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Allelopathic effect of Ricinus communis L. and Vitex negundo L. on morphological attributes of invasive alien weed: Cassia uniflora Mill

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ABSTRACT

Vitex negundo L. [Verbenaceae] and Ricinus communis L. [Euphorbiaceae], are especially well known for their industrial, pharmacological, and toxicological properties, but to date very little is known about their allelopathic potential. Hence the present study was conducted to evaluate their allelopathic perspectives on morphological characters of invasive alien weed Cassia uniflora Mill. Various concentrations [5%, 10%, 15% and 20%] of leaf leachates of selected plants were used as spray to test their effect on pot culture of test species. Results of present study indicated that the growth of plant was significantly inhibited in Cassia at all concentration of aqueous leaf leachates of selected plants when compared to control. Length of root and shoot, number of flowers, fruits and seeds of the weed was reduced with the increase in leaf leachates concentration. Dry weight and fresh weight of the weed were also negatively affected by aqueous leaf leachates of both the plants. The effect of Vitex leaf leachates was more pronounced than that of Ricinus. Since Vitex leaf leachates had greater activity than Ricinus against the invader, this plant could be best candidate for isolation and identification of allelochemicals, this might promote the discovery of new biocontrol for invasive weeds.

Key words: Allelopathic, alien invader, *Cassia uniflora* L., *Vitex negundo* L., and *Ricinus communis* L.

INTRODUCTION

Weeds have been, are, and will continue to be a major constraint to agriculture production all over the world. For controlling obnoxious weeds synthetic weedicide were an effective tool, but its excessive use led to a reduction in yield, environmental pollution and increase in herbicide resistant weeds. Hence to minimize the dependency on synthetic herbicides for controlling obnoxious weeds there is a need to find natural ways [Bhadoria, 2011]. For sustainable weed management the use of allelopathic behavior is one of the new options. Allelopathy is defined as the direct or indirect detrimental or profitable effects of one plant or another through the production of biochemical compounds that escape into the environment [Rice, 1984]. Allelochemicals produced by alien plants significantly affect the native plants irrespective of whether a native species produces allelochemicals or not [Msafiri *et al*., 2013].

Cassia uniflora Mill. [Caesalpiniaceae], which is an alien weed having worldwide distribution is selected for the present investigation. With high soil moisture and full sunlight it grows luxuriantly at places like forest, highways, railway tracks, and wasteland and even it is seen in agricultural fields.

In recent times to control weeds either directly or as natural herbicides developed from allelochemicals isolated from allelopathic plants particularly those with medicinal properties have been gaining interest [Sodaeizadeh *et al*. 2009]. *Ricinus communis* L. is a plant belonging to Euphorbiaceae, commonly found in the tropical and temperate climates of the world [Lakshmamma and Prayaga, 2006; Raoof and Yasmeen, 2006], which is well known for many of its medicinal and industrial uses [Ogunniyi, 2006; Islam *et al*., 2011]. *Vitex negundo* L. an aromatic shrub belonging to verbenaceae widely known for its use as green manure, medicine in ayurvedic, unani systems of medicine and as a mosquito repellent.

Most of the allelopathic studies were carried out in petriplates and in laboratory conditions, but it is equally important to test the extracts in soil or as foliar spray in pot culture. This study was conducted to investigate the allelopathic potential of different concentrations of aqueous leaf leachates of *V. negundo* and *R. communis* on the vegetative and reproductive attributes of alien invader *C. uniflora* and an attempt has been made to find out alternate ecofriendly approach for weed management.

MATERIALS AND METHODS

Seeds collection of test plant

Mature seeds of *Cassia uniflora* Mill. were collected from the University campus; RTM Nagpur University, Nagpur, India.

Collection and extraction of plant materials

The leaves of both *V. negundo* and *R. communis* were collected from Nagpur during the full growing stage and washed with tap water followed by shade drying. The dried leaves were grinded to powder using laboratory blender. 20g powdered leaves were soaked in 100ml distilled water for 24 h at 25^{0}C and the leachate was first filtered through muslin cloth then through Whatman filter paper No.1. The obtained leachates [20%=T4] of *V. negundo* and *R. communis* were used as stock solutions and stored in amber colored bottle. Different concentrations [5%=T1, 10%=T2, and 15 %=T3] were prepared from these stock solutions and used as spray in pot culture. Water was taken as a control and considered to be 0%=T0.

Pot Culture

Polythene bags [35 cm X 25 cm size] were filled with 5 kg soil mixture [soil: sand in 3:1 ratio]. Bags were sown with 10 seeds of test species and were thinned to 3 seedlings per bag after germination. With the emergence of first leaf, seedlings were sprayed with various leaf leachates concentration with equal quantity per plant. Spraying of leaf leachates was carried out till the flowering at the interval of 10 days. The control polythene bags were sprayed with water. Various growth parameters were recorded at vegetative and reproductive stage by considering five plants. Fresh weight and dry weight of root and shoot were also recorded by uprooting the plants. Experiment was repeated consecutively for three years with three replications.

Statistical analysis

Using statistical analysis significance of the difference in various growth parameters were tested and compared, the p-value corresponding to the F-statistic of one-way ANOVA is higher than 0.05, suggesting that the treatments are not significantly different for that level of significance. The Tukey HSD test was applied for the multiple comparisons.

RESULTS AND DISCUSSION

In present investigation aqueous leaf leachates were used as water is the best solvent extraction medium in nature. The results revealed [Table 1 and 2] that root architecture, stem length, number of leaves, flowers, fruit and seeds, fresh and dry weight of root and shoot of *C. uniflora* were negatively affected by allelopathic effect leaf leachates of *R. communis* and *V. negundo*. Significant reduction in height was recorded at T4 [26.4cm] and [25cm] of *R. communis* and *V. negundo* when compared with control [41.6cm] respectively. Root architecture was negatively affected by both the leaf leachates with the increase in concentration. Lateral spread of root was found to be maximum in control [3.80cm] and minimum spread was recorded in *R.communis* [1.55cm] at T4 but for other concentrations of both the plants lateral spread value was almost same. Number of leaves per plant was more [34.00] in control [T0] and significant reduction trend was observed in case of *R. communis* and *V. negundo* with minimum number [14.40 and 13.20] respectively. Prominent effect was observed in flower fruit production of test plant. Number of flowers were highly reduced by leaf leachates application of both the plant and it was revealed that the effect was concentration dependent [Table 1 and 2]. In green house experiment, the powder and extract of *R. communis* significantly inhibited height, leaf area and dry weight of pigweed [Marzieh *et al*., 2014]. Our findings are also in this line as maximum fresh weight and dry weight for root [0.59gm and 0.31gm] while for shoot [12.79gm and 5.32gm] was recorded at T0 [0%]. Minimum fresh weight and dry weight for root [0.24gm and 0.16gm], for shoot [2.51gm and 1.56gm] treated with *R. communis* while minimum fresh weight and dry weight for root [0.19gm and 0.12gm] and for shoot [2.12gm and 1.16gm] when treated with *V. negundo*, were recorded [Table 1 and 2]. Biomass of Cassia uniflora was significantly reduced by foliar spray of leaf leachates of both the plants when compared with control but when compared among concentrations then no significant trend of reduction was observed [Fig.1 and 2]. The inhibitory effect of foliar spray was dosage dependent except in case of root architecture. Same trend was revealed by negative allelopathic effect caused by smooth Amaranth aqueous extracts on number of developed leaves, stem length, delayed flowering and total dry matter of red bean, white bean and pinto bean [Rouhollah *et al*., 2013]. Root shoot ratio was recorded maximum for control and decreased with the application of leaf leachates [Table 1 and 2]. The rate of shoot growth might have retarded because of leaf leachates application. Decreased values of root shoot ratio were reported in two varieties of rice due to aqueous extracts of *Ageratum* and *Borreria* [Gogoi *et al*., 2002]. From Tukey test we concluded that all pair of treatments is insignificant. Results revealed that effect of *V. negundo* was more negative than *R. communis.* The chemicals present in the leaf leachates are biodegradable in short time hence will not cause problems like pesticides to the plant or soil system and can be used as control agent against alien weeds like *Cassia uniflora.* Extensive work has been carried out on germination bioassay in laboratory conditions to study allelopathy but emphasis should be also given to the allelopathic studies in field condition. As environmental conditions are different from place to place, therefore herbicidal activity of selected plants needs to be checked under different field conditions.

References

Bhadoria, P.B.S. [2011]. Allelopathy: A natural way towards weed management. *American J. of Experimental Agriculture*. **1** [1]: 7–20.

Gogoi, B., D. Kaushik and K.K . Baruch. [2002]. Allelopathic effects of some weeds on growth and yield of direct seeded upland rice [*Oryza sativa* L.]. *Indian J. Plant Physiology*, **7**: 119-125.

Islam, A.K.M.A., Z. Yaakob, N. Anuar, S.R.P. Primandari and M. Osman. [2011]. Physiochemical properties of *Jatropha curcas* seed oil from different origins and candidate plus plants (CPPs). *J. of American Oil Chemists Society*. **89**: 293–300.

Lakshmamma, P. and L. Prayaga. **[**2006]. Identifying the sources of tolerance for drought in Castor, *Ricinus communis* L. *J. of Oilseeds Research.* **33**[3]: 348–352.

Marzieh, S.N., R. Jamshid, K. Hasan , S.Bahram, A. Hajar, and B. Frouzan .[2014]. Assessment of some medicinal plants for their allelopathic potential against redroot pigweed [*Amaranthus retroflexus*]. *J. of Plant Protection Research* . **54** [1]: 90-95.

Msafiri, C.J., M.T. Tarimo and P.A. Ndakidemi. [2013]. Allelopathic effect of *Parthenium hysterophorus* on seed germination, seedling growth, fresh and dry mass production of *Alysicurpus glumaceae* and *Chloris gayana*. *American J. of Research Communication.* **1**[11]: 190-205.

Ogunniyi, D.S. [2006]. Castor oil: a vital industrial raw material. *Bioresource* Technolog. **97**:*1086-1091*.

Qasem, J.R. [1995]. The allelopathic effect of three *Amaranthus* spp. (pigweeds) on wheat [*Triticum durum*]. *Weed Research*. **35**: 41–49.

Raoof, M.A. and M. Yasmeen. **[**2006]. Aetiology, epidemiology and management of Botrytis grey mold of Castor, *Ricinus communis* L. A review. *J. of Oilseeds Research.* **23**[2]: 144–150.

Rice, E.L. [1984]. Allelopathy. 2nd Ed. Academic Press, Oriando, Florida,USA.

Rouhollah A., S. Ghanepour and F. Movahedpour.[2013]. Morpho-physiological and phenological changes induced by smooth amaranth allelopathic effects in various types of dry bean. *International J. of Agriculture and Crop Sciences*. **5**[2]: 120-124.

Sodaeizadeh, H., M. Rafieiolhossaini, J. Havlik and P. Van Damme. [2009]. Allelopathic activity of different plant parts of *Peganum harmala* L. and identification of their growth inhibitors substances. *Plant Growth Regulators*. **59**: 227–236.

Table 1 Effect of leaf leachates of *Ricinus communis* on morphological characters of *Cassia uniflora*. [Values presented are means ± STD.The p-value (0.4287) corresponding to the F-statistic of one-way ANOVA is higher than 0.05, suggesting that the treatments are not significantly different for that level of significance. For multiple comparison Tukey HSD test was applied.]

Treatments	T0 [0%]	T1R [5%]	T2R [10%]	T3R [15%]	T4R [20%]
Height [cm]	41.60±8.38	33.80±2.59	31.20±3.27	30.40±3.85	26.40±5.59
Girth [cm]	0.80±0.21	0.65±0.22	0.60±0.22	0.50±0.00	0.50±0.00
I ry root [cm]	10.44±2.42	7.80±2.39	6.94±1.79	6.84±1.35	6.44±2.91
II ry root [cm]	5.64±0.55	5.40±1.90	4.32±1.38	3.96±0.50	3.20±0.62
III ry root [cm]	1.14±1.01	0.72±0.19	1.06±0.93	1.10±0.12	0.66±0.23
Root lateral spread [cm]	3.80±0.84	2.80±0.91	2.80±0.74	2.80±0.80	1.55±0.33
Deepest root depth [DDR] [cm]	11.60±2.70	9.40±2.51	8.40±1.95	8.40±1.82	7.80±3.49
Root: Shoot ratio [cm]	0.26±0.09	0.23±0.07	0.23±0.07	0.23±0.06	0.24±0.13
Nodes/plant	32.00±9.49	28.20±10.45	26.40±6.19	19.60±2.19	15.60±1.14
No. of Branches/plant	1.00±1.41	0.80±1.10	0.80±1.10	1.40±0.89	0.40±0.89
No. of leaves/plant	34.00±11.18	26.40±10.31	27.60±6.50	23.00±4.00	14.40±2.70
Inflorescence/plant	27.00±8.46	22.40±9.66	17.60±5.03	13.60±2.51	10.20±2.17
Flowers/inflorescence	5.40±0.55	4.60±0.55	4.80±0.45	4.20±0.45	4.20±0.45
Flowers/plant	141.60±43.96	100.20±33.80	85.20±22.92	56.40±8.53	42.80±8.32
Fruits/inflorescence	4.80±0.84	3.80±0.45	3.00±0.00	2.40±0.55	1.60±0.55
Fruits/plant	97.60±29.37	74.80±25.00	38.20±10.35	26.40±4.98	16.80±4.82

seeds/plant	**412.80±103.13**	**375.00±94.53**	**172.60±54.45**	**92.60±24.68**	**65.00±15.68**
Fresh wt. of root	**0.59±0.29**	**0.39±0.14**	**0.27±0.08**	**0.28±0.06**	**0.24±0.04**
Dry wt. of root	**0.31±0.13**	**0.23±0.09**	**0.18±0.06**	**0.19±0.04**	**0.16±0.03**
Fresh wt. of shoot	**12.79±3.93**	**8.58±2.91**	**4.48±0.80**	**2.85±0.64**	**2.51±0.76**
Dry wt. of shoot	**5.32±1.72**	**3.76±1.47**	**2.36±0.20**	**1.75±0.38**	**1.56±0.79**

Table 2 Effect of leaf leachates of *Vitex negundo* on morphological characters of *Cassia uniflora*. [Values presented are means ± STD.The p-value (0.4534) corresponding to the F-statistic of one-way ANOVA is higher than 0.05, suggesting that the treatments are not significantly different for that level of significance. For multiple comparison Tukey HSD test was applied.]

Treatments	**T0 [0%]**	**T1V [5%]**	**T2V [10%]**	**T3V [15%]**	**T4V [20%]**
Height [cm]	**41.60±8.38**	**28.00±4.53**	**28.00±1.87**	**27.00±3.00**	**25.00±5.29**
Girth [cm]	**0.80±0.21**	**0.50±0.00**	**0.50±0.00**	**0.60±0.22**	**0.40±0.14**
I ry root [cm]	**10.44±2.42**	**8.34±1.94**	**7.72±1.86**	**7.16±2.87**	**6.98±1.61**
II ry root [cm]	**5.64±0.55**	**4.16±1.47**	**4.08±0.83**	**3.76±0.86**	**3.12±1.20**
III ry root [cm]	**1.14±1.01**	**1.24±0.93**	**0.56±0.13**	**0.60±0.22**	**0.50±0.00**
Root lateral spread [cm]	**3.80±0.84**	**2.70±0.54**	**2.20±0.37**	**2.20±0.60**	**1.75±1.13**
Deepest root depth [DDR] [cm]	**11.60±2.70**	**9.80±2.28**	**9.40±2.61**	**9.20±4.21**	**8.60±1.52**
Root: Shoot ratio [cm]	**0.26±0.09**	**0.30±0.07**	**0.29±0.09**	**0.26±0.11**	**0.31±0.16**
Nodes/plant	**32.00±9.49**	**18.40±3.21**	**17.80±2.17**	**15.20±1.30**	**14.20±2.28**
No. of Branches/plant	**1.00±1.41**	**0.40±0.55**	**0.20±0.45**	**0.80±0.84**	**0.00±0.00**

No. of leaves/plant	**34.00±11.18**	**20.20±3.96**	**19.00±1.87**	**19.00±4.30**	**13.20±2.59**
Inflorescence/plant	**27.00±8.46**	**16.60±4.39**	**13.80±2.95**	**14.00±6.16**	**10.20±2.17**
Flowers/inflorescence	**5.40±0.55**	**4.60±0.55**	**4.60±0.55**	**4.00±0.71**	**3.60±0.55**
Flowers/plant	**141.60±43.96**	**73.80±15.01**	**60.00±13.25**	**55.20±25.75**	**42.20±10.47**
Fruits/inflorescence	**4.80±0.84**	**3.40±1.34**	**3.00±1.58**	**2.00±0.71**	**2.00±0.71**
Fruits/plant	**97.60±29.37**	**49.00±18.11**	**33.60±24.43**	**25.20±8.67**	**17.20±6.42**
seeds/plant	**412.80±103.13**	**277.60±74.50**	**193.40±102.34**	**174.40±37.04**	**34.60±14.98**
Fresh wt. of root	**0.59±0.29**	**0.38±0.19**	**0.36±0.09**	**0.32±0.10**	**0.19±0.08**
Dry wt. of root	**0.31±0.13**	**0.24±0.11**	**0.23±0.05**	**0.21±0.07**	**0.12±0.04**
Fresh wt. of shoot	**12.79±3.93**	**2.97±1.13**	**2.63±0.56**	**2.57±0.88**	**2.12±1.18**
Dry wt. of shoot	**5.32±1.72**	**1.72±0.54**	**1.67±0.35**	**1.50±0.50**	**1.16±0.57**

Fig 1: Biomass of *Cassia uniflora* at different concentrations of leaf leachates of *Ricinus communis*.

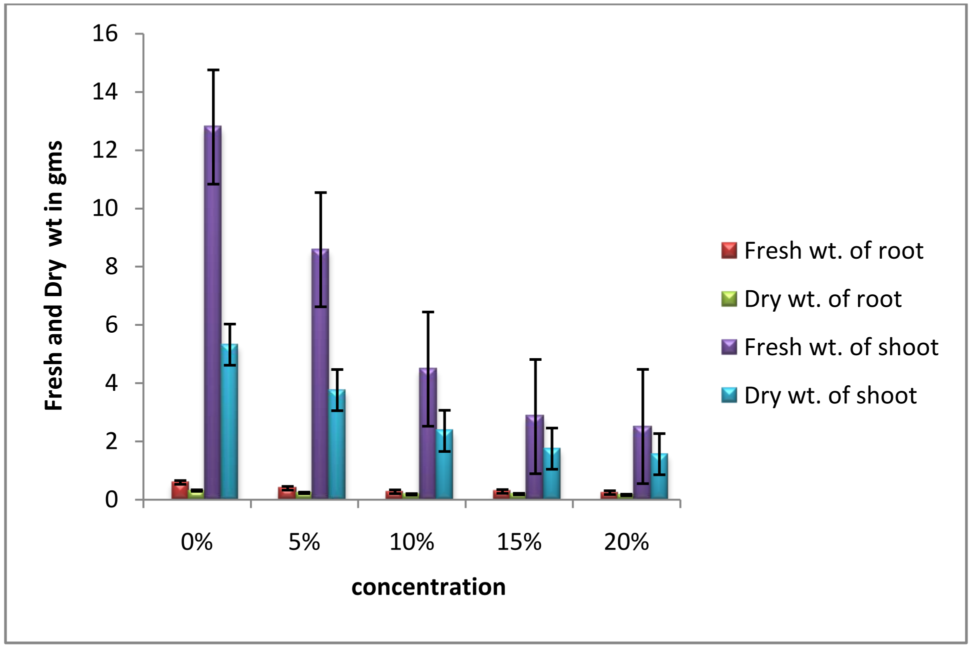

Fig 2: Biomass of *Cassia uniflora* at different concentrations of leaf leachates of *Vitex negundo*.