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strategies for the development of agricultural mechanisation
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28th Club of Bologna Members' Meeting
Session Conclusions (Session 3)

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SESSION 3

SPECIFIC MECHANIZATION: MACHINES FOR HORTICULTURE

by the Session Coordinator and Chairman: Paolo Balsari (Italy)

CONCLUSIONS

Chairman Session Conclusions

The following four oral presentations were brought forward in this Session that was then followed by a discussion:

1. The future of horticultural mechanization by *Silvana Nicola, Univerisity of Turin - Italy*
2. Horticulture mechanization and automation in open-field: state of the art and future prospective *by Danilo Monarca, University of Tuscia - Italy*
3. Automation and robotics in the protected environment, current developments and challenges for the future *by Jochen Hemming, Wageningen Univeristy & Research – The Netherlands*
4. Mechanization and automation in post-harvest processing *by Giancarlo Colelli, University of Foggia – Italy*

In the last decades there has been a large improvement of the mechanization in horticulture but still the incidence of the manpower in the final crop production costs is up to 10 times more when compared with cereals production costs and broad scale agriculture. This, as was mentioned in the *Silvana Nicola* contribution, has and it is still generating low productivity and high production costs considering also the yearly increasing of the labor cost. In addition, intensive horticulture crops require skilled labor not always easy to found and for all these reasons growers are looking to mechanization and especially automation as a profitable solution. Robots could be used in nurseries, greenhouses, open field for monitoring, picking and harvesting, grading and sorting and packing. But this innovation will come only through an intimate understanding of all parts of the system and by a multidisciplinary research, involving plant scientists, engineers, food scientists, economists and marketing expertise.

Concerning the specific mechanization and automation in open field, *Danilo Monarca* in his presentation, after having underline that more than 50% of the worldwide horticultural production come from China and only 6% from EU, has describe the machines at present used, starting from the sowing and transplanting till the harvesting ones and the most recent innovations. Concerning the harvesting he has underline that the distinction between product for the fresh market and for the processing industry is fundamental and that for the product destined directly to the table, the use of manual or only partially facilitated harvesting yards is still very widespread. There is, in that sense, the need of a more integration between the harvesting process and the post-harvest phase.

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In commercial greenhouse automation is already applied, been considered a valuable solution to obtain more yield, better product quality and much higher resources efficiency, was mentioned by *Jochen Hemming* in his presentation. This include logistic and autonomous transport of plants and harvested product in the greenhouse, spraying robots, machine vision based sorting systems for pot-plants and cut-flowers and robotic cutting, planting and grafting machines. Actual researches focus on automated crop scouting with particular effort on disease detection, phenotyping and robotic harvesting and will be able to achieved their objectives also thanks to the worldwide continuous improvement in computer hardware, software and artificial intelligence. Still needed to make robotic systems performing faster and in a simple and safe way. From the plant side the breeding of crops with novel phenotypes and plant architectures, such as fruits which are easy to see and reach by robots, will simplify and accelerate the application of robotics. From another side big players like Google, Amazon and Facebook are already pushing the development of autonomous navigation, big-data and artificial intelligence

Giancarlo Colelli in the introduction of his presentation on postharvest has underline the importance of this operation considering that fresh fruit and vegetable have living tissues witch carry on metabolic processes related to ripening and senescence and the need to maintain and preserve their high nutrition value and freshness. The extent to which their quality is compromised depend mainly on the postharvest process. Operations as washing and drying could cause relevant mechanical stress and losses of sugars and nutrients. The last decade has represented a time of great innovation for the postharvest equipment; most notably the development of optical technologies enabling to evaluate internal quality of individual fruits and to reveal more information on pre-harvest history of product, thus adding more value to the consumer. Recent innovations are mainly focused on the reduction of the impact of the postharvest operations on the product quality maintain the requested level of sustainability of the process in terms of work capacity, costs include the energy one, and environmental impacts.

During the *discussion* the participants pointed out that labor cost and human safety are the more driven key of automation in these crop area. The introduction of robot could decrease the dependence on seasonal labor which is often unavailable and unskilled. Also if probably in five years will be available commercial robot in greenhouse the human work will anyway remain in the loop also in the future. The speed of several robots is still limited, especially when applied in harvesting, and need to be increase especially in terms of actuators speed. To reach this goal a multidisciplinary research is essential.

At the end of Session Danilo Monarca have guided several of the CoB FM attending the 29th meeting to the *visit of the Stands* of some of the Manufacturers of machines for horticulture that were present at the EIMA fair exhibition. The Manufacturers visited are the following: CHECCHI & MAGLI; HORTECH Srl; GUARESI SpA; FERRARI COSTRUZIONI; MECCANICHE Srl; ORTOMEC Srl; FEDELE MARIO; J.J. BROCH S.L