Global Journal of Molecular Sciences 4 (2): 91-95, 2009
ISSN 1990-9241
© IDOSI Publications, 2009

Allelopathic Potentialities of Different Concentration of Aqueous Leaf Extracts of Some Arable Trees on Germination and Radicle Growth of *Cicer arietinum* Var. – C-235.

[1]*Sazada Siddiqui,* [1]*Ruchi Yadav,* [2]*Kavita Yadav,* [1]*Feroze Ahmad Wani,*
[3]*Mukesh K. Meghvansi,* [4]*Sudarshana Sharma and* [1]*Farah Jabeen*

[1]Department of Botany, Institute of Basic Sciences, Bundelkhand University, Jhansi - 284 128 U. P. India
[2]Department of Botany, Plant physiology laboratory, Allahabad University, Allahabad U. P. India
[3]Defence Research Laboratory, DRDO, Ministry of Defence,
Govt of India, Post Bag No. 2, Tezpur - 784 001 Assam, India
[4]Departmment of Biochemistry, Bundelkhand University, Jhansi - 284 128 U. P. India

Abstract: A laboratory experiment was conducted to assess the potential allelopathic effects of different concentrations of aqueous leaf extracts of *Ficus infectoria, Emblica officinalis* and *Acacia leucophloea* on germination and root elongation using leguminous crop *Cicer arietinum* L. as bioassay material. The experiments were conducted in sterilized petridishes. The effect of the different concentration of aqueous extracts was compared to distil water (control). The result revealed that different concentrations of *Emblica officinalis* and *Acacia leucophloea* extracts caused highly significant and significant inhibitory effect on germination and root elongation. Bioassays indicated that the inhibitory effect was proportional to the concentrations of the extracts and higher concentration has the stronger inhibitory effect. The study also revealed that inhibitory effect was much pronounced in root development rather than seed germination.

Key words: *Emblica officinalis* · *Acacia leucophloea* · *Ficus infectoria* · Root length · Germination

INTRODUCTION

The term "allelopathy" signifies the interactions between plants might lead to either stimulation or inhibition of growth. Different groups of plants like ; algae, lichens, crops and annual and perennial weeds have wide known allelopathic interactions [1-7] Several phototoxic substances causing germination and/or growth inhibitions have been isolated from plant tissues and soils. These substances, collectively known as allelochemicals, are usually secondary plant products or waste products of main metabolic pathways of plants [8-12].

The effects of secondary substances released by these mechanisms can be long lasting (13) Patric, 1971) or quite transitory [14] and can ultimately influence practices like fertility, seeding and crop rotations.

The allelopathic effect are selective [15-16] and vary with different trees since these plants will vary in the amount of indigenous secondary metabolites and would release different amounts of the phytotoxins. Generally leaves are the most potent source of allelochemicals, however, the toxic metabolites are also distributed in all other plant parts in various concentration.

Higher plants (tree crops) release some phytotoxins into soil, which adversely affect the germination and yield of crops [17]. Such type of tree crop interactions called phytochemical ecology/ecological biochemistry.

Very few research have been done on the allelopathic effect of *Ficus infectoria, Emblica officinalis* and *Acacia leucophloea* on crop so far. Therefore the experiment was conducted to explore the allelopathic effects of leaf extracts on *Cicer arietinum*.

MATERIALS AND METHODS

Ficus infectoria, *Acacia leucophloea*, *Emblica officinalis* was considered as the donor plant and the receptor agricultural crops selected was Indian Chickpea (*Cicer arietinum L.*).

Corresponding Author: Dr. Sazada Siddiqui, Department of Botany, Institute of Basic Sciences, Bundelkhnad University, Jhansi, India

The aqueous extracts were prepared from fresh leaf of the donor plant. 100 gram of fresh senescent leaves of each species were soaked in 500 ml of distil water and kept at water bath (50-55°C). After 24 hours the aqueous extract was filtered through the sieve and then some extracts were diluted to make the concentration of 15gL^{-1}, 30 gL^{-1} and 45 gL^{-1} and stored for seed treatment experiments.

Treatments: The following treatments were used in the experiment:

T_0 = Seeds of receptor plants grown in distil water only (Control),
T_1 = Seeds of receptor plants grown in leaf extracts of 15 gL^{-1} concentration
T_2 = Seeds of receptor plants grown in leaf extracts of 30gL^{-1}concentration
T_3 = Seeds of receptor plants grown in leaf extracts of 45gL^{-1}concentration.

Germination and Growth Records: The germination test was carried out in sterile petridishes of 9 cm in size placing a Whatman no. 1 filter paper on petridishes. The extract of each is concentration was added to each Petridish of respective treatment daily in such an amount just to keep the seed moist enough to get favorable condition for germination and growth. The control was treated with distilled water only. 10 seeds of agricultural crop was placed in the Petridish replicating three times. The petridishes were set at a room temperature ranging from 28-30°C. The experiment extended over a period of five days to allow the last seed germination and the measurement of the shoot and root length. The seed was considered as germinated when the radicle emerged and the germination was recorded daily. The results were determined by counting the number of germinated seeds and measuring the length of primary root. The data were subjected to Analysis of.

Ratio of germination and elongation were calculated as suggested by [18]:

$$\text{Relative germination Ratio (RGR)}\frac{\text{Germination ratio of tested plant}}{\text{Germination ratio of control}}\times 100$$

$$\text{Relative elongation Ratio (RER) of root}\frac{\text{Mean root length of tested plant}}{\text{Mean root length of control}}\times 100$$

For the calculation of percentage of inhibitory effect on germination and radicle elongation of treatment plants to control, we use the following formula [19]:

$$I = 100-(E_2 X\ 100/E_1)$$

Where,
I = % inhibition.
E_1 = Response of control plant.
E_2 = Response of treatment plant.

Statistical Analysis: Data data were compound by analysis of variance (ANOVA), using the STATVIEW 4.5 (abacus concept; Berkeley, USA) software package and difference were considered statistically significant at $p<0.05$.

RESULTS

Figures 1-3 summarize the results for the effect of *Ficus infectoria, Emblica officinalis* and *Acacia leucophloea* on germination of *Cicer arietinum*. The inhibition extent of germination has been determined to depend on both aqueous leaf concentration and incubation period. The root length was also decreased with increasing concentrations of leaf extracts. Tables 1-3 summarize root growth of germinating seeds.

Table 1: Root elongation (cm) of receptor agricultural crop to distill water (T_0) and different concentrations of *Ficus infectoria* extracts ($T_1 - T_3$)

	Duration				
Treatment	24 h	48 h	72 h	96 h	120 h
T_0	0.5	3.35	5.94	7.06	7.5
T_1 (PIE)	0.48(-4)	2.26(-32.54)	3.6(-39.40)	5.62(-20.43)	6.26(-16.54)
T_2 (PIE)	0.48(-4)	2.29(-31.65)	3.75(-36.89)	4.16(-41.10)	4.54(-39.49)
T_3(PIE)	0.29(-42)	1.76(-47.47)	3.89(-34.54)	4.86(-31.19)	5.28(-29.62)

Here, (PIE = Percent of inhibitory effect, -ve = inhibitory effect, +ve = stimulatory effect)

Table 2: Root elongation (cm) of receptor agricultural crop to distill water (T_0) and different concentrations of *Emblica officinalis* extracts (T_1 –T_3)

	Duration				
Treatment	24 h	48 h	72h	96 h	120h
T_0	1.64	3.41	6.55	7.18	7.44
T_1 (PIE)	1.44(-12.20)	1.9(-44.3)	2.35(-64.13)	2.84(-60.45)	3.4 (-54.31)
T_2(PIE)	0.48(-70.74)	0.99(-70.91)	1.39(-78.79)	1.82(-74.67)	2.26(-69.63)
T_3(PIE)	00(-100)	0.86(-74.79)	1.62(-75.28)	1.9(-73.56)	1.9(-74.47)

Here, (PIE = Percent of inhibitory effect, -ve = inhibitory effect, +ve = stimulatory effect)

Table 3: Root elongation (cm) of receptor agricultural crop to distill water (T_0) and different concentrations of *Acacia Leucophloea* extracts (T_1 – T_3)

	Duration				
Treatment	24 h	48h	72h	96h	120h
T_0	1.24	3.41	6.55	7.18	7.44
T_1 (PIE)	1.04(-16.13)	2.57(-24.64)	3.93(-40.03)	4.46(-37.89)	4.78(-35.76)
T_2(PIE)	0.91(-26.62)	2.46(-27.88)	3.56(-45.68)	3.84(-46.55)	4.27(-42.62)
T_3(PIE)	0.78(-37.11)	1.91(-44)	3.02(53.92)	3.26(-54.63)	3.69(-50.41)

Here, (PIE = Percent of inhibitory effect, -ve = inhibitory effect, +ve = stimulatory effect)

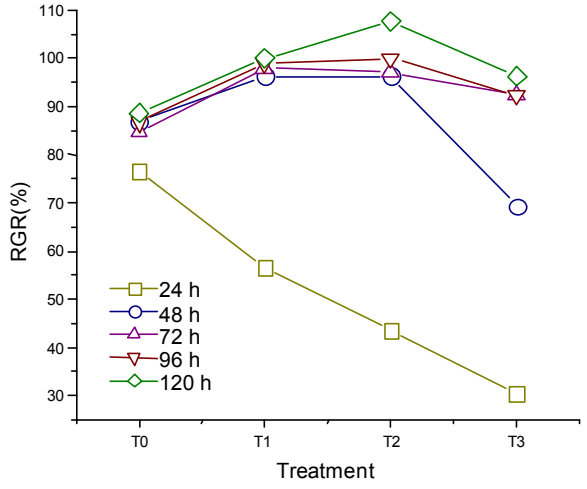

Fig. 1: Effect of aqueous leaf extract of *F. infectoria* on relative germination ratio of *Cicer arietinum* var-c-235.

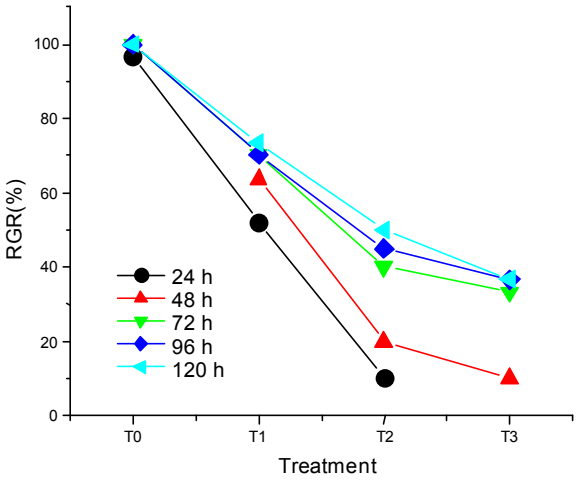

Fig. 2: Effect of aqueous leaf extract of *Emblica officinalis* on relative germination ratio of *Cicer arietinum* var-c-235.

Germination: The effect of 3-donor plants on relative germination ratio of the bioassay species are shown in Fig. 1-3. In most cases, variation of germination percent varied evenly due to different concentrations. With the increase of concentration, the inhibitory effect was progressively increased. In all cases, the maximum inhibitory effect was found at T_3 treatment except *A. leucophloea*. The maximum relative germination ratio (107.7%) was found for *F. infectoria* at T_2 treatment. Among the donor plants, *E. officinalis* shows less significant effect at all treatments to the receptor crop (in comparison to others). It was also observed that all leaf extracts delayed the germination significantly in receptor crop compared to control treatment.

Root Elongation: The root length of bioassay species was found to be greatly inhibited with the increase of the concentration of extract except *F. infectoria* (Table-1). The inhibitory effect was much more pronounced at $T_{3\ \text{concentration}}$ followed by T_2 and T_1 concentrations respectively.

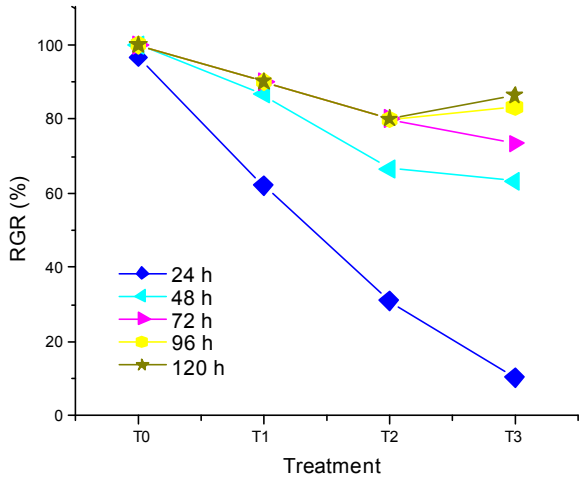

Fig. 3: Effect of aqueous leaf extract of *Acacia Leucophloea* on relative germination ratio of *Cicer arietinum* var-c-235.

The highest inhibitory effect (-74.47) was shown by *E.officinalis* at T_3 concentration followed by T_2 (-69.63) AND T_1(-54.31) treatment of same plant extract. Maximum elongation of root (7.54±1.48cm) was observed in *F. infectoria* followed by (7.4±0.45cm) in *E. officinalis.*

DISCUSSION

Considering the foregoing results, it seemed that there are significant phototoxic effect of *F. infectoria, E. officinalis* and *A. leucophloea* on germination and root elongation. These results correlated with the findings that leaf extracts of *Acacia auriculiformis* have allelopathic effect on seed germination of some agricultural crops [20]. This observation also confirmed the findings that *Emblica officinalis* and *Ficus* species have phytotoxic effect on germination and radicle growth of some food crops and root growth was more sensitive to the increasing concentration of the aqueous extract in comparison to seed germination [21-22]. The results also confirms that allelopathy is a concentration dependent phenomenon. [23-27].

The present studies showed that F. *infectoria, E. officinalis* and *A. leucophloea* has allelopathic potential. However, long term field based studies must be carried out before incorporation of these trees in any arable system.

REFERENCES

1. Jain, R., M. Singh and D. Dezman, 1989. Qualitative and quantitative characterization of phenolic compounds from *Lantana camara* leaves. Weed Sci., 37: 302-307.
2. Horsley, S.B., 1991. Allelopathy. In: Avery, M.E., G.R. Cannel and C.K. Ong (eds.). Biophysical research for Asian agroforestry. Virginia: winrock International and South Asia Books, pp: 167-183.
3. Lawrey, J.D., 1993. Chemical ecology of *Hobsonic christiansenii*, a lichencolous hypomycetes. Amer. J. Bot., 80: 1109-1113.
4. Inderjit and K.M.M. Dakshini, 1994a. Effect of cultivation on allelopathic interference success of the weed *Pluchea lanceolata*. J. Chem. Ecol., 20: 1179-1188.
5. Inderjit and K.M.M. Dakshini, 1994b. Algal allelopathy. Bot. Rev., 60: 182-196.
6. Ahmed, R., M.B. Uddin and M.K. Hossain, 2004. Allelopathic effects of leaf extracts of *Eucalyptus camaldulensis* Dehn. on agricultural crops. Bangladesh Journal of Botany, 33(2): 79-84.
7. Uddin, M.B., R. Ahmed, S.A. Mukul and M.K. Hossain, 2007. Inhibitory effects of *Albizia lebbeck* (L.) Benth. Leaf extracts on germination and growth behavior of some popular agricultural crops. Journal of Forestry Research, 18(2): 128-132.
8. Whittaker, D.C. and P.P. Feeny, 1977. Allelochemicals: Chemical interactions between species. Sciences, 171: 757-770.
9. Hall, M.H. and P.R. Henderlong, 1989. Alfalfa autotoxic fraction characterization and initial separation. Crop science, 30: 1255-1259.
10. Chon, S.U. and J.D. Kim, 2002. Biological activity and quantification of suspected allelochemicals from alfalfa plant parts. Journal of Agronomy and Crop Science, 188.
11. Bernat, W., H. Gawronska, F. Janowiak and S.W. Gawronski, 2004. The effect of barley allelopathics on germination and seedlings vigour of winter wheat and mustard. Zesz. Probl. Post. Nauk roln., 496: 289-299.
12. Ashrafi, Z.Y., H.R. Mashhadi and S. Sadeghi, 2007. Allelopathic effects of barley (*Hordeum vulgare*) on germination and growth of wind barley (*Hordeum spontaneum*). Pakistan Journal of weed Science Research, 13(1-2): 99-112.

13. Patrick, Z.A. and L.W. Koch, 1958. Inhibetion of respiration, germination and growth by substances arising during the decomposition of certain plant residues in soil canadian Journal of Botany, 36: 621-647.
14. Kimber, R.W.L., 1973. Phytotoxicities form plant residues. 1. The influence of rotted wheat straw on seedling growth. Aust. J. Agric. Res., 18: 161-374.
15. Stowe, L.G., 1979. Allelopathy and its influence on the distribution plants in an Illinois old field. Journal of ecology, 67: 1065-1085.
16. Melkania, N.P., 1986. Allelopathy and its significance on production of agroforestry plants association. Proceeding workshop of agroforestry for rural needs. Feb. 22-26, 1986, New Delhi. ISTS, solan, pp: 211-224.
17. Harborne, J.B., 1977. Introduction to Ecological Biochemistry Academic Press, New York.
18. Rho, B.J. and B.S. Kil, 1986. Influence of phytotoxication from *Pinus rigida* on the selected plants. J. Nat Sci. Wankwang University, 5: 19-27.
19. Sundra, M.P. and K.B. Pote, 1978. On the allopathic potential of root exudates from different ages of celosia argenta. Nat.Acad.Sci.Lett, 1: 56-58.
20. Bora, I.P., J. Singh, R. Borthakur and E.Bora, 1999. Allelopathic effect of leaf extracts of *Acacia auriculiformis* on seed germination of some agricultural crops. Ann. For., 7: 143-146.
21. Kumar, M., J.J. Lakiang and B. Gopichand, 2006. Phototoxic effect of agroforestry tree crops on germination and radicle growth of some food crops of Mizoram. Lyonia: a J. of ecology & applications, 11(2): 83-89.
22. Kaletha, M.S., B.P. Bhatt and N.P. Todaria, 1996. Tree crop interaction in traditional agroforestry systems of garhwal Himalaya. 1. Phytotoxic effect of farm trees on food crops. Allelopathy Journal, 3(2): 247-250.
23. Hoque, A.T.M.R., R. Ahmed, M.B. Uddin and M.K. Hossain, 2003. Allelopathic effect of different concentration of water extracts of *Acacia auriculiformis* leaf on some initial growth Parameters of five common agricultural crops. Pakistan J. of Agronomy, 2(2): 92-100.
24. Oyun, M.B., 2006. Allelopathic potentialities of *Gliricidia sepium* and *Acacia auriculiformis* on the germination and seedling vigour of maize (*Zea mays* L.). American Journal of Agr. And Bio. Sci., 1(3): 44- 47.
25. Ahmed, R., M.B. Uddin, M.A.S.A. Khan, S.A. Mukul and M.K. Hossain, 2007. Allelopathic effects of *Lantana camara* on germination and growth behavior of some agricultural crops in Bangladesh J. of Forestry research, 18(4): 301-304.
26. Siddiqui, S., S.S. Khan, M.K. Meghvanshi and S. Bhardwaj, 2009. Allelopathic effect of aqueous extracts of *Acacia nilotica* on seed germination and radicle length of *Triticum aestivum* var. – Lok – 1. Indian J. Applied & Pure Bio., 24(1): 217-220.
27. Siddiqui, S., M.K. Meghvanshi, K. Yadav, R. Yadav, F.A. Wani and A. Ahmad, 2009. Efficacy of aqueous extract of five arable trees on seed germination of *Pisum sativum* L. var VRP-6 and KPM-522. Botany Research International. Accepted