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Research Paper

Impact of *Lantana camara* and *Acacia nilotica* leaf extracts on seedlings growth of wheat (*Triticum aestivum* L.)

M. H. Rahman*, T. Tasmim, S. Khatun and R. Karim

Department of Botany, University of Rajshahi, Rajshahi-6205. Bangladesh.
*Corresponding Author: hasanur7@yahoo.com

Abstract

The present investigation was conducted to find out the impact of *Lantana camara* and *Acacia nilotica* leaf extracts on germination and growth efficiencies of three wheat varieties (PRODIP, BARI Gom-25 and BARI Gom-26). A varied response was noticed between the *Lantana camara* and *Acacia nilotica* leaf extracts on germination percentage, root length, shoot length, plant length and stimulation/inhibition percentages on seedling growth of three-wheat varieties.The higher concentration of *Lantana* leaf extracts resulted in maximum germination efficiency than *Acacia* leaf extracts. The shoot length induced by Lantana leaf extractswas more pronounced in PRODIP at T_4 treatment than BARI-Gom 25 and BARI-Gom 26. On the other hand,*Acacia* leaf extract showed decreasing shoot length with increasing extract concentration except BARI-Gom 25. In *Acacia* treatments, the shoot length was significantly different in PRODIPwheat but the other two wheat varieties showed non-significant results. The root elongation of wheat seedlingswas significantly enhanced by *Lantana* leaf extracts treatments except BARI Gom 25. However, the rootlength was not significantly varied by *Acacia* extracts except PRODIP. The vigor index was noted the highest in PRODIP at T_4 treatment of *Lantana* extracts followed by BARI-Gom25 at T_2 treatment in the same extract. The inhibition and stimulations of wheat seedlings growth were varied depended on extracts concentrations and wheat varieties. In *Lantana* extracts, BARI Gom-25 and BARI Gom-26 showed more stimulation in growth than PRODIP. For *Acacia*leaf extract, the results were not clear somehow showed stimulatory or inhibitory effect in seedling growth of wheat varieties. It was noticed that*Acacia*extracts showed more inhibitory effect in wheat seedling growth than *Lantana* treatments.

Keywords: *Lantana camara*, *Acacia nilotica*, wheat.

INTRODUCTION

Lantana camara is a fast-growing woody shrub which is a native to tropical and sub-tropical of South and Central America and currently it is widely distributed in many countries (Binggeli and Dessissa, 2002; Zalucki *et al*., 2007). It is among the top ten invasive weeds in the world causing serious threat to the biodiversity. (Sharma *et al*., 2005). *Lantana camara* (hereafter designated to as *Lantana*) grows under a wide range of climate conditions and adapted on a variety of soil types reflecting its wide ecological tolerance (Baars and Neser, 1999; Day *et al*., 2003). 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 competing for soil nutrients (Dobhal, *et al.*, 2010) and altering microenvironment (e.g. light, temperature) by forming dense thickets. Despite its recognition as among the worst invasive alien species in the world (Baars and Neser, 1999; Sharma *et al*, 2005; Zalucki *et al*., 2007) but much information are not available on the ecological interference of *Lantana* especially on agronomic crops. In the present study, the impact of *Lantana* was evaluated on wheat whichis most important agronomic crop in Bangladesh. The evaluation was viewed to find a clue about *Lantana* invasion and their effect on wheat seedling growth. Therefore, aqueous extracts of *Lantana* leaf were used for testing its impact

on seed germination and their subsequent seedling growth of three wheat varieties which are popularly grown in Bangladesh.

Acacia nilotica, a leguminous species (Mimosoideae), naturally distributed in Australia, Papua New Guinea and Indonesia (Pinoyopusarerk, 1990), introduced in Bangladesh for afforestation and reforestation of degraded and wasteland areas. Although the species is fast growing and can grow in wide ranges of soils (Davidson, 1985), the ground vegetation under its canopy indicated that it has some allelopathic potentials which might have been caused either by fallen leaves (through decomposition of litter) or plant leachates or root exudates. Consequently, the release of allelochemicals (organic substances) into the soil inhibits seed germination and establishment of agricultural crops and vegetation. King (1979) pointed out the need for investigations of allelopathy in various *Acacia* tree species used in agroforestry where there is a good chance of allelochemicals release by the intercrop trees affecting food and fodder crops. Therefore, it is essential that the allelopathic compatibility of crops should be checked before introducing *Acacia* in agroforestry system (Gaba, 1987). A certain number of researchers were done on this aspect in case of *Acacia nilotica* and their impact on some common agricultural crops used in Bangladesh. So, the present experiment was conducted on wheat (*Triticum aestivum* L.), a basic food item in Bangladesh. Now-a-days, wheat is grown in a wide range of land areas than any other crops and it is regarded as the most important food grain source for humans. The population pressure in wheat-consuming countries required that more attention to be paid towards wheat production through improvement of both quality and yield. In the present investigation, wheat seedlings were tested in petridishes and were treated with different concentrations of *Lantana* and *Acacia* leaf extracts.

The present work was undertaken to find out the impacts of *Lantana camara* and *Acacia nilotica* leaf extracts on the seed germination and seedling growth behavior of three wheat varieties which are popularly cultivated in Bangladesh.

MATERIALS AND METHODS

Plant Materials

Wheat (*Triticum aestivum* L.) Var. PRODIP, BARI Gom-25, BARI Gom-26 and Leaves of *Lantana camara* and *Acacia nilotica.*

Methods

The extraction of both *Lantana* and *Acacia* leaves were prepared from fresh leaves collected from mature *Lantana* and *Acacia* plants growing at the Rajshahi University campus, Bangladesh. The studied wheat varieties were collected from Wheat Research Centre, Dinajpur and the varieties were PRODIP, BARI Gom-25 and BARI-Gom26.

Collection and preparation of leaf extracts

The collected leaves of both Lantana and *Acacia* were washed with tap water and air-dried at room temperature. The 100g leaves of *Lantana* and *Acacia* were separately soaked in 1L distilled water and kept it at 25-30°C, for 72h. Afterwards, the aqueous extracts were filtered through the markin cloth and finally filtrated through Whatman No. 1 filter paper. The filtrates were obtained as stock solution of 100% concentration. The following solutions of 10, 25, 50and 75% were prepared separately for *Lantana* and *Acacia* from stock solution and stored it at room temperature for wheat seed treatments. The investigation was conducted in sterile petridishes with a photoperiod of 12 hours with an average room temperature of 25-30°C. Wheat seeds were first disinfected using a 10% solution of sodium hypochlorite and then washed with distilled water for several times. Petridishes were also sterilized for 2h in the oven at 100°C. Ten wheat seeds of each variety were placed on petridishes. These petridishes were moistened by following extracts of *Acaci*a and *Lantana* as a growth medium.

Germination and growth records

The germination test was carried out in sterile petridishes having a (Whatman No.1) filter paper on petridishes. The leaf extract of each treatment was added to each petridish daily in such an amount just enough to wet the seeds. The control was administered only with distilled water. The petridishes were kept in the room temperature of 25−30°C. The experiment was extended over a period of seven days to allow the last seed germination. A seed was considered as germinated, when radicle emerged and its length reached to 0.2cm.

Experimental design and treatment

The experiment was laid out in CRD with factorial arrangements having three replications. Five aqueous leaf extracts treatments (T_0=control (only distilled water), T_1=10%, T_2=25%, T_3= 50% and T_4= 75%) of *Lantana* and *Acacia* were prepared to conduct the experiment.

Data collection and analysis

The data were recorded on germination percentage, shoot length, root length, plant length and percentage of stimulatory/inhibitory effects of wheat seedlings. The data were recorded; statistically analyzed and mean comparison was done using Duncan's Multiple Range Test (DMRT) (Steel and Torrie, 1980).

Parameters calculations

Germination percentage: $GP=\sum G/N \times 100$

Where, GP is germination percentage, G is the number of germinated seeds and N is the number of seeds.

Shoot length: Shoot length was measured in cm after 7 days intervals.

Root length: Root length was measured in cm after 7 days intervals.

Vigor index (VI)= (Shoot length + Root length) × Germination percentages (Abdul-Baki and Anderson 1973)

% Stimulation /Inhibition (I): The percentage of inhibition or stimulation was calculated following the formula by Singh and Chaudhary (2011).

$$I(\%) = \frac{\text{Growth measured in extracts} - \text{Growth measured in control}}{\text{Growth measured in control}} \times 100$$

RESULTS AND DISCUSSION

Effect of *Lantana* leaf extracts

Germination percentage

There was no significant differences found among the extract treatments of Lantana in germination percentages of wheat except BARI Gom-26.The maximum germination percentages(83.33%) was recorded at T_4 treatment in BARI-Gom 26 followed by PRODIP at the same treatment. The minimum value (8.33%) was noted at control (T_0) in BARI Gom-26 (Table 1). Among the three wheat varieties, PRODIP showed the highest status of germination rate in compare to that of BARI Gom-25 and BARI Gom-26 (Fig.1).

Shoot length

The shoot length of BARI-Gom 26 showed significant differences with the treatments but PRODIP and BARI Gom-25 shoot length variation was non-significant. The shoot length was highest (8.35cm) in PRODIP at T_4 treatment whereas the lowest shoot length (0.50 cm) was noted in BARI Gom-26 at T_2 treatment (Table 1).The average performance of shoot length was noted bestin BARI Gom-25 than BARI Gom-26 and PRODIP (Fig.2).

Root length

The *Lantana* leaf extracts was significantly influenced the root length of wheat seedlings except BARI-Gom 25. The highest root length (8.70cm) was noted in PRODIP at T_4 treatment whereas the lowest (1.74cm) root length was recorded in PRODIP at T_1 treatment (Table 1). The average root length was also highest in PRODIP as compare to that of BARI Gom-26 and BARI Gom-25.

Among the four treatments, T_4 treatment (*Lantana* leaf extracts of 75%) showed stimulatory effect in PRODIP wheat at all the growth parameters than control. BARI-Gom 25 and BARI-Gom 26 showed moderate response to the *Lantana* extracts at higher concentrations (Table 1).

Effect of *Acacia* leaf extracts

Germination percentages

The germination percentages of wheat varieties were not significantly different with the treatments except BARI Gom-25.The maximum germination percentage (50%) was recorded at both T_3 and T_4 treatments in BARI Gom-26 whereas the minimum germination (16.67%) was noted at T_0 and T_1 treatments in BARI Gom-25 (Table 1). Among the three wheat varieties PRODIP and BARI Gom-26 showed the almost similar status of germination efficiency than BARI Gom-25 (Fig.1)

Shoot length

The shoot length of BARI-Gom 25 and BARI-Gom 26 were not significantly different with the treatments applied except PRODIP wheat. The highest shoot length (11.70cm) was obtained atT_0 treatment in PRODIP and the lowest value (1.14cm) was recorded atT_4 treatment in the same wheat variety. The mean performances of shoot length among the wheat varieties, BARI Gom-26 showed the highest shoot elongation followed by PRODIP (Fig.2).

Root length

The treatments of *Acacia* leaf extracts were significantly influenced the root length in PRODIP wheat but BARI

Gom-25 and BARI Gom-26, showed non-significant effect in the root length. The highest root length (10.37cm) was recorded in PRODIP at T_0 treatment whereas the lowest (1.68cm) root length was recorded at T_4 treatment at the same wheat variety (Table-1). On anaverage, PRODIP and BARI Gom-26 showedalmost the similarlevel of root elongation than BARI Gom-25 (Fig.3).

Table 1. Effect of *Lantana camara* and *Acacia nilotica* leaf extracts on germination and seedling growth of wheat after 7 days of culture.

		Wheat											
		PRODIP				**BARI-Gom 25**				**BARI-Gom 26**			
Leaf-extracts	Treat.	% Germ	Shoot length (cm)	Root length (cm)	VI	% Germ	Shoot length (cm)	Root length (cm)	VI	% Germ	Shoot length (cm)	Root length (cm)	VI
Lantana	T_0	58.33^{a}	6.11^{a}	6.87^{ab}	757.12	33.33^{a}	4.43^{a}	3.30^{a}	257.64	8.33^{b}	0.80^{b}	3.37^{b}	34.73
	T_1	44.67^{a}	2.23^{a}	1.74^{b}	177.33	58.33^{a}	6.93^{a}	5.54^{a}	727.37	16.67^{a}	1.73^{a}	6.53^{a}	137.69
	T_2	50.00^{a}	5.28^{a}	4.62^{ab}	495	75.00^{a}	6.45^{a}	6.83^{a}	996	41.67^{ab}	0.50^{ab}	3.78^{b}	178.34
	T_3	66.67^{a}	2.89^{a}	3.21^{ab}	406.68	50.00^{a}	7.48^{a}	4.81^{a}	614.5	83.33^{a}	1.64^{a}	5.31^{ab}	579.14
	T_4	75.00^{a}	8.35^{a}	8.70^{a}	1278.75	41.67^{a}	5.30^{a}	4.09^{a}	391.28	75.00^{a}	1.32^{ab}	4.80^{ab}	459
Acacia	T_0	41.67^{a}	11.70^{a}	10.37^{a}	919.65	16.67^{ab}	6.25^{a}	4.60^{a}	180.86	24.99^{a}	7.20^{a}	7.08^{a}	356.85
	T_1	49.99^{a}	8.72^{ab}	10.10^{a}	940.81	16.67^{ab}	6.28^{a}	4.50^{a}	217	41.67^{a}	11.21^{a}	8.98^{a}	841.31
	T_2	33.33^{a}	8.36^{ab}	7.05^{ab}	513.61	33.33^{ab}	6.37^{a}	5.10^{a}	382.29	24.99^{a}	7.25^{a}	6.25^{a}	337.36
	T_3	24.99^{a}	1.29^{ab}	6.68^{ab}	199.17	24.99^{ab}	5.10^{a}	4.20^{a}	232.40	50.00^{a}	3.22^{a}	4.38^{a}	380
	T_4	33.33^{a}	1.14^{b}	1.68^{b}	93.99	41.67^{a}	7.20^{a}	6.91^{a}	587.96	50.00^{a}	5.46^{a}	5.80^{a}	563

Means separated by Duncan's Multiple Range Test. In column, values followed by different letters are significantly different at p≥0.05. Each value is an average of 3 replicates and 3 cultivars.

Table 2. Percentages of inhibition/ stimulation of wheat seedling growth by imposing *Lantana camara* and *Acacia nilotica* leaf extracts after 7 days of culture.

Treatment		**% inhibition/ stimulation**								
		PRODIP			BARI Gom-25			BARI Gom-26		
Lantana		% Germ	Shoot length	Root length	% Germ	Shoot length	Root length	% Germ	Shoot length	Root length
	T_1	-23.41	-63.50	-74.67	75	56.43	67.87	100.12	116.25	93.76
	T_2	-14.28	-13.58	--32.75	125.0	45.59	106.96	400.24	-37.5	12.16
	T_3	14.29	-52.70	-53.27	50.01	68.84	45.75	900.36	105	57.56
	T_4	28.57	36.66	26.63	25.02	19.63	23.93	800.36	65	42.43
Acacia										
	T_1	19.96	-25.47	-2.60	0	0.48	-2.17	66.74	55.69	26.83
	T_2	-20.01	-28.54	-32.01	99.94	1.92	10.86	0	0.69	-11.72
	T_3	24.99	-88.97	-35.58	49.91	-18.4	-8.69	100.08	-55.27	-38.13
	T_4	-40.02	-90.25	-83.79	149.97	15.2	50.21	100.08	-24.16	-18.07

-, inhibition; +, stimulation

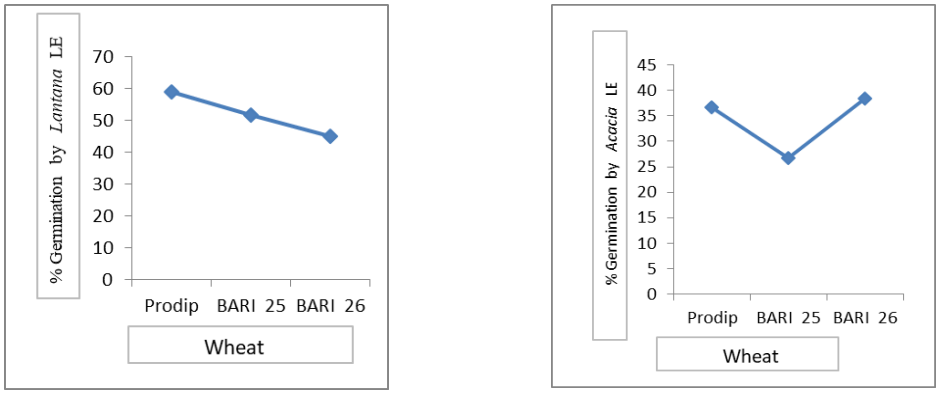

Fig. 1. The overall performances of wheat varieties in germination percentages by *Lantana* and *Acacia* leaf extracts (LE)

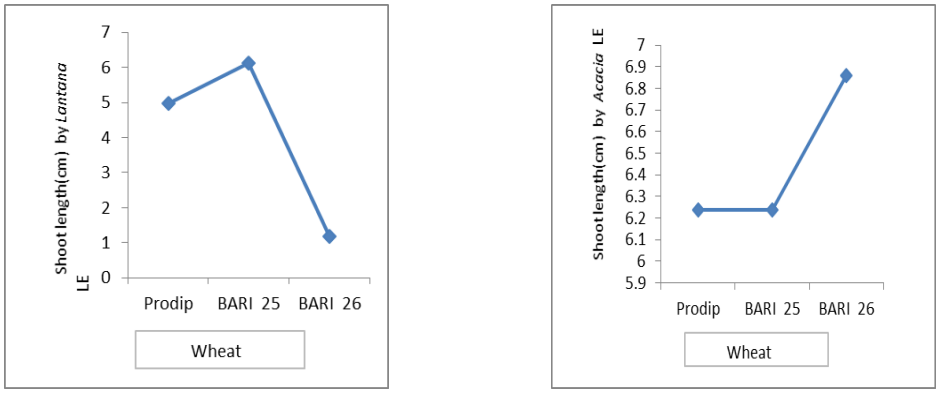

Fig. 2. The overall performances of wheat varieties in shoot length by *Lantana* leaf extracts (LE).

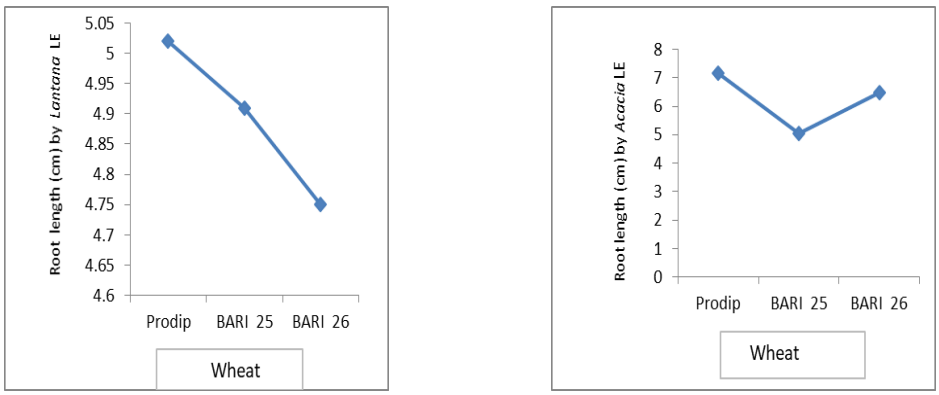

Fig 3. The overall performances of wheat varieties in root length by *Lantana* and *Acacia* leaf extracts (LE)

Stimulation and inhibition effect

The percentage of inhibition or stimulation of seedling growth of wheat varied with the treatment concentration and the investigated wheat varieties. *Lantana* leaf extracts with T_4 treatment was found to be the highest inhibitors of germination in PRODIP wheat but the same treatment showed more stimulation in germination, shoot and root growth of BARI Gom-25 and BARI Gom-26 (Table 2).On the other hand, leaf extracts of *Acacia nilotica* showed moderate inhibition in percent germination, shoot and root length (Table 2). The seedlings growth of PRODIP wheat was remarkably inhibited by *Acacia* leaf extracts but itwas stimulated in BARI Gom-25 and BARI Gom-26 wheat.

Vigor index: PRODIP showed the highest vigor index at T_4 treatment of *Lantana* extracts. But the same variety also exhibited best vigor index by T_1 treatment of *Acacia* extracts. The control was not suitable to increase vigor index for wheat seedling growth except BARI-Gom26. In comparison, *Lantana* treatments gained the better vigor index in wheat seedlings than *Acacia* treatments.

DISCUSSION

Germination percentage: The results clearly indicate that increased amount of *L. camara* and *A. nilotica* leaf extracts have stimulatory effects in germination efficiency at all wheat except T_2 and T_4 treatment for *Acacia* in seed germination. In other related researchers (Jabeen and Ahmed, 2009; Hossain and Alam, 2010) suggested that *L. camara* leaf extracts have allelopathic effects on germination and behavior of *Triticum aestivum* and *Cucurbita pepo*. It may be associated with the quality and nature of seeds or enzymatic and physiological activities facilitate for seed germination.

Shoot length: In most of the cases the shoot length of wheat varieties showed the inhibition by the *L. camara and A.nilotica* leaf extracts except BARI Gom-25. This finding is in agreement with the report of Hossain and Alam (2010) who have observed that increased application of *L. camara* leaf extracts completely inhibits shoot elongation of the plant *Abelmoschus exculantus* L. (Moench).

Root length: The root elongation was stimulated by *L. camara* leaf extracts in BARI Gom 25 and BARI Gom-26. The result is in agreement with the findings other researchers (Chou and Kuo, 1986; Alam, 1990; Bansal, 1998) and it may happened due to allelopathic effect (Leather and Einhelling, 1986; Barnes and Putnam, 1987).

The overall results concluded that *Acacia* extract was more inhibition capacity than *Lantana* extracts in seedling growth of studied wheat varieties.

CONCLUSION

Seed germination is considered to be the most critical stage especially under stress conditions. During germination, biochemical changes take place, which provides the basic framework for subsequent growth and development. The results presented inTable-2 showed that wheat varieties have been influenced by different aqueous extracts treatments. All the concentrations had inhibitory effect on the germination of all varieties as compared to the control treatment. From the obtained results, it can be concluded that *Lantana* and *Acacia* might be threats to the wheat seed germination and seedling growth under laboratory condition. Finally, it is suggested to carry out long-term field based studies to investigate the significance of these findings.

It is also concluded that all the concentrations of leaf aqueous extract of *L. Camara* and *A. nilotica* reduced the germination and growth of wheat seedlings having inhibiting properties which might be considered as a potential threat to wheat cultivation.

REFERENCES

Abdul-Baki, A.A., Anderson J.D. 1973.Vigor determination in soyabean seed by multiple criteria. Crop Sci. 13: 630-633.

Ahmed, R., Uddin, M.B. Khan, M.A.S.A and Mukul, S.A. 2007.Allelopathic effect of *Lantana camara* on germination and growth behavior of some agricultural crops in Bangladesh. Journal of Forestry Research 18(4):301- 304.

Alam, S.M. 1990. Effect of wild plant extract on germination and seedling growth of wheat. Rachis. 9: 12-13.

Ambika, S., Poornima, R.S., Palaniraj, R.S. Sati, C. andNarwal, S.S. 2003.Allelopathic plants:10. *Lantana camara* L. Allelopathy Journal. (12):147-162.

Baars, J.R. and Neser, S. 1999. Past and present initiatives on the biological control of *Lantana camara* (Verbenaceae) in South Africa. In: Olckers, T., Hill, M.P. (Eds.), Biological controls control of weeds in South Africa (1990–1999). African Entomology, Memoir No. 1.Entomological Society of Southern Africa, Johannesburg, South Africa, 182p.

Bansal, G.L. 1998. Allelopathic effects of *Lantana camara* on rice and associated weeds under the midhill conditions of Himachal Pradesh, India. In: Olofsdotter, M., (Ed.), Workshop on Allelopathy in Rice. Proceedings of International Rice Research Institute, Manila, Philippines, pp: 133-138.

Barnes, J. and Putnam, A.R. 1987. Role of benzoxazinoues in allelopathy by rye (*Secale cereal* L.). Journal of Chemical Ecology. (13): 889-906.

Binggeli, P and Desissa, D. 2002. *Lantana camara*-the invasive shrub that threatens to drive people out of their land. Newsletter of the Ethiopian Wildlife and Natural History Society. pp.4-6.

Chou, C.H. and Kuo,Y.L. 1986. Allelopathic exclusion of understory by *Leucaena leucocephala* (Lam.) deWit. Journal of Chemical Ecology (12): 1413-1448.

Davidson, J. 1985. Species and Sites What to Plant and Where to Plant. FAO, Rome.

Day, M.D., Wiley, C.J., Playford, J and Zalucki, M.P. 2003. Lantana: current management status and future prospects. Australian center for international agricultural research Canberra. ACIAR Monograph, 102: 1-128.

Dobhal, P.K., Kohli, R.K and Batish, D.R. 2010. Evaluation of impact of *Lantana camara* L. invasion on four major woody shrubs along Nayar river of Pauri Garhwal, in Himalaya. International Journal of Biodiversity Conservation, 2(7): 166-172.

Gaba, R.K. 1987. Role of Allelopathy in Social Forestry. In: Social Forestry for Rural Development, Khosla, P.K. and R.K. Kohli (Eds.). ISTS, Solan, pp: 228-234.

Gentle, C.B and Duggin, J.A. 1997. Allelopathy as a competitive strategy in persistent thickets of *Lantana camara* L.in three Australian forest communities. Plant Ecology, 132: 85-95.

Hossain, M.K. and Alam, M.N. 2010.Allelopathic effect of *Lantana camara* leaf extract on germination and growth behavior of some agricultural and forest crops in Bangladesh Journal of Weed Science Research. 16(2): 217-226.

Jabeen, N. and Ahmed, M. 2009.Possible allelopathic effect of three different weeds on germination and growth of maize (*Zea mays*) cultivars. Pakistan Journal of Botany. (41): 1677-1683.

King, K.F.S. 1979. Agroforestry and the utilisation of fragile ecosystems.For. Ecol. Manage. 2: 161-168.

Leather, G.R. and Einhellig, F.A. 1986.Bioassays in the Study of Allelopathy. In: Putnam A.R. and C.S. Tang (Eds.), the Science of Allelopathy, John Wiley and Sons, pp: 133-145.

Petmark, P. and Williams,E.R. 1991.Use of *Acacia* Species in Agroforestry. In: Advances in Tropical Acacia Research, Turnbull, J.W. (Ed.). ACIAR, Bangkok, Thailand.

Pinoyopusarerk, K. 1990. *Acacia Auriculiformis*: An Annotated Bibliography. Winrock International Institute of Agricultural Development, Australia, 154.Rice, E.L., 1979. Allelopathy: An update. Bot. Rev. 45: 15-109.

Sahid, I.B. and. Sugau, J.B. 1993.Allelopathic effects of Lantana (*Lantana camara*) and Siam weed (*Chromolaena odorata*) on selected crops.Weed Science. 41(2):303-30.

Singh, A.P. and Chaudhary, B.R. 2011.Allelopathic Potential of algae wee *Pithophora aedogonica* on the germination and seedling growth of *Oryza sativa*. Botany Research International. 4(2): 36-40.

Sharma, G.P., Raghubanshi, A.S and Singh, J.S. 2005. Lantana invasion: an overview. Weed Biology and Management. 5: 157-167.

Steel, R.G.D. and Torrie, J.H. 1980.Principles and procedures of statistics. McGraw Hill Book Company Inc. New York.

Zalucki, M.P., Day, M.D and Playford, J. 2007. Will biological control of *Lantanacamara* ever succeed? Patterns, processes & prospects. Biological Control, 42: 251-262.