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Effects of Leaf Extract of *Lantana camara* on Germination and Growth Behavior of Selected Tree Species

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A B S T R A C T

Laboratory bioassays were conducted to investigate the allelopathic effects of leaf aqueous extracts of *Lantana camara* on selected tree species (*Albizia lebbeck* and *Dalbergia sissoo*). Lantana leaf extracts has significant impact on seed germination on various forest tree species. The effect of different concentrations of lantana leaf extracts (10, 20, 30 and 40%) were recorded and compared with control (Distilled water). The aqueous extracts of *Lantana camara* causes inhibitory effect on seed germination; shoot length, root length, fresh weight of shoot and root, and vigour index of both the tree species on increasing the concentration of *Lantana camara*. The leaf extracts have more inhibitory effect on the germination percentage of *Dalbergia sissoo* than *Albizia lebbeck*. Results depicted that significant ($P<0.05$) difference in concentration levels and their interaction for the aforementioned parameters. From this study it is found that Lantana causes inhibitory effect over the germination and growth of these tree species which may be possibly due to allelopathic chemicals present in it.

Introduction

Exotic invasive weeds has become a global issue owing to the wide spread and tremendous growth overcoming the native flora. *Lantana camara* is a prime and notorious perennial thorny shrub of the family verbenaceae which is native to the American tropics commonly known as wild sage. In India also it has wide reach in agricultural, forest, community land and waste lands. The invasion of new territories by alien plant species threatens the biodiversity and the stability of the ecosystems (Davis, 2003). Invasion is considered as the second most widespread threat to global biodiversity next to habitat destruction (Leadley *et al.*, 2010). As the density of *Lantana camara* in forest increases, allelopathic interactions increase and hence there is decline in species richness (Day *et al.*, 2003). Allelochemicals are plant secondary metabolites normally released into the environment through volatilization, leaching, root exudation and decomposition of plant residues in the soil (Khalaj *et al.*, 2013). Weeds species are often rich sources of secondary metabolites (allelochemicals) and these chemicals modify the environment of other plants growing in their vicinity and this phenomenon is known as allelopathy (Nandal *et al.*, 1994). Allelopathy has traditionally been considered only the

negative chemical warfare of one organism upon another (Bansal, 1994). The different parts of lantana contain allelochemicals mainly aromatic alkaloids and phenolic compounds (Ambika *et al.,* 2003) which can interfere with seed germination and early growth of many plant species (Sahid and Sugau, 1993; Gentle and Duggin, 1997; Sharma *et al.,* 2005; Ahmed *et al.,* 2007).

Lantana can also interfere growth of nearby plants by outcompeting for soil nutrients (Dobhal, *et al.,* 2010) and altering microenvironment by forming dense thickets (Sharma and Raghubanshi, 2007). Allelopathy is a form of plant interference that can significantly influence ecosystem and agro ecosystem dynamics (Michelangelo *et al.,* 2016).

Researches have been done on the allelopathic effect of *Lantana camara* on crops but very few researches has done on tree species. Therefore the experiment was conducted to explore the allelopathic effect of *Lantana camara* leaf extracts on selected tree species.

Materials and Methods

The experiment was carried out at laboratory of College of Forestry, Sam Higginbottom University of Agriculture Technology and Sciences (SHUATS), Allahabad-U.P. In the present study we have used *Lantana camara* as the donor plant. The experiment was designed in Completely Randomized Design (CRD) in the laboratory with different concentrations of leaf extract (control, 10%, 20%, 30% and 40%) labeled as T_0, T_1, T_2, T_3 and T_4 respectively and replicated four times.

Preparation of leaf extract

For the preparation of leaf extracts 100 g of dry leaves was soaked in 500 mL distilled water and kept in 28°C room temperature for 24 hours. The solution was filtered through double layered muslin cloth. The filtrate was again filtered through Whatman No.1 filter paper into a conical flask. This solution was diluted to make 10%, 20%, 30% and 40% (on the basis of volume) and used for seed treatment.

The experiment was carried out in sterile petridishes of 12 cm in size placing double layered Whatman No.1 filter paper on petridishes. The extract of each concentration was added to each petridish of respective treatment daily in such an amount just enough to wet the seeds. The control was treated only with distilled water. 10 seeds each of *Albizia lebbeck* and *Dalbergia sissoo* were placed in the petridish replicating 4 times and was set in the laboratory. The experiment was extended over a period of 30 days to allow the germination of last seed and the measurement of the shoot and root length.

The seed was considered as germinated, when radical emerged. The germination was recorded daily and the results were determined by counting the number of germinated seeds and measuring the length of primary root and main shoot. The biomass was calculated by taking the fresh of roots and shoots.

Germination and growth behavior

In the experiment data on germination percentage, root and shoot length, fresh weight of root and shoot, and vigour index (Abdul and Anderson, 1973) were observed.

Finally, the average data obtained from the experiment was subjected to analysis of variance using OPSTAT (Sheoran *et al.,* 1998) at 0.05 probability level. On the emergence of radicle a seed was considered to be germinated. Germination was recorded daily and results were determined by counting the number of seeds germinated.

Results and Discussion

Germination

The germination percent of the two selected tree species is shown in table 1. Variation of germination percent was in accordance with the concentration of leaf extract and the increase of concentration, the inhibitory effect also increased. The maximum inhibitory effect in Albizia was (43.3%) and in *Dalbergia sissoo* was (97.05%) seen in T_4 treatment at 40% concentration. The highest germination ratio (85%) was found on *Dalbergia sissoo* at T_0 treatment followed by *Albizia lebbeck* (75%) at the same treatment. The minimum germination percent (2.5%) was in *Dalbergia sissoo* at 40% concentration (T_4). Among the receptor tree species *Albizia lebbeck* is less sensitive towards the treatments as compared to *Dalbergia sissoo.* It was observed that the *Lantana camara* leaf extracts significantly reduced the germination percentage in *Albizia lebbeck* and *Dalbergia sissoo* compared to the control (Distilled Water) treatment. These results were similar to the findings of Hossain and Alam (2010) that the different concentrations of *Lantana camara* leaf extracts caused significant inhibitory effect on germination of forest crops *Acacia auriculiformis*, *Paraserianthes falcataria*, *Albizia procera.* The allelopathic effect of *Parthenium hysterophorous* on germination of multipurpose tree species (Swaminathan *et al.,* 2012) (Fig. 1).

Growth behaviors

Shoot elongation (cm)

The average shoot length of the germinated seedlings of Forest tree species in all the treatments are shown in table 1. The study revealed that inhibition of shoot length in *Albizia lebbeck* and *Dalbergia sissoo* was progressively increased with the increase of concentration. Statistically pronounced significant effect was found at all the treatments (Fig. 2). Maximum inhibition was observed in *Albizia lebbeck* (0.02) compared to *Dalbergia sissoo* (0.03) at T_4 (40%). Maximum elongation of shoot (2.30 cm) was observed in *Dalbergia sissoo* followed by *Albizialebbeck* (2.22) at T_0 (control).

Root elongation

The root length of the bioassay species were found to be greatly inhibited with the increase of the concentration of extract. The inhibitory effect was much more pronounced at T_4 treatment followed by T_3, T_2 and T_1 treatments respectively. Maximum inhibition was occurred in *Albizia lebbeck* (0.10) at T_4 treatment. Maximum elongation of root (1.40 cm) was observed in *Dalbergia sissoo* followed by *Albizia lebbeck* (0.51 cm) both at control (Fig. 2).

Fresh weight of shoot

The fresh shoot weight of the bioassay species were found to be profoundly reduced with the increase of the extract concentration. The inhibitory effect was much more pronounced at T_4 treatment followed by T_3, T_2 and T_1 treatments respectively. Both the species were inhibited equally i.e. *Albizia lebbeck* (0.002) and *Dalbergia sissoo* (0.002) at T_4 treatment. Maximum fresh shoot weight (0.085g) was observed in *Albizia lebbeck* followed by *Dalbergia sissoo* (0.064g) both at control (Fig. 3).

Fresh weight of root

The fresh root weight of the bioassay species were found to be profoundly reduced with the increase of the extract concentration. The inhibitory effect was much more pronounced at T_4 treatment followed by T_3, T_2 and T_1 treatments respectively.

Fig.1 Effects of treatments on germination %

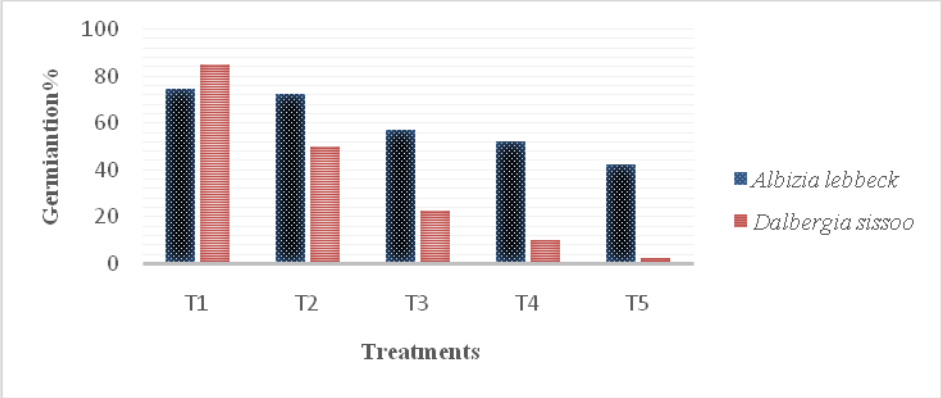

Fig.2 Effect of leaf extract on root and shoot elongation

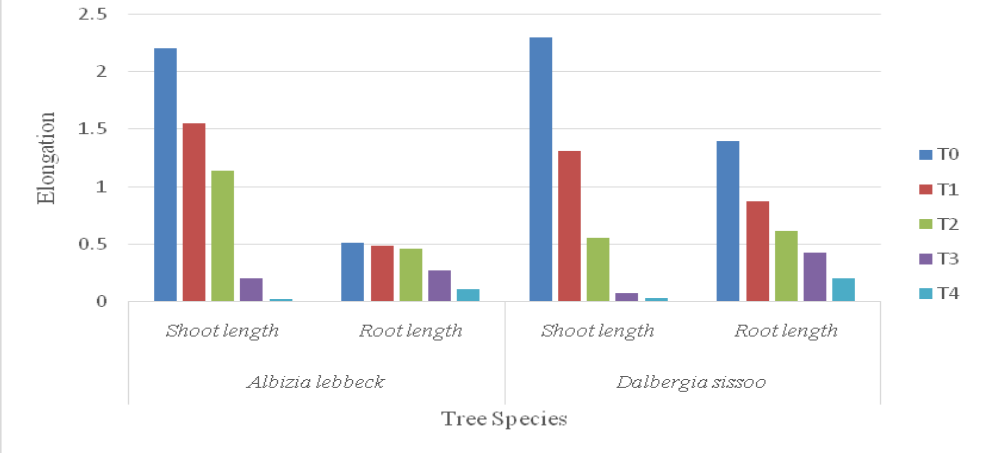

Fig.3 Effect of leaf extract on fresh shoot and root weight

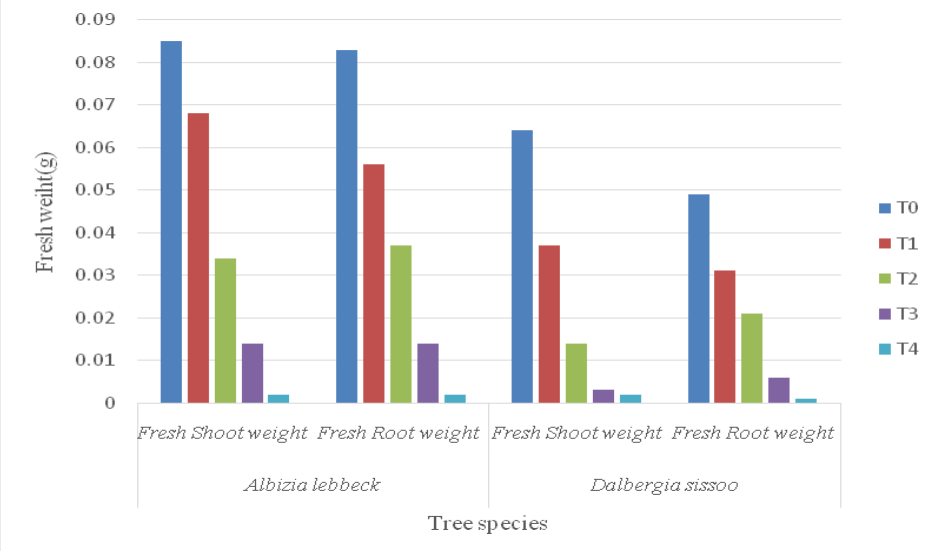

Fig.4 Vigour index of tree species on various treatments

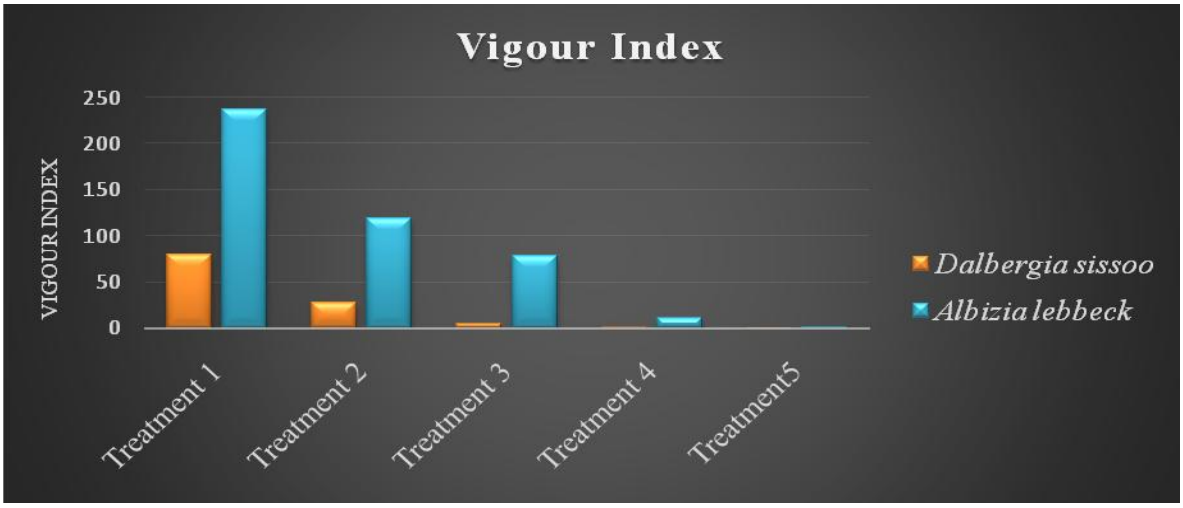

Table.1 Germination and growth behavior of forest tree species to various treatment concentrations

Tree Species	Concentration Level	Germination %	Shoot length	Root Length	Fresh Shoot weight	Fresh Root weight	Vigour Index
A. lebbeck	Control	75	2.22	0.51	0.085	0.083	236.87
	T1	72.5	1.55	0.48	0.068	0.056	119.48
	T2	57.5	1.14	0.46	0.034	0.037	78.62
	T3	52.5	0.20	0.27	0.014	0.014	11.30
	T4	42.5	0.02	0.10	0.002	0.002	1.39
SE (±)		6.83	0.21	2.27	0.005	0.004	16.34
C D at 5%		14.5	0.44	0.006	0.040	0.009	35.62
D. sissoo	Control	85	2.30	1.40	0.064	0.049	79.65
	T1	50	1.31	0.87	0.037	0.031	27.45
	T2	22.5	0.55	0.61	0.014	0.021	4.84
	T3	10	0.07	0.42	0.003	0.006	0.50
	T4	2.5	0.03	0.20	0.002	0.001	0.07
SE (±)		0.59	0.18	0.069	0.005	0.007	6.005
C D at 5%		1.27	0.38	0.43	0.024	0.014	13.08

Maximum inhibition was seen in *Dalbergia sissoo* (0.001) followed by *Albizia lebbeck* (0.002) at T_4 treatment. Maximum fresh root weight (0.083g) was observed in *Albizia lebbeck* followed by *Dalbergia sissoo* (0.049g) both at control (Fig.3).

Vigor Index

The vigour index of the treated tree species were seen reduced significantly as the concentration of leaf extracts increases. The statistical analysis of data revealed significant in vigor index of *Albizia lebbeck* and *Dalbergia sissoo* on different treatment (Fig. 4). The data for *Albizia lebbeck* (236.875) and *Dalbergia sissoo* (79.650) showed that maximum vigor index was observed in control. T_4 treatments showed substantially lower vigor index in *Dalbergia sissoo* (0.075)

than *Albizia lebbeck* (1.39). Das *et al.*, (2012) reported that with the increasing the concentration of leachate of *Shorea robusta*, the vigour index of the *Cicer aretinum* decreased. The vigour index of all the four seedlings may be due to reduced seed germination and shoot length, as vigour index is the product of germination and seedling growth.

The observation of our study confirms the findings of Bansal (1998), who reported that the suppressed seed germination and seedling growth in all associated weeds and the suppressive effect increased with an increase in percent content increasing of *L. camara* extracts. The result also revealed that root elongation and lateral root developments of receptor crops were markedly inhibited compared to that of shoot elongation. Kong *et al.*, 2007 reported that the reduction was due to the chemicals Lantadene A and Lantadene B. Shrivas & Bajpai (1988) reported that flower extracts, followed by seed and stem extracts of *Lantana indica* were more inhibitory against germination, fresh and dry weight of seedling of *Dalbergia sissoo.*

Result showed that, different concentration of aqueous leaf extract caused reduced on shoot and root elongation as well as germination in *Albizia lebbeck* and *Dalbergia sissoo.* The harmful effect of different concentration of aqueous leaf extract is pointing out the presence of allelochemicals. The result also revealed that shoot elongation was more inhibited than root inhibition. The allelopathic chemicals causing the effect should be identified. A field study is recommended to confirm the effects of *Lantana camara* on field conditions with different tree species.

Present investigation conclude that aqueous extract of leaf causes suppression of germination of further growth of *Albizia lebbeck* and *Dalbergia sissoo* as compared to control. Hence effective eradication methods for this invasive alien species should be worked out in concern with forest management, natural regeneration and establishment of new seedlings of many tree species in most forests of the country.

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