TECHNIQUES AND MACHINES FOR CONSERVATION AND ORGANIC AGRICULTURE: THE S.M.O.C.A. PROJECT

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The combination of low environmental impact farming techniques and conservation agriculture techniques is considered not feasible due to some limitations, mainly including is the strong dependence of conservation cropping systems by chemical control of weeds and the use of mineral fertilizers, which are considered essential for supporting to acceptable levels of crop productions.

In order to apply the techniques of reduced tillage also in organic and integrated agriculture, is therefore indispensable, on one hand, the availability of specific versatile and efficient machines for non-chemical cover-crop management, weed control and sod-seeding/planting, on the other hand, the optimization of cropping systems in function of improved nutrient cycling and preventive weed control.

The SMOCA project (Smart Management Conservation of Organic Agriculture) aims to integrate organic cropping systems and conservation agriculture techniques in three different scenarios (arable open field, open field vegetables and orchards) thanks to development of machines and technical itineraries that allow to apply the reduced tillage techniques even in the absence of pesticides.

Within this project, prototypes of machines were realized in order to implement conservation cropping systems with high energy efficiency.

For each scenario, three technical itineraries were compared:

- control (INT): based on integrated agriculture without use of conservation agriculture techniques. The use of agrochemicals is allowed in accordance with the disciplinary for integrated production;
- organic system (ORG): based on the organic agriculture, involves the use of cover crops (managed as green manure) and soil tillage. The non chemical management of weed flora is achieved with preventive methods and direct methods (mechanical and thermal weed control);
- organic and conservation system (ORG +): based on the deep integration between the principles of conservation agriculture and organic farming. The system aims to achieve an almost continuous coverage of the soil through the use of no-tillage techniques and cover crops managed as living or dead mulches.

The study of the overall sustainability of the different systems in comparison is conducted by means of a detailed analysis of the following aspects:

- agronomic;
- energy and environmental;
- economic.

The environmental effect of the compared systems will be mainly assessed through the study of the following aspects: greenhouse gas emissions, nutrient balance, preservation of soil quality, biological nitrogen fixation, conservation of water resources in the soil and the life cycle assessment (LCA). The efficiency and the impact of different management techniques are also continuously monitored on the orchard and vegetable crops through the study of the fruits of growth dynamics, thanks to an innovative methodology that uses a network of growth sensors spatially distributed in the field. The final product quality is also evaluated through the analysis of their levels of nutraceutical compounds. The research project is still ongoing and the prototypes of machines realized are presented in this paper.

NEW METHODOLOGICAL APPROACH FOR OPERATIONAL MONITORING OF CHAINSAW FOR THE MOTOR MANUAL FELLING OPERATIONS: PRELIMINARY RESULTS

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The present work shows the preliminary results obtained by the application of an innovative approach for the operative monitoring of the entire logging chain. This work focusses on a new proposal of innovative solution (software and hardware) of Precision Forestry, which can be employed as information system for the management of the forest companies. In general, the proposed system will be able to manage operational information as: i) the positioning, the measurement of the tree's diameter and the estimation of the volume of the tree that will be cut ii) the automatic monitoring of the felling operation performed with the chainsaw, iii) the automatic monitoring of the logging activities from the felling site to the storage. The employment of this system will allow to obtain operative information for the compilation of the register of activity, suitable to be used for the certification and traceability process as well as for the estimation of the operative costs.

The preliminary analysis has taken into account the operations performed with the use of chainsaw. The operational parameters, which characterized the productivity of felling operations through chainsaw, have been monitored thanks to the use of dedicated ICT devices. In order to detect the phases that compose the felling operation, it has been considered that the lumberjack during the effective cutting drives the chainsaw with the engine with the highest rpm. In this condition the vibration generated by the machine reaches the maximum amplitude. Therefore, assessing the duration of the vibration with the maximum amplitude, it is possible to define the effective time and the surface interested by the cut since these variables are proportional.

The experiment was conducted in a controlled environment, where a professional chainsaw (Husqvarna 560 SP) was equipped with a triaxle accelerometer. The accelerometer was installed on the upper part of the chainsaw and it was set with a sampling frequency of 1kHz.

Three vertical cuts and one which reproduce the actual felling cut (backcut+undercut) were carried out on seven logs with different diameters. During the cutting a manual time study were performed in order to validate the estimation obtained by the proposed approach.

The preliminary analysis of the results highlighted that the application of an accelerometer on the chainsaw is a good and interesting solution for the assessment of both the time study and the surface interested by the cutting. In conclusion, the tested device can be considered as a tool of Precision Forestry only if it will be possible to integrate it in a hardware with small dimension in order to avoid stress to the operator during his activities.