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Saumya Sharon Xaxa
Research Scholar, Dept of Silviculture and Agroforestry, Sam Higginbottom University of Agriculture, Technology & Sciences, Allahabad, Uttar Pradesh, India

Sameer Daniel
Assistant Professor, Dept of Silviculture and Agroforestry, Sam Higginbottom University of Agriculture, Technology & Sciences, Allahabad, Uttar Pradesh, India

Koshika Srinivas
Research scholar, Dept of Silviculture and Agroforestry, Sam Higginbottom University of Agriculture, Technology & Sciences, Allahabad, Uttar Pradesh, India

Alka Suren
Research scholar, Dept of Silviculture and Agroforestry, Sam Higginbottom University of Agriculture, Technology & Sciences, Allahabad, Uttar Pradesh, India

Correspondence
Saumya Sharon Xaxa
Research scholar, Dept of Silviculture and Agroforestry, Sam Higginbottom University of Agriculture, Technology & Sciences, Allahabad, Uttar Pradesh, India

Effect of aqueous leaf extracts of poplar (*Populus deltoides* L.) on germination and seedling growth of wheat varieties (*Triticum aestivum* L.)

Saumya Sharon Xaxa, Sameer Daniel, Koshika Srinivas and Alka Suren

Abstract
Laboratory experiment was conducted in the College of Forestry, SHUATS, Allahabad to determine effect of aqueous leaf extracts of *Populus deltoides* L. on the germination (%) and seedling growth, biomass and vigour index of *Triticum aestivum* during 2017-2018. It was noted that aqueous extracts at a concentration of 10, 20 and 40% had inhibitory effect on wheat germination and effect was found significantly higher than control treatment. The maximum germination percentage was observed in wheat variety PBW- 502 whereas the seedling growth, biomass and vigour index was observed maximum in variety PBW-154. The interaction between aqueous extracts concentration and different wheat varieties was found to be non- significant. Therefore it is observed that as the concentration of the poplar leaf extracts increases, its detrimental effects also increases on the wheat varieties.

Keywords: agroforestry, *Populus deltoides* L., aqueous extract conc., wheat varieties, allelopathy

Introduction
Cultivating agricultural crops and trees together is an ancient practice world-wide. Agroforestry refers to the sustainable land use systems involving trees combined with arable crops or animals on the same unit of land in some form of spatial arrangement or temporal sequence. In India, it has been a traditional practice and has received greater emphasis in recent years as a sustainable land use option of high potential. In agroforestry systems there are both ecological and economical interactions between the different components (Lundgren and Raintree, 1982) [5]. Allelopathy is a biological phenomenon by which an organism produces one or more biochemicals that influence the germination, growth, survival, and reproduction of other organisms. These biochemicals are known as allelochemicals and can have beneficial (positive allelopathy) or detrimental (negative allelopathy) effects on the target organisms and the community. Numerous metabolic chemicals involved in plant- plant interactions are released from the plants, primarily through leaching from above ground parts and play a significant role in plant interactions (Tukey, 1970) [10]. Allelopathic interactions in tree crop associations in agroforestry greatly influence the crop production.

Poplar (*Populus deltoides*), a winter deciduous tree, belonging to family Salicacae which is multipurpose fast growing valuable timber species. Poplar has emerged as one of the most suitable tree species for agrisilviculture system and has proved itself to be the most promising tree in irrigated agroecosystems of northern parts of India and is being raised either as block plantation or along field boundaries/windbreaks. Straight clean bole and leaflessness during winter also makes poplar very suitable for the system. Poplar has become the most preferred cash crop in north-western states (Chandra, 1986) [1]. Almost any crop (cereals, pulses, vegetables, forage, fruit/vegetable crops, etc.) can be grown with it (Sharma, 1996) [8]. Wheat during the winter season is most widely cultivated crop in the interspaces of poplar. Further, adoption of poplar-wheat model is common because of extensive research on model, food requirements and minimum support price attached with the crop for ensured marketing.

But recently, there have been reports that the growth and productivity of the wheat is reduced in the fields sheltered by *P. deltoides* and the observed reduction was due to the allelopathic interference of the tree (Sharma *et al.*, 2000) [9]. Therefore, detailed studies on the effect of tree allelochemicals on seed germination, growth and metabolism of crop plants needs to be conducted prior to recommending any tree species for agroforestry programme. Despite the increase in research on allelopathy in agroforestry systems from the last two decades, little work has been carried out to test the allelopathic effect of poplar on performance of wheat under central region of Uttar Pradesh, which needs further investigations. The present experiment is therefore, planned to study the different aqueous leaf extracts of *Populus*

deltoides on different vareities of *Triticum aestivum* under laboratory conditions on germination and growth attributes of cereal crop wheat.

Materials and Methods

The fresh leaves were collected from fully matured tree of *Populus deltoides* from research nursery of College of Forestry, Allahabad. The leaves were fully dried under shade for 3 days and ground to powder and passed through a mesh sieve to remove the visible plant residues. Aqueous extract was prepared by soaking 10g, 20g and 40g of leaf powder in 1000 ml distilled water for 24 hrs. at room temperature for the preparation of (T_1) control where distilled water was used 10% (T_2), 20% (T_3)and 40%(T_4) concentration of leaf extract respectively and the treatments were replicated three times in a completely randomized block design. The aqueous extract was filtered through four layers of cotton cloth and Whatman No. 1 filter paper and further diluted with distilled to get required concentration. Ten seeds were placed uniformly in petridishes containing double layered Whatman No.1 filter paper and watered daily with respective extract to maintain moisture for proper germination. In this way treatments consisted of 3 different concentrations and 1 control (10%, 20%, 40%and control). Germination and growth parameters (shoot and shoot length) were recorded on the twelveth day after sowing. Germination was determined by counting the number of germinated seeds. Shoot and root length of the germinated seed were measured using ruler.

Results and Discussion

Germination percentage

The results presented in Table-1 shows that wheat varieties have been influenced by different aqueous extracts of *P.deltoides* L. treatments. All the concentrations had inhibitory effect on the germination of all varieties as compared to the control treatment**.** It can be seen from the data in Table-1 that only wheat variety PBW-502 produced maximum number of seedlings (93.33%) over all other varieties while variety PBW-343 was found most sensitive towards the aqueous extracts. The interaction also showed that each concentration of extract had injurious effect on all wheat varieties than control treatment. The interaction among various aqueous extract conc. of *P.deltoides* and wheat varieties depicted that germination percentage of seed decreased with increase in concentration of leaf extract. Similarly, Garima *et al*., (2017) [2] has also reported an inhibitory effect of *P. deltoides* leaves on germination, radical and plumule length of cereal crops.

Shoot and root length (cm)

The results presented in Table-1 shows that aqueous extract concentration of *P.deltoides* has inhibitory effect on the shoot as well as root length of all wheat varieties as compared to the control treatment. It can be seen from the data in Table-1 that wheat variety PBW- 154 has maximum shoot and root length whereas wheat variety PBW-343 has minimum shoot and root length. The interaction among various aqueous extract conc. of *P.deltoides* and wheat varieties showed that shoot and root length decreased with increase in concentration of leaf extract and was found to be non- significant. Similarly, Nandal and Dhillon (1999) reported inhibitory effect of *P. deltoides* on germination, shoot and root length of wheat. Khan *et.al.*, (2014) [4] also found that the aqueous leaf leachate of three species (eucalyptus, guava, and litchi) was found to have inhibitory effect on germination, shoot, and root elongation on the tested crops viz. *Zea mays* L. (Maize) and *T. aestivum*.

Table 1: Effect of aqueous leaf extracts of *P.deltoides* on germination (%), shoot and root length (cm) of wheat varieties

Wheat Varieties	Concentration of poplar extract														
	Control			10%			20%			40%			Mean		
	G%	SL	RL	G%	SL	RL	G%	SL	RL	G%	SL	RL	G%	SL	RL
PBW-343	98.33	9.49	7.81	94.00	7.75	5.94	88.66	6.84	4.14	80.66	5.89	3.24	90.41	7.49	5.28
PBW-154	96.66	11.10	9.40	95.33	9.25	7.26	94.00	7.99	6.81	79.00	6.64	4.54	91.25	8.74	7.00
HD-2967	99.33	9.65	8.17	96.66	8.57	6.22	90.00	7.42	5.30	78.66	6.06	3.50	91.16	7.92	5.80
PBW-502	100.00	10.54	9.04	99.66	8.82	7.04	93.33	7.32	5.44	81.66	6.39	4.00	93.66	8.27	6.38
Mean	98.58	10.20	8.60	96.41	8.60	6.61	91.50	7.39	5.42	80.00	6.24	3.82			

CD at 5% for	Germination %	Shoot length	Root length
Variety	5.496	0.717	0.731
Treatments	-	0.717	0.731
Variety × treatment	-	-	-

Fresh and dry weight (g)

The data in Table-2 reveal that aqueous extracts of different concentrations significantly reduced the fresh and dry weight of wheat seedlings over control. The interaction among wheat varieties and concentrations was also found to be non-significant. Wheat variety PBW- 343 was adversely affected by the aqueous extract concentration and wheat variety PBW-154 was least affected. As the concentration increases there was decrease in the fresh and dry weight of wheat as compared to control. Ziaebrahimie *et.al.*, (2007) [11] reported that when the water extracts of eucalyptus leaves examined on germination and growth of three wheat cultivar seeds and seedlings. Results showed that: germination percentage strongly decreased, leaf and root lengths also affected and dry and wet weights of both roots and shoots showed similar change patterns. Khan *et al.*, (2009) [3] determined the allelopathic influence of aqueous extracts of *Eucalyptus camaldulensis* L. on the germination (%) and seedling growth (fresh and dry weight) of wheat. The inhibitory effects were increased as the extract concentration increased.

Seed vigour index

The data in Table-2 reveal that aqueous extracts of different concentrations significantly reduced seed vigour index of wheat seedlings over control. All the concentrations had inhibitory effect on the seed vigour index of all varieties as compared to the control treatment**.** It can be seen from the data in Table-2 that only wheat variety PBW-154 has maximum seed vigour index over all other varieties while variety PBW-343 was found most sensitive towards the aqueous extracts. The interaction among various aqueous extract conc. of *P.deltoides* and wheat varieties depicted that vigour index decreased with increase in concentration of leaf extract and was found to be non- significant. The present

findings corroborate the earliest report by Rehman *et al.*, (2010) [7] using extract of *Euphorbia heliscopia* L. against wheat, chick pea and lentil that as the concentration increases the seed vigor index decreases.

Table 2: Effect of aqueous leaf extracts of *P.deltoides* on fresh and dry weight (g), vigour index of wheat varieties

Wheat Varieties	Concentration of poplar extract														
	Control			10%			20%			40%			Mean		
	FW	DW	VI	FW	DW	VI	FW	DW	VI	FW	DW	VI	FW	DW	VI
PBW-343	1.06	0.23	1700.31	0.80	0.13	1285.22	0.60	0.15	976.32	0.50	0.11	739.42	0.74	0.15	1175.32
PBW-154	1.26	0.35	1981.13	0.96	0.26	1575.31	0.73	0.23	1391.66	0.73	0.20	875.12	0.92	0.26	1455.81
HD-2967	1.10	0.30	1770.90	0.83	0.20	1434.16	0.66	0.16	1144.80	0.60	0.13	759.90	0.80	0.20	1277.44
PBW-502	1.20	0.33	1958.66	0.91	0.23	1581.56	0.70	0.20	1195.53	0.70	0.16	851.76	0.87	0.23	1396.88
	1.15	0.30	1852.75	0.87	0.20	1469.06	0.67	0.18	1177.08	0.63	0.15	806.55			

CD at 5% for	Fresh wt.	Dry wt.	Vigour index
Variety	0.131	0.061	109.291
Treatments	0.131	0.061	109.291
Variety × treatment	-	-	-

Conclusion

From the present investigation in laboratory it can be concluded that wheat variety PBW-502 has maximum germination (%) whereas wheat variety PBW-154 was observed as the best wheat variety suitable for plantation under poplar based agroforestry system as its growth parameters and biomass were observed higher as compared to other wheat varieties. Thus, such studies may help in identifying suitable wheat variety and amount of leaf litter to be retained in the field for higher productivity in poplar based agrisilviculture system. It also revealed that aqueous extract of *Populus deltoides* at various concentration levels inhibited the germination, reduced fresh weights and dry weights of wheat seedlings. The study provides the evidence that *Populus deltoides* has allelopathic potential on wheat crop. Based on these results it can be concluded that allelopathy is a concentration dependent phenomenon, as the concentration of the poplar leaf extracts increases, its detrimental effects also increases on receptor plant.

As it is result of only one year study, further experimentation is required for its recommendation which will help in enhancing yield per unit area for sustaining productivity and fertility of soil.

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