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CONTRIBUTION OF THREE MANURES TO N NUTRITION OF POTATO CROP

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Introduction

The manures are usually considered as an important source of nitrogen. However, if they are applied to annual crops without addition of inorganic N, the effect on yield and on N uptake by plants is often very poor. On the other hand, the potential risk of nitrate leaching to water resources is great, due to the temporal lack of adjustment between the N released and plant needs. The main obstacles to the rational utilization of manures are related to the variability of their composition and to their decay process in soils, which make difficult to predict both the time and amount of N released from manures.

This study was conducted to evaluate the behaviour of three manures and urea as sources of N for potato, which is considered to be a crop particularly responsive to manures. The tuber dry weight (TDW), the N uptake by tubers and the apparent N recovery (ANR) of added N were compared. The reliability of results was checked through plant analysis and field measurements of N mineralization using an *in situ* incubation technique.

Methods

The field experiments were conducted over 2 yr (1995 and 1996) at S.^{ta} Apolónia farming (north-east Portugal). Five treatments consisting of three manures (poultry manure, PM, cow manure, CM, and town waste compost, TWC), urea and the control (non-N fertilized), organized in a block design with three replications, were imposed on a loamy textured soil. Manures and urea were applied at a rate of 100 kg N ha⁻¹ and incorporated to a 14-cm depth at planting time. The ANR was estimated by the difference method (Tyler et al., 1983). The N status of the plants was evaluated in the most fully-developed leave at the stage 60 (Nitsch et al., 1991) by petiole N-NO₃ content and total N leaf content. The procedure for soil incubation was similar to that was used by Hatch et al. (1990), but without addition of acetylene as nitrification inhibitor. The soil cores were taken with PVC tubes (14 cm height, 32 mm i. d) and placed in 1 L glass jars in 15 cm deep holes in the ground adjacent to the experimental area and incubated for periods of 14 d. Soil analysis of NH₄⁺ and NO₃⁻ were performed in not incubated and incubated samples at the end of each incubation period. The sum of fortnightly variation in inorganic N during the growing season (126 d) was used as an estimative of net mineralization.

Results

In both years urea application produced a significant increase in TDW and N uptake by tubers relatively to the control treatments. Therefore, the data clearly indicate a shortage of N supply to the crop when no mineral N was added. Nevertheless, the results showed that manuring only increases slightly TDW above the control treatment. The differences were significant only for the treatments CM in 1995 and PM in 1996, both presenting the highest N mineral content in each year, 27 and 40 g N kg⁻¹, respectively. Regarding the N uptake by tubers, the effect of manures was also limited, since only the treatment PM in 1996 was statistically higher than the control, although lower than the urea treatments. The ANR of manures were always very low (< 12%), except again for PM in 1996.

Total N leaf content and petiole nitrate content were in general agreement with TDW and N uptake by tubers. The nutritional status of manured plants did not differ from the control, except

for PM in 1996.

The estimatives of N mineralized only distinguished between urea and PM from the other treatments in 1996. Between the other manures and control, as well as among all treatments in 1995, no differences were found in net mineralization estimatives. These estimatives are coherent with the crop results and showed that only a small fraction of N from manures became available through mineralization and was recovered by the crop. They also indicated that, at short-term, the balance of mineralization/immobilization process is practically nil if the manures do not present an high N content, such as PM in 1996. Results also suggest that, at least for treatment CM in 1995, the effect of manuring in TDW may be attributed to some additional benefits over N nutrition just as the supply of other nutrients and eventually some effect on physical properties of the soil.

Table - Effect of manures and urea on TDW, N uptake by tubers, ANR, total N leaf, petiole-NO₃⁻ and N mineralized.

Year	Treatment *	TDW (Mg ha ⁻¹)	N uptake (kg ha ⁻¹)	ANR (%)	Leaf N (g kg ⁻¹ DM)	Pet.-NO ₃ ⁻ (g kg ⁻¹ DM)	N miner. (kg ha ⁻¹)
1995	Control	4,1 b**	71,4 b	----	44,5 bc	64,9 b	87,9 a
	Urea	5,2 a	111,0 a	39,5	47,5 a	112,8 a	----
	PM (17)	4,4 ab	77,8 b	6,4	44,3 c	69,7 b	86,7 a
	CM (27)	5,1 a	81,8 b	10,3	44,8 bc	75,5 b	86,9 a
	TWC (15)	4,8 ab	82,6 b	11,2	45,9 b	78,1 b	82,5 a
1996	Control	8,4 b	85,4 c	----	38,2 c	5,1 b	85,3 b
	Urea	10,3 a	143,3 a	57,9	45,0 a	55,5 a	106,5 a
	PM (40)	10,2 a	117,5 b	32,1	42,2 b	54,6 a	104,7 a
	CM (12)	9,2 ab	87,0 c	1,7	39,5 c	21,0 b	84,7 b
	TWC (17)	8,8 b	85,0 c	-0,4	37,4 c	6,6 b	78,1 b

* In parentheses the N content (g N kg⁻¹ dry matter)

** Within each column, mean values that do not have common subscript letters differ statistically at the 0,05 probability level by Fisher's LSD test.

Conclusions

These results do not diminish the importance of manures, but they suggest that there must be caution in the judgement about their contribution to N nutrition of crops which have a short growing season. The possible variability on results from manuring (e. g. TWC vs PM, in 1996) also emphasizes the need for fully developed and reliable laboratory indices well correlated with the behaviour of manures under field conditions, that permit their rational utilization with economical and environmental profits.

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