

tion by streaking plant material on bacterial media. "Clean" material showed a six-fold increase in shoot numbers every six weeks on the proliferating medium. The majority (75%) of shoots transferred to the rooting medium had produced roots after six weeks.

CONCLUSION

Limonium peregrinum can be efficiently propagated by cuttings using a very free-draining medium and standard propagation facilities. *L. peregrinum* was successfully micropropagated once bacteria-free plant material was obtained.

NUTRITION OF CONTAINER-GROWN REWA-REWA (*Knightia excelsa*)

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Abstract. The response of container-grown rewa-rewas (*Knightia excelsa*) to five levels of N, P, K and lime were studied. The plants responded strongly to added N with the largest and most green plants receiving 450 to 600g N/m³ while foliage was chlorotic at very low N rates. Phosphorus stimulated foliage growth but there was a linear increase in foliar chlorosis due to iron deficiency. Highest foliar dry matter production occurred with no added lime and pH of 3.5 in the peat: perlite medium, which is typical of a calcifuge.

INTRODUCTION

The New Zealand honeysuckle or rewa-rewa (*Knightia excelsa*) is a native tree which is found in lowland to lower mountain forests in New Zealand (3). It is found throughout the North Island and the South Island in the Marlborough Sounds and on D'Urville Island. It belongs to the Proteaceae, along with *Persea toru*, the only other New Zealand native in this family. Metcalf (3) states that it will grow in almost any well-drained, friable soil and can tolerate dry situations.

Macadamia integrifolia is also in the Proteaceae and has foliar similarities such as the spiky evergreen lanceolate leaves. Macadamias were shown to have particular nutritional requirements (6) and it was decided to evaluate the nutrition of container-grown rewa-rewas with the objective of comparing these two plants with a view to make recommendations for potting mixes.

MATERIALS AND METHODS

Experimental Design. A four-factor response surface programme of the central composite design with incomplete blocks was used as for similar work (5). It involved N, P, K, and lime additions with 30 treatments arranged in 10 blocks each consisting of three sub-blocks and four replicates per treatment.

Fertilizer Rates and Potting media. The fertilizer sources used in the experiment for N, P, and K were Osmocote (26%N), superphosphate (8%P) and sulphate of potash (39%K), respectively. Lime was applied as a mixture of dolomite and agricultural lime (3:1). In addition, trace elements were applied in the form of "Sporumix A" at 150 g/m³ and Fetrilon iron chelate at 360 g/m³. All the fertilizers were mixed as a basal dressing in the potting mix, although N and P were given as two equal applications with half being applied initially and the other half 7½ months later as a top-dressing (lightly worked into the surface).

The medium used was equal parts (1:1, vv) Hauraki sphagnum peat and fine grade perlite. Containers used were PB 8 (4.8 l) polythene Planterbags.

Plant Material. One-year-old tube-grown seedlings were potted-up on 1 July, 1981. The plants were about 90 mm tall at potting.

Growth Environment. The experiment was carried out in a thermostatically controlled glasshouse with a minimum temperature of 8°C. The glasshouse was equipped with automatic fan ventilation, with fans operating when the temperature exceeded 21°C, that maintained the maximum temperature at approximately 5°C above ambient temperature. Supplementary lighting with 100 watt incandescent lamps 2m above floor level at 1.5m centres was given to increase photoperiod to 16 hours. The seedlings were watered by hand when necessary.

Data Collection. Media samples were taken at harvest time from 8cm deep cores and were analysed by Analytical Services Limited, Cambridge, New Zealand, with the methods described by Thomas (5). Chlorosis ratings were obtained at harvest using a visual rating system where plants were scored from 0 for severe chlorosis or defoliation, to 5 for normal healthy green leaves.

Plant tops were harvested at 12 months and oven dried. Foliage samples were taken randomly using the first two fully enlarged or mature leaves on the top of the plant. Samples were aggregated together and sent to Analytical Services Ltd, who used Kjeldahl digestion for N, and nitric-perchloric acid digestion for other nutrients.

Data from this experiment were statistically analysed for analysis of variance and F test. Data presented in graphic form in this paper were computed from the equations of the response surfaces.

RESULTS

This experiment, firstly, demonstrated the dominant and important role of nitrogen for the growth of container-grown plants. Plants showed deficiency symptoms and poor growth at low N rates (Figure 1) but responded strongly to increasing levels of N which were supplied as a basal and sidedress application after seven-and-a-half months (as were P rates).

The largest and most green plants (Figure 2) were obtained at 450 and 600g N/m³. The latter rate still left significant nitrate levels in the mix at harvest time (Table 1) while leaf N appeared to relate well to the difference in media levels with the maximum rising to 1.5%N (Table 2). Severe chlorosis occurred at the nil and 150g rates of N/m³ (Figure 2) while higher rates produced larger and greener plants.

Phosphorus additions also had a strong influence on both growth and plant quality. Optimum dry matter production was over the middle rates of added P and declined strongly with nil or 400g P/m³ (Figure 1), even though this nutrient was applied in two applications. The more important factor was the influence of P on the appearance of the plants since there was a linear decline in quality (increasing chlorosis) with each additional rate of added P (Figure 2). The application rate of 300g P/m³ resulted in 0.38% foliar P which was three times higher than with the 100g P/m³ rate while foliar iron appeared higher with the latter treatment (Table 2). In general the best quality plants were those with nil P, high N and also high K; however, there was no significant response in foliar dry weight to added K.

Highest dry matter production was with nil lime and a pH of 3.5 in the peat:perlite media. Growth was significantly poorer with any lime additions and where the pH was in excess of about 5.5 (Table 1).

Table 1. Potting mix nutrient levels and pH.

Added nutrients (g/m ³) and lime (kg/m ³)			Potting mix nutrients (mg/l)						
N	P	K	lime	Nitrate-N	P	K	Ca	Mg	pH
0	200	166	6	2					5.92
600	200	166	6	78					5.19
300	0	166	6		3				6.65
300	400	166	6		56				5.20
300	200	0	6			1			5.41
300	200	332	6			25			5.81
300	200	166	0						3.47
300	200	166	12						6.08
150	100	83	3	12	14	4	119	36	6.07
300	200	166	6	35	35	6	202	47	5.78
450	300	250	9	68	28	10	191	52	5.85

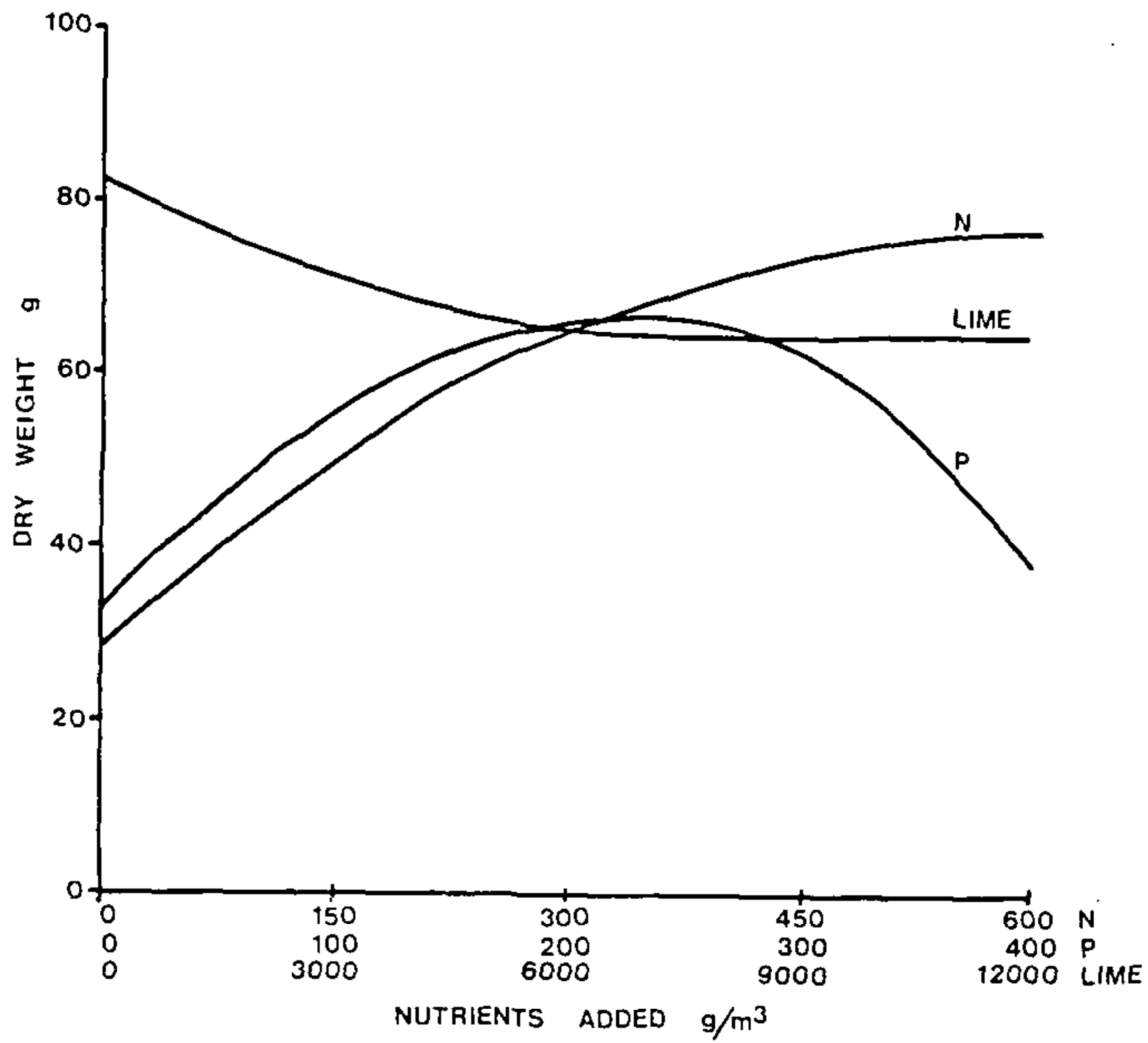


Figure 1. The influence of N and P fertilization and liming on foliar dry matter.

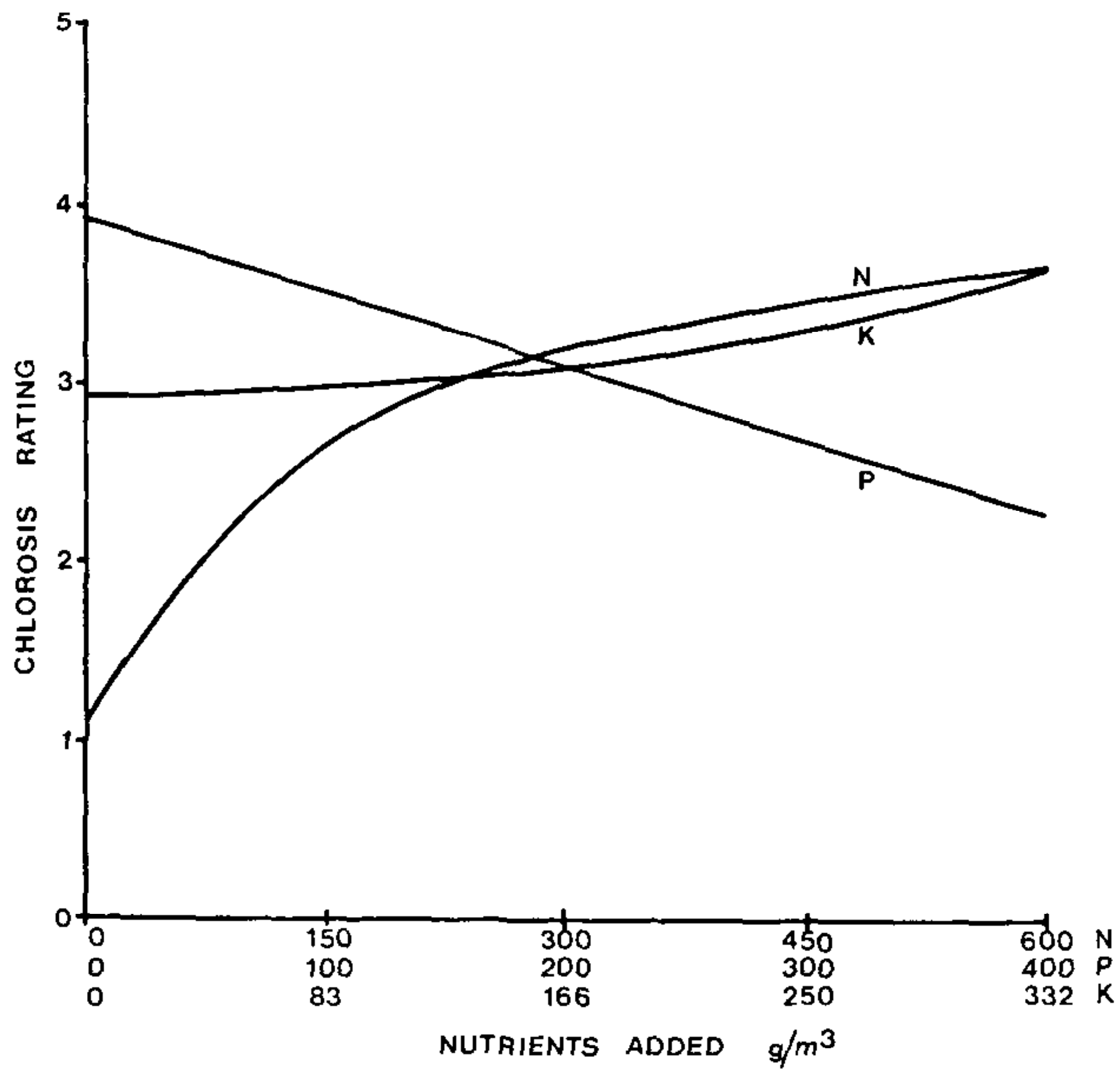


Figure 2. The influence of N, P and K fertilization on foliage colour ratings (severe chlorosis = 0 to 5 = green and full health).

Table 2. Leaf nutrient levels.

Added nutrients (g/m ³) and lime (kg/m ³)				Leaf nutrients (%)					
N	P	K	lime	N	P	K	Ca	Mg	Fe (ppm)
0	200	166	6	1.10					
600	200	166	6	1.50					
300	0	166	6		0.06				
300	400	166	6		0.26				
300	200	0	6			0.35			14
300	200	332	6			1.40			
300	200	166	0				0.8	0.19	19
300	200	166	12				0.77	0.22	6
150	100	83	3	1.16	0.13	0.81	0.89	0.27	16
300	200	166	6	1.46	0.17	0.87	0.82	0.25	14
450	300	250	9	1.19	0.38	1.02	0.86	0.20	10

DISCUSSION

In 1974 initial work was reported-on, which demonstrated that nitrogen was a common and major factor for satisfactory container production of plants, including the Proteaceae (4). This work also demonstrated a dominant role for nitrogen which agrees with the work reported here; even though *Knightia* is in the Proteaceae, there was no indication that the N rates used were too high. However, *Knightia* growth was unsatisfactory at very low N levels. *Knightia* appeared more responsive than the proteaceous shrub, *Hakea laurina*, which showed depressed growth at similarly high N levels (7).

Unpublished work with *Macadamia integrifolia* (native of Queensland, Australia) used the same experimental design as the one reported here and indicates that *Knightia* has much in common with this species of *Macadamia*. These plants have several features in common. They have similar foliage, readily suffer from foliar chlorosis, respond similarly to fertilizers and belong to the same subfamily (Grevilleoideae) of the Proteaceae (1). Excessive P fertilization in macadamias caused foliar chlorosis yet, in common with *Knightia*, there was improved foliar growth at low rates (6). Foliar chlorosis in *Knightia* was probably triggered by unfavorable foliar P to Fe ratios, as was noted for *Macadamia integrifolia* (6). Table 2 indicates quite widely varying levels of foliar P and Fe but there was insufficient data to show trends.

In conclusion, the results indicate that plants can be grown with standard rates of slow release fertilizers but that mixes should not have superphosphate or lime added. Addition of iron, such as chelated formulations, and excellent drainage but good watering, will help minimise deficiency and ensure good plant quality with no foliar chlorosis.

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A SYSTEM FOR THE EVALUATION OF ZANTEDESCHIA (CALLA LILIES)

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The breeding and selection of summer flowering *Zantedeschia* hybrids has had a long history in New Zealand. Over the past 50 years amateur breeders have crossed and back-crossed selections originating from the following species: *Z. elliottiana*; *Z. rehmannii*; *Z. albomaculata*; *Z. tropicalis*; and *Z. pentlandii*. The result of this work has led to a wide spectrum of beautifully coloured hybrids suitable for cut flowers, potted plants or garden plants.

In recent years commercial nurseries have been able to exploit the tremendous potential of this crop through the rapid multiplication process of tissue culture. Previous to this technique, clones could only be multiplied by division which was very slow and often led to disease. With tissue culture propagation it is now possible to bulk up thousands of progeny from a single clone in a very short period of time. This process is, however, expensive and a clone must be thoroughly assessed before it is selected for bulking up.

Although companies involved in commercial rhizome production each have their own field plots for evaluation, a need has arisen to carry out comparative assessments of selections, from the various producers, at one common site. This need is being fulfilled at the Massey University Bedding Plant Trial Garden in Palmerston North, New Zealand.

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