INNSPUB

International Journal of Biosciences | IJB |
ISSN: 2220-6655 (Print) 2222-5234 (Online)
http://www.innspub.net
Vol. 9, No. 2, p. 120-125, 2016

RESEARCH PAPER OPEN ACCESS

Allelopathic effect of some tree fruits on wheat (*Triticum Aestivum* L.)

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Key words: Wheat, Allelopathy, Germination, Yield, Pakistan

http://dx.doi.org/10.12692/ijb/9.2.120-125 Article published on August 31, 2016

Abstract

An experiment was conducted to determine the allelopathic potentials of fruits of different plant species on the germination of wan heat variety Pir Sabaq 2005. The experiment was laid out in completely randomized design (CRD) with three treatments and four replications. The aqueous solution of fruits of three plant species including *Eucalyptus camaldulensi, Melia azedarach* and *Sapindus mukorossi* were applied on wheat germination. All treatment significantly decrease the plumule and radical length as compare to control that is TO. Maximum root length was observed in control while minimum root length was observed in wheat due to aqueous fruit extract of *Melia azedarach*. Maximum length of seedling of wheat was observed in control while minimum seedling length was observed by extract of *Melia azedarach*. Allelopathic effect of fruit on root length can be represented as To> *Sapindus mukorossi*> *Eucalyptus camaldulensis*> *Melia azedarach* and same effect was observed in seedling length that can be shown as To > *Eucalyptus camaldulensis*> *Sapindus mukorossi*> *Melia azedarach*. It c concluded that fruit of *Melia azedarach* are more toxic and has inhibitory effect on germination of wheat as compare to other trees. This tree should not be planted near to crop because during germination period that is November their fruits become mature and fall down in field of wheat and produce aqueous extract due to action of rain water and ultimately decrease the germination.

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Introduction

Wheat (*Triticum aestivum* L.) is the main source of food all over the world. It is also known as king of cereals (Hyne 1987). It is originated from the Levant region of the Near East and Ethiopian Highlands, but now cultivated worldwide. In 2010 world production of wheat were 651 million tons, making it the third most-produced cereal after maize (844 million tons) and rice (672 million tons). Pakistan is the 8th largest wheat producer, contributing about 3.17% of the world wheat production from 3.72% of the wheat producing area.

Agro-forestry species remain a part of the agro-ecosystem for a longer period and large amount of litter is produce by it. This litter on the soil not only produces nutrient enrichment, but can also have harmful effects on the agricultural crops due to the release of the toxic substances (Ahlgren and Ahlgren, 1981). By action of rain or through decomposition of litter these toxic substances may be released. As a result toxic substances are release into the soil and inhibit seed germination of certain crops (Rice, 1979). Some scientists reported the inhibitory effect of *Dalbergia sissoo, Eucalyptus*, *Babusa* spp., *Tectonia grandis, Salix babylonica, Acacia nilotica, Morus alba, Bauhinia variegata, Ficus bengalensis, Poplus deltoides, and Leucaena leucocephala* on germination and seedling growth of certain crops (Hossain *et al*., 2002). These toxic substances were called allelochamicals and this phenomenon is called Allelopathy.

Allelopathy is Greek term which is combination of two words *allelo* and *pathy* (meaning "mutual harm" or "suffering"). This term use first time in 1937 by Austrian scientist Hans Molisch in the book Der Einfluss einer Pflanze auf die and ere- Allelopathie (The Effect of Plants on Each Other) published in German language (Willis *et al.,* 2007). He used the term to indicate biochemical that inhibits the growth of neighboring plants, by another plant (Roger *et al.,* 2006). The potential of crop residue allelopathy for weed suppression has been reviewed (Rice *et al.,* 1984.).

If crop plants during seedling time show allelopathy suppressed a weed species, crop plants will gain an advantage over weeds. Various crops have allelopathic potential or weed-suppressing activity, including oat wheat and rice (Wu *et al*., 1999, Dilday *et al*., 1994; Olofsdotter and Navarez, 1999). Khan and Hussain (2008) reported the allelopathic effects of *Eucalyptus* (*Eucalyptus camaldulensis* L.) on germination and seedling growth of wheat (*Triticum aestivum* L.). Adeniyi and Ayepola (2008) have screened the phytochemicals like tannins, saponins, cardiac glycosides in leaf of *Eucalyptus camaldulensis* L.

Fikreyesus (2011) conducted an experiment to determine the allelopathic effect of Leaf, root, bark and fruit extracts of *Eucalyptus camaldulensis* on tomato. Results also revealed that inhibitory effect was more pronounced in radicle length and germination efficiency rather than plumule length. Soil sample also showed significant ($P<0.01$) inhibitory effect on shoot length, root length, leaf area index and dry weight.

The major constituents of the essential oil from *E. camaldulensis* Dehn. were ethanone (25.36%), eucalyptol (13.73%),- caryophyllene (11.55%) and carvacrol (9.05%). Eucalyptol (50.13%) was identified as the main constituent of the essential oil of *Myrtus communis* L. The other important components were linalool (12.65%), terpineol (7.57%) and limonene (4.26%). (Akin and Aktumsek, 2012).

Xing-li (2007) studied the allelopathic effect of *Melia azedarach* L. fruits extract on against weeds and crops. In a paper disk assay, this extract inhibited the seed germination of *Avena sativa* L., *Brassica napus* L., *Chenopodium album* L., *Lactuca sativa* L. and *Sorghum halepense* L. Four chemical comstituents from the fruits of *M. azedarach* L. were isolated by techniques of column chromatography, TLC and spectroscopic data (IR, NMR, MS) etc. The structures of the four crystalline substances were identified, i. e. 1,4- benzenedicarboxylic acid dimethyl ester, melianone, melianol and melianodinol (Liding and Jingwen, 1996).

The two triterpenoidal saponins 2 and 3 containing hederagenin aglycone moiety (I) have been isolated from the butanol soluble fraction of the fruits (without shells) of *Sapindus mukorossi* (Azhar and Usmanghani,1993). *Sapindus mukorossi* has phytoconstituent that are triterpenoidal saponins of oleanane, dammarane and tirucullane type (Suhagia and Rathod,2011). The allelopathic effects of leaves, shoot and bark of *Quercus baloot* Griff, were evaluated under laboratory conditions on *Lactuca sativa, Setaria italica* and *Pennisetum americanum*.

Bearing these considerations in mind aim of this study is to investigate the allelopathic effects of fruits of *Eucalyptus camaldulensi, Melia azedarach* and *Sapindus mukorossi* on wheat germination and growth as these trees are planted near bank of agricultural field.

Materials and methods

Collection of plant material

Fresh fruit of *Eucalyptus camaldulensi, Melia azedarach* and *Sapindus mukorossi* were taken from vicinity of Department of Botany, Hazara University Mansehra in April 2013. The dried fruit were grinded separately in a grinder and after sieving, stored in air tight glass bottles. Aqueous extracts of fruit were prepared by adding 5 and 10 gm of air dried fruit in 100 ml of distilled water kept for 24 hrs at room temperature. It was filtered through Whatman filter paper no. 1 and the volume of the filtrate made to 100ml (Dhawan and Narwal, 1994).

Petridish experiment

Glass petridish (9.0×1.5 cm) were used to study the allelopathic effect of aqueous extract and distilled water as a control on the germination, seedling growth in the form of plumule length (Dhawan and Narwal, 1994). 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 and kept for germination. Whatman filter papers were used for germination tests.

Each Whatman filter paper was moistened with approximately 10 ml. of respective extracts. A control set in three replications, i.e. Whatman filter paper moistened with distilled water was maintained along with 15%. In each set of treatment three replicates were kept containing 10 seeds each respectively. These glass petri dishes were kept in laboratory conditions (in an incubator at 28°C) and observation of germination percentage, plumule length was done after an interval of 10 days. The parameters like plumule length and radical length were taken with the help of measuring scale in cm after 10 day**.**

Statistical analysis

The data was analyzed through statistical software SPSS. The recorded data were statistically analyzed by applying ANOVA to obtain the level of significance. The mean values were compared with the least significance difference (LSD) test following (Steel and Torrie, 1980) at 5% level.

Results and discussion

Effect of fruit aqueous extracts for Seedling length

Analysis of variance for this attribute (seedling length) revealed that among allelopathic plants applications significant ($P<0.05$) differences were observed within treatments, non-significant ($P>0.05$) differences were observed trough aqueous percentage while non-significant ($P>0.05$) differences were observed by TxAQ (Table- 1).

The mean values of seedling length of treated applications showed that T_0 attained maximum seedling length (3.21cm) followed by *Eucalyptus camaldulensis* (1.138 cm), *Sapindus mukorossi* (0.56cm) and *Melia azedarach* (0.38cm) attained minimum seedling length respectively (Fig.2,3). Similar result were reported by Xing-li (2007) ,Liding and Jingwen (1996). *Eucalyptus camaldulensis* also showed same result as reported by Fikreyesus (2011).

The least significant data (LSD) for this attribute (seedling length length) revealed that T_0 (3.21a) showed significant differences with *Eucalyptus camaldulensis* (1.13 b), *Sapindus mukorossi* (0.56c) and *Melia azedarach* (0.38 c).

Significant differences were observed by *Eucalyptus camaldulensis* (1.13 b) with T_0 (3.21a), *Sapindus mukorossi* (0.56c) and *Melia azedarach* (0.38c). Significant differences were recorded through *Sapindus mukorossi* (0.56c) and *Melia azedarach* (0.38c) with T_0 (3.21a) and *Eucalyptus camaldulensis* (1.13 b) while showed non-significant differences among each other (Table- 3 and Fig. 1)

Effect of fruit aqueous extracts for root length

Analysis of variance for this attribute revealed that among allelopathic plants applications highly significant ($P<0.01$) differences were observed within treatments, non-significant ($P>0.05$) differences were observed in aqueous percentage while non-significant ($P>0.05$) differences were observed by TxAQ (Table-2). The mean values of seedling length of treated applications showed that T_0 attained maximum root length (3.80 cm) and was followed by *Sapindus mukorossi* (0.71cm), *Eucalyptus camaldulensis* (0.56 cm) and *Melia azedarach* (0.42 cm) respectively (Fig.-1,2,3).

The least significant data (LSD) for this attribute (root length) revealed that T_0 (3.80a) showed highly significant differences with *Eucalyptus camaldulensis* (0.56 b), *Sapindus mukorossi* (0.71c) and *Melia azedarach* (0.42c). Significant differences were observed by *Eucalyptus camaldulensis* (0.56 b) with T_0 (3.80a), *Sapindus mukorossi* (0.71 c) and *Melia azedarach* (0.42 c). Significant differences were recorded in *Sapindus mukorossi* (0.71c) and *Melia azedarach* (0.42 c) with T_0 (3.80 a) and *Eucalyptus camaldulensis* (0.56 b) while showed non-significant differences among each other (Table -3).

Allelopathic effect of fruit on root length can be represented as TO> *Sapindus mukorossi*> *Eucalyptus camaldulensis*> *Melia azedarach* and same effect was observed in seedling length that can be shown as To > *Eucalyptus camaldulensis*> *Sapindus mukorossi*> *Melia azedarach*. It c concluded that fruit of *Melia azedarach* are more toxic and has inhibitory effect on germination of wheat as compare to other trees. This tree should not be planted near to crop because during germination period that is November their fruits become mature and fall down in field of wheat and produce aqueous extract due to action of rain water and ultimately decrease the germination (Fig.-4,5). Fruit of *Melia azedarach* highly reduce the growth of seedling length and root length due to presence of 1,4- benzenedicarboxylic acid dimethyl ester, melianone, melianol and melianodinol (Liding and Jingwen, 1996).

Table 1. Analysis of variance for fruit aqueous extract for seedling length.

Source of Variation	S.S	D.F	M.S	F	P
Treatment (T)	1.87	6	.93	6.18	.01
Aqueous Percentage(AQ)	.10	1	.10	.67	.42
TxAQ	.09	6	.04	.32	.72
Error	2.56	33	.15		
Total	75.15	48			

ANOVA values highly significant at $p<0.01$, significant at $p<0.05$ and non- significant at$p> 0.05$.

Table 2. Analysis of variance for fruit aqueous extract of allelopathic plants for root length of wheat.

Source of Variation	S.S	D.F	M.S	F	P
Treatment (T)	5.02	6	2.51	31.10	.00
Aqueous Percentage(AQ)	.31	1	.31	3.84	.06
TxAQ	.15	6	.07	.94	.40
Error	1.37	33	.08		
Total	109.63	48			

ANOVA values highly significant at $p<0.01$, significant at $p<0.05$ and non- significant at $p>0.0$.

Table 3. Least Significant Data (LSD) for fruit aqueous extract.

Treatment	Seedling Length	Root Length
Control	3.21a	3.80 a
Eucalyptus camaldulensis	1.13 b	0.56 b
Melia azedarach	0.38 c	0.42 c
Sapindus mukorossi	0.56 c	0.71 c

Means followed by similar letters in each column do not differ significantly at $P<0.05$.

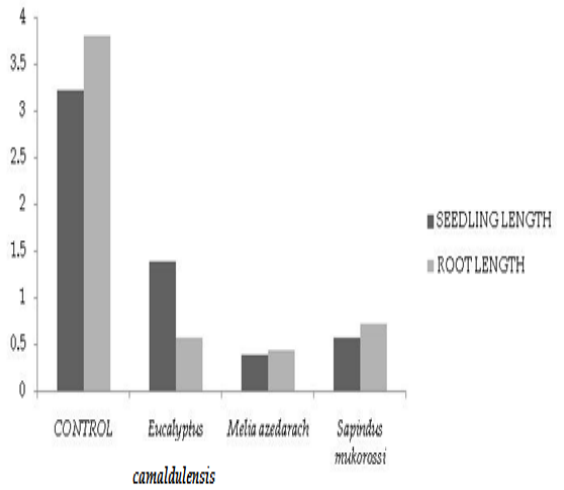

Fig. 1. Effect of fruit aqueous extracts on seedling and root growth of *Triticum aestivum*.

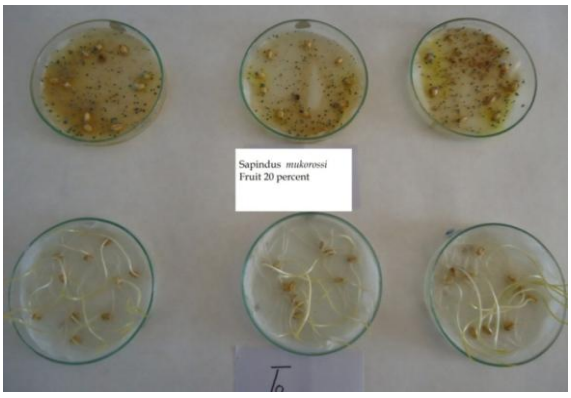

Fig. 2. Allelopathic effect of *Melia azederach* fruit on seedling and root length of *Triticum aestivum*.

Fig. 3. Allelopathic effect of *Melia azederach* fruit on seedling and root length of *Triticum aestivum*.

Fig. 4. Effect of *Melia azedarach* fruit on in agricultural field of *Tritcum aestivum*.

Fig. 5. Collection of *Melia azedarach* fruit.

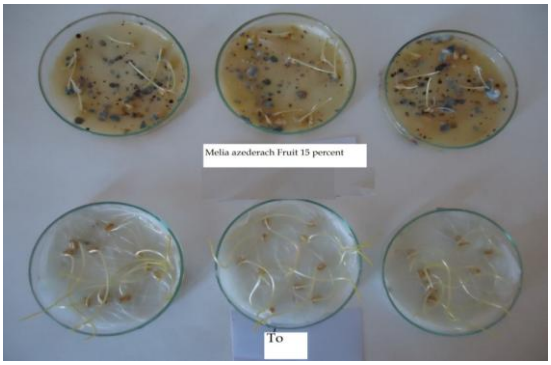

Fig. 6. Allelopathic effect of *Eucalyptus camaldulensis* fruit on seedling and root length of *Triticum aestivum*.

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