Journal of Arid Environments (1995) **31**: 83–90

Allelopathic effects of *Prosopis juliflora* Swartz

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(*Received 3 December 1993, accepted 11 February 1994*)

Allelopathic effects of aqueous extracts from under canopy soil and from different parts of *Prosopis juliflora* on germination and early seedling growth of various cultivars of *Zea mays, Triticum aestivum* and *Albizia lebbeck* were studied. Fruit and seed extracts considerably delayed and reduced germination, root, shoot and seedling growth compared with root, leaf and flower extract. Soil extract showed an inhibitory effect on germination but seedling growth remained unaffected in most of cultivars.

Keywords: *Prosopis juliflora*; allelopathy; germination

Introduction

Prosopis juliflora Swartz (Leguminosae subfam. Mimosoideae) a perennial, large shrub native to semi-arid areas of the West Indies, Mexico, Central America and northern South America (Columbia, Venezeuela, Ecuadore and Peru) has been naturalized in Pakistan since the 1950s. The species has wide ecological amplitude, distributed from the coast to 1700m. a.s.l. covering a distance of more than 1000 km. Due to an efficient mode of propagation, it competes and soon becomes the dominant species of the area. Although *P. juliflora* is an aggressive invader, found growing in habitats like coastal marshes, coastal deserts, sand dunes, flat plains, hilly areas, dry stream bed, inland saline flats, degraded and disturbed areas, flat plains with shallow water table appear to be the best suited habitat.

P. juliflora is propagated through seed. The dispersal unit consists of a pod with a high content of viscous, sugary material. The pods are eaten by animals and the seeds, after necessary acid scarification, are excreted through droppings. During the monsoon rainfall a large number of seeds germinate in animal droppings. The seedlings develop deep roots to tap underground water.

The ecological significance of phytotoxins in old field succession and in other natural communities has attracted the attention of many workers (Choesin & Boerner, 1991; May & Ash, 1990; Mizutani, 1992). Among the allelochemicals which take part in such interactions are phenols, terpenes, glucosides, alkaloids, amino acids and sugars (Harborne, 1989).

P. juliflora, during the last 45 years, has invaded all kinds of communities in the flat plains of Karachi and has now become dominant by completely eliminating the natural vegetation. This exceptional success of *P. juliflora* could be attributed to allelopathy. The present paper investigates the occurrence of allelopathic potential in *P. juliflora*.

0140–1963/95/010083 + 08 $12.00/0

Materials and methods

Donor and receptor plants

To study the allelopathic potential of *P. juliflora* Swartz, three cultivars of *Zea mays* L. (R 796, Gohar, EV 1081), four cultivars of *Triticum aestivum* L. (Inqalab, Chakwal, Pak 81, Rohtas) and *Albizia lebbeck* (L.) Benth. were used.

Extract preparation

Roots, stems, leaves, flowers, fruits and seeds of *P. juliflora* were collected. Five and 10 g of the plant material were weighed, crushed and soaked in 100 ml of distilled water for 24 h, then homogenized and filtered using Whatman No. 1 filter paper.

Five and 10 g of soil sample collected from under the canopy of *P. juliflora* were soaked in 100 ml distilled water for 24 h and, after shaking in an electric shaker for 30 min, were passed through Whatman No. 1 filter paper.

Extract bioassay

Seeds of *A. lebbeck* were scarified with sandpaper. Seeds of each test species were surface disinfected with 0·52% NaOCl (sodium hypochlorite) solution for 1 min and thoroughly washed in sterilized water and then soaked in test solutions for 4 h. Distilled water was used as a control. Seeds were then germinated using sterilized test tubes, 20 mm in diameter and 180 mm long, and lined with 3·4 × 16 cm strips of Whatman No. 1 filter paper folded to form a channel and 1·5 ml of the respective test solution was then added to each test tube. The tubes were temporarily sealed with polyethylene sheet using rubber bands. Each treatment was replicated three times with five seeds each. Germination of seeds was recorded upon emergence of radicle every 24 h for 3 days. The rate of germination was estimated by using Khan & Ungar (1984) index of germination velocity = $\Sigma G/t$, where G = number of seeds germinated at 2-day intervals, t = total germination period. The maximum value possible using this index to our data was 5, that is (15/3). Higher values represent a more rapid rate of germination. Root, shoot and seedling growth of the 72 h old plants was obtained using the same seeds that were used for germination.

The data were subjected to statistical analysis using SPSS package on IBM compatible AT (486/66) computer. A significance level of 1% was used in analysis for Duncan's multiple range test.

Results

Effect of water extracts on the rate and percentage germination

Of the soil, root, stem, leaf and flower extract of *P. juliflora*, the fruit and seed extracts were most effective in delaying the germination of test plants except for *Albizia lebbeck* which was unaffected by the extracts (Table 1). Fresh extract of leaf, flower and fruit significantly inhibited the germination of most test cultivars compared with root, stem and seed extract (Table 2).

Table 1. *Effect of different concentrations of aqueous extracts from soil and different parts of* Prosopis juliflora *on the rate of germination of various test plants*

Species	Concentration (%)	Treatments						
		Soil	Root	Stem	Leaf	Flower	Fruit	Seed
Triticum aestivum cv.								
Chakwal	0%	5·0[a]	5·0[a]	3·3[a]	4·8[a]	3·6[a]	4·8[a]	3·3[a]
	5%	4·2[b]	4·2[b]	4·3[b]	4·2[a]	2·6[b]	3·7[b]	3·2[a]
	10%	4·2[b]	3·8[c]	2·9[a]	2·2[b]	1·7[c]	1·2[c]	1·7[c]
Inqalab	0%	5·0[a]	5·0[a]	4·6[a]	5·0[a]	4·7[a]	5·0[a]	4·6[a]
	5%	4·6[a]	4·3[a]	4·3[a]	3·7[b]	3·7[b]	1·7[b]	2·3[b]
	10%	4·2[b]	4·4[a]	2·8[b]	3·0[b]	3·8[b]	0·4[c]	2·4[b]
Pak 81	0%	5·0[a]	5·0[a]	3·8[a]	4·7[a]	3·8[a]	4·7[a]	3·8[a]
	5%	4·7[a]	3·2[b]	3·6[a]	2·3[b]	3·6[a]	2·8[b]	3·7[a]
	10%	4·1[b]	3·3[b]	3·4[a]	2·8[b]	1·2[b]	1·1[c]	1·7[b]
Rohtas	0%	5·0[a]	5·0[a]	4·3[a]	5·0[a]	4.2[a]	5.0[a]	4.3[a]
	5%	4·7[a]	4·2[a]	3·9[a]	3·9[b]	4·9[a]	3·0[b]	2·3[b]
	10%	4·4[a]	3·8[a]	3·4[b]	4·1[b]	3.7[a]	2.1[c]	3.1[b]
Zea mays cv.								
EV1081	0%	4·2[a]	4·2[a]	4·2[a]	2·7[a]	2·7[a]	2·7[a]	4·2[a]
	5%	1·8[b]	3·4[b]	2·6[b]	3·7[b]	1·8[b]	1·9[a]	1·1[b]
	10%	2·8[a]	1·8[b]	2·7[b]	2·6[a]	3·2[a]	1·8[a]	1·6[b]
Gohar	0%	5·0[a]	4·2[a]	4·7[a]	4·2[a]	5·0[a]	4·2[a]	4·7[a]
	5%	3·8[b]	5·0[a]	4·8[a]	3·9[a]	4·2[a]	3·7[a]	2·7[b]
	10%	3·8[b]	4·3[a]	3·8[b]	2·3[b]	4·1[a]	3·8[a]	3·7[a]
R 796	0%	4·8[a]	4·8[a]	4·8[a]	3·3[a]	3·2[a]	3·3[a]	4·4[a]
	5%	3·1[a]	3·9[a]	3·1[a]	2·9[a]	3·7[a]	2·0[a]	1·3[b]
	10%	4·0[b]	2·8[b]	2·4[b]	3·1[a]	3·6[a]	0·8[c]	2·2[b]
Albizia lebbeck								
	0%	4·4[a]	4·7[a]	5·0[a]	5·0[a]	5·0[a]	5·0[a]	5·0[a]
	5%	4·9[a]	4·7[a]	4·9[a]	4·9[a]	5·0[a]	5·0[a]	5·0[a]
	10%	4·7[a]	4·7[a]	4·7[a]	4·7[a]	5·0[a]	4·3[a]	4·7[a]

Values for each cultivar having the same letters within a column are not significantly different at 1% level by Duncan's multiple – range test.

Effect of water extracts on the shoot growth

Soil extract had no inhibitory effect whereas, root extract promoted shoot growth in most of the cultivars studied (Table 3). The stem and leaf extract showed an inhibitory effect on some of the species tested. Flower, fruit and seed extracts significantly inhibited the shoot growth of most of the species tested. Fruit extract was most inhibitory to shoot growth.

Effect of water extracts on the root growth

Root extract promoted the root growth of some of the cultivars studied (Table 4). Soil, and stem extracts of *P. juliflora* showed no adverse effect on the root growth of all test species (Table 4). Root growth of *Triticum aestivum* cvs. Rohtas and Pak 81 were significantly affected by stem extract. However, leaf, flower, fruit, and seed extracts

Table 2. *Effect of different concentrations of aqueous extracts from soil and different parts of* Prosopis juliflora *on the final germination percentage of various test species*

Species	Concentration (%)	Treatments						
		Soil	Root	Stem	Leaf	Flower	Fruit	Seed
Triticum aestivum cv.								
Chakwal	0%	100[a]	73·2[a]	100[a]	66·6[a]	100[a]	66·6[a]	100[a]
	5%	86·6[a]	53·2[b]	86·6[b]	73·2[a]	73·2[a]	86·6b	64·2[a]
	10%	46·6[b]	33·2[c]	80·0[b]	33·2[b]	33·2[c]	66·6[a]	86·6[b]
Inqalab	0%	100[a]	100[a]	100[a]	93·2[a]	100[a]	93·2[a]	100[a]
	5%	66·6[b]	73·2[b]	93·2[b]	53·2[b]	46·6[b]	86·6[a]	100[a]
	10%	60·0[b]	80·0[b]	93·2[a]	53·2[b]	26·6[c]	60·0[b]	93·2[a]
Pak 81	0%	100[a]	80·0[a]	100[a]	80·0[a]	100[a]	80·0[a]	100[a]
	5%	46·6b	80·0[a]	66·6[b]	80·0[a]	60·0[b]	80·0[a]	100[a]
	10%	73·2[c]	26·6[b]	73·2[b]	66·6[a]	26·6[c]	73·2[a]	93·2[a]
Rohtas	0%	100[a]	86·6[ab]	100[a]	86·6[a]	100[a]	100[a]	100[a]
	5%	80·0[b]	100[a]	86·6[b]	53·2[b]	73·2[b]	73·2[b]	100[a]
	10%	86·6[ab]	80·0[b]	80·0[b]	73·2[a]	53·2[c]	53·2[c]	93·2[a]
Zea mays cv.								
EV1081	0%	53·2[a]	66·6[a]	100[a]	66·6[a]	52·2[a]	53·2[a]	100[a]
	5%	93·2[b]	40·0[b]	73·2[b]	33·2[b]	46·6[a]	46·6[a]	60·0[b]
	10%	66·6[a]	86·6[c]	46·6[c]	40·0[b]	46·6[a]	46·6[a]	80·0[c]
Gohar	0%	100[a]	100[a]	100[a]	93·2[a]	100[a]	100[a]	100[a]
	5%	86·6[a]	93·2[a]	100[a]	60·0[b]	86·6[a]	86·6[a]	100[a]
	10%	53·2[b]	86·6[a]	86·6[b]	86·6[a]	86·6[a]	86·6[a]	93·2[a]
R 796	0%	66·6[a]	66·6[a]	100[a]	93·2[a]	66·6[a]	66·6[a]	100[a]
	5%	66·6[a]	80·0[a]	93·2[a]	26·6[b]	60·0[a]	60·0[a]	80·0[b]
	10%	66·6[a]	73·2[a]	60·0[b]	46·6[c]	33·2[b]	33·2[b]	100[a]
Albizia lebbeck								
	0%	100[a]	100[a]	93·2[a]	100[a]	100[a]	100[a]	100[a]
	5%	100[a]	100[a]	93·2[a]	100[a]	100[a]	100[a]	100[a]
	10%	100[a]	100[a]	93·2a	93·2[a]	86·6[a]	86·6[a]	100[a]

Values for each cultivar having the same letters within a column are not significantly different at 1% level by Duncan's multiple – range test.

significantly inhibited the root growth. Fruit extract was even more inhibitory to root growth.

Effect of water extracts on seedling growth

Root and stem extracts had no effect on the growth of seedling, however, root extract significantly promoted seedling growth (Table 5). Leaf, flower, fruit and seed extracts significantly inhibited the growth of test species. An increase in leaf, fruit and seed extracts concentration did not show any progressive increase in inhibition, however, an increase in flower extract concentration progressively inhibited seedling growth. The growth of *Albizia lebbeck* also showed a similar pattern to the other test species.

Table 3. *Effect of different concentrations of aqueous extracts from soil and different parts of* Prosopis juliflora *on the mean shoot length (cm) of various test species*

Species	Concentration (%)	Treatments						
		Soil	Root	Stem	Leaf	Flower	Fruit	Seed
Triticum aestivum cv.								
Chakwal	0%	2·9^{a}	2·9^{a}	5·3a	3·2a	3·2^{ab}	3·2^{a}	5·3^{a}
	5%	3·3^{ab}	6·1^{b}	3·2^{b}	2·5a	1·7^{a}	0·7^{b}	3·0^{b}
	10%	3·5^{b}	5·2^{b}	3·3^{b}	1·4b	1·0^{b}	0·3^{b}	2·5^{b}
Inqalab	0%	2·6^{a}	2·6^{a}	3·3a	2·8a	2·0^{a}	2·8^{a}	3·3^{a}
	5%	2·8^{a}	4·8^{b}	2·9^{a}	1·8b	2·2^{a}	0·1^{b}	2·3^{b}
	10%	2·7^{a}	4·7^{b}	2·9^{a}	1·7b	1·8^{a}	0·0^{b}	1·5^{b}
Pak 81	0%	2·2^{a}	2·17^{a}	6·1^{a}	2·4a	4·5^{a}	2·4^{a}	6·1^{a}
	5%	3·5^{b}	4·0^{b}	3·4^{b}	1·3b	2·1^{b}	0·6^{b}	2·4^{b}
	10%	3·3^{b}	4·5^{b}	4·4^{b}	0·6b	0·8^{b}	0·2^{b}	1·8^{b}
Rohtas	0%	2·7^{a}	2·6^{a}	6·0^{a}	1·6a	6·0^{a}	1·6^{a}	6·0^{a}
	5%	3·0^{a}	4·0^{b}	3·2^{b}	1·8a	2·3^{b}	0·3^{b}	2·0^{b}
	10%	3·2^{a}	4·6^{b}	3·2b	1·4a	1·0^{b}	0·3^{b}	1·7^{b}
Zea mays cv.								
EV1081	0%	1·1^{a}	1·2^{a}	2·5^{a}	3·8^{a}	8·7^{a}	3·8^{a}	2·5^{a}
	5%	1·5^{a}	4·4^{b}	3·6^{a}	3·3^{a}	3·4^{b}	0·2^{b}	0·4^{b}
	10%	1·5^{a}	2·0^{a}	2·9^{a}	1·5^{b}	1·9^{c}	0·1^{b}	0·6^{b}
Gohar	0%	2·6^{ab}	4·2^{ab}	3·1^{a}	2·8^{a}	9·7^{a}	4·18^{a}	3·1^{a}
	5%	2·9^{a}	4·9^{a}	3·7^{a}	2·9^{a}	3·8^{b}	1·1^{b}	1·0^{b}
	10%	2·3^{b}	3·6^{b}	3·3^{a}	1·5^{b}	1·9^{c}	0·3^{c}	0·6^{b}
R 796	0%	1·8^{a}	1·8^{a}	1·8^{a}	4·9^{a}	8·7^{a}	4·9^{a}	3·1^{a}
	5%	2·2^{a}	3·0^{b}	4·6^{b}	4·1^{a}	2·6^{b}	0·2^{b}	0·3^{b}
	10%	1·7^{a}	5·6^{c}	3·0^{a}	2·0^{b}	2·4^{b}	0·2^{b}	0·8^{b}
Albizia lebbeck								
	0%	1·5a	1·4^{a}	0·7^{a}	1·5^{a}	1·4^{a}	1·5^{a}	0·7^{a}
	5%	1·4a	0·4^{a}	0·5^{a}	1·1^{a}	0·5^{a}	0·3^{b}	0·3^{a}
	10%	1·4a	0·4^{a}	0·5^{a}	1·4^{a}	1·0^{a}	0·3^{b}	0·2^{a}

Values for each cultivar having the same letters within a column are not significantly different at 1% level by Duncan's multiple – range test.

Discussion

The phytotoxic effects of the water soluble extracts of root, stem, leaf, flower, fruit, seed and under canopy soil of *P. juliflora* showed considerable differences in seed germination and early seedling growth in the eight test plants. Fruit and seed extract exhibited greater phytotoxicity than extracts from other plant parts. Soil extract had an inhibitory effect on the germination and no effect on growth of seedlings.

The phenomenon of the presence of biochemical inhibitors associated with seed and fruit structures is widespread in the plant kingdom (Khan, 1982; Hedge & Miller, 1990). Allelopathic metabolites leached out from woody plants often suppress the growth of undergrowth species sharing the same habitat (Chou, 1989). Many woody species are reported to have phytotoxins (Akram *et al*., 1990; May & Ash, 1990; Chou & Lee, 1991; Ferguson, 1991; Kil & Yun, 1992). Chou & Yang (1982) showed that leachates of the bamboo, *Phyllostachys edulis* (Carr.) H. de Lehaie contains significant amounts of allelopathic compounds that can suppress the growth of undergrowth

Table 4. *Effect of different concentrations of aqueous extracts from soil and different parts of* Prosopis juliflora *on the mean root length (cm) of various test species*

Species	Concentration (%)	Treatments						
		Soil	Root	Stem	Leaf	Flower	Fruit	Seed
Triticum aestivum cv.								
Chakwal	0%	4·8^{a}	4·8^{a}	5·4^{a}	4·5^{a}	4·1^{a}	4·5^{a}	5·4^{a}
	5%	4·4^{a}	6·1^{a}	3·9^{ab}	3·7^{a}	2·5^{ab}	0·7^{b}	3·4^{b}
	10%	4·7^{a}	6·6^{a}	3·0^{b}	1·3^{b}	1·3^{b}	0·4^{b}	3·0^{b}
Inqalab	0%	4·0^{a}	4·0^{a}	4·6^{a}	4·5^{a}	4·4^{a}	4·5^{a}	4·6^{ab}
	5%	3·7^{a}	6·1^{a}	3·5^{a}	2·1^{b}	2·7^{a}	0·2^{b}	3·1^{a}
	10%	3·4^{a}	6·0^{a}	3·7^{a}	2·9^{b}	2·9^{a}	0·1^{b}	2·2^{b}
Pak 81	0%	3·9^{a}	3·9^{a}	8·0^{a}	4·9^{a}	6·5^{a}	4·9^{a}	8·0^{a}
	5%	4·7^{ab}	5·4^{a}	3·2^{b}	2·5^{b}	3·2^{b}	0·6^{b}	2·8^{b}
	10%	5·0^{b}	5·6a	5·7^{c}	1·4^{b}	1·6^{b}	0·3^{b}	1·8^{b}
Rohtas	0%	4·4a	4·4^{a}	11·7^{a}	2·4^{a}	11·7^{a}	2·4^{a}	11·8^{a}
	5%	5·0^{ab}	3·7^{a}	4·1^{b}	3·0^{a}	3·2^{b}	0·6^{b}	1·9^{b}
	10%	5·5^{b}	11·5^{b}	4·5^{b}	1·1^{b}	1·1^{b}	0·5^{b}	2·2^{b}
Zea mays cv.								
EV1081	0%	3·3^{a}	4·2^{a}	4·7^{ab}	5·7^{a}	7·4^{a}	5·7^{a}	4·7^{a}
	5%	2·9^{a}	9·7^{b}	5·8^{a}	5·1^{ab}	5·1^{b}	0·5^{b}	0·7^{b}
	10%	3·6^{a}	3·8^{a}	3·4^{b}	3·7^{b}	3·2^{b}	0·6^{b}	0·6^{b}
Gohar	0%	6·1a^{b}	7·3^{a}	8·2^{ab}	5·4^{a}	11·2^{a}	7·3^{a}	8·2^{a}
	5%	7·0^{a}	8·8^{a}	9·1^{a}	4·3^{a}	5·6^{b}	1·5^{b}	1·6^{b}
	10%	5·6^{b}	7·0^{a}	6·4^{b}	2·0^{b}	2·7^{c}	0·9^{b}	0·7^{b}
R 796	0%	5·1^{a}	5·1^{a}	5·1^{a}	6·9^{a}	8·6^{a}	6·9^{a}	6·9^{a}
	5%	4·9^{a}	12·0^{b}	6·9^{a}	9·9^{b}	4·2^{b}	0·2^{b}	0·5^{b}
	10%	5·9^{a}	9·7^{b}	5·7^{a}	5·9^{a}	4·0^{b}	0·3^{b}	1·8^{b}
Albizia lebbeck								
	0%	3·8a	8·1^{a}	5·1^{a}	3·76^{a}	8·1^{a}	3·8^{a}	5·6^{a}
	5%	3·9a	2·9^{b}	3·6^{a}	3·88^{a}	3·8^{b}	2·2^{b}	0·4^{b}
	10%	2·6b	2·9^{b}	3·2^{a}	2·61^{a}	1·8^{b}	0·7^{b}	0·2^{b}

Values for each cultivar having the same letters within a column are not significantly different at 1% level by Duncan's multiple – range test.

weeds. The leaf leachates of *Leucaena leucocephala* (Lam). DeWit suppressed the growth of weed species found underneath the canopy, however, these leachates do not affect the seedling of *L. leucocephala* itself.

The water-soluble allelopathic substances released by the woody plants have been identified as phenolic acids, flavonoids and alkaloids (Chou, 1989) and phenolic acids like p-hydroxybenzoic, vanillic, p-coumaric and ferulic acid are ubiquitously distributed in woody species.

Allelopathic effects generally produce an inhibition of germination and early growth of seedlings (Akram *et al.*, 1990; Kil & Yun, 1992). While we did not investigate the specific mode of action, many other studies demonstrated inhibition occurring through limiting cell division, respiration, photosynthesis or by disrupting membrane regulation (Macias *et al.*, 1992).

The present study showed that water extracts of fruit and seeds are most effective in inhibiting the germination and early seedling growth. The presence of allelochemical activity in some parts of the plants suggest the possibility of a role of allelopathy in the

Table 5. *Effect of different concentrations of aqueous extracts from soil and different parts of* Prosopis juliflora *on the mean seedling length (cm) of various test species*

Species	Concentration (%)	Treatments						
		Soil	Root	Stem	Leaf	Flower	Fruit	Seed
Triticum aestivum cv.								
Chakwal	0%	7·7^{a}	7·7^{a}	10·3^{a}	7·7^{a}	7·3^{a}	7·7^{a}	10·4^{a}
	5%	7·7^{a}	10·7^{b}	7·1^{b}	6·2^{a}	4·2^{b}	1·1^{b}	6·1^{b}
	10%	8·2^{a}	11·8^{b}	6·3^{b}	2·8^{b}	2·3^{b}	0·7^{b}	5·5^{b}
Inqalab	0%	6·6^{a}	6·6^{a}	8·1^{a}	7·3^{a}	6·3^{a}	7·3^{a}	7·9^{a}
	5%	6·5^{a}	10·1^{b}	7·5^{a}	3·8^{b}	4·8^{a}	0·3^{b}	5·4^{b}
	10%	6·1^{a}	10·1^{b}	6·6^{a}	4·2b	4·0^{a}	0·1^{b}	3·7^{b}
Pak 81	0%	6·1^{a}	6·0^{a}	14·1^{a}	7·3^{a}	11·5^{a}	7·3^{a}	14·1^{a}
	5%	7·8^{b}	8·9^{b}	7·5^{b}	3·8^{b}	5·3^{b}	1·0^{b}	5·2^{b}
	10%	8·2^{b}	10·0^{b}	10·1^{c}	2·0^{b}	2·3^{c}	0·5^{b}	3·6^{b}
Rohtas	0%	7·1^{a}	7·1^{a}	11·6^{a}	4·0^{a}	11·6^{a}	4·0^{a}	11·6^{a}
	5%	8·0^{ab}	7·5^{a}	7·4^{b}	4·4^{a}	5·5^{b}	0·8^{b}	3·9^{b}
	10%	8·8^{b}	8·0^{a}	7·7^{b}	2·1^{a}	2·1^{c}	1·6^{b}	3·9^{b}
Zea mays cv.								
EV1081	0%	4·4^{a}	5·5^{a}	7·0^{a}	9·2^{a}	19·1^{a}	9·2^{a}	7·1^{a}
	5%	4·7^{a}	14·0^{b}	9·4^{b}	8·6^{a}	8·5^{b}	0·7^{b}	1·0^{b}
	10%	4·5^{a}	5·7^{a}	6·7^{a}	5·2^{b}	5·1^{c}	0·7^{b}	1·2^{b}
Gohar	0%	8·7^{ab}	10·3^{a}	11·4^{a}	8·0^{a}	20·9^{a}	10·3^{a}	11·4^{a}
	5%	9·9^{a}	13·6^{a}	12·7^{a}	7·1^{a}	9·4^{b}	2·5^{b}	2·4^{b}
	10%	7·9^{b}	10·7^{b}	11·7^{a}	3·5^{b}	4·2^{c}	1·2^{b}	1·3^{b}
R 796	0%	6·8^{a}	6·8^{a}	6·8^{a}	10·6^{a}	17·3^{a}	10·6^{a}	10·0^{a}
	5%	7·1^{a}	14·9^{b}	10·8^{b}	13·7^{b}	6·5^{b}	0·28^{b}	0·7^{b}
	10%	7·4^{a}	15·3^{b}	7·8^{a}	7·9^{c}	6·4^{b}	0·43^{b}	2·5^{b}
Albizia lebbeck								
	0%	5·2^{a}	8·9^{a}	5·8^{a}	5·2^{a}	8·9^{a}	5·2^{a}	5·8^{a}
	5%	4·9^{a}	3·4^{a}	4·0^{a}	4·9^{a}	4·2^{b}	1·4^{b}	0·5^{b}
	10%	4·1^{a}	4·3^{b}	4·1^{a}	4·1^{a}	2·8^{b}	1·4^{b}	0·4^{b}

Values for each cultivar having the same letters within a column are not significantly different at 1% level by Duncan's multiple – range test.

phenomenal success of *P. juliflora* as an invader. The absence of inhibitors in the soil extract could be attributed to heavy rainfall a few days before the soil samples were collected. This present paper only indicates the presence of allelopathic potential in *P. juliflora*; however, mere presence does not prove that allelopathy does occur under natural conditions. Future studies on the movement of allelochemicals to the soil, proof of the maintenance of allelochemic potential while present in the soil, change in inhibitor concentration after various periods of drying under natural conditions, characterization of inhibitors should help to determine whether the allelopathy is the cause of the exceptional success of *P. juliflora* on the flat plains of Karachi.

The authors wish to acknowledge the support of the University of Karachi, the National Science Research and Development Board, Pakistan, the Pakistan Science Foundation, the Third World Academy of Sciences and the International Foundation for Science, Sweden in carrying out this project. We also thank Prof Dr Abdul Ghaffar and an anonymous reviewer for their useful comments on the manuscript.

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