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

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MONITORING NITROGEN NUTRITIONAL STATUS OF VEGETABLES IN THE SOCIAL GARDEN OF POLYTECHNIC INSTITUTE OF BRAGANÇA, NE PORTUGAL

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Urban agriculture is a global phenomenon. In developing countries urban agriculture has had crucial importance in alleviating problems of extreme poverty of the populations of the larger cities. In developed countries has been particularly important during periods of economic depression. Nowadays, the urban agriculture in developed countries is increasing, aimed more at leisure, sports and recreation of the urban dwellers. These spaces are also emphasizing environmental education, by implementing environmentally friendly agricultural practices. In the case of Portugal, urban agriculture is frequently regulated by norms, implicitly or explicitly, similar to those established for organic farming. In the urban agriculture project of the Polytechnic Institute of Bragança (IPB) the participants are also encouraged to use sustainable farming practices. The fertilizers used are usually farmyard manures and other organic wastes. This work takes part of a larger project that aims to monitor the nutritional status of the plants, the residual mineral nitrogen (N) content in the soil and the contamination of plants and soils with heavy metals. In this report, it will be present results only for the first two goals.

Materials and methods

During 2013 several vegetable species were sampled in the social garden of IPB for analysis. Data from nine species sampled from six gardens each and involving a total of thirteen different gardens were considered. The plants were sampled during the growing season of 2013 following the norms established for each vegetable, regarding the sampling date and the proper tissue to be analyzed (Mills and Jones, 1996; LQARS, 2006). In the autumn, soil was monthly sampled at two depths (0-20 cm and 20-40 cm) in each of the selected gardens. Plant samples were oven-dried at 70°C, ground and analysed for tissue nutrient concentration. N concentration in plant tissues was determined by a Kjeldahl procedure. The soil samples were frozen after collected. Soil extracts were thereafter prepared by using a concentrated (2*M*) KCl solution and the extracts analysed for NO_3^- and NH_4^+ concentration by UV and visible spectrophotometry.

Results and discussion

N concentration in plant tissues was always close to the lower limit of the sufficiency range for all vegetables (Table 1). The average soil mineral N levels, in the gardens where plant samples were taken, were quite low when compared with values previously recorded for other agro-ecosystems (Magdoff et al., 1984; Rodrigues, 2004a). The concentration of mineral N in soil in the sampled gardens varied between 2.9 and 8.9 mg kg^{-1} (table 2). The gardeners fertilize their crops with farmyard manure that has been freely provided by IPB, and in lesser extent with other organic wastes.

This kind of manure usually presents N concentrations ranging between 11 to 22 mg kg^{-1} and C/N ratios between 10 and 20 (Rodrigues, 2004b; Rodrigues et al., 2006). These manures release N very slowly, being the effect on vegetation modest (Rodrigues et al., 2006), which may explain the low N concentrations in plant tissues and the low residual mineral N in the soil. The small differences that were observed in residual soil mineral N are certainly the result of the greater dedication of some gardeners. It was observed a close relationship between the gardens with great variability in species and the higher soil mineral N levels (the diversity of species grown can be seen as an index of the dedication of the gardeners).

Table 1 Leaf N concentration (mean±mean confidence intervals), sufficiency N ranges for the most commonly grown vegetables in IPB gardens and soil mineral-N (0-40 cm soil layer) in the gardens where each of the vegetables was grown.

	Leaf N concentration g kg^{-1}	Sufficiency range* g kg^{-1}	Soil mineral-N mg kg^{-1}
Strawberry	19.9±2.6	21-40	6.1±0.3
Carrot	21.3±1.0	21-35	6.0±0.4
Lettuce	23.7±1.3	25-50	6.3±0.7
Tall cabbage	29.5±1.7	31-55	6.3±0.6
NZ spinach	28.9±1.7	---	4.2±0.9
Onion	22.8±0.8	45-55	6.0±0.7
Bean	29.9±2.3	30-60	6.3±0.8
Pepper	32.0±2.0	35-50	5.8±0.6
Tomato	31.5±1.3	30-50	6.0±0.7

*Adapted from Mills and Jones (1996) and LQARS (2006).

Table 2. Soil mineral N (0-40 cm soil layer) and vegetables sampled in the corresponding garden.

Garden number	Vegetables	Soil min-N mg kg^{-1}
5	Carrot, lettuce	5.0
6	Strawberry, lettuce, cabbage, NZ spinach	5.6
8	Carrot, lettuce, cabbage, onion, bean, pepper, tomato	5.6
9	Cabbage, onion, pepper, tomato	6.9
11	Lettuce, cabbage, onion, bean, tomato	8.9
15	Strawberry, NZ spinach	5.9
19	Strawberry, carrot	7.1
20	NZ spinach	2.9
22	Carrot, lettuce, bean, pepper	7.6
32	NZ spinach	3.6
40	Onion, bean, pepper, tomato	3.7
62	Carrot, lettuce, cabbage, onion, bean, pepper, tomato	4.8
79	Strawberry, carrot, cabbage, onion, pepper, tomato	6.0

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