

18th
NITROGEN
WORKSHOP

**THE NITROGEN CHALLENGE:
BUILDING A BLUEPRINT FOR NITROGEN
USE EFFICIENCY AND FOOD SECURITY**

18th Nitrogen Workshop

PROCEEDINGS

Lisbon, Portugal, 30th June – 3rd July 2014

Editor: Cláudia M. d. S. Cordovil



INSTITUTO
SUPERIOR DE
AGRONOMIA
Universidade de Lisboa

All rights reserved. No part of this publication may be reproduced, stored in a retrieval system, or transmitted in any form or by any means, electronic, mechanical, photocopying or otherwise, without the prior permission of the *ISA Press*. If quotations are made of this publication, they must be acknowledged.

© ISA, UL 2014

Printed by: Colibri Artes Gráficas

Edited by: Cláudia S.C. Marques dos Santos Cordovil

Design and composition:

Gonçalo Cordovil

Cláudia S.C. Marques dos Santos Cordovil

ISBN: 978-972-8669-56-0

Depósito legal n.º 377 322/14

Edição:



Suggested citation: Author(s), 2014. Title. In: Cordovil C. M. d. S. (Ed.). Proceedings of the 18th Nitrogen Workshop – The nitrogen challenge: building a blueprint for nitrogen use efficiency and food security. 30th June – 3rd July 2014, Lisboa, Portugal, pp. nn-nn.

Editor and ISA disclaimer

The opinions expressed and arguments employed in this publication, as well as the quality of the tables and figures in this publication are the sole responsibility of the authors and do not necessarily reflect those of the ISA nor the Editor.

NITROGEN MINERALIZED DURING SORGHUM GROWTH AFTER SOIL INCORPORATION OF DIFFERENT WINTER COVER CROPS

D. DIAS¹, C.F. AGUIAR², M. ARROBAS², M.A. RODRIGUES²

¹ Universidade Federal de Goiás, Goiânia, BRAZIL, ² Mountain Research Centre (CIMO), Polytechnic Institute of Bragança, Bragança, PORTUGAL
e-mail: angelor@ipb.pt

Growing catch crops during the autumn/winter period is a strategy of high ecological significance since it allows reducing the residual inorganic-N present in the soil after the summer season (Rodrigues et al., 2002). Thus, winter catch crops reduce the risk of denitrification and nitrate leaching associated to the excess of rain of the autumn/winter months. Incidentally, the evergreen systems confer several other additional benefits, including protection against soil erosion and increasing soil organic matter. In recent years, agronomists and soil scientists have studied the pros and cons of the introduction of cover/catch crops in different agro-ecological conditions and cropping systems. Some were focused in comparing the performance of different plant species when they were used as catch crops (Jensen, 1992). In addition, since winter catch crops precedes summer cash crops, it is important to know the effect of the catch crop in the performance of the cash crop. As a general rule, the catch crop should present good growth rate in winter and improve soil fertility to promote the growth of the summer crop. Theoretically, lupine (*Lupinus albus*) seems to have both features. It is a species of high biomass production in autumn/winter period (Rodrigues et al., 2013) and, being a legume species with tissues of low C/N ratio, net nitrogen mineralization should occur early in the growing season of the crop that follows lupine in the rotation. In this work, results are presented of the effect of several winter cover crops in nitrogen availability in a soil cultivated with sorghum in the following summer season.

Materials and methods

In the autumn of 2011 three different ground cover systems were established: natural vegetation (weeds); cereal (a mixture of small grains); and white lupine, in four plots (replications) each. In spring, the cover crops were mowed and buried during soil preparation for the installation of sorghum (*Sorghum bicolor* L. Moench). The lupine plots were divided into two equal parts each. In half the area of each plot, all the biomass of the lupine plants was incorporated in soil. In the other half of the area, the above-ground biomass of the lupine was removed, remaining in the soil the roots of the plants. Fifteen days after the sowing of sorghum, an in situ incubation has started, consisting of filling sharp PVC tubes (140 mm high and 32 mm in diameter), pushing them directly to the soil. The soil in PVC tubes was thereafter incubated within glass jars buried next to the field plots. By a sequential analysis of inorganic nitrogen in fresh and incubated soil samples it was possible to follow net nitrogen mineralization from the organic residues incorporated in soil. For more details on the incubation technique see Rodrigues (2004a). Soil extracts were prepared from fresh and incubated samples using a KCl (2M) solution as the extractant agent. The extracts were subsequently analysed for nitrate and ammonium concentrations by UV and visible spectrophotometry.

Results and discussion

Soil nitrate levels decreased during the growing season in all plots due to the increasing uptake capability of sorghum plants (Figure 1, a). Soil ammonium levels fluctuated between 3 and 9 mg kg⁻¹ and represent the balance between net N mineralization and nitrification processes (Figure 1, b). Mineral N accumulates in aerated soils as nitrate. Nitrate accumulation during the growing season of sorghum was close to 13 mg kg⁻¹ (~18 kg N ha⁻¹) in the plots of lupines (Figure 2, a). These values are unexpected low taking into account the biomass that was incorporated in soil, and reference values found in literature (Magdoff et al., 1984; Rodrigues, 2004b), but significantly higher than the values recorded in Weeds and Cereal plots. If total inorganic-N (NO₃⁻ + NH₄⁺) was used to estimate net N mineralization (Figure 2, b) the values were lower due to the great dynamic of NH₄⁺ in soil. However, the trend was similar to that found when NO₃⁻ N form was used alone. In the plots of lupine were recorded the higher values. Also unexpected was the fact of lupine (roots) has shown similar results of lupine (total) considering the great difference of biomass incorporated.

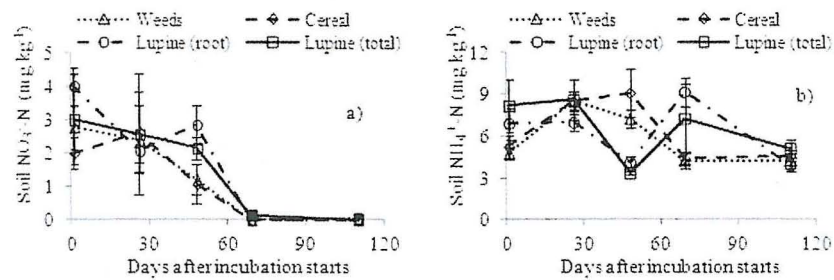


Figure 1. Nitrate-nitrogen (a) and ammonium-nitrogen (b) in soil during the growing season of sorghum in different cover cropped plots.

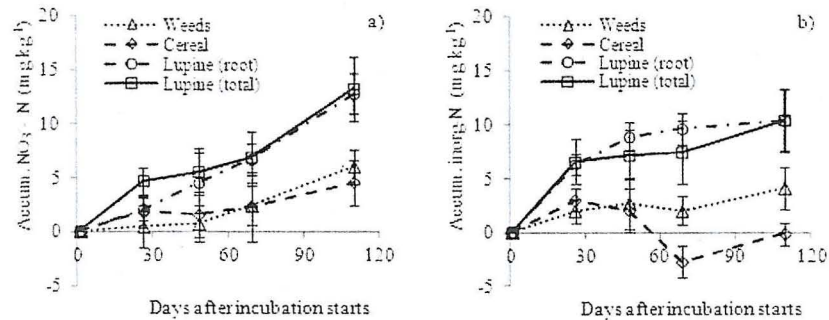


Figure 2. Total nitrate-nitrogen (a) and inorganic-nitrogen (b) accumulated in the successive periods of soil incubation during the growing season of sorghum and in the different cover cropped plots.

Jensen ES 1992. *J. Soil Sci.* 43, 335-345.

Magdoff FR, Ross D, Amadon J 1984. *Soil Sci. Soc. Am. J.* 48, 1301-1304.

Rodrigues MA 2004a. *Agron. Agric. Environ.* 24, 249-256.

Rodrigues MA 2004b. *Commun. Soil Sci. Plant Anal.* 35 (13 & 14), 2067-2085.

Rodrigues MA, Coutinho J, Martins F 2002. *Eur. J. Agron.* 17/3, 155-160.

Rodrigues MA, et al. 2013. *Scientia Horticulturae* 156, 45-51.