Environment Conservation Journal 5 (1-3) 45-50 , 2004
(ISSN 0972-3099)

Phytotoxic Effects of *Eucalyptus globulus* leaf extract on seed germination and seedling growth of Vicia

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Abstract

Eucalyptus globulus L.(Myrtaceae) stared as antisocial tree for social forestry (Kohli, 1987) is commonly transplanted through out India on roadsides, bare lands and boundaries of crop fields without considering its allelopathic effects on crop plants, especially cereals and pulses. The aerial parts, especially leaves of this tree contain volatile tarpenes (Del Moral and Muller, 1970), water soluble toxins and growth inhibitors. (Grummer and Beyer, 1960 and Al-Mousawi, Al-Naib,1976 and Pandhy *et al*. 1992). Toxic effects of different concentrations of leaf extract of *Eucalyptus globulus* (Viz-5,10, 15, 20 & 25 percent) was studied on percentage of seed germination,their survival, growth of radical and plumule and establishment of secondary roots on three species of Vicia-*V. narborensis, Vicia benghalensis.* and *V. faba.*In the present investigation each concentration showed inhibitory effects of the above parameters which gradually increases with increasing concentrations of the leaf extract. Delayed germination was also noticed in the treated seeds. *Vicia narborensis* proved to be more sensitive to these toxic leachates than the other two species. The above findings clearly showed that the transplantation of *Eucalyptus species* on boundaries of crop plants should be totally banned. Further investigation on its Cytotoxic effect (if any) is in progress.

Introduction

In plant communities, many plant species interact with each other, thus, regulate the growth of neighbouring plants by releasing certain chemicals, stimulators or inhibitors resulting into an allelopathic action (Putnam and Tang, 1986), Such Chemic Substances which interfere the physiological processes and life-cycle of another plant species in communities are referred as allelopathic substances and the phenomenon as Allelopathy. These allelochemic substances are present in various plant parts and are released into the environment by various processes such as leaching, volatilization, root exudation and decomposition of plant residues (Rice, 1984). Recently several works have been carried out on the allelopathic effects between crops and crops,between weeds and crops and between weeds and herbaceous plants (Eyini *et al.* 1989, Chandel and Mehta, 1990, Singh, 1999, Pandhy *et al*. 2000), but interactions on the tree crops are still scanty.

Eucalyptus released several volatile tarpenes (Del Moral and Muller, 1970), water soluble toxins and growth inhibitors (Grummer and Beyer, 1960, Al-Mousawi and Al-Naib, 1976, Pandhy, 2000) and volatile materials (Baker, 1966) which in one or other way inhibit the growth of crop plants.

Considering the allelopathic effect of *Eucalyptus globulus* on several important crop plants and termed as antisocial tree for forestry (Kohli, 1987), it was planned to see the phytotoxic effects of *Eucalyptus globulus* on seed germination, seedling growth and its survival on three species of Vicia Viz-*V. faba, V. narborensis* and *V. benghalensis*.

Materials and Methods

Fresh and matured leaves of *Eucalyptus globulus* (Myrtaceae) were plucked, washed thoroughly, shade dried and then soaked in distilled water for 48 hrs, (100 gms in 1 liter of distilled water). The leachate so obtained was considered as Stock solution. Further dilution was made by adding adequate amount of distilled water into the stock solution to obtain 5, 10, 15, 20 and 25 percent concentrations of the Leachate.

Seeds of *Vicia faba* and *V. benghalensis* were procured from local registered suppliers while seeds of *V. narborensis* was obtained with the courtesy of Dr. A.K. Singh**,** the then Professor of Botany, M. S. College, Motihari.

100 healthy seeds of each species of *Vicia* were taken, thoroughly washed in distilled water, then kept for soaking in different test tubes containing various concentrations of the leachate. After soaking for 24 hr. seeds were taken out, washed with distilled water and then allowed to germinate in different pertridishes lined with moist filter paper. A control set in distilled water in identical condition was also maintained for comparison. The daily record of seed germination and their mortality was noted upto a week, while length of radical, plumule and number of secondary roots were noted after seven days.

Results and Discussion

As it reveals from Table 1,2 and 3 that the percentage of seed germination and its survival is dose dependent. Increase of leachate concentration decreases the percentage of seed germination and survival of seedlings. It was also observed that increase of concentration delayed the process of germination and inhibited the growth of seedlings in all the test

cultivars of Legumes. *V. narborensis* proved to be more sensitive than other two species of Vicia.

Delayed germination with increasing doses of the leachate might be due to presence of more phytotoxins which arrest the protease enzyme activity or action of hydrolytic enzymes (Shrivastava *et al.* 1972, Singh and Saxena, 1991), Saxena and Singh (1987) are of opinion that seed germination is mostly controlled by osmotic potential which regulates the action of hydrolytic enzymes. Mishra & Srivastava (1987) and Khosh-Khui and Bassiri (1979) reports that the toxic substances present in the leachate damaged the enzyme system involved in the metabolic and repair mechanism or their degradation products in excess. Similar opinions have also been made by Nicollier *et al.* (1985), Singh & Singh (1997), Jha *et al*. (1998), Singh (1999) and Singh & Singh (2001)while Choe (1972) reports that indigenous hormones are denatured or leached out to the surround medium by exogenous application of plant regulating chemicals. In contrast there are several reports that the secondary metabolites such as α & β pinene, Limonine, Linolol, P-cimene, Citronella, α– terpenol, geraniol, citral etc. present in leaves of *Eucalyptus* are of toxic nature, hence might have inhibited the process of germination resulting decline in percentage as well as delayed in the germination process. Similar reports have also been made by Srinivasan *et al*.(1990) on Piegeonpea & Soyabean, Pandhy *et al*. (2000) on finger millet and Devasagayam and Ebenezar (1996) on arable crops.

Reduction in seedling growth as observed in present investigation has also been noticed by several co-workers such as by Singh and Nandlal (1993) on wheat, mustard and chick pea treated with *Eucalyptus rostrata* by Jaikumar *et al.* (1990) on ground nut; Pandhy *et al* (2000) on Ragi treated with *E.globulus* and by Singh and Singh (2001) on *Vicia faba* treated with *Cannabis* extract and by Singh (1999) on *Ageratum conyzoides* treated with *Parthenium hysterophorus,* Tripathi *et al.* (1981) and Mukherjee and Sahai (1985) have reported that the allelopathic actions differ from plant to plant. Gleissman and Muller (1978) is of opinion that allelochemics of plant might be incorporated into the soil by leaching of the substance from shoot canopy due to dissolving action of rain water and they might have arrested the physiological, biochemical and cytological activities of seedlings leading to poor seedling growth, similar opinion has also been made by Pandhy *et al.* (2000). While Kohli (1990) is of opinion that reduction in seedling growth by the allelochemics might be due to inhibition and/or checking of protein,nucleic acid and carbohydrate synthesis. The

opinion of Kohli (1990) seems to be more authentic as these allelochemics have greater amount of terpenoids, flavonoids and phenolics, which are more toxic to the various physiological and metabolic processes related to the seedling growth and has directly or indirectly inhibited the seedling growth and number of secondary roots. Decrease in the length of radicals and plumules at higher doses may safely be attributed to the toxic effects of the allelochemicals or their degradation products on the root tipcells, that retarded cell divison, thus,decline the length of primary and secondary roots and number of secondary roots. Similar findings have also been made by Shastree *et al.* (1989), Bansal (1992), Singh and Singh (1997), and Singh (1999).

Table-1 Effect of leaf leachate of *Eucalyptus globulus* on seed germination and seedling growth of *Vicia faba*

Leaf leachate Conc.(%)	Germination (%)	Periods taken into germination (in hrs.)	Survival (%) (mm)	Length of plumule and Radical (after a week)		No.of Sec. roots (after a Week)
				Radical (mm)	Plumule (mm)	
Control	100	48-60	95.00	55	81.5	18
5	98	48-60	91.84	51	78.4	16
10	90.00	48-72	90.00	40.5	72.6	13
15	90.00	60-84	87.7	46.2	66.4	08
20	86.00	60-84	84.88	42.4	60.5	06
25	82.00	72-84	80.48	38.5	54.2	06

Table-2 Effect of leaf leachate of *Eucalyptus globulus* on seed germination and seedling growth of *V. narborensis*.

Leaf leachate Conc.(%)	Germination (%)	Periods taken into germination (in hrs.)	Survival (%)	Length of plumule and Radical (after a week)		No.of Sec. roots (after a Week)
				Radical (mm)	Plumule mm)	
Control	94	48-60	94.68	51.4	73.2	20
5	90	48-72	90.00	50.8	72.8	18
10	86	72-84	84.88	46.00	72.4	12.
15	80	72-84	80.00	39.02	65.4	08
20	70	84.96	75.71	37.3	58.1	04
25	65	84-108	72.30	35.2	44.4	02

Table-3 Effect of leaf leachate of *E.globulus* on seed germination and seedling growth of *V. benghalensis.*

Leaf leachate Conc.(%)	Germination (%)	Periods taken into germination (in hrs.)	Survival (%)	Length of plumule and Radical (affer a week)		No.of Sec. roots (after a week)
				Radical (mm)	Plumule (mm)	
Control	96	48-60	100	62.24	120	32
5	90	48-60	90.00	60.05	115	27
10	90	48-72	87.77	54.22	105	27
15	85	48-84	81.17	49.20	94	20
20	75	60-84	80.00	45.45	91	12
25	70	60-96	78.57	40.20	82	09

References

AL-Mouswi, A.H. and Al-Naib, F.A.G. 1976. Volatile growth inhibitors produced by *Eucalyptus microthea*. ***Bull. Biol. Res. Center***.7:17-23.

Baker,H.G. 1996. Volatile growth inhibitors produced by *Eucalyptus globulus*.Madrono. S. Francisco. 18: 207-211.

Bansal, G.L. ,Nayar, M.and Bedi, Y.S. 1992. Allelopathic effect of *Eucalyptus machromlyncha* and *E. youmanni* on seedling growth of wheat and radish. ***Indian. J. Agri. Sci.,***62(II) 771-772.

Chandel, Y. S.and Mehta, P.K. 1990. Nematicidal properties of leaf extracts of wild sage *(Lantana camara)*. ***Indian. J. Agri. Sci***. 60:781-782.

Choe, H. T. 1972. Effect of presoaking seeds of *Pisum sativum* in GA_3, IAAand kinetin solution on seedling growth. ***Hort. Sci***. 7:476-478.

Del Moral, R. and Muller, C.H. 1970. The allelopathic effect of *E. camaldulensis*. ***American Midland Naturalist.*** 83: 254-282.

Devasagayam, M.M. and Ebenezar, E. G. 1996. Allelopathic effect of *Eucalyptus* on Arable crops. ***J. Ecotoxicol. Envirom. Moit***.6(1): 73-75.

Eyini, M., Jaikumar, M.and Pannirselvam, S. 1989. Allelopathic effect of bamboo leaf extract on the seedling of groundunt. ***Trop. Ecol.*** 30:138-141.

Gleissam, S.R. and Muller, C.H. 1978. The allelopathic mechanism of dominance in Brasken in Southern California. ***J. Chem. Ecol***. 4:337-362.

Grummer.,G. and Beyer, H. 1960. The influence exerted by species of Camelina on flax by means of toxic substances. *The Biology of weeds*. Ed. J.L. Harper, Black well scientific. Oxford. pp.153-157.

Jaikumar, M., Eyini, M. and Pannirselvam, S.1990. Allelopathic effect of *Eucalyptus globulus* in Ground nut and Corn. Comp. ***Physiol. Ecol.*** 15: 109-113.

Jha, P.K., Choudhary. S.K. and Prasad, A.1998. Effects of phytosaponin *(Mollugo saponin)* on the seed germination and seedling growth of *Glycine max* L. ***Bio. Journal.***10 (1 & 2): 83-85.

Khosh-Khui, M. and Bassiri, 1979. Inhibition of seedling growth by wild myrtle *(Myrtus communis)* ***Weed.Res***. 19: 45-50.

Kohli, R.K. 1987. *Eucalyptus* an antisocial tree for social forestry, Social for Rural Development,Solan ***Indian Society of tree Scientists***, pp. 235-241.

Kohli,R.K.1990.Allelopatic potential of *Eucalyptus,* project report MAB-DOEN project, India.p-199.

Mishra, G.P. and Srivastava, A. 1978. A germination inhibitor from *Mellilotus indica*. ***Bot. Soc.*** Univ. of Sagar. Vol.25/26: 54-56.

Mukherjee, U. and Sahai, R. 1985. Allelopathic effect of *Indigofera enneaphylla* on the seed gernination and seedling establishment of *Alysicarpus monilifer* ***J.ind.Bot. soc.***, 64: 169-171.

Nicollier, G. F.,Pope, D.F.and Thompson, A.C. 1985. *The Chemistry and allelopathy*, American Chemical Society, Washington,D.C. pp.-207-218.

Pandhy, B., Patnaik,P.K. and Tripathy, A.K. 2000. Allelopathic potential of *Eucalyptus* Leaf. Litter Leachates on germination and seedling growth of finger millet, ***Allelopathy Journal***.7: 69-78.

Putnam, A.R. and Tang, C.S. 1986 Allelopathy: *State of the sciences in the science of Allelopathy,* John Wiley and sons, INC, 1-17.

Rice, E.L.1984.*Allelopathy* Academic Press, Oriando, F.L.1: 131.

Saxena, O.P.and Singh, G. 1987 Osmotic priming studies in some vegetable seeds. ***Acta.Hort***. 215: 201-207.

Shastree, N. K. Pathak, S. and Islam, M.S. 1989. Studies on the allelopathic competence of *Argemone maxicana*. ***Bio. Journal.*** Vol.1 (2): 33-38.

Singh, R.B. 1999. Allelopathic effect of *Ageratum conyzoides* on seed germination and seedling growth of *Parthenium hysterophorus*. ***J. of Environ. & Polln***. 6 (2 & 3): 169-172.

Singh, G. and Saxena, O.P. 1991. Physiological and Biochemical studies associated with instant germination in tomato. *Proc. Intern. seed Symp. Jodhpur*. pp. 313-317.

Singh, R. B. and Singh, A.K. 1997. Stimulating and toxic effects of *Cannabis extracts* on seed germination and seedling growth of Pea *(Pisum satium)*.***Flora and Fauna.*** Vol.3 (2) :a107-108.

Singh, R.B. and Singh, S. 2001. Toxic effects of *Cannobis sativa* extracts on *Vicia faba*. ***J. of Environ. & Poll.*** 8 (1). pp. 75-78

Singh, R.B. and Nandlal, D.P.S. 1993. Allelopathic effects of *Eucalyptus* and *Leucana* Leaf Litter on the germination and seedling growth of some fodder crops. ***Forage Res***. 19: 13-16.

Srinivasan, K, Ramason, M. and Shantha, R. 1990. Tolerance of pulse crops to allelochemicals of tree species. ***Indian J. Pulses. Res.*** 3:40-44,

Srivastava, A.K., Sharma, K. and Ahuja, K.L. 1972. Effect of salt stress on seed germina tion and survival of soyabean seedlings, ***Trop. Ecol.*** 13:27-31.

Tripathi, R.S., Singh, R.S. and Rai, J.N. P. 1981. Allelopathic potential of *Eupatorium adenophorum,* a dominant ruderal weed of Meghalaya, *Proc. Nat. Sc. Acad*. 47: 458-465.