Germination response of *Glycine tabacina* to temperature and light

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The failure of white clover during the droughts of recent years on the Northern Tablelands, has drawn the attention of local graziers to the more persistent native herbaceous legumes such as species of *Glycine* (P. Kennedy, *pers. comm.*).

Adequate regeneration and persistence of desirable species is an important aspect of pasture stability. Germination is the first step of regeneration and diurnal temperature and light conditions assist in stimulating germination and seedling establishment at particular times and places (Thompson *et al.* 1977). Gaps in the canopy and soil litter are important for the establishment of many species, possibly because of greater fluctuations in soil temperature. Diurnal temperature fluctuations are greatest near the soil surface and diminish rapidly with depth (Thompson and Grime 1983).

This study examined the effects of diurnally alternating temperatures and light on the germination, viability and dormancy of *G. tabacina.*

Methods and materials

A two way thermogradient plate provided temperature combinations that alternated with light and dark periods. Temperatures ranged from 5°C to 45°C at 5°C intervals. The design, modified from the plans of Larsen (1971), enabled each combination of alternating and constant light/dark temperatures to occur on the thermogradient plate, giving a total of 81 combinations. Seeds of *Glycine tabacina* were scarified with sandpaper to make the seed coats permeable and 50 were placed on a moist absorptive pad in an aluminium dish at each temperature combination.

Germination was observed at 12 h intervals to detect diurnal variations and the experiment concluded at the end of the dark period of day 12. The remaining seeds from each temperature combination were placed in an incubator at 30°/20°C light/dark temperature for a further 14 days. Seeds germinating under these conditions were recorded as having enforced dormancy on the gradient plate and dead, decomposing seeds were detected at the end of the experiment by squeezing with a pair of forceps.

The final cumulative percentage germination of seeds at each temperature combination was plotted on a three dimensional graph and the percentage of seeds with enforced dormancy (through the temperature regime) and dead seeds recorded.

Results

No single temperature and light combination was optimal for the germination *G. tabacina*. Germination was high over a wide range of diurnal temperatures, particularly where the fluctuation was less than 20°C (Figure 1). Ridges were evident along both the light and dark axes at 30°C, forming a plateau at constant 30°C. A secondary pinnacle occurred at 35°/15°C light/dark combination, although few seeds germinated at the inverse 15°/35°C light/ dark combination. Germination was low or non-existent for all combinations that included either 45°C or 5°C (Figure 1). Where the temperatures fluctuated, more seeds germinated at the end of the warm period than at the end of the cool period, irrespective of whether in the light or dark.

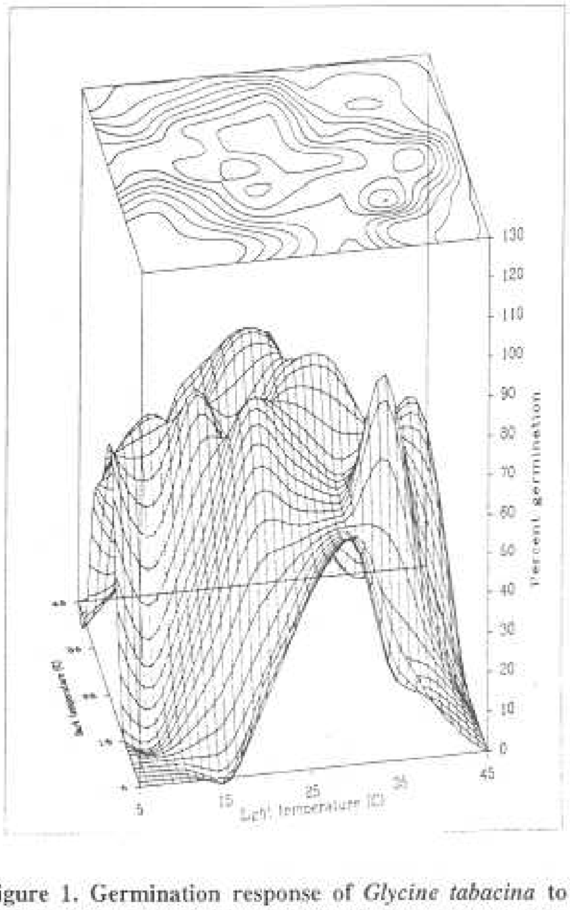

Figure 1. Germination response of *Glycine tabacina* to light and dark temperatures after 12.5 days on the thermogradient plate.

The majority of dead seeds (soft and usually covered with fungi) occurred when either the light or dark temperature was 45°C, or both the light and dark temperatures were high. Enforced dormancy was highest at low temperatures and alternating temperatures which included 40°C.

Discussion

The results of this study suggest that scarified seeds of *G. tabacina* are most likely to germinate when diurnal soil temperatures fluctuate by less than 20°C and when the maximum temperatures are less than 45°C. Such situations could arise on the Northern Tablelands near the soil surface in autumn or spring but would be influenced by the amount of canopy cover and leaf litter. The hard seeds of *G. tabacina* must be softened in the field before germination will occur. No details are available for this species but hard seeds of other species in the family Fabaceae are rendered permeable to water in the field by exposure of the seeds, when dry, to alternating temperatures within the range of 60°/15°C (Baskin and Baskin 1989). These conditions are more likely to occur within canopy gaps at the soil surface in the summer. Management practices that reduce the level of grass canopy or accumulated leaf litter may therefore increase the amount of field germination. Manipulations such as intense animal impact may bring more deeply buried seeds closer to the surface and stimulate germination.

The greater number of germinants at the end of the warm period compared with the number at the end of the cool period at fluctuating temperatures did not support the suggestion by Toole *et al.* (1956) that a germination response to thermoperiodicity is caused by respiratory intermediates created at high temperatures promoting germination at low temperatures.

References

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