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PHYTOTOXICITY OF *FUMARIA INDICA* ON WHEAT

S.M. CHAGHTAI, ABDUS SADIQ AND MOHAMMAD IBRAR

Department of Botany,
Islamia College, University of Peshawar, Peshawar, Pakistan.

Abstract

The allelopathic potential of *Fumaria indica* (Hausskn.) Pugsley was tested in laboratory experiments. The aqueous extracts from the plant parts significantly inhibited germination and growth of *Triticum aestivum* L. var. Blue Silvar. The toxicity varied from part to part and also depended upon the amount of the plant material used, the soaking period and the freshness of the material assayed. Dry leaves were found to be highly toxic.

Introduction

Plants secrete chemical substances with which it changes its biotic and abiotic environment. The leachates of the plants influence other plants growing around it and in many instances affect its survival. Many angiospermic plants have been found to retard the germination and growth of other species (Bate-Smith & Metcalfe, 1957; Muller, 1965, 1966, 1969; Rovira, 1969; Tukey, 1970; Rice, 1974). Allelopathy, in many cases, plays a far greater role than competition in inhibiting the germination and growth (Rice, 1974).

The weeds have been known as very tough competitiors of desired plants for nutrients and the physical environmental variables. Besides, weeds may also cause biochemical inhibition of growth of crop plants. *Fumaria indica* a very common weed of the wheat fields in Pakistan has also been noticed growing in moist places in spring season. The present paper reports the biochemical inhibition of growth of wheat caused by *F. indica.*

Materials and Methods

Aqueous extracts were prepared by soaking 5, 10 and 15 g of crushed fresh and dried roots, stem, leaves, inflorescence and the whole plant of *F. indica* in 100 ml of double distilled cold water separately for 24, 48 and 72 hours at 26°C. The effect of aqueous extract was tested against *Triticum aestivum* L. var. Blue Silver, using standard filter paper bioassay technique following Khan (1982). Distilled water was used as control with 5 replicates of each treatment. Ten seeds per Petri dish were incubated for 72 hours at 26°C (± 2) in complete darkness. Germination of seeds and the length of radicle was recorded and statistically analysed using 't' test.

In mulching experiment small glazed pots, 22 cm in diam, were lined internally with polythene sheets leaving the bottom hole open and filled with soil collected from 5-10 cm depth where *F. indica* was growing. Wheat was sown, 10 seeds per pot. Dried and crushed plant material of *F. indica* was uniformly spread over the surface of the soil 7g in each pot. For control pieces of filter paper were spread on the surface of the soil. The pots were kept in open and watered three times in a week. After 8 weeks fresh weight and root-shoot ratio was measured. The plants were dried at 60°C for 48 h and dry weight determined.

Results and Discussion

Aqueous extract from dried plant material inhibited growth of wheat more than the extract from fresh material which is contrary to the findings of Bokhari (1978) who, in prairie grasses, found the extracts from fresh shoots more toxic. Leaves and roots are reported to contain relatively larger quantities of toxic substances than other parts of the plant (Lawrence & Kilcher, 1962; Grant & Sallans, 1964; Tukey & Morgan, 1964; Rovira, 1969; Rice, 1974). In *F. indica* the leaves and the stem leachates exhibited greater potential of inhibition of growth.

1. *Fresh plant material*

Extracts from fresh plant material did not affect germination; however, growth of radicle was significantly reduced. The aqueous extracts from various plant parts having different concentrations and soaking periods seemingly possessed different growth inhibiting potentials and did not show a consistent pattern. Maximum inhibition observed was in water extract from 15 g of stem soaked for 48 h followed by leaf extracts (Table 1). In 60% cases maximum retardation of growth occurred in 48 h soaking period; whereas in 80% cases water extracts from 15 g fresh material produced the same effect.

The aqueous extracts from stem, roots and whole plant showed maxiumm inhibition of growth in 48 h soaking period, inhibition being directly related to the concentration of extract. Leachates from leaves retarded growth of the radicle.

Water extracts from roots, stem and the leaves appeared to be more toxic to growth, whereas leachates from the inflorescence and whole plant were least effective. It would appear that phytotoxins in fresh plant material occur in such a dilute from that they did not inhibit germination of wheat. The growth of radicle although retarded but the effect was not pronounced. In nature, the rain dripping, may not be carrying such an amount of toxins into the soil which could markedly inhibit wheat growth.

Table 1. Effect of *Fumeria indica* plant extract on germination of wheat and growth of radicle expressed as percent of control; Figures in parentheses represent percent germination.

Plant Part	Concentration (g/100 ml water	DRY Soaking h			FRESH Soaking h		
		24	48	72	24	48	72
Root	5	59.0* (93)	45.4* (93)	36.6* (93)	100.2 (100)	80.3 (80)	87.2 (93)
	10	32.4* (93)	5.7* (87)	19.3* (80)	78.6+ (93)	77.8+ (100)	78.1+ (100)
	15	4.1* (78)	– (53)*	1.7* (53)*	71.8+ (100)	61.7+ (100)	67.8+ (93)
Stem	5	15.8* (67)	27.1* (100)	31.1* (100)	67.3* (100)	45.0* (93)	45.1* (100)
	10	10.8* (20)*	4.8* (93)	6.1* (93)	69.1* (100)	26.8* (100)	58.3* (100)
	15	–	1.6* (93)	1.8* (80)	45.6* (93)	12.1* (87)	44.5* (93)
Leaves	5	40.1* (100)	11.4* (95)	34.5* (95)	82.3 (93)	99.2 (100)	53.6* (93)
	10	0.7* (80)	–	–	41.8* (100)	86.3 (100)	41.2* (87)
	15	–	–	–	54.1* (100)	69.1+ (100)	66.7+ (93)
Inflorescence	5	37.2* (100)	55.6* (100)	42.3* (100)	87.2 (93)	91.8 (87)	108.5 (100)
	10	31.9* (100)	45.6* (87)	14.1* (100)	100.0 (93)	104.9 (100)	91.6 (100)
	15	25.4* (93)	2.8* (73)	0.5* (93)	72.1+ (100)	73.7+ (93)	74.7+ (93)
Whole Plant	5	55.6* (100)	58.2* (100)	57.0* (100)	105.2 (100)	105.3 (100)	104.5 (100)
	10	38.9* (87)	34.9* (100)	33.0* (93)	88.8 (93)	91.3 (100)	102.9 (100)
	15	17.6* (87)	11.9* (60)*	22.2* (80)	81.4 (100)	56.1* (100)	74.1+ (93)

* Significant at 1% level; + significant at 5 % level.

2. *Dry plant material*

Extracts from all plant parts was found to inhibit germination and growth of the test species (Table 1). The concentration appeared to be more effective than the soaking period in retarding the growth of radicle plant. A soaking period of 48 h showed highest inhibitory effect on growth, soaking for 72 h did not inhibit growth and in many cases it showed an increase. Maximum inhibition of growth was found in leaf extract followed by stem, root, inflorescence and the whole plant extract. In leaf extract treatment, no germination occurred in 55 % cases. At lower concentrations, the toxicity of stem and inflorescence extracts remained unaffected by soaking periods. The toxicity of extracts from the roots and the leaves increased with the increase in concentration and the soaking duration.

Mulching Treatment

Where mulch of *F. indica* was spread over the soil surface growth of wheat remained unaffected whereas in filter paper bioassay the aqueous extracts from dried plant material inhibited growth (Tables 1 & 2). The destruction of the phytotoxins by soil microbes and their inactivation through adsorption by the colloidal fraction of the soil may be the possible reason. Similar results with *Encelia* (Gray Bonner, 1948) and *Artemisia absinthium* (Grummer, 1955) have been reported. The temperature and the texture of the soil are also believed to nullify the effects of toxines (Chou & Miller, 1972; Khan, 1982). Growth of *Lepidium* roots was inhibited by litter extract only when growing on filter paper and the inbibition disappeared when soil was placed under the filter paper (Grummer, 1955). Other possible explanation may be the lack of sufficient time needed for the decomposition of plant residue in soil since the soil extract was found free of toxins when no decomposition of plant residues occurred (Patrick 1955). According to Borner (1957) the inhibition of growth depends on the quantity of the plant residue

Table 2. Effect of *Fumeric indica* used as mulch on height, fresh and dry weight of wheat

Treatment	wheat plant		
	Height (cm)	Fresh Weight (g)	Dry Weight (g)
Control	36.3	1.204	0.363
SE	± 4.80	±0.24	± 0.08
Mulch Treatment	33.6	1.210	0.363
SE	± 3.34	±0.48	± 0.13

or the concentration of aqueous extract in soil. The mulch of *F. indica* used in the experiment may not have been sufficient to induce inhibition. However, in filter paper bioassay the concentration of aqueous extract rather than the soaking period of the dried plant material was more important for the inbibition of growth (Table 1).

F. indica contains water soluble substances which inhibit growth of wheat plant with which it grows as a weed in nature. The rainwashes from live plant carry toxic substances to the soil. The decaying plant material also discharges growth inhibiting substances in the soil. Whereas in nature the inhibitory action of *F. indica* on wheat is conditioned by the strength of the leachate and the activity of the soil microbes some other factors such as soil temperature and soil texture supposedly counterbalance the effect of the phytotoxins (Khan, 1982; Chou & Muller, 1972). Whether the toxic potential of *F. indica* in the soil is controlled by soil temperature and soil type needs to be tested.

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