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ALLELOPATHIC EFFECTS OF SOME DESERT PLANTS ON SEED GERMINATION AND SEEDLING GROWTH OF *CALLIGONUM POLYGONOIDES* L.

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ABSTRACT

Allelopathic effect of aqueous extracts of *Capparis decidua, Leptadenia pyrotechnica, Aerva tomentosa, Crotolaria burhia* and *Lasiurus sindicus* on seed germination and seedling growth of *Calligonum polygonoides* was studied in laboratory conditions. Delayed and inhibitory effect on germination percentage and seedling growth was observed in *Calligonum polygonoides* when treated with shoot and root aqueous extracts. The degree of inhibition was directly proportional to the concentration of the extracts. *Cappar's decidua* extracts were more toxic and showed 100% germination inhibition.

INTRODUCTION

The influence of plants including both beneficial and harmful interactions have important applications in many fields of biological sciences. Chemical compounds leached from plants may affect adjacent plants and thus play a role in allelopathy. The ecological significance of allelopathic influence has been pointed out by Whittakar and Fenny (1971), Datta and Roy (1974) and Chatterji (1975). Rice (1974) has given a comprehensive account in respect of higher plants and micro-organisms. Mohanot and Soni (1977), Rao et al. (1979) and Datta and Chatterji (1980) have demonstrated allelochemic effects of some weed species in India.

Calligonum polygonoides is one the characteristic component of the plant communities in the arid zone of the north-western part of Rajasthan in India (Cooke 1904; Bhandari 1978). It is of considerable importance because of high fuel value and as a sand binder. It grows in association with some desert grasses, shrubs, undershrubs and herbs and is considered to be very valuable common indigenous shrub (Shakhawat 1961).

The present study reports the influence of aqueous extracts of the aerial (shoot only) and underground parts (root) of characteristic desert species on seed germination and subsequent seedling growth of *Calligonum polygonoides*.

MATERIAL AND METHODS

The seeds of *Calligonum polygonoides* Linn. were collected from Beechwal and C.A.Z.R.I., RRS, Bikaner in the month of April. Five species viz. *Crotolaria burhia* Buch-Ham., *Leptadenia pyrotechnica* (Forsk) Decn., *Capparis decidua* (Forsk) Edgew., *Aerva tomentosa* (Burm.f.) Juss. and *Lasiurus sindicus* Henr. were selected for study of their allelopathic effects.

Aqueous extracts were made by directly soaking 6 gs each of dried plant material in 100 ml of glass distilled water. These were kept for 48 hours at room temperature (20° ± 1°C). The extracts were filtered and made upto 100 ml by adding more distilled water. This was known as stock solution 6 : 100 (A), further dilutions i.e. 3 : 100 (B) and 1 : 100 (C) were prepared from the stock solutions.

One hundred healthy seeds of *Calligonum* without bristles for each set were soaked separately in different extracts for 12-18 hours at room temperature. Soaked seeds were surface sterilized next day with 0.1% mercuric chloride solution for five minutes and washed twice with distilled water and kept for germination over moist filter paper in petri dishes under laboratory conditions at 20° ± 1°C temperature. The filter papers were kept moistened with approximately 20 ml of respective extracts. A controlled set of distilled water was kept along with it. Observations on germination were continued up to 30 days at intervals of five days. After fifteen days, all the seeds were transferred to petri dishes containing filter paper moistened with approx. 20 ml distilled water and respective extracts.

The percentage inhibition in seed germination, hypocotyl and radicle growth in the treatment sets were later computed in comparison to control sets as follows :

i) Seed germination inhibition (%) $= 100 \times (N - n/N)$,

ii) Hypocotyl elongation inhibition (%) $= 100 - 100 \left(\frac{N}{S}\right) \times \left(\frac{s}{n}\right)$,

iii) Root growth inhibition (%) $= 100 - 100 \left(\frac{N}{R}\right) \times \left(\frac{r}{n}\right)$,

where,

N—germination % (70) in control,

n—germination % in treatment,

S—number of plants with hypocotyl length ≥ 34 mm in control seedling,

s—number of plants with hypocotyl ≥ 34 mm in treatment,

R—number of plants with radicle length ≥ 57 mm in control seedling,

r—number of plants with root length ≥ 57 mm in treatment.

Table 1. Seed germination and seedling growth of *Calligonum polygonoides* under the influence of aqueous extracts of desert plants

Weeds	Plant Part	Conc.*	Percentage Germination in Days			Length in mm after 30 Days	
			10	20	30	Hypocotyl	Root
	Root	A	6	23	39	23.1	12.8
Crotolaria		B	7	39	54	32.0	21.4
burhia		C	22	42	66	48.1	34.4
	Shoot	A	2	4	6	14.0	7.8
		B	8	35	42	44.1	19.6
		C	13	43	48	55.2	26.5
	Root	A	—	1	21	9.4	0.8
Leptadenia		B	—	10	22	14.8	10.9
pyrotechnica		C	11	48	69	33.2	31.4
	Shoot	A	—	1	5	—	—
		B	4	22	31	33.1	11.1
		C	9	37	49	54.0	25.0
	Root	A	—	—	—	—	—
Aerva		B	1	10	19	14.4	7.0
tomentosa		C	11	39	61	24.4	27.5
	Shoot	A	—	1	5	—	—
		B	2	9	20	19.8	7.4
		C	17	47	59	35.7	19.8
	Root	A	—	2	37	12.9	0.5
Lasiurus		B	5	43	65	32.8	27.3
sindicus		C	15	49	66	33.0	16.6
	Shoot	A	—	9	27	24.2	5.6
		B	4	45	57	47.2	13.4
		C	23	51	65	65.2	33.2
—	Control		19	53	70	57.0	34.2

*Concentration : A=6:100, B=3:100, C=1:100

RESULTS AND DISCUSSION

Initiation of germination was delayed in aqueous extracts of all concentrations of the different plants as compared to that in the control (Table 1). The final percentage germination and growth of seedling were also noticed to be inhibited in shoot and root extracts of the plants, and degree of inhibition was directly proportional to the concentration of the extract (Table 2). Shoot extracts were observed to be more inhibitory than the root extracts. The root and shoot extracts of *Capparis decidua* showed strong (100%) inhibitory effect on percentage germination at all the concentrations. Inhibitory effect of root extract of *crotolaria burhia* was at par with that of *Lasiurus sindicus*. With the dilution of the extracts the inhibitory effect of percentage germination was decreased (Table 2). The least inhibitory effect was observed by root

Table 2. Percentage inhibition of seed germination, hypocotyl elongation and root growth of *Calligonum polvgonoides* under the influence of aqueous extracts of desert plants

Weeds	Conc*	Seed germination inhibition (%) by extracts of		Hypccctyl inhibition (%) by by extracts of		Root growth inhibition (%) by extracts of	
		Root	Shoot	Root	Shoot	Root	Shoot
Crotalaria	A	48.5	87.1	100.0	100.0	100.0	100.0
burhia	B	22.8	40.0	22.6	60.2	79.3	11.6
	C	5.7	31.4	(—) 51.9	76.8	49.4	53.6
Laptadenia	A	70.0	92.8	100.0	100.0	100.0	100.0
pyrotechnica	B	68.5	57.7	74.6	82.0	83.1	76.0
	C	1.4	30.0	27.3	77.2	89.2	9.1
Acrva	A	100.0	92.8	100.0	100.0	100.0	100.0
tomentosa	B	72.8	71.4	100.0	100.0	100.0	81.4
	C	12.8	15.7	36.0	90.5	100.0	57.4
Lasiurus	A	47.1	61.4	100.0	100.0	100.0	95.4
sindicus	B	7.1	18.5	48.5	100.0	88.5	47.9
	C	5.7	7.1	(—) 1.2	31.4	100.0	(—) 36.9

*Concentration : A=6:100, B=3:100, C=1:100

and shoot extract (A) of *Lasiurus*. Shoot extracts were found to be more inhibitory than the root extracts except in *Aerva tomentosa*. The diluted root extract (C) of *Leptadenia pyrotechnica* showed least inhibitory effect on seed germination in comparision to control (Table 1).

The seedling growth of *Calligonum polygonoides* was affected variably in different concentration of all the aqueous extracts of root and shoot. The hypocotyl and root growth showed inhibitory/promotry effect in a variable manner in different concentration of root and shoot extracts of plant species. Significant inhibition of hypocotyl and root growth was observed in root and shoot extracts (A) of all species (Table 2). With the lower concentration of the root and shoot extracts (B & C) the inhibitory effect on hypocotyl and root growth was decreased in all species except *Capparis*.

Root extract of *Crotolaria burhia* (C) and shoot and root extracts of *Lasiurus sindicus* (C) showed stimulatory effect on hypocotyl (-51.9%) and on both root (36.9%) and hypocotyl (-1.2%), respectively (Table 2). However, none of the extracts at higher concentration (A & B) showed promotory effect. This was in confirmity with the observation made by Chatterji (1975) where aqueous extracts of *Crotolaria medicagenia* in lower concentration stimulated the growth of hypocotyl and radicle of the seedling while the higher concentration was inhibitory.

The growth pattern of root was same as that of hypocotyl in shoot and root extract of *Laptadenia pyrotechnia* and *Aerva tomentosa* at 6:100 (A) concentration. It appears that all the allelopathics are water soluble compounds, mostly phenolic in nature (Schreiner and Reed 1908). Phenolic compounds may be inhibitory, in-effective or stimulatory in their biological activites (Kefeli and Kadyrov 1971). The effects of root and shoot extracts of *Capparis decidua* indicated the presence of a potent growth retarding factor of allelopathic implication for *Calligonum*. Intentive study of the plant communities in relation to Capparis might be of great practical value for understanding their allelochemic interactions. Further studies on alleolopathic phenomena in desert plant communities are therefore, necessary to understand their pattern distribution, early establishment and dominance.

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