Indian J. of Agroforestry Vol. 17 No. 2 : 27-30 (2015)

Allelopathic potentialities of extracts of leaf litter of some selected tree species on wheat in field condition

Akshita Banga, O.P.S.Bana[1], Anil Yadava, V.K. Sah[1], Sumit Chaturvedi[1], Jyoti[2], P. Tripathi[3] and N. Bisht[1]

S.S. Jeena campus, Kumaun University, Almora -263 601. Uttarakhand, India

[1]G.B. Pant University of Agriculture and Technology, Pantnagar, U.S. Nagar -263 145. Uttarakhand, India

[2] D.S.B. Campus, Kumaun University, Nanital -263 139. Uttarakhand, India

[3]Y.S. Parmar University of Horticulture and Forestry, Nauni, Solan- 173 230. H. P., India

Corresponding author's Email: akshita.banga@gmail.com

ABSTRACT: Allelopatic effect of aqueous leaf extract of four agroforestry tree species *viz*., *Populus deltoides*, *Eucalyptus hybrid*, *Anthocephalus cadamba*, *Terminalia chebula* were examined on growth and yield of wheat in the *Tarai* region of Uttarakhand. The experiment was conducted in pot with thirteen treatments *i.e*. rhizospheric soil collected from underneath various tree species (i.e. Poplar, Eucalypt, Kadam, Harar) irrigated either with leaf extract of corresponding species or with normal water and normal soil collected from open field irrigated with either tree leaf extracts or normal water (control). The leaf extracts at 2 % concentration were applied only for first irrigation and later irrigations with normal water. The growth and yield of wheat was favoured by rhizospheric soil irrigated with corresponding tree leaf extract over either rhizospheric soil with normal water or normal soil plus leaf extracts/ water. The maximum grain yield of 13.03 (g/pot) was recorded with ES_2L_2 (rhizospheric soil from underneath Eucalypt irrigated with leaf extract of Eucalpyt, which was at par with ES_1L_1 (enriched soil from Poplar with Poplar extract), ES_3L_3 (enriched soil from Kadam with Kadam extract), ES_3NW (enriched soil from Kadam with normal water) and ES_4L_4 (enriched soil from Harar with Harar extract).

Key words: Agroforestry, allelopathy, leaf extract and rhizosphere

Received on: 23/12/2014 Accepted on: 26/06/2015

1. INTRODUCTION

Proper establishment of a crop is a pre-requisite for achieving optimum growth and productivity. Crop establishment is governed by a number of factors like quality of seed, soil physico-chemical properties, moisture, aeration and environmental factor like temperature. In agroforestry, wherein forest trees are deliberately integrated with agricultural crops, the soil properties are greatly influenced by way of litter fall, addition of tender twigs, rhizospheric alterations by roots etc. The freshly added tree biomass (litter, twigs and bark) also create physical barriers/obstacle to the germinating crops. Continuous addition of organic biomass/matter and its leachate/exudates releases allelochemicals during irrigation and rainy season, which are largely responsible for changed physico-chemical properties of soil. These allelochemicals enter into the ecosystem by way of volatilization, root exudation, leaching and litter decomposition. The addition of these allelochemicals may have varying degree of effects on seed germination, seedling vigour, crop growth and ultimately on the yield of the crops of different nature like cereals, pulses, oilseeds etc. depending upon their genetic makeup and physiology.

Agroforestry is a sustainable and economically viable land use system extending fast in many parts of the country particularly in northern states, where wheat as cereals, mustard as oilseeds and lentil as pulse are the major *rabi* (winter) crops. In a normal soil, under open field, sole crops are exposed to congenial environment. Whereas, in agroforestry system owing to changed atmospheric and rhizospheric environment, the crops growing condition are largely modified under the influence of woody components, which are likely to influence the crop performance. The effect of trees through root exudates or most probably through decomposition of litter has been significant in affecting crop growth and yield. Siddiqui *et al.* (2009) observed

the inhibited germination and radicle length in wheat by leaf extract of *Prosopis juliflora* under agroforestry land use system. Several workers have reported inhibitory effect of leaf extract of some tree species like *Eucalyptus* on germination and growth of associated crops. Thapaliyal *et al.* (2008) found that germination and radicle length of *rabi* crops namely wheat and lentil were reduced due to allelopathic effect of three commonly grown farm trees *viz. Terminalia bellirica, Terminalia chebula* and *Aegle marmelos*. However, stimulatory effect of *Azadirachta indica* leaf leachate on growth of crops like *Vigna radiata* and *Lolium perenne* have been reported by Saxena and Singh (1978).

The tree species like Poplar and Eucalyptus are already being raised in agroforestry by the farmers of the area. However, several other species have good agroforestry potential and may become important after development of adequate market for them. The present study, therefore envisages to assess the impact of enriched soil from underneath trees and the corresponding tree leaf extract on wheat crop growth and yield.

2. MATERIALS AND METHODS

A pot experiment was conducted to study the allelopathic effect of aqueous tree leaf extract of different tree species (viz., *Populus deltoids* (Poplar), *Eucalyptus hybrid* (Eucalyptus), *Anthocephalus cadamba* (Kadam), *Terminalia chebula* (Harar) on growth and yield of wheat.

Experimental details

Plants of wheat were raised from locally collected seeds in 20 cm diameter pots. For this each pot was filled with 5 kg of soil collected from 0-15 cm soil layer from the open field (independent from trees *i.e.* normal soil) and rhizospheric soil (underneath different tree species). Twenty four seeds of wheat variety "UP 2584" were sown in each pot by making twelve holes 3 cm deep and 5 cm apart from each other on November 23, 2009. Fifteen days after sowing, pots were thinned to12 plants/pot. At crown initiation stage, they were sprayed with 2% concentration (31.4 ml stock solution dissolved in tap water and final volume 314ml) of leaf extract of each species in corresponding enriched soil media in pots. The experiment was conducted in Randomized block design with twelve treatments (Table 1). For each treatment three replicates were maintained.

Table 1. Treatment details

Treatments	Symbol used
Enriched soil from under *Populus deltoides* + leaf extract*	ES_1L_1
Enriched soil from under *Populus deltoides* + normal water	ES_1NW
Enriched soil from under *Eucalyptus hybrid* + leaf extract	ES_2L_2
Enriched soil from under *Eucalyptus hybrid* + normal water	ES_2NW
Enriched soil from under *Anthocephalus cadamba* + leaf extract	ES_3L_3
Enriched soil from under *Anthocephalus cadamba* + normal water	ES_3NW
Enriched soil from under *Terminalia chebula* + leaf extract	ES_4L_4
Enriched soil from under *Terminalia chebula* + normal water	ES_4NW
Normal soil**+ *Populus deltoides* leaf extract	NSL_1
Normal soil+ *Eucalyptus hybrid* leaf extract	NSL_2
Normal soil+ *Anthocephalus cadamba* leaf extract	NSL_3
Normal soil+ *Terminalia chebula* leaf extract	NSL_4
Control (Normal soil + Normal water	NSNW

*The 2% aqueous leaf extract of each tree species was used to provide first irrigation in corresponding enriched soil media in pots.

**Normal soil was from open field, whereas enriched soil was the rhizospheric soil (0-15 cm depth) from under different tree species.

Data recording

Observation on growth parameters *viz.*, plant height and lead area/shoot were recorded at 40, 60 and 80 days after spraying following the post harvest observation *viz*, number of grain/ spike, grain weight/ spike,1000 grain weight and grain yield.

3. RESULTS AND DISCUSSION

Plant height

Plant height was measured at different growth stages to monitor the variation in growth of wheat plant due to different combinations of treatments. The plant height at all the growth stages was influenced significantly due to various conbinations of soil and tree leaf extract (Fig. 1). At 40 and 80th DAS, it was noticed that enriched soil from Kadam applied with leaf extract of Kadam (ES_3L_3) produced maximum plant height of 16.5 and 38.7 cm, respectively while at 60 DAS, it was with ES_2NW(enriched soil from under Eucalyptus + normal). Enhanced growth under enriched soils may be attributed to improved physico-chemical properties of the rhizospheric soils compared to open field conditions,

which provides better growing environment, particularly the nutrient supply. It is in accordance with the view of Sharma *et al.* (2005). The rhizospheric soil from underneath trees either with corresponding leaf extracts or normal water recorded significantly or numerically higher values for plant height as compared to soil from open/ normal soil with or without leaf extract.

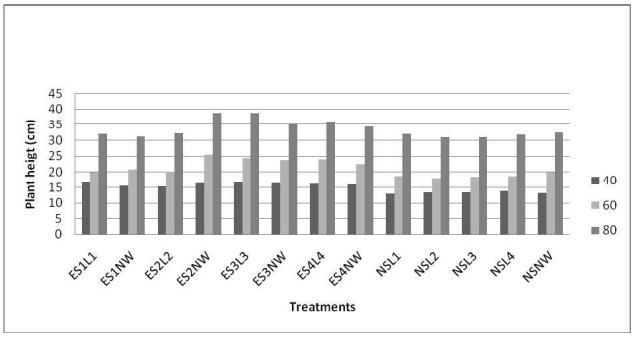

Fig. 1. Plant height (cm) of wheat as influenced by various treatments at different growth stages

Leaf area/shoot

Leaf area was significantly superior in rhizospheric soil treated with leaf extract, whereas it decreased under normal soil along with application of leaf extract.

After 80 DAS, application of leaf extract / normal water in rhizospheric soil and normal soil could not affect the leaf area significantly. The leaf area/shoot increased gradually from 40th to 60th day stage. Among all the treatment combinations, maximum (12.10 cm^2/shoot) leaf area at 40th DAS was attained in rhizospheric soil from underneath of Eucalyptus treated with normal water (ES_2NW), which was significantly superior than all the combinations of normal soil and leaf extracts/normal water but remained at par with all the combinations of soil from underneath trees and corresponding leaf extracts/normal water. At 60th day stage, the highest (28.38 cm^2/shoot) leaf area was recorded under ES_4L_4 (enriched soil from underneath Harar treated with Harar leaf extract), which was significantly more than all other combinations except ES_1NW (enriched soil from Poplar treated with normal water), ES_2NW (enriched soil from underneath Eucalyptus treated with normal water) and ES_3L_3 (enriched soil from underneath Kadam treated with its leaf extract) at 60th day stage (Fig. 2).

Yield and yield attributes

The result revealed that, yield attributing characters viz.,

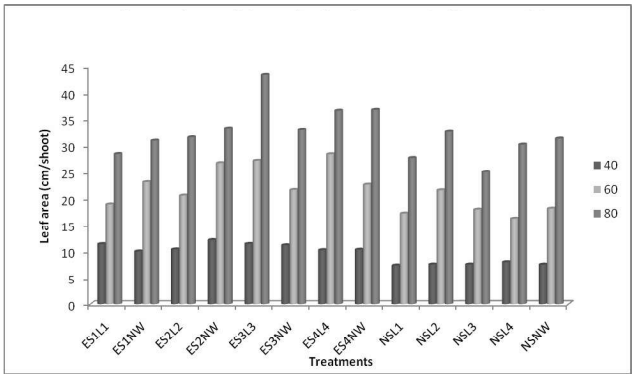

Fig. 2. Leaf area (cm2/shoot) of wheat as influenced by various treatments at different growth stages

grains/spike and grain weight/ spike were influenced significantly by various treatments (Table 2). Higher number of grains/spike and grain weight/spike were recorded under enriched soil from poplar with its leaf extract (ES_1L_1) which was followed by NSL4. ES_2L_2 (rhizospheric soil from underneath Eucalypt irrigated with leaf extract of Eucalpytus recorded the maximum grain yield, which was at par with ES_1L_1 (enriched soil from Poplar with Poplar extract), ES_3L_3 (enriched soil from Kadam with Kadam extract), ES_3NW (enriched soil from Kadam with normal water) and ES_4L_4 (enriched soil from Harar with Harar extract). All the combinations of rhizosphere soil with corresponding leaf extracts recorded higher grain yield as compared to their respective enriched soil with normal water combinations. The application of leaf extracts to the corresponding rhizospheric soils proved to be superior compared to the normal water application. However, leaf extracts and

Table 2. Yield and yield attributes as influenced by various treatments

Treatments	No. of grains/ spike	Grain weight/spike (g)	1000 - grain weight (g)	Grain yield (g/pot)
ES_1L_1	20.6	1.00	48.78	12.73
ES_1NW	19.0	0.82	43.51	10.82
ES_2L_2	14.4	0.62	42.87	13.03
ES_2NW	13.0	0.53	41.60	10.25
ES_3L_3	17.4	0.78	44.46	12.92
ES_3NW	14.1	0.65	46.13	11.65
ES_4L_4	18.8	0.82	44.34	12.23
ES_4NW	16.0	0.82	46.80	10.32
NSL_1	19.5	0.84	43.73	10.40
NSL_2	18.3	0.87	47.51	10.67
NSL_3	18.5	0.81	43.68	9.67
NSL_4	19.9	0.91	45.77	10.92
NSNW	19.5	0.93	43.09	10.62
C D at 5%	3.6	0.18	NS	1.75

normal water had no significant difference for grain yield/ pot under normal/soil from open. Grain yield increased significantly under rhizospheric soil from underneath trees plus corresponding leaf extract than rhizospheric soil plus normal water. It may be due to continuous addition of tree leaves and other plant parts in rhizospheric soil that gets enriched in terms of soil organic matter and other plant essential nutrients, which probably, besides ensuring higher nutrient availability also improves the physical condition.

REFERENCES

Saxena, S. and Singh, S. 1978. Influence of leaf leachates from *Eucalyptus globulus* and *Aesculus indica* on the growth of *Vigna radiata* and *Lolium perenne*. *Indian J. Ecology*, 5: 148-152.

Sharma, N.K., Sharma, J.S. and Dadhwal, K.S. 2005. Effect of poplar leaves incorporation on growth and yield of wheat in relation to fertilizer application. *Indian Forester*, 131(4): 563-573.

Siddiqui, S., Bhardwaj, S., Khan, S.S., and Meghvanshi, M.K. 2009. Allelopathic effect of different concentration of water extracts of *Prosopis juliflora* leaf on seed germination and radicle length of wheat (*Triticum aestivum* Var-Lok-1). *American- Eurasian J. Sci. Res.* 4(2): 81-84.

Thapaliyal, S., Bali, R.S., Singh, B. and Todaria, N.P. 2008. Allelopathic effects of tree of economic importance on germination and growth of food crops. *J. Herbs, Spices and Medicinal plants*, 13(4): 11-23.