

THE EFFECT OF COMPETITION AND USE OF FERTILISER ON THE SEEDLING EMERGENCE OF INTRODUCED GORSE (*ULEX EUROPAEUS*) AND SCOTCH BROOM (*CYTISUS SCOPARIUS*)

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ABSTRACT

The effect of varying levels of rangeland vegetation competition, as modified by application of fertiliser, on the establishment of introduced Scotch broom (*Cytisus scoparius*) and gorse (*Ulex europaeus*) was monitored over a five year period. Two growing seasons after fertiliser addition, vascular plant cover in the fertilised plots was two-fold greater than in the control plots. After 5 years, higher levels of vascular plant cover induced a highly significant ($P < 0.0001$) three-fold reduction in emergence of gorse from 37% in the control to 12% in the fertilised treatment ($P < 0.0001$). However, higher levels of vascular plant cover had no significant ($P < 0.64$) effect on emergence of broom, which was 42% in the untreated and 39% in the fertilised treatment with high vascular plant cover. Implications for gorse and broom invasion and management are discussed.

Keywords: gorse (*Ulex europaeus*), Scotch broom (*Cytisus scoparius*), seedling emergence, competition, fertiliser.

INTRODUCTION

Gorse (*Ulex europaeus*) and Scotch broom (*Cytisus scoparius*) are two of New Zealand's most common woody weeds. Competition can affect their establishment success from seed. Reduced gorse establishment has been noted within swards of herbaceous species such as ryegrass (*Lolium perenne*), browntop (*Agrostis tenuis*), Yorkshire fog (*Holcus lanatus*) and white clover (*Trifolium repens*) (Thompson 1974; Ivens 1979; Hartley & Phung 1982; Popay et al. 1990; Richardson & Hill 1998). Much less appears to be known about the effect of competition on broom establishment. In fact, Hosking et al. (1998) reported that broom seedlings died in plots where vegetation cover was <20%, and that at sites near the climatic limit of the species in Australia, broom seedlings required grass species to help them establish.

A trial was established at Mt Barker in the Rakaia catchment, Canterbury, to determine the effect of vegetation competition improved by fertilisers on the establishment of introduced Scotch broom and gorse, both sown as seed into an unimproved high country grassland.

MATERIALS AND METHOD

The trial site was on an Acheron soil on a flat terrace beneath Mt Barker near Lake Coleridge at an elevation of 620 m. Records taken on-site between 1996-2005 show an annual average rainfall of 748 mm. The vegetation, covering 100% of the trial area, consisted of unimproved short 'grassland' dominated by hawkweeds (mainly *Hieracium pilosella*), hard tussock (*Festuca novae-zelandiae*), browntop (*Agrostis capillaris*) and moss (mainly *Racomitrium* spp.), with a component (about 20%) of low stature woody species (mainly *Leucopogon fraseri* and *Coprosma petriei*). Apart from the hard tussock, very little of the vegetation cover exceeded 50 mm in height.

The two treatments used in the trial were untreated (existing vegetation cover) and one application of fertiliser (100 kg N/ha, 110 kg P/ha and 6 kg S/ha as diammonium phosphate; Cropmaster[®]DAP, Ravensdown).

Within each treatment, ten seeds of gorse and broom were separately placed within, and gently worked into the vegetation of 10 x 10 cm subplots, separated by an unsown subplot. Seed for the trial was collected in North Canterbury and had an average viability of 90% and 96% for gorse and broom respectively. Seed sowing took place in October 2001. The trial was laid out in a randomised-block design, with each block replicated 30 times.

The fertiliser treatment was applied to plots 2 weeks after sowing. Immediately after sowing, wire netting was secured over every plot as protection from birds and rabbits. Vegetation productivity was sampled by means of dry matter clips taken at the end of the second growing season. Samples were sorted into vascular (monocotyledon, dicotyledon and woody) and non-vascular (moss) components before oven drying and weighing. Seedlings were counted in the autumn of the first growing season after sowing (2002), and then autumn thereafter for 5 years. At each assessment all counted seedlings were removed.

A logistic regression model was used to analyse the proportion of sown seed that germinated during the course of the trial. The model was fitted using the SAS procedure GENMOD with the dispersion parameter estimated by the mean deviance to allow for over-dispersion. The model contained factors representing replication, species, treatment (fertilised versus unfertilised), and the interaction between species and treatment. F-ratios of model terms, tests comparing means, with means and standard errors of emergence proportions, were obtained from the model. Germination data were adjusted to take into account differences in seed viability.

RESULTS

Effect of fertiliser on vegetation growth

Application of fertiliser induced a two-fold increase in vascular plant cover. Two growing seasons after fertiliser addition, vascular plant cover in the untreated and fertilised treatments was respectively 255 g/m² and 544 g/m². Fertiliser induced increases in monocotyledon and dicotyledon cover were similar, at 121% and 108% respectively, whilst woody plant cover increased by 66%. There was no significant change in moss cover.

Effect of fertiliser on gorse and broom seedling emergence

In the unfertilised treatment no significant difference ($P < 0.15$) in seedling emergence after 5 years was found between gorse and broom (Fig. 1). However, there was a significant interaction between species and treatment ($P = 0.0004$) (Fig. 1). Fertilising caused a highly significant ($P < 0.0001$) reduction in seedling emergence of gorse, from 37% to 12%. In contrast, fertilisation did not significantly ($P < 0.64$) affect emergence of broom seedlings, which was 42% in the untreated and 39% in the fertilised treatment.

DISCUSSION

The hypothesis that an increase in vegetation competition will suppress the emergence of invading seedlings has been proven at Mt Barker in the case of gorse, and supports the findings of a number of other researchers. Bell (1961) and Ivens (1979) showed that vigorous pasture growth suppressed gorse establishment, and that if sheep grazing was added, gorse control was almost complete. Hartley & Phung (1979) compared gorse seedling survival amongst different grasses, and found survival was lowest in browntop and highest in perennial ryegrass (*Lolium perenne*), with Yorkshire fog (*Holcus lanatus*) having an intermediate effect. The addition of white clover (*Trifolium repens*) led to greater mortality of gorse seedlings. This result was different to that of Popay et al. (1990) who found no significant difference in seedling numbers within swards of four different grass species. Thompson (1974) showed that the addition of phosphate and nitrogen reduced seedling survival in ungrazed pasture. This was confirmed by Hartley & Phung

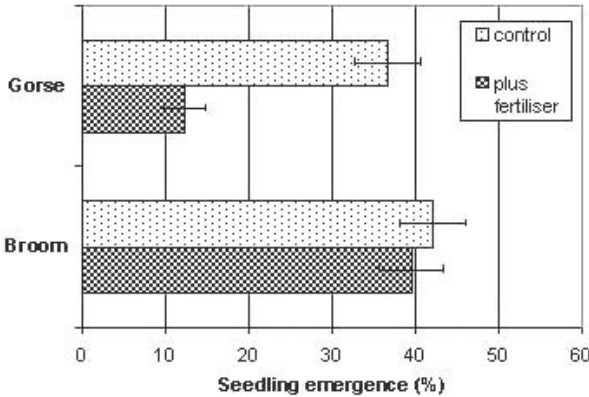


FIGURE 1: Total seedling emergence from viable seed of gorse and broom over 5 years after sowing with and without one application of fertiliser. Each value shown is the mean \pm the standard error of 30 sample plots.

(1982), and again by Popay et al. (1990), who found that applications of superphosphate, nitrogen and lime all significantly reduced gorse seedling numbers, and that nitrogen had the longest lasting effect. The significant suppression of gorse seedlings at the Mt Barker trial (from 37% to 12%) was brought about by increased vegetation competition from one application of Cropmaster[®]DAP, containing 18% N, 20% P and 1% S. Separation of the different effects of the three nutrient elements was not attempted.

At Mt Barker, the fertiliser effect on the seedling emergence of broom was quite different to that of gorse. At the rate applied, Cropmaster[®]DAP did not affect broom seedling numbers. The ability of broom to tolerate increased competition and moisture stress is indicated by a limited number of other studies. Previous research shows broom establishes best after soil or vegetation disturbance (Bossard 1991). Despite this Hosking et al. (1998) wrote that ‘At the Braidwood sites, near the climatic limit of the weed in Australia, broom seedlings require grass species to help them establish.’ All seedlings died where other vegetation cover remained < 20%.

Although the use of fertilisers suppressed the numbers of gorse seedlings emerging, this may not be significant in terms of cost-effective control. Reducing the density of seedlings would have little worth if there were still sufficient numbers establishing to eventually dominate the site. In addition, lower seedling numbers are of little value if control is by means of machine (flail mowing or bulldozer scraping), blanket use of chemicals (usually aerial spraying) or by fire. When using these ‘extensive’ control methods, the cost of controlling relatively few bushes/ha will be little different from controlling many times more. Hence, more knowledge is needed about the rates and frequency of fertiliser addition needed to gain as complete seedling suppression as possible, especially where mature bushes exist and seed is being produced annually. This will vary with the type of competitive vegetation – for example, exotic grasses respond well to fertilisers and could be more competitive than dicotyledonous species. At Mt Barker, grasses were not as dominant as they are in many other parts of the high country

In the Mt Barker trial, broom was significantly more tolerant of vegetation competition than gorse, indicating that control strategies solely involving increasing the vigour of resident vegetation cover may be effective with gorse, but not so with broom.

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