



White lupine as a beneficial crop in Southern Europe I. Potential for N mineralization in lupine amended soil and yield and N₂ fixation by white lupine

C. Carranca^{a,*}, M.O. Torres^b, J. Baeta^a

^a L-INIA (INRB), Quinta do Marquês, Av. República, Nova Oeiras, 2784-505 Oeiras, Portugal

^b Instituto Superior de Agronomia, Tapada da Ajuda, 1349-017 Lisboa, Portugal

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ABSTRACT

Two experiments were carried out at Pegões (central Portugal) to determine the potential N mineralization in a pulse amended disturbed and undisturbed soil incubated at several temperatures, and to evaluate for 2 years the yield and N₂ fixation capacity of sweet lupine (*Lupinus albus* L. cv. Estoril) inoculated with a mixture of rhizobia strains or nodulated by indigenous soil bacteria and submitted to conventional tillage or no-till practices. A completely randomized block design for soil mobilization with three replicates was used for the laboratory study, and completely randomized blocks for inoculation and tillage treatments with four replicates were used for the lupine yield and N₂ fixation experiment. Residue N immobilization occurred immediately after mature residue return to the soil independent of temperature, and was greater at 7 °C especially in the disturbed topsoil. Greater immobilization was also observed by doubling the amount of mature residue incorporated in the soil. This was expected since soil microorganisms would be in direct contact with the fresh organic matter and would be provided with more organic carbon under these circumstances. Nitrogen mineralization proceeded after 5 days of amendment. Potential N mineralization was higher at 25 °C than at 18 or 7 °C, for both conventional and no-till practices. At 25 °C, 42% of buried residue-¹⁵N was released over 210 days, at a smaller rate than 18 °C (49%) over 81 days. Lupine yield and N₂ fixation capacity were similar in plots that were not inoculated and those receiving the mixture of three rhizobia strains. White lupine had an efficient symbiosis with indigenous soil rhizobia at pod-filling (>99%, >100 kg N ha⁻¹ year⁻¹) which was not affected by tillage. At this stage, plant residue including visible roots and nodules accounted for a soil N input of +96 kg ha⁻¹ year⁻¹ (91% of crop N), showing the large soil N benefit by the crop at this stage. The lupine residue at pod-filling stage can be used as a green manure under the conditions of organic farming systems. The apparent N "harvest" index of the pulse at pod-filling was only 9% though at maturity phase it should result in a higher value and the legume will show a lower fertilizer N value.

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* Corresponding author. Tel.: +351 214403517; fax: +351 214416011.
E-mail address: c.carranca.ean@clix.pt (C. Carranca).