THE RESPONSE OF GORSE SEEDLINGS TO DEFOLIATION AND SHADING

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Summary

Pastures established from gorse (*Ulex europaeus*) develop large gorse seedling populations which are often controlled and/or eradicated by grazing management. To gain more information on this process the effect of intensity of defoliation at two growth stages and the interaction with shading was studied in the glasshouse. Results showed that only seedlings defoliated well below the growing point died, although regeneration from callus tissue was observed in some cases. Removal of leaves and/or cotyledons reduced growth. Gorse seedlings appeared to be adapted to defoliation by becoming prostrate after cutting. Shading and defoliation/shading reduced growth, delayed spine formation but did not cause seedling death.

INTRODUCTION

During pasture establishment on land cleared from gorse (*Ulex europaeus*) many gorse seeds germinate. On one farm, following a burn, the authors estimated that the newly established pasture contained about one million recently germinated gorse seedlings per hectare.

Control and/or eradication of these seedlings is generally by grazing management. There seems to be no quantitative data on the effect of defoliation on gorse seedlings, nor on the interaction of defoliation and shading. Millener (1961) studied environmental factors affecting the trend from juvenile to adult development, while Bieniek and Millington (1967, 1968) have studied the physiology of thorn formation in gorse.

EXPERIMENTAL METHODS

The study was carried out in a glasshouse under 13 hours daylength and ambient air temperatures. Seed separated from soil collected underneath gorse bushes was used. To induce germination the seeds were dipped into boiling water for one minute (Millener 1961). The heat treated seeds were sown at a depth of 0.5 cm in trays containing Ohakea silt loam, fertilised with 300 kg/ha equivalent of superphosphate. Despite the rigorous heat treatment, germination was very uneven.

Twenty days after sowing *Rhizobium* (strain 5042) was applied to induce nodulation. At 40 days the seedlings were thinned to give 15 seedlings (at the same stage of development) per replication with at least two replications per treatment.

Four defoliation treatments (nil, lax, hard and complete) were carried out at two growth stages. Seedlings at the cotyledon stage were defoliated below the cotyledons (complete) or with one or both cotyledons removed (lax and hard). At the 6 to 9 trifoliate leaf stage seedlings were defoliated below the cotyledons (complete); with cotyledons only remaining (hard) or four trifoliate leaves remaining (lax).

The defoliation treatments were applied to the cotyledonary and 6 to 9 trifoliate leaf stages at four and eight weeks after sowing respectively. After a further six weeks all the 6 to 9 trifoliate leaf treatments were

re-cut, with half the treatments being harvested while the other half were allowed to regrow for a further four weeks. After 14 weeks the cotyledonary stage treatments were harvested.

Shade treatments were applied six weeks after sowing, to seedlings at the 4 to 6 trifoliate leaf stage. Layers of fine cloth netting were used to obtain light values of 80, 40 and 20 percent full daylight as measured with a lux meter. After eight weeks of shading the seedlings were harvested and the shades were replaced for a further eight weeks before cutting a second time. Seedlings subjected to different treatments were identified by coloured plastic markers. Measurements of root and shoot dry weight (DM), number of shoots, seedling height and width were made on all seedlings. The effect of shading on spine development were assessed by scoring on a 1 to 3 scale, where 1 was assigned to spines soft to touch and 3 to spines that were hard and sharp to touch.

RESULTS

All seedlings died with complete defoliation at the 6 to 9 trifoliate growth stage. However at the cotyledon growth stage the remaining "stump" often formed a callus, from which regrowth sometimes resulted, particularly when defoliation was close to the growing point (Table 1). Death of shoot "stumps" was often associated with rotting at the soil surface. No seedling deaths were recorded in the other defoliation treatments.

TABLE 1: THE EFFECT OF COMPLETE DEFOLIATION ON COTYLEDONARY GORSE SEEDLINGS

Weeks after defoliation	Cut well below growing point	Cut close to growing point
	% "stumps surviving"	
5	65	81
9	57	62
	% regeneration from callus	
9	0	20

The effects of nil and partial defoliation on gorse seedlings are presented in Table 2. The effects of shading before and after cutting on gorse seedlings are presented in Table 3 and Table 4 respectively.

TABLE 2: THE EFFECT ON NIL AND PARTIAL DEFOLIATION ON GORSE SEEDLINGS

Defoliation Intensity	Shoot DM (mg)	Root DM (mg)	Shoot/Root Ratio	Height (cm)	Width (cm)	Height/width Ratio	Number of Shoots
COTYLEDONARY STAGE (Defoliated at 4 weeks, harvested 14 weeks)							
Nil	340 a	105 a	3.24 a	12.4 a	2.2 a	5.6 a	1.0 a
Lax	264 a	81 a	3.26 a	11.1 a	1.9 a	6.0 a	1.13 a
Hard	191 b	71 a	2.70 a	9.4 a	1.7 b	5.5 a	1.08 a
6 to 9 TRIFOLIATE LEAF STAGE (Defoliated at 8 weeks, harvested 14 weeks)							
Nil	385 A	126 A	3.15 A	10.1 A	3.9 B	2.59 A	1.27 B
Lax	216 B	77 B	3.25 A	5.8 B	5.2 A	1.12 B	2.60 A
Hard	133 C	54 C	2.29 B	3.8 C	5.1 A	0.75 C	2.29 A
6 to 9 TRIFOLIATE LEAF STAGE (Defoliated at 8 and 14 weeks, harvested 18 weeks)							
Nil	1411 A	597 A	2.67 B	22.2 A	3.2 a	6.90 A	1.25 B
Lax	508 B	124 B	4.04 A	10.0 B	4.7 a	2.13 B	5.48 A
Hard	176 C	101 B	2.00 C	5.8 C	3.6 a	1.61 C	4.35 A

TABLE 3: THE EFFECT OF SHADING FOR EIGHT WEEKS ON GORSE SEEDLINGS

	Shoot DM (mg)	Height (cm)	Width (cm)	Number of Shoots	Spine Development
Full light	571 a	16.5 a	3.7 a	4.2 a	2.7 A
80% light	436 b	17.5 a	3.1 a	1.8 b	2.3 B
40% light	309 c	18.5 a	2.9 a	1.6 b	1.7 C
20% light	183 d	17.2 a	2.6 a	1.2 b	1.2 D

TABLE 4: THE EFFECT OF SHADING, FOR EIGHT WEEKS AFTER DEFOLIATION, ON GORSE SEEDLINGS

	Shoot DM (mg)	Number of Shoot	Spine Development
Full light	1075 A	7.40 a	2.35 A
80% light	650 B	7.04 a	2.00 B
40% light	252 C	3.63 c	1.50 C
20% light	275 C	4.40 b	1.04 D

DISCUSSION AND CONCLUSION

While both defoliation and shading reduced dry matter production, gorse seedlings generally survived such treatments. It was only when defoliation was below the growing point, especially in seedlings that had developed beyond the cotyledonary stage, that seedling death always occurred. However Bieniek and Millington (1968) reported a 50% death of gorse seedlings when low light intensities were coupled with short (8 hour) daylengths. Gorse seedlings appear to be less dependent on cotyledons for growth and development than many other woody angiosperms and showed a response similar to *Ulmus americana*, (Marshall and Kozlowski 1973). Observations the authors have made in the field would suggest that a grazing intensity sufficient to defoliate seedlings below the cotyledons is difficult to achieve. Even if this intensity of grazing could be achieved, the effects on subsequent pasture production may be undesirable.

Gorse seedlings would appear to be adapted to defoliation, producing short shoots that have a prostrate habit. This was especially so in seedlings defoliated after trifoliate leaf production had begun. In the field the authors have observed similar prostrate forms which appeared to have survived several grazings. Brandon (*pers. comm.*) suggested that factors other than defoliation may be important in controlling seedlings, especially treading and pulling effects. Damage to the root system by the grazing animal, especially in the summer and autumn, may result in seedlings dying from moisture stress. While observations would support this hypothesis it needs to be tested in the field.

The delay in spine formation due to shading would mean that seedlings may stay soft and hence be readily grazed. Once the spines harden, control by grazing is likely to become less effective.

Quantitative field data is required to follow up these experiments.

REFERENCES

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(Chairman's Summary continued)

foliage kill and extent of shoot dieback to arrive at an index of effectiveness. The possibility of developing a physiological test as a basis for early assessment of devitalization was discussed, but there was a strong feeling that there was no substitute for patience in gauging woody weed response.

Inconsistencies in weed response to treatment, especially that of gorse, are still a major source of puzzlement to many. Clearly, we have reached the point where major progress in our understanding of this will only come when we match the effort on chemical control with equal effort on fundamental studies of weed physiology and ecology, and herbicide absorption and translocation.