Article

Evaluation of allelopathic potential of agricultural land associated trees on germination attributes of wheat (*Triticum aestivum* L.)

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Abstract
An experiment was conducted to determine the allelopathic effects of leaves of different trees including *Juglans regia, Melia azedarach,* and *Ailanthus altissima*, on the germination of two different wheat varieties i.e., traditional and approved. Significant variation was noticed among the treatments in germination attributes. Maximum radical length was observed in both the wheat varieties due to aqueous leaf extract treatments of *J. regia* while minimum radical length was observed in both the wheat varieties by the aqueous leaf extract of *M. azedarach*. While maximum plumule length in both wheat varieties was also revealed by the aqueous leaf extract of *J. regia* while minimum plumule length was observed by extract of *M. azedarach.* Furthermore, the allelopathic effect of *M. azedarach* was observed to have great r than *A. altissima* on the germination and growth of wheat. it is concluded that leaves of *J. regia* can be used as bio fertilizer due to its growth enhancing effect while leaves of *M. azedarach* and *A. altissima* contains allelo-chemicals that strongly inhibit the seed germination and reduce plumule and radical length of wheat.

Keywords allelopathic; allelochemicals; wheat; weeds; germination.

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1 Introduction

Wheat *(Triticum aestivum* L.) and it is the major cereal crop of the world. Wheat is an edible grain, one of the oldest and most important belonging to the family Poaceae cereal crops (Marwat et al., 2013). In 100 grams, wheat provides 327 calories and is a rich source of multiple essential nutrients, such as protein, dietary fiber, manganese, phosphorus, carbohydrates and niacin (Shewry et al., 2015).

In Pakistan, wheat contributes about 10% to agriculture and 2.1% to total GDP of the country (ESP, 2014-2015). Average grain yield of wheat is very low, i.e., 2.845 tons ha^{-1} (ESP, 2016-17). According to Nayyar et al. (1992), major causes of low production are uncertainty of rain-fall, sub-standard methods of cultivation, insufficient water availability and weed invasion.

Weeds are unwanted plants which were born at the same time when a man started to grow the plants intentionally for food. According to Marwat et al. (2013), about 30,000 weeds have been reported from all over the world. Dangwal et al. (2010) stated 250 weed species which usually cause damage to major food crops. A study carried out to investigate the weed flora of District Mansehra, Pakistan revealed 63 weed species belonging to 32 families, common in food crops (Shah and Khan, 2008). About 30 different kinds of weed species are usually found in the field of wheat in Sindh from which 12 to 16 weed species are broadly distributed and causing losses up to economic threshold level (Ahmed and Sheikh, 2003). The farmers are not paying a serious attention on the weed control or using eradication practice, thus the competitive and allelopathic nature of these weeds are estimated to cause about 17-25% loss, found by agricultural research in wheat annually (Tunio, 2004).

Allelopathy is a biological phenomenon of interaction among plants by which an organism produces one or more biochemical's that influence the germination, growth, survival, and reproduction of other organisms (Iqbal et al., 2010). These biochemical's are known as allelochemicals and can have beneficial (positive allelopathy) or detrimental (negative allelopathy) effects on the target organisms and the community (Zhang, 2014; Shah et al., 2019). Allelochemicals can potentially be used as growth regulators, herbicides, insecticides, and antimicrobial crop protection products (Cheng and Cheng, 2015). Different modes of action are shown by allelochemicals on the plant. Such as the inhibition of root and shoot reduction of seeds germination and these are the first visible allelopathic stress symptoms. Allelopathy plays an important role in agro-ecosystems and affects the quality and quantity of growth (Kohli et al., 1991; Singh et al., 2001). Plants produce a large variety of secondary metabolites like phenols, tannins, terpenoids, alkaloids, polyacetylenes, fatty acids and steroids, which have an allelopathic effect on the growth and development of some plant or neighboring plants. Considerable knowledge has been obtained concerning the chemicals involved in allelopathy and their effect on other plans (Rice, 1984; Narwal and Tauro, 1994). These chemicals are produced in above or below ground plant parts or in both to cause allelopathic effects in a wide range of plant communities.' For example, the bark, leaf and leaf litter extracts of *Quercus glauca* and *Q. leucotrichophora* significantly suppressed the both germination plumule and radical length and chlorophyll content of wheat, mustard and lentil (Bhatt et al., 1994). Therefore, the current study was carried out to evaluate the effect of selected tree leaves on local and approved wheat varieties.

2 Study Area and Methodology

2.1 Study site

Fresh leaves of *Juglans regia, Melia azadarach* and *Ailanthus altissima,* were collected from the agriculture land of tehsil Mansehra and Experiments were conducted at department of botany, Government Post College, Mansehra, Pakistan.

2.2 Data collection

After collection the proposed allelopathic trees leaves were washed, and shade dried then were grinded separately in a grinder for preparation of different extracts concentrations. Then after sieving the material stored in air tight glass bottles. The seeds of *Triticum aestivum* were soaked in distilled water overnight. Next day the seeds were surface sterilized with 0.1 percent mercuric chloride solution for two minutes and washed twice with distilled water.

The experimental treatments were T_1= *Juglans regia* (5g), T_2= *Juglans regia* (10g), T_3= *Melia azadarach* (5g), T_4= *Melia azadarach* (10g), T_5= *Ailanthus altissima* (5g), T_6= *Ailanthus altissima* (10g) and a control T_0= Distilled water.

The experiment was conducted in the lab by using the completely randomized design (CRD). In the 250-ml Erlenmeyer flasks containing 100-ml distilled water, 5 and 10 grams of grinded plant leaves material was added in separate flasks then wrapped by aluminum foil and placed for 8-10 days in laboratory. After that each flask material was filtered into separate beaker and tagged. Filter paper was placed in each Petri dish, then 8-10 seeds of wheat were placed in Petri dishes and extract of plants were added in it (amount moistened the filter paper).

2.3 Data analysis

Analysis of variance (ANOVA) was evaluated to find the level of significance by statistically analyzing the recorded data (Khan et al., 2016). For calculating mean values comparison, least significant difference (LSD) test at 5% level was Statistical software (SPSS 8.1) was used for analysis.

3 Results and Discussion

The comparative performance investigation of wheat seedlings, the quantitative attributes such as radical and plumule length of wheat were observed and recorded. The comparative performance of wheat seedling attribute is given in the following;

3.1 Wheat seedling attributes

3.1.1 Radical length

Data regarding radical length is presented in Fig. 1 which shows a gradual increase in all varieties and treatments as recorded after regular interval of time, i.e., day 4, 6 and 8. Maximum radicle length was recorded in V2T0 (17.8 cm) followed by V1T3 (17.5 cm). Control and experimental treatments were significantly different from each other.

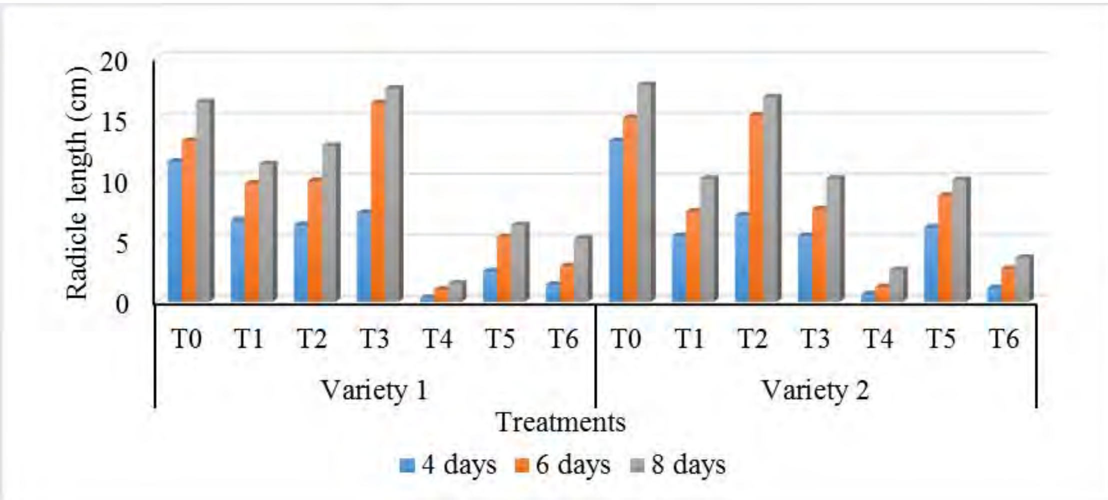

Fig. 1 Radicle length in all treatments after 4, 6 and 8 days of experiment.

3.1.2 Plumule length

Data regarding plumule length is presented in Fig. 2 which shows a gradual increase in all varieties and treatments as recorded after regular interval of time, i.e., day 4, 6 and 8. Maximum radical length was recorded in V1T0 (5.6 cm) followed by V2T1 (5.4 cm). Significant difference was observed in experimental and control treatments.

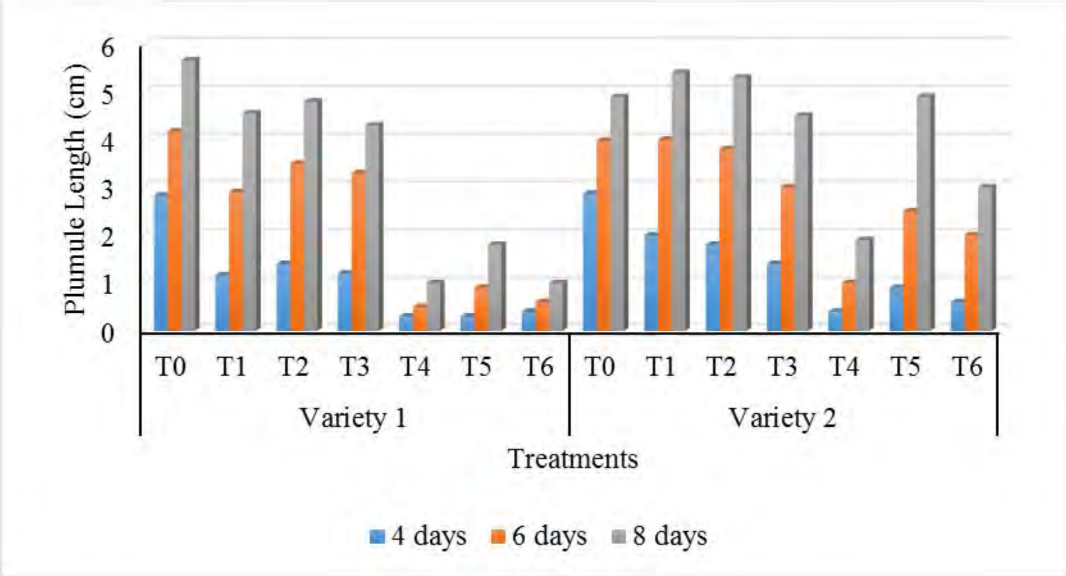

Fig 2. Plumule length in all treatments after 4, 6 and 8 days of experiment.

3.2 Correlation Studies

The correlation study of both the traits of wheat seedling growth was obtained and the results are shown in (Table 1 and 2).

3.2.1 Wheat (Traditional)

The correlation results (Table 1) showed that root length and plumule length at day 4, 6 and 8 is positive and highly significantly correlated with all the attributes.

3.2.2 Wheat (Approved)

The correlation results (Table 2) showed that root length and plumule length at day 4, 6 and 8 is positive and highly significantly correlated with all the attributes.

Table 1 Correlation coefficient of wheat among quantitative traits evaluated at different treatments of application.

Traits	RL day : (cm)	PL day 3 (cm)	RL day 4 (cm)	PL day 4 (cm)	RL day 5 (cm)	PL day 5 (cm)	RL day 6 (cm)	PL day 6 (cm)	RL day 7 (cm)	PL day 7 (cm)	RL day 8 (cm)	PL day 8 (cm)
RL day 3 (cm)												
PL day 3 (cm)	. 800											
RL day 4 (cm)	**.915**	**.844**										
PL day 4 (cm)	**.836**	**.977**	. 890									
RL day 5 (cm)	.905	**.802**	**.983**	.857								
PL day 5 (cm)	.820	**.766**	**.876**	.851	.861							

RL day 6 (cm)	.856	**.721**	.937	.801	**.967**	.871						
PL day 6 (cm)	.774	**.719**	.836	.823	.817	**.923**	.839					
RL day 7 (cm)	.851	**.738**	.931	.803	.961	.874	**.989**	.835				
PL day 7 (cm)	.710	**.667**	.780	.778	.756	.856	.789	**.972**	.779			
RL day 8 (cm)	.850	**.735**	.935	.805	.965	.863	.990	.835	**.998**	.785		
PL day 8 (cm)	.624	**.568**	.706	.680	.691	.808	.739	.924	.721	**. 959**	.719	

Highly significant at P< 0.01

Table 2 Correlation coefficient of wheat among quantitative traits evaluated at different treatments of application.

Traits	RL day 3 (cm)	PL day 3 (cm)	RL day 4 (cm)	PL day 4 (cm)	RL day 5 (cm)	PL day 5 (cm)	RL day 6 (cm)	PL day 6 (cm)	RL day 7 (cm)	PL day 7 (cm)	RL day 8 (cm)	PL day 8 (cm)
RL day 3 (cm)												
PL day 3 (cm)	. 800											
RL day 4 (cm)	**.915**	**.844**										
PL day 4 (cm)	**.836**	**.977**	. 890									
RL day 5 (cm)	.905	**.802**	**.983**	.857								
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PL day 8 (cm)	.624	**.568**	.706	.680	.691	.808	.739	.924	.721	**. 959**	.719	

Highly significant at P< 0.01

Results from this experiment reveal maximum radical length in petri dishes supplemented with *Melia azadarach* (5g) for traditional wheat variety. While, for approved variety, control treatment, i.e., distilled water was found to be the best. However, same plant extract showed minimum radical length at higher concentration (10g) in both varieties. It shows that the quantity and concentration of plant extract must be optimized in order to achieve desired results.

Plumule length was maximum in control for traditional variety while in approved variety, it was maximum in *J. regia* (5g). This result is similar to Aliskan and Terzi (2001). The phytochamicals like caryophyllene, pinene, germacrene are present in *J. regia* leaf which increase the length of plumule in wheat germination (Verma et al., 2013). It is concluded that *J. regia* leaves can be used as biological fertilizer because of its growth enhancing effect. Again, minimum plumule length was observed in both varieties supplemented with *M. azedarach* (10 g). Similar results were reported by Khan et al. (2016). Leaves of *M.*

azedarach are more toxic and has inhibitory effect on germination of wheat, and it decrease the wheat radical and plumule length. It might be due to presence of 1,4- benzene dicarboxylic acid dimethyl ester, melianone, melianol and melianodinol (Khan et al., 2016).

4 Conclusion

Based on this investigation we suggest concluded that leaves of *J. regia* should be used as biological fertilizer because of its growth supporting and enhancing effect. While the leaves of *M. azedarach* are more toxic and has inhibitory effect on the germination of wheat as compared to other trees. This tree should not be planted near to crop as well as irrigation land because during germination period in autumn season that is November their leaves fall down in field of wheat and produce aqueous extract due to action of rain water and ultimately decreases growth and(delete) germination and growth

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