

Abstract

Conciliating Traditional Green Manure Technique and Modern Precision Agriculture †

Anne-Karine Boulet ^{1,*}, Carlos Alarcão ², António Ferreira ¹ and Rudi Hessel ³

¹ CERNAS, Coimbra College of Agriculture, Polytechnic Institute of Coimbra, Bencanta, 3045-601 Coimbra, Portugal; aferreira@esac.pt

² Regional Directorate of Agriculture and Fisheries of the Central Region (DRAPC)—Baixo Mondego Experimental Center, Quinta de N^o Sr^a do Loreto, 3020-201 Coimbra, Portugal; alarcao@drapc.gov.pt

³ Soil Physics and Land Use Team, Wageningen Environmental Research, Wageningen UR, P.O. Box 47, 6700 AA Wageningen, The Netherlands; rudi.hessel@wur.nl

* Correspondence: anne.karine@esac.pt

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Abstract: Currently the productivity of some European cropping systems is maintained artificially by increasing production factors like mineral fertilizers or pesticides in order to mask the loss of productivity resulting from soil quality degradation. Green manures are known as a good alternative to the use of mineral fertilizers and pesticides. They are an important source of nitrogen and reduce significantly weed invasion. Nevertheless, the literature providing a precise quantification of total nutrients available for plants after incorporation of leguminous species cultivated in Portugal is scarce. This lack of knowledge's makes farmers worried about hypothetical productivity loss, making them to use excessive complementary amounts of mineral fertilizer. Providing farmers with tools to calculate accurately the reduction of mineral fertilizer will increase their gain and avoid environmental pollution by nutrients leaching. Under the scope of the international H2020 SoilCare project, a study was conducted during the winter and spring of 2018–2019 at Baixo Mondego valley in Central Portugal, where the main land use is the monoculture of irrigated corn. The nutrient uptake was determined for 5 species of legumes: pre-inoculated Pea (*Pisum sativum* L.); Yellow Lupin (*Lupinus luteus*), Red Clover (*Trifolium pratense*); Balansa Clover (*Trifolium michelianum*); Arrowleaf Clover (*Trifolium vesiculosum*) and a control (natural vegetation). For each treatment, we determined total dry matter yield for leguminous and weeds, macronutrients uptake (N and P Total, K, Na, Ca, Mg, S) and micronutrients uptake (Cu, Zn, Fe, Mn). Combining soil analyses, theoretical main crop needs in nutrients (short cycle grain maize) and mineralization rates, we calculated the precise amendment needed to obtain the expected yield of maize in what concerns the macronutrient. The production of total dry matter (leguminous and weeds) was very similar for the 5 treatments e.g., about 7 ton/ha. Nevertheless, considering leguminous production, the higher dry matter yields were obtained for the Arrowleaf Clover and the lower for the Red Clover respectively 5.5 and 3.5 ton/ha. The macronutrient content (N,P,K) of the leguminous ranged between 22.9 and 28.0 g/kg for N, 2.4 and 3.1 g/kg for P and 12.1 and 31.5 g/kg for K. The Yellow Lupin presented the higher values of N, the clovers the higher values of P and K. The total quantity of macronutrients incorporated in the soil was in average 152 kg/ha for N, 20 kg/ha for P and 170 kg/ha for K with the higher quantities for Arrowleaf Clover. We considered a mineralization coefficient of 0.5 for N and 0.6 for P during the first year and a nutrient extraction of 280 kg/ha of N, 50 kg/ha of P and 245 kg/ha of K, for a production yield of 12 t/ha of corn grain. After correction of plant needs following the soil analyses results, we determined an optimized fertilization rate of 180-40-0, where the green manure supplies about 35%, 25% and 100% of the NPK extraction of the grain maize.

Keywords: green manure; macro-micronutrients; precision agriculture



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