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Use of alley cropping in a Mediterranean mandarin orchard: an alternative to improve soil fertility

Diego Soto Gómez, Virginia Sánchez Navarro, Silvia Martínez Martínez, Juan Antonio Fernández, José Alberto Acosta Avilés, and Raúl Zornoza

Department of Agricultural Engineering, Technical University of Cartagena, Paseo Alfonso XIII 48, 30203, Cartagena, Spain

The use of tree monoculture systems in Mediterranean areas can accentuate problems already existing in the area, resulting from lack of moisture, low levels of organic matter and high temperatures. In these crops, the soil in the alleys remains bare practically all year, so that in addition to the above limitations, there is an increase in erosion owing to direct exposure to meteorological agents. Owing to climate change, all these disadvantages may be aggravated over time. To improve soil conditions in orchard alleys, various techniques such as mulching, reduced tillage, cover crops or alley cropping can be used. These techniques aim to reduce erosion, improve soil structure and water conditions, and increase the amount of organic matter while slowing down soil mineralization. Alley cropping can also provide complementary commodities for farmers, with important economic benefits. Thus, the objective of this study was to assess if two different crop diversifications applied in mandarin alleys from the Mediterranean region can enhance soil fertility after three crop cycles. For this, three different treatments were applied: i) a mandarin monoculture with bare alley soil all year (MM); ii) a multiple cropping of vetch/barley and then fava bean (AC1) repeated every year in the alleys; and iii) a rotation of fava bean, purslane and cowpea (AC2). Three soil samplings were carried out in February 2019, 2020 and 2021 at 0-10 cm and 10-30 cm depth. Samples were characterized for properties related to fertility: total nitrogen, exchangeable NH_4^+ , NO_3^- , cation exchange capacity (CEC), exchangeable Ca, Mg and K, soluble B, and available P, Cu, Zn, Fe and Mn. Results showed that in AC1, a significant increase in CEC and exchangeable Ca was observed, while NO_3^- and B slightly decreased. In AC2, there was a decrease in NH_4^+ and NO_3^- concentrations, with significant increases in B and P. In addition, in AC1 and AC2, there was an increase trend in total nitrogen. With regard to bioavailable metals, their behavior was similar in all treatments, with a general decrease along time; only the amount of bioavailable Zn increased. Regarding mandarin yield, there was a slight decrease with crop diversification. However, in 2021, a low mandarin yield was recorded in all treatments caused by *Alternaria spp.* In AC1, this decrease was partly compensated by the alley crops, corresponding to 26% of the overall land production. In AC2, cowpea production was lower < 2% of land production, so it did not compensate for the losses caused by *Alternaria spp.* It can be concluded that the AC1 diversification works better than AC2, as it helps to improve soil CEC and increases overall land production, reducing the dependence on a single crop in case of perturbations, such as pests/diseases.

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