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of a tillable platform. Moreover the main health risks due to biomechanical overload (risk of WRMSDs - Work Related Muscle Skeletal Disorders) have been analyzed through the risk index assessment, with particular regard to the operators involved in harvesting and in manual handling of the product. Data analysis and evaluation of safety aspects will identify the machine's ability to meet the harvesting operations and any limitations in terms of safety.

AUTOMATIC DETECTION OF POWDERY MILDEW IN GRAPEVINE: IMAGING APPROACHES FOR ACCURATE SENSING IN FIELD CONDITIONS

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Key words: disease detection, multispectral imaging, grapevine, precision crop protection.

Powdery mildew (*Erysiphe necator* Schwein) is a major fungal disease for grapevine, and for other specialty crops as well as, causing severe damages to yield and quality of the produce.

This disease is thoroughly controlled by uniform fungicides spraying to vineyards, following a calendar that can easily result in ten to fifteen fungicide treatments conducted with application rates of 500-1000 dm^3/ha or higher. Nevertheless, since primary infections are not evenly diffused, but rather they emerge from discrete foci, there is an evident potential of benefits associated to the development technologies for high-precision crop protection, *i.e.* systems able to detect initial infection foci and to operate targeted treatments on them, instead of applying homogenous and unselective sprayings as currently done.

Thanks to its specific features, proximal optical sensing from tractor, or other field platform, is a major candidate technique to early detect infection foci in grapevine and other specialty crops with vertical canopy structure.

In the case of powdery mildew infection, anyway, the sensitivity in detecting early symptoms can be largely limited by the combination of small dimensions, low density, and spatial arrangement of thin fungal structures.

This paper illustrates some of the results obtained by the authors in different experiments conducted on grapevine's powdery mildew automatic detection by means of multispectral imaging (in green, red and near-infrared channels) and of hyperspectral imaging (in 450-900 nm); and it discusses the measurements approaches aimed to improve the accuracy of the detection in field conditions and the data analysis algorithms.

THE OPEN FLAME "PYRO-DISINFECTION" AND "PYRO-WEEDING" HEAT TREATMENTS FOR THE SUSTAINABLE CULTIVATION OF LEAFY GREENS

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Key words: LPG flaming, leaf vegetables, minimum tillage, weed control, crop residue.

"Fresh-cut leafy vegetables" are horticultural crops grown for the production of ready-to-eat (RTE) bagged salads. In Italy specialized farms grow these crops mainly under protected cultivation, using high technical levels to ensure high-quality produce. To remunerate investments adequately, growers need to repeat many crop cycles throughout the growing season and the soil is repeatedly tilled to sow succeeding cycles. Soil preparation commonly involves primary tillage with spading and rototilling tools, incorporating previous crop residues and organic fertilizers, followed by secondary tillage to form suitable raised seed beds. This intensive tillage causes great soil disturbance, accompanied by degradation of soil structure and acceleration of soil organic matter mineralization. Plant health is also an important issue, the high planting density and the microclimatic features of the greenhouse may promote the development of plant diseases. Disease management is difficult because the production cycle is very short and few active substances are authorized for use. The adoption of wide crop rotations and other agricultural practices that interrupt cultivation, such as soil solarization or green manures, is not economically feasible in the greenhouse. The leaves are harvested at commercial maturity by cutting the stem above the soil level, but leaving the crown and the roots in place. The green residue is ordinarily incorporated in the soil, however such a practice should be avoided because plant pathogens survive on crop debris and inoculum may accumulate in the soil. Removing all crop residues after harvest is an effective management strategy to help prevent diseases from becoming established. Dedicated machinery and farm implements have been specifically developed for managing crop residue and for reducing tillage intensity. These machines combine the removal of crop residues and the use of "open flame" LPG burners, applying a thermal treatment that disinfects crop residues and the top layer of the soil, removing inocula and eliminating weed seeds. The integration of these mechanical actions will enable farmers to switch from ordinary tillage to reduced tillage systems: after harvest all residues are removed employing a brush-cleaner and/or an uprooting horizontal blade, together with a broadcast flame treatment to accelerate the dehydration of green residues. Following this soil cleaning phase, the raised beds are prepared for the next cycle using a specifically designed combined-type machine, that integrates a heat treatment apparatus with a vertical axis rotary hoe for shallow tillage. This innovative system prepares the soil between harvests, while ordinary tillage can be applied every third cycle, drastically reducing the intensity of mechanical actions on the soil. In this paper an integrated system, based on the use of the thermal treatment and the minimum tillage is described in detail. Many important farms of the RTE sector have adopted these techniques in their production protocols, proving the effectiveness of integrating the flame treatment, the removal of crop residue, and the minimum tillage for seedbed preparation. An overall agro-ecological equilibrium can be assured, safeguarding soil fertility, reducing or limiting phytosanitary problems and achieving high yield and high quality leafy greens.