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Allelopathic Potential of *Artemisia vulgaris* L. and *Pinus roxburghii* Sargent : A Bioassay Study

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In the present study, an attempt was made to investigate the influence of plant and soil extracts of *Artemisia vulgaris* L. and *Pinus roxburghii* Sargent on two test species, viz., *Lepidium virginicum* L. and *Lolium perenne* L. The plant and soil extracts had an inhibitory effect on the germination of the test species which differ considerably according to the extracts of various components, i.e., young developing leaves, old mature leaves, leaf and woody litter. In *Artemisia vulgaris*, young developing leaves and in *Pinus roxburghii* litter extracts were found more inhibitory compared to other components. Physical features of the extracts, viz., *p*H and conductivity, had least differences with distilled water (control). The presence of certain hydropholic metabolites was concluded as the principal cause for the inhibitory or allelopathic potential of these species. *Lolium perenne* was found relatively tolerant to the allelopathic effect compared to *Lepidium virginicum*.

Key Words: Allelopathic potential, *Artemisia vulgaris* L., *Pinus roxburghii*

Introduction

The influence of substances released by plants as root-exudates, plant leachates and as a by-product of litter and dead root decomposition has been described admirably by Rovira (1969), Whittakar and Feeny (1971), and Bokhari (1978). Several workers have observed that the growth of many herbaceous species underneath the canopy of *Fagus* and *Acor* trees was better compared to that under *Populus* and *Salix* (Turkey 1970). Certain plant species including *Artemisia* and *Pinus* have been reported to be deleterious for the understorey vegetation (Rice 1974). The present study was undertaken to elucidate the influence of *Artemisia vulgaris* L. and *Pinus roxburghii* Sargent on two test species, viz., *Lepidium virginicum* L. and *Lolium perenne* L.

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Material and Methods

Aliquot of various components of *A. vulgaris* and *P. roxburghii*, i.e., young developing leaves, old mature leaves, leaf and woody litter (only for *P. roxburghii)* was extracted separately, by soaking 50 g of plant material with one litre of distilled water (control) at room temperature of 24±2°C for 48 hr following Bokhari (1978). The extracts were then filtered through two layers of Whatman's filter paper No. 1. The physical features, viz., *p*H and conductivity of the extracts, and that of distilled water were measured immediately following filtration.

For screening the influence of each extract, a bioassay test was conducted using *Lepidium virginicum* and *Lolium perenne* as test species. One-hundred uniform-sized healthy seeds of each test species, were plated equidistantly in separate sterilized Petri-dishes (12 cm diameter) over a single layer of blotting paper, moistened with 10 ml of extract/ distilled water. Each treatment was replicated three times with the same number of control seeds for each test species. The germination experiment was performed at room temperature under continuous light. Radicle emergance was considered as the index of germination and counts of seed germinated were taken each day for ten days. The blotting papers were moistened with the extract/distilled water every alternate day.

Soil samples, minus litter, were taken from the surface layer (0.5 cm depth) at five sites, each around the plant and away from the canopy. The samples of each type were mixed separately, to form the composite samples. The effects of soil were studied by preparing extract in the same manner as described earlier.

Appropriate 't-test' (Snedecor & Cochran 1967) was used to compare the response of various extracts with that of control.

Results and Discussion

Table 1 presents the comparison of certain physical features of extracts with distilled water. All the extracts of both the species were acidic in nature. The *p*H ranged from 5.4 (soil extract around plant) to 6.2 (old leaf extract) for *A. vulgaris* and 5.0 (young leaf extract) to 6.5 (soil away from the canopy) for *P. roxburghii*. The conductivity of the extracts was relatively higher than that of control. However, the differences between physical features of extracts and control seem to be insignificant.

Aquous extracts of various plant components and soils for both the species have shown significant inhibitory effect on germination of both the test species as compared to the germination of the same in distilled water (tables 2 & 3). The inhibitory effect of various plant components of *A. vulgaris* was higher as compared to that of *P. roxburghii*. In the former, the young leaf extract was

Table 1 *Physical features of plantand soil extracts of* Artemisia vulgaris *and* Pinus roxburghii

Extracts	*A. vulgaris*		*P. roxburghii*	
	*p*H	Conductivity (m mhos/cm)	*p*H	Conductivity (m mhos/cm)
Control	6.5	0.01	6.5	0.01
Young leaf	5.8	0.20	5.0	0.03
Old leaf	6.2	0.25	5.6	0.20
Leaf litter	—	—	5.9	0.20
Woody litter	—	—	6.1	0.30
Soil*	5.4	0.15	6.2	0.10
Soil**	5.6	0.10	6.5	0.05

* and **—Extracts of soil collected around the plant and away from the canopy, respectively

Table 2 *Effect of plant and soil extracts of* Artemisia vulgaris *on seed germination (percent) of the test species (Mean ± S.E.)*

Extracts	*L. virginicum*	*L. perenne*
Control	97.33±0.77	93.33± 0.88
Young leaf	4.66±0.77‡	34.66±14.64‡
Old leaf	12.66±3.08‡	72.00± 2.31‡
Soil*	81.66±7.13†	59.33±12.33‡
Soil**	92.00±6.93	75.66± 0.77‡

† and ‡—Significantly different from control at 5% and 1% level of significance, respectively
* and ** See table 1 for explanation

Table 3 *Effect of plant and soil extracts of* Pinus roxburghii *on seed germination (percent) of the test species (Mean ± S.E.)*

Extracts	*L. virginicum*	*L. perenne*
Control	97.33±0.77	93.33±0.88
Young leaf	58.66±2.66‡	76.66±2.66‡
Old leaf	75.33±3.53‡	89.33±1.76†
Leaf litter	34.66±4.05‡	73.33±1.33‡
Woody litter	42.66±0.81‡	72.66±1.76‡
Soil*	35.00±1.73‡	71.00±1.52‡
Soil**	84.00±1.52‡	86.66±0.88‡

† and ‡—See table 2 for explanation
* and **—See table 1 for explanation

more inhibitory to germination of both the test species, whereas the extracts of leaf litter and soil of the latter were more inhibitory to germination of *L. virginicum* seeds. *L. perenne* seeds were relatively more resistant to the inhibitory effect of the extracts as compared to *L. virginicum*.

The influence of leaf leachates on the germination and growth of plants is due to the presence of nutrients, growth regulators, alkaloids and toxins (Bode 1958, Tukey 1966). Studies by Schlatterer and Tisdale (1969) on *Artemisia tridentata*; Jameson (1963) on *Pinus edulis* and Grodzinsky and Gaidamak (1971) on *Pinus silvestris* and *P. strobus* have indicated the presence of water-soluble toxins for the failure of many herbaceous species to grow underneath their canopy. Grummer (1961) reported three sesquiterpene inhibitors, viz., β-darophyllene, bisabolene and chamazulene and quercitin from the leaves of *Artemisia absinthium*. Lee and Monsi (1963) identified a tannin and p-coumaric acid in the extracts and in soil from *Pinus densiflora*. In the present investigation, the marked inhibitory effect of the plant and soil extracts of *A. vulgaris* and *P. roxburghii* on the phytometer species, despite the insignificant differences in physical features, may be attributed to the presence of certain allelopathic-hydrophilic metabolites in plant materials or to the presence of volatile terpenes, as reported in certain other species (Muller et al. 1964, Del Moral & Muller 1970). These substances when released in the soil either through leaching or by volatilization, inhibit germination and growth of other plant species (Rice 1974). Further studies on (i) the allelopathic potential of these species under natural conditions, (ii) the effect of dilution on the allelopathic potential, and (iii) identification of the allelochems. are in process.

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