Characterization of Cover Crops for use in Olive Groves and Vineyards in Certified Systems under Mediterranean Conditions

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Olive groves and vineyards are two of the most widespread crops in the Mediterranean region. In Andalusia (southern Spain) they occupy 18% of the regional surface (98% of this is olive groves), shaping the landscape and impacting the regional economy. The olive-growing areas in Andalusia have been pointed out repeatedly as heavily degraded areas by water erosion (e.g. Bennett, 1960). In the vineyards, experimental work in other Mediterranean regions (e.g. Gómez et al., 2011) indicated high soil degradation when the management system was based on bare soil. Soil management in olive orchards using cover crops in lanes has shown its effectiveness at reducing erosion, increasing biodiversity and improving soil properties at experimental farms (Gómez et al., 2009a; 2009b). However, numerous practical problems still remain when trying to disseminate and introduce cover crops in commercial plantations. For example, one problem is risk of competition with the olive or vine crops for soil water when management of the vegetative cover is inadequate, because of the large variability in optimal mowing date depending on soil, climate and olive orchard characteristics. In studies on the sustainability of Andalusian olive groves (e.g. Barea and Ruiz, 2009) the need for expansion of certified production systems (e.g. organic, integrated, etc.) linked to quality labels with large commercial imprints to achieve higher prices is highlighted. These certified systems are absolutely dependent on the use of cover-crops with beneficial species for agroecosystems, in the deeper biological sense.

The aim of this study was to characterize alternative cover-crops (monospecific and multispecific) for use as an agro-environmental technique in olive groves and vineyards, especially in certified production systems in Andalusia. For this, three native plant species (*Bromus rubens* (B), *Medicago truncatula* (M), and *Anthemis arvensis* (A)), which are respectively a grass, legume and composite plant, having short growing seasons, and three mixtures (B+M, B+A, B+M+A), using three different proportions of each in each mixture, were selected as treatments. In addition, we used the mixture of varieties of *Brachypodium distachyon* registered under the trade name of “Vegeta”. All alternatives were sown in autumn under two different soil and climatic conditions in the province of Córdoba (“Vega del Guadalquivir”, VG, and “Sierra Morena”, SM) using a dose of 2.66 (B), 1.70 (M), 0.10 (A) and 3.35 (Vegeta) g-seed/m^2 in monospecific cover-crops. During the growing cycle we characterized the phenological stage (BBCH-scale), evolution of the vegetative cover (periodic measurements of ground cover), production of aerial and fine root biomass, and fine root length density and vertical distribution (sampling of plants and soil in early spring and end of the growing season), evolution of soil moisture (periodic measurements with neutron probe), and N supply to soil.

The results of the first trial year (2014-2015) in VG showed rapid establishment of cover crops, despite the late planting (7-10 November), with percentages of ground cover (12-January) of 57% (B), 40% (Vegeta), 33% (M) and 20% (A), and varying between 43-52% in the mixtures. The shortest growth cycle was that of A (flowering: 21-March), followed by M (28-March) and

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B (4-April), with Vegeta having a later cycle. Aerial biomass production in early spring (6-10 April) was similar in B, M and the mixtures (average of 6.24 Mg/ha), and lower in A and Vegeta (3.53 Mg/ha), (Figure 1); although, production of Vegeta at the end of its growth cycle (16-May) increased to 6.30 Mg/ha. Fine root length density (7-13 April) varied significantly between B and Vegeta (7,930 m/m^3; 1-m depth) and A and M (2,491 m/m^3), with intermediate values for the mixtures; while fine root biomass followed the sequence B>Vegeta>M>A, with significant differences between B (302 g/m^3; 1-m depth) and M and A (188 and 124 g/m^3, respectively), (Figure 2).

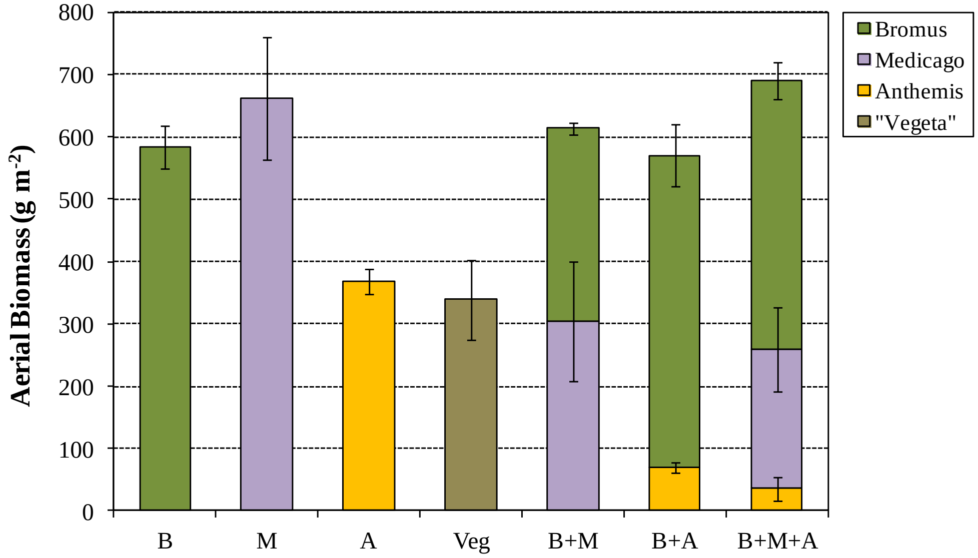

Figure 1. Aerial biomass (g/m^2) of cover crops in early spring (6-10 April, VG). Mixtures were in the proportions 1:1 (B+M, B+A) and 1:1:1 (B+M+A), according to the sowing dose of monospecific cover-crops.

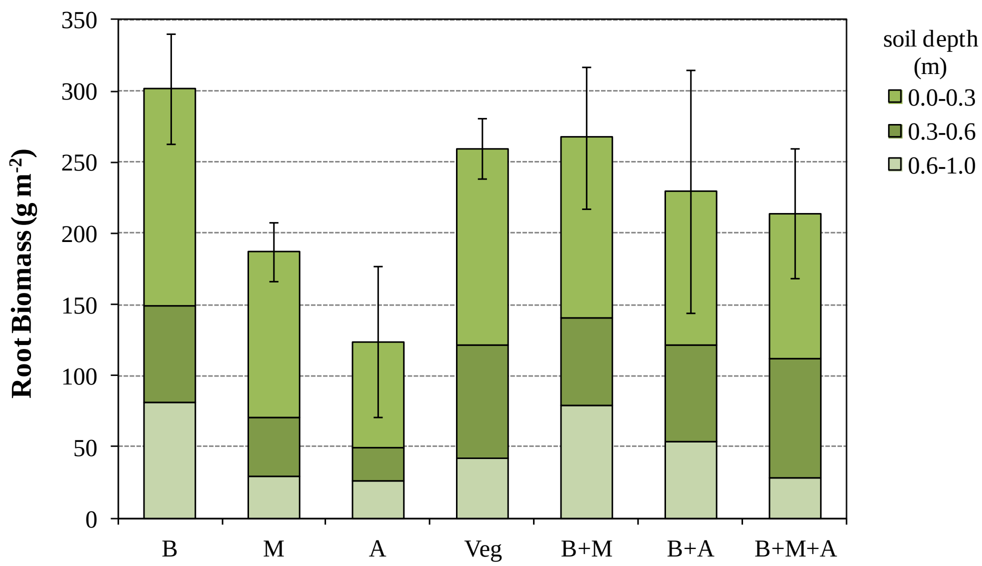

Figure 2. Fine root biomass (g/m^2) of cover crops in early spring (7-13 April; VG).

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