



Summary

Deciduous fruit tree production is the main sub-sector contributing to the agricultural production in Spain, with 31% of it. The Ebro Valley, with 68% of the total surface, is the principal producing area. It is also one of the main areas of expansion of intensive almond cultivation and where other tree crops, such as vineyards, have also great importance. The production of those crops faces a key Challenge contemplated in the Spanish Research Plan of Science, Technology and Innovation 2017-2020: the "Improvement of the competitiveness and environmental, economic and social sustainability of agricultural production, through the introduction of processes and technologies that increase the efficiency and sustainable intensification, including the prevention, protection and control of pests and diseases. The present project, addressed to Precision and Sustainable Fruit Production, totally fits within this challenge. Four issues to improve fruit orchard management are proposed:

- (1) Canopy phenotyping by means of photon-based sensors (LiDAR, RGB, RGB-D cameras, multispectral sensors) to monitor vegetation and to decide about mechanical pruning methods adapted to special constraints to enhance yield,
- (2) Early detection of pests and diseases by means of remote sensing from drones, and crop protection methods adapted to spatially variable plots to optimize pesticide dosage,
- (3) Fruit detection and 3D modelling based on the combined use of photon-based sensors and computer vision and
- (4) Efficient sampling methods for yield estimates adapted to effective scouting within the plots.

Under this approach, the project has been methodologically designed in two main objectives:

- (1) Canopy phenotyping and spatial variability evaluation in fruit and vine orchards, and
- (2) Practical application of canopy parameters and spatial information in pruning management, precise pesticide application, and efficient scouting and sampling for fruit orchards monitoring and yield estimation.

The project aims to continue previous work on Precision and Sustainable Fruit Production of the Research Group on AgrolCT and Precision Agriculture (GRAP, University of Lleida), to which the major part of the research team and of the working plan belong. The expertise gained in past research projects and contracts in (i) canopy phenotyping and 3D tree architecture mapping, (ii) optimizing pesticide spraying and dose adjustment in tree crops, (iii) testing mechanical pruning to new yield and quality standards as a canopy management system, and (iv) assessing new sampling schemes in orchards for more efficient yield estimation and better crop scouting; guarantees the achievement of the research objectives.

The use of photon-based sensors are presumed to be a key technology in 3D canopy phenotyping. In this respect, the project will suppose a steep forward in the precise characterization of vegetative growth, fruit detection and modelling of lighting conditions, which influence the physiological response of trees. Also sampling methods for more efficient yield estimation and better crop scouting will be developed. In addition, phytosanitary treatments will be optimized on the basis of early pests and diseases detection and map-based applications. This will contribute to a more sustainable fruit production. The project can also contribute to the appearance of new business opportunities, job creation and modernization of the agricultural sector.