White lupine as a beneficial crop in Southern Europe. II. Nitrogen recovery in a legume–oat rotation and a continuous oat–oat

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ABSTRACT

One experiment lasting for two years was carried out at Pegões (central Portugal) to estimate the impact of mature white lupine residue (Lupinus albus L.) on yield of fodder oat (Avena sativa L. cv. Sta. Eulália) as the next crop in rotation, comparing with the continuous cultivation of cereal, under two tillage practices (conventional tillage and no-till) and fertilized with five mineral nitrogen (N) rates, with three replicates. Oat as a first crop in the rotation provided more N to the agro-ecosystem (63 kg N ha−1) than did lupine (30–59 kg N ha−1). This was at a cost of 100 kg of mineral N ha−1, whereas lupine was grown without addition of N. A positive response of oat as a second crop was obtained per kg of lupine-N added to the system when compared with the continuous oat–oat. The cereal also responded positively to mineral N in the legume amended soil in contrast with the oat–oat sequence where no response was observed, partly due to the fast mineralization rate of lupine residue and a greater soil N immobilization in the continuous oat–oat system. Each kg N ha−1 added to the soil through the application of 73 kg DM ha−1 mature lupine residue (above- and belowground material) increased by 72 kg DM ha−1 the oat biomass produced as the second crop in rotation when 150 kg mineral N ha−1 were split in the season, independent of tillage practice. Mature legume residue conserved in the no-till soil depressed the yield of succeeding cereal but less than the continuous oat–oat for both tillage practices, where the application of mineral N did not improve the crop response.

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