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Sustainable strategies to contain the Olive Quick Decline Syndrome in southeast Italy

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The definition Olive Quick Decline Syndrome (OQDS) comes from the fact that the symptoms observed were initially confused and non-specific, since more abiotic and biotic factors were thought to be involved. Indeed, the Salento olive trees affected by OQDS were seen to be massively infested by *Zeuzera pyrina*, while the wood contained various vascular fungi such as *Phaeoacremonium parasiticum*, *Pm. rubrigenum*, *Pm. minimum* (= *Pm. aleophilum*), *Pm. alvesii*, *Phaeomoniella* spp. and fungal species belonging to the family Botryosphaeriaceae. The presence of *Z. pyrina*, whose larvae develop in tunnels bored into branches and twigs, is generally regarded as a factor predisposing the plant to attacks by secondary pests, including beetles, bark beetles, longhorn beetles, bacteria and fungi. Moreover, the scientific literature points to numerous fungal pathogens, such as *Verticillium dahliae* (Baidez *et al*., 2007), *Phoma incompta*, *Cytospora oleina*, *Eutypa lata*, *Pm. parasiticum*, *Pm. rubrigenum*, *Pm. minimum*, *Pm. alvesii*, *Pm. italicum*, *Phaeomoniella* spp., *Pleurostomophora richardisae* (Carlucci *et al*., 2013; 2015), and species belonging to Botryosphaeriaceae (Carlucci *et al*., 2013; 2015; Kaliterna *et al*., 2012; Romero *et al*., 2005; Taylor *et al*., 2001; Urbes-Torres *et al*., 2013) that in some cases are able to block the xylem vessels, while in others can cause cankers affecting large areas of the woody tissue of branches and the main trunk of olive trees. However, the presence of *Xylella fastidiosa* has been confirmed and considered as the primary causal agent of OQDS in Salento olives crops (Saponari *et al*., 2013).

In 2015, an experimental trial was conducted on olive groves located in the infected area of Salento (Gallipoli area), affected by rapid desiccation in order to assess the possibility of containing the symptoms by using products with different activities combined with good farming practices. For this purpose, products with very low environmental impact were chosen, such as agricultural chemicals, resistance-inducing biostimulants and fertilisers. Each trial setup included seven plants more than 70-80 years old showing clear symptoms of desiccation in leaves and branches. Eighteen tests were performed: one untreated control, 12 in which the olive trees were treated with only one of the 12 products available and five in which the olive trees were treated by combining two or three of those products. Root and leaf treatments (according to the instructions on the label of each product) were performed at intervals of 25-35 days apart, up to a maximum of six applications. Starting from 60 days after the first treatment, the effectiveness of sustainable products used was evaluated by: (i) assessing the vegetative development of the plants treated by determining the number of leaves that developed on the last twig produced after the first treatment starting from the point of insertion; (ii) assessing the chlorophyll index, i.e. the total chlorophyll content in plant tissues, which provides an indirect marker of the nutritional status of the plant; and (iii) assessing the leaf stomatal conductance, i.e. the plant water potential indicating the capacity for sap to travel from the roots to the leaves. The data collected were subjected to variance analysis (ANOVA) and the averages were compared using the Duncan test ($P < 0.05$). Moreover, laboratory research focused on assessing the direct or collateral inhibitory effects of certain products used in the 'open air trials' against fungal pathogens associated with common olive diseases. The fungi tested were *Colletotrichum acutatum* and *C. gleosporioides* (responsible for drupe anthracnose), *Phaeoacremonium minimum*, *Pm. parasiticum*, *Pm. italicum*, *Pm. scolyti*, *Phaeomoniella* spp., *Pleurostomophora richardsiae* (both responsible for vascular diseases and cankers), *Lasiodiplodia citricola* (responsible for wood diseases), *Verticillium dahliae* (responsible for vascular and root disease) and *Rosellinia necatrix* (responsible for root rot).

The preliminary results obtained showed that the treatments performed on olive trees suffering from OQDS were all effective, regardless of the numeric value. In particular, treated plants displayed increased vegetative vigour (number of leaves), higher chlorophyll index and stomatal conductance values, and were thus statistically significant. The best results were obtained from plants tested using a combination of the products.

The results of the field tests highlighted the capacity of olive plants to react to pathogenic attack when standard agricultural practices (ploughing, milling, and pruning) and phytosanitary treatments were put in place. Moreover, the best results seem to have been achieved in plants treated with combined applications of two or more products with different characteristics. This would indicate the desirability of a strategic approach meeting all the plant requirements, ranging from nutrition to protection and defence, particularly in situations such as those prevalent in the Salento.

These preliminary and partial results of experimental activities of just one year need to be confirmed and validated by subsequent experiments in next years. Based on these experiments, it is possible to state that, at least in the 'infected' area considered in the Salento, it is possible for olive trees to coexist with the bacterium, and for the bacterium to coexist with the territory, since the olive plants' productivity was not compromised by the presence of the bacteria. This situation was also helped by performing good agricultural practices, i.e. proper ordinary agricultural and phystosanitary management. Furthermore, we believe that more time is needed for scientific verification and confirmation, and that treatment cycles should be repeated for at least another two years (in 2016 and 2017) to validate the encouraging results obtained scientifically.

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