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## Fertilisation strategies for sown organic pasture in the Mediterranean mountains of north-east Portugal

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**Key words** fertilisation, manure, organic farming, pasture.

**Introduction** The leptosols are dominant soils in the North-east of Portugal, and are occupied mainly with forest, shrubs, cereal and fallow. The restricted and dispersed areas of pasture and fodder crops limit the sustainability of bovine and ovine meat production in organic farming. To achieve this goal in future, the conversion of some of these areas to long-term legume-rich pastures is essential. This experiment was developed to study the viability of these kinds of crops in organic farming systems on these soils.

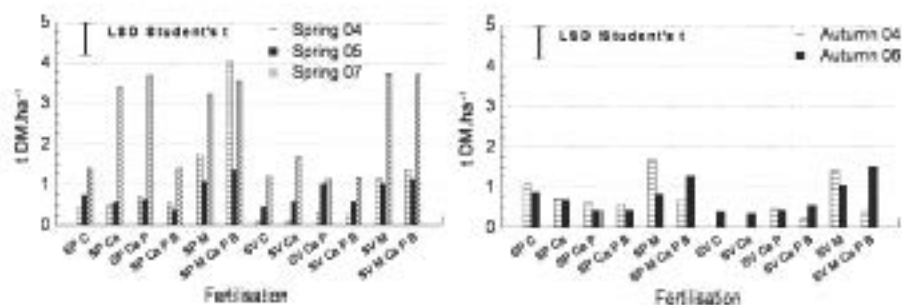
**Materials and methods** The experiment has been carried out since autumn 2003 near Bragança (NE Portugal-41°50' N, 6°35' W and 860 m asl) in a leptosol with 24 g kg<sup>-1</sup> organic matter (OM) content, 4.5 pH(H<sub>2</sub>O), 42 mg kg<sup>-1</sup> P<sub>2</sub>O<sub>5</sub> and 81 mg kg<sup>-1</sup> K<sub>2</sub>O. It comprised the comparison of six fertiliser treatments (F) within two types of pasture (PA), spontaneous vegetation (SV) and sown pasture (SP). The fertiliser treatments included different combinations of bovine farmyard manure [(M)-30 t ha<sup>-1</sup>], lime [(Ca) 1.5 t ha<sup>-1</sup> of lime], phosphorous [(P) 100 kg ha<sup>-1</sup> of P<sub>2</sub>O<sub>5</sub>], boron [(B) 1 kg ha<sup>-1</sup>] and the control with no fertiliser (C). The treatments were: (i) C; (ii) Ca; (iii) M; (iv) Ca+P; (v) Ca+P+Bo; (vi) M+Ca+P+Bo. The SP seed rate was 18 kg ha<sup>-1</sup> in the following proportion of functional groups: 9 annual legumes (50%); 2 perennial legumes (5%); 4 grasses (41%); and chicory (4%). It was conducted as a two factor nested design, fertilisation treatments within pasture type, with three random replicates (enclosure cages of 1 m<sup>2</sup>) per subplot. The vegetation was subjected to the usual grazing in the farm, and the dry matter (DM) yield samples were obtained each year at the end of spring and autumn, inside the enclosure cages on a 0.5×0.5 m quadrat. The data for DM yield excluded a reseeded fallow period from autumn 2005 to spring 2006 and seasonal yields (SY) were analysed as repeated measures.

**Results and discussion** There were significant effects for the F(PA) × SY interaction ( $p < 0.0001$ ) on DM yields, for the effect of F(PA) on DM yields, on spring and autumn DM yield differences and on individual DM yields ( $p < 0.01$ ). Treatment means for each season and year (Fig 1) showed the following results: a) treatments with manure were always the highest yielding group; b) the SV control treatment yielded significantly less than the four manure treatments in spring 2004 and 2007, less than the SP M+Ca+P+Bo treatment in spring 2005, less than the SP M and SV M in autumn 2004 and less than the SP M+Ca+P+Bo and SV M+Ca+P+Bo treatments in autumn 2006; and c) only the SP Ca and SP Ca+P treatments had similar yields to the manure treatments in spring 2007. The high values of legume proportion in these last two treatments in spring 2007 (54 and 61% DM respectively) may explain the importance of natural reseeding of annual legumes in these treatments. Rinehart (2006) advises manure use in pasture establishment and Jagtap and Abamu (2008) also verified yield improvement of maize under cattle manure application in the absence of N fertiliser.

**Conclusions** Manure demonstrated itself to be the most valuable fertilisation strategy for pasture yield in these low fertility soils and climate conditions. Liming may boost the reseeding of annual legumes and have also a significant effect on dry matter production in the medium term.

### References

- Rinehart, L., 2006. Pasture, rangeland and grazing management. ATTRA National Sustainable Agriculture Information Service. Paul Driscoll edition, NCTA, USA, 20 pp.
- Jagtap, S.S., Abamu, F.J., 2008. Matching improved maize production technologies to the resource base of farmers in a moist savanna. *Agricultural Systems* 76, 1067-1084.



**Figure 1** Dry matter yields in spring and autumn for the 12 fertiliser and pasture type treatments.