DOTTORATO DI RICERCA IN BIOLOGIA CELLULARE E DELLO SVILUPPO

41° Cycle

Project proposal for a PhD scholarship (with no financial support from Sapienza)

Title of the research: Water management in fruit crops: evaluation of metabolic response and fruit quality using proximal sensing techniques.

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Summary

Climatic change promotes an annual accumulated water deficit, requiring irrigation for several crops, such as fruit trees. The increasing water demand for agricultural products, including food, fodder, and fuel, driven by a growing human population, requires more efficient water use in agriculture. In this context, scientists face an increasing challenge to develop innovative water management practices that promote sustainable agricultural systems and improve the performance of agricultural water use. Water resource management is essential for fruit production, especially in drought areas, both to optimize cropping and minimize waste. In fact, reduced tree growth, yield and fruit quality could be observed as a consequence of water scarcity. At the same time, an over-use of water resources can favor nutrient leaching, water-logging problems, incidence of pests and diseases and high water management costs. Therefore, an optimization strategy of water applications is key challenge and an opportunity for improving irrigation water-use efficiency. This project aims to explore orchard trees' metabolic responses and the variability in fruit quality when the water stress occurs during the fruit-growing season. Deficit irrigation strategies (DI) have been widely investigated as valuable and sustainable production methods in dry regions. However, DI can led to various effects on crops, potentially altering plant development by depressing photosynthetic rates, reducing carbon sources, and negatively impacting crop growth and production. Nevertheless, not all DI strategies result in negative outcomes. Plant responses to water-stress primarily depend on crop phenology, and the observed effects are closely related to factors such as the timing, duration, crop

physiological status, irrigation water quality, plant genotype, and the degree of stress endured by the crop. In this context, early detection of water deficit stress is crucial for efficient water management in crop irrigation

The project is focused on the use of molecular biomarkers and spectroscopic techniques combined with chemometric tools to develop predictive models that provide a valuable perspective for monitoring the physiological state of crops. This work also evaluates the key relationships between water status and crop response to determine the best irrigation strategy, identifying critical phenological crop stages most sensitive to water withholding under Mediterranean climate conditions. Finally, the effects of DI on fruit quality parameters will be evaluated.

Pertinent Publications of the proponent (last 5 years)

1) Amoriello, T., Ciorba, R., Ruggiero, G., Masciola, F., Scutaru, D., & Ciccoritti, R. (2025). Vis/NIR Spectroscopy and Vis/NIR Hyperspectral Imaging for Non-Destructive Monitoring of Apricot Fruit Internal Quality with Machine Learning. Foods, 14(2), 196.
2) Ciccoritti, R., Ruggiero, G., Ciorba, R., Manetti, C., Amoriello, M., & Amoriello, T. (2025). Shelf-life assessment of apricot fruit during cold storage by a portable visible and near-infrared hyperspectral imaging device. European Food Research and Technology, 1-14.
3) Stagno, F., Brambilla, M., Roccuzzo, G., & Assirelli, A. (2024). Water use efficiency in a deficit-irrigated orange orchard. Horticulturae, 10(5), 498.
4) Amoriello, T., Ciorba, R., Ruggiero, G., Amoriello, M., & Ciccoritti, R. (2023). A performance evaluation of two hyperspectral imaging systems for the prediction of strawberries' pomological traits. Sensors, 24(1), 174.
5) Amoriello, T., Hou, C., & Ciccoritti, R. (2023). Digital innovations in sustainable agri-food systems. Frontiers in Plant Science, 14, 1304500.
6) Ciccoritti, R., Ciorba, R., Mitrano, F., Cutuli, M., Amoriello, T., Ciaccia, C., ... & Ceccarelli, D. (2021). Diversification and soil management effects on the quality of organic apricots. Agronomy, 11(9), 1791.
7) Ceccarelli, D., Antonucci, F., Talento, C., & Ciccoritti, R. (2021). Chemical characterization in the selection of Italian autochthonous genotypes of plum. Scientia Horticulturae, 281, 109922.
8) Puglisi, I., Nicolosi, E., Vanella, D., Lo Piero, A. R., Stagno, F., Saitta, D., Roccuzzo G., Consonni, S., & Baglieri, A. (2019). Physiological and biochemical responses of orange trees to different deficit irrigation regimes. Plants, 8(10), 423.