SEASONAL GERMINATION AND ESTABLISHMENT OF GORSE

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SUMMARY

On areas kept bare after clearing gorse (*Ulex europaeus*) in November 1977 many seedlings emerged with the autumn rains but emergence peaks in the next two seasons were in late spring. Only 25% of the total seeds to 10 cm soil depth germinated during this period. At another site where plots were cleared by burning after spraying with 2,4,5-T or 2,4,5-T/picloram seedling numbers declined by 90-95% in 20 months with pasture establishment and grazing. On a root-raked plot, without grazing, fewer seedlings died and growth was more vigorous. Where there was no burning after spraying gorse seedlings emerged together with volunteer grasses as the bush canopy disintegrated but they remained weak.

INTRODUCTION

The ability of gorse infestations to re-establish from seed is the principal reason for the persistence of the gorse problem in New Zealand, despite widespread control operations over the past thirty or more years. The seed problem was first emphasized by Moss (1959). Zabkiewicz and Gaskin (1978) likewise stressed that most gorse regrowth originates from seed rather than from stem sprouting. Ivens (1978) showed that in the absence of grazing, clearing was followed by a flush of germination which fell off as a vegetational cover became established. The work reported here was started to determine the seasonal pattern of germination in the absence of a vegetational cover.

The effects of competition and grazing on the survival and growth of artificially established gorse seedlings in pasture have been examined by Ivens (1979), Hartley *et al* (1980) and Hartley and Phung (1982). Little information is available, however, on the effects of sward development and grazing on populations of seedlings developing naturally and a further objective of the present studies was to examine this situation.

METHOD

The observations were made on an area of hillside gorse at an altitude of 140 m near Palmerston North. At Site 1, cleared by hand in November 1977 (and not burnt) a number of 0.5m² permanent quadrats was established and kept free of vegetation by hand weeding. Gorse seedlings were counted and removed at intervals over a period of 26 months, after which soil samples were taken to a depth of 10 cm and the remaining seed extracted. On a second set of quadrats at the same site, volunteer vegetation was allowed to establish on other permanent quadrats and the development of the gorse seedlings recorded without removal.

At a neighbouring site used to compare various techniques of clearing in a Ministry of Agriculture trial (Site 2) a series of 0.1 m² permanent quadrats (10 per plot) was established on plots which had received the following treatments:

- a. 2,4,5-T 8.0 kg/ha sprayed 2.2.78, burnt 27.4.78.
- b. 2,4,5-T 4.4 kg/ha + picloram 1.1 kg/ha sprayed 2.2.78, burnt 27.4.78.
- c. root raked January 1978.
- d. 2,4,5-T 4.4 kg/ha + picloram 1.1 kg/ha sprayed 2.2.78, not burnt.

The sprays were applied by helicopter. Plots a and b were topdressed, and sown with a grass/clover mixture on 16 May 1978. Grazing started at the end of September. With

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treatment c the pasture mixture was sown at the same time but the plot was not grazed until the spring of 1979 and treatment d was neither sown nor grazed. Gorse seedlings were counted (but not removed) and visual estimates of percent ground cover made two months after the burn. Periodic re-assessments were made for 18 months.

RESULTS

Fig. 1 shows the numbers of gorse seedlings appearing at different times of year at Site 1 over the period December 1977-January 1980 as average numbers per month. Monthly rainfall and 5 cm soil temperatures (means of daily 9 a.m. readings) from a meteorological station 4.5 km away are also shown. Soil conditions were relatively dry from the time of clearing until April and the first flush of germination took place during the March-May period, thereafter falling to low values with declining soil temperatures in winter. The second peak of germination occurred when temperatures increased in the late spring-early summer while the soil moisture level was still high. With the onset of drier conditions in January and February germination again fell and did not rise again until the next late spring-early summer period.

Fig. 1: Rate of emergence of gorse seedlings from time of clearing in November 1977 until January 1980 (means of 6 x 0.5 m² quadrats) and record of monthly rainfall and mean 5 cm soil temperatures at the nearest meteorological station.

The total numbers of gorse seedlings emerging are given in Table 1 and it will be seen that 731/m² appeared over a period of 25 months. Counts of ungerminated seed extracted from the soil showed that approximately 70% of the seed down to 5 cm had germinated. Below this depth, however, there were still more than twice as many ungerminated seeds as the number emerging over the previous two years.

TABLE 1: Gorse seedlings emerging after clearing in November 1977 on quadrats maintained free of vegetation (together with residual seed number after 25 months) compared with seedling numbers on unweeded plots.

	Plots kept bare* cumulative total/m ²	Plots unweeded + Gorse seedlings present/m ²	%cover (all species)
February 1978	46	28	12
May 1978	329	199	50
June 1978	393	126	50
July 1978	421	-	-
November 1978	435	97	67
January 1979	601	98	80
April 1979	653	65	100
August 1979	672		
October 1979	677		
December 1979	693		
January 1980	731		
<u>January 1980 seeds/m² extracted from soil</u>			
0 -2.5 cm	130		
2.5-5 cm	190		
5 -10 cm	1750		
Total	2070		

* means of 6 x 0.5 m² quadrats

+ means of 12 x 0.1 m² quadrats

Table 1 also shows the contrasting situation where quadrats were not kept bare. During the first flush of germination the pattern was very similar to that on the weeded plots. From May 1978 onwards, however, as a vegetational cover became established, the numbers germinating were exceeded by those dying. Initially the cover consisted mainly of broadleaved weeds including black nightshade (*Solanum nigrum*), Scotch thistle (*Cirsium vulgare*) and catsear (*Hypochoeris radicata*). Later the grasses, Yorkshire fog (*Holcus lanatus*), browntop (*Agrostis tenuis*) and sweet vernal (*Anthoxanthum odoratum*) became dominant. By April 1979, 17 months after clearing, there were an average of 65 gorse seedlings/m², many of them 25-30 cm high, growing through a dense grass cover.

The results of observations at Site 2 are shown in Table 2. On the three plots where the gorse cover was removed by burning or root-raking large numbers of seedlings appeared during the first few weeks when there was little competing vegetation. In terms of germination per month the numbers were 2-4 times those recorded at Site 1, probably a reflection of the greater age of the gorse resulting in a larger soil seed population. Later, although germination continued, seedling numbers declined rapidly. The rate of decline was very similar on the two sprayed and burnt pots (differences not significant at any date) but with root-raking the numbers declined more slowly in the absence of grazing.

Where the original gorse cover was sprayed but not removed, very few seedlings appeared in the first 6 months but, as the canopy opened up and grasses started to become established (mainly Yorkshire fog), gorse emergence also increased, especially during the early summer period. When observations were concluded there were more gorse seedlings on this plot than on any of the others.

TABLE 2: Development of gorse seedling population and herbaceous ground cover after four different clearing treatments (means of 10 x 0.1 m² quadrats)

		2,4,5-T burnt, oversown grazed		2,4,5-T/picloram burnt, oversown grazed	
		Gorse/m ²	% cover	Gorse/m ²	% cover
June	1978	618	2	371	5
October	1978	309	54	177	73
January	1979	120	70	108	84
March	1979	141	77	123	84
June	1979	46	74	69	71
October	1979	23	83	50	75
January	1980	29	99	44	92

		Rootraked oversown, not grazed in first season		2,4,5-T/picloram not burnt, not oversown not grazed	
		Gorse/m ²	% cover	Gorse/m ²	% cover
June	1978	728	2	8	0
October	1978	466	54	14	6
January	1979	476	83	273	22
June	1979	272	100	193	62
January	1980	168	100	309	79

DISCUSSION

The appearance of numerous gorse seedlings is commonly observed after clearing operations and burning accelerates germination of some seeds as well as killing others (Zabkiewicz and Gaskin 1978). The present work shows that burning is not the only factor involved as, after clearing in summer, many seeds germinated in autumn, without burning. In subsequent years, when the soil surface was kept bare the maximum germination occurred in early summer and not in autumn. A possible explanation for this pattern is that over a period of several years many seeds lose their dormancy under a dense gorse canopy but are unable to germinate for some reason until the canopy is removed. Subsequent germination peaks in early summer could be explained by the dormancy breaking factors being operative mainly in winter or early spring. The nature of the dormancy breaking factors remains to be determined. It is clear, however, that even when the ground remained bare for three growing seasons after clearing no more than 25% of the total seed present germinated, leaving a large reserve below 5 cm capable of germinating after soil disturbance at a later date.

Under normal conditions in the field sown pasture or volunteer species provide a ground cover within a few months of clearing and, as the ground cover thickens, gorse germination declines. The success of the seedlings depends to a large extent on the type of management applied. As the present observations indicate, establishment of a pasture and the early introduction of grazing results in a large reduction in seedling numbers, but there is no evidence that residues of picloram affect seedling growth. At the final observation 20 months after burning the numbers of seedlings were relatively small on both plots which were sprayed and burnt. Those that were present were being kept small by grazing and it was considered that numbers would be further reduced by continuing grazing pressure.

On the root-raked plot, in the absence of grazing during the first season, there was a smaller reduction in seedling numbers and the survivors were more robust, up to 30 cm high. Control of these seedlings by grazing would have been difficult. On the plot which was sprayed without being burnt, the gorse seedlings germinated and grew up with competing herbaceous vegetation, eventually becoming numerous. Having been shaded, however, they were soft and spindly and would have been expected to be relatively susceptible to the effects of grazing.

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