The Effect of Type and Rate of Controlled-Release Fertiliser on the Performance of Hardy Nursery Stock in Containers

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Four controlled-release fertilisers (CRFs): Ficote 140 (14N-3.5P_2O_5-6.5K_2O), Multicote 8 (18N-2.6P_2O_5-9.8K_2O), Osmocote 12-14 month (15 : 4 : 9), and Plantacote 12M (15N-4.3P_2O_5-12.5K_2O) were compared for the production of hardy nursery stock. These fertilisers were incorporated into a peat compost at three rates to provide 450, 750, and 1050 g N m-3. Five plant subjects were studied: ×*Cupressocyparis leylandii* 'Castlewellan Gold', *Choisya ternata, Ligustrum ovalifolium, Ulex europaeus* 'Strictus', and *Ozothamnus ledifolius*. The four fertilisers and three rates were applied in a factorial design for each subject. Rooted cuttings were potted up into 2-litre pots in May and placed in a bed with overhead irrigation. The plants were evaluated in December and May for vigour, colour, height, fresh weight, and marketability. Higher rates of CRF resulted in increased fresh weight and other characters evaluated for most of the plant subjects and fertilisers tested. Plants were more responsive in terms of vigour and marketability than in colour and height. Ficote and Osmocote were the most consistently successful of the fertilisers. Multicote gave poor results with *Ligustrum* but was satisfactory with the other subjects. *Ulex* performed poorly with Plantacote. These results may be related to trace element nutrition.

INTRODUCTION

Controlled-release fertilisers (CRFs) are widely used in Great Britain and Ireland for the production of nursery stock plants in containers. Small plants are commonly potted into 2-litre pots in spring, grown on during the summer and autumn, and are ready for sale in the autumn and following spring. The present experiment compared four CRFs that are available in Ireland for this type of production schedule.

METHODS

Four CRFs — Ficote 140, Multicote (8-10 month), Osmocote (12-14 month), and Plantacote (12M) — were incorporated into a peat compost at three rates to provide nitrogen at 450, 750, and 1050 g m^{-3}. The actual rates of fertiliser used are shown in Table 1.

Rooted plants of ×*Cupressocyparis leylandii* 'Castlewellan Gold', *Choisya ternata, Ligustrum ovalifolium, Ulex europaeus* 'Strictus', and *Ozothamnus ledifolius* were planted into 2-litre pots in May and stood down on a gravel bed with overhead irrigation. Half of the plants were harvested in December and the remainder in May. At the same time plant height was measured and the plants were assessed for vigour, colour and overall marketability.

Table 1. Amounts (kg m^{-3}) of controlled-release fertilisers used in the experiment.

Fertiliser	Specification (N-P_2O_5-K_2O)	Rate 1	Rate 2	Rate 3
Ficote 140	14-3.5-6.5	3.21	5.35	7.49
Multicote 8	18-2.6-9.8	2.50	4.16	5.82
Osmocote (12-14 month)	15-4-9	3.00	5.00	7.00
Plantacote 12M	15-4.3-12.5	3.00	5.00	7.00

Three samples of 60 granules of each fertiliser, excepting Plantacote, were taken from the pots at assessment time. These were ground with a mortar and pestle, made up to 250 ml with distilled water and analysed for residual nutrients. This same procedure was also carried out with unused granules and the results of the residual analysis were expressed as a percentage of the original values.

The four CRFs were added to silica sand which was poured into plastic cylinders which had a mesh secured at the bottom. The cylinders were placed in a funnel and then transferred to a glasshouse in June. Every 2 weeks, over a 20-week period, the cylinders were leached with distilled water and the leachate was collected and analysed.

RESULTS

As there was no significant interaction between CRF type and rate, the results for each factor are presented separately. The effect of rate of CRF on the fresh weights of the plants at the end of the experiment are shown in Table 2.

Table 2. Effect of rate of controlled-release fertiliser on the fresh weight (g per plant) of five subjects.

Rate	*×Cupressocyparis leylandii*	*Choisya*	*Ligustrum*	*Ulex*	*Ozothamnus*
Low	196.0	93.1	35.5	160.8	134.6
Medium	228.3	135.2	41.5	211.8	139.9
High	299.0	158.3	68.3	231.9	162.1
F-test	***	***	***	***	***
S.E.	13.4	8.61	5.52	9.64	5.04

There was a very positive response to increases in the rate of CRF in all five plants. In order to summarise the large amounts of data obtained, the values for each character recorded were expressed in relative terms with the highest value being assigned 100 and the other values expressed as a percentage of the highest value. The results were then averaged across the categories to obtain a single value for each rate which gave a measure of the overall performance of that rate for the particular subject. The results of this exercise are shown in Table 3. This clearly shows that the high rate of CRF gave the best overall performance. *Ozothamnus* was the least responsive of the five plants.

Table 3. Relative performance of five subjects at three rates of controlled-release fertiliser (CRF)—May rating.

Subject	Low	Rate of CRF Medium	High
×*Cupressocyparis leylandii*	88	90	100
Choisya	79	94	100
Ligustrum	74	77	100
Ulex	88	96	98
Osmanthus	95	93	99
Mean	85	90	99

The effect of the four CRF types on fresh weight are shown in Table 4. There was no significant effect with ×*C. leylandii* and *Ulex* but the other three species performed better with Ficote and Osmocote than Multicote or Plantacote. The relative performances at the final harvest, calculated as for the rates, are shown in Table 5. This clearly shows that Ficote and Osmocote performed better overall than the other CRFs. *Ligustrum* did particularly badly when Multicote was used (Tables 4 and 5). The results of the leaching experiment for nitrogen and copper are shown in Fig. 1. All the fertilisers showed a controlled release of nitrogen and this result was also obtained with the other major nutrients. Ficote released nitrogen more rapidly than the other fertilisers. The picture was quite different for the trace elements. Only Ficote and Osmocote had a consistent controlled release pattern for the trace elements tested [copper (Cu), zinc (Zn), manganese (Mn), and boron (B)]. Multicote released no Cu for 10 weeks and then only very small amounts. Plantacote, by contrast, released over 60% of its Cu content at the first leaching and thereafter only very small amounts. A similar pattern of an initial flush followed by little subsequent release was found in the case of B both for Multicote and Plantacote.

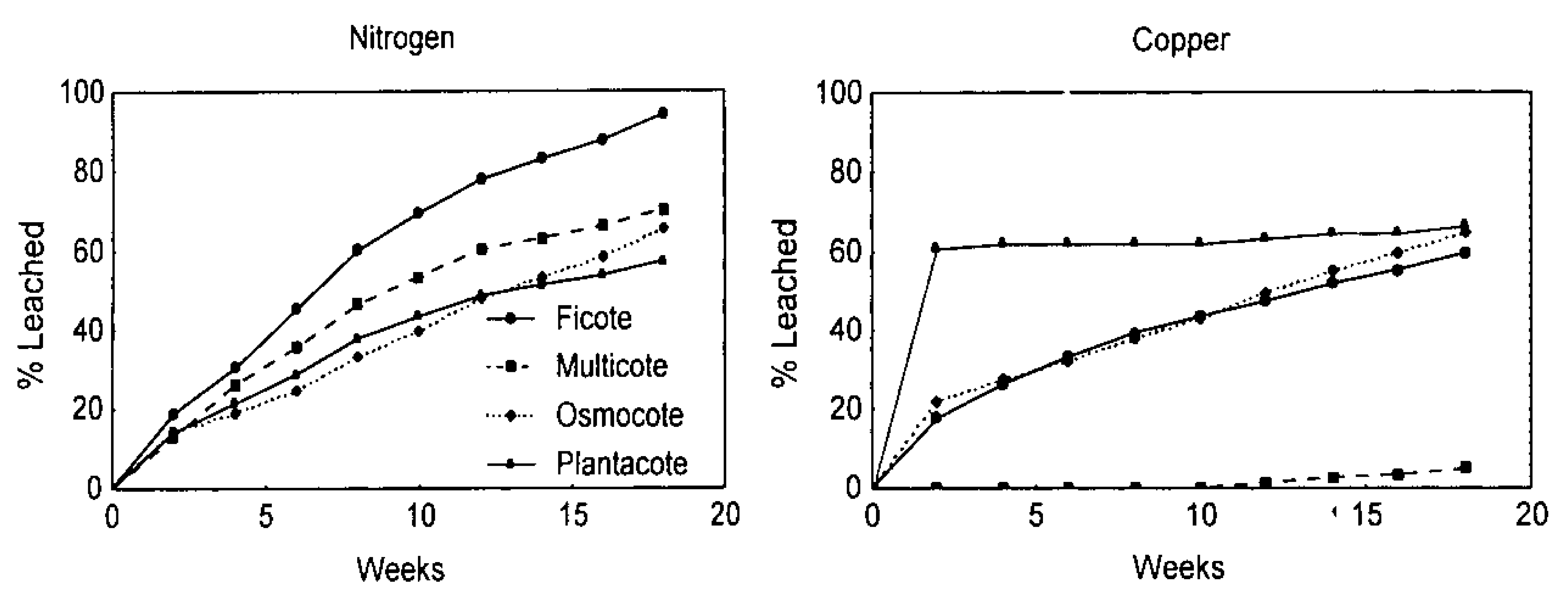

Figure 1. Release pattern of nitrogen and copper in four controlled-release fertilisers.

Table 4. Effect of type of controlled-release fertiliser (CRF) on the fresh weight (g per plant) of five subjects.

CRF	×*Cupressocyparis leylandii*	*Choisya*	*Ligustrum*	*Ulex*	*Ozothamnus*
Ficote	241.0	160.4	62.3	202.0	148.9
Multicote	256.0	97.6	18.7	188.6	132.6
Osmocote	232.4	151.9	64.1	220.8	155.0
Plantacote	234.9	105.5	48.7	194.6	137.3
F-test	NS	***	***	NS	*
S.E.	15.5	9.94	6.37	11.1	5.82

Table 5. Overall relative performance of four controlled-release fertilisers (CRFs) at the final harvest.

CRF	×*Cupressocyparis leylandii*	*Choisya*	*Ligustrum*	*Ulex*	*Ozothamnus*	Mean
Ficote	97	97	99	98	92	97
Multicote	92	84	65	91	85	83
Osmocote	98	98	93	97	96	96
Plantacote	91	87	90	89	96	91

Table 6. Residual analysis of controlled-release fertiliser granules in December and May as percent of original values.

	EC[1]	N	P	K
December, 1995				
Ficote	22	13	40	25
Multicote	30	21	45	37
Osmocote	35	25	51	33
May, 1996				
Ficote	8	2	20	7
Multicote	21	12	41	24
Osmocote	17	10	34	12

[1] Electrical conductivity

The residual analysis of the fertiliser granules is shown in Table 6. They agree with the leaching results in showing that Ficote had the quickest release of nitrogen and therefore the lowest reserve in the residual analysis. At the end of the experiment, Ficote was almost entirely depleted of N while Multicote and Osmocote still had some reserve. Nitrogen was depleted more rapidly than K, and P was slowest of all. The EC values were intermediate.

DISCUSSION

The results on the rate of CRF indicate that growers risk a loss of crop quality if they reduce the application rate of fertiliser. Although CRFs are expensive fertilisers in terms of the unit cost of N, P, and K, reducing rates to save on costs is almost always a mistake. *If a CRF costs IR£75 for 25 kg and is used at a rate if 5 kg m* $^{-3}$, *then the* 10 g of CRF in a 2-litre pot will cost 3 pence. The product at the end of the growing period of 12 months will have a sales value of IR£1.20 to IR£1.50. Any savings made by cutting back on CRF will clearly be outweighed by any negative impact on product quality and therefore sales price. The prime consideration, apart from environmental concerns, in deciding on fertiliser application rate is the effect on product quality.

Osmocote and Ficote gave more consistent results than either Multicote or Plantacote in these experiments. The results from the leaching experiment indicate that the release pattern of some trace elements in the latter two fertilisers is erratic and their overall poorer performance may be related to this. For instance, tissue analysis showed that the copper content of plants grown with Multicote was lower than with the other fertilisers. However, copper supplementation experiments would be necessary to prove that this was the factor affecting plant performance.

Residual analysis of the CRF granules gave results that were in agreement with the leaching results, in differences between the fertilisers and in the rate of depletion of N, P, and K. This could be a useful and simple method for checking on the growth potential of a compost. Although nitrogen is probably the most critical element to measure, if the relationship between N and EC are fairly constant then the EC could be used as an indication of residual nutrient levels. If this is the case then it should be possible for growers to carry out the test on the nursery and obviate the need for a laboratory analysis.