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Allelopathic Effects of *Lantana camara* on Seed Growth behaviour of Wheat (*Triticum aestivum*) and Mustard (*Brassica campestris*)

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Abstract

Lantana camara have been selected for present study to investigate their allelopathic effects on wheat and mustard. Seeds of the applied crops treated with different concentration of L.camera leaf aqueous extract viz. 2%,4%,6% & 8% and its allelopathic effects on different parameters i.e. seed germination, mortality percentage and seedling growth have been observed. Study showed that the higher concentration of L.camara leaf aqueous caused more deleterious effects and reduced the growth rate of treated seeds than the lower concentration in all the observed parameters. Lantana is a major weed with the potential to spread to all medium rainfall rangeland and agricultural areas. Lanana can produce serious allergic problem in human beings and posses a potential risk to most agricultural areas.

Keywords: Allelopathy, Lantana, Weed, Agro-forestry.

Introduction

Weed are undesirable plants which compete with main crops in the growth media for nutrients, moisture, space, light and hamper the healthy growth ultimately reducing the growth and yield both qualitatively and quantitatively[1,2]. Lantana is among top ten invasive weed on the earth[3]. Lantana has allelopathic effects against agronomic crops[4,5]. It contain 50 species among them *Lantana camara* contain more harmful allelochemicals[6]. *L. camara* is a native plant in tropical America and widely distributed throughout the world and is now major weed in coastal areas, roadsides, fence-lines, river bank, forestry and barren areas and it infests millions of hectares of grazing and agricultural land in more than 50 countries[7]. Lantana plant also grows well on nutrient rich and on nutrient deficient barren soils and in good light availability[8,9]. Reduced performance due to weed is fact but one of the most effective ways of increasing yield potential is the scientific management of weeds[10]. However, it may produce and releases different phenolic acids, flavonoids, terpenes and terpenoides. Among these secondary metabolites, some are known allelochemicals inhibiting the germination and growth of other organisms[11]. Allelopathy of *L.camara* may be to cause shifting community distribution and composition when it invades in ecosystem. Keeping in view above fact, present investigation was carried out to study the allelopathic effect on wheat and mustard.

Materials and Methods

The experiment was conducted in 2015 in tree biology laboratory,Botany department, of HNBGU Campus Badshahithaul, Tehri Garhwal. Leaves of *Lantana camara* were collected from Chamba, district Tehri Garhwal and were separately cut using a pair of shears and dried under shade for 16 days until all the moisture content present in leaves were removed. The completely dried leaves then grinded using a pestle mortar into fine powder form. Aqueous extracts were prepared mixing dried 2,4,6, and 8gm powder in 1oo ml of distilled water dissolved and left for 24 hours. Then filter through two layers of filter paper to use their aqueous extract. The experiment was carried out with 10 petri dishes that were arranged systematically and were lined with three layer of filter paper. Seeds of applied crops (wheat and mustard) were thoroughly cleaned manually before giving the treatment. Each petri dishes marked as 2%, 4%, 6% & 8% and distilled water was applied for the control using dropper. All petri dishes were kept at the average maximum- minimum room temperature ranging from 25^0C-18^0C and continuously treated with water and respective concentration. The experiment was looked after thoroughly and regularly for its entire duration. This activity was under taken for two week, until all the seeds were either germinated or expired. The radicle and plumule length of the entire seedling were measured using a plastic measurements rod while plumule and radicle fresh weight was measured using electric balance on the 14 days of experiment. Data on seed germination percentage, mortality percentage, length of radicle and plumule were recorded and statistically analyzed through ANOVA.

Results and Discussion

Seed growth behavior of applied crop have influenced by different concentration of *L.camara* aqueous extract. The lower concentration (2% and 4%) favored higher seed germination percentage than the higher concentration (6% and 8%) in comparison to control in both applied crops. After 8th days of

experimentation maximum 100% germination have been recorded under 2% concentration in wheat which is followed by 60% in 4% concentration in comparison to control (100%). 8% concentration showed 0% germination in mustard while 10% have been recorded in wheat under the same concentration (Figure-1, 2 and 3). Seed germination and seedling process affected by allelochemicals in the decreasing order of *L.camara* leaf aqueous extract. Allelochemicals activity on seed germination may be due to the transition of energy system. The phytotoxicity of Lantana was the maximum due to complex interaction between its phenolic compounds[12]. Inhibition in germination and seedling growth may be due to change in activities of enzyme that effect on transition of reserved compounds during germination. The delay or inhibition on germination and seedling growth in applied crops might be due to the presence of phytotoxins in *L. camara* leaf aqueous extract[13,14]. Table-1 and 2 shows the growth rate of plumule and radicle of wheat and mustard. Lower concentration resulted in better length of plumule and radicle than the higher concentration. Maximum lengths of plumule 4.0cm have been recorded under 2% concentration and this is followed by 4% (2.8cm). The higher concentration retarded the growth of the plumule and its length 1.3cm was minimum at 6% concentration. Maximum radicle length 2.8cm was recorded under 2% concentration while minimum 0.3cm was recorded at 6% concentration. The 2% concentration was found most effective in enhancing the plumule length of wheat and it was recorded maximum 8.2cm in comparison to other applied concentration. Since initially the growth rate of plumule and radicle of wheat and mustard was slower than the control. Root length in wheat is susceptible to the rye aqueous extract because it is more exposed on allelopathic materials[15]. Some specific effects of compounds implicated in allelochemicals interaction include inhibition of cell division modification on of cell wall construction membrane permeability and function etc. Treated seeds of wheat and mustard by *L.camara* leaf aqueous have more inhibiting effect on growth of seedling and have decreased the number of seedlings. Allelopathic compounds are damaging to the seedlings, in this case, plant growth will be lower than the control plants[16]. Mortality percentage of the treated seed has been observed. Maximum 100 % mortality percentage was recorded at 8% concentration in mustard which is followed by 90% at the same concentration in wheat in comparison to control (Figure-4). Fresh wt. and dry wt. of treated seed of wheat and mustard have influenced by the different concentration of *L.camara* leaf extract and an inhibitory effects was noticed (Table-3). Factors in this process can reduce the dry wt. of shoot include the reduction in absorption of nutrient from root and leaves needed for photosynthesis and also a reduction in photosynthesis in cell division and protein synthesis in hormones, which ultimately reduces the cell growth[17]. It is revealed from statistical analysis that difference between the different concentrations was significant (ANOVA Table-4, 5). The reduction in seed germination and seedling growth might be attributed to interference of metabolic activities of wheat and mustard by different allelochemicalas of *L.camara*.

Table-1
Effects of different concentration of *L. camara* leaf aqueous extract on plumule (PL) and radical (RL) length of Wheat after 12 days

Replicate	Parameter	No. of days											
		1	**2**	**3**	**4**	**50**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
Control	PL	*	*	*	0.2	0.7	1.0	3.2	6.7	8.7	9.5	11.6	13.2
	RL	*	*	*	0.2	0.2	1.5	2.0	4.2	5.9	6.6	8.7	9.6
2%	PL	*	*	*	0.2	0.5	1.1	1.4	2.6	3.1	4.2	5.3	8.2
	RL	*	*	*	0.2	0.2	0.3	0.7	1.5	2.8	3.6	4.1	4.6
4%	PL	*	*	*	0.1	0.4	1.2	1.1	1.4	2.0	2.3	3.2	4.2
	RL	*	*	*	0.2	0.4	0.9	1.2	1.2	1.6	2.0	2.4	2.6
6%	PL	*	*	*	*	*	0.2	0.6	0.8	0.1	1.3	1.7	2.0
	RL	*	*	*	*	*	0.1	0.9	0.8	1.2	1.6	1.8	1.9
8%	PL	*	*	*	*	*	*	0.4	0.6	0.8	1.0	1.3	1.6
	RL	*	*	*	*	*	*	0.2	0.8	0.3	0.7	0.9	1.2

*No seed germination

Table-2
Effects of different concentration of *L. camara* leaf aqueous extract on plumule (PL) and radical (RL) length of Mustard after 12 days

Replicate	Parameter	No. of days											
		1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
Control	PL	*	*	*	0.2	0.2	1.7	2.1	3.6	4.1	4.1	4.7	5.2
	RL	*	*	*	0.3	0.8	1.1	1.4	1.9	2.2	2.6	2.9	3.1
2%	PL	*	*	*	*	0.4	0.6	1.2	2.3	2.8	3.2	3.6	4.0
	RL	*	*	*	*	0.6	0.2	1.2	1.8	2.1	2.3	2.4	2.6
4%	PL	*	*	*	*	0.2	0.6	0.8	1.2	1.3	1.4	2.3	2.8
	RL	*	*	*	*	0.1	0.7	1.2	1.3	1.5	1.6	1.7	1.8
6%	PL	*	*	*	*	*	0.2	0.5	0.2	0.8	1.0	1.2	1.3
	RL	*	*	*	*	*	0.3	0.5	0.1	0.2	0.2	0.3	0.3
8%	PL	*	*	*	*	*	*	*	*	*	*	*	*
	RL	*	*	*	*	*	*	*	*	*	*	*	*

*No seed germination

Table-3
Effects of different concentration of *L.camara* leaf aqueous extract on average fresh and dry weight

Replicate	Wheat				Mustard			
	Plumule		Radicle		Plumule		Radicle	
	Av. Fresh wt.(mg)	**Av. Dry wt. (mg)**	**Av. Fresh wt.(mg)**	**Av. Dry wt. (mg)**	**Av. Fresh wt. (mg)**	**Av. Dry wt. (mg)**	**Av. Fresh wt. (mg)**	**Av. Dry wt. (mg)**
Control	.o415	.00772	.00354	.000419	.00951	.0005421	.09564	.005429
2%	.0241	.00545	.0254	.000325	.0214	.000325	.06231	.00215
4%	.0154	.00425	.02141	.005421	.0124	.00213	.01432	.00122
6%	.0125	.000374	.02145	.00215	.0119	.00101	.0125	.00079
8%	.0122	.000225	.0124	.00512	*	*	*	*

*Seed not survive

Table-4
Analysis variance for plumule (A) and radicle (B) length of Wheat (ANOVA)

A

Source of variation	SS	DF	MSS	Calculated vr	Tabulated vr
Dose	89.671	4	22.417	4.755	2.19
Days	231.722	11	21.065	4.469	1.95
Error	207.401	44	4.713	-	-

B

Dose	64.087	4	16.021	9.386	2.19
Days	128.511	11	11.682	6.844	1.95
Error	75.10	44	1.706	-	-

Table-5(A)
Analysis variance for plumule (A) and radicle (B) length of Mustard (ANOVA)

A

Source of variation	SS	DF	MSS	Calculated vr	Tabulated vr
Dose	48.294	4	12.07	9.7	2.19
Days	23.183	11	2.1075	1.697	1.95
Error	54.643	44	1.241	-	-

B

Dose	16.017	4	4.004	20.10	2.19
Days	28.668	11	2.606	13.08	1.95
Error	8.761	44	0.1991	-	-

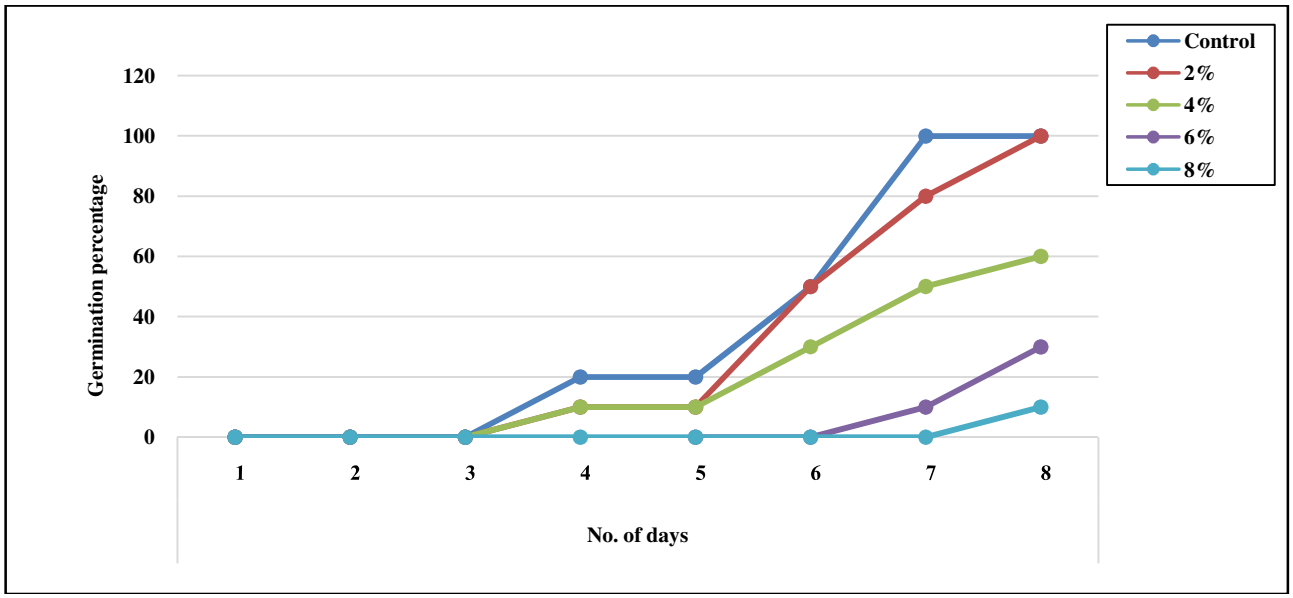

Figure-1
Effects of different concentration of *L. camara* leaf aqueous extract on germination percentage of wheat

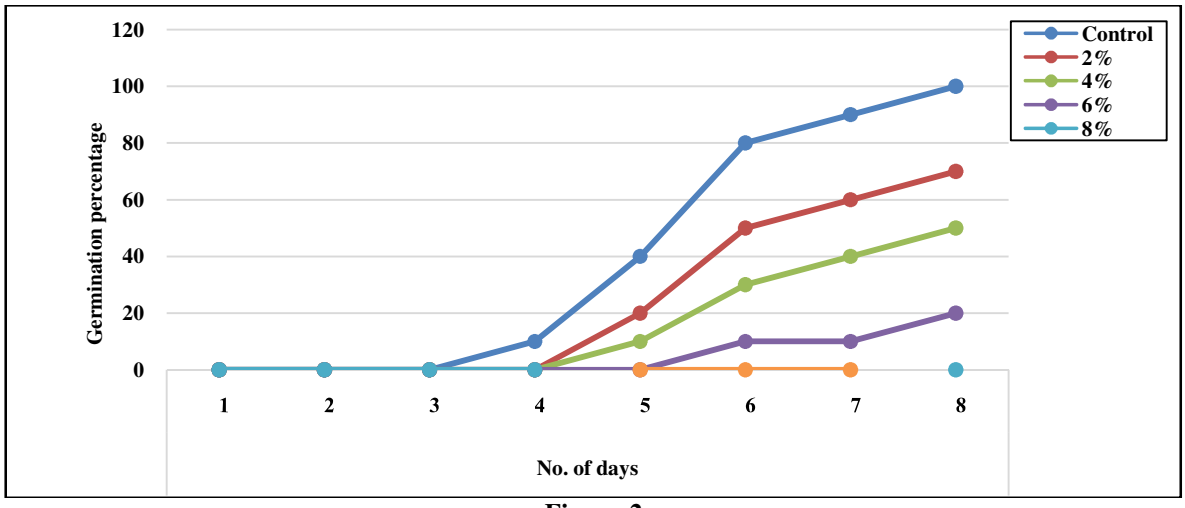

Figure-2

Effects of different concentration of *L. camara* leaf aqueous extract on germination percentage of mustard

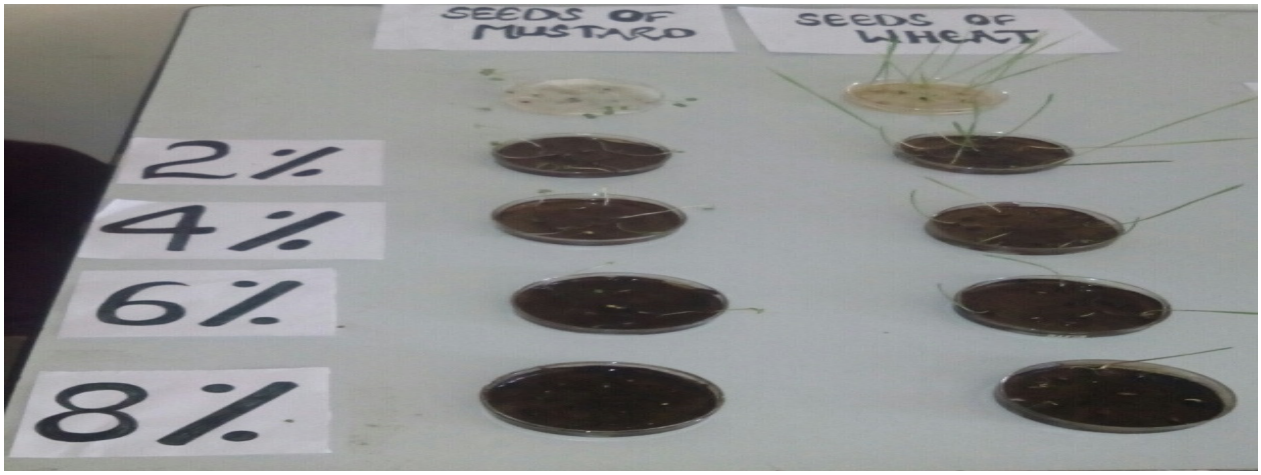

Figure-3

Effects of different concentration of *L. camara* leaf aqueous extract on seed germination and seedling growth of wheat and mustard

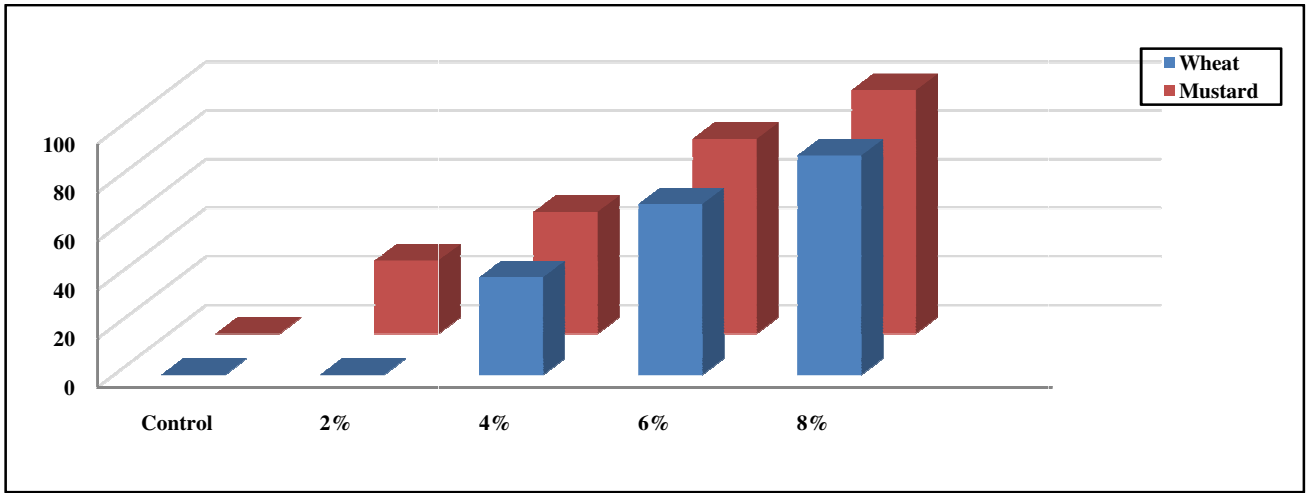

Figure-4

Effects of different concentration of *L. camara* Leaf aqueous extract on mortality percentage of wheat and mustard

Conclusion

The finding of the study indicates that *L. camara* have high allelopathic potential toward wheat (*Triticum aestivum)* and mustard (*Brassica campestris*). Seed germination and seedling growth suffered more in higher concentration (6%, 8%) than lower concentration (2%, 4%). Mostly all the cases in higher concentration showed inhibitory effects in different parameters. Inhibition and reduction may be due to the change in activities of enzymes that effect on transition of reserved compounds and energy system during germination. Study also indicates that allelopathic and overspreading nature of Lantana near cropping area can make the serious problem for crop production.

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