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EFFECT OF LEAF AND BARK AQUEOUS EXTRACTS ON GERMINATION AND RADICLE LENGTH OF CROPS IN MIZORAM

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ABSTRACT

Leaf and bark aqueous extracts of Anthocephallus chinensis, Albizzia procera and Aporosa octandra were tested on crops viz. Oryza sativa, Glycine max and Brassica campestris for phytotoxic effects on germination and radicle length. Leaf and bark extracts of trees inhibited the germination and radicle length of all crops except G. max for radicle length in bark aqueous extract of A. chinensis, which stimulated to the extent of 30.03% over control. The lowest germination of crops (irrespective of trees and source of extracts) was for B. campestris (55 %) followed by O. sativa (82.5%) and G. max (84.5%). Similarly, like germination, maximum growth of radicle was for G. max (8.42 cm) followed by O. sativa (4.72 cm) and B. campestris (2.95 cm). Thus, in order of toxicity of trees (irrespective of crops) were Aporosa octandra > Albizzia procera > Anthocephallus chinensis. However, the tolerance in crops was in order of (irrespective trees and source of extract) G. max > O. sativa > B. campestris.

Key words: Allelochemicals, allelopathy, inhibition, water extract, stimulation, tolerance.

INTRODUCTION

Plant-plant interactions are of paramount importance in agroforestry system (Sharma *et al.* 1982; Tripathi *et al*. 1998). Plant produces a large number of chemical compounds which vary in their chemical composition and concentration and affect growth of another plant or even its own species (Rice, 1984). In agro ecosystem, allelopathy has been correlated to problems with crop production on certain soil types (Schreiner and Reed, 1907; 1908) with stubble mulch farming (Patric *et al.* 1963) and with certain types of crop-rotations (Patric, 1971). Generally it is observed that leaves, bark and root are the most potent source (Igboanugo, 1986; Bansal, 1992; Mughal, 2000) of allelochemicals, however, the toxic metabolites are distributed in all other plant parts in various concentrations (Basavaraju and Gururaja, 2000).

Most of the allelochemicals are secondary substances, which do not occur in all living matter but appear sporadically (Whittaker and

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Fenny, 1971). These substances are biosynthesized from the metabolism of carbohydrates, fats and amino acids and arise from acetate or the shikimic acid pathway (Robinson, 1983). Many of these compounds have been implicated as allelopathic agents and have been classified into various classes (Rice, 1974; 1979; Putnam, 1985).

Although, the allelopathic studies of trees and crops have been reported by various workers in different parts of the country (Melkania, 1984; Saxena and Singh, 1987; Suresh and Vinaya-Rai, 1987), however, such studies in north-eastern parts of India, especially Mizoram have so far not been carried out by any worker. Therefore, the study was carried out to analyze the effects of leaf and bark of trees (*Aporosa octandra, Anthocephallus chinensis and Albizzia procera*) on germination and radicle growth of crops (*Oryza sativa, Brassica campestris* and *Glycine max*) of this region.

MATERIALS AND METHODS

The study was conducted in the laboratory of the Department of Forestry, Mizoram University, Aizwal, located between latitude 92^0 38' to 92^0 42' and longitude 23^0 42' to 23^0 46' at an elevation 900 m ASL. The mature leaves and dry natural flaked off bark were collected from selected tree species. The leaf and bark were air-dried and ground separately in a mechanical grinder. A sieved powder sample of 2 g (2% concentration) of each component (leaf and bark) was weighed and added to 100 ml of double distilled water and kept for 24 hours at room temperature (25~30 ^{0}C). The resulting brownish and dark solutions were filtered through three layers of Whatman No.1 filter paper and stored in the dark place in conical flasks. The effects of aqueous extracts on seed germination and radicle length were tested by placing 25 seeds of each test crop (four replicates) in Petri dishes (9 cm dia.) containing three layers of Whatman No.1 filter paper saturated with the aqueous extracts. A separate control series was set up using distilled water. Moisture in the Petri dishes was maintained by adding of aqueous extracts/distilled water as required. The number of seeds germinated was counted everyday for 7 days after which the observation was stopped.

RESULTS AND DISCUSSION

Bark and leaf aqueous extracts of *A. octandra* clearly inhibited germination of all food crops compared with control. Among the crops, *O. sativa* was the most resistant to leaf and bark aqueous extracts of *A. octandra* and average germination (bark and leaf) was 87% followed by *Glycine max* (82.5%) and *B. campestris* (10%). The germination of *B. campestris* in bark was 20% and reduced completely (100%) in leaf extract. The germination of *O. sativa* and *G. max* was

89 and 85 % (in bark) and 85 and 80% (in leaf), respectively (Table-1). Similarly, the radicle length of crops in *A. octandra* irrespective of source of extracts was 3.24 cm for *O. sativa*, 0.71 cm for *B. campestris* and 6.23 cm for *G. max*. The radicle lengths were depressed to be more in leaf extract than the bark extract (Table-2).

Table-1. Effect of aqueous extracts of trees on germination percent of food crops. Values in parenthesis indicate percent inhibition over control. (Same letter (s) in a row indicates non-significant statistical difference among means of treatments p ≤0.05).

	O. sativa	*B. campestris*	*G. max*
Aporoso octandra			
Bark	89 (3.26)ab	20 (76.74)b	85 (10.53)ab
Leaf	85 (7.61)b	00 (100)b	80 (5.26)b
Control	92a	86a	95a
Anthocephallus chinensis			
Bark	82 (10.87)b	85 (1.16)ab	91 (4.21)ab
Leaf	80 (13.04)b	80 (6.98)b	87 (8.42)b
Control	92a	86a	95a
Albizzia procera			
Bark	80 (13.04)b	73 (15.12)b	79 (16.84)b
Leaf	79 (14.13)b	72 (16.28)b	85 (10.53)b
Control	92a	86a	95a

Table-2. Effect of aqueous extracts of trees on radicle Length (cm) of food crops (Same letter (s) in a row indicates non-significant statistical difference among treatment means p ≤0.05).

	O. sativa	*B. campestris*	*G. max*
Aporoso octandra			
Bark	5.94 ± 0.52a	1.42 ± 0.38b	9.59 ± 0.65a
Leaf	0.54 ± 0.08b	0.00 ± 0.00c	2.88 ± 0.20b
Control	8.54 ± 0.48a	7.87 ± 1.17a	11.19 ± 1.78a
Anthocephallus chinensis			
Bark	4.77 ± 0.60b	5.69 ± 0.12ab	14.55* ± 0.61a
Leaf	5.37 ± 0.64b	4.16 ± 0.02b	4.10 ± 0.49b
Control	8.54 ± 0.48a	7.87 ± 1.17a	11.19 ± 1.78a
Albizzia procera			
Bark	5.92 ± 0.92b	3.25 ± 0.51b	8.9 ± 0.21a
Leaf	5.79 ± 0.36b	3.19 ± 0.11b	10.48 ± 1.12a
Control	8.54 ± 0.48a	7.87 ± 1.17a	11.19 ± 1.78a

* Indicating stimulation over control value

A. chinensis reduced the germination of *B. campestris* as 1.16 % (in bark) and 6.98 % (in leaf) extracts compared with control. However, the reduction in *O. sativa* was 10.87% and 13.04% (in bark and leaf extracts) and 4.21% and 8.42% (in bark and leaf extracts) of *G. max*, respectively. The radicle growth of all crops reduced in *A. chinensis* compared with control, except *G. max* in bark aqueous extract, which was stimulated 30.03% over control value (Fig.1). The reduction of *O. sativa* over control was 44.14% in bark and 37.12% in leaf extracts. Similarly, *B. campestris* reduced 27.70% and 47.14% in bark and leaf aqueous extracts respectively (Fig.1).

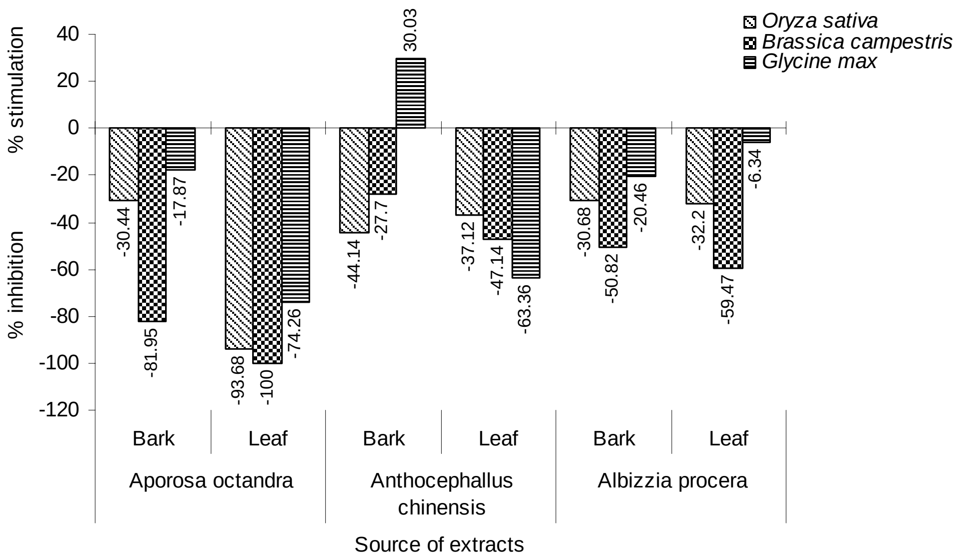

Fig. 1. Effect of aqueous extract on percent inhibition / stimulation of radicle length of food crops over control.

The germination of crops in *A. procera* (irrespective of leaf and bark treatments) was 82, 79.5 and 72.5% for *G. max, O. sativa* and *B. campestris,* respectively. The highest reduction in germination was 16.84% for *G. max* in bark extract whereas, minimum (10.53%) in leaf extract for *G. max*. The average growth of radicle across bark and leaf extracts of trees in test crops was 3.22 cm, 5.85 cm and 9.69% in *B. campestris, O. sativa and G. max*, respectively. The findings of this research show that the bark and leaf aqueous extracts of trees were toxic to these crops. The average germination of the crops (irrespective of trees and source of extract), *G. max* (84.5%) was the most tolerant crop followed by *O. sativa* (82.5%) and *B. campestris* (55%). However, germination (irrespective of crops and source of extract), *A. chinensis* (84.17%) was the most suitable tree followed by *A. procera* (78%) and *A. octandra* (59.83%). Similarly, like germination, radicle length was also higher in *Glycine max* (8.42 cm) followed by *O. sativa* (4.72 cm) and *B. campestris* (2.95 cm). Among the trees (irrespective of crops) the highest radicle length of crops was observed in *A. chinensis* (6.44 cm) followed by 6.25 (*A. procera*) and 3.39 cm (*A. octandra*).

Several workers reported that leaf and bark having toxic metabolites, which are distributed in plant parts (Rice, 1979; Igbonugo, 1986; Suresh and Vinaya-Rai, 1987). Bark and leaf extracts of *Grewia oppositifolia*, *Ficus roxburghii*, *Bauhinia variegata*, *Kydia calycina* were also reported toxic to *Echinochloa frumentacea*, *Elusine coracan*, *Zea mays, Vigna unguiculata* and *Glycine max* crops (Kaletha *et al.* 1996). Leaf and bark aqueous extracts of some agroforestry trees were tested for phytotoxic effects on germination and radicle length and found that leaf and bark of *Adina cordifolia* and *Grewia oppositifolia* reduced the germination of *Dolichous biflorus* and *Glycine max*. Radicle length of crops was also significantly reduced by *Adina cordifolia*, *Celtis australis*, *Grewia oppositifolia*, *Holoptelea integrifolia*, *Moringa olifera* and *Ougeina oojenensis* (Bhatt *et al.* 1993). Prasad *et al.* (2006) also reported the effect of aqueous extracts of leaf, pod and stem of *Cassia tora* tested on germination and seedling growth of *Parthenium hysterophorus*. The aqueous extracts of various parts of *Cassia tora* significantly inhibited germination and seedling growth of *Parthenium hysterophorus*. Tripathi e*t al.* (1998) tested *Tectona grandis*, *Albizia procera* and *Acacia nilotica* tree specie on germination and seedling growth of *Glycine max* and reported that leaf extract of all tree species showed stimulatory effect on germination, growth, chlorophyll, protein, carbohydrate and praline content of *Glycine max* and highest percent of germination stimulated in *Albizzia procera*. Kumar *et al.* (2006) tested three crops i.e. *Oryza sativa*, *Phaseolus vulgaris* and *Pisum sativum* under *Alnus nepalennsis*, *Artocarpus heterophyllus* and *Emblica officinals* tree species in bioassay culture and found germination of *Oryza sativa* stimulated in *Alnus nepalensis*, however the radicle growth of all food crops depressed significantly ($P < 0.01$, $P < 0.05$) under aqueous extracts of all trees.

CONCLUSIONS

The study reveled that in order of suitability of trees (irrespective of crops tested) were *A. chinensis* > *A. procera* > *A. octandra*. However, among the crops (irrespective of trees and source of aqueous extract) the most tolerant crop was *G. max* > *O. sativa* >

B. campestris. In general these tree species were found toxic to the growth of agricultural crops, even though the tree species tested help the farmers in various ways by providing fire wood, minor timber and fodder. The bark normally affects the growth of crops nearby bole of trees but leaves are more toxic for crops by spreading all over the area of agricultural fields. Therefore, in order to minimize the adverse effect of trees on crops, the frequency of trees if possible may be reduced and branches should be lopped before leaf shedding.

REFERENCES CITED

Bansal, G.L. 1992. The science of allelopathy: problems and prospects. *In* P. Tauro and S.S. Narwal (eds.). Allelopathy in agro-ecosystems. Indian Society of allelopathy, Harayana Agriculture University, Hisar, India.

Basavaraju T.B. and R. Gururaja. 2000. Tree-crop interactions in agroforestry systems: a brief review. Indian Forester, 126(11):1155-64.

Bhatt, B.P., D.S. Chauhan and N.P. Todaria. 1993. Phytotoxic effects of tree crops on germination and radicle extension of some food crops. Tropical Sci., 33:69-73.

Igboanugo, A.B.I. 1986. Phytotoxic effects of some Eucalyptus on food crops, particularly on germination and radicle extension. Tropical Sci., 26:19-24.

Kaletha, M.S., B.P. Bhatt and N.P. Todaria. 1996. Tree-crop interaction in traditional agroforestry systems of Garhwal Himalaya. 1. Phytotoxic effects of farm trees on food crops. Allelopathy J., 3(2):247-50.

Kumar, M., J.L. Jousha and B. Gopichand. 2006. Phytotoxic effects of agroforestry tree crops on germination and radicle growth of some food crops of Mizoram. Lyonia, 11(2):83-89

Melkania, N.P. 1984. Influence of leaf leachates of certain woody species on agricultural crops. Indian J. Ecol., 11:82-86.

Mughal, A.H. 2000. Allelopathic effects of leaf extract of *Morus alba* L. on germination and seedling growth of some pluses. Range Manage. and Agrofo., 21(2): 164-169.

Patric, Z.A., T.A. Toussoun and W.C. Snyder. 1963. Phytotoxic substances in arable soils associated with decomposition of plant residues. Phytopath., 53:152-161.

Patric, Z.A. 1971. Phytotoxic substances associated with the decomposition of plant residues in soil. Soil Sci., 111:13-8.

Prasad, S., B. Singh and N.P. Todaria. 2006. Effect of *Cassia tora* on germination and growth of *Parthenium hysterophorus* Allelopathy J., 17(2):303-311.

Putnam, A.R. 1985. Weed Allelopathy. *In* S. O. Duke (ed.). Weed Physiology, Reproduction and Ecophysiology 1, pp.131-155, Boca Raton, CRC, Press, Florida, USA.

Rice, E.L. 1974. Allelopathy. Academic Press, New York, USA.

Rice, E.L. 1979. Allelopathy- an update. Bot Rev. 45:5-109.

Rice, E.L. 1984. Allelopathy. Academic Press, New York, USA, p. 422

Robinson, T. 1983. The organic constituents of higher plants. 5th ed. North Amherst, Cordus Press, Massachusetts, USA.

Saxena, S. and J.S. Singh. 1987. Influence of leaf leachates from *Eucalyptus globulus* and *Aesculus indica* on the growth of *Vigna radiata* and *Lolium perenne*. Indian J. Ecol., 5:48-58.

Schreiner, O. and H.S. Reed. 1907. The production of deleterious excretions by roots. Bull. Torrey Bot. Club 34:279-303.

Schreiner, O. and H.S. Reed. 1908. The toxic action of certain organic plant constituents. Bot. Gazette (Chicago) 45:73-102.

Sharma, D.D., K.L. Sidana and R.R.Singhhvi.1982. Allelochemic effect of *Peganum harmala* L. on *Pennisetum typhoides* L. (Bajra). Indian J. Bot., 5:115-119.

Suresh, K.K. and R.S. Vinaya-Rai. 1987. Studies on the allelopathic effects of some agroforestry tree crops. Intl'. Tree Crops J., 4:109-15.

Tripathi, S., A. Tripathi, D.C. Kori and S. Tiwari. 1998. Effect of tree leaves aqueous extracts on germination and seedling growth of Soybean. Allelopathy J., 5 (1):75-82.

Whittaker, R.H. and P.P. Fenny. 1971. Allelochemics: chemical interactions between species. Sci., 171:757-70.