

RESEARCH ARTICLE

Allelopathic effect of *Parthenium hysterophorus* L. on photosynthetic pigments and biochemical constituents of *Vigna aconitifolia* L.

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Manuscript details:	ABSTRACT
<p>Received: 22. 09.2017 Accepted: 29.12.2017 Published : 31.12.2017</p> <p>Editor: Dr. Arvind Chavhan</p> <p>Cite this article as: Patil Bhimarao J and Khade Hemlata N (2017) Allelopathic Effect of <i>Parthenium hysterophorus</i> L. on Photosynthetic Pigments and Biochemical constituents of <i>Vigna aconitifolia</i> L.; <i>International J. of Life Sciences</i>, 5 (4): 677- 682.</p> <p>Copyright: © 2017 Author (s), This is an open access article under the terms of the Creative Commons Attribution-Non-Commercial - No Derivs License, which permits use and distribution in any medium, provided the original work is properly cited, the use is non-commercial and no modifications or adaptations are made.</p>	<p>Allelopathy play a significant role in agro-ecosystem, and affects the growth, quality and quantity of the products by the interactions among crops and weeds. <i>Parthenium hysterophorus</i> L., is one of the obnoxious weed. The fresh aqueous extracts in the concentration of 5%, 10%, 15%, 20% were tested against photosynthetic pigments and biochemical constituents in <i>Vigna aconitifolia</i> L. The seeds soaked in above concentrations for 4 and 9 hrs. The seven days old seedlings were used for analysis of photosynthetic pigments and biochemical constituents. This study indicated that the higher concentration of leaf extract of <i>Parthenium hysterophorus</i> L. i.e. 20% was more inhibitory than control. An increased concentration of extract decreased the photosynthetic pigments, carbohydrate, and enzymes in <i>Vigna aconitifolia</i> L. This indicates that allelochemicals are present in the aqueous extract of <i>Parthenium hysterophorus</i> as it shows inhibitory effect on plant growth.</p> <p>Keyword: <i>Vigna aconitifolia</i>, <i>Parthenium hysterophorus</i>, Photosynthetic pigments.</p>
	<h2>INTRODUCTION</h2> <p>Allelopathy may also play an eminent role in the intraspecific and interspecific competition and may determine the type of interspecific association. The plant may exhibit inhibitory or rarely stimulatory effect on germination and growth of other plants in the immediate vicinity. Due to the action of allelochemicals a large number of physiological functions and biochemical reactions are affected such as seed germination, cell division, cell elongation Setia <i>et al.</i> (2007). Many allelochemical have been identified since experiments began to isolate and determine allelopathic potential of plant compounds that have been identified thus, for include a variety of chemicals such as phenolic acids, coumarins, benzoquinones, terpenoids, glucosinolates and tannins (Putnam and Duke, 1978). Allelochemicals or plant derived chemicals offer a great potential as biopesticides because they are comparatively safer for environment and allelochemicals can possibly</p>

replace the use of harmful synthetic herbicides Rokiek *et al.* (2006). *Parthenium hysterophorus* L. one of the "worst weeds, is a herbaceous, erect and annual plant belonging to the family Asteraceae. It is known as poisonous, pernicious and aggressive weed. *Parthenium hysterophorus* L. has been reported to contain several allelochemicals, like parthenium, kempferol, p-cumaric acid, caffeic acid etc. (Pickman and Towers, 1982). Chemical analysis has indicated that all plant parts of *Parthenium hysterophorus* L. contain toxin from chemical group of sesquiterpene lactones (Oudhia and Tripathi, 1998). *Vigna aconitifolia* L. is a drought resistant legume commonly known as moth bean, it belongs to family Fabaceae. Moth bean sprouts and protein rich seed crop grown in India for both human consumption and as a forage crop. The present study has been undertaken to evaluate the allelopathic effect on various treatment aqueous extract of *Parthenium hysterophorus* L. on photosynthetic pigments, carbohydrates, proteins and enzymatic activity *Vigna aconitifolia* L.

MATERIAL AND METHODS

Fresh leaves of *Parthenium hysterophorus* L. in its vegetative stage were collected from agriculture fields & Nagthane, District satara. Leaves were instantly separated and washed with tap water to remove soil particles blot properly and shade dried for a week. The dried leaves were ground into a fine powder separately using a mixer grinder. Leaf powder was weighed in 5, 10, 15 and 20 gm and soaked in 100 ml. of distilled water separately and mixed thoroughly by keeping in rotatory shaker. Keep it over night at the room temperature. After 24 hrs. of soaking, extracts were filtered through double layered muslin cloths. The filtrate was a stock solution and then prepared 5, 10, 15 and 20% concentration with distilled water. Collection of seed samples of *Vigna aconitifolia* L. was obtained from local area of Satara. Healthy uniform seeds of *Vigna aconitifolia* L. were surface sterilized with 1% Sodium Hypo-Chloride for 10 minutes. Then rinsed with distilled water for several time to remove excess of chemical. Then 100 seeds were soaked separately in different concentrations of plant extract for 4 hrs. and 9 hrs. in 100 ml. beaker. Seeds soaked in distilled water were treated as control. Then 30 treated seeds were placed in petri plates containing wet blotting papers. At each concentration triplicate sets were arranged at room temperature ($30 \pm 2^\circ\text{C}$) for

germination. After the completion of 7 days of seed soaking, seedlings were used for testing the photosynthetic pigments like chl.a, chl.b, total chl. and Carotenoides estimated according Arnone and krick method. The carbohydrates and total proteins were estimated by using (Sadasivam's, 1992) and Lowery *et al.* (1951) methods respectively. The enzymes like protease, ATPase and Amylase were estimated by standard methods. Calculation values were presented in observation table.

Statistical analysis:

The analysis was carried out in three replicates for all determinations. The mean and standard deviation were calculated. The data were analyzed by one way analysis of variance (ANOVA). A multiple comparison procedure of the treatment means was performed by Duncan's new multiple range test.

RESULTS AND DISCUSSION

In *Vigna aconitifolia* L. chlorophyll a, b, total chlorophyll and carotenoid content were gradually decreases with increasing concentration of leaf extract at 4 hrs. and 9 hrs. seed soaking period (Table 1). The *Parthenium hysterophorus* L. showed allelopathic effect on photosynthetic pigments in *Vigna aconitifolia* L. When the seeds of *Vigna aconitifolia* L. treated with *Parthenium hysterophorus* L. leaf extract as per seed soaking hours, the photosynthetic pigments were decreased in 9 hours seed treatment than the 4 hours. The minimum total chlorophyll content was found $0.689 \text{ mg.}100\text{g}^{-1}$ in 20% concentration at 9 hrs. seed soaking period. The carotenoid content *i.e.* $6.60 \text{ mg.}100\text{g}^{-1}$ obtained in 20% concentration. The photosynthetic pigments were reduced as compare to control in all treatments. Chlorophylls are important molecules which act as core component of pigment complexes surrounded the photosynthetic membrane and play a foremost role in photosynthesis (Siddiqui and Zaman, 2005). Chlorophyll a and b and carotenoids concentration correlate to the photosynthetic potential of a plant and give indication of the physiological status of the plant (Young and Britton, 1990). Many workers have reported that chlorophyll content and ion uptake was reduced significantly by allelochemicals Alsaadawi *et al.* (1986). Reduction in chlorophyll content may be due to the fact that allelochemicals either inhibit the synthesis of chlorophyll or perhaps they breakdown the

chlorophyll molecule by acting on the pyrolic ring and the phytol chain Blum *et al.* (1993). (Thapar and Singh, 2003) reported depletion of chlorophyll and protein content in *Parthenium* due to allelochemicals derived from *Amaranthus viridis*. Allelochemicals inhibit rate of photosynthesis due to interference with water balance and chlorophyll content which may result in reduction in the amount of protein Colton *et al.* (1980). Photosynthetic pigments of pepper seedlings were reduced by allelochemical stress reduced in chlorophyll a, chlorophyll b, and total chlorophyll were previously reported as a result of allelochemical stress Singh *et al.* (2009), Moradshahi *et al.* (2003), Ramkrishnan *et al.* (2014), Peng *et al.* (2004) also pointed out that the allelochemical produced by invasive species affects the photosynthesis and plant growth by destroying the chlorophyll.

Sugar and starch were $21.45.100g^{-1}$ and i.e. $21.06.100g^{-1}$ in 20% concentration at 9 hrs respectively (table 2). Total protein content was reduced 19.00 mg/g in 20% concentration at 9 hrs. seed soaking period. Nine hours seed soaking treatment was more effective than 4 hrs seed treatment in starch, sugar and protein. Increased amount of carbohydrate indicates to the fact that the plant is under stress and it is gathering up its energy reserves to meet any condition of adversity. (Einhellig, 1996) observed that, normal ways of protein synthesis is inhibited in Lettuce seedling (*Lactuca Sativa*) when treated with cinnamic acid. (Padhy, 2000) have reported that, the aqueous leaf extract litter leachate

of Eucalyptus globulus decreased the protein content in both root and shoot of finger millet. The aqueous extract of *Ranunculus arvensis* plant materials inhibited the germination of wheat varieties and also if caused a decrease in the protein content (Bansal, 1997). Ghayal *et al.* (2013) reported that, at lower concentration treatment with *Synedrella* leaf leten-tachates there was significantly less reduction in starch content of tomato and brinjal seedling, as compare to controls. However, starch increases with higher concentration of *Synedrella* leaf leachates. Das *et al.* (2012) reported that, reduction in total soluble sugar contain in chickpea seedling with treatment of 100%(V/V) leaf leachates of *A. auriculiformis*, *A. occidentale*, *A. lebbek*, *E.citridora*, *E. oofficinalis*, *S robusta*.

The reduction of ATPase content $0.042\text{ }\Delta\text{OD min}^{-1}g^{-1}$ was found in 20% concentration at 9 hrs. seed soaking period (table 3). The diminution of protease content $0.94\text{ h}^{-1}g^{-1}$ fresh weight was found in obtained in 20% concentration at 9 hrs. seed soaking period. The decrease in Amylase activity $0.256\text{ min}^{-1}g^{-1}$ was obtained in 20 % concentration at 9 hrs. seed soaking period. As compare to 4 hrs seed treatment 9 hrs treatment showed more inhibitory effect on ATPase and protease. The amylase enzymes content declined in 9 hrs seed soaking treatment as compare to 4 hrs. ATP is regarded as the most important biological energy currency, ATPase the enzyme which bring about hydrolysis of this compound merits a special attention. According to (Matsumoto and Yamaya,

Table 1: Effect of aqueous leaf extract of *Parthenium hysterophorus* L. on Photosynthetic pigment in *Vigna aconitifolia* L.

Sr. No.	Conc. of extract (%)	Seed Soaking Period in hours							
		4				9			
		Chl. 'a'	Chl. 'b'	Total Chl.	Caroteno ids	Chl. 'a'	Chl. 'b'	Total Chl.	Caroten oids
1	Control	10.54 ± 0.196	14.23 ± 1.046	24.77 ± 0.153	25.02 ± 0.052	0.33 ± 0.030	1.82 ± 0.047	2.15 ± 0.143	1.17 ± 0.055
2	5	8.66 ± 0.049	12.51 ± 0.124	21.17 ± 0.125	24.64 ± 0.310	0.131 ± 0.0009	1.37 ± 0.055	1.50 ± 0.018	1.026 ± 0.016
3	10	8.45 ± 0.081	11.89 ± 0.945	20.34 ± 0.098	20.91 ± 0.058	0.107 ± 0.0092	1.04 ± 0.0081	1.14 ± 0.041	0.81 ± 0.526
4	15	8.33 ± 0.363	10.62 ± 0.193	18.95 ± 0.016	20.73 ± 0.113	0.086 ± 0.0047	0.733 ± 0.041	0.81 ± 0.049	0.79 ± 0.605
5	20	6.39 ± 0.098	10.17 ± 0.048	16.56 ± 0.473	16.35 ± 0.121	0.043 ± 0.0047	0.646 ± 0.012	0.689 ± 0.067	6.60 ± 0.506

* Values are expressed in $mg.100g^{-1}$ fresh weight.

* Bottom values are Mean \pm SD.

Table 2: Effect of aqueous leaf extract of *Parthenium hysterophorus* L. on carbohydrates and proteins in *Vigna aconitifolia* L.

Sr. No.	Conc. Of extract (%)	Seed Soaking Period in hours					
		4			9		
		Sugar	Starch	Total Protein	Sugar	Starch	Total Protein
1	Control	52.21 ± 0.198	9.22 ± 0.020	95.66 ± 4.71	48.44 ± 0.164	6.25 ± 0.016	89 ± 1.632
2	5	46.32 ± 0.050	13.4 ± 0.141	78.00 ± 0.816	43.39 ± 0.094	11.00 ± 0.816	63.0 ± 2.160
3	10	42.44 ± 0.297	19.25 ± 0.012	66.33 ± 3.091	38.34 ± 0.224	16.00 ± 0.163	54.00 ± 4.320
4	15	37.57 ± 0.010	23.24 ± 0.020	48.00 ± 4.966	30.48 ± 0.385	18.23 ± 0.524	34.00 ± 1.699
5	20	24.47 ± 0.226	26.16 ± 0.942	24.33 ± 1.69	21.45 ± 0.085	21.06 ± 0.418	19.00 ± 0.816

*Bottom values are Mean ± SD

*Duncan's multiple range test (p=0.05)

Table 3: Effect of aqueous leaf extract of *Parthenium hysterophorus* L. on enzymatic activity in *Vigna aconitifolia* L.

Sr. No.	Conc. Of extract (%)	Seed Soaking Period in hours					
		4			9		
		ATPase	Protease	Amylase	ATPase	Protease	Amylase
1	Control	0.038 ± 0.0081	22.08 ± 0.899	10.3 ± 0.014	0.044 ± 0.0033	5.83 ± 0.32	7.533 ± 0.169
2	5	0.014 ± 0.0008	19.61 ± 0.352	6.63 ± 0.124	0.011 ± 0.0017	4.91 ± 0.265	4.6 ± 0.081
3	10	0.036 ± 0.0009	15.01 ± 0.736	4.46 ± 0.047	0.029 ± 0.004	3.53 ± 0.306	2.93 ± 0.355
4	15	0.026 ± 0.0124	13.57 ± 0.371	3.23 ± 0.071	0.015 ± 0.0124	2.63 ± 0.413	1.923 ± 0.040
5	20	0.078 ± 0.0081	10.46 ± 0.523	2.77 ± 0.009	0.042 ± 0.0008	0.94 ± 0.044	0.256 ± 0.009

*Bottom values are Mean ± SD

*Duncan's multiple range test (p=0.05)

1984). ATPase enzyme is present at every site of energy transfer. Similar results were observed by (Sharma and Grewal, 1987) revealed that in germination seeds of soyabean there was decreases in the protease enzyme activity due to moisture stress. From this it is clear that enzyme protease is lowered in seed germinating seeds of *Vigna aconitifolia* L. treated with aqueous leaf extract of *Parthenium hysterophorus* L. The result from the present investigation were supported by various researchers (Chugh and Sawhney, 1996) concluded that in germination seeds of Pea the enzyme activity was decreased due to increasing concentration of cadmium also some allelochemicals are reported to affect the enzyme

activity. The leaf leachates of *Gmelina arborea* inhibition the activity of some hydrolytic enzymes amylase, catalase and acid phosphatase in legumes seeds Ramakrishnan *et al.* (2014). The allelopathic effect of aqueous leaf extract of *Eupatorium odoratum* on amylase activity in *Cicer arietinum* and *Cajanus cajan* showed activity of of amylase was decreased in *Cajanus cajan* after increase in concentration (Madane and Patil, 2017), (Chavan and Pawar, 2007) reported that the effect of leaf leachates of *Eucalyptus globulus*, *Moringa olerifera*, *Parthenium hysterophorus* L. and *Glycine max* decreased the activity of alpha amylase and invertase in germinating seeds of sorghum bicolor (L.) Moench. The study indicates that *Parthenium*

hysterophorus L has inhibitory effect on enzymatic activity in *Vigna aconitifolia* L.

CONCLUSION

The allelochemicals present in aqueous leaf extract of *Parthenium hysterophorus* had adversely effect on the photosynthetic pigments and biochemical content of *Vigna aconitifolia* L. The physiological and biochemical processes inhibit and delay the germination as well as metabolism of *Vigna aconitifolia* L.

Conflicts of interest: The authors stated that no conflicts of interest.

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