PRODUCTION FOR GREENHOUSE PLASTICS WASTE MANAGEMENT

Monica C.M. Parlato*[*1], Valenti Francesca[1] Claudia Arcidiacono[1], Simona M.C. Porto[1],

[1]Department of Agriculture, Food and Environment, University of Catania,
Building and land Engineering Section
Via S. Sofia 100, 95123, Catania, Italy;
[*]Presenting author: monica.parlato@unict.it; mob. +393471773796.

Keywords: plastics waste management; land management; sustainability; GIS modelling; spatial index.

Abstract

Yearly in Europe, more than 1 million tonnes of Agricultural Plastic Waste (APW) are generated, and in particular, in Italy, more than about 350,000 tonnes of agricultural plastic materials are used. Nowadays, the use of plastic materials is considered in protected cultivation for a number of components such as crop shelter coverings, irrigation pipes, mulching films, packaging, and seedling containers. Application of plastic films for coverings in protected cultivation enables a significant advantage for the production system by obtaining a shortening of the growing season. However, in the absence of a correct disposal management of plastic waste, environmental degradation could take place with serious ecological and economic consequences.

In this study, land use analysis related to protected crops was carried out in a study area with the final aim of quantifying the yearly amount of APW coming from crop shelter coverage. The study area was localised in the province of Ragusa, the area with the highest concentration of protected crops in Italy constituting approximately 57% of the total national surface.

Firstly, the areas with the highest density of crop shelters (i.e., greenhouses and tunnels) were mapped by implementing a GIS (Geographical Information System) populated with data collected from land use maps, digital colour orthophotos, and remote sensing images. The results of this first phase showed that the density of greenhouses and tunnels is still elevated nearby the coastline, highlighting that the indications of the territorial plan of the Province of Ragusa concerning the movement of protected crops from the coast to the internal rural areas were disregarded. Within the high-density areas, thirty samples, each one of about 150 ha, were selected and analysed in order to classify crop shelter into typologies.

Next, a suitable index for computing APW was chosen from literature and was computed to obtain the related heatmaps. Finally, sensitivity analyses were carried out by varying thickness, lifetime, and density of the covering films of the greenhouses and tunnels located in the considered samples. The index ranged between 2,484 kg $ha^{-1}year^{-1}$ and 976 kg $ha^{-1}year^{-1}$.

Results of the study provide basic information for analysing the environmental impact due to transportation of APW to collection centres, recycling industries or landfills located in the neighbouring of the study area.

CODE: 114

Rural buildings, facilities and territory – section 2 –poster

8.7 MESH GENERATION FOR CFD SIMULATIONS FOR A DAIRY COW SEMI-OPEN FREE-STALL BARN

***Nicoletta Tomasello*[*1], *Francesca Valenti*[1], *Simona M.C. Porto*[1], *Giovanni Cascone*[1]**

[1]Department of Agriculture, Food and Environment, University of Catania,
Via S. Sofia 100, 95123, Catania, Italy;
[*]Presenting author: nicolettatomasello@unict.it; mob. +39 3385427463

Keywords: Air flow simulation, Complex geometry, Livestock building

Mesh generation is a fundamental and critical problem in geometric data modelling and processing involved in numerical computations or simulations (e.g. solving partial differential equations (PDE) using finite difference methods (FDM), finite element methods (FEM), or finite volume methods (FVM)). Mesh generation requires geometric data discretization by using polygonal or polyhedral elements. Meshing procedure failure is a relevant problem for numerical simulations. For this reason meshing process, especially of geometrically complex three-dimensional fluid flows, has attracted much attention in recent times because most engineering configurations involve critical issues that do not make it possible an easy mesh processing due to the time consuming and the difficult procedure of blocking complex domains.

In this context, the study here described put forward guidelines for mesh generation during the CFD modelling phase carried out for simulating natural ventilation within a semi-open free stall barn for dairy cows. The barn and its surroundings (i.e., other buildings such as milking parlour, and rows of trees) arranged partly upwind and partly downwind were modelled by using Autodesk AutoCAD 2016®. The mesh processing was conducted by using Ansys CFD 17.1®and the simulations were carried out by using Ansys Fluent 17.1®. The mesh used was hexahedral and the grid was unstructured since it was very flexible compared to the structured one for building complex geometries. Rules given by literature guidelines were followed to choose the cells parameters (i.e. ratio and spacing). Furthermore, alternative configurations – which include finest grids – were adopted for comparing and analysing the different outcomes.

The results of this research are relevant because in literature there are only few studies related to the mesh generation of semi-open free-stall dairy barns since in such buildings the proximity of other objects (such as other buildings serving the barn and trees) generally could affect indoor air flows. Therefore, this study could be useful as a guideline for carrying out CFD simulation in similar configurations.

CODE: 025

Topic: Rural buildings, facilities and territory
Type of presentation: Poster.

8.8 MILK-PRODUCTION IN BARNS WITH COMPOST BEDDING AND FREE STALL: A PROFITABILITY ANALYSIS

Marcos Aurélio Lopes[1*], Gustavo Rafael de Oliveira Silva[1]; André Luís Ribeiro Lima[1]; Geraldo Márcio da Costa[1]; Flávio Alves Damasceno[1]; Vitor Pires Barros[2]; Matteo Barbari[3]

[1] Federal University of Lavras, Campus Universitário, PO Box 3037, Lavras, Minas Gerais, Brazil, 37200-000, Fax: 55 35 3829 1148. E-mail: malopes@ufla.br
[2] Recursos Humanos no Agronegócio – Rehagro
[3] Department of Agriculture, Food, Enverоment and Forestry (DAGRI), Università degli Studi di Firenze.
** Author for correspondence*

Abstract:
Nowadays two intensive systems are used to produce milk from dairy cows: the free stall system and the compost barn system. The latter only recently has been introduced into several Countries, including Brazil. Various studies have addressed the dimensions, installation cost, and parameters to be measured in a compost barn, and other works cite possible advantages of the system in relation to reproduction, mastitis, and hoof injuries. However, no study has reported a profitability analysis of compost barn systems in the world. The objective of this study was to comparatively analyse the profitability of compost barn and free stall milk-production systems in Brazil as a mean of helping producers and technicians to choose the type of facility most suitable for each farm. Data collected from four farms from January to December 2016 were analysed. The data were distributed equally among compost barn and free stall systems. The cost of milk production was estimated according to the operating cost methodology and considering the milk production cost centre, which involved both lactating and dry cows. Additionally, gross and net margins were estimated as indicators of profitability. The results showed that the average gross and net margins were not influenced by the type of facility. They were positive in both of the production systems analysed, indicating that they are able to produce in the short and medium term. By comparing the components of the total operating cost of the compost barn and free stall farms, it was concluded that there were differences only in the "medications" item, which constituted a lower proportion of the compost barn farms due to the lower percentage expended for intramammary antibiotics for mastitis, and in the "bedding for cows" item, which represented the lowest proportion in the free stall system. Depreciation and total operating cost were similar in the two systems. Milk sales made up a higher percentage of the revenue in the free stall farms, while the expectations of revenues from wastes were similar in the two production systems. Given that there were no significant economic differences between the types of facility, it is concluded that ease in management, productivity, reproductive performance, animal health (hoof injuries and mastitis), environmental issues, and availability of water and bedding material should be the motivators for choosing one system over the other.
Key words: Dairy cattle, Compost bedding, Free stall, Cost centers, Production cost.

CODE: 131

Reference topic: Rural buildings, plants and territory
AIIA section: 2nd Section - Rural buildings, plants and territory
POSTER presentation

8.9 NET FENCES AGAINST INSECT VECTORS OF *XYLELLA FASTIDIOSA*

Sergio Castellano[1], Giuseppe Starace[2], Marco Lippolis[3], Marcella De Musso[3], Giacomo Scarascia Mugnozza[4]

[1] *University of Foggia- SAFE Dept., 71100, 25 Napoli St., Foggia, Italy*
[5] *University of Salento – Dept. of Engineering for Innovation - Via per Arnesano, Lecce, Italy*
[3] *Sachim srl- Via Mastricale 7, Putignano, Italy*
[4] *University of Bari Aldo Moro- DISAAT Dept., via Orabona 4, Bari, Italy*

Keywords: insect-proof net, integrated pest management, nursery, fence

In the last years, in Apulia Region, three kinds of meadow spittlebugs have been identified as vectors of the bacterium *Xylella fastidiosa* from infected to uninfected olive trees and blocking the contact with them seems to be the only way to avoid plants infection. Aim of this research has been to develop a net protection system, specifically designed for in-field cultivations, able to prevent the access of infected spittlebugs. The system is based on an experimental *anti- meadow spittlebugs* knitted net, mesh 2.4mm, designed and tested by the authors in a previous study. The net covers a steel-wood frame designed in order to resist to climatic loads, to easily install and remove the net, to reduce the shading on the tree and its own visual impact. The main agronomic, structural, constructive and aesthetic aspects of the net system were all analysed. The net permeability to air was measured in a micro-wind tunnel facility at Sachim srl in Putignano (Italy). The wind pressure coefficients on the structure were calculated based on literature correlation with the permeability of the net. The frame was designed according to structural Eurocodes. The effect of the net system on the cultivation was evaluated starting with the measurement of the radiometric properties of the net in laboratory facility (transmissivity and haze) of the University of Bari.

CODE: 017

Reference topic: Monitoring and modeling of the interactions among soil hydrological, plant and atmosphere processes, and agricultural management practices

AIIA section: 2°

Proposal: Poster

8.10 ODOR NUISANCE IN THE LIVESTOCK FIELD: A REVIEW

Cecilia Conti[1*], Marcella Guarino[1], Jacopo Bacenetti[1]

[1]Department of Environmental Science and Policy, Università degli Studi di Milano, Via Giovanni Celoria 10, 20133, Milano – Italy

* cecilia.conti@unimi.it

The development of residential areas near farms, and the intensification and specialization of livestock activities have led to a considerable increase in the potential of odor nuisance for nearby residents. Odor nuisance can be defined as «the cumulative effect of repeated events of annoyance caused by exposure to odors, over an extended period of time, that leads to modified behavior». The impact of these odors on the surrounding areas depends on different factors, the amount of odors emitted from the site, the distance from the site, weather conditions, topography, other than odors sensitivity and tolerance of the neighbourhood.

The perceived odor is the results of the mixture of different volatile chemical species, including sulfur, nitrogen, and volatile organic compounds. Odor emissions from animal production facilities, deriving principally from faeces and urines, depends on species, housing, management, feeding methods, manure storage and spreading methods.

The aim of this review was to investigate, through the analysis of the published literature, air dispersion models used to determine setback distances, aimed at maintaining adequate buffer zones between livestock units and residents. The bibliographic research was focused on odor assessment, characterization and effects. Articles with the title and/or abstract description unfitting these themes were not considered. The inserted keywords were “Odor”, “Livestock” and “Odor impact”.

Different types of models can be used to simulate the dispersion of pollutants into the atmosphere. Most dispersion models are Gaussian models, which assume the concentration profile across the plume to follow a Gaussian probability curve. The other models follow the Lagrangian or Eulerian approaches. They are mathematical models used to estimate or to predict the downwind concentration of air pollutants emitted from sources such as farms.

Setback distances, based on atmospheric dispersion models, are established according to the number of animals, their species, housing, and manure management and spreading systems in order to provide a tool for odor nuisance control. For example, OFFSET model uses tabulated odor emission numbers and tabulated odor reduction factors based on site-specific data of animal species together with type and area of buildings, manure storages and handling methods, and any odor control technology used.

Since odors have such a big impact on the surrounding environment, it is necessary to quantify the nuisance also from an environmental point of view. Thus, it is reasonable to assess the importance of the odours in a life cycle assessment (LCA) framework, useful to suggest the adoption of possible mitigation strategies.

CODE: 045

Reference topic: Rural buildings, facilities and territory/Computer and communication technologies

AIIA section: 2°

Proposal: Poster

8.11 SMART DAIRY FARMING: INNOVATIVE SOLUTIONS TO IMPROVE HERD PRODUCTIVITY

Claudia Arcidiacono[3], Matteo Barbari[4], Stefano Benni[5], Elisabetta Carfagna[7], Giovanni Cascone[3], Leonardo Conti[4], Luigi di Stefano[8], Marcella Guarino[1], Lorenzo Leso[4], Massimo Mancino[3] , Stefano Mattoccia[8], Giulietta Minozzi[6], Simona M.C. Porto[3], Giorgio Provolo[2], Giuseppe Rossi[4], Anna Sandrucci[2], Alberto Tamburini[2], Patrizia Tassinari[5], Nicoletta Tomasello[3], Daniele Torreggiani[5], Francesca Valenti[3].

[1]Department of Environmental and Policy Science, Università degli Studi di Milano, Via Celoria, 10 - 20133, Milano – Italy

[2]Department of Agricultural and Environmental Sciences ,Production, Landscape, Agroenergy, Università degli Studi di Milano, Via Celoria, 2 - 20133, Milano – Italy

[3]Department of Agriculture, Food and Environment, Università degli Studi di Catania, Via S. Sofia, 100 -95123 Catania – Italy

[4]Department of Agriculture, Food, Environment and Forestry, Università degli Studi di Firenze, Via San Bonaventura, 13 50145 Firenze –Italy

[5]Department of Agricultural and Food Sciences, Università di Bologna, Viale Giuseppe Fanin 50 - 40127 Bologna – Italy

[6]Department of Veterinary Medicine, Università degli Studi di Milano, Via i Celoria, 10 - 20133, Milano – Italy

[7]Department of Statistical Sciences "Paolo Fortunati", Università di Bologna, Via Belle arti, 41, - 40126 Bologna – Italy

[8]Department of Computer science and Engineering, Università di Bologna, Viale Risorgimento 2, - 40136 Bologna – Italy

The increase in food global demand, food safety alarms and new dietary trends are straining the farmers: on the one hand, they have to guarantee the welfare and adequate conditions of life for the animals and reduce the environmental footprint; on the other hand, they have also to develop new strategies to improve farm management reducing costs. The current conditions and the expected developments of dairy sector highlight a strong need for more efficient and sustainable farming systems, both at global and local scale. It becomes important to study housing, herd management and heat stress that can affect the welfare of dairy cows and, consequently, their productive and reproductive performances which impact on the economic and environmental sustainability of the dairy chain.

New techniques can improve environment, welfare and conditions of dairy cows and, consequently, enhance reproduction and production. At the same time, lacks in literature highlight the need to push forward researches on real-time data monitoring, acquisition and processing. Effective tools to cope with these challenges have been provided by Precision Livestock Farming (PLF), which is nowadays increasingly applied and makes it possible to control quali-quantitative parameters related to production, health, behaviour, real-time locomotion of each animal of the herd. ICT are increasingly adopted in every aspect of livestock farming, thus switching the analysis framework from data-poor to data-rich situation.

The research key challenge is therefore to turn those data into knowledge that allows providing real-time support in farming optimization.

This research focuses on dairy cattle farming and specifically on different systems to collect, process and derive useful information from data on animal welfare and productivity (i.e. activity, oestrus detection, drinking behaviour, milk production, etc.). A multi-disciplinary approach involving biosystems engineering, animal husbandry, genetics, data science and deep learning has been adopted with the aim to generate a **decision support system** to help farmers achieving the optimal performances of the farming systems.

Keywords: sustainability; animal housing; numerical modelling; efficient animal production; Precision Livestock Farming

CODE: 179

Reference topic: Rural buildings, facilities and territory

AIIA section: 2nd Section - Rural buildings, plants and territory

8.12 THE APULIAN TERRITORY THROUGH VISUAL RESEARCH

Enrico Liano*, Ileana Blanco, Giacomo Scarascia Mugnozza.

Department of Agricultural and Environmental Science DISAAT – University of Bari, via Amendola 165/A, 70126 Bari, Italy – enrico.liano@uniba.it

**** Presenting author:** Enrico Liano, Department DISAAT University of Bari, via Amendola 165/A, 70126 Bari, Italy. Telephone: +39 0805442863. Email: enrico.liano@uniba.it*

Abstract

The Apulian territory is strongly characterized by a rural architectural heritage that is full of history. Rural and industrial buildings, their redevelopment or degradation, are the testimony of a history whose investigation is complex and varied over time.

The Regional Territorial Landscape Plan, which entered into force in 2012, promotes the realization of a self-sustainable and lasting socio-economic development and education for a conscious use of the regional territory. The knowledge, conservation, use and promotion of the Traditional Apulian Architectural Heritage are among its aims. This in fact constitutes the memory of a place, culturally identifies a local community and the territory. In-depth knowledge of the identifying characteristics of the rural heritage is essential before any recovery intervention specifically aimed at protecting and enhancing the buildings, the landscape and the environmental context. A recovery activity, mindful of these issues, can generate strategic resources for reaching wider objectives of regional development.

The visual anthropology applied to the territory has the power to represent everything that is likely to be perceived and told by an observer, therefore almost all of the culture of a human group, of a community, of a society.

This study applies the method of visual anthropology for the analysis of case studies of the Traditional Apulian Architectural Heritage, through a rigorous use of visual sources and ethnographic and ethno-historical research techniques. The potential of visual anthropology in the knowledge of the territory is highlighted.

Keywords: architectural heritage, rural buildings, visual anthropology.

9 AIIA Section 3 - Mechanization and technologies for agricultural production

President

Marco Vieri

University of Firenze

Vice President

Luigi Sartori

University of Padova

9.1 PURPOSE

The Section proposes the development, sharing and dissemination of scientific and technical knowledge in the field of agricultural, forestry, animal husbandry and green areas. This includes both the design and construction aspects of the machines and plants for the processes, as well as the methods, techniques and technologies to optimize their performance in energy, environmental, economic and social terms.

9.2 TOPICS OF INTEREST

The Section develops its activities in the field of machinery, equipment and systems, sensors, automation and robotics, process control, logistics in agricultural, forestry and livestock supply chains.

10 AIIA Section 3 – Oral Presentations

Oral Presentations

CODE: 072

Topics: Mechanization and technologies for agricultural production – AIIA, 3d section

Paper proposal for oral presentation

10.1 A NEW MODEL TO ESTIMATE THE TOTAL LUBRICANT OILS CONSUMPTION RATE IN AGRICULTURAL TRACTORS

Aldo Calcante[1], Massimo Brambilla[2], Carlo Bisaglia[2], Roberto Oberti[1]

[1]Department of Agricultural and Environmental Sciences, Università degli Studi di Milano, Milan Italy

[2]Consiglio per la Ricerca in Agricoltura e l'Analisi dell'Economia Agraria (CREA), Centro di Ricerca Ingegneria e Trasformazioni Agroalimentari (CREA-IT), Treviglio, Italy

Presenting Author:

Aldo Calcante, Department of Agricultural and Environmental Sciences, Università degli Studi di Milano, Via Celoria 2, 20133 Milan Italy.
Tel. +3902 50316864, Fax. +3902 503111, email aldo.calcante@unimi.it

In agricultural tractors, an effective lubrication is of paramount importance for the durability of components and for efficiency of power's transmission. Indeed, lubricants reduce wear and friction of moving parts, remove heat and potential damaging impurities, preserve surfaces from oxidation and corrosion.
Lubricant oils are used in tractor's engine, transmission, hydraulic system, front and rear axles, steering and braking system, resulting in a relevant total amount of oil which must be regularly changed at intervals recommended by manufacturers. This leads to a significant total oil consumption rate, whose estimation has relevance for the accurate accounting of tractors operating costs and for applying environmental analysis of mechanised agricultural operations.
The objective of this work is to propose and validate an up-to-date equation to estimate the total lubricant oils consumption rate (HTOC) as a linear function of tractor's rated engine power (Pr) in agricultural tractors, by extending the definition of oil consumption rate given by ASABE Standard D497.7 (2011). To this aim, a linear regression analysis was conducted on a dataset of 255 recent tractor's models. After calibration, the equation resulted to estimate the actual oil consumption with R^2= 0.75. The overall prediction RMSE resulted to be 0.033 kg h^{-1}. The equation was finally applied to an independent dataset of actual oil lubricant consumption rates obtained from a field survey of 118 agricultural tractors operating in northern Italy. Application of the equation to the field survey data showed an R^2 of 0.89 and RMSE of 0.010 kg h^{-1} between predicted and actual values.
The proposed equation resulted to estimate the actual oil consumption fairly more accurately than other methods available in literature, (e.g. ASABE and LCA equations).

CODE: 010

Topic: Mechanization and technologies for agricultural production

AIIA Section: III

Proposed for: Oral or Poster presentation (no preference)

10.2 A PROTOTYPE, BIOMASS-FUELED FLAMER FOR IN-ROW WEED CONTROL IN VINEYARDS

Gianfranco Pergher, Rino Gubiani

Dipartimento di Scienze Agroambientali, Alimentari e Animali (D4A), Università degli Studi di Udine. Via delle Scienze 208, 33100 Udine. Fax No. 0432 558603.

email: gianfranco.pergher@uniud.it

Rising concern about the effects of herbicides on the environment and on human health has led to renewed interest in non-chemical weed control, particularly on the row of vineyards, with mechanical (tillage, mowing, brushing) or thermal methods (flaming, steaming, hot-foam machines) (Bekkers, 2011; Hammermeister, 2016).

A new, biomass-fueled (wood pellet), flaming prototype (CS Thermos), was tested in spring-summer 2018 and compared with tillage (disc cultivator, weeder blade, and finger blade) and mowing (in-row, vine-skipping mower).

The field experiment was performed in a guyot-trained, 15-years Merlot vineyard in Buttrio (Friuli Venezia Giulia), with three main treatments (Flaming, Tillage, and Mowing) and four replicates on randomised blocks. Four applications were made between May 10 and July 27. Before and after each application, aboveground weed biomass was assessed using 0.5 m x 0.5 m frames. Efficacy (in % of weed biomass removed or killed) and re-growth between two applications (in g dry biomass / m^2) were calculated for each treatment.

The efficacy of Flaming was generally superior to that of both Tillage and Mowing, particularly around vines (64-75% versus 31%-48%). However, weed regrowth was better controlled by Tillage than by Flaming, with reductions in total weed biomass production until July 27 of 34%, and 18%, respectively, versus Mowing.

Advantages of Flaming versus Tillage and Mowing, and of the biomass-fueled prototype versus conventional, LPG-fueled flamers are discussed in the paper along with agronomical and technical solutions to prevent risks of uncontrolled fires.

Bekkers T. 2011. Weed control options for commercial organic vineyards. Wine & Viticulture Journal, July/August 2011, 62-64.

Hammermeister A.M. 2016. Organic weed management in perennial fruits. Scientia Horticulturae 208, 28–42.

CODE: 110

Reference Topic: Spatial and landscape analysis.
AIIA Section: 2a. Proposal for Oral presentation or Poster: Oral presentation.

10.3 ASSESSMENT OF FOREST BIOMASS AND CARBON STOCKS AT STAND LEVEL USING SITE-SPECIFIC PRIMARY DATA TO SUPPORT FOREST MANAGEMENT

Luca Nonini[1*], Calogero Schillaci[1], Marco Fiala[1]

[1]Department of Agricultural and Environmental Sciences. Production, Landscape, Agroenergy, University of Milan. Via G. Celoria 2, 20133 Milan, Italy.
[*]Presenting Author: Luca Nonini. E-mail address: luca.nonini@unimi.it, Tel.: 02 503 16694.

1. Introduction

To estimate wood biomass (WB) and carbon (C) stocks of forests, several models have been developed; they differ in terms of details and scale of application. Stand level models are particularly important because stands represent the reference forest management units (FMU). The aims of the study were: (i) to assess WB and C stocks of Valle Camonica forests (Northern Italy) at stand level and (ii) to map the spatial distribution of these stocks.

2. Material and methods

A first model has been recently developed to calculate WB and C stocks at stand level in different pools: (i) aboveground and (ii) belowground WB and (iii) dead organic matter, using site-specific primary data collected in forest management plans (FMPs). In the study, new information and calculation methods were introduced to provide a more reliable and flexible model. For each stand, starting from the initial growing stock volume (GSV, t DM), the gross current increment (GCI, $t \cdot year^{-1}$ DM) is estimated each year, applying the first derivative of the Richards growth function. Specific parameters are used, according to stand's characteristics (species and type of management). For the year *n*, GSV is calculated starting from GSV of the year *n-1*, adding GCI and subtracting losses in the year *n* due to: (i) harvesting, (ii) small-scale mortality and (iii) disturbances (wildfires, windstorms, avalanches, and insects' outbreaks). For the latter, the model allows the quantification of GSV fraction that is transferred to dead organic matter pool, according to the type of disturbances. Starting from GSV, annual aboveground and belowground WB – and the corresponding C stocks – are calculated applying specific coefficients, defined according to stand's characteristics and derived from literature. For each stand, dead organic matter (dead WB and litter) – and the corresponding C stocks – of the year *n* are calculated taking into account, as inputs: (i) small-scale mortality, (ii) fraction of WB due to disturbances and (iii) harvesting residues, and, as outputs, dead organic matter decomposition. In the study, the model was tested to the dataset of 2019 stands of Valle Camonica forests (45 FMPs; 37000 ha), covering the period from 1984 to 2016. The model was then integrated with a Geographic Information System (ArcGIS software®) to produce digital maps and analyze the spatial distribution of WB and C stocks.

3. Results

For each stand under analysis, a classification sheet (SCC) with a user-friendly interface was developed. Each SCC is organized in two hierarchical levels (L_1 and L_2). L_1 contains general input information extracted from FMPs (e.g. location, species, type of management, initial growing sock volume and gross increment). L_2 is organized in two sublevels (L_{2A} and L_{2B}). L_{2A} contains specific input (e.g. harvestings or disturbances) and output (calculated by the model, related to WB and C stocks in the pools over the time) information; L_{2B} includes specific input information related to mechanization (type of biomass cutting performed and characteristics of the biomass harvesting chains). The model described here can be efficiently used to support forest management and decision-making processes at a local or district level.

CODE: 105

Reference topic: Mechanization and technologies for agricultural production

Proposal: Oral presentation

10.4 AUTOMATIC ESTIMATION OF TRACTOR MISSION PROFILE USING CAN-BUS DATA

Mattetti M.[1,*] and Molari G.[1]

[1] Department of Agricultural and Food Sciences –University of Bologna, viale G. Fanin, 50, 40127, Italy

**Corresponding and Presenting Author: Michele Mattetti, Department of Agricultural and Food Sciences, University of Bologna, viale G. Fanin 50 - 40127 Bologna, Italy,*

tel. +39 051 2096174, fax +39 051 2096178, email: michele.mattetti@unibo.it

Abstract

Mission profile is a synthetic description of the tractor usage by the entire population of farmers. Mission profile is important for machine manufacturers for an optimal design of tractors and for farmers for a proper machine budgeting. The derivation of the mission profile is a non-trivial task and its mainly based on surveys completed by farmers. However, farmers might be imprecise in completing surveys and therefore, the estimation cannot be entirely relied on surveys. Modern tractors is fully equipped with sensors integrated into the CAN-BUS network, which continuously monitor the tractor operating parameters. The aim of the paper was to develop a method to automatically estimate the mission profile using the CAN-BUS data. On a tractor, a CAN-BUS data logger and a GPS receiver were installed and data were acquired for 140 hours under real operating conditions. Tractor positions were classified using a GIS approach and the operating conditions were classified in function of the usage of the tractor subsystems. The method highlights that the tractor operated on field, on idle and on-road duties for the 44%, 17% and 15% of the time, respectively. Thanks to this method a precise estimation of customer usages can be outlined.

Keywords: CAN-BUS, farm usage, ISOBUS, tractors

CODE: 069

AIIA Section 3: Mechanization and technologies for agricultural production

ORAL presentation

10.5 BROTWEG – A PATH OF BREAD IN AN ALPINE ENVIRONMENT: NEW MECHANICAL SOLUTIONS FOR GRAIN PROCESSING IN STEEP MOUNTAIN SLOPES

Sabrina Mayr[1], Riccardo Brozzi[2], Alice Cervellieri[1], Thomas Desaler[3], Raimondo Gallo[1], Josef Gamper[4], Bernhard Geier[5], Laurin Holzner[1], Pasqualina Sacco[2], Fabrizio Mazzetto[1]

[1]Faculty of Science and Technology of Free University of Bolzano/Bozen, Italy. Piazza Università 5, I-39100 Bolzano, e-mail: sabrina.mayr@unibz.it
[2]Fraunhofer Italia, Via A. Volta 13 A, 39100 Bolzano, Italy
[3]Neuero Italiana S.A.S, Via Montani 7, 39012 Merano, Italy
[4]Taser Alm, Schennaberg 25, 39017 Scena, Italy
[5]Geier srl, Via Prati Nuovi 13, 39020 Marlengo, Italy

A remarkable area of the cultivable land in South Tyrol has an inclination above 30%, which precludes the use of conventional machines for its cultivation. The project “Brotweg” is facing this problem by developing technologies for grain cultivation in a steep mountain environment up to an inclination of 70%. Furthermore, a technical solution for the whole grain processing after harvesting up to the production of bread is evolved. With the help of an entire facility the grain processing can be performed directly at the farm, which allows the farmer to act more independent while increasing his profitability. The aim of this project is to offer farmers an alternative or a supplement to livestock and dairy farming. It will improve and facilitate the working condition for farmers. To reach these goals many issues must be solved: a) Mechanical solutions for grain seeding and harvesting in steep slopes must be developed. One of the main challenges thereby is to prevent erosion. b) A solution for grain processing and conservation on the farm must be found. The existing structures of a farm are limiting the size of the facility. c) The grain is processed to bread directly on the farm and distributed in a further step. The whole processing path must satisfy all safety restrictions, environmental terms and consider all possible geological problems of a steep mountain slope. We present the implementation of a grain processing facility in an existing farm structure and the development of the seeding and harvesting machines for steep slopes.

CODE: 001

3rd AIIA Section; Reference Topic: Mechanization and technologies for agricultural production

10.6 COMPUTATIONAL EVALUATION OF THE TRACTIVE PERFORMANCES OF A M.F.W.D. TRACTOR

Nicolò Regazzi, Mirko Maraldi, Giovanni Molari

Affiliation: Department of Agricultural and Food Sciences, University of Bologna
Viale Giuseppe Fanin 50, 40127, Bologna, Italy.

Presented by Nicolò Regazzi (E-mail: nicolo.regazzi2@unibo.it, Phone +39 051 2096193)

ABSTRACT FOR ORAL PRESENTATION

The increasing demand of better tractive performances and reduced fuel consumptions have pushed both the world of off-highway vehicles' manufacturer and of research to invest a considerable amount of money and time in the design of more efficient vehicles.

In this context an optimization study on the features of agricultural tractors and the development of a mathematical model is particularly suitable; moreover from an accurate bibliographic research emerged that several model have been built up for generic off-road vehicles but few have been done for agricultural tractors, is important to underline that tractors present unique features such as non-isodiametric wheels and the 4WD system realized with a pair of meshing gears, for these reasons there is the need to develop a new tractor model.

To develop this kind of model we used a bottom-up, stress-based and semi-empirical approach. We started from the normal and tangential stresses acting at the wheel-soil interface, once the stresses have been reconstructed we computed forces and torques acting at the wheel hub and then we were able to compute the power delivery efficiency of the tractors or by means of the gear-ratios of the transmission we can determine the operating point of the internal combustion engine.

The implemented model relies on a system of four equations, three integral equations coming from the equilibrium of the vehicle (vertical, horizontal and rotational) and a rigid body constraint equation that correlate the slip of the front and rear wheels, the four unknowns of the system are the slip of front and rear wheels and the contact angle of the front and rear wheels. Subsequently we evaluated the power delivery efficiency varying 5 different constructive parameters: mass distribution, wheelbase, wheels radius ratio, drawbar height and front wheels lead on 8 different steps for a total of 8^5 simulations. A gradient method based on the central difference scheme was implemented in order to understand which the most influential parameters are.

The three most influential parameters: mass distribution, front wheels lead and wheels radius ratio have been used to develop a simplified second order polynomial expression of the power delivery efficiency and finally the first derivative provides the formulation of the optimal mass distribution.

This study has been validated with some field data coming from a middle power class, row-crop tractor running on tilled loam soil.

From this study we noticed that the best configuration is an isodiametric vehicle with the mass distribution slightly shifted toward the front axle, decreasing the radius of the front wheels the optimal mass distribution is shifted on the rear of the vehicle. The lead of the front wheels affects the power delivery efficiency of the vehicle in a detrimental manner and tends to move moderately the optimal mass distribution on the rear axle.

CODE: 019

Reference topic: Mechanization and technologies for agricultural production

AIIA section: 3a Section - Mechanization and technologies for agricultural, animal, forestry production and for green spaces

10.7 CONTROLLED MECHANICAL VENTILATION TO REDUCE PRIMARY ENERGY CONSUMPTION IN AIR CONDITIONING OF GREENHOUSES

C. Perone [1,*], P. Catalano [1], F. Giametta [1], G. La Fianza [1], L. Brunetti [1], B. Bianchi [2]

[1] Department of Agriculture, Environment and Food Science(A.A.A.) - University of Molise
Via Francesco De Sanctis, 86100 Campobasso (Italy)
claudioperone@gmail.com

[2] Department of Agro-environmental and Territorial Sciences (DISAAT), University of Bari "Aldo Moro"
Via Amendola 165/A, 70126 Bari (Italy)

Air conditioning is one of the major cost in greenhouses production. One of the most interesting energy efficiency strategies is the reduction of the energy use itself. Mechanical ventilation with heat recovery could allow for a reduction in energy use for heating and cooling air inside greenhouses. After a preliminary study carried out in laboratory, a mechanical ventilation prototype was tested in a real case. The unit was installed at service of a mini-tunnel greenhouse located in Termoli (Campobasso) – Italy. The ventilation system consists of a high efficiency heat exchanger, able to recover thermal energy from the exhaust air, and a heat pump to adjust the supply air temperature before entering in greenhouse. A perforated duct was installed for the air distribution and a single grid was used to suck the indoor air. To evaluate the energy performance of the unit a supervision system allowed measuring and collecting all the thermophysical parameters, in each side of the machine, and in the heat pump circuit. Four NTC probes were used to assess the temperature uniformity inside greenhouse.

First tests were carried out on temperature control during winter season. They show that the indoor air temperature (set at 27 °C) is suitably adjusted by driving the unit with the reference probe installed on the machine recovery side. Only an offset of few Celsius degrees is observed due to duct heat loss and the recovery grid placed on one side. Furthermore, the mechanical ventilation system had also shown notable energy performance: COPs (mean value) of 5.4 and 5.7 at outdoor air temperature of 18.0 °C and 15.7 °C respectively.

Keywords: Mechanical ventilation, heat recovery, greenhouse ventilation, energy efficiency, heat pump

Proposal for Oral Presentation

CODE: 002

Reference topic: Mechanization and technologies for agricultural production

AIIA section:3°

Proposal: Oral

10.8 ECONOMIC AND ENVIRONMENTAL PERFORMANCES OF A NEW DOUBLE WHEEL RAKE

Jacopo Bacenetti[1*], Luciana Bava[2], Gabriele Repossi[3]

[1]Department of Environmental and Policy Science, Università degli Studi di Milano, Via Giovanni Celoria 2, 20133, Milano – Italy

[2]Department of Agricultural and Environmental Science, Università degli Studi di Milano, Via Giovanni Celoria 2, 20133, Milano – Italy

[3]Repossi Macchine Agricole srl, Via Vittorio Emanuele II, 40, Casorate Primo (PV) – Italy

* jacopo.bacenetti@unimi.it

Timeliness is one of the key-aspects for good haymaking. In this context, the availability of machines characterised by high field capacity and high productivity is important because allow the reduction of product losses thanks to a good timing of the different operations carried out during the whole haymaking process.

This study presents the preliminary results related the development and testing of an innovative rake (namely Ra-Rake). The Ra-Rake, developed by the Repossi Macchine Agricole company thanks to the financial contribution of the EU project No 778475, is based on a new double wheel rake which includes a double rotating unit that thorughan innovative design, allows not to collect stones nor dust during the raking process.

During the spring and summer of 2018, field tests were carried out, mainly on alfalfa, comparing the Ra-Rake with different rakes (belt rake, rotary rake and comb rake). The main operational parameters were measured (working times, working speed, effective field capacity, product losses, etc.) and an economic and environmental assessment was performed considering an increasing working area from 400 to 2000 ha/year.

Economic evaluation, carried out using the method of fixed and variable costs, highlighted how the Ra-Rake shows the best performances independently to the worked area. About the environmental impact, evaluated using the Life Cycle Assessment approach, the best results are achieved by the comb rake while the Ra-Rake performs better than the belt rake. Similarly, to the economic cost, also the different environmental impacts depend on the annual worked area. When the area increases the environmental impacts decrease.

Due to the high mass, the impact for Ra-Rake manufacturing and maintenance is one of the main responsible of its environmental impact. In the future, the development of additional Ra-Rake models, built using the same chassis but with higher working width, will allow to reduce the environmental impact (thanks to higher working capacity).

CODE: 088

10.9 EVALUATION ON THE STABILITY OF TREE USED AS ANCHORS IN CABLE YARDING OPERATIONS

Luca Marchi[1], Omar Mologni[1], Stefano Grigolato*[1], Raffaele Cavalli[1]

[1]Dept of Land, Environment, Agriculture and Forestry, Università degli Studi di Padova
Viale dell'Università 16, 35020 Legnaro PD; e-mail: stefano.grigolato@unipd.it

ORAL PRESENTATION - *3a Sezione - Meccanizzazione e tecnologie per le produzioni agricole*

Most of the fatal injuries that occur in cable yarding operations are related to both breakage of the skyline or failure of its anchoring system. The high forces, necessary to provide a cable path that consent an efficient transportation of the logs, are dynamically amplified by the oscillation of the moving weight (in case of fully suspended loads) and by the sudden accelerations applied to the carriage when ground obstacles are encountered (in case of semi-suspended loads). These high-magnitude forces must be withstood by the anchoring system, in general consisting of a sufficiently large tree or stump available in the nearby area, over which the rope end is secured. Due to the lack of effective methods that predict the actual load carrying capacity of such anchoring solution, failure due to overturning or stem breakage of the tree is likely possible.

The present work aims to apply the knowledge of tree stability assessment to the case of trees used as anchors in cable yarding operations. Comparison between data of experimental pulling tests that simulated failure of the anchors due to uprooting and data collected from direct field measurements are made. More in detail: i) pulling tests data consist of force vs. rotations curves obtained from destructive pulling tests on mature trees with medium-high diameter at breast height; ii) field data of real cable logging systems consist of force vs. rotations curves obtained by the synchronization between the variations of tensile forces in the skyline and the anchors' relative displacements. The correlation between the two sets of data is made in order to develop an assessment technique, based on continuous monitoring, that guarantee a better level of safety of the anchors than actual empirical methods.

CODE: 109

Reference Topic: Mechanization and technologies for agricultural production.
AIIA Section: 3a. Proposal for Oral presentation or Poster: Oral presentation.

10.10 HIGH ACCURACY SITE-SPECIFIC SECONDARY DATA FOR MECHANICAL FIELD OPERATIONS TO SUPPORT LCA STUDIES

Marco Fiala[1], Luca Nonini[1*]

[1]Department of Agricultural and Environmental Sciences. Production, Landscape, Agroenergy, University of Milan. Via G. Celoria 2, 20133 Milan, Italy.
[*]Presenting Author: Luca Nonini. E-mail address: luca.nonini@unimi.it, Tel.: 02 503 16694.

1. Introduction

Methodologies to quantify the environmental impacts of mechanical field operations are widely applied, but, usually, system inputs and outputs come from international databases or literature and rarely represent the studied situation. The aim of the study was to quantify site-specific secondary data related to mechanical field operations in EU cereal cropping (from soil tillage to grain and straw transportation), paying particular attention to barley crop.

2. Material and methods

The model ENVIAM v1 ("ENVironmental Inventory of Agricultural Machinery operations"), developed some years ago, has been implemented into ENVIAM v2. Through this second version, each mechanical field operation is subdivided into 13 working times. For each of them, according to tractor power and engine load, (i) direct consumptions (fuel, lubricants, AdBlue®) and (ii) emissions into the air (i.c. engine exhausted gases of CO_2, CO, HC, NO_x and PM) are calculated. Indirect consumptions of materials composing the mass of tractors and implements are also computed, taking into account: (i) physical lifetime of the machine, (ii) duration of the operation and (iii) a specific repair factor. Finally, the model allows the calculation of the mass of heavy metals (Cd, Pb and Zn) released into the soil due to tire abrasion. Three scenarios (S) of barley cultivation were identified (AAU: S1 = 50 ha, S2 = 100 ha, S3 = 200 ha); these scenarios have the same: (i) percentage of barley area (60% of AAU), (ii) soil texture (medium) and slope (flat conditions), (iii) barley field distance from the farm (2 km) and shape (rectangular), (iv) mechanical operations sequence (10 in total) and type of machine, (v) cropping inputs (seeds and herbicide rates). For each scenario, two barley varieties were taken into account: (i) currently in use (BarNow) and (ii) future (BarPlus). The latter is characterized by: (i) higher grain and straw yields (+25% and +14.5% $t \cdot ha^{-1}$ DM, respectively), (ii) greater N-fertilization (+20% $kg \cdot ha^{-1}$ of N), (iii) use of TIER 5 tractors' engines (-90% of NO_x emissions using SCR system and AdBlue®), (iv) lower minimum specific fuel consumption (-10% $g \cdot kWh^{-1}$), and (v) greater Effective Field Capacity (+10% and +15% $ha \cdot h^{-1}$ for low and high technological level of machines, respectively). These accurate inventories provided by ENVIAM v2 were then used to carry out an LCA analysis related to barley cultivation in EU.

3. Results

For operations performed by an implement coupled with a tractor (9/10 in barley cropping), the environmental performances strongly depend on the correct tractor power choice; moreover, the assumption of carrying out the operation at a constant engine load, leads to large underestimations of emissions into the air. Inputs used for BarNow cropping amount to: fuel FC = 67÷74 $kg \cdot ha^{-1}$, lubricants LC = 560÷725 $g \cdot ha^{-1}$, mass MC = 7.9-8.8 $kg \cdot ha^{-1}$. Inputs used for BarPlus cropping amount to: fuel FC = 55÷60 $kg \cdot ha^{-1}$, lubricants LC = 535÷690 $g \cdot ha^{-1}$, mass MC = 7.2-8.0 $kg \cdot ha^{-1}$, AdBlue® AdB = 2.8-3.0 $kg \cdot ha^{-1}$. The highest fuel and mass consumptions are, in any scenario, related to tillage operation.

CODE: 140

Topics: Mechanization and technologies for agricultural production – AIIA, 3d section
ORAL

10.11 IMPROVED ESTIMATION OF LEAF BIOMASS IN ROMAINE LETTUCE CULTIVATION TROUGH 3D IMAGING APPROACHES

Alberto Zani, Emanuele Tona, Aldo Calcante, Roberto Oberti

Department of Agricultural and Environmental Sciences, Università degli Studi di Milano, Milan Italy

Presenting Author:
Roberto Oberti, Department of Agricultural and Environmental Sciences, Università degli Studi di Milano, Via Celoria 2, 20133 Milano (Italy).
Tel. +3902 50316867, Fax. +3902 503111, email: roberto.oberti@unimi.it

A crucial aspect of market quality and shelf life of leafy vegetables for RSE is the stage and homogeneity in plants growth. The growth-rate of leaf area or plant head biomass is a crucial indicator for the feedback on the management of production process, and for the possibility of selective harvesting of homogenous lots of leafy vegetables aimed for ready-to-eat salads market.
A classical approach for the non-destructive assessment of the growth of vegetable plants relies on top-view color imaging of plant heads, which enable to estimate the leaf biomass by measuring the projected area of the head canopy at different points in time. Nevertheless, such technique results in more and more limited accuracy as the stage of growth progresses, due to leaves overlapping and to occlusions of the plant top-view.
The availability of cost-effective time-of-flight cameras with three-dimensional (3D) capability may enable a valuable step ahead towards an accurate and fast technique for on the-go estimate of leaf vegetables growth and biomass at greenhouse and field scale.
In this work, an experiment was conducted by acquiring in vivo images 3D images on undisturbed Romain lettuce potted plants at different growing stages. Top-view color and depth images (RGB-D) were obtained with a Kinect V2 (Microsoft, USA) in a greenhouse setup. Immediately after the acquisitions, each lettuce plant was destructively harvested to determine the total area of detached leaves and the corresponding fresh weight of the biomass. A 3D point-cloud was derived for each plant, and processed to extract head volume and to estimate leaf area by applying two approaches at different level of complexity (namely: concave hull volume and single leaves area addition).
The classical top-view, area-projection color image was overpassed in the capability of estimating plant head leaf biomass by both the 3D approaches, that correlated fairly well (R2=0.71) with the values of fresh biomass destructively measured even at more advanced growing stages.

CODE: 136

Potential reference topic and AIIA section:

- *Mechanization and technologies for agricultural production*
- *Machines and facilities for agricultural products and food processing*

AIIA section: 3rd
Proposal: Oral

10.12 LIFE-VITISOM: A EU PROJECT FOR THE SET-UP OF VRT ORGANIC FERTILIZATION IN VINEYARD

Domenico Pessina[1], Davide Facchinetti[1], Lavinia Galli[1]

[1]Department of Agricultural and Environmental Sciences, Università degli Studi di Milano - Via Celoria 2, 20133 Milan, Italy.
Presenting author: domenico.pessina@unimi.it; 02 503 16876

Abstract

The VRT (Variable Rate Technolgy) is at present applied at several agricultural crops, and describes any technology which enables producers to vary the rate of inputs. Regarding the fertilization, on the market are already available many spreaders equipped with devices able to distribute granular and powdery inorganic (mineral) fertilizers, adopting the VRT solution. Different problem is represented by the organic fertilizers spreading, because the materials show typically a remarkable variation in their physical parameters, such as the size, water content, density, ecc., mainly due to their very different original sources and managing operations. The EU LIFE-Vitisom project focuses on the set-up of 5 organic fertilizer spreaders, able to the distribution in VRT mode in vineyards.

The organic fertilizers (matrices) taken into account have been compost, manure and solid digestate: they show very different chemical and physical features. In order to assure the best running of the machines, each spreader was hydraulically fully managed, by adopting an independent system powered by a pump driven by the tractor PTO. The VRT distribution was based on prescription maps (i.e. based on plant vigour) or, as an alternative at the beginning of the growing season, using a set of sensors reading locally and in real time the branches dimension.

The field tests were carried out in 2017 and 2018 seasons, and were devoted to measure the spreading of the 3 matrices in VRT mode, by comparing the theoretical (implemented in the software) and the real rates distributed. The tests were carried out by adopting two different solutions: 1) some plastic sheets (of a known area) were placed on the inter-rows surface, to collect the fertilizers distributed during the travelling of the spreader, in order to calculate the resulting rate, to be later compared to the expected VRT value; 2) the entire spreader was weighed (placing under their wheels some plates with load cells) before and after working in an entire inter-row, and comparing the weight of the material distributed with the correspondent average expected from the prescription map.

In respect to the acceptable devation (± 20%), the results shows values exceeding the limits in the major part of the tested condition. This is probably due to the vertical and above all longitudinal (compaction) forces to which the matrix is subjected when stored on the machine. In particular, during the spreading routine the material is quite compressed in the horizontal direction by the bulkhead that is pushing it towards the rear rotors. A possible solution (at present under investigation) is to vary the bulkhead travelling speed (i.e. the matrix flow to be distributed) not only considering the prescription map or the local sensors signals, but also taking into account the material density increase from the beginning to the end of a single spreading routine.

CODE: 106

Reference topic: Mechanization and technologies for agricultural production

AIIA section: n.3

Proposal: Oral presentation

10.13 MODELLING OF AGRICULTURAL MACHINERY TRENDS FOR POWER, WEIGHT, WORKING WIDTH AND PRICE

Francesco Marinello [(1)], Tatevik Yezekyan [(1)], Giannantonio Armentano [(2)], Luigi Sartori [(1)]*

[(1)] *Department of Land, Environment, Agriculture and Forestry - University of Padova, viale dell'Università 16, 35020 Legnaro (PD), Italy.*

* Corresponding author: Francesco Marinello (francesco.marinello@unipd.it).

Abstract. Rural mechanisation and fleet organisation have an essential impact on agricultural production and on sustainable development of farm institutions. Machine functional parameters define fleet composition and management and, thus, play an important role in economic and environmental performance. Programming methods and decision support systems are available in the market, however, there is still a lack of applicative tools which allow modelling and forecasting of technical parameters as well as costs to complete the decision tasks. Availability of such models in relation to dimensions, weight, power or working capacity, is then particularly necessary not only to support decisions at the different applied management levels (farmer, stakeholder, policy makers), but also to study the impact of farm machine on the environment and in general to understand trends in agricultural mechanization.

The present research is aimed at identifying the most relevant parameters (including working width, overall dimensions, weight and power) for different groups of agricultural machines, modelled and characterized through the application of linear and multiple linear regression analyses. The study is defined on the basis of a database populated on purpose with more than 5500 agricultural machines models (30 machine groups) available in the market. Extracted equations give evidence of high correlations (R^2>0.75) in particular between costs, weights and needed power, supporting the possibility of analyses on mechanization trends, from both economical, management and environmental point of view.

Keywords*:* functional parameter; operation research; modelling; linear programming; fleet management

CODE: 015

Potential reference topic and AIIA section:

- *Mechanization and technologies for agricultural production*
- *Machines and facilities for agricultural products and food processing*

AIIA section: 3rd

Proposal: Oral

10.14 N-TRE: A MODEL FOR THE EVALUATION OF THE NARROW TRACTORS REAL EFFICIENCY

Lavinia Galli[1], Davide Facchinetti[1], Domenico Pessina[1]

[1]Department of Agricultural and Environmental Sciences, Università degli Studi di Milano - Via Celoria 2, 20133 Milan, Italy.

Presenting author: domenico.pessina@unimi.it*; 02 503 16876*

Abstract

The efficiency of the so called "narrow tractors" is affected not only by their engine and transmission design evolution, but also by the usage modes adopted. In fact, especially in vineyards and orchards, many tasks do not require high engine power and traction pull, but only a remarkable oil flow, because many implements are hydraulically driven.

The present work is aimed to create a model (also customizable) to evaluate the Narrow Tractor Real Efficiency (N-TRE), taking into account also different scenarios, in terms of time and intensity usage. In a first attempt, the running conditions and the power requirement of the main tasks carried out in viticulture were considered, simulated in a stationary mode by means of an electromagnetic dynamometer, integrated with a device for measuring the fuel consumption.

The basic output has been a series of engine performance curves (power, torque and specific consumption, SFC), both at full and partial loads. On these curves some characteristic operating points were identified, simulating the typical tractor running conditions when working in vineyard. Finally, based on the typical working capacity of each task, the average annual working time was assigned, considering a medium-sized wine farm (10 ha).

Being inversely related to the SFC, the average tractor efficiency was then calculated starting from the single SFCs, weighed with the time duration of each task.

This procedure was applied in identical mode at two narrow tractor models of similar engine power, but different pollutant gas emission level (Stage II and III B), and for 3 scenarios related to intensity and duration usage.

The more recent tractor (Stage III B) saved approx 13% of fuel than the older; on the other hand, its reduction of SFC was 12.7, 8.98 and 8.12 % respectively for the light, medium and heavy scenarios. As expected, the most striking advantage was obtained with regard to pollutant emissions: considering the medium scenario, a reduction of 93.4 and 57.1% of the two most impacting components produced by the diesel engine (i.e. particulate and nitrogen oxides respectively) was recorded.

CODE: 064

AIIA SECTION: 3a – MECHANIZATION AND TECHNOLOGIES FOR AGRICULTURAL, ANIMAL, FORESTRY PRODUCTION AND FOR GREEN SPACES.

ABSTRACT PROPOSED FOR ORAL PRESENTATION

PRESENTING AUTHOR: Paolo Marucco, DiSAFA, University of Turin (UNITO), Largo Paolo Braccini, 2, 10095 Grugliasco (TO), Italy. Tel.: +39.011.6708610 E-mail: paolo.marucco@unito.it

10.15 OPTIMA H2020 AND LIFE-PERFECT PROJECTS: DEVELOPMENT AND APPLICATION OF NEW TECHNIQUES FOR SUSTAINABLE PPP SPRAY APPLICATION.

P. MARUCCO, M. GRELLA, F. GIOELLI & P. BALSARI.

Department of Agricultural, Forest and Food Sciences (DiSAFA), University of Turin (UNITO), Largo Paolo Braccini, 2, 10095 Grugliasco (TO), Italy.

In 2018 two European projects dealing with the optimisation of spray application techniques and involving DiSAFA started. The H2020 OPTIMA Project (OPTimised Integrated Pest Management for precise detection and control of plant diseases in perennial crops and open-field vegetables) is aimed at defining an environmentally friendly IPM framework for Alternaria leaf blight in carrots, downy mildew in vineyards, and apple scab in orchards, by providing a holistic integrated approach which includes major elements related to integrated disease management, such as i) the use of novel bio-PPPs, ii) disease prediction models, iii) spectral disease detection systems, and iv) precision spraying techniques. The overall goal is to integrate those elements and develop 3 prototype smart sprayers in collaboration with 2 sprayer manufacturers (CAFFINI for carrots and vineyards, and FEDE for apple orchards). The developed sprayers will be evaluated in commercial fields in France (carrots), Italy (vineyards), and Spain (apple orchards).

The objective of LIFE PERFECT Project (Pesticide Reduction using Friendly and Environmentally Controlled Technologies) is to demonstrate the reduction of the contamination of pesticides and their metabolites in the air and consequently in the soil as well as in the bystander body using the Optimal Volume Rate Adjustment tools (OVRA) and spray drift reducing tools (SDRT) which will lead to decrease the pesticide risk for fauna, flora and humans. Experimental tests will be carried out in Italy in vineyards and in Spain in citrus orchards with the aim to measure the reduction of PPP environmental contamination adopting OVRA and SDRT tools with respect to the reference conventional spray application techniques. A detailed presentation of the projects and of the first results achieved will be made at the Conference.

CODE: 067

Reference topic: Mechanization and technologies for agricultural production

10.16 PERFORMANCE COMPARISON OF A PLOUGH EQUIPPED WITH WORN AND NEW PLOUGHSHARES

M. Varani*, M. Mattetti, G. Molari

Department of Agricultural and Food Sciences – Bologna University, viale G. Fanin, 50, 40127, Italy *Corresponding and Presenting Author:Massimiliano Varani, DISTAL, University of Bologna, via G. Fanin 50 - 40127 Bologna, Italy,

tel. +39 051 2096189, fax +39 051 2096178, email: massimiliano.varani@unibo.it

ABSTRACT FOR ORAL PRESENTATION

The development of agricultural machines with high durability is one of the manufacturers main purpose. In fact, the achievement of this goal leads to customer satisfaction due to lower machine inactivity and call-backs. Regarding tillage machines, soil engaging tools are the components more subjected to durability problems since those are subjected to severe wear. There are several wear modes on tillage tools, but the predominant cause of material loss is due to the abrasive action of soil particles. This phenomenon should be minimized since it impairs the tool specifications and affects tractor performances, tillage quality and machine maintenance costs. Regarding the plough, its body edges are extremely subjected to wear phenomena due to the fact that those are the most active regions during the tillage process. The purpose of this work is to investigate how the shapes of worn ploughshares of a semi-mounted plough influences the tractor performances and the tillage quality. Previous studies already investigated on the relationship between the tool cutting edge shape and the developed drought by means of experiments and Finite Elements Modelling, but it was never measured how it influence tractor performances and tillage quality during real field operations. The methodology adopted in this study consists in a comparison of the tractor performances between its configuration with a plough equipped with worn ploughshares and the configuration with the same plough with new ploughshares. Both configurations were tested in the same working condition (field, weather, working depth, etc…) with different tractor speeds, and every configuration was repeated 3 times. The tractor speed was measured with a GPS receiver, while load sensing pins were installed on the three point hitch in order to measure the drought. Other important tractor parameters such as engine power, slip percentage and fuel consumption were acquired through a CAN logger. The tillage quality was evaluated with the standard test method for sieve analysis (ASTM C136).

CODE: 151

Reference topic: *Mechanization and technologies for agricultural production*

AIIA section: *nr. 3 - Meccanizzazione e tecnologie per le produzioni agricole / Mechanization and technologies for agricultural production*

Authors' proposal ***ORAL PRESENTATION***

10.17 PROPOSAL OF A MIXED EXPERIMENTAL-NUMERICAL APPROACH TO EVALUATE THE EFFECTS OF DIESEL-BIODIESEL-BIOETHANOL BLENDS FOR FUELLING FARM TRACTORS

Marco Bietresato[1], Carlo Caligiuri[1], Anna Bolla[1], Massimiliano Renzi[1], Fabrizio Mazzetto[1]

[1] *Libera Università di Bolzano, Facoltà di Scienze e Tecnologie, piazza Università 5, Bolzano, I-39100, Italy*

Corresponding author: Marco Bietresato; marco.bietresato@unibz.it; ph.: +39 0471 01 71 81; fax: +39 0471 01 70 09

Biofuels have always been of a certain interest in the technical-motor field, due to the beneficial effects they can produce when used to fuel internal combustion engines. Liquid biofuels such as biodiesel and bioethanol are being studied in particular applied to Diesel engines, widely used in heavy-duty applications and, therefore, also in agriculture. In this last field, moreover, the interest is even greater, thanks to the possibility to create interesting supply-chain economies and reduce the energy demands of the sector by proposing a partial self-sufficiency.

However, the effects of the many biofuels on the performance and environmental impact of a machine can be different and, sometimes, even antithetical. Hence, the maximisation of biofuels properties requires necessarily the search for a trade-off in their use, e.g. by mixing them in appropriate percentages. A chemical-analytical approach to this problem, even if theoretically possible, could be extremely simplifying at the modelling level and too little generalizable due to the extreme variety of technical solutions (EGR, SCR) adopted in engines and regulations of them. For this reason, the approach to these topic has always been purely-experimental, even if the interpretation of the resulting effects is often difficult and, generally, little predictive. Therefore, we decided to apply the Response Surface Methodology, usually adopted in other areas characterized by very complex phenomena (i.e., in industrial engineering), to process the data collected during some tests at the dyno on a New Holland T4020V tractor. Through this technique we have obtained multi-parameter regression equations that can be useful to describe the tractor outputs (performance curves, pollutants) and identify the optimal fuel-blends composition. Finally, through the same technique, we have found that bioethanol should be added only to blends having a minimum of 8-12% of biodiesel to give advantages in terms of NOx concentration reduction.

Keywords: farm tractor; diesel engine; biodiesel; bioethanol; response surface method; optimization; engine performances; exhaust gases.

CODE: 139

Potential reference topic and AIIA section:

- *Mechanization and technologies for agricultural production*

AIIA section: 3rd
Proposal: Oral

10.18 TRACLAS: A COMPACT TRACTOR PROJECT TO IMPROVE THE SAFETY WHEN WORKING ON SLOPE UNDER CANOPY

Domenico Pessina[1], Davide Facchinetti[1], Simone Pascuzzi[2], Francesco Santoro[2], Pierluigi Febo[3], Santo Orlando[3], Danilo Monarca[4], Massimo Cecchini[4], Maurizio Cutini[5], Vincenzo Laurendi[6]

[1] Dipartimento di Scienze Agrarie e Ambientali (DiSAA) - Università degli Studi di Milano - Via Celoria 2, 20133 Milan, Italy.
[2] Dipartimento di Scienze Agro-Ambientali e Territoriali (DiSAAT) - Università degli Studi di Bari - Aldo Moro – Via G. Amendola 165/a, 70126 Bari, Italy
[3] Dipartimento Scienze Agrarie, Alimentari e Forestali (SAAF) - Università degli Studi di Palermo – Viale delle Scienze, 90128 Palermo, Italy
[4] Dipartimento di Scienze Agrarie e Forestali (DAFNE) - Universita' degli Studi della Tuscia – Via S. Camillo de Lellis, 01100 Viterbo, Italy
[5] CREA-ING - Consiglio per la ricerca in agricoltura e l'analisi dell'economia agraria - Via Milano 43, 27047 Treviglio (Bg), Italy
[6] INAIL - Istituto Nazionale Assicurazione Infortuni sul Lavoro - P.le Pastore 6, 00144 Roma, Italy

Presenting author: domenico.pessina@unimi.it; 02 503 16876

Tractor overturning is the first cause of serious (often fatal) accidents in agriculture; in Italy annually determines about 120-140 victims. The ROPS (Rolling Over Protective Structure), in combination with a seat belt regularly fastened, retain and protect the driver from being hit and crushed by the tractor in case of overturning.
Various types of ROPS are available at present, from simple two post roll-bar to cabs. For narrow-track tractors, used particularly in specialized crops (fruit, grapevine, vegetable and nursery gardening, greenhouse, etc.), two post roll-bar, fitted in front of the tractor and that could be tilted to allow the travelling under canopy without damaging foliage and fruits, were introduced for a long time. These roll-bars were designed to stay in vertical position (protection on), or be lowered when the vehicle has to pass in the rows or under the trees. Unfortunately, very often this type of roll-bar after being tilted, is not longer repositioned vertically, neutralizing its protective function. For eliminating this problem, INAIL (National Insurance Institute for Occupational Accidents) has funded a research project, named TRACLAS, for the designing and manufacturing of a compact tractor, that could be complementary and competitive, in terms of performance, to what is now available on the market, but that has to be equipped with a fixed ROPS.
This research is devoted to develop a prototype having a very low height (namely not exceeding 1.70 m) to be compared in terms of performance with the traditional competitors, in farms cultivating different crops (vineyard, olive, almond and hazelnut tree, etc.).
The working conditions, the technical features of the tractor running in the considered farms, as well as the canopy dimensions of the specialized crops have been already investigated. The manufacturing of the compact prototype is in progress. After its completion, it will be tested by comparing its performance with those of the tractors already running in the farms. Evaluation of ergonomic and safety conditions, stability measurements and field performance measurements will be also carried out.

CODE: 041

AIIA SECTION: 3a – MECHANIZATION AND TECHNOLOGIES FOR AGRICULTURAL, ANIMAL, FORESTRY PRODUCTION AND FOR GREEN SPACES.

ABSTRACT PROPOSED FOR ORAL PRESENTATION

PRESENTING AUTHOR: Marco Manzone, DiSAFA, University of Turin (UNITO), Largo Paolo Braccini, 2, 10095 Grugliasco (TO), Italy. Tel.: +39.011.6708610 E-mail: marco.manzone@unito.it

10.19 TECHNICAL SOLUTIONS FOR UNDER-ROW WEED CONTROL IN VINEYARDS: EFFICACY, COSTS AND ENVIRONMENTAL ASPECTS ANALYSIS.

M. MANZONE, P. MARUCCO & P. BALSARI.

Department of Agricultural, Forest and Food Sciences (DiSAFA), University of Turin (UNITO), Largo Paolo Braccini, 2, 10095 Grugliasco (TO), Italy.

In order to improve the quality and quantity of grape production, vineyards require an accurate weed control. The presence of weed is considered one of the main cause of the grape production reduction. Generally, in vineyards it is possible to distinguish two different types of weed control: inter-row and under-row. The inter-row weed control can be carried out using conventional implements coming from the agricultural sector adapting their working width to interrow distance. Differently, the under-row weed control must be performed using specific implements developed for this purpose able to remove weeds near the vine trees without damaging them. In this study, three different techniques (hoeing, chemical control, and mulching) used in vineyard's under-row weed control were compared considering their: operative and economic aspects, energy consumption and environmental impacts. Trials were performed in a vineyard located in Canelli (At), Italy, characterized by 3 different gradient slopes (<5%, 10-15%, >20%). Each technique has been tested in 3 adjacent rows per each of the 3 vineyard slopes (randomized block test). Two weed control treatments were performed (at 50 days interval) during the peak vegetation growth period (from mid-April to mid-August). Major families of weeds in the test rows were described and scored (%), and weed control efficiency was measured by comparing the weeds cover area projected to the ground vs the test area. The efficacy of weed control was expressed as % of weeds removed after each treatment. The environmental impact of the all weed control techniques was determined through CO_2 emission analysis. Results highlights that the hoeing, characterized by low operational costs and energy requirement, scored acceptable working performances. Chemical weed control achieves the best efficacy/efficiency and overall costs, but its negative environmental impact outweigh the positive results in its use. Overall, the mulching can be considered the best alternative to chemical weed control for its good performances in weed control, despite high hourly costs and energy requirement.

CODE: 068

AIIA Section 3: Mechanization and technologies for agricultural production

ORAL presentation

10.20 THE DEVELOPMENT OF A SMALL STRIPPER HEADER FOR CEREAL HARVESTING IN STEEP MOUNTAIN ENVIRONMENT

Laurin Holzner[1], Riccardo Brozzi[2], Alice Cervellieri[1], Thomas Desaler[3], Raimondo Gallo[1], Josef Gamper[4], Bernhard Geier[5], Sabrina Mayr[1], Pasqualina Sacco[2], Fabrizio Mazzetto[1]

[1]Faculty of Science and Technology of Free University of Bolzano/Bozen, Italy.
Piazza Università 5, I-39100 Bolzano, e-mail: laurin.holzner@unibz.it
[2]Fraunhofer Italia, Via A. Volta 13 A, 39100 Bolzano, Italy
[3]Neuero Italiana S.A.S, Via Montani 7, 39012 Merano, Italy
[4]Taser Alm, Schennaberg 25, 39017 Scena, Italy
[5]Geier srl, Via Prati Nuovi 13, 39020 Marlengo, Italy

In the near past cereal cultivation in South Tyrol has decreased significantly. Especially monocultures of apples are cultivated in the valleys, whereas mountain farmers mainly live on dairy. Cereal cultivation displays an alternative or supplement to livestock farming in alpine terrain. The aim of the project "Brotweg" is to revitalize the cultivation of cereals in mountain areas with up to 70% inclined slopes. Though, to offer a real alternative to livestock farming, mechanization of the cultivation is essential so that the work can be performed by a small workforce. To be able to perform properly the above tasks, the problem of having reliable and suitable machines for seeding and harvesting must be solved. Despite their devices for automatic leveling available, modern seeders and combine harvesters are not satisfactory for the extreme slopes in alpine terrains. The development of a machine for small tracked vehicles enables the harvest in the extreme slopes. With the help of a winch, the stability of the vehicle is ensured and by extending to a hybrid drive, the braking energy can be recovered via the winch. Energy efficient harvesting in steep slopes can be attained by weight savings. The application of a stripping process significantly reduces the proportion of straw to grain and thereby the total crop volume is decimated which results in a weight reduction. Furthermore, in terms of transporting weight is saved by using pneumatic conveying systems instead of screw conveyors for grain transportation into a storage container. To estimate the energy demand of a pneumatic conveying system, an experimental set-up is built. Moreover, it is tried to optimize the introduction of the crop into the air stream and its separation from it. The operation of the stripper header requires an exact tuning of the kinematic parameters. If the speed of movement and the rotational speed of the rotor do not coincide, the harvest losses exceed the permissible limits. The optimal operating parameters of the stripper, i.e. rotor height or rotor to hood clearance, are investigated by theoretical calculations. The focus hereby lies on different inclinations of the field.

CODE: 073

AIIA SECTION: 3a – MECHANIZATION AND TECHNOLOGIES FOR AGRICULTURAL, ANIMAL, FORESTRY PRODUCTION AND FOR GREEN SPACES.

ABSTRACT PROPOSED FOR ORAL PRESENTATION

PRESENTING AUTHOR: Fabrizio Gioelli, DiSAFA, University of Turin (UNITO), Largo Paolo Braccini, 2, 10095 Grugliasco (TO), Italy. Tel.: +39.011.6708844 Fax: +39.011.2368844 E-mail: fabrizio.gioelli@unito.it

10.21 THE H2020 INNOSETA PROJECT

F. Gioelli, P. Marucco, F. Nuzzo & P. Balsari

Department of Agricultural, Forest and Food Sciences (DiSAFA), University of Turin (UNITO), Largo Paolo Braccini, 2, 10095 Grugliasco (TO), Italy.

Agriculture strongly relies on Plant Protection Products (PPP) for pest management to support sustainable yield productivity. Nevertheless, PPPs have potential negative impact on the environment and human health when not appropriately applied. In the last years, a better and safer use of PPPs has become a central theme in sustainable agriculture. Thus, spraying technologies have undergone important improvement in terms of efficiency and safety, as a consequence of the latest advances in electronics, data management and safety aspects. However, a significant gap between research & industrial developments and farmers still exists. Therefore, to enhance European agriculture sustainability it is necessary to make the latest information available for relevant agriculture stakeholders including farmers, advisors, contractors and policy-makers. The main objective of the H2020 INNOSETA project is to set up an INNovative self-sustainable thematic network on Spraying Equipment, Training and Advising (INNOSETA) to close the gap between the available novel high-end crop protection solutions and European agriculture. To do so, a thorough inventory of EU-wide research results, relevant projects on the specific thematic, innovative industry products (machineries and components) and available training materials was carried out by the project partners. A total of 224 scientific and technical papers, 150 projects, 256 industry solutions and 279 training materials were found. Results were afterwards screened by the project partners by using criteria set to select concrete, technology-ready and practical innovations. At the end of the screening process 77 articles, 40 projects, 122 industry products and all training materials were selected and will serve as inputs for an ICT tool represented by an online interactive open access platform available for all stakeholders. The platform will be launched online in May 2019. At the mid-term conference the detailed results of the inventory and the platform working principle will be presented.

CODE: 003

Reference topic: Mechanization and technologies for agricultural production

AIIA section: 3°

Proposal: Oral

10.22 THE BEST ENVIRONMENTAL IMPACT ALTERNATIVE FOR SOIL TILLAGE AND SOWING: FARMER OR CONTRACTOR?

Bacenetti Jacopo[1], Facchinetti Davide[2], Lovarelli Daniela[2], Pessina Domenico[2]

[1] Department of Environmental and Policy Sciences. Università degli Studi di Milano. Via Celoria 2, 20133 Milan, Italy.

[2] Department of Agricultural and Environmental Sciences. Università degli Studi di Milano. Via Celoria 2, 20133 Milan, Italy.

Presenting author: jacopo.bacenetti@unimi.it*; 0250316869*

In the last years, the role of agro-mechanical contractors is continuously growing of importance, above all for field operations requiring high technology and specialization, hence advanced and efficient machinery. In Italy, contractors provide actually agricultural farms specialized in cereal products with over 40% of the mechanization needs, in particular for sowing (approx. 65%), spraying (75%) and harvesting (85%). Compared to farmers, contractors can more promptly amortize their investments and at the same time can help reducing also the environmental impact, due to the use of better performing machinery.

The goal of this study is to evaluate whether the preparation of the seedbed and the sowing operations carried out by contractors have a lower environmental impact than those performed by farmers. In 2018, data were collected about 20 agro-mechanical contractor companies, located in Northern Italy. Investigated information regarded technical, operating and usage machines characteristics. Both conventional and minimum tillage were taken into account, evaluating sandy, medium-textured and clayey soil textures. Regarding the farmers, no direct surveys were carried out, but a typical farm (50 ha land area, double cropping and fleet of 4 tractors) was considered as a reference. By combining such information, comparable operation sequences carried out by contractors and farmers were identified.

Thanks to the Life Cycle Assessment (LCA) approach the environmental impact of these operations was quantified. As functional unit "1 ha of worked and seeded soil" was considered. Both for contractors and farmers, the main inventory data regard fuel consumption of self-propelled machinery and consequent emission of exhaust gases; the ILCD (International reference Life Cycle Data network) characterization method was adopted, for translating inventory data into potential environmental impacts.

Results show how the impact of the seedbed preparation and sowing is generally lower when carried out by contractors. Compared to farmers, Climate Change is reduced by 24.5% for conventional tillage and 9.1% for minimum tillage. The greatest reductions in environmental impact are shown for PM production (70% and 42%, respectively for conventional and minimum tillage) and acidification (64% and 40%). These differences are mostly related to the emission reduction devices fitted on the most modern tractors (mostly used by contractors).

In conclusion, the increase in operations carried out by contractors can lead to a considerable reduction of the environmental impact deriving from agricultural mechanization.

CODE: 062

AIIA SECTION: 3a – MECHANIZATION AND TECHNOLOGIES FOR AGRICULTURAL, ANIMAL, FORESTRY PRODUCTION AND FOR GREEN SPACES.

ABSTRACT PROPOSED FOR ORAL PRESENTATION

PRESENTING AUTHOR: Marco Grella, DiSAFA, University of Turin (UNITO), Largo Paolo Braccini, 2, 10095 Grugliasco (TO), Italy. Tel.: +39.011.6708610 E-mail: marco.grella@unito.it

10.23 THE INFLUENCE OF AIR SPEED AND LIQUID FLOW RATE ON PNEUMATIC SPRAY QUALITY.

M. GRELLA[a], P. MARUCCO[a], A. MIRANDA-FUENTES[b] & P. BALSARI[a].

[a]Department of Agricultural, Forest and Food Sciences (DiSAFA), University of Turin (UNITO), Largo Paolo Braccini, 2, 10095 Grugliasco (TO), Italy.
[b]Department of Aerospace Engineering and Fluid Mechanics, Universidad de Sevilla, Ctra. de Utrera km 1, Sevilla 41013, Spain.

The efficacy of treatments in vineyards largely depends on the necessary balance between leaf coverage and spray drift containments. For these reasons, several improvements have been developed regarding hydraulic atomizing equipment in the last years. On the contrary, very few advances have been made in pesticide application equipment characterized by pneumatic atomizing, with respect to the droplet size and collateral risk of drift and spray losses, even if this type of sprayer is widely used in vineyard areas in Italy and Europe. Furthermore, even if knowledge about nozzles droplet size generation is of major importance, scarce scientific information are available on pneumatic nozzles. In this framework, the objective of the present work was to investigate the relationships between the droplet size spectra characterization parameters and the main operational parameters, namely liquid flow rate (LFR) and air speed (AS), in pneumatic nozzles. Different LFRs and ASs were combined in laboratory conditions to assess their influence on the droplet size spectra (D10, D50 and D90), homogeneity (Relative Span Factor, RSF) and driftability (V_{100}) in two different pneumatic nozzles (cannon-type and hand-type nozzles) usually mounted on the multiple-row pneumatic sprayer Cima 50 Plus 400L equipped with spray head “2 hands - 2 cannons”. All the investigated droplet size parameters resulted significantly affected by LFR and AS. The droplet V_{100} was also affected by both factors. The findings obtained can help vineyard farmers and technicians to effectively increase the efficiency and, therefore, the efficacy of the pesticide when applied with pneumatic nozzles reducing at the same time the spray drift risk by appropriately selecting the operational parameters, namely LFR and AS.

CODE: 063

AIIA SECTION: 3a – MECHANIZATION AND TECHNOLOGIES FOR AGRICULTURAL, ANIMAL, FORESTRY PRODUCTION AND FOR GREEN SPACES.

ABSTRACT PROPOSED FOR ORAL PRESENTATION

PRESENTING AUTHOR: Marco Grella, DiSAFA, University of Turin (UNITO), Largo Paolo Braccini, 2, 10095 Grugliasco (TO), Italy. Tel.: +39.011.6708610 E-mail: marco.grella@unito.it

10.24 TOWARD A METHODOLOGY TO CLASSIFY AIRBLAST SPRAYER ACCORDING TO THEIR DRIFT POTENTIAL REDUCTION PERFORMANCES.

M. GRELLA[a], P. MARUCCO[a] & P. BALSARI[a].

[a]Department of Agricultural, Forest and Food Sciences (DiSAFA), University of Turin (UNITO), Largo Paolo Braccini, 2, 10095 Grugliasco (TO), Italy.

Drift is one of the most important issues to be consider for realise a sustainable pesticide application. This study proposes and tests an alternative methodology for quantify the Drift Potential (DP) for bush/tree crop sprayers, trying to avoid the difficulties faced in conducting field trials according to the present reference standard protocol (ISO22866:2005). The new method assumes that longer droplet lingering times may enlarge the risk of spray drift generated in windy conditions. Thanks to a specific test bench device, it is possible to collect and quantify the spray fraction that remains suspended over the test bench immediately after passage of the sprayer and that can potentially be carried out of the target zone by environmental air currents, defined as "potential drift fraction". In order to minimize the variability of results due to canopies variations and environmental conditions the proposed methodology require to made the test in absence of target and in calm of wind. Contextually, a variation of original test method (absent a target) was used to investigate the possible effect of the target on the final results, placing a real vineyard target between the sprayers and the test bench. The methodologies have been tested using two vineyards sprayers: i) conventional airblast sprayer Dragone k2 500 in four configurations, deriving from the combination of two nozzle types (conventional ATR80 orange & air induction TVI8002) and two fan airflow rates (High 20,000 $m^3 \cdot h^{-1}$ & Low 11,000 $m^3\ h^{-1}$), and ii) pneumatic sprayer Cima 50 Plus 400L equipped with spray head "2 hand – 2 cannon" in two configuration, deriving from the different passage of sprayer between the rows (passages in each row using only hand nozzles type activated & every two rows using all spray head nozzles activated). By the comparison with the results obtained from a reference sprayer, following the ISO22369-1:2013 methodology for sprayers drift reduction classification, the resulting drift reduction potential (DRP), obtained from the two indirect methodologies investigated (presence or not of the target), were compared. The test bench trials confirmed the ability of the proposed methodology to discriminate the DP generated by different vineyard sprayers and their configurations tested. Furthermore, the results obtained from the two indirect methods compared, indicate that, although the vineyard target influence the total amount of liquid collected by test bench, the absence of target is negligible and irrelevant in terms of final drift reduction sprayers classification. The test bench and the proposed methodology shall therefore be considered as a possible alternative of the present standardized methodology (ISO22866:2005) for classify air blast sprayers in function of their drift reduction.

CODE: 111

AIIA SECTION: 3a – Mechanization and technologies for agricultural, animal, forestry production and for green spaces

10.25 TRACTOR-ROTARY HARROW FORCES INTERACTIONS: FIRST FIELD MEASUREMENTS

D. Ricauda Aimonino [1,*], P. Barge[1], A. Biglia[1], L. Comba[2], P. Gay[1], M. Manzone[1], M. Mattetti[3], G. Molari[3], C. Tortia[1], M. Varani[3] & P. Balsari[1]

[1]DiSAFA, Università degli Studi di Torino, Largo Paolo Braccini 2, 10095 Grugliasco (TO)
[2]DENERG, Politecnico di Torino, Corso Duca degli Abruzzi 24, 10129 Torino
[3]DiSTAL, Università degli Studi di Bologna, Viale G. Fanin 50, 40127 Bologna

ABSTRACT PROPOSED FOR ORAL PRESENTATION

PRESENTING AUTHOR: Davide Ricauda Aimonino; davide.ricauda@unito.it

Agricultural operations such as soil tillage require a high amount of energy and determine strong wear of both tractor and implements.

The rotary harrow is one of the primary implement for extensive soil tillage. In modern agriculture, farmers demand to operate at increasingly higher speed (> 1.6 m/s), with the possibility of coupling other implements to the harrow, such as seeding machines, thus involving hard operative conditions. These needs push the manufacturers to find innovative solutions and design mechanical components able to withstand high mechanical stress. In most cases manufactures use to oversize harrow mechanical parts with a consequent increase in tractors' static and dynamic loads and fuel consumptions. The study of innovative design solutions requires the knowledge of the interactions between tractor and harrow in different operating conditions in order to identify the most stressed components.

This paper report results of an experimental campaign in which the measurements of physical parameters that define the tractor-harrow interactions (e.g. traction and PTO loads), the influence of working condition (e.g. tractor speed), the fuel consumptions and engine torque were taken. The research was carried out in the context of PRIN 2015 project (Prot. 2015KTY5NW), partially financed by the Italian Ministry of University and Research.

The experimental campaign was taken in the field using a U-frame hitch coupler (ASAE S278.6), equipped with dynamometric pins interposed between the tractor and the harrow. The three-point hitch coupler recorded the intensity and the direction of forces generated by the harrow during the tractor running. The torque of the tractor drive shaft was also determined by replacing the PTO shaft with a torque meter, while the tractor speed, fuel consumption [dm^3/h] and torque engine tractor were monitored by means the tractor J1939 CAN port. Measurements were performed in a sandy soil previously ploughed, using the harrow with three different working depth (6, 10 and 15 cm), two different forward speeds (0.83 and 1.6 m/s) and two rotors angular speed (29.6 and 43 rad/s).

Results highlighted the strict correlation between working depth, forward speed, rotors angular speed and the resistance forces recorded by the hitch.

CODE: 070

Reference topic/section: **Mechanization and technologies for agricultural production**

Proposal for: **Oral presentation**

10.26 VALIDATION OF A TEST-SET FOR THE ASSESSMENT OF THE PERFORMANCE OF FRONT AXLE SUSPENSION SYSTEMS IN NARROW-TRACK TRACTORS

Maraldi Mirko [a,], Mattetti Michele [a], Molari Giovanni [a]*

[a] *Department of Agricultural and Food Sciences (DISTAL) – University of Bologna, Viale G. Fanin 50, 40127 Bologna, Italy*

[*] *Corresponding author: mirko.maraldi@unibo.it*

Abstract

Equipping tractors front axle with suspension systems is a design solution typically adopted on tractors over 100 kW of power; however, front axle suspensions have been recently introduced in narrow-track tractors as well. The reason lies with the fact that front axle suspensions can considerably improve tractor comfort and stability, and these topics are becoming of great concern for narrow-track tractors as well. However, the choice of introducing front axle suspension systems on narrow-track tractors has generated tough challenges for manufacturers: first, the lack of space for positioning the suspension is a concern; moreover, the lack of background knowledge on the response of these tractors to the introduction of a front axle suspension has forced companies to search for methods to systematically assess the performance of the suspension system.

The aim of this paper is the validation of an experimental test procedure for the assessment of the performance of front axle suspensions of narrow-track tractors. The test procedure comprises two bumps tests (parallel and asymmetric) and a braking test, designed to excite each tractor rigid mode selectively. During the tests, accelerations along three orthogonal directions and other dynamic parameters (tractor speed, pitch rate and roll rate) are measured in real-time. Aggregated data (root mean square and peak-to-peak values) are calculated and used as indexes for the comparison of different tractors and suspension systems. To validate the procedure, two tractors of the same power class (approximately 80 kW) were tested: one equipped with a conventional unsuspended front axle, and one with a front axle suspension. The suspension was composed of two hydraulic units connected to a longitudinal trailing arm and a Panhard rod.

Test results showed that a front axle suspension is effective in reducing the pitch motion (5% to 20% reduction depending on tractor speed) and the vertical acceleration (15% to 20% reduction) of narrow-track tractors. Furthermore, results showed that the suspension is ineffective in reducing the tractor roll, the roll dynamics being mostly affected by the rigid rear axle. These results are consistent with the studies reported in the literature, indicating that the procedure can successfully be applied to a systematic evaluation of the ride behaviour of tractors of the same power class having different operating setups (in terms of tyres, front axle suspension, etc.). The advantage of using this procedure is the reduction of the need for in-field tests in favour of a test-set where the variability by ground variability and by the driving manoeuvres is significantly reduced.

Keywords: front axle suspension; validation; narrow-track tractor.

11 AIIA Section 3 - Posters

POSTERS

CODE: 152

Reference topic:	*Mechanization and technologies for agricultural production*
AIIA section:	*nr. 3 - Meccanizzazione e tecnologie per le produzioni agricole / Mechanization and technologies for agricultural production*
Authors' proposal	***POSTER PRESENTATION***

11.1 AN INTEGRATED SYSTEM FOR THE REAL-TIME DETECTION AND RECORDING OF ENGINE PARAMETERS OF AGRICULTURAL MACHINES DURING DYNO TESTS: DEVELOPMENT, SET-UP AND FIRST TESTS

Marco Bietresato[1], Matteo Malavasi[1], Fabrizio Mazzetto[1]

[1] *Libera Università di Bolzano, Facoltà di Scienze e Tecnologie, piazza Università 5, Bolzano, I-39100, Italy*

Corresponding author: Marco Bietresato; marco.bietresato@unibz.it; ph.: +39 0471 01 71 81; fax: +39 0471 01 70 09

One of the crucial points in the development of an experimental-test system is coordinating the acquisitions from the many connected measuring instruments. In general, there are two ways of addressing this issue, based respectively: (i) on an ex-post synchronization of the readings previously gathered during the tests, or (ii) on a properly-said synchronization of the instruments during the experimentation.

The *first approach* can give interesting results, even if it can be computationally heavy, having the experimenter to manage files with different formats, with data coming from instruments with different sampling frequencies and, maybe, having also non-synchronized internal clocks.

The *second approach* is certainly more effective, allowing the user to have, just at the end of a test session, ready-made data for any subsequent processing phase. However, it needs a lot of work for its implementation. Indeed, it requires the set-up (or the creation) of many hardware interfaces, the writing of software and, possibly, also the implementation of a simple and reliable user interface.

Such this latter approach has been followed in the creation of the control subsystem of the integrated test-system for agricultural machines, part of the equipment of the "*Agroforestry Innovation Laboratory*" of the Free University of Bozen-Bolzano. This management subsystem, based on Labview, has a graphical user-interface able to: (1) simultaneously acquire data from a trailed PTO-dyno, a fuel-consumption meter, an exhaust-gas chemical analyser, a datalogger with different thermocouples, (2) display in real time the value of the acquired quantities, (3) plot in real time the motor-performance graphs (torque, power as a function of engine speed) and other time-dependant graphs, (4) save the acquired data in a format compatible with the most common spreadsheets. After illustrating the main features of this acquisition system, we presented also its successful application in the test of a New Holland T4020V tractor.

Keywords: mobile test-equipment; engine test; agricultural machines; trailed PTO-dyno; Labview; hardware/software interface.

CODE: 181

Topic: Mechanization and technologies for agricultural production
AIIA Section: 3
Preference: Poster

11.2 ASSESSMENT OF A BIG SQUARE BALER ABLE TO REDUCE SOIL IMPURITIES DURING BALING PROCESS. FIRST EVALUATIONS.

*Guerrieri A.S.[1], Santoro F.[2], Anifantis A.S.[2], Pascuzzi S.[2]**

[1] *Dept. of Agriculture, Forests, Nature and Energy-University of Tuscia, 01100 Viterbo, Italy*
[2] *Dept. of Agricultural and Environmental Science-University of Bari Aldo Moro, Italy;*
*Corresponding Author: simone.pascuzzi@uniba.it

Abstract
The zootechny, albeit with important changes, is still today an essential economic sector for our society. The optimization of the results in the zootechnical field depends largely on the feeding of the animals; in this regard, fodder-crops play a fundamental role in the European agricultural and economic sector. The production of dried fodder has relevance in Southern Italy; whereas silage fodder is used in Northern Italy due to the climatic-territorial characteristics. Unfortunately, the agronomic and meteorological conditions generate physical and microbiological problems in the production of fodder in Central and Southern Italy and some of the fundamental complications are: i) the high content of clostridia; ii) the presence of terricolous anaerobic bacteria; iii) the high humidity rate held inside the bales of dried fodder. The soil inside the fodder often is the vehicle of a large number of CFUs (colony forming units) of bacteria of the Clostridium genus, with consequent repercussions on the welfare of the cows as well as on the quality of the milk products.
Taking in mind the aforesaid, the purpose of this work is to evaluate the performance of a big square baler, made by the Cicoria Manufacturer (Southern Italy), whose main characteristics are high cleanliness level of dried fodder. The main constructive and working characteristics of this machine are reported, and the results obtained from first experimental investigations carried out on different types of forage are evaluated.

Keywords: big square baler, straw, hay, zootechny.

CODE: 081

AIIA 3rd Section: Mechanization and technologies for agricultural, animal, forestry production and for green spaces

Topic: Monitoring and modeling of the interactions among soil hydrological, plant and atmosphere processes, and agricultural management practices

11.3 COMPARATIVE EVALUATIONS OF CONVENTIONAL AND MULTISPECTRAL CAMERAS TO DETECT PLANT BLOOM CHARGE IN A CONTROLLED ENVIRONMENT

Petrera Stefania, Gallo Raimondo, Daglio Gabriele, Mazzetto Fabrizio

Free University of Bolzano, Piazza Università 1, Bolzano, 39100

Abstract

The digitalization and interconnection in the environmental sector are becoming of primary interest and are apply through smart and digital approaches, particularly using different sensing technologies to support monitoring activities. To apply such approaches, agricultural mechanization is studied and optimized through automation and field robot applications.

This case-study aims to find a system able to automatically provide information about the bloom charge in apple orchards. The functionality and reliability of several optical sensors is tested to find new solutions (hardware and software) to provide information, not only objectively, but also to ensure more time efficient collection and processing of data.

Optical sensors, such as conventional and multispectral cameras, were tested in an indoor laboratory in order to check performances avoiding external influences from uncontrolled environments. A shelf with different levels was used to simulate a field-canopy. The leaf wall was created through the positioning of total green-plants (leaves only) and plants with white flowers of different sizes and forms. The post-processing of images, taken with the tested sensors, was carried out with both Matlab and GIS software to automatically provide information about the number and size of flowers. The validation of the system consisted of comparing the investigated information obtained through a manual survey with those obtained through automatic computation. The firsts are the result of a manual measurement, of the surface and of the number of flowers, in the RGB image, instead, the latest are the result of a Matlab and GIS algorithm. A good correlation between the manually and automatically-obtained information was found ($r>0.85$).

These systems could allowed for descriptive maps to be created, which could be used as a reference for automatic activation of machines (sprayers), not only to be employed in thinning operations (i.e. chemical treatments or pruning), as well as terrestrial observations and the elaboration of descriptive maps in support of services such as agricultural monitoring, operational and cultural monitoring, particularly prevision of productivity in fruit orchards and land cover changes detection.

E-mail: Stefania.Petrera@unibz.it

A poster is proposed.

CODE: 057

Topic: Mechanization and technologies for agricultural production
AIIA section: Mechanization and technologies for agricultural production
Poster presentation

11.4 DESIGN AND ASSESSMENT OF A TEST RIG FOR HYDRAULIC FLUIDS

Daniele Pochi[1*], Roberto Fanigliulo[1], Renato Grilli[1], Laura Fornaciari[1], Carlo Bisaglia[2], Maurizio Cutini[2], Massimo Brambilla[2], Fulvio Palmieri[3], Giancarlo Chiatti[3]

[1]Consiglio per la ricerca in agricoltura e l'analisi dell'economia agraria (CREA), Centro di ricerca Ingegneria e Trasformazioni agroalimentari (Research Centre for Engineering and Agro-Food Processing), Via della Pascolare, 16 – 00015 Monterotondo (Rome), Italy
[1]Consiglio per la ricerca in agricoltura e l'analisi dell'economia agraria (CREA), Centro di ricerca Ingegneria e Trasformazioni agroalimentari (Research Centre for Engineering and Agro-Food Processing), Via Milano, 43 -24047 Treviglio (BG), Italy
[3] Università degli Studi Roma Tre, Dipartimento di Ingegneria, Via Vito Volterra, 62, 00146 Rome, Italy
*Corresponding author. Email: daniele.pochi@crea.gov.it

Abstract

The adoption of a new hydraulic fluid or lubricant in a productive process depends on performing tests that require complex systems and often last as long as the normal lifetime of the oil itself. Suitably compressing the duration of such tests would allow to evaluate a higher number of fluids. This is an important issue nowadays, since there is an intense activity of development of bio-based lubricants, with high biodegradability, intended to replace the conventional ones. The characteristics of these new products will have to be adequately and rapidly evaluated to identify the best ones that must be comparable to their benchmarks.

Based on this trend, CREA-IT developed a test rig for hydraulic fluids (OTR) performing heavy work cycles (150-200 h) with small oil volumes (20 dm^3), with the aim of accelerating the aging of the tested fluid with respect to what usually occurs, e.g., in agricultural tractors (average lifetime: 800-1000 h; oil volume up to 120 dm^3). The possibility to control the workload and to repeat the work cycles allows the comparative evaluation of fluids by observing their hydraulic performances and the variations on their chemical-physical characteristics. The OTR's hydraulic circuit consists of a reservoir, a low-pressure circulation pump, a main filter, a high-pressure pump, a system of solenoid valves and overpressure valves (up to 400 bar) and a heat exchanger. The high pressure pump forces the oil through the high pressure valves determining a mechanical stress (the lamination of the oil output) and a thermal stress (an instantaneous thermal leap of 50°C up to 90° C). The technical performance is continuously monitored. The OTR acceptance test was carried out on a widespread and reliable mineral fluid (assumed as a reference for future tests) in a 245 h work cycle, at 400 bar operative pressure. Oil samples were taken, at time intervals of 30 h, for laboratory measurements of significant chemical-physical parameters. The OTR maintained constant all functional parameters during the work cycle. It seems to be suitable for tests aimed at comparing different fluids.

CODE: 155

Reference topic: Mechanization and technologies for agricultural production
POSTER Session

11.5 DEVELOPMENT AND IMPLEMENTATION OF AN ULTRA-LOW VOLUME (ULV) SPRAYING EQUIPMENT INSTALLED ON A COMMERCIAL UAV

Alberto Sassu[2], Luca Ghiani[1], Antonio Pazzona[1], Filippo Gambella[1].

[1] Department of Agriculture, University of Sassari, Viale Italia 39, 07100 Sassari, Italy.
[2] Inspire s.r.l., Via XX Settembre 33/10, 16121 Genova, Italy.

Abstract. The aerial pesticide application assumes remarkable weightiness, especially in agricultural contexts, characterized by immediate interventions hardly executable through the traditional spraying techniques. The UAVs are versatile and easy to manage technology, capable to perform pesticide application on small and hardly attainable land parcels thanks to a specific crop spraying system. The opportunity to plan automatic flights allows performing an accurate application, optimize the quantity of pesticide applied and limit the contact between the operator and the toxic product. The main objective of work was to develop a small pesticide spraying system (< 1 kg weight payload), with the purpose to install it on board of commercial UAV, Phantom 4 pro DJI©, with a maximum payload of 3.0 kg and utilize the Ultra-Low Volume sprayer for manage commercial bio-pesticide sprayed by UAV on horticultural crops. The second objective was to carry out test to verify the amount of water consumption for the treatment and the time consumption of UAV's battery with different payload installed on board using different type of tank volume capacity (from 0.5 L to 1.5 L) and at last, measure the operational time of the system in field.

CODE: 022

Reference topic: Mechanization and technologies for agricultural production

AIIA section: 3a Section - Mechanization and technologies for agricultural, animal, forestry production and for green spaces

11.6 DIGITAL IMAGE METHOD TO EVALUATE THE ECOLOGICAL EFFICIENCY OF A SPECIFIC MACHINE FOR DISTRIBUTION OF PESTICIDES IN VINEYARDS OF APULIAN REGION

P. Catalano[1,*], F. Giametta[1], C. Perone[1], R. Romaniello[2], B. Bianchi[3]

[1] Department of Agriculture, Environment and Food (A.A.A.) - University of Molise Via Francesco De Sanctis, 86100 Campobasso (Italy), catalano@unimol.it

[2] Department of Science of Agriculture, Food and Environment (SAFE) - University of Foggia, Via Napoli 25, 71122 Foggia (Italy)

[3] Department of Agro-environmental and Territorial Sciences (DISAAT), University of Bari "Aldo Moro" , Via Amendola 165/A, 70126 Bari (Italy)

An image analysis procedure was developed to evaluate the performances of a specific machine for distribution of pesticides in vineyards. In particular, the environmental efficiency was evaluated of a prototype of tunnel sprayer machine, specifically designed for the distribution of pesticides in Apulian espalier vineyards. These vineyards represent a significant biological system of the national wine producing area, but there are no machines designed to meet the agronomic requirements of these crops. Before final image processing, some pre-processing operations were carried out to optimize the input image and color space conversion. The field tests were characterized by a comparison between the prototype and a standard air sprayer, so also the off-target during different distributions was assessed.

The operating agronomic and weather conditions were extremely adverse; in fact, the vegetation, deliberately, has not been standardized by pruning and it appeared very irregular on the sides of the rows, moreover the wind speed was close to the upper limit for the treated crops.

Despite the conditions in which the tests were carried out, the drift affected an area with a depth less than 4 m from the sprayed row, significantly reducing the risk of contamination of nearby crops and housing. However, a limitation of the recovering system was found since it does not allow the total containment of the off-target sprayed product; this led to a high dispersion in the ground, even if only at the row adjacent to the sprayed one. The proposed digital image method is proved suitable to carry out a comparative evaluation of the field data.

Keywords: Image analysis procedure, Tunnel sprayer prototype, Apulian vineyard, Spray deposition on the ground, Spray dispersion in atmosphere, Off-target recovering.

Proposal for Poster

CODE: 027

Reference topic and AIIA section: Mechanization and technologies for agricultural production
This abstract is proposed for Poster presentation

11.7 EFFICIENCY OF TRACTOR DRAWBAR POWER TAKING INTO ACCOUNT SOIL-TIRE SLIPPAGE

Maurizio Cutini[1], Massimo Brambilla[1], Carlo Bisaglia[1], Daniele Pochi[2], Roberto Fanigliulo[2]*

[1]CREA Consiglio per la ricerca in agricoltura e l'analisi dell'economia agraria (Research Centre for Engineering and Agro-Food Processing), Via Milano, 43 -24047 Treviglio (BG), Italy
[2]CREA Consiglio per la ricerca in agricoltura e l'analisi dell'economia agraria (Research Centre for Engineering and Agro-Food Processing), Via della Pascolare, 16 – 00015 Monterotondo (Rome), Italy
*Corresponding author. Email: maurizio.cutini@crea.gov.it

Keywords: Fuel consumption, traction, agricultural tire, dynamometer vehicle

Abstract

Drawbar work is one of the primary purposes of agricultural tractors. In particular, heavy drawbar works on cultivated soils are the most critical ones following the efficiency impairment that results from wheel slippage.
To mitigate this, some countermeasures are taken in practice like ballasting the tractor, reducing the forward speed or adapting the tires set (i.e. size, pressure). Moreover, the lack of information on tractor dynamics regarding its slippage on soil doesn't help to find optimal and more efficient solutions. In fact, the adoption of the OECD Code 2 international standard for drawbar power and fuel consumption assessment if on the one hand makes it possible to obtain comparable data and to develop algorithms on tractor dynamics and efficiency, on the other recommends to carry out such measurements on asphalt or concrete test tracks.
To investigate this aspect with specific reference to cultivated soils, the data of 100 tractors of different engine power and weight were used to obtain a regression equation as starting point to analyze the driveline efficiency, the power lost as rolling resistance and the power lost for slippage. To fit the results on soil conditions, three tractors fitted with agricultural tires of different size and with different mass and tire pressure setting were tested in field conditions to correlate drawbar force with slippage. The obtained algorithm was introduced in the previous equation to define i) the tractor efficiency during drawbar work on soil, calculated as ratio between drawbar power and PTO power, ii) the tractor setting for its optimization, iii) the correct working speed, iv) the effect of more tractive tire on efficiency and, consequently, the effect of these parameters on fuel consumption.
This research defines a method, that could be used for different tractors, settings and different soils, that makes it possible to develop a simplified algorithm, herewith presented. The results show that in case of heavy drawbar work, keeping the wheel slippage below 10% and running the tractor at low forward speeds result in higher tractor efficiency. On the other hand, in case of light drawbar work, optimum efficiency is achieved with low rolling resistance and when tractor operates at high speed.

CODE: 150

Topics: Mechanization and technologies for agricultural production
AIIA section: 3ª Sezione - Meccanizzazione e tecnologie per le produzioni agricole
proposal for Poster

11.8 REAL-TIME MEASUREMENT OF SILAGE MOISTURE CONTENT DURING LOADING OF A TMR MIXER WAGON: PRELIMINARY RESULTS

V. Perricone[1], A. Costa[1], A. Calcante[2], A. Agazzi[2], M. Lazzari[1], G. Savoini[1], M. Chiara[3], E. Sesan[4], F.M. Tangorra[1]

[1]Department of Health, Animal Science and Food Safety, University of Milan, Milano, Italy; [2]Department of Agricultural and Environmental Sciences - Production, Landscape, Agroenergy. University of Milan, Milano, Italy; [3]PTM s.r.l., Visano (BS), Italy; [4]Sgariboldi s.r.l., Codogno (LO), Italy
Corresponding author: F.M. Tangorra, Department of Health, Animal Science and Food Safety, University of Milan, Milano, Italy, francesco.tangorra@unimi.it

Dry matter (DM) intake in dairy cows is a key factor to meet nutritional requirements and optimal performance, reducing the incidence of metabolic diseases. Moisture content of silages, can undergo huge variations during storing, affecting the total daily DM consumed by the animals. The aim of the study was to develop a system, based on microwave sensor technology, to measure the silages moisture content during loading of TMR mixer wagons. A microwave moisture sensor (MMS) for bulk materials (FL-Wapp, Ludwig, Mainz, Germany) was used. The MMS was first calibrated over four different types of silages (corn, CS; high moisture corn, HMCS; barley, BS; soybean, SS) using samples collected from four different farms located in Lombardy (Northern Italy). The MMS was mounted directly behind the loading drum of the conveyor arm of a horizontal self-propelled mixer wagon (Gulliver 6014, Sgariboldi srl, Codogno, Italy). A control logic was implemented to record in real-time and continuously the silages moisture content during the TMR mixer wagon loading. Field tests were carried out at the University of Milan experimental farm (Landriano, Italy) between February and March 2019. CS, HMCS, BS, and SS samples were collected from the silo face immediately before the TMR mixer wagon loading and then were assessed for moisture content in the laboratory by official methods (Reg. CE 152/2009). These values were compared with CS, HMCS, BS, and SS moisture content recorded by the MMS during the TMR mixer wagon loading. Accuracy of the MMS was determined based on mean difference (Md) and coefficient of determination (R^2) between the moisture content recorded by the sensor and that derived from the laboratory. The coefficient of variation (CV) was calculated for repeatability. The negative Md values suggested that the MMS underestimated the moisture content of all the silages used in the field tests, ranging from -3.0 % to -7.6% respectively for CS and SS. Except for SS (R^2=0.95), the MMS provided a moderately accurate silage moisture data (R^2=0.62 for CS and HCMS; R^2=0.61 for BS). The repeatability CV ranged from 2.0% and 4.0% respectively for SS and HMCS.

Acknowledgements
The research was co-funded by Regione Lombardia in the framework of POR FESR 2014-2020 (Axis I, Objective 1.b.1). Project P.L.U.S.- Precision Livestock Unifeed System (ID: 145923 CUP: E77H16001570009).

CODE: 113

Reference topic: Mechanization and technologies for agricultural production

AIIA section: n.3

Proposal: Oral presentation

11.9 SENSORIZATION OF A ROTARY HARROW FOR OPTIMIZATION OF SOIL TILLAGE OPERATION

Francesco Marinello [(1*)], Filippo Pegoraro [(2)], Luigi Sartori [(1)]

[(1)] Department of Land, Environment, Agriculture and Forestry - University of Padova, viale dell'Università 16, 35020 Legnaro (PD), Italy.

[(2)] Alpego spa, via Giovanni e Giuseppe Cenzato 9, 36045 Almisano (VI), Italy.

* Corresponding author: Luigi Sartori (luigi.sartori@unipd.it).

Abstract. Agricultural operations can have a relevant influence on environmental as well as economic sustainability. In particular, tillage practices are among the operations that mainly influence soil properties as well as energy consumption, with evident impact on farm economy and on environment. The possibility of optimizing tillage operation is thus interesting in order to allow not only improvement of soil structure and cloddiness, but also better management of residues, minimization of soil disturbance and of vertical translocation of organisms, and reduction of energetic costs.

The present paper reports on a research study carried out for the development of a power harrow equipped with sensors, which detect the working depth, the height and load on the levelling bar. Data are managed by an ECU (Electronic Control Unit) which provides a feedback signal for the optimization of the working depth and the position of the levelling bar. Field tests were carried out in order to validate the effectiveness of the approach. For the scope, specific analyses were concurrently carried out to validate the proposed solution, including fuel consumption, power absorption and soil analyses (sieving, three-dimensional roughness and permanence time in the rotary harrow chamber).

Finally, it is shown how the proposed approach can help maximization of the constancy of working depth and avoidance of excessive tillage intensity.

Keywords*:* rotary harrow; energy; soil disturbance; optimized tillage; cloddiness

CODE: 079

Reference topic: Mechanization and technologies for agricultural production. AIIA section: 3

11.10 SPRAYER INSPECTION IN SICILY ON THE BASIS OF WORKSHOP ACTIVITY

Emanuele Cerruto, Giuseppe Manetto, Domenico Longo, Rita Papa

University of Catania – Department of Agriculture, Food and Environment

Via S. Sofia 100 – 95123 Catania – Italy

Presenting author: Cerruto Emanuele, fax no.: +39 0957147605, e-mail: ecerruto@unict.it

According to the 128/2009/CE directive for the sustainable use of pesticides, all Pesticide Application Equipment (PAE) should have been inspected by the 26th November 2016 in all member States. Inspection is the means by which increase the sprayer application efficiency and mitigate the negative effects of phytosanitary treatments on the human health (workers, bystanders, and consumers) and the environment. The inspection activity in Italy received a significant boost after the Legislative Decree no. 150/2012, which incorporates the Directive 128 and the National Action Plan. In fact, the number of inspected sprayers has increased from about 12 200 in 2012 to about 39 200 in 2016, while in the same time number of authorized workshops and licensed inspectors has increased from 148 to 255 and from 398 to 653, respectively (Allochis *et al*., 2017).

In Sicily, according to the national database of authorised workshops for functional inspection and adjustment of the sprayers, operate (update at 23.02.2019) 18 workshops: 7 in the province of Agrigento, 2 in the province of Catania, 1 in the province of Palermo, 4 in the province of Ragusa, 1 in the province of Syracuse, and 3 in the province of Trapani.

In this paper the reports produced by each workshop centre during its inspection activity are analysed. This analysis allows knowing, on regional basis, not only number and types of inspected pesticide application equipment, but also the results of the inspection and how the different models of sprayer are spread in the territory and their prevalent use.

References

- Allochis D., Balsari P., Marucco P. 2017. The Italian sprayers inspection situation after the expiry of the deadline set by the National Action Plan and the Directive 2009/128/EC. 11th International AIIA Conference, July 5–8, 2017, Bari, Italy.
- European Commission. 2009. Directive 2009/128/EC of the European Parliament and of the Council of 21 October 2009 establishing a framework for Community action to achieve the sustainable use of pesticides. In: Official Journal, L 309/71, 24/11/2009.
- National database of authorised workshops for functional inspection and adjustment of the sprayers, available at http://www.laboratorio-cpt.to.it/authorized-workshops/?lang=en, accessed on 27.03.2019.

CODE: 029

11.11 UNMANNED AERIAL VEHICLES (UAVS) FOR CROP PROTECTION STAGE IN HIGH SLOPE TERRACED VINEYARD: A CASE STUDY

Marco Rimediotti[1], Valentina De Pascale[1], Riccardo Lisci[1], Stefania Lombardo[1], Paolo Marras[2], Luisa Martelloni[3], Eleonora Salvini[1], Daniele Sarri[1], Marco Vieri[1]

[1]DAGRI - Dipartimento di Scienze e Tecnologie Agrarie, Alimentari Ambientali e Forestali, Piazzale delle Cascine 15, 50144 Firenze, Italy

[2]AERMATICA3D, Via Tettamanti 1, Colverde (CO) Italy,

[3]DISAAA - Dipartimento di Scienze Agrarie, Alimentari e Agro-ambientali, Via Del Borghetto 80, 56124 Pisa, Italy

Corresponding author: Marco Vieri – marco.vieri@unifi.it

Unmanned aerial vehicles (UAVs) are increasingly used for remote monitoring of crops. Recently, the available use of UAVs in agriculture sector has been expanded by the developing of various type of implements. One emergent application is their use in the context of crop protection in complex geographic terrains that are not easily accessible by conventional technologies. A number of technologies that assist UAVs are available, e.g. real-time kinematic global navigation satellite systems (GNSS), the geographic information system, aerial photography, multisensory data fusion, real-time image processing, soil mapping, yield monitoring, and variable rate aerial spraying applications following prescription maps.

As for the last aspect, the directive 2009/128/EC (European Commission, 2009), which established a framework for Community action to achieve the sustainable use of pesticides, stated that the spraying from UAVs is allowed only in special cases (e.g., no viable alternatives, or there must be clear advantages in terms of reduced impacts on human health and environment as compared with land-based application of pesticides). However, through precision agriculture aviation technologies, a reduction in the use of pesticides is possible, while enhancing the application performance, especially in terrains hardly accessible by operators. In fact, this is one of the main problems that negatively affects the terraced viticulture in the Candia's area (Massa, Italy) and more generally in high slope scenarios.

This research investigated the sprayer performance of a commercial UAV, equipped with different types of nozzles. It also compared this new technology with the sprayers used in the farm (i.e., a knapsack sprayer and a sprayer gun).

The performances of the UAVs, knapsack sprayer and sprayer gun were evaluated in terms of working capacity (ha h^{-1}), droplet coverage (%), density (droplets cm^{-2}), and volume median diameter (DV0.5) (μm).

The results showed that the working capacity of the UAV was 2-fold that of the sprayer gun 1.6-fold that of the knapsack sprayer. Droplet coverage, density and size were variable and affected by the position of the targets (water sensitive papers) and the type of sprayer used.

POSTER

12 AIIA Section 4 - Agricultural electrification and use of energy

President

Gianfranco Pergher

University of Udine

Vice President

Ester Foppa Pedretti

University of Marche

12.1 PURPOSE

Over time, the role of agriculture in relation to energy has evolved and the company - with respect to this fundamental factor of production - is moving from being a user to being a producer. From this, the analyzes and the studies that have had as object the rationalization of the uses of the resources are moving towards themes of production of the same starting from matrix of agricultural-forestall and agro-industrial origin. The objectives of the AIIA IV Section also evolved along this directive. Born with the intent to start studies and actions to help farms in the process of electrification and optimization of energy consumption, the Section has changed its approach over time, accompanying, with research themes, the evolution of agricultural production of agro-energies and establishing a strong link between the agricultural world and cutting-edge technology. Currently the IV Section of the AIIA deals with issues in the energy sector ranging from the evaluation of the energy resources of the territory, to their production, to the evaluation of the characteristics of the matrices used and to the techniques for their exploitation.

12.2 TOPICS OF INTEREST

The skills necessary for the development of research conducted by Section Members and the corresponding areas of activity are increasingly transversal given the numerous aspects involved in the studies. Proceeding with a bottom up vision, we cite: Characterization of materials: the skills and chemical knowledge are very important, to deepen the characteristics of the materials and, if possible, to arrive at standard features that are often ill-suited to the complex heterogeneity of agricultural products. Study of energy transformations and related plants: plants and transformations concern the treatment and conversion of biomasses into thermal energy, electricity and bio-fuels for traction. Activities of interest range from motor engineering topics, to thermo-technique, to microbiological transformations. Study of energy production and transformation chains: analysis and analysis activities concern topics ranging from the production of raw materials (aspects related to classic mechanics and agricultural mechanization) to the management of residual materials, to control the emissions produced during the combustion process). Technical and economic analysis is considered with a system approach. LCA of energy products: studies are needed to objectively assess the energy-environmental sustainability of the supply chains. Study of the inclusion of supply chains in the territory: the territory is analyzed in terms of both the definition of energy density and management and organizational analysis. The topics dealt with are highly topical and the results are immediately

applicable in the production world, where they contribute to the improvement of transformations and product quality. Furthermore, the activities carried out contribute to spreading and improving the energy culture in the agricultural sector.

13 AIIA Section 4 – Oral Presentations

Oral Presentations

CODE: 095

Topic AIIA:Agricultural electrification and energy usage
Oral presentation

13.1 ANAEROBIC DIGESTION OF AGRO-INDUSTRIAL WASTES: A REVIEW ON PROCESS

S. Castellucci[1*], D. Monarca[2], M.Carlini[1], A.Mennuni[1]

[6] *DEIM, University of Tuscia, Largo Università snc, 01100 Viterbo*
[7] *DAFNE, University of Tuscia, Via San Camillo de Lellis sns, 01100 Viterbo*

[*]*Corrisponding author: sonia.castellucci@unitus.it *Oral presentatione: sonia.castellucci@unitus.it*

Nowadays energy world awareness has been influenced by new targets, to reach the environmental pollution reduction and a renewable waste management. Anaerobic digestion represents an alternative way to product methane, without using of fossil sources, in accordance with the newest WtE (Waste to Energy) applications. The biologic degradation of the organic matter in anaerobic condition produces different substances, especially two gases: methane and carbon dioxide. This process engages different microbial groups that interacts each other: hydrolitycs, acetogenic, homoagetogenic, and methanogens bacteria, which produce CO_2 and in particular methane, representing about 2/3 of the all biogas produced. The methanogens bacteria interest only the final position of the anaerobic process. Methane, that is not many soluble into the water, is in the gas phase, instead carbon dioxide is in gaseous and liquid phase.In detail anaerobic co-digestion technology is increasingly used to simultaneously treat solid and liquid organic waste to balance nutrient content, to reduce the negative effects of toxic compounds in the process, and to increase biogas yield. The aim of this study is to achieve a review of the technical performance of co-digestion plants fed with agro-industrial wastes.

The proposed review intends to take into consideration the techniques used for the management of agro-industrial waste, most produced on the Italian territory, thus providing for the most parameters used process meters that guarantee the greatest possible yield in terms of biogas. Particular attention will be paid to the possible process inhibitors present in agro-industrial waste and all the possible remedies applicable to reduce their effects in the production process

CODE: 138

Reference topic: *Agricultural electrification and energy usage*

AIIA section: *4th section: Elettrificazione agricola ed utilizzazione dell'energia*

Proposal for Oral presentation

13.2 COMPARISON OF ENVIRONMENTAL IMPACT OF TWO DIFFERENT BIOELECTRICITY CONVERSION TECHNOLOGIES BY MEANS OF LCA

Mauro Villarini[a, *], Sara Rajabi Hamedani[a], Vera Marcantonio[a], Andrea Colantoni[a], Massimo Cecchini[a], Danilo Monarca[a]

Affiliation: [a] DAFNE Department of Tuscia University, Viterbo 01100, Italy

[*]Corresponding author: via San Camillo de Lellis, 01100 Viterbo - mauro.villarini@unitus.it, Tel: +39 0761357357 ; mob. +39 3402266196

Between the energy sources biomass waste is considered more and more important and the choice of the most appropriate energy conversion process is essential. The present paper presents a study for biomass waste to two distinguished energy conversion processes and the comparison of their environmental impact. The considered processes are gasification combined with internal combustion engine for power generation and combustion combined with an ORC system with same electric power and same biomass flow as input to the conversion process.

The biomass wastes analysed are the most produced on the Italian soil, chosen for their suitable properties with the conversion processes. For the first conversion process, it is based on the sensitivity studies carry out in the paper and pay attention to the cold gas efficiency and to the LHV, it has selected the best configuration process for the best syngas composition to feed the internal combustion engine. The influence of syngas fuel properties on the engine is studied through the electrical efficiency and the cogeneration efficiency. The second energy system is based on Organic Rankine Cycle. In the past two decades, thanks to its feasibility and reliability, Organic Rankine Cylce (ORC) has received great attention. Both the mentioned systems have been investigated by means of Aspen Plus simulation and the energy produced has been considered to assess their impact. This study evaluates the environmental profile of the two biomass-based energy production small-scale system. Environmental performance from cradle-to-gate was investigated by life cycle assessment (LCA) methodology. Biomass production shows high influence over all impact categories. In the syngas production process, the main impacts observed are global warming potential (GWP), acidification potential (AP) and photochemical oxidation (POFP).

CODE: 009

Reference Topic: Agricultural electrification and energy usage

AIIA Section: 4

Oral Presentation

13.3 DOES PRECISION PHOTOVOLTAIC IRRIGATION REPRESENT A SUSTAINABLE ALTERNATIVE TO TRADITIONAL SYSTEMS?

Giuseppe Todde[a], Maria Caria[a], Antonio Pazzona[a], Luigi Ledda[a], Luis Narvarte[b]

[8]Department of Agricultural Science, University of Sassari, Italy;

[9]Solar Energy Institute, Universidad Politecnica de Madrid, Spain.

Presenting Author: Giuseppe Todde, Department of Agricultural Science, University of Sassari, Viale Italia 39, 07100 Sassari, Italy, Fax 079229285, e-mail gtodde@uniss.it

Over the last decades, traditional agricultural production has been converted to intensive cultivation systems, characterized by high production yields and better product quality. Although this conversion is improving not exclusively the profitability of farms, it requires a large amount of energy input which generates resultant environmental impacts. Precision agriculture is a farming management concept which implies the use of modern technologies to know precisely what inputs are needed where, in what amount and when. The goal of precision agriculture is to optimize returns of inputs while preserving the use of natural resources and the associated environmental emissions. Likewise, the setting up of precision irrigation techniques contributed to mitigate negative issues related to climate change.

The objective of this study was to assess whether precision photovoltaic irrigation represents a sustainable alternative to traditional systems, where the energy and environmental performances were firstly evaluated through energy and carbon payback times (EPBT and CPBT). The study involved five Photovoltaic Irrigation Systems (PVIS), ranging from 40 kWp to 360 kWp, installed in Spain, Portugal, Morocco and Italy in the framework of the European Union Horizon 2020 Program's MASLOWATEN Project.

The results show an average EPBT of 3.3 years and CPBT of 6.3 years, whit an energy return on investment (EROI) of 9.0. Additionally, the PVIS were able to achieve low emission rates with an average of 77.4 g CO_2e per kWh produced. The energy and environmental performance of the PVIS are closely influenced by weather conditions, irrigation requirements and water availability. Moreover, the implementation of precision PVIS in existing irrigation networks allowed to improve the irrigation practices, avoiding the exploitation of natural resources and the emissions of large amounts of GHG to the environment.

CODE: 099

Reference topic: Agricultural electrification and energy use.

AIIA section: n.2

Proposal: Oral presentation or Poster

13.4 ENERGY EFFICIENCY ASSESSMENT OF FULLY AUTOMATED DAIRY-FARM

Andrea Pezzuolo [(1)], Francesco Marinello [(1)], Luigi Sartori [(1)], Stefano Guercini [(1)]*

[(1)] *Department of Land, Environment, Agriculture and Forestry - University of Padova, viale dell'Università 16, 35020 Legnaro (PD), Italy.*

* Corresponding author: Andrea Pezzuolo (andrea.pezzuolo@unipd.it).

Abstract. The structural developments that are taking place in the livestock sector, such as enlargement of herds and land areas or reduction of family workforce, are contributing to an increasing demand for farm efficiency. The need for increased farm productivity set against a declining workforce is driving research toward a development of fully automated dairy farm. Automation in livestock farm is developed for various monitoring and control services such as herd management, milk production, environmental control and behaviour monitoring. In such applications, automated systems are used in order to collect data on physiological and health conditions of the animals. Subsequently they are made available to the farmer, providing a general overview of the condition of the herd as well as detailed actions on herd management. However, a more advanced use of automation devices that take part in the production process without a direct human-control relies on the most advanced automation application in dairy production involves the use of robots or intelligent machines that are capable of interacting with their work environment.

The present research was focused on the energy monitoring of a fully automated dairy farm, located in the Veneto region of Italy, including automatic: milking system (AMS), feeding systems (AFS), calf feeder system (ACFS), robotic scraper (ARS) and climate control by destratification fans (ADFS). The paper reports an analysis on performance indices to quantify improvements in the functionality of the automated systems, including energy consumption and man labour. Preliminary results have shown a reduction of energy consumption of at least 35% compared to conventional systems and, moreover, the energy consumption of the farm has become constant with a higher flexibility than conventional systems.

Keywords: dairy barn, automation, automatic systems, energy consumption, energy use.

CODE: 008

Oral Presentation

Topic: Computer and communication technologies; Section: 4ª Elettrificazione agricola e utilizzazione dell'energia.

13.5 LIFE CYCLE IMPACT ASSESSMENT OF CARROT CULTIVATION AND PROCESSING: AN ITALIAN CASE STUDY FOR A SMALL FAMILY COMPANY IN THE MARCHE REGION.

Ilari, A.[1], Duca, D.[1], Toscano, G.[1], Vecchiarelli, V. Foppa Pedretti, E.[1]

Department of Agricultural, Food and Environmental Sciences - Università Politecnica delle Marche Via Brecce Bianche 10, 60131 Ancona.

Alessio Ilari: a.ilari@univpm.it

The Italian agricultural system is represented for 24% about by the vegetable sector. About this the large amount in terms of production and surface is due to horticultural products accounting for 13% about. In 2017 the national carrot estimated production was 510Mt with a related surface of 11000 ha about. This means that carrot alone represents about 3% of the total horticultural production. The most important districts for cultivation in Italy are in Abruzzo, Emilia-Romagna. Sicilia, Lazio. Environmental impact assessment has been conducted throughout the LCA method (ISO 14040:2006; 14044:2006), and reference PCR (Arable crops, 2013:05 v.2.0). The software used for impact calculation is SimaPro® with updated databases.

-Goal and scope: Goal is to assess the impact of 1 kg of carrots (FU) with different packaging's solutions in order to assess the impact of different products and production stages.

-Inventory: It was carried out through information obtained from primary data provided both by the farmers and by the processing company through interviews and consultation of official documents.

-Impact assessment: It was carried out using CML_IA characterization model that includes several impact categories, among which the most important are the GW, AC, PO, EP.

-Interpretation: Data and results obtained were interpreted highlighting, the phases of greatest impact through a contribution analysis, and the impact variability due to data uncertainties through an uncertainty analysis.

The potential impact for the GW category varies between $1.2e^{-1}$ and $2.1e^{-1}$ kg CO_2 eq, for AC between $7.04e^{-4}$ and $1.06e^{-3}$ kg SO_2 eq, for OP between $2.89e^{-5}$ and $5.25e^{-5}$ kg C_2H_4 eq, for EP between $2.19e^{-4}$ and $3.05e^{-4}$ kg PO_4^{3-}. The greatest impacts are recorded for products with smaller sizes (0.5 kg trays). For larger formats the most impactful phase is field cultivation while for the smaller ones is packaging. As far as transport is concerned, the greatest impact is on the product coming from Mesola (FE) and not from Sicily, due to greater loading efficiency.

CODE: 094

Topic AIIA:Agricultural electrification and energy usage
Oral presentation

13.6 LIGNOCELLULOSIC BIOMASS : CHEMICAL AND THERMAL PRE-TREATMENT FOR ENERGETIC UTILIZATION IN ANAEROBIC DIGESTION PROCESS

M.Carlini[1**], D. Monarca[2], S.Castellucci[1*], A. Mennuni[1]

[10] *DEIM, University of Tuscia, Largo Università snc, 01100 Viterbo*
[11] *DAFNE, University of Tuscia, Via San Camillo de Lellis sns, 01100 Viterbo*

[*] *Corrisponding author: sonia.castellucci@unitus.it*
[**] *Oral presentation: maurizio.carlini@unitus.it*

Energy recovery from biomass can significantly reduce the global carbon emission and environment pollution. A number of conversion processes are available to convert biomass to energy, cuch as biological, biochemical and thermo-chemical processes.

Generally, in biomass, the three main components hemicellulose, cellulose and ligninform the cellwall with a complex and thee-dimensional structure. Therein, lignin links with hemicellulose by covalent bonding, surrounding cellulose inside.

The anaerobic digestion process should be considered as a very attractive solution to produce biogas from lignocellulosic biomass, furthermore the digestate obtained from the process is rich in lignin and therefore optimal feed for a gasification process. In case of lignocellulosic biomass this needs to be chemically and thermally treated before being directly involved into the anaerobic digestion reaction. This work aims to give a detailed analysis of biomass energy properties in terms of its use in anaerobic digestion processes, before and after targeted treatments, highlighting any improvements that should be made to the procedures by literature. Related process parameters are also investigated. The conducted experimental campaign shows how the thermal pre-treatment at low temperatures increases the volatile solids content from 57% to 74% (w/w), decreasing the ash content.

14 AIIA Section 4 - Posters

POSTERS

CODE: 020

Reference topic and AIIA section: Agricultural electrification and energy usage

This abstract is proposed for Poster presentation

14.1 DEVELOPMENT OF AN ENERGY EFFICIENCY INDEX FOR AGRICULTURAL TRACTORS BASED ON OECD CODES DATA

C.Carnevali[1], S.Angelelli[1]

1 ENAMA Ente Nazionale per la Meccanizzazione Agricola Via Venafro, 5, 00159, Roma (Italy) carlo.carnevali@enama.it silvio.angelelli@enama.it

Keywords: Fuel consumption; Tractor classification; Energy saving

The need of more energy efficiency requires the use of tractors with better energy performance. The main energy losses in agriculture tractors take place at the engine and at the transmission. A possible way to merge the farmers and the Countries goals could be the introduction of an Index to help the first to choose the best tractor for their business and to help the second to evaluate the introduction of public aid. In this research, ENAMA presents the method used for developing an energy efficiency Index (C_{APD}) taking into account the data of the tractors tested in accordance with OECD (Organization for Economic Co-operation and Development) Code 2 standard. In particular the results of the PTO (Power Take-off) and of the Fuel Consumption test have been used. The index, expressed in specific volumetric fuel consumption (SVFC), takes into account both the engine and the transmission influence and it is also easy to adapt for future developments of the research. Two-hundred twelve model of tractors are analyzed and classified in five categories; from the lowest to the highest fuel consumers following this method. Almost half of the tractors with different Power (kW) are distributed close to the regression line of the index. The accuracy of the new index has been considered, taking into account the experiences of other international classifications. By this classification method, distribution of classified tractors can be used for practical application.

CODE: 037

Reference topic and AIIA section: Agricultural electrification and energy usage

This abstract is proposed for Poster presentation

14.2 EVALUATION OF COAXIAL PIPES FOR BASAL HEATING AS ALTERNATIVE HEATING SYSTEM FOR LEAFY VEGETABLES

Fedrizzi M.[1*], Terrosi C.[2], Cacini S.[2], Burchi G.[2], Cutini M.[3], Brambilla M.[3], Bisaglia C.[3], Figorilli S.[1], Costa C.[1], Massa D.[2]

*[1] CREA Research Centre for Engineering and Agro-Food Processing, Consiglio per la ricerca in agricoltura e l'analisi dell'economia agraria (Council for Agricultural Research and Economics), Via della Pascolare, 16 00015 Monterotondo (Rome), Italy * fax +390690625591 marco.fedrizzi@crea.gov.it*

[2] CREA Research Centre for Vegetable and Ornamental Crops, Consiglio per la ricerca in agricoltura e l'analisi dell'economia agraria (Council for Agricultural Research and Economics), Via dei Fiori 8, 51017 Pescia (PT), Italy

[3] CREA Research Centre for Engineering and Agro-Food Processing, Consiglio per la ricerca in agricoltura e l'analisi dell'economia agraria (Council for Agricultural Research and Economics), Via Milano, 43 24047 Treviglio (BG) Italy

Keywords: *Ocimum basilicum,* Mediterranean greenhouse, LPG boiler, temperature, canopy, energy

Protected horticulture is a highly energy-consuming sector in which the optimization of energy use and cost for heating facilities is strategic for high environmental and economic sustainability of productions. Main aim of the work, carried out within the activities of the AGROENER project (funded by the Italian Ministry of Agriculture, MiPAAF), was to evaluate coaxial pipes, used for basal heating, as an alternative system for growing crops with reduced (small) canopies, such as leafy vegetables. during the tests, an area of a greenhouse was equipped with coaxial pipes, positioned on the cultivation substrate surface, realizing the localization of heating at plants canopy level. in comparison with this, in a separate area was installed a traditional heating systems, based on an air burner, in which the whole greenhouse volume was heated. Coaxial pipes system was connected to a LPG powered boiler, while the air heater unit burner consisted in a floor standing unit diesel fueled. With a series of dataloggers the values of soil and air temperature, air humidity and energy consumption of each group of benches were detected. a Flir infrared camera was used to detect the temperature of the plant canopy. Temperatures were maintained at 15 °C by means of thermostats: i) positioned at canopy level in the basal heating system; ii) positioned at a height of 1.00 m respect to canopy in the traditional system. The two heating systems were tested on a cultivation of basil grown in a soilless system (benches filled in with peat and perlite) during the winter 2017. Plants were transplanted in January in a plastic Mediterranean greenhouse, fed by fertirrigation, and harvested two times for plant yield evaluation. No significant difference was detected between the two systems in terms of produce yield and quality. Indeed, monitoring of temperatures by means of data loggers in both systems, confirm that coaxial pipes used for basal heating, as previously described, can guarantee constant temperature at canopy level.

CODE: 184

Reference topic and AIIA section: Agricultural electrification and energy usage

14.3 THE ERASMUS+ PROJECT PLANET: PLAN FOR AGRICULTURE RENEWABLE ENERGY TRAINING

Alessandro Sopegno[1], Patrizia Busato[1], and Remigio Berruto[1]

[1]Department of Agriculture, Forestry and Food Science, University of Torino, Grugliasco, Italy

Presenting author: Alessandro Sopegno, alessandro.sopegno@unito.it

Presentation request: Poster

The EU Skills Panorama identified RES-related skill needs in agriculture crucial. It underlines the need for improving skills on "using renewable energy". Green jobs are growing at double rate in Agriculture than other sectors, but there is indeed a lack of technical, management and legal skills needed to upkeep and maintain RES plants on a daily basis.

The partners identify these needs and are interested in providing training to fill in this gap. The PLANET consortium has long experience in RES in agriculture. The training programme will address farmers, but also agricultural advisors, and technical students employed on RES in the future.

The training will be completely modular and divided into four modules: 1) ICT skills, 2) biogas and biomethane, 3) solid biomass and 4) solar energy (both thermal and photovoltaic). It will be developed following the innovative "flipped classroom" methodology, mixing online training modules, in-class modules, and work-based learning periods, and available in 5 languages.

The training plan will last 18 weeks. Trainees will be able to choose only the modules of interest. Trainers involved in the project will also be taught how to use the platform, the in-class training material, and will have access to a trainer's toolkit.

In Italy, France, Austria and Netherlands, 10 trainers and 100 trainees will follow the first experimentation of the programme. Ten trainers from non-participating countries will participate to this experimentation and disseminate the programme in their countries.

This training will provide updated support to 1) farmers willing to invest in RES, 2) owners of RES plant to optimise its performance, 3) Advisors and Consultants, and 4) students who followed the programme and acquire ECVET accreditation, increasing their employability and mobility. PLANET will lower the risks associated with RES business in agriculture.

We are working to achieve the ECVET certification, in order to have the skills recognized in each EU country.

The training material will be available also for teaching the subject of renewable erergies for agriculture.

The training material can be seen at: www.erasmus-planet.eu upon registration.

15 AIIA Section 5 - Ergonomics and work organization

President

Domenico Pessina

University of Milano

Vice President

Massimo Cecchini

University of Tuscia

15.1 PURPOSE

The 5th Section aims on the one hand to improve the working conditions and the safety of the operators, and on the other to optimize the management of the company and its organization, through the use of tools for planning operations in the field and of logistics with a system approach. The 5th Section of the AIIA represents the national reference platform for technicians and all operators connected to these activities. It provides the latest developments in terms of tools and methodologies for work organization and logistics in the agricultural, forestry and agro-food sectors, ergonomics and operator safety, through coordination and cooperation in organizing conferences, seminars, workshops related to these issues.

15.2 TOPICS OF INTEREST

Work organization: advancement of knowledge for the optimized management of processes with the aim of improving the technical and economic sustainability of the agro-food, agro-energy and forestry sectors, including that of the public and private green sector. Logistics: optimization of transport operations and product distribution with techniques borrowed from industrial applications (Management Resource Planning, Just in Time, Lean Thinking, Simulation models, Linear programming, etc.), with the aim of improving technical sustainability -economic and the quality of the agro-food, forestry and agro-energy chains and to allow the traceability of the supply chain. Systems management: development and improvement of decision support systems for operations and logistics planning at strategic, tactical and operational level. Ergonomics: study of ergonomics as an integral part of the management of processes for agricultural, agro-industrial and forestry production, which provide for different levels of physical and mental fatigue. Safety and health of operators: improving the assessment of risks and accidents for workers in the agricultural, forestry and agro-food sectors, promoting the safety of workers and processes even within integrated quality management systems. The topics addressed in the 5th section of the AIIA help to improve production efficiency in the agricultural sector and its supply chains - labour savings, improvement of working conditions, fuel savings and input of factors deriving from the application of agriculture of precision - also through the introduction of new information and computer technologies. The improvements concern the development of adequate operations management strategies both at a tactical and an operational level to optimize the use of the new machines and to comply with the regulations and constraints that make process management more complex. A particularly important issue is supply chain logistics, which extends beyond the company boundaries to reach the end user, be it the biomass processing plant, the packaging and processing plant of the agricultural product, or retail distribution of the product. In particular, the challenges relate to the efficient and effective flow of goods, services

and information from the point of origin to the point of consumption, with the aim of satisfying stakeholders' requests. Logistics concerns important aspects such as the traceability of production and their quality, the optimization of collection and transport operations, the optimized management of zoo-technical waste, the segregation of genetically modified products, electronic commerce in agriculture and the distribution of local product . The 5th section actively collaborates in disseminating research topics both nationally and internationally, participating with its representatives in conferences organized every two years by the CIOSTA ***'Commission Internationale de l'Organisation Scientifique du Travail en Agriculture'*** which has as a purpose, the organization of work, ergonomics and worker safety.

16 AIIA Section 5 – Oral Presentations

Oral Presentations

CODE: 024

Reference topic: Ergonomics and work organization

16.1 A BOTTOM-UP APPROACH TO TRACTOR SAFETY: IMPROVING THE HANDLING OF FOLDABLE ROLL-OVER PROTECTIVE STRUCTURES (FROPS) THROUGH USER CENTRED DESIGN

Lucia Vigoroso[a], Federica Caffaro[a], Margherita Micheletti Cremasco[b] Ambra Giustetto[b], Giuseppe Paletto[a], Eugenio Cavallo[a]

[a]Institute for Agricultural and Earth Moving Machines (IMAMOTER) - National Research Council of Italy (CNR), Strada delle cacce, 73 - 10135 Torino, Italy

[b]Department of Life Sciences and Systems Biology, University of Torino, via Accademia Albertina, 13 – 10123, Torino, Italy, E-mail address of the presenting Author: l.vigoroso@ima.to.cnr.it

Tractor rollover is the main cause of fatal and non-fatal accidents in agriculture; fitting Rollover Protective Structures (ROPS) on tractors is the most effective solution to prevent deaths in case of rollover. Foldable Rollover Protective Structures (FROPS) have been developed to facilitate tractor operation in low overhead clearance zones. However, many fatalities and serious injuries in tractor rollover accidents occur when the FROPS is left by the operator in the folded-down position after passing an obstacle. Little is known about the reasons of such behavior and few solutions have been suggested to overcome this issue. In the present study an ergonomic multidimensional analysis of FROPS operation considering users' critical behaviors and perceptions in their interaction with the tractor features were assessed, to develop user-centred design solutions to improve the manual handling of FROPS. A group of farmworkers (n=21) was observed and interviewed while handling the FROPS on their own tractor, to point out critical behaviors, perceptions of effort and discomfort, and suggestions for technical improvements. A set of FROPS-related objective measurements including the forces required to operate the foldable roll-bar were also taken. The participants reported moderate levels of perceived effort, as the entity of the force required to operate the FROPS was minimized by the low handling frequency. The observations pointed out some postural criticalities affected by FROPS technical features; moreover, the participants adopted some spontaneous strategies to facilitate the handling of the roll-bar which in some cases increased the exposure to the risk of falling. Based on the present results some recommendations for technical adjustments are proposed to encourage the correct use of FROPS thus preventing fatal accidents due to tractor rollover.

Proposed as: oral presentation.

CODE: 076

Reference topic: Ergonomics and work organization *AIIA section: 5*

16.2 EFFECTS OF ROD AND OSCILLATING FREQUENCY ON THE VIBRATIONS TRANSMITTED TO HAND-ARM SYSTEM BY TWO OLIVE PORTABLE HARVESTERS

Giuseppe Manetto, Emanuele Cerruto, Rita Papa

University of Catania – Department of Agriculture, Food and Environment, Via S. Sofia 100 – 95123 Catania – Italy

Presenting author: Manetto Giuseppe, fax no.: +39 0957147605, e-mail: gmanetto@unict.it

The use of olive portable harvesters is increasing especially with the diffusion of the new lithium accumulators that have long autonomy, reduced mass, and can be carried by the same operator. In fact, all the main manufactures have introduced new models of these machines that are characterized to use carbon fibres, plastic, and aluminium in order to reduce the total mass of the harvester that is held by the hands of the operators. Furthermore, many models have a telescopic rod so to make unnecessary the use of stairs during the harvesting of the higher trees and to satisfy the market requests.

It is known that the vibrating portable harvesters cause high solicitations in charge to the hand-arm system of the operators that can produce several disorders (Chetter *et al.*, 1998; Calvo *et al.*, 2018). Overall, the solicitation level is mainly influenced by the kinematics of the harvester head, but the rod material, its geometry (length and diameter) and configuration (fixed or telescopic) also play a relevant role (Manetto e Cerruto, 2013; Catania *et al.*, 2017).

Taking into account these aspects and to evidence the influence of the rods, in this study the vibrations transmitted to the hand-arm system by two portable harvesters, having two running frequencies, were measured. The two machines were different for material of the rod (the first one in aluminium, the second one in carbon fiber) and for kinematics of the harvester head. Each harvester head was installed on rods both with fixed length and telescopic.

In order to minimize the influence of the external factors, the vibration measurements were carried out in no load conditions and with each machine always operated by the same person.

Acceleration was measured, at different times, in two points next to the hand positions and for the telescopic rods with both their maximum and minimum length.

References

- Calvo A., Romano E., Preti C., Schillaci G., Deboli R. (2018). *Upper limb disorders and hand-arm vibration risks with hand-held olive beaters*. International Journal of Industrial Ergonomics, 65, 36-45.
- Catania P., Bono F., Vallone M. (2017). *Evaluation of the vibrations transmitted to the hand-arm system in the use of portable harvesters for olives*. Agricultural Engineering International: CIGR Journal, 19(2), 129-138.
- Chetter I. C., Kent P. J., Kester R. C. (1998). *The hand arm vibration syndrome: A review.* Vascular, 6(1), 1-9.
- Manetto G., Cerruto E. (2013). *Vibration risk evaluation in hand-held harvesters for olives*. Journal of Agricultural Engineering, 44, 705-709.

CODE: 134

Topic: Ergonomics and work organization

16.3 NEW APPROACHES FOR AGRICULTURE: RATIONAL AND INNOVATIVE METHODS FOR SUSTAINABLE PRODUCTION

Stefania Lombardo[1], Daniele Sarri[1], Valentina De Pascale[1], Eleonora Salvini[1], Riccardo Lisci[1] Marco Rimediotti[1], Marco Vieri[1]

DAGRI[1] - Department of Agriculture, Food, Environment and Forestry, Piazzale delle Cascine 15, 50144 Firenze, Italy

Corresponding author: stefania.lombardo@unifi.it

The way we produce food depends on three main production factors: land, capital, and work. The food production process involves and depends on the agricultural sector from the very beginning. Moreover, farming system depends on climatic and weather conditions and that is why farmers need economical support for their production. Nevertheless, to overcome this weakness, the lean farming approach can be useful to optimize production process, gaining cost savings in terms of sustainability. Lean farming is only the tip of the spear, but is fundamental to apply it in the farming system. All the methods applied in the past for optimizing processes, as coltural calendars or CIOSTA method, are today part of the lean farming process creation. The best solution has been taken from the past added and combined with the toyotist model which will help farming to add value in the production process, from technical and technological choices to rationalization of waste for each simple step.

Due to global and local constraints on climate and waste the circular economy model must be taken into account when we look at the food production process.

In this circular model applied to agriculture, the design thinking process finds its ideal position in the design step. It is a reiterative process made by five steps (Empathize>Define>Ideate>Prototype>Test) which should be firstly applied to each production phase as the lean thinking farming approach with its 5S (1. Sort, 2. Set in order, 3. Shine, 4. Standardize, 5. Sustain). In this framework, circular economy is the referral macro system and design thinking is necessary to put into the flow the innovation part. In the end, the lean farming approach is required to support the rationalization of the production process. In conclusion, agriculture is an *a priori* circular process and the aim of applying the “lean” in farming is to simplify not the whole process (circular economy process) but to “lean” the single step that comprise the production process.

Keywords: Circular economy, Design thinking, Lean Farming, Work Organization

CODE: 183

Reference Topic: Ergonomics and work organization

AIIA Section: 5

Oral Presentation

16.4 OPTIMISATION OF MANPOWER UTILISATION IN A PROFESSIONAL FOOD SERVICE BY MEANS OF DISCRETE EVENT SIMULATION MODELS

Patrizia Busato[1], Alessandro Sopegno[1], and Riccardo Guidetti[2]

[1]Department of Agriculture, Forestry and Food Science, University of Torino, Grugliasco, Italy

[2]Department of Agricultural and Environmental Sciences - Production, Landscape, Agroenergy, University of Milan, Milano, Italy

Presenting author: Patrizia Busato, patrizia.busato@unito.it

Presentation request: oral

In recent years, collective catering has had to overcome various problems, rewarding in most cases the most capable companies, but leading them to lower the cost of their offer to the minimum terms.

In this sector, where the manpower represents 40-50% of the cost of the meal, it is essential to optimise the operational organisation through the efficiency of the processing flows and of the processing times of the recipes.

The objective of this study was to investigate possible reduction in staff available. To do so, the Authors used the discrete event simulation modelling as a decision support tool for the analysis of the variations of resources and processes within the organisation of the work of an industrial kitchen, in order to identify possible economies in labor force.

Thanks to the collaboration of a large company in the collective catering sector, it was possible to detect the kitchen processes on a company canteen that process 800 meals a day on site and 150 meals prepared for delocalized facilities. Currently, the staff is composed by 4 persons and the kitchen is equipped with two ovens. Both these two resources are the limiting factors in the system, because are required in many preparations.

A typical menu was followed, consisting of dishes according to the usual service of the canteen. After dividing the operations required to complete the recipes into individual actions, the data collection phase began. Once the timing data was collected, the discrete event simulation model was created using ExtendSim9® software. In the model, the number of operators and ovens used could be varied.

The staff change study has yielded interesting results. The minimum number of operators needed is 3, to complete the preparation in the established time, with a reduction of 25% of the staff available. Proceeding with up to seven operators was the quickest way to finish the preparation in just over 200 minutes, but with less than 35% of staff use, which is consequently not convenient.

In conclusion, this first trial demonstrates that the use of a simulation model is realistic and feasible in the optimisation of the chitchen processes for large company restaurants.

Is the intention of the authors to expand this research to other sizes of both commercial and collective catering services.

CODE: 040

Reference Topic: Ergonomics and work organization

AIIA Section: 5

Oral Presentation

16.5 PERFORMANCE AND USABILITY OF AUGMENTED REALITY HEAD-WEARABLE DEVICE IN LIVESTOCK FARMING OPERATIONS

Maria Caria[1], Giuseppe Todde[1], Gabriele Sara[1], Marco Piras[2], Antonio Pazzona[1]

[1]Department of Agricultural Science, University of Sassari, Italy

[2]Agris Sardegna, Agricultural Research Agency of Sardinia, Sassari, Italy

Presenting Author: Maria Caria, Department of Agricultural Science, University of Sassari, Viale Italia 39, 07100 Sassari, Italy, Fax 079229285, e-mail mariac@uniss.it

In recent years, smart glasses for augmented reality (AR) are spreading particularly in professional contexts. Many companies are developing head-wearable devices with different display types (monocular or binocular), user interface designs and features (e.g. battery life, weight, camera definition, flash memory, etc). These overall characteristics are important factors that can affect smart glasses wearing experience, leading to different acceptance levels by the users. Over the last decades, dairy farms have adopted new technologies to improve their productivity and profit. However, a gap of knowledge has been found in the scientific literature in regards to the application of augmented reality in livestock farms. Head-wearable device for AR could provide benefits to dairy farmers and animals, allowing real-time information while working. The benefits include more rapid informed decisions, potential labour savings, increase quality of life for farmers and reduce health issues through efficient and constant monitoring of each animal.

The aim of this study was to improve the knowledge on how augmented reality device interacts with the farm environment, focusing primarily on human perception and usability. Research has been conducted examining the F4 smart glasses for AR (GlassUp, Modena, Italy) during a milking operations. Sixteen participants completed the farm task, reading different types of content on AR device. The outcomes evaluations showed that smart glasses for AR can offer promising opportunities for adoption of a head-wearable device in hands-free livestock operations, assessing data consulting and information about animals.

CODE: 012

Potential reference topic and AIIA section:

- Ergonomics and work organization

16.6 SPATIAL ANALYSIS FOR DETECTING RECENT WORK ACCIDENTS IN AGRICULTURE IN ITALY

Massimo Cecchini, Ilaria Zambon, Danilo Monarca, Alvaro Marucci, Andrea Colantoni

Tuscia University, DAFNE department, San Camillo de Lellis, 01100 Viterbo, Italy; cecchini@unitus.it; ilaria.zambon@unitus.it; monarca@unitus.it; colantoni@unitus.it

Abstract: Work safety has been recently considered a growing request in multi-disciplinary research across different working sectors, e.g. in open-field activities in agriculture. Precise guidelines and policy strategies are stimulated with the aim of providing a greater safety of operators and a more premeditative awareness of the potential risks. Computing work accidents is regularly achieved using classical approaches; however, it is difficult to quantify potential accidents or fatalities due to several factors (e.g. age of operators, their training formation, but also environmental or geo-morphological characters). The paper focuses on recent work accidents (2012–2017) occurred in the Italian agricultural sector. It has classified the accidents at work according to their severity (e.g. fatal, with/without permanent disabilities) and on the way of occurrence (e.g. overturning of the tractor). An approach used was based on the spatial analysis offering numerous suggestions, such as where and when injuries occurred more, the socio-demographic profile of the involved people (e.g. gender, age, nationality) and additional agricultural practices (e.g. mechanization processes applied). Revealing inherent patterns of safe (or unsafe) working conditions at the provincial scale (NUTS level 3 as designed by EUROSTAT), results exposed that training or educational programs should be planned in specific areas with the purpose of increasing awareness to risky events in agriculture. Future scenarios can be discovered based on explicit evidences dealing with risk factors and functioning conditions at various working sites with the ending objective to launch appropriate technical, legislative and operational procedures to decrease work accidents.

CODE: 039

5th section - Ergonomics and work organization
Proposal for Oral presentation

16.7 TECHNICAL AND ECONOMIC EVALUATION OF URBAN TREES PRUNING BY CLIMBING ARBORISTS

Marcello Biocca, Pietro Gallo, Giulio Sperandio

Consiglio per la ricerca in agricoltura e l'analisi dell'economia agraria (CREA), Centro di ricerca Ingegneria e Trasformazioni agroalimentari, via della Pascolare 16 -00015, Monterotondo (Rome), Italy.
Tel: +39 0690675215; E-mail: marcello.biocca@crea.gov.it

In recent years, the techniques funded on rope-based access to the tree canopy (the so-called tree-climbing), have been spreading in Italy. These methods allow to operate on trees placed in any location, resulting extremely suitable for trees grown in urban environment. In the meantime, the potential use of the residual wood biomasses coming from maintenance of urban trees, is becoming more and more interesting. This study evaluated the productivity and costs of tree pruning procedures operated by professional climbing arborists. Overall, seven work sites were sampled with time studies. Work time was measured for every single phase from the beginning of pruning operations to the transport of the residual biomass to the collection point, using centesimal stopwatches and video recording. Total observation time amounted to 27.78 hours, during which seven trees were pruned. Based on work times and estimated biomass weight, the work productivity was then calculated. The evaluation of the operating costs of each work site was carried out by means of an analytical method, considering the fixed and the variable costs and the costs for the labor force. A Multiple Linear Regression (MLR) modelling was adopted to predict the time per tree and its cost utilizing only the data of the yards.
The work time analysis showed that the preparation of the work site and its dismantling, was a critical phase, reaching a maximum of 45% of the gross work time (average 26%). The results showed that the average gross time of the work sites was 6 h/Mg, with average productivity of 0.19 Mg/h and an average cost of 173 €/tree.
The regression analysis allowed to individuate four regressors (easily to measure) that are capable to predict the unitary time and cost. They were: (1) tree diameter of at d.b.h (m); (2) height of the tree (m); (3) distance from the tree to the residual biomass collection point (m); (4) number of operators.
This paper can contribute to optimize the operations of caring and maintaining trees in urban sites using tree-climbing methods.

17 AIIA Section 5 - Posters

POSTERS

CODE: 023

Reference topic: Ergonomics and work organization

AIIA section: 5a Section - Improve the working conditions and safety

17.1 AMBIENT AND PERSONAL NOISE EXPOSURE ASSESSMENT IN A PASTA FACTORY

B. Bianchi [1,*], U. Ayr [2], F. Giametta[3] and P. Catalano[3]

[1] Department of Agro-environmental and Territorial Sciences (DISAAT), University of Bari "Aldo Moro" , Via Amendola 165/A, 70126 Bari (Italy), biagio.bianchi@uniba.it

[2] Department of Civil Engineering Sciences and Architecture (DICAR) - Polytechnic of Bari , Via E. Orabona 4, 70125 Bari (Italy)

[3] Department of Agriculture, Environment and Food (A.A.A.) - University of Molise, Via Francesco De Sanctis, 86100 Campobasso (Italy)

The trials were carried out in a pasta factory in Bari Province (Italy). Fixed point noise measurements were carried out at the center of the three work areas, for 8 h and for different times; then these measurements were integrated over 8 h. Personal measurements, making dosimeters worn by different operators employed in the company; for these operators the level of daily noise exposure was also determined using the measurements carried out at a fixed point.

The measurements carried out at fixed sample points show that exposure times of less than 8 hours give levels similar to those obtained for 8 working hours, although almost always lower. Considering that they are close to the limits of action fixed by Directive 2003/10/EC, the choice of the time period for measuring noise levels could assume importance to obtain reliable noise levels for exposure assessment evaluation.

The highest noise levels are in the press and packaging areas: between 86.3 dB(A) and 82.7 dB(A) and no significant peak levels. Furthermore, working activity of the workers is well planned because their movements allow to avoid staying for long time in areas where their continuous noise exposure can exceed the most critical values.

Dosimeter data can be a source of concern for the workers' health and therefore for their employers who are responsible for health and safety. The reality of the situation is that operators are engaged in activities that bring them to work very close to machines; in this way they are subjected to levels of noise exposure different from that measured in fixed sample points. Therefore, the indicative of the situation in the workplace could be the phonometer data but if daily exposure levels were border-line, they would be compared with personal noise measurements.

This study has further confirmed that the risk evaluation is not an exact science; in that it does not consist only of technical and mechanical factors, but needs also to consider the many factors connected to workers' interaction with the workplace.

Keywords: Phonometer and dosimeter measures, noise risk assessment, safety procedures.

Proposal for Poster

CODE: 033

Poster

Section 5 - Ergonomics and work organisation

17.2 DESIGNING AND DEFINING GOOD PRACTICES IN THE SERVICE OF THE WORKERS' REPRESENTATIVE FOR SAFETY IN AGRICULTURE: THE PROJECT FOR A META-RLS

Andrea Colantoni*[1], Massimo Cecchini[1], Ilaria Zambon[1], Danilo Monarca[1], Filippo Gambella[2], Rosita Garzi[3]

[1]*Tuscia University, DAFNE department, San Camillo de Lellis, 01100 Viterbo, Italy; cecchini@unitus.it; ilaria.zambon@unitus.it; monarca@unitus.it; *colantoni@unitus.it*

[2]*Department of Agriculture, University of Sassari, Viale Italia, 39-07100 Sassari, Italy; gambella@uniss.it*

[3]*Dipartimento di filosofia, scienze sociali, umane e della formazione, Università degli Studi di Perugia: rosita.garzi@unipg.it*

Abstract: The professional role of the Representative for Workers' Safety (WSR) representatives an opportunity for the current debate among the firm's safety and prevention organization since workers effectively follow the measures identified to improve the working environment and its safety. The WRS must therefore have a basic knowledge of the risks that may be present in the work environment and their effects. The WSR must then be able (i) to highlight and systematize critical points, (ii) to compare with workers and other subjects that carry out prevention activities, (iii) being aware of the main reference laws and bodies. Within this background, agriculture is a poorly studied sector in Italy, where there are still many critical issues and points of uncertainty. However, in 2008, 121 fatal accidents occurred in the agricultural sector, recording a peak of incidents and placing it in the second position after the sector of construction. The present work aims to pursue an innovative training concept that serves as a "best practice" for the creation of a Mentor in Agriculture (META-RLS as defined in our project), which he is a representative of workers for safety in agriculture, since he is an effective and performing mentor in communication and awareness raising to the culture of safety and corporate well-being. The present project has the aim of pursuing the following objectives: (i) to contribute to the growth and awareness of the 'culture' of safety in the agricultural sector, understood as the protection of the individual and of the environment. the environment; (ii) to better define the professional profile of the WSR, with job didactic methodologies by promoting an innovative training path as an added value; (iii) to develop a national network consisting of universities, firms, bilateral bodies, trade unions, associations of category, agricultural enterprises, European partners and networks; and (iv) to distribute and share good practices in the agricultural field for WRS. The working methodological approaches are based on both quantitative and qualitative research techniques and methods. Starting from the main objectives, further specific objectives should be identified and defined related to the improvement of the communicative and behavioral effectiveness of WSR, using methods and tools of 'shared planning' and 'collaborative learning'.

CODE: 143

- *Topic: Mechanization and technologies for agricultural production*
- *AIIA Section: 5*

17.3 EFFECT OF DIFFERENT AXIAL FANS CONFIGURATIONS ON AIRFLOW RATE

Sabina Failla[1], Elio Romano[2], Carlo Bisaglia[2], Domenico Longo[1], Giampaolo Schillaci[1]

[1] Department of Agricoltura, Alimentazione e Ambiente (Di3A), University of Catania, Via S. Sofia 100, 95123 Catania, Italy. E-mail: sfailla@unict.it
[2] CREA – Research Centre for Engineering and Agrofood Processing
Via Milano 43, 24047 Treviglio (BG).

Abstract
The distribution of plant protection products on orchards and vineyard is still a low efficiency process, that is, modest deposit on the canopy and consequent high environmental spreading. In this process, the role of fans and airflow rate is crucial and the state of the art provides for a point of several factors: i) optimize the distribution of air through an airflow rate characterized by the lowest possible vertical component ("horizontal cross-flow") and how much more uniform for each release plane of the same flow; ii) adapt the horizontal flow of the air flow to the width of canopy by adjusting the fan speed and the forward speed; iii) use appropriate nozzles to improve treatment effectiveness and reduce drift.
The general objective of the research is to contribute to a less impacting methods in tree crops, optimizing the air flows in relation to the canopy characteristics and reducing the risks of drift that involve an impact on the environment of not negligible entity.
The aim of the work is to assess the airflow rate of different axial fan configurations in order to adjust the fan speed and direction, reducing energy consumptions.
Axial fans of different diameters, number and shape of the blades, as well as different configurations in terms of angle and rotation speed of the blades and air outlet section were taken into consideration. Tests were carried out at an Inspection Center for sprayers with a conventional machine where different axial fans were assembled. The manager of the Center is also a sprayer manufacturer for agriculture.
The methodology followed the International standard ISO/FDIS 9898 for the measurement of the flow rate by means a pipe connected to the suction side of the fan. A special frame was realized for measuring of flow rate at outlet side of the fan.
In order to study the correlation between fan configuration and energy consumption a mechanical torque was used to derive the power absorbed during fan working at the different configurations.

CODE: 048

Topic: Ergonomics and work organization
Proposal for Poster

17.4 FARMERS' ATTITUDES TOWARD ON FARM ADOPTION OF SOIL ORGANIC MATTER: EVIDENCE FROM PIEDMONT REGION, ITALY.

Niccolò Pampuro, Federica Caffaro and Eugenio Cavallo

Institute for Agricultural and Earth Moving Machines (IMAMOTER), Italian National Research Council (CNR)—Strada delle Cacce, 73 - 10135 Torino (TO), Italy
n.pampuro@ima.to.cnr.it*; Tel: +39-0113977715; Fax: +39-0113489218*

ABSTRACT:

Nowadays, it is well known that the productivity, quality and ecological functioning of soils are strongly connected with soil organic matter. More in detail, soil organic matter ensures nutrients accumulation, soil pH buffering capacity, soil retention of pollutants and soil structure.
Despite the known benefits related to organic matter, since the last decades of the last century, due to the excessive intensification of agricultural practice, many soils, especially in the Mediterranean regions, are characterized by a significant reduction of soil organic matter content. These areas typically present low (≤ 2%) or very low (≤ 1%) organic carbon content. The Communication "Towards a Thematic Strategy for Soil Protection", adopted by the European Parliament in April 2002, in order to increase soil organic carbon content, identified two typologies of C-rich input: crop residues and livestock wastes, such as compost and digestate.
As pointed out by previous studies, to sustainably increase the content of soil organic matter, farmers should change their soil management practices, which often rely heavily on the application of mineral fertilizers and intensive soil tillage. This is particularly relevant in Piedmont region - northwestern Italy - where the hilly soils are characterized by very low values of soil organic matter.
The present study aimed at investigating perceptions and attitudes toward the use of soil organic matter on farm in a group of agricultural operators in Piedmont. A group of farmers and farmworkers (n=46) were administered a questionnaire assessing the actual use and perceived usefulness of the adoption of soil organic matter on farm, together with economic and environmental issues related to the adoption.
The results of the study show different patterns of operators' perceptions based on farm size and farm operation. Implications for targeted territorial interventions to enhance the adoption of soil organic matter are discussed.

CODE: 044

Topic: Ergonomics and work organization

AIIA section: Innovative biosystems engineering for sustainable agriculture, forestry and food production

Poster presentation

17.5 FIRST TESTS ON A PROTOTYPE DEVICE FOR THE ACTIVE CONTROL OF THE VIBRATIONS ON AGRICULTURAL TRACTORS

D. Pochi, L. Fornaciari, R. Grilli, M. Betto, S. Benigni, R. Fanigliulo*

Consiglio per la ricerca in agricoltura e l'analisi dell'economia agraria (CREA), Centro di ricerca Ingegneria e Trasformazioni agroalimentari (Research Centre for Engineering and Agro-Food Processing), Via della Pascolare, 16 – 00015 Monterotondo (Rome), Italy

**Presenting author: roberto.fanigliulo@crea.gov.it*

Abstract

In old tractors, apart from tires, the only means for the reduction of vibration was a seat consisting of a sheet metal shell supported by a simple U-shaped spring. Today, the effects of seats, cabins, axles, suspensions and tires combine to increase comfort and safety at levels that were once unimaginable. Trying to contribute to improve the safety and comfort levels in the work-places, this work describes a first experience on the application of a vibration active control system (VAC) on a medium-power agricultural tractor. Its seat was replaced by a new seat whose suspension was integrated by an electromagnetic actuator generating counter-phase shocks (opposing to those caused by soil unevenness) on the basis of the signals received from two accelerometers measuring the vibrations at the seat and the cab platform. A further instrumentation measured the whole-body vibration, at the driver seat, providing the frequency analysis and the calculation of the weighted accelerations and the acceleration sum vector (a_v). The tests were carried out at first on a plane track with two steel bars as obstacles to overcame, then on a compacted ground circuit with a section with natural unevenness. They aimed at evaluating the effects of the AVC by comparing the whole-body vibrations measured in "ON" and "OFF" mode.

Track with obstacles – The frequency analysis showed that the higher solicitations always occur for frequency between 0.5 and 10 Hz (maximum around 5 Hz). The AVC was mostly effective on the z-axis with linear a_z of 0.91 ms^{-2} in "ON" mode against 1.81 ms^{-2} in "OFF" mode and a_v of 1.51 ms^{-2} in "ON" mode against 2.36 ms^{-2} in "OFF" mode.

Compacted ground circuit – The maximum values always occurred at 2.5 Hz. Also, in this case the reduction mostly regarded the a_z component ("ON": 0.664 ms^{-2}; "OFF": 0.945 ms^{-2}). The resultant a_v were 1.466 ms^{-2} and 1.965 ms^{-2} respectively for "ON" and "OFF". In both tests, the differences between the values of weighted accelerations were lower due to the effect of the filter "A".

The above data resulted from the acquisition along the entire established paths. Since only limited sections of the tracks were uneven, the results underestimated the actual reduction achieved on the obstacles, which becomes more evident by observing the FFT diagrams.

CODE: 080

Reference topic: Ergonomics and work organization

17.6 PERCEIVED BARRIERS TO THE ADOPTION OF SMART FARMING TECHNOLOGIES IN PIEDMONT REGION, NORTHWESTERN ITALY: THE ROLE OF USER AND FARM VARIABLES

Federica Caffaro[a], Eugenio Cavallo[a]

[a]Institute for Agricultural and Earth Moving Machines (IMAMOTER) - National Research Council of Italy (CNR), Strada delle cacce, 73 - 10135 Torino, Italy

E-mail address of the presenting author: f.caffaro@ima.to.cnr.it

Smart Farming Technologies (SFTs) can increase the sustainability of agricultural production, based on a more precise and resource-efficient approach. According to the European Union (EU) policies, the adoption of SFTs represents a key factor for the future of the European farming and a thematic network has been developed and funded by the Horizon 2020 program to identify and deliver new Smart Farming solutions to fit farmers' needs. However, previous studies pointed out a low level of SFTs adoption, often highlighting that successfully adopted technologies and innovations may be nevertheless rejected by the users, who go back to the traditional practices even where benefits were being enjoyed. A limited amount of empirical research is available on the reasons of farmers' attitudes toward the adoption of such new technologies and innovations. This study aimed at investigating the role played by sociodemographic variables, farming system characteristics, and perceived barriers in affecting the adoption of SFTs in a sample of Italian farmers. Three-hundred and ten farm operators were administered a paper-and-pencil questionnaire addressing perceived economic and commercial barriers in the use of SFTs and a set of user and farm-related variables (i.e. education, farm size, being a sole farmer). The analyses showed that education and working alone on-farm influenced the perception of economic barriers, which in turn played the major role in affecting the adoption of SFTs. Larger farms were more likely to adopt the SFTs investigated. The present results pointed out some critical aspects which may benefit from tailor-made interventions in terms of policies, work re-organization and/or operators' training, to support and widen the use of SFTs in the Italian context.

Proposed as: poster presentation.

CODE: 120

Reference topic: Ergonomics and work organization AIIA section: 5

17.7 PRELIMINARY INVESTIGATION ON SYSTEMS FOR THE PREVENTIVE DIAGNOSIS OF FAULTS ON AGRICULTURAL OPERATING MACHINES

Cecchini M., Piccioni F., Ferri S., Marcantonio V., Monarca D., Colantoni A.

Department of Agriculture and Forest Sciences, University of Tuscia, Via S.Camillo De Lellis, 01100, Viterbo (Italy), cecchini@unitus.it

The aim of the research consists in investigating on failures induced by vibrations on machines, with the focus on the agricultural ones. The research on literature has brought to light a considerable amount of data on the driving machines and not much on the operating machines, the ones that we looked for. For this reason, it was decided to direct a survey straight to the people who every day have to do with agricultural machinery: operators, subcontractors and manufacturers. They were asked about the most frequent breakage, with particular attention to the rotary harrow, the subject of study of this work.

The questionnaire results show the types of failures the harrow is most vulnerable, an indication about the times of failure and reparation, and the need to install a potentially useful preventive maintenance supporting system on these machines.

A part of the work was then focused on the proposal of a method of investigation for bearing failures in the rotary harrow, considering that these have been reported in both literature and in the survey as the most at risk components. The proposed method in this work serves as a starting point for the development of a future on board sensor-based maintenance system for continuous bearing monitoring.

Proposed for Poster

CODE: 164

Ergonomics and work organization.

17.8 RISK PERCEPTION IN FOREST UTILIZATIONS: EXPERIMENTAL ANALYSIS IN THE BASILICATA FOREST SITES.

P. D'Antonio, D. Cardinale, N. Moretti.

SAFE, University of Basilicata
paola.dantonio@unibas.it

The present legal framework for the protection of health and safety in the workplace, established by Legislative Decree 81/2008, has identified the "work-related stress" as one of the risks to assessed, according to the contents of European Agreement of 8 October 2004, and the importance of its management.
The present analysis deals with an important subject as the workplace safety, in particular the risk perception and the work-related of the operators in the agro-forestry sector.
The sampling plan was based on the delivery of structured questionnaire, administered to 378 units, of which 171 women and 207 men. The results surveyed have defined the working target through descriptive statistics and probing the individual risk areas for the work context through parametric and non parametric statistics so as to identify possible risk constellations by means of clustering analysis of the K-means iterative algorithm and to explore indicators of predictivity through the implementation of stepwise multiple regression statistics. The raw data were subjected to analysis of the main PCA components in the multivariate statistics to simplify the source data and finally applied an analysis using SEM structural equation models to analyze the existing interrelations between latent variables.
The analysis carried out shows that the accident and safety sector can not be and should not be considered only as a repressive instrument to identify specific violations or responsibilities to be punished. It must instead be considered as a tool for the further deepening to identify measures and strategies to eliminate or to minimise the risk perception and the work – related stress in the same or in a similar working environment.

CODE: 176

Topic: Mechanization and technologies for agricultural production

Type of Presentation: POSTER

17.9 THE EVALUATION OF TECHNICAL PERFORMANCES OF ORCHARD-PRUNING RESIDUE HARVESTER IN CALABRIA

S. Benalia[1], S. Papandrea[1], B. Bernardi[1], G. Zimbalatti[1], A. Leuzzi[2], R. Bonofiglio[2], F. Gallucci[3], A. Tonolo[4], L. Pari[3], A. R. Proto[1]

[1]University Mediterranea of Reggio Calabria, Department of AGRARIA, Località Feo di Vito, 89122, Reggio Calabria, Italy

[2]Azienda Regionale per lo Sviluppo dell'Agricoltura Calabrese (ARSAC), Regional Agency for the Development of Calabrian Agriculture, Viale Trieste 95, 87100, Cosenza, Italy

[3]Council for Agricultural Research and Agricultural Economy Analysis CREA IT- Via della Pascolare, 16 - 00015 Monterotondo (RM), Italy

[3]Ministry of Agricultural, Food and Forestry Policies and Tourism (MiPAAFT), Via XX Settembre, 20, 00187, Roma, Italy

Corresponding author: soraya.benalia@unirc.it

Abstract

In order to analyse technical performances, work productivity as well as economic aspects while harvesting orchard-pruning residues, several trials were performed in the experimental farms of the ARSAC (Regional Agency for the Development of Calabrian Agriculture). This study, funded by Ministry of Agricultural, Food and Forestry Policies and Tourism (MiPAAFT) to promote the correct use of agro-forestry biomass developing the local biomass supply-chain with the cooperation between different actors (FAESI Project), aims to optimize the harvesting and the correct use of pruning biomass. Different fruit crops were considered, mainly, citrus, olive and fruit orchards. Prior to harvesting operations, the operators manually windrowed the pruned biomass. Pruning residues were harvested by the chipper Peruzzo mod. COBRA Collina 1600, which was mounted on a New Holland TN95F 95 CV tractor. Data about operational working time as well as working productivity were recorded according to CIOSTA requirements. The preliminary outputs revealed satisfactory results, despite some encountered problems due windrow characteristics. Indeed, the operative time (TO) was in average 6.85 h/ha, among which 57.03 % was represented by the effective time (TE) while the remaining 42,93% included the different accessory times (TA). The chipper working capacity was of 1.77 ton/h. Further trials are still in progress in order to confirm the obtained outcomes and to assess economic performances.

CODE: 162

Topic: Ergonomics and work organization

AIIA Section: V

Proposed for: Oral or Poster presentation (no preference)

17.10 THE RISK IN FORESTRY WORKERS IN FRIULI VENEZIA GIULIA. AN OVERVIEW IN LAST 200 YEARS

Rino Gubiani, Gianfranco Pergher

Dipartimento di Scienze Agroambientali, Alimentari e Animali (D4A), Università degli Studi di Udine. Via delle Scienze 208, 33100 Udine. Fax No. 0432 558603.

email: rino.gubiani@uniud.it

Statistics on accidents in forestry are largely inadequate, making comparison and data aggregation difficult. Available data suggest that forestry-related work is among the most hazardous of all non-military activities. In fact, forest activities often take place in remote areas, on steep terrain, in areas covered with vegetation and obstacles, and where even walking can be hazardous.

The estimated rate in the United States of America of 135.9 casualties per 100 000 employees (Bureau of Labor Statistics, 2017) can be compared with about 25-30 in EU forestry, and 3-12 in the other working sectors (Gifford, 2009).

One goal of this study was to understand if such values have always been so high, if causes were the same along time, and how this was related to equipment or behavioural factors. To overcome this problem we collected three kind of statistics: ex-voto for accidents between 1800-1950, a survey in a group of forestry farms for professional workers, and newspaper articles about non-professional workers, totalling 1170 cases. The ex-voto analized (about 200 cases) were classified according to INAIL definitions. For the forestry sector we collected 100 cases with 30 casualties in the 2006-13 period, including both professional and non-professional workers. For professional workers, by using a check list created for this research, we also analyzed the risk perception in the forestal operations.

The results indicated a rate of 4.1 casualties per million m^3 timber in Italy for professionals, and 5.1 for non-professionals. Such values are higher than for other developed countries, but close to the situation in Japan were forestry condition are similar (steep ground, bad weather and so on). The rate per 100 000 workers was similar both in Italy and in the USA.

When we analyzed all cases we found that the body location was always the same and in general the wounds or contusions caused to the legs hit by falling logs or trees. Among the older accidents we found some caused by avalanche and gunshots, when forestry work was carried out in all seasons and frequently included hunting. One type of accident that remained constant in the time was slipping on the soil or falling due to forestry conditions. This problems was reduced only by increasing mechanization in forestry labor.

The results about the risk perception showed that forestry workers perceived their work as a low risk task, with the exception of the physical fatigue, that recorded a medium risk level.

Ackerknecht, C.G. 2014. Occupational accidents footprint: new concept linked to chain of custody management. Ciencia & Trabajo, 16(51): 131–136.

Garland, J.J. 2018. Accident reporting and analysis in forestry: guidance on increasing the safety of forest work. Forestry Working Paper No. 2. Rome, FAO.

18 AIIA Section 6 - Machines and plants for processing agricultural production

President

Giovanni Carlo Di Renzo

University of Basilicata

Vice President

Paolo Gay

University of Torino

18.1 PURPOSE AND TOPICS OF INTEREST

The VI section of the AIIA studies and investigates all the engineering aspects related to the transformation processes of agro-food production.

The main task of the Section is to encourage exchange of ideas among researchers and professionals interested in these topics: engineers, agronomists, food technologists.

The Section has always paid particular attention to the systems used in the sector of the so-called agricultural industries (dairy, wine and oil): the various research groups, created within the Association and developed in the various University and other research centres, they are always involved evaluating available technologies providing useful information for their optimization.

For example, studies related to the optimization of machines for processing milk and cheeses, for the extraction of extra virgin olive oil, and for the management of oenological processes can be traced back to members of this Section.

The research ranges from energy-type assessments to the design of some plant components, also through the application of forecasting models, to the optimization of the control and monitoring of the process.

In addition to the classic agricultural industries, the sector of post-harvesting of fresh fruit and vegetables has always been a subject of interest in this Section. The studies carried out concern the optimization of both the sorting and selection systems, with particular regard to non-destructive techniques, and of conservation technologies (modified atmospheres, refrigeration systems, etc.).

In recent years, interest has been particularly focused on development of technologies supporting the production in the Fourth Range (fruit and vegetable products ready for consumption) which represent one of the most interesting challenges for the entire agricultural sector.

In the last few years, finally, the evolution of the agro-food sector has expanded the Section's interests also within the whole food production system: more and more frequently researchers members of the VI Section are involved in study of problems related, for example, to transformation of meat, to the production of flour and pasta, but also to the world of catering, logistics and the problems of large-scale distribution (GDO).

The plant engineering approach has led to in-depth research aimed at evaluating machine / product / process interaction and of the potential effects related to performance in terms of working capacity, but also in terms of processing yield, product quality and by-products (also in relation to food safety), operator safety, and the sustainability of the entire production cycle.

The Section promotes the dissemination among researchers from the academic world and from the industrial sector, either seminars, to support productive realities, and, more typically, scientific conferences.

The members are active both in the Working Groups of EurAgEng (***European Society of Agricultural Engineers***) related to the themes of "food engineering" (AP06 ***Innovative technologies for dairy farming***, PM11 ***Fruit and vegetable production engineering***, etc.) and in the VI section (***Postharvest Technology and Process Engineering***) of the CIGR (***International Commission of Agricultural and Biosystem Engineering***).

19 AIIA Section 6 – Oral Presentations

Oral Presentations

CODE: 135

Topic: Machines and facilities for agricultural products and food processing
AIIA section VI

19.1 A NEW MALAXER FOR IMPROVING EXTRA VIRGIN OLIVE OIL QUALITY

Catania P.*, Febo P., Vallone M.

University of Palermo, Department of Agricultural, Food and Forest Sciences, viale delle Scienze ed. 4, 90128 Palermo, Italy.

** e-mail of corresponding author: pietro.catania@unipa.it*

Summary
In recent years many studies have been conducted on olive oil mill and processes for improving Extra Virgin Olive Oil (EVOO) quality. The malaxer is the most studied machine among all, it is responsible for malaxation, which represents a very important and critical step in the EVOO extraction process. The processing conditions allowing a selective control of the enzymes represent a crucial point of the oil mechanical extraction process, strictly related to the sensory and healthy quality of EVOO. The authors designed a new malaxer provided with a customized software for the smart management of the malaxation process to obtain high quality EVOO. The new malaxer is equipped with SCADA system that allow the management of the entire malaxation process: olive paste input and output, exposure to air time and process duration. Different programs ~~of the software~~ can be chosen according both to the variety and quality of the olives and the type of EVOO that is to be obtained in terms of volatile and phenolic components of the final product. The innovative machine has been included in a current olive mill of the in order to evaluate the quality of Cerasuola and Nocellara del Belice EVOOs. Oil samples were collected after each test, put in 100 mL dark glass bottles, stored at 12 °C and transported to the laboratory where analyses were performed. The results obtained confirm that the quality of EVOO in terms of quantity of volatile and phenolic components can be designed by intervening on some parameters during the malaxation process. This was possible with the use of the new malaxer provided with SCADA system that allowed to manage the biochemical processes that lead to the formation of volatile and phenolic components.
Keywords: olive oil mill, software, polyphenols, volatile components,

Preferred presentation: oral

CODE: 104

19.2 INDUSTRIAL DEMONSTRATION OF MEGASONICS TECHNOLOGY FOR ENHANCED OIL RECOVERY

Antonia Tamborrino[a] [a], Pablo Juliano[b], Peter Mansour[b], Roberto Romaniello[c], Pablo Canamasas[d], Piotr Swiergon[b], Kai Knoerzer[b], Claudia Guillaume[d], Leandro Ravetti[d], Alessandro Leone[c]

[a]Department of Agricultural and Environmental Science, antonia.tamborrino@uniba.it
[b]Csiro - agriculture and food
[d]Department of the Science of Agriculture, Food and Environment, University of Foggia, Via Napoli, 25, 71122, Foggia, Italy
[d]Boundary Bend - ltd

Abstract In recent years, the application of high frequency ultrasound standing waves (megasonics) on olive paste has proven to provide additional olive oil extractabilities beyond 3% both at laboratory and small olive plant scale. The technology demonstration involved a megasonic conditioning of the olive paste after malaxation to further promote coalescence effects and oil release before the decanter separation step. Previous was research carried out in 1 kg trials (100 kJ/kg, 600 kHz ultrasound) and then results were further validated with 350 kg batches (22 kJ/kg, 600 kHz ultrasound) in small industrial plants both in Australia and Italy. Findings demonstrated also an increase in the level of phenolic compounds in the olive oil, while maintaining sensory and chemical properties characteristic of extra virgin olive oil according to the Olive Oil Council standard. In recent months a megasonic vessel was developed to demonstrate the megasonic technology at a scale of 3.6 ton batches using a continuous (2.8 ton/h) process post malaxer. A 1400 L megasonic treatment system was designed for scale up trials with 9 kJ/kg (600 kHz) ultrasound energy inputs. Trials with barnea and picual varieties were tested in a single processing line with and without megasonic application, showing improvements of up to 4.4%. Other trials involved the megasonic treatments of pastes previously malaxed with enzyme and malaxation reduction trials from 90 to 60 min, also showing a positive effects of the technology in an industrial setting.

Keywords: megasonics, ultraound, extractability, yield, quality

CODE: 090

Topic: Machines and facilities for agricultural products and food processing

AIIA section: 6th

19.3 LIFE CYCLE THINKING APPLIED TO THE ANALYSES SECTOR: A CASE STUDY ON OLIVE OIL ANALYSES USING E-LCA AND LCC APPROACH

Andrea Casson*, Roberto Beghi, Valentina Giovenzana, Ilaria Fiorindo, Alessio Tugnolo, Riccardo Guidetti

Department of Agricultural and Environmental Sciences (DiSAA), Università degli Studi di Milano, via Celoria 2, 20133 Milano, Italy.

**Presenting author: Andrea Casson, Department of Agricultural and Environmental Sciences (DiSAA), Università degli Studi di Milano, via Celoria 2, 20133 Milano, Italy, andrea.casson@unimi.it*

(Proposal for Oral presentation)

Abstract

The Life Cycle Thinking (LCT) is an approach that aims to evaluate the sustainability profile of a process, a product or a service, and takes in account all the steps involved in the life cycle.

In the olive oil production chain, the activities related to the analyses of olives maturity index and of the quality parameters of the olive oils were neglected by LCT studies so far. Therefore, the aim of the work was to evaluate the sustainability of the analyses performed on olives and olive oils, comparing the chemical methods with the optical one base on visible and near infrared spectroscopy (vis/NIR).

The assessment considers the different ways to perform the analyses. The chemical one consists in a destructive approach using reagents, different devices and with high energy consumption for some steps; vis/NIR does not need any sample-preparation, reagents and requires less time.

The Environmental Life Cycle Assessment (E-LCA) was applied to evaluate the environmental sustainability. Moreover, the Life Cycle Cost (LCC) analysis was carried out to quantify the economic sustainability of the two method of analyses. The functional unit was defined as one analysis and for both the two methods a "from cradle to grave" approach was used identifying all the inputs (data, amount of resources or raw materials, devices or chemicals that enter in one process) and outputs (final materials and waste materials) of the chemical and optical analyses. The environmental profile comparison allows to identify that the vis/NIR analysis is sharply better, 38 times than the chemical one.

Regarding the LCC evaluation, the single analysis has quite the same price and the variation is due to the chemicals and analytical tools used. Even for the LCC evaluation, the optical analysis is preferable and cheaper, showing costs 60% less compared to the chemical analysis.

In conclusion, considering the E-LCA and the LCC methods, the optical analyses are more sustainable than the chemical ones. Optical analyses as vis/NIR spectroscopy can be properly defined as green technologies.

Keywords: sustainability, vis/NIR spectroscopy, olives, laboratory, LCT

CODE: 075

19.4 NON-DESTRUCTIVE CLASSIFICATION OF OLIVES BASED ON HARDNESS USING SPECTRAL PROFILES AND HYPERSPECTRAL IMAGING

Farahmand Babellahi[1], Mudassir Chaudhry[1], Maria Luisa Amodio[1], Raffaele Pezzoli[2], Claudio Quarantelli[2] Giancarlo Colelli[1]

[1]Dip.to di Scienze Agrarie, degli Alimenti e dell'Ambiente, Università di Foggia, Via Napoli 25, 71122 Foggia Italy
[2]RAYTEC VISION SpA, Via Paradigma 94/a, 43122 Parma (PR) Italy

Abstract

The potentiality of spectral profiles and hyperspectral images in the Vis-NIR (400-1000 nm) and NIR (900-1700 nm) regions was investigated for the classification of the intact olives based on hardness. Hyperspectral images for a total of 172 intact olive samples were acquired; 100 samples being in the hard class and 72 samples in the soft class. The spectral profiles of all the olive samples were extracted from the image pixels using self-developed MATLAB codes. Principle component analysis (PCA) was used for the initial exploration of the spectral data which provided a reliable discrimination of the hard and soft olives based on the first two principle components in the NIR range. For supervised classification Linear Discriminant Analysis (LDA) and Partial Least Squares Discriminant Analysis (PLSDA) was used over the wavelength range of 400-1700 nm in the Vis-NIR and NIR regions merged together. Reliable classification results were obtained without any pretreatment of the data both using LDA and PLSDA. In case of LDA the correct classification rate was found to be 98.03% with 100% classification of the hard olives in the relevant class and three samples from the soft olives were misclassified in the hard olives using only using only four variables. PLSDA model also yielded reliable classification results with a non-error rate of 100% where all the samples were followed by model simplification using different wavelength selection techniques including the variable importance in projection (VIP) and the loadings plots. The few wavelengths selected with the VIP algorithm were significantly effective in correct classification of hard and soft olives resulting in 100% classification of the olives. Moreover, Hypertools version 2.0 were used for the classification is intact olives using PLSDA; a reliable classification was achieved based on the hyperspectral image and as well as on pixel basis for the hard and soft olives. It was concluded that hyperspectral imaging specially with wavelength selection possesses significant potential for the classification of hard and soft olives.

Keywords: Classification, PLSDA, Olives, Wavelength selection, Hypertools

Preferred method of presentation: ORAL

CODE: 051

Topic: Machines and facilities for agricultural products and food processing
AIIA section VI

19.5 PNEUMATIC PRESS APPLICATION TO PROCESS POMEGRANATE FRUITS

Vallone M.*, Febo P., Catania P.

University of Palermo, Department of Agricultural, Food and Forest Sciences, viale delle Scienze ed. 4, 90128 Palermo, Italy.

** e-mail of corresponding author: mariangela.vallone@unipa.it*

Summary
Pomegranate juice consumption greatly increased in recent years due to the strong potential of its different components, polyphenols and anthocyanins among all. Commercial pomegranate juice production involves pressing the fruits. The machines used for this purpose can directly affect the quality of the obtained product and its health properties. Therefore, investigating the pressing machine types and adjustment is a new goal to preserve juice yield and improve its nutraceutical properties. The aim of this study was to assess the influence of the pressing stage, i.e. the value and duration of the applied pressure, on pomegranate juice properties. Pomegranate fruits (cv. Wonderful One) were manually harvested in November 2017 and mechanically processed to extract juice. A shelling machine was first used to process the entire fruit, similar to a destemming machine used in the wine sector, made up of a stainless steel drilled cylinder, with steel blades inside arranged in a spiral on an axial shaft. Then, a pneumatic press typically applied in grape processing was used to extract the juice from the arils. The membrane, put in a half side surface of the press, by air inflating, compresses the arils on the opposite part of the cylinder by extracting the juice. The machine was set up to make 8 pressing cycles with pressure steps gradually increasing from 0.3 to 1.8 bar and total duration of 85 minutes. Pomegranate juice samples were collected and transported to the laboratory where analyses were performed: pH, total soluble solid, titratable acidity, total phenolic content, antioxidant capacity, anthocyanins were determined in triplicates. Chromatograms of the juice volatile fraction were also obtained. The optimal pressure level to be applied to enhance the nutraceutical and aromatic properties of the juice, and also guarantee a good juice yield, was identified.

Keywords: anthocyanins, polyphenols, pomegranate juice, Wonderful One

Preferred presentation: oral

CODE: 145

Topic: Machines and facilities for agricultural products and food processing

19.6 SPECTRAL FINGERPRINTING APPROACH FOR THE PREDICTION OF INTERNAL CONSTITUENTS AND CLASSIFICATION OF ROCKET LEAVES (*DIPLOTAXIS TENUFOLIA*) BASED ON SEASON OF HARVEST

Muhammad Mudassir Arif Chaudhry[a], Maria Luisa Amodio[a], Jose Manuel Amigo Rubio[b], Leonarda Mastrandrea[a], Farahmand Babellahi[a], Giancarlo Colelli[a]

[a] *Dipartimento di Scienze Agrarie, degli Alimenti e dell'Ambiente, Università di Foggia, Via Napoli 25, 71122 Foggia, Italy*

[b] *Dept. of Food Science (KU-FOOD), Chemometrics and Analytical Technologies CAT. Faculty of Sciences, University of Copenhagen, Rolighedsvej 30, DK 1958Frederiksberg C. (Denmark)*

*Presenting Author: Muhammad M. A. Chaudhry, Università di Foggia, Via Napoli 25, 71122 Foggia, Italy, mudassir.chaudhry@unifg.it

Abstract

'Rocket' is a collective name to indicate many species of green leaves belonging to Brassicacea family and are significantly consumed in the Mediterranean countries either as stand-alone salads or mixed with other vegetables. They are well known for their pungent smell, bitter flavor and high nutritional value. The potentiality of hyperspectral imaging in the Vis-NIR and NIR ranges for the prediction of vitamin C to formulate a global model utilizing data from various seasons over a time span of two years followed by development of PLS-DA models for the classification of rocket leaves based on harvest times has been investigated. For the prediction of vitamin C content, PLSR calibration models were developed with an R^2 of calibration of 0.75 and an R^2 of cross validation of 0.69 using 516 replicates acquired over the two years in the NIR range. Moreover, for the PLSDA classification models 302 samples were used and excellent classification was achieved (non-error rate (NER) = 97.5%) for the samples from 4 different seasons over a year with a true positive rate (TPR) of 1.00, 0.97, 1.00 and 0.93 for all four classes, respectively. Furthermore, PLSDA also served as a reliable classification tool for the classification of samples from different years with a NER of 100%. It was concluded that this approach showed good potentialities of application; NIR spectra were useful in predicting the internal constituents of rocket leaves while the Vis-NIR range served better for classifying the samples based on season of harvest.

Presentation method: oral

CODE: 089

Topic: Remote Sensing in agricultural and forestry systems

AIIA section: 6th

19.7 TESTING OF OPTICAL PROTOTYPES FOR THE FRUIT AND VEGETABLE SECTOR: CASE STUDIES FROM PRE- TO POST-HARVEST

Roberto Beghi*, Valentina Giovenzana, Alessio Tugnolo, Andrea Casson, Riccardo Guidetti

Department of Agricultural and Environmental Sciences (DiSAA), Università degli Studi di Milano, via Celoria 2, 20133 Milano, Italy.

**Presenting author: Roberto Beghi, Department of Agricultural and Environmental Sciences (DiSAA), Università degli Studi di Milano, via Celoria 2, 20133 Milano, Italy, roberto.beghi@unimi.it*

(Proposal for Oral presentation)

Abstract

Monitoring the ripeness progress until the harvest is a crucial issue since fruit quality is closely related to it. Therefore, the research for non-destructive methods which could explore many samples and give a rapid and comprehensive overview of ripening would be helpful. Moreover, the evaluation of the postharvest quality, e.g. senescence of ready-to-eat vegetables, could be greatly helped by new analytical methods that are rapid and integrated into the production process to meet consumer demand.

The aim of the research was to design, build and test prototypes of miniaturised low-cost and user-friendly devices envisaged mainly to support small-scale growers both in pre-harvest and in post-harvest monitoring. The systems were tested on two case studies: (i) to monitor the ripening of wine grape until harvest and (ii) to evaluate the postharvest life of fresh-cut salad to discriminate freshness levels during the shelf life.

Pre-prototypes of fully integrated, stand-alone optical device incorporating MEMS sensors (tuned photodiode arrays, interference filters, LEDS, optics) were designed and built. Two systems equipped with digital 6-channel sensors each for spectral identification in the visible and SW-NIR. The sensors cover 12 independent on-device optical filters from 400 nm to 860 nm.

Optical analyses were collected on grape bunches and on leaves of fresh-cut salad using the two prototypes. Reference parameters (i.e. soluble solids content and titratable acidity for grape, and colour and senescence classes for fresh-cut salad) were analysed on each sample for the calculation of predictive models using MLR regression technique.

The correlation between the optical data and the parameters were explored and the results were encouraging underlining a small loss of information comparing data from the prototypes to models from more expensive commercial vis/NIR devices.

Keywords: vis/NIR spectroscopy, simplified system, MEMS, ripeness, senescence, chemometrics

CODE: 171

Topic: Machines and facilities for agricultural products and food processing
AIIA SECTION: 6
ORAL

19.8 THE EFFECTS OF MATERIALS AND ASSEMBLY METHODS ON GAS SELECTIVITY OF BLOW® DEVICE

Matera A.[1], Altieri G., Genovese F., Di Renzo G.C.

[1]School of Agriculture, Forestry, Food and Environmental Science University of Basilicata
Via dell'Ateneo Lucano 10, 85100 Potenza
attilio.matera@unibas.it

In the present paper, the effect of materials and assembly methods on gas perm-selectivity of the patented Blow® device are described. Blow® is an innovative device that allows the bidirectional gas exchange across a sealed package. The device results particularly useful for managing the partial pressures of a gaseous mixture in modified atmosphere packaging (active and passive) a for fruit and vegetables, with a high level of carbon dioxide or low level of oxygen.

The latest version of Blow® device is produced by assembling two different parts: the main body containing the microincision, and the lid, covering the upper side of the microincision. Only after the application of the lid, the Blow® device has the breathable property that makes it an innovative solution for fruit and vegetable packaging.

Preliminary tests showed that the Blow®'s material and the assembly procedure affect the gas selectivity of the device. To evaluate the weight of these variables on the breathable characteristics of the device, five different plastic materials (three traditional PP, LDPE, ABS and two bioplastics PLA and Mater-Bi) two welding system (thermal and ultrasonic) and three different levels of pressure and temperature during the welding operation were compared over the experiment.

For each material and test condition, the diffusion of oxygen and carbon dioxide was measured by its time constant, i.e. the pressure discharging time measured from 400 to 10 Pa of differential pressure across the package.

Furthermore, the suitability of the device built with different materials it has been tested by simulation on different produces.

CODE: 103

19.9 ULTRASOUND AND PULSED ELECTRIC FIELDS TECHNOLOGIES APPLIED TO THE OLIVE OIL EXTRACTION PROCESS

Roberto Romaniello[a], Antonia Tamborrino[b], Alessandro Leone[a]

[a]Department of the Science of Agriculture, Food and Environment, University of Foggia, Via Napoli, 25, 71122, Foggia, Italy, roberto.romaniello@unifg.it
[b]Department of Agricultural and Environmental Science, University of Bari Aldo Moro, Via Amendola 165/A, 70126, Bari, Italy

Abstract

Ultrasounds (US) and pulsed electric fields (PEF) have been tested in an industrial olive oil mill o condition the olive paste. Olives of cultivar Coratina were processed in comparative mode using traditional process and innovative process (involving US and PEF).

The use of US and PEF, in addition to the traditional malaxation process, determined a significant improvement of extraction yield. The experiments shown the ability of US and PEF to modify the olive paste structure, determining the consequent increase in oil releasing from cellular vacuoles. Several tests have to be performed to optimize the machines' functionality in the way to improve the whole olive oil extraction process.

Keywords: PEF, US, Olive oil, extraction yield, industrial mill, Coratina

20 AIIA Section 6 - Posters

POSTERS

CODE: 166

Topic Poster Presentation: Machines and facilities for agricultural products and food processing

20.1 AN INNOVATIVE VAT FOR THE CONTINUOUS RECOVERY OF VOLATILE COMPOUNDS DURING FERMENTATION

Giulia Angeloni*, Lorenzo Guerrini, Piernicola Masella, Agnese Spadi, Fabio Baldi, Alessandro Parenti

Dipartimento di Scienze e Tecnologie Agrarie, Alimentari Ambientali e Forestali (DAGRI), Università degli Studi di Firenze, Piazzale delle Cascine 15, 50144, Firenze, Italia
**email: giulia.angeloni@unifi.it*

During the production of fermented alcoholic beverages a part of the volatile organic compounds, that represent the aromas of the product being processed, disperse with the gaseous phase. The loss of volatile compounds has a significant impact on the overall product aroma.

The preservation of beverage aroma and the loss recovery during processing is a key issue that is becoming increasingly important in the beverages technology. This loss is mostly due to the leakage of carbon dioxide, that drag out the aromatic compounds.

To date all solutions proposed for the recovery of aromas by condensing the gases, provide for condensation systems separated from fermentation tank.

A new apparatus for fermentation of beverages, equipped internally with a system for reducing the losses of the volatile organic compounds, has been purposely designed, then tested and patented.

This apparatus comprises a container having a single inner chamber for the fermentation of liquids and for the continuous condensation of fermentation vapors, with relapse of volatile organic compounds directly in the mass under fermentation.

The condensation of the vapors is realized thanks to a refrigerant jacket at the top portion of the tank, able to cool and condense the fermentation vapors.

The system has been developed and tested by several trials performed on wine and beer fermentations. Esters, acids, terpenes, alcohols, and lactones can be recovered with a condensation device. Moreover, the recovery system stimulated the de novo synthesis of esters from carboxylic acids and alcohols.

Thus, using different temperatures, the condensation of the gasses escaping during the fermentation can be used as a tool to modulate the final aroma of the beverages.

CODE: 074

20.2 EARLY DETECTION OF CHILLING INJURY IN CUCUMBERS USING HYPERSPECTRAL IMAGING AND CHEMOMETRICS METHODS

Farahmand Babellahi[1], Maria Luisa Amodio[1], Jitendra Paliwal[2], Chyngyz Erkinbaev[2], Muhammad Mudassir Arif Chaudhry[1], Giancarlo Colelli[1]

[1] Dip.to di Scienze Agrarie, degli Alimenti e dell'Ambiente, Università di Foggia, Via Napoli 25,

71122 Foggia Italy

[2]Department of Biosystems Engineering, University of Manitoba, Canada

ABSTRACT

Cucumber (*Cucumis sativus*) is a popular vegetable around the world and low temperature is an effective way to maintain its quality during postharvest processes. As a chilling sensitive vegetable, cucumber is subject to chilling injury at temperatures below 7–10 °C. . Consequences of chilling injury in cucumbers are water-soaked areas, pitting and accelerated decay. Nowadays, implementation of non-destructive techniques for evaluation of quality in agricultural products is impressively increasing, since these techniques are fast, reliable, and comparably cheap. Despite various studies on the detection of chilling injury there is a lack of literature regarding development of non-destructive techniques and methodologies for the early detection of chilling injury particularly in cucumbers. Thus, the objective of this study is (a) development of a classification model to discriminate between fresh fruits, fruits stored at 4 ^{0}C (chilling temperature), and fruits stored at 12 ^{0}C (safe temperature) regardless of storage day, (b) development of a classification model for classifying days of storage at 4 ^{0}C, since this is the chilling temperature. In this regard, a total of 130 mature cucumbers were purchased from a local fresh retailer market located in Winnipeg, Manitoba, Canada. They were grouped in 13 groups each includes 10 fruits. The first 10 samples considered as fresh products and the rest were kept in two cold chambers (4 ^{0}C and 12^{0}C). Fruits were removed from each chamber at in interval of every three days and were left for 24h at room temperature (~20 ^{0}C) to eliminate the temperature effect from the fruits before imaging. Images were acquired in Vis-NIR (400-1000 nm) and SWIR (1000-2500 nm) ranges in Image Processing Lab of Agricultural Engineering faculty at University of Manitoba. After extraction the data from images by self-developed algorithm, Principal Components Analysis (PCA) were conducted on the data in order to exploration and finding outliers, and consequently Partial Least Square-Discriminant Analysis (PLS-DA) was the method that were performed as a classifier. The results were shown a good classification among the fruits were kept in 4^{0}C and between fresh and stored ones as well.

Keywords: Cucumbers, Hyperspectral imaging, Classification, PLS-DA

Preferred method of presentation: POSTER

CODE: 168

Reference topic: Machines and facilities for agricultural products and food processing

AIIA 6th Section: Equipment for Processing of Agricultural Products Purpose

Proposal for: Poster presentation

20.3 EFFECT OF PACKAGING TECHNOLOGY ON THE QUALITY OF PRE-COOLED CLEMENTINE FRUIT

Francesco GENOVESE*, Giovanni Carlo Di RENZO[1], Giuseppe ALTIERI[1], Luciano SCARANO[1] and Maria Concetta STRANO*[2]

[1] School of Agricultural, Forest, Food and Environmental Sciences, University of Basilicata, 85100, Potenza, Italy

[2] Council for Agricultural Research and Economics (CREA), Research Centre for Olive, Citrus and Tree Fruit, 95024, Acireale (CT), Italy

** Corresponding Author: Corso Savoia, n.190, 95024 Acireale (CT), Italy.*

e-mail: mariaconcetta.strano@crea.gov.it

In the present work authors report the results of comparative tests on Clementine fruit (*Citrus clementina* Hort. ex Tan.) with the aim of reducing the weight loss and preserving the constitutive properties of the fruits.

The tests were carried out by setting up an experimental protocol, dividing Clementine fruits in six homogeneous groups (280 fruits for each of them): three groups were subjected to the pre-cooling (using a cooling unit prototype) followed by storage at controlled temperature (6°C±0.5) and relative humidity (90%), while the other three were directly stored in cold storage room without pre-cooling.

Additionally, in order to reduce fruit weight loss, HDPE bags were used for wrapping.

After the initial classification of fruits, a total amount of 50 fruits were used for the following assessment: weight, TP analysis (initial and residual deformation and consistency), and physical-chemical parameters (peel and pulp colour, juice yield, total soluble solids content, pH and titrable acidity).

The following determinations were carried out during the cold storage, with frequency of 15 days, up to 30 days plus 7 days of shelf life: VOC, O_2 and CO_2 concentration inside the packaging, weight loss, decay incidence (Penicilli decay and minor decay), physiological disorders (chilling injury and aging), TP analysis and physical-chemical parameters.

Main results showed that during the storage the use of HDPE bags significantly reduced fruit weight loss, chilling injury and aging with respect to the unwrapped fruit. However, a higher presence of total decay was observed in all wrapped fruit, although it was absent on precooled fruit, up to 15 days of cold storage. Precooling reduced significantly ethylene production inside packaging.

Keywords: Citrus fruit, smart packaging, fruit quality, shelf-life.

CODE: 091

Topic: Machines and facilities for agricultural products and food processing

AIIA section: 6th

20.4 ENVIRONMENTAL BENEFITS: CONVENTIONAL VS INNOVATIVE PACKAGING FOR OLIVE OIL

Ilaria Fiorindo*, Andrea Casson, Roberto Beghi, Valentina Giovenzana, Alessio Tugnolo, Riccardo Guidetti

Department of Agricultural and Environmental Sciences (DiSAA), Università degli Studi di Milano, via Celoria 2, 20133 Milano, Italy.

**Presenting author: Ilaria Fiorindo, Department of Agricultural and Environmental Sciences (DiSAA), Università degli Studi di Milano, via Celoria 2, 20133 Milano, Italy, ilaria.fiorindo@studenti.unimi.it*

(Proposal for Poster presentation)

Abstract

In the last years, different issues as costs and lower availability of materials and resources became a driving force to increase the sustainability of agro-food activity. In this scenario, the olive oil industry is characterized by different processes that could affect the environment. Moreover, the plastic packaging used in the sector could have a relevant environmental impact referred both to the production phase and to the disposal scenario. Therefore, the aim on the work was the evaluation of the environmental impact of two different mono-use olive oil packaging. This study is part of the project "Sustainability of olive oil System (S.O.S.)", funded by AGER.

A conventional packaging composed by polyethylene (PE), polyethylene terephthalate (PET), polyurethane (PU) and aluminium was compared to a bio-based packaging composed by bio-polyethylene (Bio-PE), polylactic acid (PLA) and a thin layer of aluminium.

A Life Cycle Assessment (LCA) was performed to identify the environmental profiles of the two packaging. The functional unit was defined as one mono-use packaging (10 mL volume). The study considered the environmental performance related to all the activities from the raw material extraction, through the transformation phases, till the disposal scenario.

The comparison of the two packaging showed that the conventional packaging affects more in the impact category "climate change" (1,5 times), "human toxicity" (1,4 times) and in "resource depletion" where the results are 4 times higher respect to the innovative packaging due to the extraction of non-renewable raw materials. Nevertheless, higher impacts are attributable to the bio-based packaging for ecosystem quality categories as "eutrophication" (1,2 times), "freshwater ecotoxicity" (1,5 times) and "acidification" (1,2 times).

Analysing the waste management scenario, it is not possible to identify a clear disposal procedure due to the composition of the packaging, the consumers' behaviour and the regional regulations. Therefore, in this study it was supposed the incineration of both the products.

In conclusion it is not possible to confirm that the bio-based olive oil packaging is more environmentally friendly respect to the conventional one, due to the land use and to the need as well of impacting chemical processes also to produce the bio-based films.

Keywords: polyethylene, polylactic acid, LCA, bio-based, sustainability

CODE: 146

Topic: Machines and facilities for agricultural products and food processing

20.5 HYPERSPECTRAL FLUORESCENCE IMAGING METHOD FOR EARLY DETECTION OF MATURE AND IMMATURE GREEN TOMATOES (*SOLANUM LYCOPERSICUM* L.)

Danial FATCHURRAHMAN[a*], Maria Luisa AMODIO[a], Leonarda MASTRANDREA[a], Muhammad Mudassir Arif CHAUDHRY[a], Giancarlo COLELLI[a]

[a]Dipartimento di Scienze Agrarie, degli Alimenti e dell'Ambiente, Università di Foggia, Via Napoli 25, 71122 Foggia, Italy

[*]Presenting Author: Danial Fatchurrahman, Università di Foggia, Via Napoli 25, 71122 Foggia, Italy, rahmandanial@gmail.com

Abstract

The potentiality of hyperspectral fluorescence imaging was evaluated for the non-destructive detection of mature and immature green tomatoes. Hyperspectral fluorescence imaging with excitation wavelength at 365 nm and UV-VIS CCD camera as the detector was employed over mature and green-immature tomatoes from 200 randomly harvested fruits at the green stage. Soluble Solid Content (SSC), pH, total acidity (TA), color change, and conventional sensorial analysis for tomato seed texture were conducted for maturity conformation. The results suggested that over the storage period SSC, pH and TA changed in mature green tomatoes while no change was observed in these parameters in immature green tomatoes. Partial least squares discriminant analysis (PLS-DA) was used for the classification of mature green and immature green tomatoes yielding correct classification with 100% non-error rate. It was revealed that the fluorescence intensity in the surface area of immature green tomatoes was significantly higher in the red region (690 nm) as compared to those of mature green tomatoes. Conclusively, hyperspectral fluorescence imaging can be utilized as an effective and reliable classification tool for classifying mature and immature green tomatoes.

Presentation method: poster

CODE: 161

Potential reference topic and AIIA section:

- Spatial and landscape analysis
- Machines and facilities for agricultural products and food processing

20.6 INNOVATIVE TECHNOLOGIES FOR THE FEEDING OF DAIRY CATTLE TO ENSURE ANIMAL WELFARE AND PRODUCTION QUALITY (INNOVALAT)

Umberto Bernabucci[1], Nicola Lacetera[1], Loredana Basirico[1], Patrizia Morera[1], Danilo Monarca[1], Massimo Cecchini[1], Bruno Ronchi[1], Andrea Colantoni*[1]

[1]Tuscia University, DAFNE department, San Camillo de Lellis, 01100Viterbo, Italy;
**colantoni@unitus.it*

Abstract: The growing crisis of identity that European agriculture and its production and breeding systems are going through, together with the contraction of margins in the markets and the persistence of the global financial crisis, is increasingly encouraging companies to diversify their products and processes in order to improve their competitive positions in the markets or, at least, to free themselves from the competition of the costs of "commodities", putting environmental and productive sustainability in second place, negatively influencing the aspects linked to the optimization of the efficiency of production processes, to those of quality and not of secondary importance for animal welfare.Cows with a high productive aptitude in order to express their genetic potential in the best possible way must be efficiently fed; the productive aptitude, in order to manifest itself, must be adequately supported by a correct feeding (quantity and quality) and above all by a correct management of the same (method of administration). Correct nutrition management is of extreme importance not only for the best expression of genetic potential, but also to safeguard animal health and welfare and finally to avoid waste because the incidence of food costs on the cost of milk production is in the order of 50-60%.Precision feeding or Precision Feeding (PF) is developing very successfully in the field of precision animal husbandry. Precision" is the degree to which something comes close to the desired and predetermined conditions. This is a new animal husbandry practice made possible by recent developments in information technology, telematics and robotics. Precision Feeding is a new way of thinking, an evolution of mentality and routine in agriculture. The objectives of this technique can be summarized in four points: (i) the right amount of nutrients;(ii) the right proportion of ingredients;(iii) the right composition of the ration;(iv)right moment of distribution.The objectives of the study are to evaluate the effect of using innovative technologies in an IoT context (specifically Nb-IoT - Narrowband - Internet of Things), aimed at optimizing the (precision) feeding of high production dairy cows to improve animal welfare and dairy characteristics of the milk produced. Experimental tests will be set up on Friesian dairy cow farms for this purpose. Four farms will be identified in a limited area of central Italy.

CODE: 034

Topic: machines and facilities for agricultural products and food processing.

AIIA section: 3rd Mechanization and technologies for agricultural production; 6rd Equipment for processing of agricultural products.

20.7 INVERSION OF A NUMERICAL MODEL TO ESTIMATE THE EFFECTIVE MOISTURE DIFFUSIVITY IN BAKING CAKE

Chiara Cevoli, Angelo Fabbri

Department of Agricultural and Food Sciences (DISTAL) – Bologna University
Corresponding author:chiara.cevoli3@unibo.it

The moisture diffusivity is an important physical parameter to model food baking processes. Unfortunately specific moisture diffusivity values are not easily found in literature, especially measured or calculated during the baking processes.
The aim of this research was to estimate the effective moisture diffusivity of a cake during baking for three different oven temperature (140, 160 and 180°C). Classical *slope* method and the inversion of a specific numerical model were used. By using the inverse method, it was possible to estimate the cake moisture diffusivity as a simultaneous function of temperature and moisture content.
The research work was divided in three phases: i) experimental determination of the moisture concentration versus time during the baking process and calculation of the moisture diffusivities by using the *slope* method; ii) development of a numerical heat and mass transfer model for the determination of moisture content versus time; iii) parameter estimation of moisture diffusivity as a function of temperature and moisture content, by minimizing the distance between numerical model and experimental results using a feasible optimization algorithm.
The estimated moisture diffusivity coefficients are close to those reported in literature for similar bakery products. The experimental and calculated moisture contents were in good agreement showing a determination coefficients R^2>0.993.
The advantages of the inverse technique respect to the classical slope method, is that realistic geometries and boundary conditions can be used and that the diffusivity may be introduced as a function of a desirable property (eg. moisture content, temperature, porosity).

Proposal for poster

CODE: 170

Topic: Machines and facilities for agricultural products and food processing

AIIA Section: 6

POSTER

20.8 OPTIMIZATION OF DONKEY MILK PASTEURIZATION PROCESS

Matera A.[1], Altieri G., Genovese F., Di Renzo G.C.

[1]School of Agriculture, Forestry, Food and Environmental Science University of Basilicata
Via dell'Ateneo Lucano 10, 85100 Potenza
attilio.matera@unibas.it

Donkey milk represents an interesting food solution as new-born feeding, especially if physiological limitations concerning the milk availability in post-pregnancy or immune diseases cow's milk proteins occur.

Currently, due to the scarce availability of raw materials (i.e. limited donkey livestock and low milk's yield), artisanal or batch thermal treatment methods, without any temperature control system, are widely used and recognized in the marketing of pasteurized donkey's milk, despite they are non-reliable processes leading to uncontrolled thermal damage of the bioactive molecules.

In this work, an innovative low capability (40 l/h) continuous flow sanitation plant, designed for High Temperature for Short Time (HTST) treatments, was characterised. The plant was made of frame and heat exchanger plates stainless steel AISI 304. The milk is gently heated indirectly by the heating system using water vapour. The sanitation unit includes all the equipment for the automatic, quick heating and cooling of milk, as well as an automatic control system for the milk moving (solenoid valves) and an integrated temperature recorder. In this experiment, a matrix with three pasteurization temperatures (75, 85, 92 °C) and times (3, 6, 9 s) was tested, and the efficacy of heating exchange was evaluated on lysozyme content and microflora enumeration (*L. monocytgenens*, *Enterobacteriaceae*, total aerobic bacteria) as soon as after the treatments and over 15 days-storage at 4 °C.

The HTST apparatus showed high performance; the complete eradication of *Enterobacteriaceae* detected the efficacy of the treatments at every time and temperatures tested. Decreasing in total bacterial count and lysozyme content was affected by treatment size.

Through this methodological approach, it was possible to investigate the effect of HTST treatments (following by cooling soon) on the primary chemical and microbiological standard for donkey milk, in order to set up an official sanitation protocol that allows optimising its nutritional value.

CODE: 032

Topic: machines and facilities for agricultural products and food processing.

AIIA section: 3rd Mechanization and technologies for agricultural production, 6rd Equipment for processing of agricultural products.

20.9 POTENTIAL OF THE HYPERSPECTRAL IMAGING TO DETERMINE DOCKAGE AND FOREIGN MATERIALS IN GRAIN

Chiara Cevoli, Angelo Fabbri, Giovanni Molari

Department of Agricultural and Food Sciences (DISTAL) – Bologna University
Corresponding author:chiara.cevoli3@unibo.it

The amount of material other than grain is an important quality parameter in grain products. High quality means supply the grains without damage (healthy grain) by insects or fungi but also without undesirable contaminants including foreign materials and dockage.

Dockage is any material mixed with wheat which can be removed using specified cleaning units, and foreign material is anything that is not wheat and that remained in the wheat after the removal of dockage using proper cleaning procedures.

In recent years, hyperspectral imaging has proven to be effective in grain quality inspection. The aim of this study was to evaluate the potential of the application of the hyperspectral imaging (400-1000 nm) to determine the foreign materials and dockage (stones, chaff, insect, broken kernels and insect-damaged kernel) in three type of grain: corn, wheat and millet seeds. A specific set-up was developed and the solar illumination (lighting source) was used.

The work was divided in two steps: i) definition of the contaminate spectra; ii) on the base of the spectra identified in the previous step, the different foreign materials and dockage were discriminated in mixture of grains and contaminates. Different classification algorithms were tested and the best classifications were obtained by using the vector angle classification or absolute difference methods.

Proposal for poster.

CODE: 148

Topic: Machines and facilities for agricultural products and food processing

20.10 REDUCING MECHANICAL DAMAGE INDUCED BY FRESH-CUT PROCESSING

Alessia Incardona, Maria Luisa Amodio, Giancarlo Colelli

Dipartimento di Scienze Agrarie, degli Alimenti e dell'Ambiente, Università di Foggia, Via Napoli 25, 71122 Foggia, Italy

*Corresponding Author: giancarlo.colelli@unifg.it

Abstract

Consumers increasingly demand for convenient and healthy products such as fresh-cut fruits and vegetables. An important issue is tissue browning and softening caused my wounding stress. Cutting operations in fresh-cut processing play a significant role in tissue damage resulting in induction of wounding stress. The intensity of mechanical damage is highly associated to the morphology of the cut tissue and to the sharpness of the cutting tool used. The degree of sharpness (defined as the required force exerted by the instrument to cut a reference body) is an important factor for an efficient cutting operation and a methodology has been developed in order to formulate a quantitative index (blade sharpness index, BSI). The aim of this project is to define a methodological approach to evaluate the degree of sharpness of a cutting tool, correlating it with the mechanical damage on the plant tissue (based on biochemical, physiological and morphological analysis) with the objective to define a threshold within which maximum cutting efficiency can be achieved also in terms of shelf-life of the fresh-cut produce. In addition it will also explore the combination of BSI and treatments on fruit and vegetable products in order to decrease the effects of mechanical damage. Keeping under consideration these general objectives, preliminary trials for method standardization were performed and results are hereby presented.

Keywords: cutting, mechanical damage, blade, sharpness, browning

Presentation method: poster

CODE: 147

Topic: Machines and facilities for agricultural products and food processing

20.11 SUSTAINING LOW-IMPACT PRACTICES IN HORTICULTURE THROUGH NON-DESTRUCTIVE APPROACH TO PROVIDE MORE INFORMATION ON FRESH PRODUCE HISTORY & QUALITY (*FRESH&LOW*)

M.L. Amodio[a], M. Cefola[b], F. Babellahi[a], M.M.A. Chaudhry[a], M.L.V. De Chiara[a], A. Moiz[a], B. Pace[b], F. Serio[b], A. Stasi[a], G. Colelli[a]

[a] Dipartimento di Scienze Agrarie, degli Alimenti e dell'Ambiente, Università di Foggia, Via Napoli 25, 71122 Foggia, Italy

[b] Istituto di Scienze delle Produzioni Alimentari, Consiglio Nazionale delle Ricerche, Via Amendola, 122/O 70126 Bari, Italy

*Corresponding Author: giancarlo.colelli@unifg.it

Abstract

The general aim of Project *Fresh&Low* is the enhancement of sustainably-produced fresh produce by implementation of low-input agricultural practices (LIP) having a positive impact on product quality along with the development of non-destructive (ND) techniques for real-time quality assessment and product discrimination, leading to new marketing strategies supporting added value products and resulting in profit enhancement. Producing high quality products represents a key driver in horticultural sector although the concept of quality has evolved substantially over the past few decades. From traditional attributes (visual and organoleptic) also representing the main focus of most of the quality standards and regulations, more recently other important aspects are gaining relevance: the consolidated consumer attention towards nutritional value and their increasing sensibility toward the environmental impact of production processes. Methodology was designed for two crops (tomato (*Solanum lycopersicum* L.) and rocket leaves (*Diplotaxis tenuifolia* L.)) diffusely produced in greenhouses with following sub-objectives: (i) enhance the efficiency of resources (optimized use of water and fertilizers), (ii) measure the quality of products by conventional and innovative ND approaches, providing innovative tools for discrimination of those obtained by LIP and further prediction of the quality while in their package, and (iii) testing of hypothesis to identified the influence on the quality certification of LIP by ND methods on consumer adoptions and their willingness to buy so that an adequate and realistic marketing strategies established. Reduction in the impact of agriculture on the climate, ensuring superhigh quality products for consumer, bigger profit for farmers and lowest food losses are the expected results. Project *Fresh&Low* will start in 2019 and will finish in 2022.

Keywords: low-impact, water, nitrogen, NIR, prediction, Vis-NIR, classification, market

Presentation method: poster

CODE: 174

Topic Poster Presentation: Machines and facilities for agricultural products and food processing

20.12 SIEVING OPTIMIZATION TO PRODUCE WOOD CHIPS OF HIGH QUALITY

Giulia Angeloni*, Lorenzo Guerrini, Federico Guasconi, Alessandro Tirinnanzi, Claudio Fagarazzi, Piernicola Masella, Agnese Spadi, Fabio Baldi, Alessandro Parenti

Dipartimento di Scienze e Tecnologie Agrarie, Alimentari Ambientali e Forestali (DAGRI), Università degli Studi di Firenze, Piazzale delle Cascine 15, 50144, Firenze, Italia
**email: giulia.angeloni@unifi.it*

The International Organization for Standardization (ISO) describes as "chipped" the woody biomass in the form of pieces with a defined particle size produced by mechanical treatment with sharp tools such as knives (ISO 17225-4 2014). Furthermore, there are additional voluntary certifications with more restrictive specifications. The A1+ class of ISO standard proposes this class as most valuable wood chips. Particularly, in this class are defined "cippatino" chips with over than 60% – by weight – of particles in the range between 3.15 mm and 16 mm in length; less than 1% under 3.15 mm long; less than 5% longer than 16 mm, and no chips longer than 31.5 mm allowed. For the quality certifications and for efficient use as fuel, is required a product with uniform particle size, therefore it is necessary to separate the particles according to their dimensions using grading sieves to remove fines and/or oversize contamination or looking for a range of highly accurate product fractions.

The objective of the study was to analyze different feed rates of the sieve, with the aim of analyzing the effects on the final product. Through the analysis of the sieving sizes, we have tried to define and characterize the phenomena that occur when the sieving parameters change in order to optimize the production of wood chips of high quality.

Sieving tests were carried out in 3 replicates with three different feed rates of the sieve (high, medium, low). The samples were analyzed for these quality parameters: productivity, sieving errors weight, density, water content, calorific value. Two sieving errors are considered: right sized chips discarded, wrong sized chips in "cippatino". Productivity increased with sieve feeding rate, with a high feed rate maximum productivity was detected, whereas with medium and low levels no difference were detected and there was a low productivity. Concerning sieving quality, right sized chips discarded ranged from 8.4% (lower) to 12% (high). The lower amount of wrong sized chips was found at medium feed rate.

The granulometry analyzes were also carried out through a digital processing software to have a wider overview to understand the phenomena that occur during processing.

CODE: 092

Topic: Machines and facilities for agricultural products and food processing

AIIA section: 6th

20.13 THE E-LCA AS A TOOL TO QUANTIFY THE ENVIRONMENTAL IMPACT OF MEAT AND LEGUMES-BASED BURGERS

Alessio Tugnolo*, Roberto Beghi, Valentina Giovenzana, Andrea Casson, Ilaria Fiorindo, Riccardo Guidetti

Department of Agricultural and Environmental Sciences (DiSAA), Università degli Studi di Milano, via Celoria 2, 20133 Milano, Italy.

**Presenting author: Alessio Tugnolo, Department of Agricultural and Environmental Sciences (DiSAA), Università degli Studi di Milano, via Celoria 2, 20133 Milano, Italy, alessio.tugnolo@unimi.it*

(Proposal for Poster presentation)

Abstract

Thanks to its high biological and nutritional values, the meat has always been considered an interesting food for a good diet. However, ethical reasons, religious restrictions and the high prices have driven the consumers' behaviours towards alternative products. Nowadays, the demand for new food formulations has an upward trend. This is also due to the growing awareness of consumers about the environmental impact of food productions. In this scenario, the legumes are considered an alternative food compared to meat.

For this reason, one of the aims of the international project "Legume Genetic Resources as a tool for development of innovative and sustainable food Technological system" (LeGeReTe) is to evaluate the environmental sustainability of legume-based products.

An Environmental-Life Cycle Assessment (E-LCA) was performed to evaluate the environmental profile of one meat burger and one legume-based burger. A conventional functional unit of '1 burger (100 g)' and an alternative one of '15 g of proteins' were used, applying for the study a "from cradle to grave" approach.

The environmental impact assessment helped to identify the most impactful activities: for both the production chains, the agricultural phases were identified as the most damaging. Regarding the production processes, the legume-based burger was identified as the most energy demanding compared to the meat burger.

Considering a functional unit of 1 burger, the results suggest that the meat burger is 3.44 times more impactful compared to the legume-based burger. While switching to a nutritional functional unit (15 g of proteins), the results showed that to reach the same protein content of a meat burger, is necessary to double the legume-based burger production which remains anyway the most sustainable option.

In conclusion, the legume-based burger can be defined as the most environmentally-friendly solution both from a production and from a nutritional point of view.

Keywords: meat, legume, LCA, environment, sustainability

CODE: 149

Reference topic: Machines and facilities for agricultural products and food processing

AIIA section: 6

20.14 USE OF ULTRASOUNDS IN THE EXTRACTION PROCESS OF VIRGIN OLIVE OIL AND INFLUENCE ON MALAXATION TIME

Mauro Pagano[1]*, Roberto Tomasone[1], Carla Cedrola[1], Marco Fedrizzi[1], Gianluca Veneziani[2], Maurizio Servili[2]

[1]Consiglio per la ricerca in agricoltura e l'analisi dell'economia agraria, Centro di Ingegneria e Trasformazioni agroalimentari (CREA-IT).

[2]Dipartimento di Scienze, Agrarie, Alimentari ed Ambientali (DSA3) dell'Università degli Studi di Perugia

** presenting author: Mauro Pagano*

e-mail address: mauro.pagano@crea.gov.it

Council for Agricultural Research and Economics, Agricultural Engineering Research Centre for Engineering and Agro-Food Processing

Via della Pascolare 16, 00016 Monterotondo (ROME), Italy

Ultrasound technology has multiple applications in the food industry. The use of power ultrasonic in the olive oil industry is an innovative technique applied for the treatment of olive paste. The high-power ultrasound (US) device is inserted in the processing line, downstream of the hammermill and upstream of the malaxer. The high-intensity sound waves exert a mechanical action by means of acoustic cavitation, causing cell walls to break and cell content to escape, including oil droplets from vacuoles. This article describes an experimental US device, tested in an olive mill having a working capacity of 2 tons/hour of olives. Different operating parameters were applied in the milling operations (malaxation time and olive paste flow rate) to test the impact of the ultrasound treatment on the physical and chemical characteristics of the oils. The extraction tests were carried out with olives harvested at three different maturity stages (early, medium, late) and with three different durations for the malaxation phase, whereas the sonication time was the same for all treatments. The US treatment was applied to the olive paste flowing through connection pipes in continuous operation, at a 20 kHz frequency and a 2.8 kW power. The yield and the organoleptic quality of the virgin olive oils extracted (VOO) were evaluated according to standard procedures. Three different malaxation times (10 min, 20 min and 30 min) were used in oil extraction. The oil extraction yields progressively decreased with shorter malaxation time. In particular, olives processed at an early ripening stage require longer malaxation phases, lasting at least 10 minutes, to improve oil extractability. The US treatment increases oil yield up to 22.7% when milling olives at an early ripening stage. The effectiveness of this treatment decreases with fruit maturity, therefore oil yield improvement gradually declines with olive ripeness. No significant effects were found on the legal and commercial parameters of the VOO obtained (including quality indices, sterols, triterpene dialcohols, waxes and diacylglycerols) from olives with medium to early ripeness. Significant physical changes were observed in the sonicated oil compared to the control oil extracted via the traditional process. In general, the ultrasonic treatment was found to increase the efficiency and speed of extraction, also giving olive oils enriched in bioactive compounds, such as polyphenols, tocopherols, carotenoids and chlorophylls.

keywords: technological innovation; olive mill, cavitation, milling machinery, oil quality

This proposal is for a **Poster** presentation

21 AIIA Section 7 - Information and communication technologies

President

Fabrizio Mazzetto

University of Bolzano

Vice President

Paolo Tarolli

University of Padova

21.1 PURPOSE

The purpose of the 7th Section is to promote the use of Information and Communication Technologies (ICT) to optimize the management of all agricultural and agro-food production processes, in order to improve their quality and sustainability. The effective adoption of ICT in this sector requires the combination of tools and knowledge applied to biological systems including: advanced sensors, control and monitoring techniques, Automation, Robotics, Artificial Vision, advanced data and information management, use of new communication networks. The activities of the 7th Section therefore require an active cooperation with all the other sections of the AIIA, and therefore of the CIGR, for a complete harmonization in the use of ICT in the different production phases of each agro-food chain.

21.2 TOPICS OF INTEREST

The 7th Section promotes information and communication technologies both through dissemination in the academic and post-university fields, and through research and development of new systems and applications, with reference to the following sectors: In-situ and remote sensors, from land, air and satellite platforms; Information Processing Technologies (Information Processing Technologies); Simulation and Modelling (Simulation and modelling); Expert Systems (Knowledge Based Systems); Decision Support Systems (Decision Support Systems - DSS); Computer Vision and Artificial Intelligence (Artificial Intelligence); Geographic Information Systems (Geographical Information Systems - GIS); Global Positioning Systems (GPS); Business and Crop Management Systems (Farm and Crop Management Systems); Precision Agriculture (Precision Agriculture); Networks for data sharing in agriculture (Agricultural Data Communication Networks); Data Extraction (Data Mining); The 7th section organizes and coordinates meetings, seminars and scientific conferences both nationally and internationally, also in collaboration with related associations, and promotes the formation of interdisciplinary groups for participation in research projects.

22 AIIA Section 7 – Oral Presentations

Oral Presentations

CODE: 043

Topic: Computer and communication technologies

Proposal: Oral presentation

22.1 A PROTOTYPE OF SERVICE ORIENTED ARCHITECTURE FOR PRECISION AGRICULTURE

Simone Lanucara [(1)], Alessandro Oggioni [(1)], Salvatore Di Fazio [(2)], Giuseppe Modica [(2)]

[1]*Istituto per il Rilevamento Elettromagnetico dell'Ambiente, Consiglio Nazionale delle Ricerche (IREA-CNR), Via Bassini, 15, 20133 Milan, Italy*

[2]*Dipartimento di Agraria, Università degli Studi Mediterranea di Reggio Calabria, Località Feo di Vito, 89122 Reggio Calabria, Italy*

Corresponding Author: Lanucara Simone, lanucara.s@irea.cnr.it

Abstract

With an expected global population of over nine billion by 2050, food production is a major challenge that will be further exacerbated by climate change and by the reduced water supply and the environmental impacts of intensive plant and livestock production. The United Nations Food and Agriculture Organization (FAO) recommends adopting digital technologies to increase productivity and address the risk of food security. This is also in line with the recent Italian guidelines for Precision Agriculture (PA) (Decree of the Ministry of Agricultural Policy of 22 December 2017). PA takes advantage of digital technologies to: 1) analyse the space-temporal variability in agricultural production at field level; 2) understand the causes of variability; 3) implement sound strategies for field management. PA is a data-intensive discipline characterised by the collection, storage, processing and dissemination/sharing of digital data collected from various sources. The main issues in the implementation and spread of PA include the harmonization of heterogeneous data from different sources, the interpretation of the huge amount of data collected, the understanding of the causes of variability and the ability to propose robust strategies for managing variability inter- and intra-field. To help solve these issues, in this work, we propose a software infrastructure with the aim of providing a basis for the development of information systems for the PA, based on: Service Oriented Architecture (SOA) concept, free open-source software (FOSS), the interoperability of data and web services for sharing them. In more details, the web services that enable interoperability are Open Geospatial Consortium (OGC) standards for geospatial and sensors data, while for agricultural machinery data the ISO standards are adopted.

We propose a case study in the framework of the SATFARMING project, funded by the private company IBF Servizi S.p.A. and devoted to the following research goals: 1) Implementation of a SOA prototype composed by three structural layers (presentation, service and the storage) compliant with SOA architecture, each of which with dedicated modules enabling logical functionalities. 2) Customization of open-source software interface that implement the provided modules, these improve a) data identification by metadata and semantic enablement; b) data authorization to users; c) data processing; d) data interoperable sharing at syntactic level; 3) Implementation of standard OGC web services enabling data interoperability.

The SOA prototype here discussed and completely based on free and open source software, i.e. without licensing fees, could represent a reliable platform to manage PA even in low-income countries.

CODE: 078

22.2 AGROBOT SMASH A ROBOTIC PLATFORM FOR THE SUSTAINABLE PRECISION AGRICULTURE

Daniele Sarri[1], Valentina De Pascale[1], Riccardo Lisci[1], Stefania Lombardo[1], Marco Rimediotti[1], Eleonora Salvini[1], Marco Vieri[1]

[1]DAGRI – Department of Agriculture, Food, Environment and Forestry - University of Florence, Piazzale delle Cascine 15, 50144 Firenze, Italy

Corresponding author: Daniele Sarri – daniele.sarri@unifi.it

The growing need for production processes oriented to environmental sustainability is leading the development of advanced robotic technologies. In this scenario, the Smart Machine for Agricultural Solutions High-tech SMASH project is focusing on the development of robotic collaborative ecosystem, modular and integrated for the monitoring and sustainable management of crops in view the actuation of precision agriculture approach. The project is implementing technological solutions to address and resolve some issues related to nutrition safety (e.g. nitrate content on vegetable) and environmental sustainability (e.g. pesticide use, production process waste) in two representative scenarios of speciality crops (viticulture) and vegetable (spinach). The final version of robotic collaborative ecosystem will be made of four main modules: an unmanned ground vehicle (AgroBot), a soil monitoring unit (Plantoid) a aereial unit (FlyBot) and a mobile service unit on the field (AncillaryBot). The SMASH platform includes ICT technologies for the coordination of the four modules, elaboration and data management of acquired data with both several non and invasive sensing technologies (e.g. vision system, photonic sensors, proximal sensing) and destructive. Moreover the AgroBot is equipped with actuators like robotized arm and intelligent manipulators which allow the picking of samples and waste in the field. The vegetable sampling are chemically analysed both on the go in the field or in post processing in the AncillaryBot. The high-level objective is (a) to manage site-specifically agronomic problems of crops trough monitoring and analytical control (e.g. soil analysis, mineral content assessment and organic compounds in leaves and fruits, etc.), (b) carry out operations modulated on the basis of the monitoring carried out (e.g. targeted delivery of products) (c) perform elementary operations, such as collecting samples, in a targeted and geo-referenced manner, in addition to the traditional laboratory analytical procedures. The field data are collected in a cloud and processed by machine learning techniques and data mining extrapolation in order to translate simple measurements and indexes into information for decision-making, forecasting productions and standardizing solutions.

Keywords*: precision management, monitoring, grapevine, nitrate, automation.*

Oral presentation

CODE: 042

Computer communication technologies – AIIA 2nd Section

Proposal for Oral presentation

22.3 COMPUTER VISION IDENTIFICATION AND POSITION DETECTION OF FRIESIAN COWS

Stefano Benni[a], Filippo Bonora[a], Luigi Di Stefano[b], Stefano Mattoccia[b], Matteo Poggi[b], Patrizia Tassinari[a], Daniele Torreggiani[a]

a. *Department of Agricultural and Food Sciences, University of Bologna*
b. *Department of Computer Science and Engineering, University of Bologna*

Viale Fanin 50, 40127 Bologna, Italy – stefano.benni@unibo.it

Precision Livestock Farming relies on several ICT approaches to acquire in the most efficient way precise and up-to-date data concerning individual animals. In dairy farming particular attention is paid to automatic animal recognition and cow position tracking, as such information is closely related to animal behavior and thus to possible health issues. At the same time, computer vision and pattern recognition approaches based on deep-learning developed in recent years have outperformed previous methods by a large margin: in PLF these systems are suitable to provide novel sources of information about cow welfare thanks to the individual animals detection and the identification of codified behavioral patterns.

This study represents a preliminary step for the development of a deep learning system of animal position detection and tracking inside the barn. The final goal is the development of a tool meant to be implemented in the farm to determine the time spent by every individual cow in specific areas of the barn and to early identify anomalous behaviors and thus preventively carry out specific corrective actions concerning environmental conditions or farming management. The aim of the part of the research presented in this study is to develop a system for the automatic recognition of individual dairy cows in videos recorded in the barn, which can work in real time and record output time histories for each animal.

Specifically, deep learning techniques for the detection of the cows in the herd has been implemented and tested on a pilot farm with computer vision procedures. Then precision-recall curves were elaborated for the identification of individual cows and for the global results to assess the performance of the network. The outcomes of the study showed that it is possible to identify individual cows based on their morphological appearance and that the piebald spotting pattern of a cow's coat represents a clearly distinguishable visual element to effectively train a computer vision network.

Keywords: deep learning, Precision Livestock Farming, computer vision, detection, piebald spotting pattern, precision-recall

CODE: 108

Conference topic: computer and communication technologies

AIIA Section II

The proposal for Oral presentation

22.4 DESIGN OF A DATABASE FOR DATA MANAGEMENT IN PRECISION FARMING AND DECISION SUPPORT SYSTEMS

Chiappini S.[1], Galli A.[2], Malinverni E.S.[1], Zingaretti P.[3],Orsini R.[2], Fiorentini M.[2], Zenobi S.[2]

[1]Dipartimento d'Ingegneria Civile, Edile e Architettura (DICEA), [2]Dipartimento di Scienze Agrarie, Alimentari ed Ambientali (D3A), [3]Dipartimento di Ingegneria Informatica (DII)

s.chiappini@staff.univpm.it, a.galli@univmpm.it

Università Politecnica delle Marche, via Brecce Bianche 10, Ancona (Italy)

KEYWORDS: geodatabase, UAV, data processing.

Precision Agriculture/Farming is nowadays an important challenge aiming to improve environmental quality in rural areas, giving more sustainability to agricultural operations by improving the quality of fieldworks and, last but not least, increasing the food safety and security for social life. To these purposes, the setting up of specific methodologies is required with the aim to build a precision Farming Management System (FMS) at farm level involving Geomatics and aiming to optimize field operations enhancing agricultural performance and improving the ability to predict and mitigate environmental risks. The research activities here presented are a part of a multidisciplinary project named "PFRLab: Setting of a Precision Farming Robotic Laboratory for cropping system sustainability and food safety and security" founded by the Università Politecnica delle Marche in the 2017-2020 years. The main goal of the research is to define and to apply, within the experimental farm of Università Politecnica delle Marche as case study, an overall methodology based on the use of advanced technologies (like Unnamed Aerial Vehicle (UAV), Internet of Thing (IOT), Remote Sensing and field sensors) for collecting and organizing big amounts of field data in order to build a Decision Support System (DSS) oriented to increase performances of precision farming experimental trials and making farm's decisions potentially more productive and efficient. The data collected during the first step of the project have been stored in a relational database organized in a set of multi-tables. Users can enter the database using as field key the agricultural operation of interest and the year of the event for each parcel of the farm. All the queries are exportable in a GIS open source software through .csv format files. In this way farmers are fostered to organize their own geodatabase of the farm, with the aim to improve the management of all activities they have to perform also reinforcing all decision making processes through more knowledge.

CODE: 077

Remote Sensing in agricultural and forestry systems - Oral presentation proposal

22.5 LOW COMPLEXITY VINEYARD MODELLING FROM UAV BASED DENSE 3D-POINT CLOUDS FOR PRECISION AGRICULTURE

Lorenzo Comba[1,*], Shahzad Zaman[2], Alessandro Biglia[2], Davide Ricauda[2], Fabrizio Dabbene[3], Paolo Gay[2]

[1]Dipartimento Energia (DENERG), Politecnico di Torino, Corso Duca degli Abruzzi 24, 10129 Torino, Italy
[2]Dipartimento di Scienze Agrarie, Forestali e Alimentari (DiSAFA), Università degli Studi di Torino, Largo Paolo Braccini 2, 10095 Grugliasco (TO), Italy;
[3]Consiglio Nazionale delle Ricerche (CNR), Institute of Electronics, Computer and Telecommunication Engineering (IEIIT), c/o Politecnico di Torino, Torino, Italy

*Presenting Author: lorenzo.comba@polito.it

In Precision Agriculture, robotic platforms and machines play a crucial role in effective management of crops by acquiring extensive crop data and by autonomously performing infield operations. Enhanced path planning tasks and proper complex interaction with crops can be achieved if, in addition to standard 2D georeferenced field maps, autonomous robots for site specific operations and for crop monitoring tasks could exploit information provided by up to date three dimensional models of the crop. Nowadays, very dense 3D point cloud can be obtained by terrestrial laser scanner (TLS) and/or by processing imagery from unmanned aerial vehicle (UAV) with structure from motion (SFM) approach. Anyway, these huge dataset, even if accurate and reliable, cannot be easily transmitted and processed in real-time by the vehicles and machines on board control system, due to their relevant dimension and complexity.

In this work, a new algorithm to properly reduce the complexity of 3D dense point-cloud of vineyards is presented, which provide a 3D mesh surface with a limited number of instances. The algorithm can automatically classify sections of point-cloud representing vines and inter-row areas, respectively, applying different processing methods accordingly. Vineyards result to be spatially modelled by a dataset even 400 times lighter, assuring in the meanwhile a neglectable loss of information. Optimal values of algorithm parameters were determined by a linear programming approach, minimizing an error function defined as combination of four model quality indexes.

The obtained georeferenced low-complexity 3D model maps of vineyard and, in detail, of vine row plants are compatible with real-time computation and allow to improve the reliability of autonomous vehicle navigation in complex scenarios, such as open field with row crop layout. The developed methodology does not require vine rows to be rectilinear, can properly process dense model of hilly field and it is robust to inter-row grassing occurrences.

CODE: 172

Topic: Remote Sensing in agricultural and forestry systems

Proposal: Oral presentation

22.6 MONITORING ONION CROPS USING UAV MULTISPECTRAL AND THERMAL IMAGERY: FIRST RESULTS

Gaetano Messina*, Salvatore Di Fazio*, Biagio Siciliani**, Antonio Curcio**, Salvatore Praticò*, Giuseppe Modica*,

**Dipartimento di Agraria, Università degli Studi Mediterranea di Reggio Calabria, Località Feo di Vito, I-89122 Reggio Calabria, Italy*

*** DR-One S.r.l., Via Card. F. Ruffo n. 6 87033 - Belmonte Calabro, Cosenza, Italy*

Corresponding Author: Gaetano Messina, gaetano.messina@unirc.it

Agriculture constitutes one of the most important fields where Remote Sensing is employed, particularly in the aspects related to precision agriculture (PA). PA means a management strategy that, using modern instruments, aims at carrying out agronomic interventions in compliance with the actual crop needs and the biochemical and physical characteristics of the soil. PA analyzes and manages the spatial variability of the field to optimize profitability, sustainability and protection of agro-ecological services.

The present paper shows the potentiality of coupling multispectral and thermal imagery acquired by an unmanned aerial vehicle (UAV) in monitoring crops. A case study in onion crop (Cipolla rossa di Tropea IGP) is provided. Multitemporal surveys were carried out by means of a fixed-wing UAV, equipped with a multispectral camera Sequoia Parrot (R-G-RedEdge-NIR) and a quadricopter equipped with a thermal camera Flir Vue Pro 640 R. Prior to proceed with UAV surveys, soil characteristics were analyzed on the basis of a systematic sampling. According to the characteristics of thermal cameras, aluminum is used as the material of control targets with their size identified clearly in the thermal images.

UAV multispectral imagery were calibrated with a panel with known reflectance, and verified with a spectroradiometer (Apogee Ps-300) on bare soil and vegetation. With regard to thermal ground truths, wet and dry panels/surfaces have been used as references, measuring their temperature before and after UAV thermal flights by means of a handheld infrared thermometer. Vegetation indexes and a water stress index were obtained to monitor vegetation vigor during the crop season.

CODE: 129

VII sezione AIIA: Tecnologie informatiche e delle comunicazioni.

TOPIC: Remote Sensing in agricultural and forestry systems

Proposed for ORAL presentation

22.7 MULTI-SENSOR UAV APPLICATION FOR THERMAL ANALYSIS ON A DRY-STONE TERRACED VINEYARD IN RURAL TUSCANY LANDSCAPE

Grazia Tucci [1], Erica Isabella Parisi [1], Giulio Castelli [2,3,*], Alessandro Errico [2,3], Manuela Corongiu [1], Giovanna Sona [4], Enea Viviani [5], Elena Bresci [2,3], Federico Preti [2,3]

[1] SCHEMA - Joint Laboratory between Department of Civil and Environmental Engineering, Italian (DICEA), Military Geographic Institute, University of Florence and IMGI, Via di S. Marta, 3, 50139 Florence, Italy

[2] Department of Science and Technology of Agriculture, Food, Environment and Forestry (DAGRI), University of Florence, Via di S. Bonaventura, 13, 50145 Florence, Italy

[3] Water and Vegetation (WaVe) Research Unit, University of Florence, Via di S. Bonaventura, 13, 50145 Florence, Italy

[4] Department of Civil and Environmental Engineering (DICA), Polytechnic University of Milan, P.zza Leonardo da Vinci, 32, 20133 Milan, Italy

[5] Italian Military Geographic Institute (IMGI), Via C. Battisti, 10/12,50122 Florence, Italy

** Presenting author: DAGRI, Università degli Studi di Firenze, Via San Bonaventura, 13, 50145, Firenze, Italy. Mail: giulio.castelli@unifi.it*

Italian dry-stone wall terraces represent one of the most iconic features of agricultural landscapes in all the areas of the country, being part of sites listed among UNESCO World Heritage Sites and FAO Globally Important Agricultural Heritage Systems (GIAHS). The analysis of microclimate effects induced by alterations of hillslope profiles and by the presence of dry-stone walls is of particular interest for the evaluation of benefits and drawbacks of terraces cultivation, both at the national and at the global scale. The aim of this work is to present the thermal characterization of a dry-stone wall terraced vineyard in the Chianti area (Tuscany, Italy), realised with the aim to detect possible microclimate dynamics induced by dry-stone terracing. Aerial surveys were carried out by using two sensors, in the Visible (VIS) and Thermal InfraRed (TIR) spectral range, mounted on two different Unmanned Aerial Vehicles (UAVs). Our results reveal that, in the morning, vineyard rows close to dry-stone walls have statistically lower temperatures with respect to the external ones. In the afternoon, due to solar insulation, temperatures raised to the same value for each row. The results of this early study, jointly with the latest developments in UAVs and sensors technologies, justify and encourage further analyses on local climatic modifications induced by terraces.

Reference: Tucci, G.; Parisi, E.I.; Castelli, G.; Errico, A.; Corongiu, M.; Sona, G.; Viviani, E.; Bresci, E.; Preti, F. Multi-Sensor UAV Application for Thermal Analysis on a Dry-Stone Terraced Vineyard in Rural Tuscany Landscape. *ISPRS Int. J. Geo-Inf.* **2019**, *8*, 87.

CODE: 133

Remote Sensing in agricultural and forestry systems - oral presentation

22.8 NEURAL NETWORK ALGORITHMS FOR REAL TIME PLANT DISEASES DETECTION USING UAV

*Mariano Crimaldia, Vincenzo Cristianoa, Marco Iserniab, Paolo Ivanovb, and Fabrizio Sarghinia,**

University of Naples "Federico II" – Department of Agricultural Sciences -80055 portici (NA) - Italy

b) Desà SrL

**corresponding author: fabrizio.sarghini@unina.it*

Precision agriculture principles appeared in the early 1980s as field management techniques in order to improve the inputs/yields ratio such as the insertion of nitrogen, phosphorous and potassium in high energy and intensive crops (i.e. maize, sugar beet). Nowadays, precision agriculture aims to optimize investments and yields taking into account environmental and conditions variability between different plots, influencing every aspect of agriculture such as tillage, seeding, fertilization, irrigation and pesticide spraying. In order to achieve all these goals, development of new sensors and field data gathering must be taken into account. In recent years, Unmanned Aerial Vehicles (UAVs) have been used in agriculture as part of photogrammetric and remote sensing tasks, but new opportunities arise also in pesticide distribution. In this case, high resolution images are required, introducing a technical complexity linked to data transfer and storage. One possibility is to store only images requiring a post processing, dropping all images proposing a standard healthy crop. The use of Artificial Intelligence (AI), and Deep Learning (DL) in particular, allows larger learning capabilities and thus higher performance and precision of real-time classification and detection. The aim of this work is to develop and test a DL model in order to detect in real-time plants diseases. The neural network has been trained with a dataset of RGB images, then tested on a test set. The system adopted a Convolutional Neural Network (CNN) as feature extractors from the input images and TensorFlow as framework, showing good results in disease detection.

CODE: 153

Reference topic: Innovative biosystems engineering for sustainable agriculture, forestry and food production.

Oral presentation

22.9 USE OF UAVS AND CANOPY HIGH MODEL APPLIED ON A TIME SCALE IN THE VINEYARD.

Luca Ghiani[1], Alberto Sassu[2], Vanessa Lozano[1], Giuseppe Brundu[1], Davide Piccirilli[1], Filippo Gambella[1].

[1]Department of Agriculture, University of Sassari, Viale Italia 39, 07100 Sassari, Italy

[2]Inspire s.r.l., Via XX Settembre 33/10, 16121 Genova, Italy

Among the main objectives in "Precision Farming", there is a more rational use of chemicals products and their better application in the field. The benefits that can be achieved are various: from the best quality and reduced costs of products, up to the increase in business productivity with considerable advantages both from an economic point of view and in terms of the environmental impact.

Among the technologies on the market, the use of UAVs (Unmanned Aerial Vehicles) is emerging. The new aerial monitoring techniques offer, in a short amount of time, a range of services that are useful in agriculture, including the real time evaluation of phytosanitary status and the acquisition and calculation of high-precision data, such as measuring heights, areas and volumes.

Currently, field measurements in agriculture carried out using mathematical formulas that contain physical measurements of crown height, thickness and distance between canopies (i.e. Tree Row Volume or TRV). These calculations allow us to estimate dosages concerning phyto-sanitary treatments on the canopy, evaluating the relationships between spraying volumes and the epigeal part of the plant.

The activity carried out within the research project "MARS - Multiple Airdrones Response System" concerned the development of an innovative methodology of analysis for the computation of the *Vitis vinifera* surfaces and leaf volumes at different times during the season. The project main purpose was to compare the volumes obtained from measurements on field with those obtained through both MATLAB code and GIS software from a 3D model reconstruction, integrating aerial photogrammetric information. Preliminary results show that the volumes obtained with this 3D reconstruction are lower than those calculated in the field with a reduction of around 50%.

CODE: 093

Remote Sensing in agricultural and forestry systems

22.10 USE OF A MULTIROTOR-UAV EQUIPPED WITH A MULTISPECTRAL CAMERA TO DETECT VINEYARD DISEASES: A CASE STUDY ON BARBERA AND DOLCETTO CV.

Gabriele Daglio[1], Raimondo Gallo[1], Monica Rinaldi[1], Nadia Massa[2], Valeria Todeschini[3], Fabrizio Mazzetto[1]

[1]*Faculty of Science and Technology, Free University of Bozen (FUB), Piazza Universitá 5, 39100 Bolzano (BZ), Italy*

[2]*Università del Piemonte Orientale, Dipartimento di Scienze e Innovazione Tecnologica - DISIT, Viale T. Michel 11, 15121 Alessandria (AL), Italy*

[3]*Università del Piemonte Orientale, Dipartimento di Scienze e Innovazione Tecnologica - DISIT, Piazza Sant'Eusebio 5, 13100 Vercelli (VC), Italy*

Corresponding author: **Gabriele Daglio,** gabriele.daglio@unibz.it

Oral presentation

Abstract

Viticulture is one of the most important productive sectors of agriculture, especially in the North of Italy. If the vineyards are not properly monitored and managed, they can be subject to a large production of losses, mainly due to vegetative stress or diseases. These issues can be present even if the vineyard is well managed. Among the diseases, the Esca disease (ED) is one of the most widespread in the vineyards, especially in the North-West of Italy and it is difficult to be predicted. The ED is associated with a group of fungal trunk diseases of *Vitis vinifera*. The plant affects by ED shown a general decay, a lack of production and in the most serious cases the plants could die in a very short time. The main symptoms generally appear at level of wood and leaves. When the disease moves on the leaves during the spring, they have yellow spots which turn to red-brown before their complete drying.

This research aims to develop and validate a fast and reliable system able to recognize diseased plants in vineyard through remote sensing applications. This experiment was carried out in a vineyard in the North -West of Italy, where every year a lot of vines affected by ED were recorded. The survey was carried out on several rows of *V. vinifera* plants cv. Dolcetto and Barbera, three for each cultivar. The system tested during this work consisted of a multirotor-UAV (Unmanned Aerial Vehicle) equipped with a multispectral camera. The camera is capable to acquire images in five bands: Blue, Green, Red, RedEdge and Nir. Before starting the UAV flight, a ground survey was performed in order to assess the health status of the plants. All the plants which had disease symptoms or stresses were geoferenced (with RTK-GNSS unit) and classified (from 1 to 4) according to the level of disease as follows: 1) few symptoms on some leaves and not very evident, 2) some symptoms and canopy not dry, 3) general widespread symptoms, canopy partially dry, 4) canopy totally dry. During the field test, the UAV flew at three different flying altitude: 30-50-70 meters. According to the flying altitudes, the collected images were elaborated using Pix4Dmapper software in order to: i) extract the vineyard rows, ii) identify their surface covered by a plant and iii) calculate a NDVI map for each plant. Portion of vineyard row with low NDVI values means that an unhealthy plant was detected. The results obtained were compared and correlated with the information collected during ground survey in order to evaluate which is the best flying altitude in terms of precision, accuracy and low time consuming of data-processing.

23 AIIA Section 7 - Posters

POSTERS

CODE: 052

Topic: Remote Sensing in agricultural and forestry systems

Poster presentation

23.1 A METHOD TO IMPLEMENT A MONITORING SYSTEM BASED ON LOW-COST SENSORS FOR MICRO-ENVIRONMENTAL CONDITIONS MONITORING IN GREENHOUSES

Romano E*., Brambilla M., Cutini M., Toscano P., Bisaglia C.

CREA – Research Centre for Engineering and Agrofood Processing
Via Milano 43, 24047 Treviglio (BG).
Tel. & Fax: +39 0363 49603 – elio.romano@crea.gov.it

Keywords: air temperature, air moisture, protected crops, Arduino board, remote sensing

Greenhouse vegetable and flower productions occur in different environment and latitudes making it difficult the creation of general guideline for microclimate control. Changes in the internal microclimate (e.g. occurring from an increase of air humidity) result in different effects on air temperature at varying of the features of the site where the greenhouse is located (i.e. latitude, altitude, proximity to the coast).

Following this, there is a need for precise monitoring of the greenhouse environment based on a high density of sampling devices which, in turn, result in the substantial increase of the operating costs. However, subsequent to the technological innovation, the acquisition and the running costs of such monitoring devices are nowadays decreasing so that monitoring systems, based on high quality and performance sensors and cards for data storage and processing, are readily available in the market.

This research aimed to find a solution to manage and implement the outcome of various information (humidity, temperature and luminosity) on the internal environment of a tunnel greenhouse to point out the most critical dynamics occurring during the growth cycle of basil plants in summer.

Placing low-cost sensors inside a tunnel greenhouse made it possible to acquire data with an adequate rate (0.1 min^{-1}) and spatiotemporal distribution throughout the facility. Data storage and processing took place thanks to an on purpose created weather station based on Arduino Yun Rev2 board equipped with Wi-Fi module that made it possible its remote control.

According to results the highest variability of temperature and moisture inside the greenhouse occurred when the solar radiation begins to heat the cover of the greenhouse (between 6.00 and 7.00 AM) and few hours after the maximum peak of solar radiation (843.4 ± 133.3 W/m^2).

The use of low-cost sensors combined with spatial fitting of the data provided insights about the effective microenvironmental conditions occurring on daily basis. This, implemented with IoT technologies, will be the base for the realization of economic monitoring systems.

CODE: 132

Reference topic: Computer and communication technologies

23.2 A SKYLINE DEFLECTION ANALYSIS METHODOLOGY FOR TIMBER VOLUME ESTIMATION IN YARDING OPERATIONS

Raimondo Gallo[1], Luca Marchi[2], Stefano Grigolato[2], Raffaele Cavalli[2], Fabrizio Mazzetto[1]

[1] Free University of Bozen-Bolzano, Faculty of Science and Technology, Piazza Universitá 5, 39100, Bolzano, Italy. Phone +39 0471 017623

[2] Dept. Land, Environment, Agriculture and Forestry, University of Padova, Viale dell'Università 16, 35020 Legnaro PD Italy

Corresponding Author: raimondo.gallo@unibz.it

Poster presentation

This paper describes the theoretical approach which can be followed to perform an automatic load monitoring during yarding activities. The goal of this methodology is the weight assessment of the loaded biomass during the inhaul phase in cable logging operations.
The theoretical approach is based on the use of the physical equatins used to design the catenary shape of the yarding skyline as consequence of the deflection due to its own weight, carriage's and load's weights. Indeed, if the main technical features of the yarding line and the distance (the sag) between unloaded and loaded catenary profile are known, by inverting the equations it is possible to calculate the total weight of the load which has generated that deflection.
Referring to the yarding operations, in order to obtain this data, it is necessary to know the linear weight of the rope, the line length (planimetric distance between the spars), the difference in height between the tower yarder and the end spar and the rope deflection reached during the inhaul. Whereas, the deflection is an information which is not possible to know *at priori*, because it is different for each inhaul. To measure this amount, a GNSS unit was installed on the carriage. Data related to latitude, longitude and altitude are used to design the lateral profile of the carriage during the travels. Through this approach it is possible to have the altitude of the carriage along the line during both, the outhaul and inhaul. Besides the rope weight, during the outhaul phases the recorded deflection is proportional to the carriage's weight, while in inhaul it is proportional to the sum of the weights related to the carriage and the load. The subtraction of the values collected in the travels permits to compute the deflection due to the hauled timber. A comparison between the weights estimated by the approach here proposed and those measured through manual surveys during fully suspended yarding operations will be done to validate the accuracy of the proposed methodology.

CODE: 059

AIIA. Section: Remote Sensing in agricultural and forestry systems - Poster

23.3 AN INNOVATIVE METHODOLOGY TO REDUCE TIME CONSUMING DATA ANALYSIS IN PRECISION VITICULTURE

Monica F. Rinaldi [a*], Raimondo Gallo [a], Gabriele Daglio [a], Fabrizio Mazzetto [a].

[a]Free University of Bozen - Bolzano, Faculty of Science and Technology - Fa.S.T., Piazza Università 5, I-39100 Bolzano, Italy, email: MonicaFernanda.Rinaldi@unibz.it*

Abstract: Remote Sensing (RS) tools in Precision Viticulture (PV) to detect disease levels of plants implies big data-sets and time-consuming analysis of data. In this study we used remote images collected by a rotary-wind Unmanned Aerial Vehicles (UAVs) equipped with a Micasense RedEdge.MX^{TM} multispectral camera and a Terrestrial LIDAR Scan (TLS). These tools gave us large amount of data in a short period of time. i.e., one flight with a UAV at thirty meters of altitude implies more than three and a half thousand images in a covered area of approximately three hectares (about 7 Gigabytes). The aim of this research was to develop a methodology that shortens the post-processing phase of data. Our team ran data sets taken from a vineyard orchard during two crop monitoring surveys, in June and August 2018. The monitored vineyard was in Ovada municipality (AL – Piedmont region, North-west of Italy). As a first step of the data procedures, through photogrammetry approaches, Digital Terrestrial Model (DTM) and Digital Surface Model (DSM) to detect the shape of single plants. The achieved results were then validated with the same analysis obtained with those collected by the TLS. We then analyzed the reflectance of the canopy with different methodologies using open source software, to detect changes in the pixels in relation to the reflectance curve between healthy plants and stressed plants, respectively. We expect that the proposed methodology will help us to be time efficient and provide us with a clearly defined step by step approach suitable to detect condition of vegetative stress. The obtained information can be used to define best agronomical practices to carry out to reduce the identified stress.

Keywords: Remote sensing (RS); Precision Viticulture (PV); Unmanned Aerial Vehicle (UAV); LIDAR scan (TSL); multispectral camera.

CODE: 154

Poster session

Section *Topic: Computer and communication technologies*

23.4 DEVELOP OF A MATLAB CODE SYSTEM FOR THE EVALUATION OF SPRAY DISTRIBUTION WITH WATER-SENSITIVE PAPER

Luca Ghiani[1], Alberto Sassu[2], Davide Piccirilli[1], Gianluca Marcialis[3], Filippo Gambella[1].

[1] Department of Agriculture, University of Sassari, Viale Italia 39, 07100 Sassari, Italy.

[2] Inspire s.r.l., Via XXsettembre 33/10, 12121 Genova Italy

[3] Dipartimento Ingegneria elettronica, University of Cagliari, Piazza D'Armi snc, 09123 Cagliari

Abstract. One of the biggest problems of agriculture is the reckless use of pesticides, frequently applied incorrectly, with the consequent waste of product and environmental pollution. The characterization of spray application is a good preventive technique to limit the volume of distributed product, to perform a more efficient application and to restrict the spray drift. Since there is no specific sampling technique useful for every context, it is necessary that every methodology is known in all of its aspects before being employed. The colorimetry, fluorimetry and spectrometry methods are very accurate, but they are costly and time-consuming, compared to the assessment of a water-sensitive paper (WSP), which can be performed through an image's analysis software. This software is able to detect and to estimate different features of the drops using an image, often obtained from a common office scanner. The main objective of this work was to develop a MATLAB code to evaluate the spray distribution over a WSP. After a preprocessing step in which the WSP has been isolated inside the image, the individual drops are identified through the difference between their color (blue) and the color of the remaining dry part of the paper (yellow). Once the surface of every drop has been estimated, we have been able to assess different features, like the number of the drops per cm^2, their Normal Median Diameter (NMD) and Normal Volume Diameter (VMD).

CODE: 156

Reference topic: Innovative biosystems engineering for sustainable agriculture, forestry and food production.

AIIA section: Remote Sensing in agricultural and forestry systems

Poster session

23.5 DETECTION AND MONITORING OF ALIEN WEEDS USING UNMANNED AERIAL VEHICLE IN AGRICULTURAL SYSTEMS IN SARDINIA (ITALY)

Vanessa Lozano[1], Giuseppe Brundu[1], Luca Ghiani[1], Davide Piccirilli[1], Albero Sassu[2], Maria Teresa Tiloca[1], Luigi Ledda[1], Filippo Gambella[1]

1Department of Agriculture, University of Sassari, Viale Italia 39, 07100 Sassari, Italy
2Inspire s.r.l., Via XX settembre 33/10, 16121 Genova, Italy

Emerging technologies such as high-resolution Unmanned Aerial Vehicle (UAV) surveys combined with object-based image analysis and field surveys could represent a reliable, precise and effective tool to support land management in agricultural systems. The technological advances of UAVs can also promote the detection and regular monitoring of invasive alien plants and agricultural weeds. This study was conducted in the framework of two projects funded by the Sardinian Regional Authority, i.e. the project "MARS - *Multiple Airdrones Response System*" and the project "CarBio - *Carciofo Biologico: innovazione e sostenibilità di filiera*". The objective of the study has been to identify, map and monitor alien weed species in agricultural systems to provide an overview on the future applications and challenges of precision farming. In particular, we evaluated how UAV imagery can be used to map and evaluate the cover of *Oxalis pes-caprae*, a South African plant species present in a number of crops in Sardinia as an alien invasive weed, with negative direct and indirect effects on the affected crops. Our core assumption is that the most reliable species discrimination can be achieved by targeting flights during flowering (in late winter - early spring) to allow an easier detection due to species-specific spectral differences. To estimate *O. pes-caprae* cover in the field, we established a network of 1x1 m ground control plots, GPS located, between the artichoke's rows. Additionally, we assessed the presence of possible correlation between the cover estimated in the field and in the UAV imagery. Therefore, *O. pes-caprae* infestation was acquired using RGB, Red Edge and NIR cameras installed on board of a *Phantom 4 pro (DJI)*. As a preliminary result, we present the mapping of *O. pes-caprae*, highlighting the cost-effectiveness and replicability of this approach to detect the presence of this alien weed in agricultural fields.

CODE: 165

23.6 EXPERIMENTAL METHODOLOGY FOR THE CREATION OF PRESCRIPTION MAPS FOR NITROGENOUS FERTILIZERS IN VARIABLE RATE ON CEREAL CROPS.

C. Fiorentino[1], A. Donvito[1], P. D'Antonio[2]

[1] *Digimat SPA, Matera.*
[2] *SAFE, Università della Basilicata.*
paola.dantonio@unibas.it

Agricultural fields in southern Italy have been always considered as uniform entities and managed accordingly. However, uniform agronomic management in fields where spatial variability is present, is economically and environmentally inefficient. Wheat yield production in Mediterranean environment is highly affected by rainfall and amount of soil water stored into the soil before and during the growing season. The crop response to rainfall is a result of dynamic interaction of spatial static properties such as soil texture, position in the landscape and dynamic properties (soil water content, infiltration and crop water use).
The study was carried out on a 18 ha field located in Melfi - Basilicata, Southern Italy during five years of alternate cultivation of wheat and forage. In particular, wheat has been sown in 2013-14 (Duilio), 2015-16 (Saragolla) e 2017-18 (Core) growing season.

Yield map, spatial maps of NDVI index (from Landsat8 satellite, 30m spatial resolution), Digital Terrain Model (DTM, 5m spatial resolution), rainfall and temperature data were collected non-destructively. Total growing season rainfall was correlated with grain yield after dividing it into long fallow (June–November), short fallow (September–November), growing season (December–May), vegetative (December–February), reproductive (March–May). The spatial maps were used to define spatial and temporal yield variability and to identify three stable zones within the field, “low yield stable” (LS), “average yield stable” (AS), “high yield stable” (HS). The LS zone included few pixels located at the boundaries of the field. The pattern of stable zone was highly correlated to the soil topography. Short fallow rainfall was highly correlated with grain yield of HS. March and April rainfall was correlated with the AS zone. This technique is implemented in a web-GIS service.
The objectives of this study were to identify spatially and temporally stable areas throughout the field, understanding the influence of rainfall on spatial and temporal variability of wheat yield.

Starting from this map, prescription maps are produced to experiment the distribution of variable-dose nitrogenated fertilizers with the Kverneland GEOSPAT Exacta TL Fertilizer spreader. This operation in the case of cereal crops, today still represents a highly impactant intervention from the economic and environmental point of view.

CODE: 096

23.7 FOSTERING DIGITAL INNOVATION IN AGRICULTURE AS IN NEW FARM MACHINERY THROUGH TERRITORIAL ECOSYSTEMIC APPROACH AND APPROPRIATE LEARNING STRATEGIES

Valentina De Pascale, Riccardo Lisci, Stefania Lombardo, Marco Rimediotti, Eleonora Salvini, Daniele Sarri, Marco Vieri

[1]DAGRI - Dipartimento di Scienze e Tecnologie Agrarie, Alimentari Ambientali e Forestali, Università di Firenze, Piazzale delle Cascine 15, 50144 Firenze, Italy

Corresponding author: Marco Vieri – marco.vieri@unifi.it

Knowledge flow fluidity perceived today echoes in every scientific field. Theories and methods, as well as innovations, stands themselves out and drown, sometimes in a lonely and dissociative way.

This factor bring to light the issue of communicate the innovation, the terminology and language use, and research sharing, in an environment where digital seems to correspond to abstraction.

Benefits that come from the digital world are many, and even more and give researchers, but also to companies, the chance to put into practice new innovative and advanced techniques. What is important to underline is the potential, maybe today not so expressed, that computerization give to community: the chance to convert it in digitalization. So, digitization is the approach in computerize data, the digitalization is a systemic approach in comprehend the opportunities of technologies, computing, data processing and ICT. Digitalization includes people networks building that transform data in a shareable, affordable and useable resource. Digitalization means complexity, system, network and community.

The university of Florence, through a partnership with other European Universities (Greece, Portugal and Spain), is coordinating since 2018, SPARKLE project in sustainable precision agriculture with systemic point of view, promoting a holistic approach and encourage entrepreneurship in agriculture. Towards innovative teaching methods, that take advantages from the use of technology, the project aims to develop a systemic and open idea of digital world that could build community of practice, not only between the project coordinators but also with all the external entities and targets (student and agripreneurs). This community aspire to a maximum sharing and spreading of knowledge.

The report deals with the needed territorial eco-systemic vision to dominate in a profitable way the huge universe of technologies and practices today available from high tech and digitization.

POSTER

CODE: 028

Topic: *Remote Sensing in agricultural and forestry systems*

***Type of presentation*:** *Poster*

23.8 MONITORING OF COFFEE TREE GROWTH THROUGH CROP SURFACE MODELS AND MGVRI WITH IMAGES OBTAINED WITH RPA

Gabriel Araújo e Silva Ferraz[1*], Luana Mendes dos Santos[1], Marco Thulio Andrade[1], Letícia Aaparecida Gonçalves Xavier[1], Diogo Tubertini Maciel[1], Patricia Ferreira Ponciano Ferraz[1], Giuseppe Rossi[2] and Matteo Barbari[2]

*[1] Federal University of Lavras, Campus Universitário, PO Box 3037, Lavras, Minas Gerais, Brazil,CEP 37200-000, gabriel.ferraz@ufla.br**

[2] Department of Agriculture, Food, Environment and Forestry (DAGRI), University of Florence, Via San Bonaventura, 13 -50145, Florence, Italy

** Author for correspondence*

Abstract:

Monitoring of crops during the vegetative and reproductive period is necessary for precision farming. Currently, remote sensing platforms such as remotely piloted aircraft (RPA) have stood out. Considering the above, the objective of this work was to evaluate the application of MGVRI vegetation index and Crop Surface Models (CSM) with images obtained by an RPA, to monitor the growth of coffee trees in the months, June 2017, December 2017 and May 2018. The experiment was carried out at the Federal University of Lavras, Lavras, Minas Gerais, Brazil, in an area cultivated with coffee species *Coffea arabica* L.. A RPA equipped with a digital camera was used to take photos and AgisoftPhotoScan software was used to build the mosaic of photos and CSM. The processing of the images to obtain the height of the plants, application of the MGVRI index and the preparation of the map layouts were performed in the QGIS software. With the CSM it was possible to identify the crop failure areas. Crop Surface Models (CSM) showed to be a promising technique for the monitoring of coffee tree growth, making it possible to identify crop failures and growth variations. The MGVRI index failed to identify crop failures, confused soil with vegetation and was influenced by variations in lighting in the area.

Keywords: Precision Agriculture, plant height, remote sensing, UAS, index vegetation.

CODE: 144

Topic: Computer and communication technologies

Type of Presentation: POSTER

23.9 RGB IMAGING FOR THE EVALUATION OF BAKERY PRODUCT FEATURES

Souraya Benalia, Bruno Bernardi, Gaetano Messina, Pasquale Barreca, Giuseppe Zimbalatti

University Mediterranea of Reggio Calabria, Department of AGRARIA, Località Feo di Vito, 89122, Reggio Calabria, Italy

Corresponding author: bruno.bernardi@unirc.it

Abstract

Bakery product quality depends on their contents as well as the industrial process they are subject to, including baking. This latter induces many biochemical reactions within the dough, generating a series of complex physico-chemical changes in the final product, determining thus, its external features such as colour, shape, size and texture. The aspect and the colour of a bakery product are among the most important quality parameters taken into account by the consumer while purchasing a determined product. Indeed, the achievement of a specified colouring represents a reliable indicator of an optimal baking. Bakery product colour can be assessed through the browning index (BI) that refers to browning occurrence in either enzymatic or non-enzymatic processes. In this context, the present work aims to assess bakery product features, particularly colour, considering the BI, by employing computer vision systems. Samples of whole-wheat toasted bread were withdrawn from different trays of an industrial oven. RGB images of the samples were first taken using a laboratory computer vision system and then analysed. Colour properties expressed as CIElab *L**, CIElab *a** and CIElab *b** as well as the BI were measured and then statistically analysed. The output showed a significant differences between the samples according to their position in the tray oven (χ^2=591.33, gdl=2, p=2.2 e^{-16}). The principal component analysis PCA results showed different clusters, each one corresponding to the assessed groups of samples. The highest variability is mainly expressed by the first component with 54.152 % followed by the secondo one with 17.492 %.

24 Committees

24.1 SCIENTIFIC COMMITTEE

SURNAME	NAME	ROLE	E-MAIL
SCARASCIA MUGNOZZA	GIACOMO	President	giacomo.scarasciamugnozza@uniba.it
GIORDANO	GIUSEPPE	Vice President	giuseppe.giordano@unipa.it
MONARCA	DANILO	Past President	monarca@unitus.it
COPPOLA	ANTONIO	President of section 1	antonio.coppola@unibas.it
TASSINARI	PATRIZIA	President of section 2	patrizia.tassinari@unibo.it
VIERI	MARCO	President of section 3	marco.vieri@unifi.it
PERGHER	GIANFRANCO	President of section 4	gianfranco.pergher@uniud.it
PESSINA	DOMENICO	President of section 5	domenico.pessina@unimi.it
DI RENZO	GIOVANNI CARLO	President of section 6	giovanni.direnzo@unibas.it
MAZZETTO	FABRIZIO	President of section 7	fabrizio.mazzetto@unibz.it
PRETI	FEDERICO	Vice President of section 1	federico.preti@unifi.it
CASCONE	GIOVANNI	Vice President of section 2	gcascone@unict.it
SARTORI	LUIGI	Vice President of section 3	luigi.sartori@unipd.it
FOPPA PEDRETTI	ESTER	Vice President of section 4	efoppa@univpm.it
CECCHINI	MASSIMO	Vice President of section 5	cecchini@unitus.it, dr.cecchini@alice.it
GAY	PAOLO	Vice President of section 6	paolo.gay@unito.it
TAROLLI	PAOLO	Vice President of section 7	paolo.tarolli@unipd.it, tarolli.paolo@gmail.com
GANDOLFI	CLAUDIO	Director JAE	claudio.gandolfi@unimi.it
BAGARELLO	VINCENZO	Associate Editor JAE	vincenzo.bagarello@unipa.it
BARBARI	MATTEO	Associate Editor JAE	matteo.barbari@unifi.it

24.2 ORGANIZING COMMITTEE

- Antonio Coppola
- Giovanni Carlo Di Renzo
- Giuseppe Altieri
- Paola D'Antonio
- Alessandro Comegna
- Francesco Genovese
- Attilio Matera
- Luciano Scarano
- Luigi Gioviale
- Cosimo Marano

24.3 ORGANIZATION

SAFE - School of Agriculture, Forestry, Food and Environmental Sciences - University of Basilicata

with the technical support of Ninetek Innovazioni per l'Agro-industria s.r.l., spin-off company of the University of Basilicata

With the patronage of:

- *University of Basilicata*
- *SAFE - School of Agriculture, Forestry, Food and Environmental Sciences*

25 Conference Programme

12 September 2019

Main Location: Matera Campus (S1-S2-S3-S4) (link)

09:00 12:30 AIIA Opening

S1			
09:00	11:00	prof. P. Tassinari	Coordination meeting
11:00	12:30	prof. G. Scarascia Mugnozza	AIIA executive committee
S2			
09:00	11:00	prof. P. Balsari	Presentation of European Project TOPPS (link)
S3			
09:00	10:30	dr. F. Genovese	Presentation of European Project MYPACK (link)
S4			
09:00	10:30	prof. G. Schillaci	Presentation of RAGUSA-SHWA (link)
S5			
08:30	11:00	-	AGR/09 full professors meeting
12:30	14:00	FREE	LUNCH

14:00 16:30 Conference Opening

S1				
13:30	16:00	**Registrations Opening**		
		Invited speakers	Oral presentations	
14:00	14:30	prof. G. Scarascia Mugnozza	Conference Opening Welcome Address from Authorities	
14:30	15:00	prof. A. Coppola	Challenges in Soil Hydrology Research (Sfide nel campo dell'idrologia del suolo)	(link)
15:00	15:30	prof. A. Toccolini, prof. P. Tassinari	Rural buildings, landscape, environment: analysis, modeling, monitoring, design, planning (Costruzioni rurali, paesaggio, ambiente: analisi, modellazione, monitoraggio, progettazione, pianificazione)	(link)
15:30	16:00	prof. R. Guidetti	From food transformation to food service: life cycle thinking and green technologies (Dalla trasformazione alla somministrazione degli alimenti: il life cycle thinking e le green technologies)	(link)
16:00	16:30	prof. P. D'Antonio	Precision agriculture and 5G: the new challenges of agricultural mechanics (Agricoltura di precisione e 5G: le nuove sfide della meccanica agraria)	(link)
16:30	17:00	Coffee-break		

17:00 19:00 Parallel Session 1 (oral and/or E-Poster presentation)

S1-S2-S3-S4			
17:00		link to S1 Programme	link to S2 Programme
	19:00	link to S3 Programme	link to S4 Programme

20:30 **Conference Dinner (link)**

13 September 2019

Main Location: Matera Campus (S1-S2-S3-S4) (link)

09:00 11:00 Parallel Session 2 (oral and/or E-Poster presentation)

S1-S2-S3-S4			
09:00		link to S1 Programme	link to S2 Programme
	11:00	link to S3 Programme	link to S4 Programme

11:00	11:30	Coffee-break

11:30 13:00 Parallel Session 3 (oral and/or E-Poster presentation)

S1-S2-S3-S4			
11:30		link to S1 Programme	link to S2 Programme
	13:00	link to S3 Programme	link to S4 Programme

13:00	14:00	LUNCH

14:00 16:00 Parallel Session 4 (oral and/or E-Poster presentation)

S1-S2-S3-S4			
14:00		link to S1 Programme	link to S2 Programme
	16:00	link to S3 Programme	link to S4 Programme

16:00	16:30	Coffee-break

16:30 18:30 Conference Closing

S1			
16:30	17:00	prof. G. Scarascia Mugnozza	Workshop Conclusions
17:00	18:30	prof. G. Scarascia Mugnozza	AIIA Members Assembly

18:30	20:00	MOVE TO LOCATION #2	***SAN ROCCO***	->>> |
				|
		Location #2: San Rocco (link)		<<<- |
20:00	21:00	**Tasting of wines and typical foods of Lucan cuisine**		

kindly offered by "Associazione Cuochi Materani"

(link to website) (link to facebook)

14 September 2019

>>> 09:30 – 12:30 Matera guided tour <<<

26 Room S1 programme (main location Matera Campus)

The room S1 programme is related to presentations belonging to AIIA Section I

	Room	S1	Part 1	Chairman	prof. Alessandro Santini
	Day	12-Sep-2019	CODE #	speaker	Water management in agricultural and forestry systems
1	17:00	17:20		prof. A. Santini	Foreword: Relevant progresses in water management in the agricultural and forestry context
2	17:20	17:40		dr. R. Zucaro	National Program For Rural Development to finance irrigation infrastructures
3	17:40	18:00		prof. C. Gandolfi	Integrated Computer modeling and monitoring for Irrigation Planning in Italy
4	18:00	18:20		dr. F. Marra	The Southern Apennines River Basin District Planning: a Tool for Hydrogeological Risk and Water Bodies Management
5	18:20	18:40		prof. M. Borga	Analysis and predictions of water pathways and partitioning in forest ecosystems: use of isotopic techniques
	18:40	19:00		prof. A. Coppola	Discussion

	Room	S1	Part 2	Chairman	prof. Antonio Coppola
	Day	13-Sep-2019	CODE #	speaker	Water management in agricultural and forestry systems
1	9:00	9:13	11	Lavrnić S.	Removal efficiencies of a surface flow constructed wetland treating agricultural drainage water - a case study from Emilia-Romagna
2	9:13	9:26	21	Todisco F.	A Check of water drop impact effects on surface soil saturated hydraulic conductivity
3	9:26	9:39	54	Licciardello F.	Characterization of constructed wetland substrates and evaluation of their hydraulic behavior
4	9:39	9:52	58	D'Urso G.	Operational monitoring of irrigation in the Campania Region (Italy) for the compliance of EU Water Directive by using Sentinel-2 data
5	9:52	10:05	86	Facchi A.	Groundwater recharge through winter flooding of rice areas
6	10:05	10:18	87	Fabiani G.	How does tree water uptake change over time along a hillslope?
7	10:18	10:31	124	Dragonetti G.	SIRR-MOD - A decision support system for identifying optimal irrigation water needs at field and district scale
8	10:31	10:44	163	Ventura D.	On the performance of a novel hybrid constructed wetland for stormwater treatment and irrigation reuse in Mediterranean climate
9	10:44	10:57	127	Castelli G.	Managing microclimates in agroecosystems: building local resilience with a global perspective

	Room	S1	Part 3	Chairman	
	Day	13-Sep-2019	CODE #	speaker	Water management in agricultural and forestry systems
1	11:30	12:15		Prof. G.B. Bischetti	The didactics in AGR-08 sector
	12:15	13:00			Poster Session

	Room	S1	Part 4	Chairman	prof. Federico Preti
	Day	13-Sep-2019	CODE #	speaker	Water management in agricultural and forestry systems
1	14:00	14:13	6	Bagarello V.	A comprehensive check of USLE-based soil loss prediction models at the Sparacia (south Italy) site
2	14:13	14:26	16	Martini L.	Evaluating the effects of forest cover changes on sediment connectivity in a catchment affected by multiple wildfires
3	14:26	14:39	56	Cislaghi A.	Biodegradable geosynthetics for geotechnical and geo-environmental engineering
4	14:39	14:52	65	Andreoli A.	How much did river restoration projects improve morphological quality? Study cases in South Tyrol.
5	14:52	15:05	85	Errico A.	Managing riparian vegetation in anthropized environments: a modeling tool for the best practice choice
6	15:05	15:18	125	Gentile F.	Modeling the effect of different management practices for soil erosion control in a mediterranean watershed
7	15:18	15:31	101	Zuecco G.	How does evapotranspiration affect streamflow? Ecohydrological monitoring and modelling in two forested catchments
8	15:31	15:44	157	Coviello V.	On the use of critical rainfall thresholds for debris flows in early warning systems: insights from the Gadria catchment, eastern Italian Alps
9	15:44	15:57	158	Petroselli A.	The benefit of continuous modelling for design hydrograph estimation in small and ungauged basins

Poster Session			
1	71	Lama G.F.C.	Two-dimensional numerical modeling of hydraulic experiments in a drainage channel under different riparian vegetation scenarios
2	100	Zuecco G.	Understanding flood generation in meltwater-dominated catchments through stable isotopes of water
3	55	Gandolfi C.	Drought variability and trend over Lombardy plain from meteorological station records (1951–2017)
4	7	Vanella D.	Retrieving reference evapotranspiration for irrigation scheduling: forecast or past weather data?

5	53	Ortuani B.	On the description of soil variability through EMI sensors and pedological surveys in precision agriculture
6	66	Masseroni D.	Comparison of different methods for topographic relief of rural canals for the assessment of flow rate and storage capacity
7	115	Iovino M.	Evaluation of green roof ageing effects on substrate hydraulic characteristics
8	118	Zema D.A.	Effects of channel hydro-morphology and vegetation cover on check dam functioning and conservation in a large river of méxico
9	123	Gentile F.	Influence of check dams on riparian vegetation cover through lai field measurements and remote sensing
10	128	Castelli G.	Validation of Normalized Difference Infrared Index (NDII) to estimate soil moisture in traditional olive cultivation systems, Tunisia
11	159	Bombino G.	A modified catchment connectivity index (mCCI) for applications in mediterranean watersheds
12	167	Palladino M.	A conceptual model for the prediction of soil bulk density
13	98	Tarolli P.	A diagnostic framework for mapping and quantifying the geomorphic impact of wild boars
14	182	Pirastru M.	Field experimental tests for soil erosion evaluation in the coppices of Marganai (Sardinia)

27 Room S2 programme (main location Matera Campus)

The room S2 programme is related to presentations belonging to AIIA Section II

	Room	S2	Part 1	Chairman	prof. Matteo Barbari
	Day	12-Sep-19	CODE #	Speaker	Rural buildings, landscape, environment: analysis, modeling, monitoring, design, planning
1	17:00	17:12	38	Lay-Ekuakille A.	Analysis of the evolution of protected areas by implementing SAR geodata with GIS techniques
2	17:12	17:24	13	Blanco I.	Modelling of the thermal effect of green façades on building surface temperature in Mediterranean climate
3	17:24	17:36	82	Valenti F.	Spatial analysis of feedstock supply and logistics to localise new biogas plants
4	17:36	17:48	49	Finzi A.	Performances of a collective integrated treatment system of livestock manure for energy recovery and nitrogen removal
5	17:48	18:00	102	Santolini E.	Shading screens characterization by means of wind-tunnel experiments and CFD modeling

	Room	S2	Part 2	Chairman	prof. Maria Nicolina Ripa	
	Day	12-Sep-19	CODE #	Speaker	Rural buildings, landscape, environment: analysis, modeling, monitoring, design, planning	
1	18:00	18:12	97	Sigura M.	Ecosystem services assessment for ecological corridors: a study case at local scale in Italy	
2	18:12	18:24	26	Fabrizio E.	Thermal Environment Inside a Mechanically Ventilated Greenhouse: Results from a Long-Term Monitoring	
3	18:24	18:36	121	Barbaresi A.	The incidence of building envelope design in the thermal behaviour and energy need of food processing buildings	
4	18:36	18:48	122	Ledda A.	Adaptation to climate change in Sardinia: a scrutiny of regional plans	
1	18:48	18:51	46	Lanteri P.	Definition of a methodology to support planning and design of agricultural areas within suburban parks	E-Poster
2	18:51	18:54	169	Paolillo A.	Design of catering facilities: a meta-design approach	E-Poster
3	18:54	18:57	180	Fuina S.	Enhancement of the roman bridge of Canosa in the Ofanto valley landscape	E-Poster
4	18:57	19:00	17	Conti C.	Odor nuisance in the livestock field: a review	E-Poster

	Room	S2	Part 3	Chairman	prof. Claudia Arcidiacono
	Day	13-Sep-19	CODE #	Speaker	Rural buildings, landscape, environment: analysis, modeling, monitoring, design, planning
1	9:00	9:12	117	De Montis A.	Assessing resilience: a comparative approach to ecological networks
2	9:12	9:24	107	Bovo M.	Damages to rural buildings and facilities observed in the aftermath of 2012 Emilia earthquakes
3	9:24	9:36	141	Marcheggiani E.	Community Led Local Development and PSL, potentials for refuelling the urban-rural linkage: a case in central Italy
4	9:36	9:48	84	Guido V.	Ammonia emission reduction with innovative slurry fertigation techniques: first results of the project LIFE ARIMEDA
5	9:48	10:00	36	Fuina S.	Innovative tensile structures for protected crop facilities

	Room	S2	Part 4	Chairman	prof. Marcella Guarino	
	Day	13-Sep-19	CODE #	Speaker	Rural buildings, landscape, environment: analysis, modeling, monitoring, design, planning	
1	10:00	10:12	173	Modica G.	Proposal of a Web-based Multi-Criteria Spatial Decision Support System (MC-SDSS) for agriculture	
2	10:12	10:24	30	Ponciano P.	Physical properties of panels produced with cement and lignocellulosic materials	
3	10:24	10:36	112	Porto S.M.C.	Modelling dairy cow behaviour in free stall barns: the case study of cow oestrus detection from accelerometer data	
4	10:36	10:48	18	Cillis G.	Spatial analysis of rural buildings impact on agro-forestry landscape using GIS	
1	10:48	10:51	179	Liano E.	The Apulian territory through visual research	E-Poster
2	10:51	10:54	142	Marcheggiani E.	Geotagged social media to characterize tourist flows in rural areas: a case in southern Italy	E-Poster
3	10:54	10:57	25	Barbari M.	Milk-production in barns with compost bedding and free stall: a profitability analysis	E-Poster
4	10:57	11:00	114	Tomasello N.	Mesh generation for CFD simulations for a dairy cow semi-open free-stall barn	E-Poster

	Room	S2	Part 5	Chairman	prof. Salvatore Di Fazio	
	Day	13-Sep-19	CODE #	Speaker	Rural buildings, landscape, environment: analysis, modeling, monitoring, design, planning	
1	11:15	11:27	5	Bibbiani C.	Evaluation of Green-walls Efficiency for Building Energy Saving	
2	11:27	11:39	---	---	---	
3	11:39	11:51	175	Cervelli E.	Spatial MultiCriteria Decision Analysis and Ecosystem services in the Vesuvius National Park (southern Italy) as a tool for post-fire landscape restoration planning	
4	11:51	12:03	130	Gholami M.	Calibrated Simulation of a Farm Building Farmstead: Defining Uncertainty of Rural Buildings Energy Models	
1	12:03	12:06	45	Guarino M.	Smart dairy farming: innovative solutions to improve herd productivity	E-Poster
2	12:06	12:09	116	Parlato M.	Heatmap Production for Greenhouse Plastics Waste Management	E-Poster
3	12:09	12:12	131	Castellano S.	Net fences against insect vectors of Xylella fastidiosa	E-Poster
4	12:12	12:15	178	Recanatesi F.	Assessment of climate change impact in a peri-urban watershed of the metropolitan area of Rome (Italy)	E-Poster

	Room	S2	Part 6	Chairman	prof. Daniele Torreggiani
	Day	13-Sep-19	CODE #	speaker	Rural buildings, landscape, environment: analysis, modeling, monitoring, design, planning
1	12:15	12:27	60	Manniello C.	Planning the flows of residual biomass produced by wineries for their valorisation in the framework of a circular bioeconomy
2	12:27	12:39	126	Serra V.	Indicator of connectivity: application to specific Sardinian cases
3	12:39	12:51	61	Mattachini G.	Effects of feeding frequency on the behavior patterns of dairy cows in an automatic feeding and milking system
4	12:51	13:03	14	Convertino F.	Heat fluxes in a green façade system: mathematical relations and an experimental case
5	13:03	13:15	177	Costantino A.	Standardized Assessment of the Energy Performance of Animal Houses: a Case Study of two Growing-Finishing Pig Houses

	Room	S2	Part 7	Chairman	prof. Andrea De Montis
	Day	13-Sep-19	CODE #	speaker	Rural buildings, landscape, environment: analysis, modeling, monitoring, design, planning
1	14:15	14:27	31	Ponciano P.	Physical proprieties of alternative bedding materials for dairy cattle
2	14:27	14:39	47	D'Emilio A.	Modeling soil thermal regimes during a solarization treatment in closed greenhouse by means of symbolic regression via genetic programming
3	14:39	14:51	137	Fumagalli N.	Users' Perception and preference of different vegetation configuration along rural greenways
4	14:51	15:03	4	Grohmann D.	Urban agriculture, cui prodest? Seattle's Picardo farm as seen by its gardeners
5	15:03	15:15	160	Bacenetti J.	A life cycle assessment comparative study of digestate application with fertigation and traditional techniques in LIFE ARIMEDA project
6	15:15	15:27	35	Benni S.	A numerical model quantifying heat stress susceptibility of individual dairy cows
7	15:27	15:39	50	Statuto D.	Comparison of the efficiency of plastic nets for shading greenhouse in different climates

28 Room S3 programme (main location Matera Campus)

The room S3 programme is related to presentations belonging to AIIA Section III

	Room	S3	Part 1	Chairman	prof. Giovanni Molari
	Day	12-Sep-19	CODE #	speaker	Mechanization and technologies for agricultural production
1	17:00	17:15	69	Mayr S.	Brotweg – A path of bread in an alpine environment: new mechanical solutions for grain processing in steep mountain slopes
2	17:15	17:30	70	Maraldi M.	Validation of a test-set for the assessment of the performance of front axle suspension systems in narrow-track tractors
3	17:30	17:45	151	Bietresato M.	Proposal of a mixed experimental-numerical approach to evaluate the effects of diesel-biodiesel-bioethanol blends for fuelling farm tractors
4	17:45	18:00	139	Pessina D.	TRACLAS: a compact tractor project to improve the safety when working on slope under canopy
5	18:00	18:15	1	Regazzi N.	Computational evaluation of the tractive performance of a M.F.W.D. tractor
6	18:15	18:30	15	Pessina D.	N-TRE: a model for the evaluation of the Narrow Tractors Real Efficiency
7	18:30	18:45	105	Mattetti M.	Automatic estimation of tractor mission profile using CAN-BUS data
	18:45	19:00			Poster Session

	Room	S3	Part 2	Chairman	prof. Luigi Bodria
	Day	13-Sep-19	CODE #	speaker	Mechanization and technologies for agricultural production
1	9:00	9:15	106	Marinello F.	Modelling of agricultural machinery trends for power, weight, working width and price
2	9:15	9:30	72	Calcante A.	A new model to estimate the total lubricant oils consumption rate in agricultural tractors
3	9:30	9:45	3	Bacenetti J.	The best environmental impact alternative for soil tillage and sowing: farmer or contractor?
4	9:45	10:00	67	Varani M.	Performance comparison of a plough equipped with worn and new ploughshares
5	10:00	10:15	111	Ricauda Aimonino D.	Tractor-rotary harrow forces interactions: first field measurements
6	10:15	10:30	2	Bacenetti J.	Economic and environmental performances of a new double wheel rake
7	10:30	10:45	68	Holzner L.	The Development of a Small Stripper Header for Cereal Harvesting in Steep Mountain Environment
	10:45	11:00			Poster Session

	Room	S3	Part 3	Chairman	prof. Pietro Catania
	Day	13-Sep-19	CODE #	speaker	Mechanization and technologies for agricultural production
1	11:30	11:45	140	Oberti R.	Improved estimation of leaf biomass in Romaine lettuce cultivation trough 3D imaging approaches
2	11:45	12:00	109	Nonini L.	High accuracy site-specific secondary data for mechanical field operations to support LCA studies
3	12:00	12:15	110	Nonini L.	Assessment of forest biomass and carbon stocks at stand level using site-specific primary data to support forest management
4	12:15	12:30	88	Grigolato S.	Evaluation on the stability of tree used as anchors in cable yarding operations
5	12:30	12:45	19	Perone C.	Controlled mechanical ventilation to reduce primary energy consumption in air conditioning of greenhouses
	12:45	13:00			Poster Session

	Room	S3	Part 4	Chairman	prof. Paolo Balsari
	Day	13-Sep-19	CODE #	speaker	Mechanization and technologies for agricultural production
1	14:00	14:15	136	Pessina D.	LIFE-Vitisom: a EU project for the set-up of VRT organic fertilization in vineyard
2	14:15	14:30	10	Pergher G.	A prototype, biomass-fueled flamer for in-row weed control in vineyards
3	14:30	14:45	41	Manzone M.	Technical solutions for under-row weed control in vineyards: efficacy, costs and environmental aspects analysis
4	14:45	15:00	62	Grella M.	The influence of air speed and liquid flow rate on pneumatic spray quality
5	15:00	15:15	63	Grella M.	Toward a methodology to classify airblast sprayer according to their drift potential reduction performances
6	15:15	15:30	64	Marucco P.	OPTIMA H2020 and LIFE-PERFECT projects: development and application of new techniques for sustainable PPP spray application
7	15:30	15:45	73	Gioelli F.	The H2020 INNOSETA project
	15:45	16:00			Poster Session

Poster Session			
1	22	Catalano P.	Digital image method to evaluate the ecological efficiency of a specific machine for distribution of pesticides in vineyards of Apulian Region
2	27	Cutini M.	Efficiency of tractor drawbar power taking into account soil-tire slippage
3	29	Rimediotti M.	Unmanned aerial vehicles (UAVs) for crop protection stage in high slope terraced vineyard: a case study
4	57	Pochi D.	Design and assessment of a test rig for hydraulic fluids
5	113	Sartori L.	Sensorization of a rotary harrow for optimization of soil tillage operation
6	150	Tangorra F.	Real-time measurement of silage moisture content during loading of a TMR mixer wagon: preliminary results
7	152	Bietresato M.	An integrated system for the real-time detection and recording of engine parameters of agricultural machines during dyno tests: development, set-up and first tests
8	155	Gambella F.	Development and implementation of an Ultra-Low Volume (ULV) spraying equipment installed on a commercial UAV
9	181	Pascuzzi S.	Assessment of a big square baler able to reduce soil impurities during baling process. First evaluations
10	79	Cerruto E.	Sprayer inspection in Sicily on the basis of workshop activity
11	81	Petrera S.	Comparative Evaluations of Conventional and Multispectral Cameras to Detect Plant Bloom Charge in a Controlled Environment

29 Room S4 programme (main location Matera Campus)

The room S4 programme is related to presentations belonging to AIIA Section IV, V, VI and VII

	Room	S4	Part 1	Chairman	prof. Giancarlo Colelli (AIIA Section VI)
	Day	12-Sep-19	CODE #	speaker	Machines and facilities for agricultural products and food processing
1	17:00	17:12	51	Vallone M.	Pneumatic press application to process pomegranate fruits
2	17:12	17:24	75	Babellahi F.	Non-destructive classification of olives based on hardness using spectral profiles and hyperspectral imaging
3	17:24	17:36	89	Beghi R.	Testing of optical prototypes for the fruit and vegetable sector: case studies from pre- to post-harvest
4	17:36	17:48	90	Casson A.	Life Cycle Thinking applied to the analyses sector: a case study on olive oil analyses using E-LCA and LCC approach
5	17:48	18:00	103	Romaniello R.	Ultrasound and pulsed electric fields technologies applied to the olive oil extraction process
6	18:00	18:12	104	Leone A.	Industrial demonstration of megasonics technology for enhanced oil recovery
7	18:12	18:24	135	Catania P.	A new malaxer for improving extra virgin olive oil quality
8	18:24	18:36	145	Amodio M.	Spectral fingerprinting approach for the prediction of internal constituents and classification of rocket leaves (diplotaxis tenufolia) based on season of harvest
9	18:36	18:48	171	Matera A.	The effects of materials and assembly methods on gas selectivity of Blow ® device
	18:48	19:00			Poster Session

	Room	S4	Part 2	Chairman	prof. Paolo Gay (AIIA Section VII)
	Day	13-Sep-19	CODE #	speaker	Remote Sensing in agricultural and forestry systems
1	9:00	9:12	108	Chiappini S.	Design of a database for data management in precision farming and decision support systems
2	9:12	9:24	43	Lanucara S.	A prototype of service oriented architecture for precision agriculture
3	9:24	9:36	-	-	-
4	9:36	9:48	42	Benni S.	Computer vision identification and position detection of Friesian cows
5	9:48	10:00	77	Comba L.	Low complexity vineyard modelling from UAV based dense 3D-point clouds for precision agriculture
6	10:00	10:12	78	Sarri D.	AgroBot Smash a robotic platform for the sustainable precision agriculture
7	10:12	10:24	93	Daglio G.	Use of a multirotor-UAV equipped with a multispectral camera to detect vineyard diseases: a case study on Barbera and Dolcetto cv.
8	10:24	10:36	129	Castelli G.	Multi-Sensor UAV Application for Thermal Analysis on a Dry-Stone Terraced Vineyard in Rural Tuscany Landscape
9	10:36	10:48	133	Sarghini F.	Neural Network algorithms for real time plant diseases detection using UAV
10	10:48	11:00	172	Modica G.	Monitoring onion crops using UAV multispectral and thermal imagery: first results
11	11:00	11:12	153	Gambella F.	Use of UAVs and Canopy High Model applied on a time scale in the vineyard.

	Room	S4	Part 3	Chairman	prof. Marco Fiala (AIIA Section IV)
	Day	13-Sep-19	CODE #	speaker	Agricultural electrification and energy usage
1	11:30	11:45	95	Castellucci S.	Anaerobic digestion of agro-industrial wastes: a review on process
2	11:45	12:00	94	Castellucci S.	Lignocellulosic Biomass : chemical and thermal pre-treatment for energetic utilization in anaerobic digestion process
3	12:00	12:15	138	Villarini M.	Comparison of environmental impact of two different bioelectricity conversion technologies by means of LCA
4	12:15	12:30	99	Pezzuolo A.	Energy Efficiency Assessment of Fully Automated Dairy-Farm
5	12:30	12:45	8	Ilari A.	Life Cycle Impact Assessment of carrot cultivation and processing: An Italian case study for a small family company in the Marche region
6	12:45	13:00	9	Todde G.	Does precision photovoltaic irrigation represent a sustainable alternative to traditional systems?

	Room	S4	Part 4	Chairman	prof. Danilo Monarca (AIIA Section V)
	Day	13-Sep-19	CODE #	speaker	Operators' safety and well-being in agricultural activity
1	14:00	14:15	12	Zambon I.	Spatial analysis for detecting recent work accidents in agriculture in Italy
2	14:15	14:30	24	Vigoroso L.	A bottom-up approach to tractor safety: improving the handling of Foldable Roll-Over Protective Structures (FROPS) through User Centred Design
3	14:30	14:45	76	Manetto G.	Effects of rod and oscillating frequency on the vibrations transmitted to hand-arm system by two olive portable harvesters
4	14:45	15:00	39	Biocca M.	Technical and economic evaluation of urban trees pruning by climbing arborists
5	15:00	15:15	40	Caria M.	Performance and usability of augmented reality head-wearable device in livestock farming operations
6	15:15	15:30	134	Lombardo S.	New Approaches For Agriculture: Rational And Innovative Methods For Sustainable Production
7	15:30	15:45	183	Busato P.	Optimisation of manpower utilisation in a professional food service by means of discrete event simulation models
	15:45	16:00			Poster Session

Poster Session			
1	20	Carnevali C.	Development of an Energy Efficiency Index for Agricultural Tractors based on OECD Codes data
2	37	Fedrizzi M.	Evaluation of coaxial pipes for basal heating as alternative heating system for leafy vegetables
3	184	Sopegno A.	The Erasmus+ Project PLANET: plan for agriculture renewable energy training
4	162	Gubiani R.	The risk in forestry workers in Friuli Venezia Giulia. An overview in last 200 years
5	23	Bianchi B.	Ambient and personal noise exposure assessment in a pasta factory
6	33	Colantoni A.	Designing and defining good practices in the service of the Workers' Representative for Safety in Agriculture: the project for a META-RLS
7	44	Fanigliulo R.	First tests on a prototype device for the active control of the vibrations on agricultural tractors
8	48	Pampuro N.	Farmers' attitudes toward on farm adoption of soil organic matter: evidence from Piedmont region, Italy
9	80	Caffaro F.	Perceived barriers to the adoption of Smart Farming Technologies in Piedmont region, Northwestern Italy: the role of user and farm variables
10	120	Cecchini M.	Preliminary investigation on systems for the preventive diagnosis of faults on agricultural operating machines
11	164	D'Antonio P.	Risk perception in forest utilizations: experimental analysis in the Basilicata forest sites.

12	176	Proto A.	The evaluation of technical performances of orchard-pruning residue harvester in Calabria
13	143	Failla S.	Effect of different axial fans configurations on airflow rate
14	32	Cevoli C.	Potential of the hyperspectral imaging to determine dockage and foreign materials in grain
15	34	Cevoli C.	Inversion of a numerical model to estimate the effective moisture diffusivity in baking cake
16	74	Babellahi F.	Early detection of chilling injury in cucumbers using hyperspectral imaging and chemometrics methods
17	91	Beghi R.	Environmental benefits: conventional vs innovative packaging for olive oil
18	92	Beghi R.	The E-LCA as a tool to quantify the environmental impact of meat and legumes-based burgers
19	146	Amodio M.	Hyperspectral Fluorescence Imaging Method for Early Detection of Mature and Immature Green Tomatoes (Solanum Lycopersicum L.)
20	147	Colelli G.	Sustaining low-impact practices in horticulture through non-destructive approach to provide more information on fresh produce history & quality (fresh&low)
21	148	Colelli G.	Reducing mechanical damage induced by fresh-cut processing
22	149	Pagano M.	Use of ultrasounds in the extraction process of virgin olive oil and influence on malaxation time
23	161	Colantoni A.	Innovative technologies for the feeding of dairy cattle to ensure animal welfare and production quality (INNOVALAT)
24	166	Angeloni G.	An innovative vat for the continuous recovery of volatile compounds during fermentation
25	168	Genovese F.	Effect of packaging technology on the quality of pre-cooled Clementine fruit
26	170	Matera A.	Optimization of Donkey Milk Pasteurization Process
27	174	Angeloni G.	Sieving optimization to produce wood chips of high quality
28	132	Gallo R.	A skyline deflection analysis methodology for timber volume estimation in yarding operations
29	144	Benalia S.	RGB imaging for the evaluation of bakery product features
30	154	Gambella F.	Develop of a matlab code system for the evaluation of spray distribution with water-sensitive paper
31	28	Ferraz G.	Monitoring of coffee tree growth through Crop Surface Models and MGVRI with images obtained with RPA
32	52	Romano E.	A method to implement a monitoring system based on low-cost sensors for micro-environmental conditions monitoring in greenhouses
33	59	Rinaldi M.F.	An innovative methodology to reduce time consuming data analysis in Precision Viticulture
34	96	Salvini E.	Fostering digital innovation in agriculture as in new farm machinery through territorial ecosystemic approach and appropriate learning strategies
35	156	Gambella F.	Detection and monitoring of alien weeds using Unmanned Aerial Vehicle in agricultural systems in Sardinia (Italy)

36	165	D'Antonio P.	Experimental methodology for the creation of prescription maps for nitrogenous fertilizers in variable rate on cereal crops.

Biosystem Engineering for sustainable agriculture, forestry and food production

International Mid-Term Conference 2019
Italian Association of Agricultural Engineering (AIIA)

Matera, University of Basilicata, September 12-13, 2019