EFFECTS OF PASTURE SPECIES, LIME AND FERTILISER ON GORSE SEEDLING REGENERATION

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SUMMARY

After a gorse-covered hillside had been root-raked, large plots were over-sown with perennial ryegrass, cocksfoot, browntop or Yorkshire fog, all with white clover. Smaller plots within each large plot were then top-dressed with lime, superphosphate, nitrogen, or combinations of these. The emergence and survival of gorse seedlings was monitored and the development of gorse cover observed for 3 years. Lime, superphosphate and nitrogen application all had some effect in reducing seedling numbers, with the effects of nitrogen apparently lasting longest. Different oversown pasture species had no effect on establishment or survival of gorse seedlings.

INTRODUCTION

After gorse (*Ulex europaeus*) has been cleared, up to 20700/m² seeds can be left in the soil (Zabkiewicz and Gaskin 1978). Gorse seedlings emerging after clearing can be controlled if good pasture cover is established quickly and grazed hard (Bell 1941). This does not always work in practice (Radcliffe 1985) and many farmers find that herbicide applications are needed.

Ivens and Mlowe (1980) showed that ryegrass competed strongly with gorse seedlings. Hartley and Phung (1979) found that gorse seedling survival was highest in a Ruanui perennial ryegrass (*Lolium perenne*) sward and lowest in browntop (*Agrostis capillaris*), with Yorkshire fog (*Holcus lanatus*) having an intermediate effect. The addition of white clover (*Trifolium repens*) to the sward leads to greater mortality of gorse seedlings (Hartley and Phung 1979; Thompson 1974).

Gorse growing alone responded positively to phosphate but not to potash, nitrogen or lime (Thompson 1974), whereas in ungrazed pasture gorse seedling survival was reduced by nitrogen and phosphate. Hartley and Phung (1982) confirmed that both phosphate and nitrogen reduced the numbers of gorse seedlings in grazed pasture, and Hartley and Phung (1979) found that lime had the same effect.

A technique regularly used for gorse control in New Zealand has been root-raking, where a bulldozer is driven down a hillside, removing most of the vegetation and some of the topsoil. Although this removes standing gorse plants, it leaves behind bare and sometimes poor quality soil containing gorse seeds. The experiment described here investigated how best to revegetate a root-raked area, with seed, fertiliser or lime inputs to reduce the regrowth of gorse seedlings.

METHODS

The experimental area, near Palmerston North, was a south facing hillside with tall, dense gorse until April 1979, when the gorse was burnt after being sprayed with herbicide in February 1978. Some areas of gorse were unaffected by the fire and gorse regenerated over most of the burnt area. The hillside was root-raked in January 1983.

Eight relatively uniform, long main plots were marked out, running up and down the slope and ranging in size from 455 to 670 m². Each of four grass species — Ellett perennial ryegrass (20 kg/ha), Massey Basyn Yorkshire fog (10 kg/ha), browntop (5 kg/ha), Wana cocksfoot (*Dactylis glomerata*) (10 kg/ha) — was oversown by hand, with 3 kg/ha of Huia white clover, on two replicated main plots on 2 March 1983.

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Soon after establishment of the oversown species, 4.5 m by 5 m fertiliser sub-plots were marked out within each grass species plot. A block of eight sub-plots was placed at the top end of each cultivar strip and another block at the lower end. Each of these blocks constituted a 2^3 factorial with phosphate (as superphosphate) at 20 kg or 80 kg/ha, nitrogen (as urea) at 0 or 50 kg/ha or lime at 0 or 5000 kg/ha.

The lime and superphosphate were applied on 11 May 1983 and nitrogen was applied at 50 kg/ha on both 29 August 1983 and 28 February 1984.

Soil samples taken in October 1983 and June 1985 were analysed by the Quicktest method at the Ruakura Soils Laboratory. In June and July 1983, gorse seedlings were counted in 20 0.5 m^2 quadrats on each sub-plot. At the same time, four 0.5 m^2 permanent quadrats were marked out in each sub-plot. Subsequent seedling counts were made in one or more of these permanent quadrats. At the last count in July 1984, hardened, older seedlings and soft seedlings were counted separately. In March 1985 and October 1986, visual estimates of gorse biomass on each sub-plot were made on a scale from 0 (no gorse) to 10 (the highest amount of gorse found on any plot).

The whole area (of about 5 ha) was grazed for the first time in late July 1983, with 200 ewes for 4 days. Subsequent grazings were monthly, of similar intensity, until June 1984 when the area was set-stocked. The grazing pressure was not regarded as particularly intense.

RESULTS

Both lime and superphosphate had rapid and marked effects on pH (and calcium) and phosphate levels respectively (Table 1). Two years after application, lime effects were still as marked, but the effects of superphosphate had declined.

TABLE 1: Effects of phosphate (P) and lime on soil Quicktest results.

Date	Treat	pH	Ca	Olsen P
Jan 1983	—	5.2	2.9	3.2
Oct 1983	low P	5.7	4.4	6.4
	high P	5.8	5.2	17.8
	(LSD, 5%)	(0.4)	(1.5)	(2.5)
	no lime	5.2	2.9	13.6
	+lime	6.3	6.7	10.6
	(LSD, 5%)	(0.1)	(0.8)	(4.4)
June 1985	low P	5.8	5.1	6.0
	high P	5.9	5.8	8.2
	(LSD, 5%)	(0.4)	(1.8)	(1.1)
	no lime	5.3	3.0	8.0
	+lime	6.4	7.9	6.2
	(LSD, 5%)	(0.2)	(1.0)	(1.2)

Gorse seedlings emerged in large numbers (up to 600/m^2) in March 1983. In June/July 1983, the overall average number in all 512 fixed quadrats was 203/m^2, with the higher rate of phosphate having fewer gorse seedlings than the lower rate (Table 2). At the last count in July 1984, the average number of seedlings was 19/m^2. The pattern of decline is shown in Table 2. Applications of superphosphate, nitrogen and lime all significantly reduced gorse seedling numbers. There was no significant effect of pasture species on gorse seedlings, though fewest seedlings were present in Wana cocksfoot plots and most in Ellett ryegrass plots.

Lime and nitrogen also had significant effects on the number of newly emerged (soft) seedlings present in the plots in July 1984 (Table 2).

The effects of nitrogen were still present in March 1985 and October 1986, with less gorse being present in the plots which had received nitrogen.

TABLE 2: Gorse seedling numbers and gorse biomass scores as affected by superphosphate (P), nitrogen (N) and lime, averaged over all other treatments.

Date	Low P	High P	No N	+ N	No lime	+ lime	Actual mean
			Log seedlings/m^2				No./m^2
July 83	5.22	5.05	5.19	5.09	5.17	5.11	203.0
(LSD, 5%)	(0.12)		ns		ns		
Nov 83	3.83	3.37	3.93	3.27	3.65	3.55	53.1
(LSD, 5%)	(0.29)		(0.29)		ns		
Jul 84 (Hard)	2.93	2.52	3.05	2.40	2.87	2.58	18.9
(LSD, 5%)	(0.21)		(0.21)		(0.21)		
(Soft)	1.48	1.38	1.57	1.28	1.58	1.27	4.2
(LSD, 5%)	ns		(0.20)		(0.20)		
			Gorse biomass score				
Mar 85			4.4	3.1			
(LSD, 5%)			(0.4)				
Oct 86			4.2	3.2			
(LSD, 5%)			(0.5)				

DISCUSSION

Gorse control on the trial site was poor. Even in the best plots, gorse seedling numbers were high enough to ensure a rapid return to dense gorse cover. This could have been partly due to inadequate grazing, to patchy pasture establishment, and possibly to the delay in response of pasture species to applied nutrients on the impoverished soil left by root-raking. Neighbouring properties were highly successful in controlling gorse after root-raking, but only through using high inputs of herbicides after pasture had been established.

The reduction in numbers of gorse seedlings achieved under the best treatments here are inconsequential if more intensive grazing or broadcast herbicide use or both are necessary afterwards. However, treatments like nitrogen and phosphate could also weaken gorse seedlings and make them more susceptible to herbicides or intense grazing. In addition, treatments like lime can reduce the subsequent establishment of gorse seedlings in existing pasture, as shown in Table 2. Reduced numbers or vigour of gorse seedlings, could also help the effectiveness of biological control agents such as the recently released gorse spider mite (*Tetranychus lintearius*).

Nitrogen-, phosphate- and lime-treated areas all had fewer gorse seedlings, almost certainly through increased competition from pasture species. Had grazing pressure been more intense and pasture cover more uniform, these three treatments could have caused greater reductions in numbers of gorse seedlings. The work confirms earlier results (Thompson 1974; Hartley and Phung 1984) showing that both nitrogen and superphosphate applications improved pasture growth at the expense of gorse seedlings.

We have been unable to confirm the benefits of oversowing one pasture species rather than another for gorse seedling control, perhaps because of site variability and limited replication. Perennial ryegrass may not, however, be the best species to sow. The presence of clover seems to have some beneficial effects, and its inclusion in seed mixes is recommended, although subsequent herbicide applications could kill clover. Both lime and superphosphate boosted the clover content of the swards. In terms of reduction in gorse seedling numbers, nitrogen was the most effective input, with superphosphate second and lime third.

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