Pesticides reduction, improvement of soil quality and olive traceability by means of zeolite-rich tuff: the Zeoliva project

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Zeoliva is a 3-years project financed by the Italian Ministry of Agricultural, Forestry and Food Policies (MIPAAF) and led by the University of Ferrara and the National Research Council of Bologna. The project goals are the improvement of soil quality and the contrasting of olive fruit fly infestation (*Bactrocera oleae)* by means of natural and sustainable methods which implies the reduction of chemical fertilizer and pesticide inputs in olive growing. To reach these objectives, natural zeolites (chabazite-rich tuff from central Italy) were used both as foliar treatments (micronized form, WP2) and as a soil amendment (granular form, WP3) in various experimental sites located in the Emilia-Romagna region (Italy). Two sites (Site A: organic, Site B: conventional) were dedicated to WP2 on adult olive trees to reduce the use of chemical pesticides (Dimethoate) or as an alternative to chemical traps (Spintorfly) in fighting *Bactrocera oleae*. In Site A, the tested treatments were: natural zeolite (ZN), NH_4^+ enriched zeolite (ZA) and conventional practices of Spinosad+Spyntor Fly on traps (SF); in Site B: zeolite+Dimethoate (ZN-DM), Dimethoate (DM) and no foliar treatment (CNT). Leaves and olives were analyzed by ICP-MS to identify which Major Elements and Rare Earth Elements (REE) can be used to label the origin of the final products for food traceability purposes.

REE showed a higher trend for the treatments with zeolite (ZN and ZA in site A; ZN in site B) than in the control (CNT) and conventional treatments (SF or DM). Statistical analyses such as Principal Component Analysis (PCA) and Partial Least Squares-Discriminant Analysis (PLS-DA) were applied to the dataset. On one hand, the PCA indicated differences between groups of plants treated with zeolite and those without, both in leaves and olives matrices; on the other hand, PLS-DA pointed out that some elements (Rb, Zr, Nb, La and Th in site A; Sm and Dy in site B) can be potentially suitable as markers for olives traceability.

Concerning WP3, experimentations (2019-2021) took place in three sites on young olive trees (⬚ 3 years old) in which 500 g of natural zeolites were added at transplant. Plants grown on soil amended with natural zeolites (ZN) were compared to those grown on unamended soil (CNT). Fertilizer inputs were reduced by 50% in ZN plants to demonstrate the beneficial effects of natural zeolites on soil N retention. At each site, soils and leaves were sampled three times in three

replicates per treatment: March-April (Pre-Fertilization), May-June (Post-Fertilization) and October-November (Harvest) each year. Soil and leaves total N, soil NO_3^--N, NO_2-N and anions in H_2O extracts were monitored to evaluate differences between treatments.

Soil and leaves N content was not significantly different between ZN and CNT in most cases at each site. Given that in ZN treatment the N input was reduced by 50% and that crop N uptake was similar, it can be assumed that fewer N losses occurred in ZN treatments thanks to the presence of natural zeolites.