RESPONSE OF SEEDLING GORSE TO FERTILISERS

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SUMMARY

The growth of seedling gorse (*Ulex europaeus*) and 'Grasslands Nui' perennial ryegrass (*Lolium perenne*) was measured over 18 weeks in a glasshouse experiment. The species were grown singly and together and the response to nitrogen, potassium, phosphate and combined fertilisers assessed. Gorse shoot and root growth and root nodule number were greatly increased by phosphate but not by other fertilisers. Ryegrass responded less strongly to phosphate but, in association with gorse, was stimulated by nitrogen. It is suggested that adding nitrogen to the fertilisers used in establishing pasture is likely to make grasses more competitive and discourage gorse invasion more than the use of phosphate alone.

INTRODUCTION

Pasture management is generally recognized as a key factor in preventing the establishment of seedling gorse on cleared land (Ivens 1979, 1982; Hartley *et al* 1980) and the use of fertilisers is an important aspect of management. With seedlings grown in containers Thompson (1974) reported a strong response of gorse to phosphate and less or no response to potash or nitrogen. Under field conditions Hartley and Phung (1979) found no significant effect on seedling survival from a nitrogen application and Ivens (1979) detected no effect from phosphate. In the field it seems clear that the response of gorse seedlings to fertilisers will be due partly to the direct influence of the fertiliser and partly to an indirect influence via the competitive effects of the pasture grasses.

Little information is available on the relative responses of associated seedling gorse and pasture species to fertiliser treatments and the present trial was conducted using gorse and ryegrass, grown under glasshouse conditions, to provide data which might help in determining the fertiliser treatment most likely to discourage reinvasion of gorse and the development of pasture on cleared land.

METHOD

Perennial ryegrass and pre-germinated, scarified and inoculated gorse seeds were sown in 30 x 30 x 20 cm boxes of phosphate deficient Tokomaru silt-loam soil at a density of 48 plants/box (equivalent to 533/m²) in April 1977. Each species was grown individually and the two were combined in a ratio of three gorse to one ryegrass. The fertiliser treatments listed below were applied immediately after sowing. The experiment was continued for 18 weeks with the temperature maintained at 20 ± 5 °C, without supplementary lighting but watered as necessary.

N (urea)	50 kg/ha
P(superphosphate)	70 kg/ha
K (potassium chloride)	56 kg/ha
O (no fertiliser)	
all combinations of the above	

Treatments were replicated four times and the replicates arranged in blocks. At the conclusion of the experiment plants were removed from the soil, the dry weights of shoots and roots determined and nodules on the gorse roots counted.

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RESULTS

The data given in Table 1 showed a strong response of gorse seedlings to phosphate, the shoot dry matter being more than doubled in monoculture and almost doubled in the mixture with ryegrass. Gorse showed no response to the other fertilisers. The ryegrass growth was also increased by the phosphate application. In monoculture the increase was less than that of gorse but in the mixture, at a lower density of grass plants, it was of the same order. In the mixture the grass growth was also increased by the nitrogen application. With neither species was there any significant interaction between the fertilisers.

TABLE 1: The effects of fertiliser treatments on shoot dry matter of gorse and ryegrass after 18 weeks as % of untreated.

Fertiliser	Gorse alone	Ryegrass alone	3 gorse/1 ryegrass mixture	
			Gorse	Ryegrass
N	104	104	103	134*
P	216**	137**	184**	188**
K	93	104	88	94
NP	226	146	180	243
NK	104	117	104	144
PK	220	141	169	186
NPK	222	136	199	227
O (g DM/box)	4.1	14.6	2.2	8.4
(mg/plant)	85	304	61	700

* ** Figures in columns refer to individual treatment means but significance indications refer to main effects at $P = 0.05$ and 0.01 (no interactions significant)

As the untreated yields in Table 1 indicate, the early growth of the ryegrass was much faster than that of the gorse and, where the two species were grown together, the average weight per plant of ryegrass was more than twice that in monoculture, whereas the average plant weight of gorse was reduced.

TABLE 2: The effects of fertiliser treatments on root dry matter of gorse and ryegrass after 18 weeks as % of untreated.

Fertiliser	Gorse alone	Ryegrass alone	3 gorse = 1 ryegrass mixture	
			Gorse	Ryegrass
N	92	136	127	122*
P	128**	177**	109	231**
K	90	109	102	81
NP	112	172	105	255
NK	100	123	125	150
PK	108	197	102	207
NPK	118	183	95	241
O (g DM/box)	2.0	14.4	1.1	9.4
(mg/plant)	42	300	31	783

* ** Figures in columns refer to individual treatment means but significance indications refer to main effects at $P = 0.05$ and 0.01 (no interactions significant)

The root dry weight figures in Table 2 show responses similar to those of the shoots but, although with ryegrass the phosphate treatment caused a greater increase in root than shoot, with gorse the root response was smaller than that of the shoot. Thus while in the absence of fertiliser the shoot/root ratio of gorse was about twice that of ryegrass, there was a fourfold difference between the species with the addition of phosphate. Where the two species were grown together the roots of ryegrass showed a nitrogen response similar to that of the shoots but no effect of phosphate on the root growth of gorse was noted.

TABLE 3: The effect of fertiliser treatments on gorse root nodulation after 18 weeks as % of untreated.

Fertiliser	Gorse alone	Gorse in mixture
N	105	93
P	249**	134**
K	110	90
NP	190	126
NK	110	105
PK	169*	144
NPK	178	147
O (no./plant)	14.7	11.8

* ** Figures in columns refer to individual treatment means but significance indications refer to main effects and interactions at $P = 0.05$ and 0.01

Although the addition of phosphate caused a small increase in gorse root growth compared with the increase in shoot growth, it resulted in a large increase in root nodules in the gorse monoculture, as shown in Table 3. Because the increase where phosphate was combined with potassium was much smaller than with phosphate alone the analysis shows a significant P K interaction, the interpretation of which is doubtful. It is not considered likely that it represents a genuine effect of potassium in reducing the nodule stimulating effect of phosphate. Where gorse and ryegrass were grown together the increase in nodulation with the phosphate treatment was smaller, but still highly significant.

DISCUSSION

The results emphasize the low competitive ability of gorse seedlings against ryegrass in the early stages of establishment. After 18 weeks the average gorse shoot weight in monoculture without addition of fertiliser was only 28% of the ryegrass shoot weight and, when the two species were grown together in the proportion of three gorse to one ryegrass, this figure was reduced to 9%. In terms of root growth the gorse was even less competitive and figures comparable to the above were 14% for the monocultures and 4% for the mixture.

The experiments confirm the strong response of gorse to phosphate and the lack of response to nitrogen reported by previous workers (Thompson 1974; Hartley and Phung 1979). Ryegrass also responded strongly to phosphate and, although the nitrogen application did not affect the growth of grass in monoculture, it resulted in a significant increase in the mixture.

There was a greater response of ryegrass to phosphate when growing with gorse than in monoculture. As there were only 12 ryegrass plants per box in the mixtures compared with 48 per box in the monocultures the greater response to phosphate in the former may have been due to reduced competition, which might also explain the greater response of grass to nitrogen in the mixtures.

Examination of the gorse roots showed that the number of nodules was correlated with the shoot weight but not root weight. In association with ryegrass, when the gorse roots made little growth, application of phosphate still resulted in a significant increase

in nodule number. The decrease in nodulation resulting from nitrogen treatment reported by Thompson (1974) was not confirmed in the present work.

The response of gorse seedlings to fertiliser treatment shown in this work is very similar to that of pasture legumes. Thus the high rates of superphosphate applied to encourage the establishment of clover will also tend to encourage the growth of gorse seedlings. In mixed associations the growth of grass was increased by application of phosphate and also nitrogen. Combinations of nitrogen and phosphate might therefore be expected to make grass growth more competitive against gorse than phosphate alone. An implication of these results is that, in establishing pasture on land liable to gorse seedling invasion, more consideration should perhaps be given to using nitrogen in the initial fertiliser application to help establish as competitive a grass cover as possible rather than applying phosphate alone. As Hartley *et al* (1980) have shown, a key factor in limiting invasion by gorse seedlings is the early introduction of stock. With the increased grass growth resulting from application of nitrogen it should be possible to increase the grazing pressure and thus increase the number of gorse seedlings destroyed by trampling and grazing.

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