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Inhibitory effects of smooth brome leachates on leafy spurge

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Introduction

Biological control of leafy spurge has in large measure been directed towards the use of insects and fungal pathogens to reduce the populations of the weed (Harris *et al.* 1985). Reductions in the population of a given weed species such as leafy spurge could conceivably be achieved by the presence of another more desirable species. The competitive advantage that one species can achieve over another may occur in a number of ways, including allelopathy (cf. Putnam and Tang 1986). The material described in this paper provides a brief summary of some of the results that we have obtained from studies on the effects of root leachates on leafy spurge.

Materials and methods

Seedlings of smooth brome (*Bromus inermis* Leyss.), timothy (*Phleum pratense* L.), and leafy spurge (*Euphorbia esula* L.) that served as the source of leachate were grown from seed and maintained in controlled environment chambers under conditions similar to those described elsewhere (Koukkari *et al.* 1984). The seeds were sown on cheese cloth suspended on plastic rafts that were kept afloat in pans, first in distilled water (about 10 days), and then in Hutner's nutrient solution (cf. Hillman 1969). Most of the root growth and development occurred in the nutrient solution that was below the cheesecloth. After about seven days, the solutions in which the roots developed, from here on referred to as leachates, were used in various experiments. The experiments were designed to test the effects of each of the leachates on *Lemna minor* L. growth and chlorophyll (Koukkari *et al.* 1984), seed germination of lettuce (*Lactuca sativa* L.) and leafy spurge, and seedling growth and development of leafy spurge.

Results

The effects of leachates on *Lemna* fronds and chlorophyll, seed germination, and leafy spurge seedlings are illustrated in Table 1, 2, and 3. Both the smooth brome and leafy spurge leachates appeared to inhibit frond production, while only the leafy spurge leachates seemed to cause a decrease in total chlorophyll levels.

Table 1. Effects of Leachates on *Lemna*¹

Leachate	number of fronds	chlorophyll ²
None	21.20 ± 2.62	30.92 ± 4.88
Timothy	28.80 ± 3.78	32.28 ± 5.28
Brome	16.60 ± 2.27	30.25 ± 4.87
Spurge	9.89 ± 2.78	19.11 ± 4.53

¹Each value = mean ± SEM of 10 replications.

²Total chlorophyll as ug/mg dry weight.

Table 2. Effects of root leachates on seed germination.

Leachate	% Seed Germination*	
	Leafy Spurge ¹	Lettuce ²
None	63 ± 0.03	100
Timothy	62 ± 0.04	82 ± 0.41
Brome	61 ± 0.05	39 ± 0.14
Spurge	80 ± 0.03	64 ± 0.32

*Each value = mean ± SEM of 8 (leafy spurge) or 4 (lettuce) replications.

¹n = 50.

²n = 7.

Although leachate from all three species inhibited the germination of lettuce seeds, none of them inhibited the germination of leafy spurge. In fact, the leachate of leafy spurge appeared to enhance germination of leafy spurge seeds.

The results of a more comprehensive study are illustrated in Table 3. The leachates of brome appeared to show the greatest effects on the seedlings, and this effect was primarily on shoot height and visual rating. In many instances the shoots of the leafy spurge seedlings that were transferred to brome leachate turned brown, appearing to be dead within a few days. Experiments are being continued to study the effects of these and other leachates on leafy spurge and to determine the nature of the substances that promote the inhibition.

Table 3. Effects of root leachates on leafy spurge seedlings¹.

Leachates	Visual ² Rating of	Number Leaves	Plant Height	Root Length	Chlorophyll ³
None	1.4±0.2A	4.6±0.3AB	56.9±3.4C	60.4±8.7	28.3±3.5CDE
Brome	4.7±0.2B	1.6±0.5A	4.8±4.8	57.2±10.4	9.8±3.2A
Timothy	2.9±0.7AB	3.8±0.4AB	28.7±8.6A	44.4±10.4	15.5±3.1AB
Spurge	1.1±0.1A	4.6±0.3AB	50.1±3.2BC	63.8±12.4	22.6±2.4BCD
Brome	3.0±0.6AB	3.8±0.6AB	29.6±9.0A	66.9±10.8	31.9±12.0DE
Timothy	1.9±0.5AB	5.2±0.8B	47.1±7.2BC	78.1±11.5	32.6±4.4E
Spurge	2.8±0.6AB	3.9±0.6AB	43.9±7.2B	50.4±5.3	29.2±7.5DE
Brome	3.5±0.6AB	3.3±0.4AB	19.5±7.6A	48.9±8.3	18.3±2.4ABC
Timothy	1.5±0.5A	4.9±0.5AB	46.1±7.3BC	48.5±6.8	28.3±3.7CDE

¹Each value represents the mean ISEM for 8 leafy spurge seedlings and means within a column having a common letter do not differ significantly at the 5% level.

²ug/mg dry weight.

³rating scale 1-5 (1 = healthy, and 5 = leaf and stem dead).

Acknowledgements

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