Nutrient Survey of Nursery Stock in Ireland and U.K. Including Nutrient Reserve Analysis in Controlled-Release Fertiliser and Leaf Analysis

M. Prasad
Research Centre, Horticultural Division Bord na Móna, Main Street Newbridge, Ireland

Bord na Móna Horticultural Division is providing technical support to growers in Great Britain and Ireland, involving measurement of available nutrient, nutrient reserve in controlled-release fertiliser(CRF) and analysis of foliage. There was a significant inverse relationship between the nutrient reserve in CRF and time of potting. This relationship is not linear and there are strong indications that for the 12 to 14 month formulations of CRF, most of the nitrogen has been released, by 8 to 10 months. From the data obtained in 1993/95 we have compiled "normal" levels of major nutrients of over 50 species. In addition the frequency distribution of micronutrients from over 100 samples has been compiled. This type of information will be invaluable for diagnostic purposes and to make an informed decision whether to top-dress in spring.

INTRODUCTION

Soil (substrate) testing and plant analysis is a normal facet of certain areas of agriculture and horticulture (Westermann, 1990). However, there is relatively little detailed information on desirable levels available for nursery stock (Aendekerk, 1982; Alt, 1989; and Smith 1978). In addition, information of this type on most of the species grown in Great Britain and Ireland is generally lacking. Information that is available may not be directly relevant to conditions in Great Britain and Ireland.

Substrate analysis for nutrients gives only a snapshot of the nutrition level at that particular time. In order to make use of such analysis, regular monitoring is required but cost of analysis precludes this. However, pH measurement is more worthwhile as, under normal conditions it will not change dramatically during cropping. In the nursery industry the use of controlled-release fertiliser (CRF) is widespread and because the rate of nutrient release is dependent on many factors, e.g. temperature, growers often wish to know how much nutrient reserves are available in order to decide whether they need to top-dress.

In 1993, Bord na Móna started to provide a technical support to the nursery stock growers in Ireland and this was extended to three regions in the UK in 1995/6. This technical support consists of substrate analysis based on 1 : 1.5 water extract, determination of nutrient reserve in CRF, and leaf analysis. The substrate and nutrient reserve analysis is carried out in mid summer and spring whilst leaf analysis is done in mid summer. This type of information helps avoid possible nutrition problems and allows growers to optimise nutrition for plant growth. This paper surveys the results obtained from CRF analysis and foliage analysis.

MATERIALS AND METHODS

The number of properties sampled were as follows: Ireland, 1993, 15; 1994, 12; 1995, 14; and 1996, 14; Great Britain: 1995, 10 and 1996, 8. Substrate samples were taken in mid Summer except in 1996 when samples were taken in spring. Leaf sampling was taken in mid Summer (June to early August). Occasional samples were also taken in November.

Available Nutrient. Substrate samples were generally taken from at least 10 pots. The samples were extracted with water in the ratio of 1:1.5 (Dutch method). pH, conductivity, NH_4-N, NO_3-N, P, and K were determined in the extract. This analysis gave the amount of nutrients immediately available to the plant.

Nutrient Reserve. The samples were extracted as before except that all the granules were crushed prior to extraction. In the extract soluble N(NH_4-N + NO_3-N), P, and K were determined. Subtracting the available nutrient from this value gave the nutrient reserve or nutrient left in the granules. The percentage reserve was then calculated using the amount of CRF originally added at potting.

Leaf Analysis. Leaf samples were taken from at least 10 plants. They were dried, ground and analysed for N, P, and K using a sulphuric acid and selenium digest using an auto analyser (O'Neill and Webb, 1970). Ca, Mg, and micronutrients were analysed after ashing using an AAS.

RESULTS AND DISCUSSION

There was a highly significant inverse relationship between the amount of nitrogen left in the granule (N reserve) and the time of potting (Fig. 1). In other words, as expected the longer the time from potting the lower the N reserve. These results which are from 1995 and 1996 data showed that the release from CRF granule (12-14 months) is not linear and there are strong indications that after 8 to 10 months from potting, most of the N appears to have been released. Any N that is still left in the granule appears to release very slowly and may not be adequate for the flush of growth in spring. However the proviso should be made that if the fertiliser granules

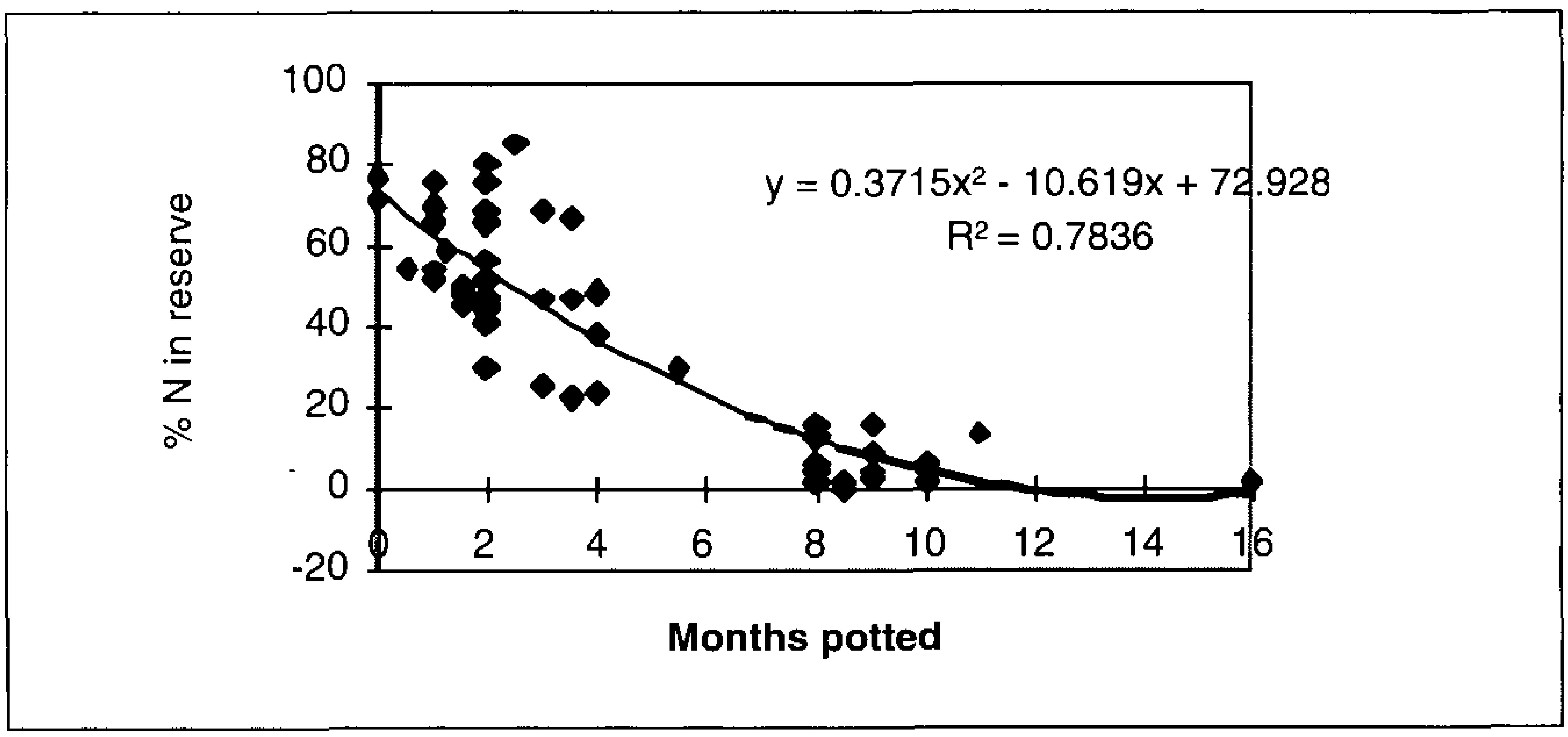

Figure 1. Relationship between time of potting and nitrogen (N) reserve in control-release fertilizer.

were not mixed properly in the substrate the values presented here could either overestimate or underestimate the reserves. Other data where the granules were analysed separately, however, would support these findings. In addition it was found that N is released faster than K from the granules. The measurement of N in the granule rather than K or soil conductivity is more relevant because N has such a major effect on growth.

Leaf nutrient levels are given in Table 1. The values can be considered "normal" as most of the plants in this survey were growing well and looked healthy. These crops have been classified on basis percent N. This basis can be used as a starting point in deciding the rate of fertiliser application and/or composition of liquid feed. Because there is a large assortment of cultivated crops, this is one way to group crops having approximately the same N concentration. If these values are to be used for diagnostic purposes the time of sampling is critical as most nutrient levels fall sharply with age while Ca actually increases. These values are therefore valid only for the same sampling time (Fig. 2). As further data is available the classification of some of the crops may need to be adjusted.

The frequency distribution of micro nutrients is given in Fig. 3. For iron levels in the leaf, 74% fell in the range 50 to 200 ppm; for manganese, 71% fell in the same range; for zinc, 78% fell in the range 10 to 60 ppm and for copper (Cu), 84 fell in the range of 4 to 8 ppm. These values can also be considered as sufficient or 'normal' levels for nursery stock growers in Great Britain and Ireland. The Cu levels found here are lower that those found by Smith (1978) in the U.S. and as described by Reuter and Robinson (1987).

In conclusion, some very valuable information is now available on leaf macro- and micro-nutrient levels of more than 50 species and cultivars commonly grown in Great Britain and Ireland. More results are needed to obtain more consistent values

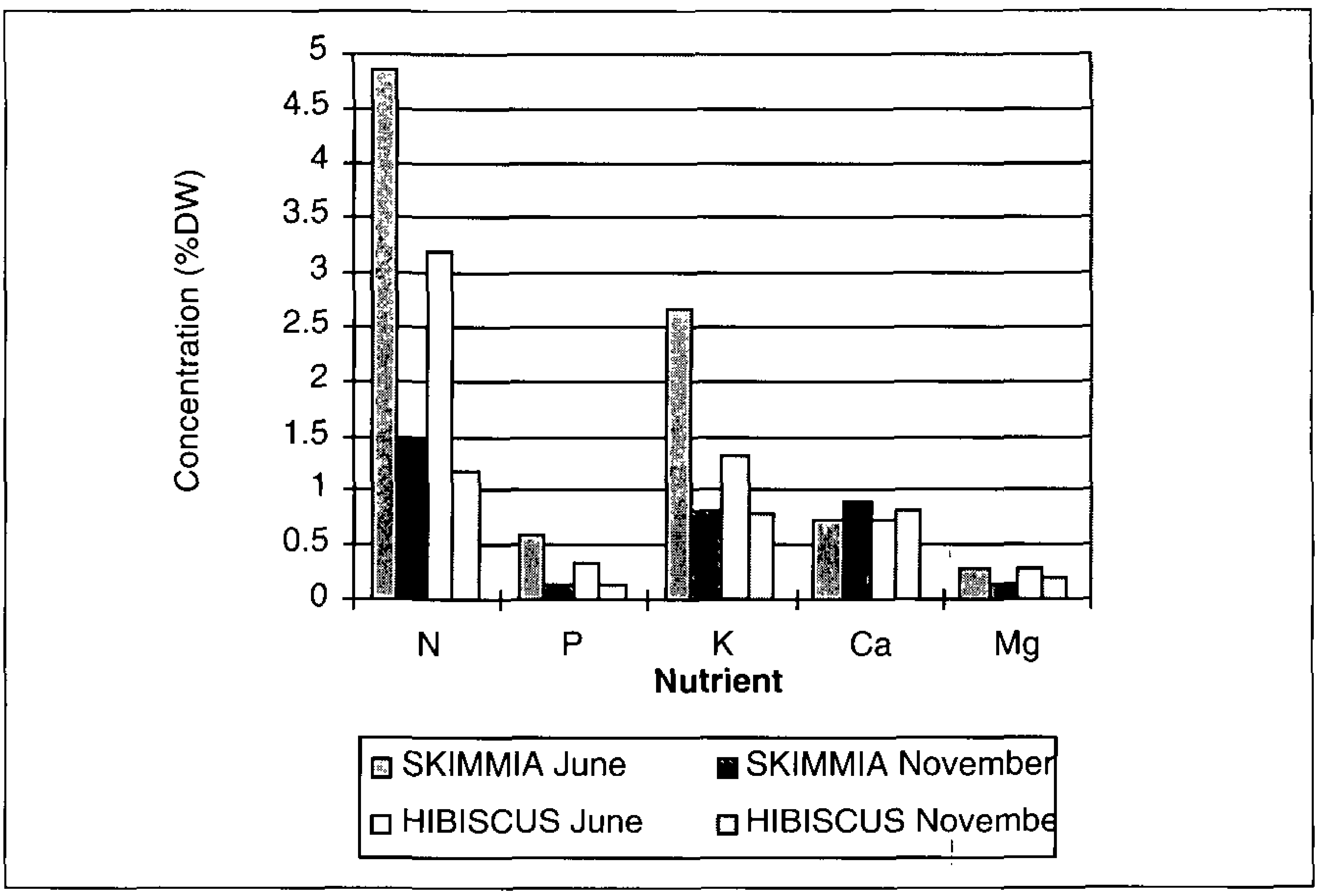

Figure 2. Effect of sampling time on leaf nutrient levels.

Table 1. Leaf nutrient levels (%D.W.) of nursery stock plants (June-August sampling)

	Low N				
	N	P	K	Ca	Mg
Azalea deciduous *(Rhododendron)*	0.7-1.27	0.8	0.33-0.57	0.42-0.64	0.17-0.64
Azalea evergreen *(Rhododendron)*	2.15-2.38	0.21-0.27	0.60-0.69	0.65-0.73	0.35-0.38
Berberis	1.53-1.89	0.13-0.15	0.47-0.99	0.35-0.66	0.16-0.17
Calluna	1.54-2.48	.08-0.23	0.54-0.83	0.41-0.69	0.16-0.27
Camellia	1.61-1.77	0.13-0.15	0.54-1.17	0.62-0.84	0.18-0.28
Coreopsis	2.17	0.42	1.09	-	-
Erica carnea	1.59-2.46	0.14-0.21	0.92-1.75	0.63-0.65	0.30-0.31
E. ×*darleyensis*	1.51-1.93	0.13-0.17	0.89-0.99	0.42-0.50	0.21-0.26
E. 'Springwood'	1.53-2.20	0.15-0.22	0.68-1.09	0.35-0.50	0.16-0.20
Hebe	2.15	0.24	0.81	0.63	0.28
Hosta	2.11	0.38	1.16	-	-
Hedera 'Monty'	1.34	0.08	0.42	-	0.72
Lavatera	1.58	0.57	0.88	1.69	0.53
Viburnum tinus	0.99-1.88	0.14-0.15	0.47-1.30	0.42-1.61	0.19-.31
V. davidii	1.58	0.13	1.04	1.10	0.35
Viburnum	1.3-1.88	0.09-0.23	1.10-1.36	0.57-1.71	0.30-0.55

Table 1. (continued) Leaf nutrient levels (%D.W.) of nursery stock plants (June-August sampling)

	Medium N				
	N	P	K	Ca	Mg
Ash (*Fraxinus excelsior*)	2.28-3.21	0.24-0.58	1.33-2.25	0.46-0.47	0.23-0.25
Camellia 'Donation'	1.68-2.65	0.15-0.23	0.54-1.12	0.33-0.62	0.22-0.28
Cordyline	1.62-2.54	0.16-0.19	0.32-0.94	0.27-0.38	0.53-0.66
Gooseberry (*Ribes uva-crispa*)	2.70	0.21	0.81	1.18	0.53
Green beech (*Fagus sylvatica*)	2.63-2.70	0.12-0.16	0.82-0.85	0.74-0.91	0.20-0.27
Hypericum 'Hidcote'	1.69-2.95	0.20-0.34	0.92-1.35	0.45-0.76	0.21-0.27
Juniperus	1.81	0.08	1.05	0.85	0.27
Leucothoe	2.47	0.49	1.53	-	0.13
Rhododendron	2.43	0.19	0.31	0.85	0.58
Brachyglottis Dunedin Hybrid	2.55	0.18	1.79	2.16	
(*Senecio greyi*)		0.80			
Skimmia	1.93-4.87	0.12-0.60	0.87-2.66	0.36-0.75	0.27-0.75
Taxus	2.92	0.29	1.78	0.60	0.34

Table 1 (continued). Leaf nutrient levels (%D.W.) of nursery stock plants (June-August sampling)

	High N				
	N	P	K	Ca	Mg
Azalea (evergreen) (*Rhododendron*)	2.38-3.18	0.23-0.40	0.69-1.04	0.46-0.71	0.27-0.53
Apple (*Malus*)	3.60	0.81	4.34	0.66	0.68
Acer pseudoplatanus	3.36	0.66	1.35	1.80	0.69
Buddleja	2.83-4.99	0.21-0.43	0.91-2.55	0.74-1.11	0.35-0.65
Astilbe 'Kohl'	3.13	0.21	1.45	1.48	0.32
Ceanothus	3.91-4.40	0.28-0.36	1.24-1.53	0.78-2.43	0.19-0.26
Chaenomeles	1.4-3.25	0.39	1.08-1.48	1.14	0.43
Cotoneaster	2.44-5.22	0.23-0.33	1.43-1.58	0.70-0.93	0.21
Cytisus	2.11-3.99	0.15-0.58	0.80-1.17	0.74-0.83	0.16-0.36
Eucalyptus	1.55-3.99	0.12-0.25	0.65-0.88	0.64-0.78	0.29-0.45
Euonymus	3.54	0.48	1.14	1.15	0.73
Jasminum nudiflorum	3.26	0.38	1.91	0.74	0.40
Houttuynia	3.25	0.28	1.29	0.65	0.83
Hibiscus	3.19	0.34	1.33	0.71	0.28
Lavatera 'Rosea'	2.76-3.29	0.24-0.49	0.73-1.40	0.49-1.05	0.52-0.68
Lavender (*lavandula*)	2.84-3.70	0.29-0.35	1.58-1.80	1.07-1.10	0.67-0.88
Miscanthus sacchariflorus	234-4.74	0.25-1.16	0.92-4.16	0.31-0.66	0.25-0.45
Oak (*Quercus*)	3.21-3.38	0.34-0.35	0.99-1.03	0.30	0.30-0.38
Prunus	3.85	0.48	1.68	0.59	0.15
Prunus domestica 'Victoria'	3.61	0.21	1.24	0.80	0.41
Prunus lauroceresus	2.43	0.29	1.75	1.96	0.45
Sambucus	2.44-5.08	0.23-0.93	2.01-4.90	0.94-3.74	0.69-1.54
Tradescantia	4.66	0.40	3.22	0.32	0.89
Weigela	3.46	0.43	1.83	-	0.45

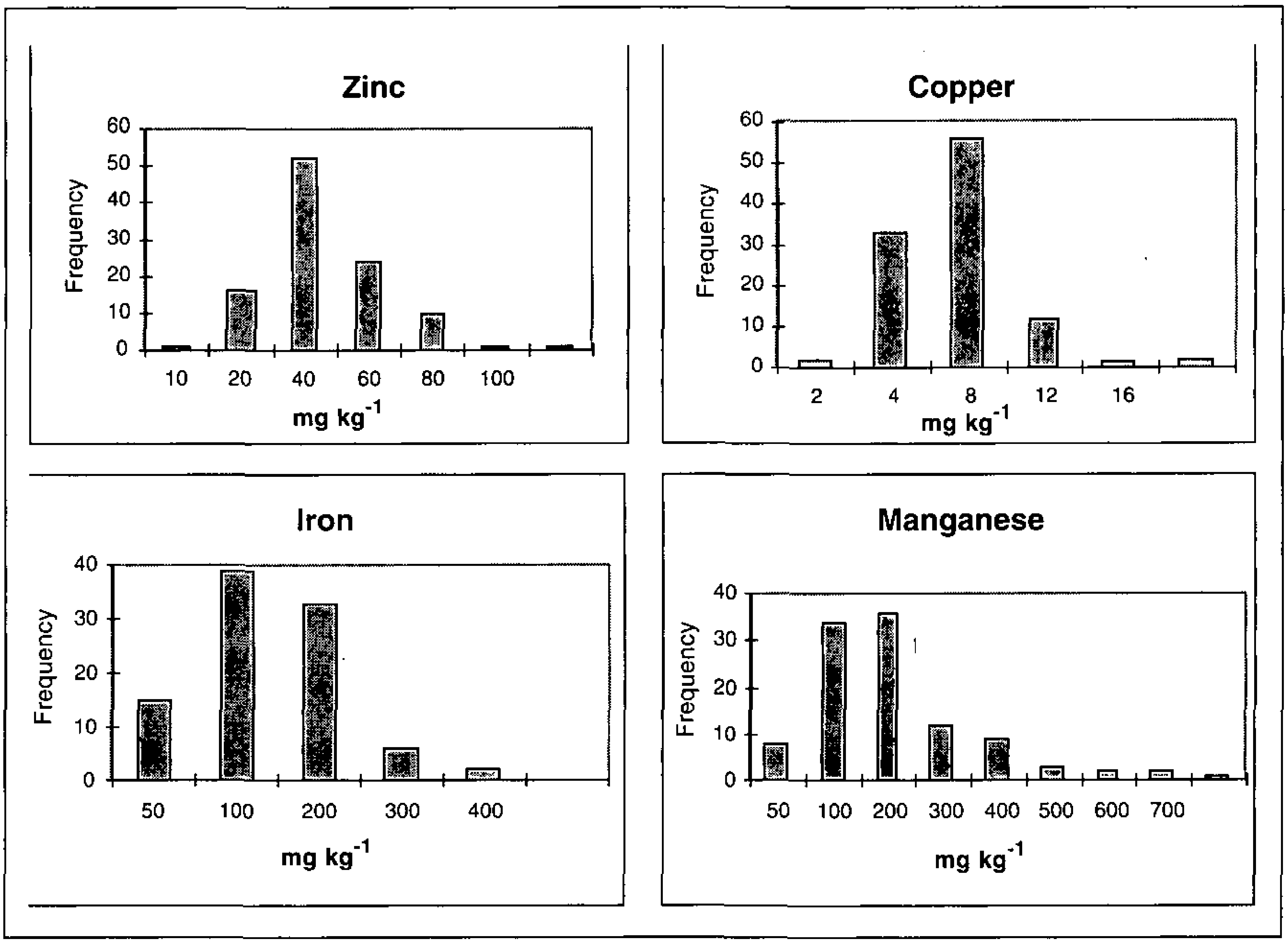

Figure 3. Frequency distributions of percent leaf micronutrient levels in nursery stock from Ireland and the United Kingdom.

for some crops, e.g. *Chaenomeles*. In addition, the determination of CRF reserves has given valuable information on nutrient reserves available and there are strong indications that in some situations the reserves may be unexpectedly low. The decision to top dress or liquid feed e.g. in spring before the flush of growth, can be decided rationally on basis of N reserve analysis.

LITERATURE CITED

Aendekerk, T.G.L. 1982. *Deficiency symptoms in agricultural plants.* Boskoop, Netherlands.

Alt, D. 1990. Dungen in der Baumschule, Verlag Bernhold Thalacker, Braunschweig, Germany.

O'Neill, J.V. and **R.A. Webb.** 1970. Simultaneous determination of N, P and K in plant material by automatic methods. J. Sci. Food Agric. 21:217-219.

Reuter, D and **J. Robinson.** 1987. Plant analysis—an interpretation manual. Inkata Press Melbourne, Sydney.

Roorda Van Eysinga, J.P.N.L. and **K. W. Smilde.** 1981. Nutritional disorders in glasshouse tomatoes and lettuce. Centre for Agric. Publ & Documentation, Wagengin, Netherlands.

Smith, E.M. 1978 a, 1978 b. Foliar Analysis of Woody ornamental Ohio Agric. Res. Center Circular 236.

Westermann, R.L. 1990. Soil testing and plant analysis. (3rd ed.). Soil Sci. Soc. Amer. Inc., Madison, Wisconsin.