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New HorizoN
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INNOVATIONS FOR SUSTAINABLE USE OF NITROGEN RESOURCES

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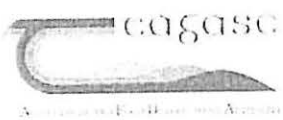

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Comparing N recovery from legumes grown as green manures in olive orchards

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1. Background & Objectives

Green manuring is probably the only option for extending on a great scale the acreage of organic farming in the perennial crops of the Mediterranean basin such as olive groves. Olive growers, in general, do not have animals so the availability of organic manures is not sufficient to maintain soil fertility. In addition, the organic composts approved for organic farming on the market have high prices and are sometimes speculative, in relation to their fertiliser value (Rodrigues et al., 2006). In NE Portugal there is a long tradition in the cultivation of white lupin (*Lupinus albus*) as a means of improving soil fertility. However, little is known about the dry matter yield and N fixation potential of lupin in these agrosystems, and also of the transfer of fixed N to the trees. In this work the results of dry matter yield and N recovery by lupin, vetch (*Vicia villosa*) and a mixture of self-reseeding annual legumes are presented. The trial also included plots of oats (*Avena sativa*) and natural vegetation.

2. Materials & Methods

Two field trials were carried out on Carrascal farm (Vila Flor) and Suções (Mirandela) in NE Portugal. On Carrascal farm the treatments of the experimental design were: white lupin, vetch, a mixture of self-reseeding annual legumes, oats and natural vegetation as control. The species/varieties of the mixture were: *Ornithopus compressus* cv. Charano, *Ornithopus sativus* cvs. Erica and Margurita, *Trifolium subterraneum* cvs. Dalkeith, Seaton Park, Denmark and Nungarin, *Trifolium resupinatum* cv. Prolific, *Trifolium incarnatum* cv. Contea, *Trifolium michelianum* cv. Frontier and *Biserrula pelecinus* cv. Mauro. On Suções, the treatments were: white lupin, the same mixture of self-reseeding annual legumes, oats and natural vegetation fertilised with N (60 kg N ha^{-1}) and not fertilised. Dry matter yield and N recovery were determined from field samples of the above-ground biomass. Nitrogen concentration in plant tissues was determined by a Kjeldahl procedure.

3. Results & Discussion

White lupin produced 6.9 and 8.2 Mg DM ha^{-1} and accumulated 138 and 195 kg N ha^{-1} in the above-ground biomass at Carrascal and Suções, respectively (Figures 1 and 2). The values may be considered high if compared with others reported in the literature (Carranca et al., 2009). In Carrascal, vetch showed slightly lower DM yield than white lupin, but its tissues presented higher N concentration. As a result, N recovered was slightly higher in vetch (156 kg N ha^{-1}) in comparison to lupin. Annual legumes produced 5.6 and 6.4 Mg DM ha^{-1} and recovered 105 and 110 kg N ha^{-1}. Oats showed fair DM yields (4.7 and 3.0 Mg ha^{-1}), but N concentrations in tissues were very low (5.4 and 5.2 g kg^{-1}), recovering only 25.6 and 15.7 kg N ha^{-1}. The dry matter yields recorded from the natural vegetation not fertilized were low (1.1 and 0.7 Mg ha^{-1}) and N recoveries very low (11 and 7 kg N ha^{-1}), revealing that these soils presented very low levels of N availability. Applying N, only a small increase in DM yield was found (1.1 Mg N ha^{-1}), but N concentration in tissues increased markedly (20.8 g kg^{-1}). The reduced stimulus in DM yield of natural vegetation by N application in spring is explained by reduced nitrophily, a short growing season, and the small size

of several dominant species in the infertile soils where the orchards are established, such as *Mibora minima*, *Crassula tillaea* and *Spergula arvensis* (Rodrigues et al., 2009).

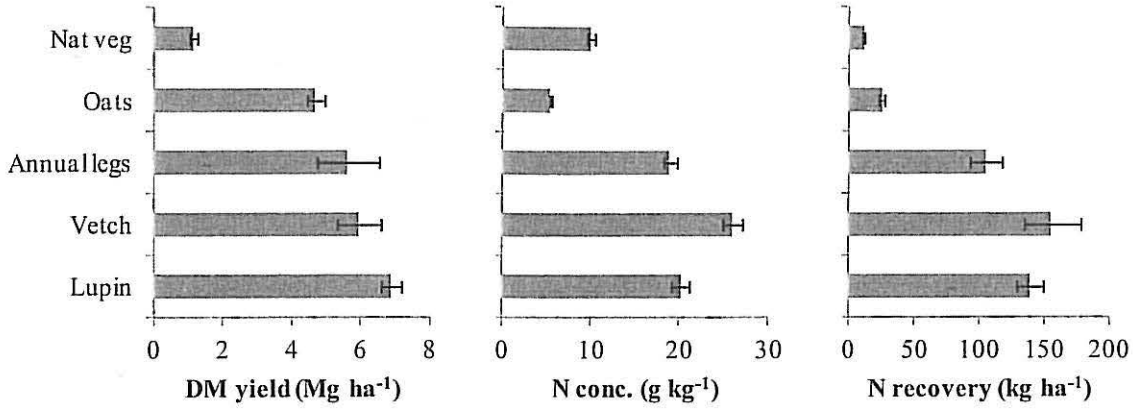

Figure 1. Dry matter yield, N concentration and N recovery in above-ground biomass in Carrascal farm, Vila Flor.

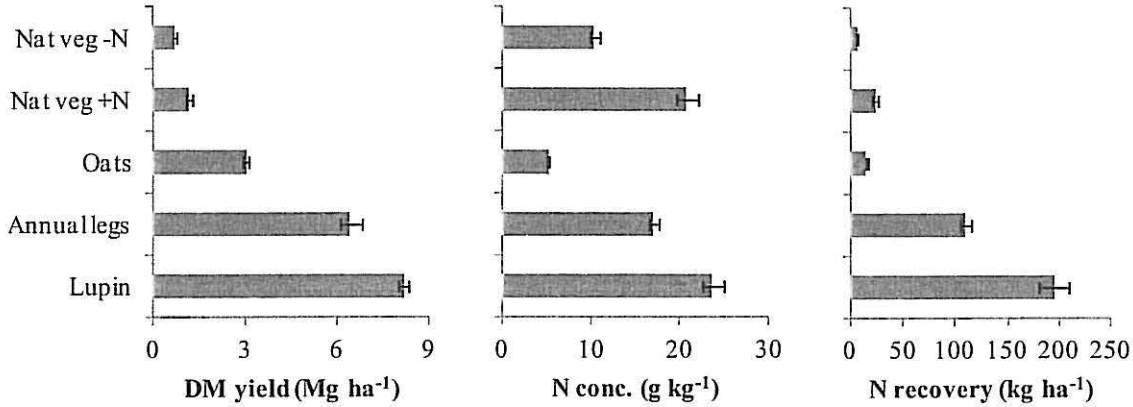

Figure 2. Dry matter yield, N concentration and N recovery in above-ground biomass in Suções, Mirandela.

4. Conclusion

The legume species included in these experiments were particularly well adapted to the agroecological conditions of the region. They showed high potential for DM yield and N fixation in soils with very low natural fertility. White lupin and vetch might accumulate more than 150 kg N ha^{-1} yr^{-1}, values that seem high enough to ensure the N nutrition of the trees without additional fertilisers. However, further studies are necessary to evaluate the efficiency of N transfer to the trees.

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