

## ALLELOPATHIC EFFECTS OF *VERBESINA ENCELIOIDES* CAV.

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### ABSTRACT

Extracts from various parts of *Verbesina encelioides* Cav. (Compositae) inhibited seed germination and reduced seedling growth in *Tephrosia purpurea* Baker, *Cassia occidentalis* L., *Crotolaria medicagenia* Lamk. and *Indigofera linnaei* Ali. Leaf and floral extracts were more toxic than the extract of stem and leachates of root.

### INTRODUCTION

Many plants of the family Compositae are known for their allelopathic nature (Kobayashi et al., 1974). *Verbesina encelioides* Cav. forms pure stands on wastelands and roadsides and is found gregarious amongst grasses in semi-arid conditions near Jaipur. Particularly during flowering (August-October), it dominantly covers the lands probably due to allelochemicals. Therefore, the present study was undertaken to study the allelopathic effects of *V. encelioides* on seed germination and seedling growth of some selected test species.

### MATERIAL AND METHODS

Inhibitory effects of different extracts of *V. encelioides* plant parts on the germination and seedling growth of four common weed species of Jaipur region, namely *Tephrosia purpurea* Baker, *Cassia occidentalis* L., *Crotolaria medicagenia* Lamk. and *Indigofera linnaei* Ali, were studied.

Aqueous extracts of fresh stem, leaves and flowers of *V. encelioides* were prepared by crushing 1, 5, 10, and 20 g of the respective parts in 100 ml of distilled water and filtering the solution through two layers of muslin cloth.

Root leachates were prepared by soaking 1, 5, 10 and 20 g of fresh roots in 100 ml of distilled water for 24 hrs. The water was filtered and used for moistening the seeds of the test plants.

The senescing leaves were collected from the field, air dried and powdered. A layer of 0.025, 0.050, 0.1, 0.25 and 0.5 g leaf powder of *V. encelioides* was placed under the filter papers in all the trials except control.

Surface sterilized seeds of the four test species, moistened with the respective extract of *V. encelioides*, were germinated in Petri plates, lined with moistened filter papers and kept at temperatures of 30°C and 18°C, respectively. The observations for germination were recorded daily and after one week, the length of ten longest seedlings from each Petri plate were measured. The results were statistically analysed using Students' t test.

## RESULTS AND DISCUSSION

### Effect of fresh leaf extracts and senescent leaves :

Fresh leaf extracts and leachates from senescent leaves of *V. encelioides* significantly reduced the germination followed by lowered radicle and plumule length of all the four test species. The extent of reduction was correlated with the leaf concentrations, At higher concentrations, the seeds of *C. medicagenia* and *I. linnaei* failed to germinate (Tables 1, 2, and 3).

Table 1. Effect of senescing leaf powder (g) of *Verbesina encelioides* on seed germination, survival percentage, radicle and plumule length

Test species	Concentration dry material (g)	Germination (%)	Survival (%) after 10 days	Radicle length (cm)	Plumule length (cm)
<i>Tephrosia</i>	Control	78 <sup>a</sup>	78 <sup>a</sup>	3.16 <sup>a</sup>	4.32 <sup>a</sup>
	0.025	74 <sup>b</sup>	74 <sup>b</sup>	2.28 <sup>b</sup>	3.64 <sup>b</sup>
	0.050	70 <sup>c</sup>	56 <sup>c</sup>	1.53 <sup>c</sup>	3.48 <sup>c</sup>
	0.1	58 <sup>d</sup>	38 <sup>d</sup>	0.67 <sup>d</sup>	2.07 <sup>d</sup>
	0.250	44 <sup>e</sup>	20 <sup>e</sup>	0.50 <sup>d</sup>	1.81 <sup>c</sup>
	0.5	30 <sup>f</sup>	20 <sup>e</sup>	0.50 <sup>d</sup>	1.08 <sup>d</sup>
<i>Cassia</i>	Control	82 <sup>a</sup>	82 <sup>a</sup>	3.22 <sup>a</sup>	4.44 <sup>a</sup>
	0.025	74 <sup>b</sup>	74 <sup>b</sup>	1.50 <sup>b</sup>	3.74 <sup>b</sup>
	0.050	68 <sup>c</sup>	68 <sup>c</sup>	1.11 <sup>c</sup>	4.01 <sup>b</sup>
	0.1	68 <sup>c</sup>	68 <sup>c</sup>	0.44 <sup>d</sup>	1.75 <sup>c</sup>
	0.250	52 <sup>d</sup>	32 <sup>d</sup>	0.19 <sup>e</sup>	0.83 <sup>d</sup>
	0.5	38 <sup>e</sup>	34 <sup>d</sup>	0.12 <sup>e</sup>	0.33 <sup>e</sup>
<i>Crotolaria</i>	Control	100 <sup>a</sup>	100 <sup>a</sup>	0.82 <sup>a</sup>	4.97 <sup>a</sup>
	0.025	100 <sup>a</sup>	40 <sup>b</sup>	0.80 <sup>a</sup>	3.04 <sup>b</sup>
	0.050	94 <sup>b</sup>	14 <sup>c</sup>	0.48 <sup>b</sup>	1.32 <sup>c</sup>
	0.1	8 <sup>c</sup>	—	—	—
	0.250	—	—	—	—
	0.5	—	—	—	—
<i>Indigofera</i>	Control	98 <sup>a</sup>	98 <sup>a</sup>	1.95 <sup>a</sup>	3.01 <sup>a</sup>
	0.025	92 <sup>b</sup>	78 <sup>b</sup>	0.88 <sup>b</sup>	2.72 <sup>a</sup>
	0.050	52 <sup>c</sup>	32 <sup>c</sup>	0.50 <sup>c</sup>	2.08 <sup>b</sup>
	0.1	—	—	—	—
	0.250	—	—	—	—
	0.5	—	—	—	—

Average of 50 seedlings; means not followed by same alphabets are significantly different at P=0.05

Table 2. Effect of fresh leaf, stem and flower aqueous extracts and root leachates of *Verbesina encelioides* on per cent seed germination (G) and survival after 10 days (S) of test species

Source of extract	Conc. (g/100ml)	<i>Tephrosia purpurea</i>		<i>Cassia occidentalis</i>		<i>Crotalaria medicogenia</i>		<i>Indigofera tinctoria</i>	
		G	S	G	S	G	S	G	S
Leaf	C	94 <sup>a</sup>	94 <sup>a</sup>	86 <sup>a</sup>	86 <sup>a</sup>	100 <sup>a</sup>	100 <sup>a</sup>	90 <sup>a</sup>	90 <sup>a</sup>
	1	58 <sup>b</sup>	38 <sup>b</sup>	68 <sup>b</sup>	68 <sup>b</sup>	8 <sup>b</sup>	—	8 <sup>b</sup>	—
	5	30 <sup>c</sup>	20 <sup>c</sup>	38 <sup>c</sup>	38 <sup>c</sup>	8 <sup>b</sup>	—	—	—
	10	10 <sup>d</sup>	—	15 <sup>d</sup>	—	—	—	—	—
	20	—	—	—	—	—	—	—	—
	C	94 <sup>a</sup>	94 <sup>a</sup>	86 <sup>a</sup>	86 <sup>a</sup>	100 <sup>a</sup>	100 <sup>a</sup>	90 <sup>a</sup>	90 <sup>a</sup>
Stem	1	88 <sup>b</sup>	88 <sup>b</sup>	82 <sup>b</sup>	82 <sup>b</sup>	100 <sup>a</sup>	100 <sup>a</sup>	76 <sup>b</sup>	76 <sup>b</sup>
	5	86 <sup>b</sup>	86 <sup>b</sup>	80 <sup>b</sup>	80 <sup>b</sup>	98 <sup>a</sup>	98 <sup>a</sup>	40 <sup>c</sup>	32 <sup>c</sup>
	10	82 <sup>c</sup>	80 <sup>c</sup>	72 <sup>c</sup>	72 <sup>c</sup>	98 <sup>a</sup>	98 <sup>a</sup>	40 <sup>c</sup>	32 <sup>c</sup>
	20	76 <sup>d</sup>	76 <sup>d</sup>	60 <sup>d</sup>	60 <sup>d</sup>	96 <sup>a</sup>	96 <sup>a</sup>	32 <sup>d</sup>	20 <sup>d</sup>
	C	94 <sup>a</sup>	94 <sup>a</sup>	86 <sup>a</sup>	86 <sup>a</sup>	100 <sup>a</sup>	100 <sup>a</sup>	90 <sup>a</sup>	90 <sup>a</sup>
	1	80 <sup>b</sup>	80 <sup>b</sup>	84 <sup>a</sup>	84 <sup>a</sup>	96 <sup>a</sup>	96 <sup>a</sup>	76 <sup>b</sup>	76 <sup>b</sup>
Flower	5	72 <sup>c</sup>	64 <sup>c</sup>	50 <sup>b</sup>	20 <sup>b</sup>	8 <sup>b</sup>	—	—	—
	10	72 <sup>c</sup>	54 <sup>d</sup>	32 <sup>c</sup>	20 <sup>b</sup>	—	—	—	—
	20	60 <sup>d</sup>	32 <sup>c</sup>	8 <sup>d</sup>	—	—	—	—	—
	C	94 <sup>a</sup>	94 <sup>a</sup>	86 <sup>a</sup>	86 <sup>a</sup>	100 <sup>a</sup>	100 <sup>a</sup>	90 <sup>a</sup>	90 <sup>a</sup>
	1	94 <sup>a</sup>	94 <sup>a</sup>	82 <sup>b</sup>	82 <sup>b</sup>	98 <sup>b</sup>	98 <sup>b</sup>	90 <sup>a</sup>	90 <sup>a</sup>
	5	80 <sup>b</sup>	78 <sup>b</sup>	80 <sup>b</sup>	80 <sup>b</sup>	98 <sup>b</sup>	98 <sup>b</sup>	90 <sup>a</sup>	90 <sup>a</sup>
Root	10	68 <sup>c</sup>	66 <sup>c</sup>	78 <sup>b</sup>	78 <sup>c</sup>	96 <sup>b</sup>	96 <sup>b</sup>	88 <sup>a</sup>	88 <sup>a</sup>
	20	34 <sup>d</sup>	18 <sup>d</sup>	82 <sup>c</sup>	82 <sup>d</sup>	92 <sup>c</sup>	92 <sup>c</sup>	72 <sup>b</sup>	70 <sup>b</sup>

Average of 50 seedling; means not followed by same alphabets are significantly different at P=0.05.1.

Table 3. Effect of fresh leaf, stem and flower extracts and root leachates of *Verbesina encelioides* on radicle and plumule growth (7th day) of test species

Source of extract	*Conc. g/100 ml	<i>Tephrosia purpurea</i>		<i>Cassia occidentalis</i>		<i>Crotolaria medicagenia</i>		<i>Indigofera tinctoria</i>	
		Radicle length (cm)	Plumule length (cm)	Radicle length (cm)	Plumule length (cm)	Radicle length (cm)	Plumule length (cm)	Radicle length (cm)	Plumule length (cm)
Leaf	C	1.50 <sup>a</sup>	3.16 <sup>a</sup>	5.28 <sup>a</sup>	6.62 <sup>a</sup>	1.08 <sup>a</sup>	4.94 <sup>a</sup>	3.29 <sup>a</sup>	3.04 <sup>a</sup>
	1	0.94 <sup>b</sup>	2.07 <sup>b</sup>	0.44 <sup>b</sup>	1.75 <sup>b</sup>	—	—	—	—
	5	0.76 <sup>c</sup>	1.16 <sup>c</sup>	0.27 <sup>c</sup>	1.19 <sup>c</sup>	—	—	—	—
	10	—	—	—	—	—	—	—	—
	20	—	—	—	—	—	—	—	—
	C	1.50 <sup>a</sup>	3.16 <sup>a</sup>	5.28 <sup>a</sup>	6.62 <sup>a</sup>	1.08 <sup>a</sup>	4.94 <sup>a</sup>	3.29 <sup>a</sup>	3.04 <sup>a</sup>
Stem	1	1.20 <sup>b</sup>	2.46 <sup>b</sup>	3.69 <sup>b</sup>	5.63 <sup>b</sup>	0.11 <sup>b</sup>	4.40 <sup>a</sup>	1.82 <sup>b</sup>	1.93 <sup>b</sup>
	5	1.10 <sup>b</sup>	2.20 <sup>b</sup>	2.88 <sup>c</sup>	4.79 <sup>c</sup>	0.68 <sup>c</sup>	3.74 <sup>a</sup>	0.86 <sup>c</sup>	1.43 <sup>c</sup>
	10	0.70 <sup>c</sup>	2.23 <sup>b</sup>	2.23 <sup>d</sup>	4.68 <sup>c</sup>	0.58 <sup>c</sup>	2.6 <sup>b</sup>	0.81 <sup>c</sup>	1.14 <sup>d</sup>
	20	0.60 <sup>c</sup>	2.04 <sup>b</sup>	1.54 <sup>e</sup>	3.53 <sup>d</sup>	0.44 <sup>d</sup>	2.58 <sup>b</sup>	0.26 <sup>d</sup>	1.12 <sup>d</sup>
	C	1.50 <sup>a</sup>	3.16 <sup>a</sup>	5.28 <sup>a</sup>	6.62 <sup>a</sup>	1.08 <sup>a</sup>	4.94 <sup>a</sup>	3.29 <sup>a</sup>	3.04 <sup>a</sup>
	1	0.90 <sup>b</sup>	2.34 <sup>b</sup>	4.67 <sup>a</sup>	5.30 <sup>a</sup>	0.84 <sup>a</sup>	4.41 <sup>a</sup>	1.59 <sup>a</sup>	1.91 <sup>b</sup>
Flower	5	0.54 <sup>c</sup>	1.90 <sup>c</sup>	1.30 <sup>b</sup>	1.81 <sup>b</sup>	—	—	—	—
	10	0.39 <sup>d</sup>	1.92 <sup>c</sup>	0.23 <sup>c</sup>	—	—	—	—	—
	20	0.20 <sup>e</sup>	1.8 <sup>c</sup>	—	—	—	—	—	—
	C	1.50 <sup>a</sup>	3.16 <sup>a</sup>	5.28 <sup>a</sup>	6.62 <sup>a</sup>	1.08 <sup>a</sup>	4.94 <sup>a</sup>	3.29 <sup>a</sup>	3.04 <sup>a</sup>
	1	1.55 <sup>a</sup>	3.25 <sup>a</sup>	4.93 <sup>a</sup>	6.52 <sup>a</sup>	1.14 <sup>a</sup>	4.86 <sup>a</sup>	3.51 <sup>a</sup>	3.36 <sup>a</sup>
	5	1.40 <sup>a</sup>	2.85 <sup>a</sup>	4.28 <sup>a</sup>	6.05 <sup>a</sup>	1.10 <sup>a</sup>	4.51 <sup>a</sup>	3.05 <sup>a</sup>	3.04 <sup>a</sup>
Root	10	1.32 <sup>a</sup>	2.20 <sup>a</sup>	3.93 <sup>b</sup>	5.52 <sup>b</sup>	1.14 <sup>a</sup>	4.36 <sup>a</sup>	2.49 <sup>a</sup>	3.09 <sup>a</sup>
	20	0.32 <sup>b</sup>	1.22 <sup>b</sup>	3.89 <sup>b</sup>	5.60 <sup>b</sup>	1.01 <sup>a</sup>	4.41 <sup>a</sup>	0.96 <sup>b</sup>	2.51 <sup>a</sup>

Average of 50 seedlings; means not followed by same alphabets in a column are significantly different at  $P=0.05$ .

\*C = Control

The senescing leaves were as inhibitory as the fresh leaves suggesting retention of toxins in the litter, as also observed by Al-Saadawi and Al-Rubeaa (1985).

#### Effect of stem extract :

The radicle and plumule length of the four test species was significantly inhibited by the stem extract of *V. encelioides* (Table 3). Of all the test species, the germination of *I. linnaei* was most affected (Table 2) suggesting a high degree of specificity of the test species for allelochemicals. Stowe (1979) also pointed out that allelochemicals were species-specific and may not have adverse effect on certain species.

#### Effect of floral extracts :

Floral extracts of *V. encelioides* were highly toxic and were inhibitory to the seed germination, radicle and plumule length of all the test species. *I. linnaei* was found to be most susceptible, its seeds failed to germinate at higher concentrations (5%, 10% and 20%) of floral extracts and those of *C. medicagenia* and *C. occidentalis* germinated poorly and died later on (Tables 2, 3).

#### Effect of root leachates :

The seed germination, radicle and plumule length of *T. purpurea* and *I. linnaei* were significantly reduced by the higher concentrations of root leachates of *V. encelioides* which however had little effect on *C. occidentalis* and *C. medicagenia* (Tables 2, 3).

The laboratory bioassays partly explain the dominance of *V. encelioides* in nature. Very few plants of *T. purpurea* were found to be associated it.

The leaves were found to be most inhibitory followed by inflorescence, stem and root, presumably because of variable quantities of water-leachable allelochemicals in different tissues.

The greater inhibitory effects of leaves and flowers in bioassays, as compared to stem and root leachates, suggest that in nature, fallen leaves and floral parts are responsible for elimination of other species leading to the formation of almost pure stands of *V. encelioides*. Residual effects of the toxins thus released into the soil however, remain to be explored.

### REFERENCES

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