INNSPUB

International Journal of Biosciences | IJB |
ISSN: 2220-6655 (Print) 2222-5234 (Online)
http://www.innspub.net
Vol. 11, No. 5, p. 286-293, 2017

RESEARCH PAPER OPEN ACCESS

Effect of aqueous extracts of eucalyptus (*Eucalyptus camaldulensis* L.) on germination and seedling growth of wheat (*Triticum aestivum* L.).

Sohail Akram*[1,2], Muhammad Safeer[1], Muhammad Saqlain Zaheer[3], Rashid Iqbal[3,4]

[1]*Department of Forestry, Range and Wildlife Management, The Islamia University of Bahawalpur, Pakistan*

[2]*College of International Education, Yanshan University, Qinhuangdao, Hebei, China*

[3]*Department of Agronomy, The Islamia University of Bahawalpur, Pakistan*

[4]*Department of Agroecology, Faculty of Science and Technology, Aarhus University, Blichers Alle, Tjele, Denmark*

Key words: Wheat, Allelopathic effect, Germination, Eucalyptus

http://dx.doi.org/10.12692/ijb/11.5.286-293 Article published on November 30, 2017

Abstract

Allelo-chemicals produced from leaves, roots, bark, fruits and seeds of many plants influence the growth and germination of another adjacent plant. A lab experiment was conducted to study the allelopathic effect of aqueous extracts of Eucalyptus leaves (*Eucalyptus camaldulensis* L.) on germination percentage and seedlings of three varieties of wheat. Experiment was laid out in steel trays with CRD factorial arrangement, having four replications in agronomic lab of University College of Agriculture and Environmental Sciences, The Islamia University of Bahawalpur, Pakistan during 2015. It has been observed from the experiment that aqueous extracts of Eucalyptus leaves at a concentration 10, 15, 20 and 25% had negative effect on wheat germination percentage and found significantly higher fresh and dry weight of Seedling in control treatment. With increasing the extract concentration of Eucalyptus the inhibitory effect also increased. The findings indicate that wheat sown in field under or near eucalyptus trees has inhibitory effect on germination, growth and ultimately resulting in lower yields of wheat.

***Corresponding Author:** Sohail Akram ✉ sohailakram205@gmail.com

Introduction

Allelopathy is a phenomenon in which an organism produces bio-chemicals that influence the growth, survival and reproduction of other organisms. These alleleo-chemicals may have beneficial or detrimental effect on the other organisms (Stamp, 2003). Numbers of plants have been reported that has the allelopathic effect on another plant (Rice, 1984). Allelo-chemicals have the negative effect on cell division, pollen germination, nutrient uptake, enzymes functions and photosynthesis (Willis, 2010). Allelo-chemicals present in the leaves, flowers and buds of the plants (Putnam and Tang, 1986).

Plants live in association in group and compete with each other for various life requirements (Caton *et al.*, 1999). Plants produce certain chemicals that decrease the germination and growth of other plants. Residue exudates and leachates of many plants reported that decrease the growth and development of plants. Allelo-chemicals produce by the decomposition of leaves, stem, roots, fruit and seeds and cause wide range of injurious to plants (Alam and Islam, 2002). Allelo-chemicals have negative effect on the field crop eco-system that cause delay germination, mortality of seedlings, reduction in growth and crop yield (Herro and Callaway, 2003). Some Allelo-chemicals are severally effect the crop growth and development even under low concentration (Arshad and Frankenberger, 1998).

Wheat (*Triticum aestivum*) is the most important cereal crop of the world and staple food of 35 % of the world population (Raza *et al.*, 2017). Wheat cultivated on wide range of climatic condition in the world, most people consume it more than any other cereal grain (Singh *et al.*, 2007). Wheat grain contains 11-16.5% protein, 60-90% starch, 1.5-2% fat, 1.2-2% inorganic ions and vitamins (Guarda *et al.*, 2004). It provides approximately 55% carbohydrates and 20% of food calories consumed globally (Breiman and Graur, 1995). Tanveer *et al.* (2010) reported that root, stem, leaf and fruit extracts of *Euphorbia helioscopia* has negative effect on wheat crop. Some allelo-chemicals release from *E. helioscopia* that cause in the reduction of seedling vigor index, root and shoot length, root dry weight, and total dry weight of wheat. Khan *et al.* (2008) conducted an experiment to check the allelopathic effect of *Eucalyptus* on wheat and make the aqueous solution of *Eucalyptus* with different concentration and grow wheat with its application. It is noticed that *Eucalyptus* has the negative allelopathic effect on the growth of wheat that decrease the germination, root dry weight, root fresh weight, plant dry weight and plant fresh weight. Aqueous extract of Eucalyptus leaves decrease the seed germination, root and shoot length, fresh and dry weight in maize (Khan *et al.*, 2004)

Eucalyptus natively found in tropical region and it belongs to family Myraceae. It can grow in wide range of climate and soil conditions (Dawar *et al.*, 2007). *Eucalyptus* produces high potential allelochemicals. Aqueous extract of air dried leaf of *E. citirodora* had inhibitory effect on the seed germination in wheat (Sing *et al.*, 1992). Nandal (1999) noticed that belt of *Eucalyptus* trees had more adverse effect on wheat as compare to the poplar tree belt. However different performances of wheat varieties are noticed with different tree species by many workers (Nandal *et al.*, 1999b; Singh *et al.*, 1992). In view of the above findings it was imperative to conduct experiment to check the effect of *Eucalyptus* on the germination percentage and growth of wheat seedling.

Material and method

Experimental area

This experiment was conducted at agronomy Lab. of University College of Agriculture and Environmental Sciences, Islamia University of Bahawalpur, Pakistan, during 2015. Aqueous extract of Eucalyptus and three wheat varieties used as experimental materials.

Collection and preparation of aqueous extract of Eucalyptus

Fresh leaves of *E. camaldulensis* L. trees were collected from mature trees growing near the department of agronomy, 1st wash the leaves very carefully with distilled water and store them at room temperature. After drying, Leaves of *Eucalyptus* were soaked in distilled water with the ratio of 1:20 and place it for 24 hours. Afterwards, it filtrated through Whatman No. 1 paper.

The Filtrate was obtained as stock solution of 100% concentration. Concentration solution of 10, 15, 20 and 25% prepared from stock solution by diluted it with distilled water. Seeds of 3 wheat varieties (Aas-11, Punjab-2011) obtained from regional Agriculture Research Institute Bahawalpur.

Experimental design and treatment

The experiment was laid out in CRD with factorial arrangements, having three replications. Five aqueous extract treatments (T0= control by using distilled water only, T1= 10% concentration of aqueous extract of Eucalyptus, T2= 15%.

Concentration of aqueous extract of Eucalyptus, T3= 20% concentration of aqueous extract of Eucalyptus, T4= 25% concentration of aqueous extract of Eucalyptus) on 3 wheat varieties (Aas-11, Punjab-2011, AARI) are applied in this experiment. Seeds were sown in steel trays. Trays filled with washed sand.

Data collection and analysis

Data on seed germination percentage, fresh and dry weight of wheat seedling and hypocotyl length were recorded for one month. Data were analyzed following analysis of variance (Genstat, 2008) procedure. Treatment means were separated using least significant difference (Little and Hills, 1978; Steel and Torrie, 1992).

Results and discussion

Germination Test (%)

Seed germination is the most important stage for the crop yield and it is also critical stage under stress condition. The data shown that there was significant difference in the germination of the seeds with different concentration of aqueous extracts of eucalyptus leaves (Fig. 1).

Highest Mean Seed Germination (90.44%) was recorded in the control treatment following by (72.88%) when applied 10% aqueous extract of eucalyptus leaves. Lowest Mean Seed Germination (33.34%) recorded when applied 25% aqueous extract of eucalyptus leaves.

Non-significant difference in seed germination was in two wheat varieties of (Punjab-2011, ARRI). Maximum Mean seed Germination (63.26%) was recorded in Ass-11 (Table 1). The interaction was slightly significant. Maximum Seed Germination (93.66%) was recorded when applied no aqueous extract of eucalyptus leaves in Ass-11 variety.

Results indicate that Ass-11 has maximum germination percentage as compare to the other two varieties so it had some tolerance potential towards the allele-chemicals. These findings are same and in line with the finding of Khan *et al.* (2009).

It was reported that leaf extract of plants showed most prominent allelopathicity than root, stem and seed extract (Verma *et al.*, 2012). Allelochemicals can reduce respiration substrates and metabolic energy of seeds which decrease germination and seedling growth (Yarnia *et al.*, 2009).

It was noticed that all wheat varieties significantly affected by the extract application. With the increasing concentration of aqueous extract of eucalyptus germination was negatively affect due to the Allelo-chemicals (Nandal *et al.*, 1999).

Table 1. Allelopathic effect of *Eucalyptus* on germination (%) of three wheat varieties

Treatments	To 0% Extract of Eucalyptus	T1 10% Extract of Eucalyptus	T2 15% Extract of Eucalyptus	T3 20% Extract of Eucalyptus	T4 25% Extract of Eucalyptus	Mean
V1= Aas-11	93.66 a	75 c	63 d	49 e	35.66 f	63.26 A
V2=Punjab-2011	89 ab	71.66 c	58.33 d	45.66 e	32.33 f	52.93 B
V3= AARI	88.66 b	72 c	58.66 d	46 e	32 f	53.06 B
Mean	90.44 A	72.88 B	59.99 C	46.88 D	33.34 E	

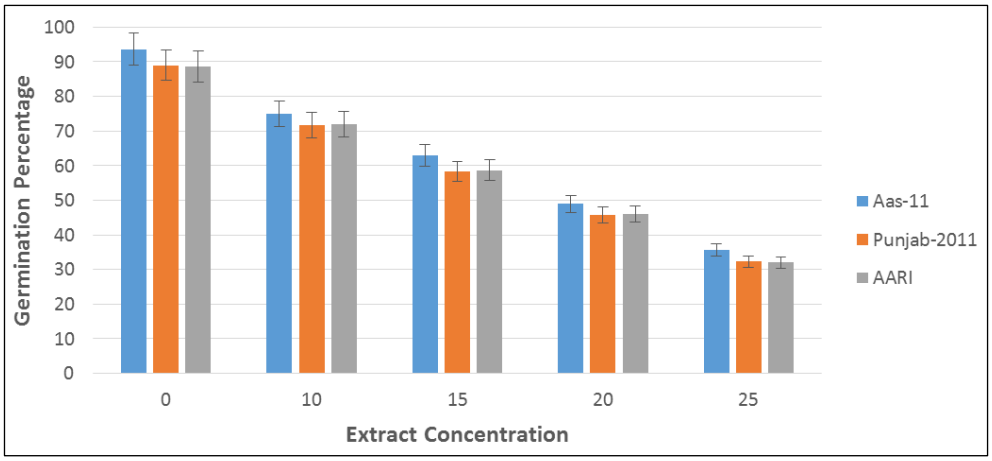

Fig. 1. Comparison effect of *Eucalyptus* plants extract on germination (%) of three wheat varieties.

Seedling Fresh weight (g)

Seedling fresh weight data shown that there were significant difference in the seedling fresh weight with different concentration of aqueous extracts of eucalyptus leaves. Highest mean seedling fresh weight (5.47g) was recorded in the control treatment following by (4.51g) when applied 10% aqueous extract of eucalyptus leaves. Lowest mean seedling fresh weight (1.45g) recorded when applied 25% aqueous extract of eucalyptus leaves (Table 2).

Non-significant difference in Seedling Fresh weight was recorded to the two wheat varieties of (Punjab-2011, ARRI). Maximum Mean Seedling Fresh weight (3.24g) recorded in Ass-11. The interaction was slightly significant. Maximum seedling fresh weight (5.73g) was recorded when applied no aqueous extract of eucalyptus leaves in Ass-11 variety and lowest seedling fresh weight (1.38g) recorded in Punjab-2011 when applied 25% aqueous extract of eucalyptus (Fig. 2). These results are same with the research findings of Khan *et al*. (2009).

Same results were noticed by Yang *et al*. (2002) in rice plant when treated with allelo-pathic phenolics. El-khatib *et al*. (2004) reported effect of allelochemicals substances on cell division causes a reduction in root growth. The root growth reduction affects the root efficiency. Therefore, this decreases mineral uptake, nutrient absorption and the transport of nutrients from the root to other plant parts. In summation, the seedling weight becomes reduced.

Seedling Dry weight (g)

Seedling Dry weight data shown that there were significant differences in the seedling dry weight with different percentage of aqueous extracts of eucalyptus leaves. Highest.

Mean Seedling Dry Weight (1.20g) was recorded in the control treatment following by (0.86g) when applied 10% aqueous extract of eucalyptus leaves. Lowest mean seedling dry weight (0.22g) recorded when applied 25% aqueous extract of eucalyptus leaves (Table 3).

Table 2. Allelopathic effect of *Eucalyptus* on seedling fresh weight (g) of three wheat varieties.

Treatments	To 0% Extract of Eucalyptus	T1 10% Extract of Eucalyptus	T2 15% Extract of Eucalyptus	T3 20% Extract of Eucalyptus	T4 25% Extract of Eucalyptus	Mean
V1= Aas-11	5.73 a	4.77 c	3.41 e	2.3 f	1.58 g	3.24 A
V2=Punjab-2011	5.33 b	4.37 d	3.17 e	2.06 f	1.38 g	2.98 B
V3= AARI	5.36 b	4.40 d	3.20 e	2.1 f	1.41 g	3.01 B
Mean	5.47 A	4.51 B	3.26 C	2.15 D	1.45 E	

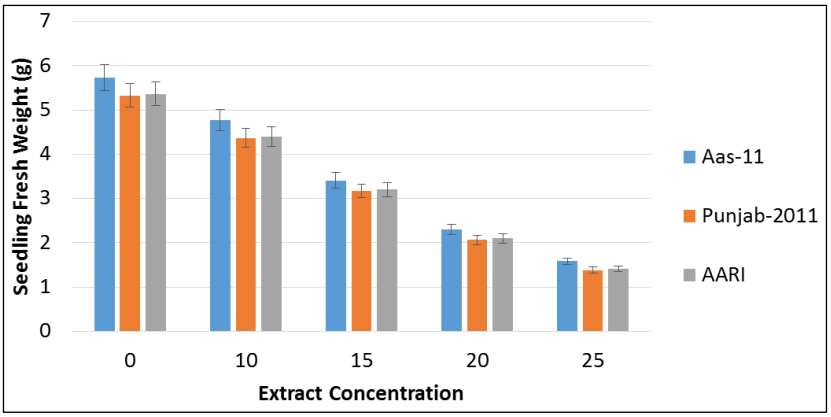

Fig. 2. Comparison effect of *Eucalyptus* plants extract on seedling fresh weight (g) of three wheat varieties

Non-significant difference in Seedling Fresh weight was recorded to the two wheat varieties of (Punjab-2011, ARRI). Maximum mean seedling dry weight (0.66g) recorded in Ass-11. The interaction was slightly significant. Maximum seedling dry weight (1.31g) was recorded when applied no aqueous extract of eucalyptus leaves in Ass-11 variety and lowest seedling dry weight (0.21g) recorded in Punjab-2011 and AARI when applied 25% aqueous extract of eucalyptus (Fig. 3).

Allelo-chemicals have negative effect on seeding dry weight. Chemicals such as terpenoids, alkaloids, phenolics has the inhibitory effect on germination percentage, growth and development of plant (Siddiqui and Zaman, 2005).

Dawar *et al.* (2007) reported that aqueous extracts of Eucalyptus had the negative effect on the crop growth and development but all the plants of a specie not equally effected, some has the potential to resist against theses allelo-chemicals.

Table 3. Allelopathic effect of *Eucalyptus* on Seedling dry weight (g) of three wheat varieties

Treatments	To 0% Extract of Eucalyptus	T1 10% Extract of Eucalyptus	T2 15% Extract of Eucalyptus	T3 20% Extract of Eucalyptus	T4 25% Extract of Eucalyptus	Mean
V1= Aas-11	1.31 a	0.91 c	0.73 d	0.35 f	0.24 gh	0.66 A
V2=Punjab-2011	1.13 b	0.84 c	0.64 e	0.29 fg	0.21 h	0.58 B
V3= AARI	1.16 b	0.84 c	0.64 e	0.29 fg	0.21h	0.59 B
Mean	1.20 A	0.86 B	0.67 C	0.31 D	0.22 E	

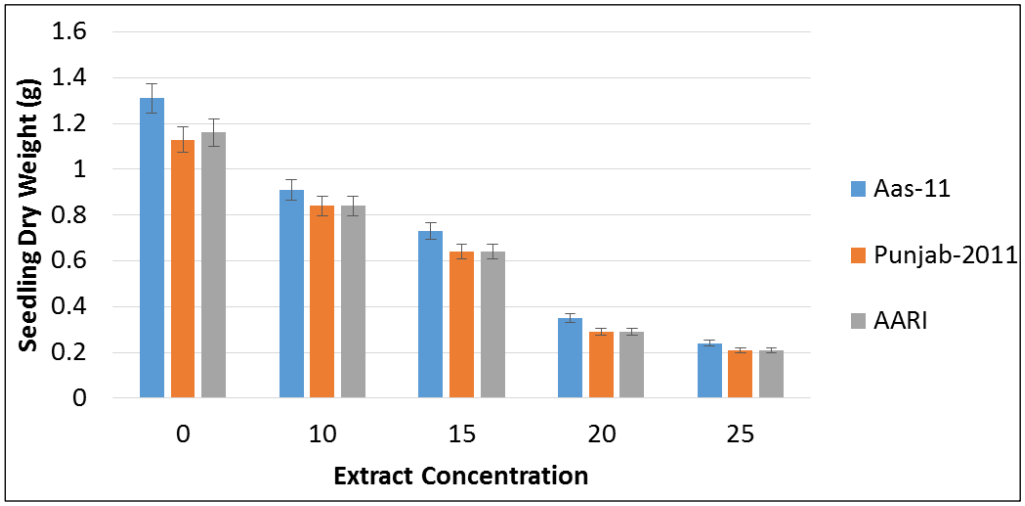

Fig. 3. Comparison effect of *Eucalyptus* plants extract on seedling dry weight (g) of three wheat varieties.

Hypocotyl Length (mm)

Hypocotyl length data shown that there were significant differences in the Hypocotyl length with various concentrations of aqueous extracts of eucalyptus leaves. Highest mean hypocotyl length (58.69 mm) was recorded in the control treatment following by (54.71mm) when applied 10% aqueous extract of eucalyptus leaves (Fig. 4). Lowest mean hypocotyl length (32.73mm) recorded when applied 25% aqueous extract of eucalyptus leaves. Non-significant difference in Hypocotyl length was recorded from two wheat varieties of (Punjab-2011, ARRI). Maximum mean hypocotyl length (49.64mm) recorded in Ass-11. The interaction was slightly significant. Largest hypocotyl length (63.3mm) was recorded in Aas-11 when applied 10% aqueous extract of eucalyptus leaves and lowest hypocotyl length (31.01mm) was recorded in Punjab-2011 and AARI when applied 25% aqueous extract of eucalyptus (Table 4). Results indicate that Ass-11 has largest Hypocotyl Length as compare to the other two varieties so it had some tolerance potential towards the allele-chemicals. Phiri (2010) reported that *Moringa oleifera* leaf extracts increased hypocotyls length of wheat by 14.9% and reduced radicle length of rice by 28.6%. These result are also in line with Dawar *et al.* (2007), reported that negative effect of aqueous extracts of Eucalyptus differ from species to species. Some species has potential to resist against these allelo-chemicals.

Table 4. Allelopathic effect of *Eucalyptus* on Hypocotyl length (mm) of three wheat varieties

Treatments	To= 0% Extract of Eucalyptus	T1= 10% Extract of Eucalyptus	T2= 15% Extract of Eucalyptus	T3= 20% Extract of Eucalyptus	T4= 25% Extract of Eucalyptus	Mean
V1= Aas-11	59.7 a	63.3 c	45.8 e	41.3 fg	36.2 h	49.26 A
V2=Punjab-2011	58.31 b	50.43 c	42.01 d	35.07 f	31.01 gh	43.38 B
V3= AARI	58.06 ab	50.4 c	41.46 e	34.92 f	31.01h	43.17 B
Mean	58.69A	54.71 B	43.09 C	37.1 D	32.73 E	

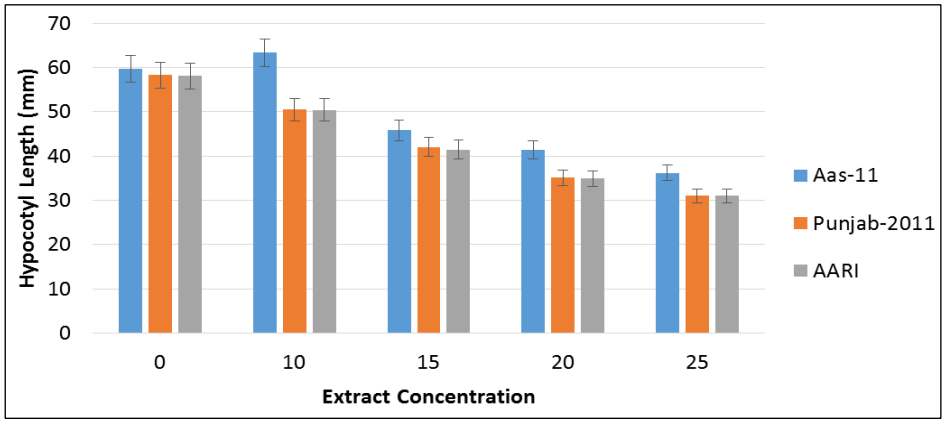

Fig. 4. Comparison effect of *Eucalyptus* plants extract on seed hypocotyl length (mm) of three wheat varieties.

Conclusions and recommendations

In result of above findings effect of aqueous extracts of eucalyptus leaves (*Eucalyptus camaldulensis* L.) on germination and seedling growth of wheat (*Triticum aestivum* L.) shown that eucalyptus adversely affect the germination and growth of the wheat crop. With increasing the concentration of aqueous extracts of eucalyptus solution, germination and seedling growth of wheat is decreased adversely. Leaves of the eucalyptus plant produce the allelo-chemicals that have negative impact on the plant growth. Growing of the wheat plant near the eucalyptus tree severally affect the growth of wheat plant. In field condition leaves of eucalyptus tree that lay down in the soil decrease the wheat crop growth so there is need to guide the farmers to not grow the eucalyptus tree near the growing area of wheat crop.

References

Alam SM, Islam EU. 2002. Effect of aqueous extract of Leaf, stem and root of nettle leaf goosefoot and NaCl on germination and seedling growth of rice. Pakistan Journal of Scientific and industrial research **1(2),** 47-52.

Arshad M, Frakenberger WT Jr. 1998. Plant growth regulating substances in the rhizosphere: Microbial production and functions. Advances in Agronomy **62,** 145-151.

Breiman A, Graur D. 1995. Wheat Evolution. Israel Journal of Plant Sciences **43**, 85-98.

Caton BP, Mortimer AM, Hill TC, Gibson JE, Fisher AJ. 1999. Weed morphology effects on competitiveness for light in direct-seeded rice. Proc. 17th Asian-Pacific, weed Sci, Soc. Conf. Bangkok **1A,** 116-120.

Dawar S, Summaira M, Younus, Tariq M, Zaki MJ. 2007. Use of Eucalyptus sp., in the control of root infecting fungi on mungbem and chick-pea. Pakistan Journal of Botany **39(3),** 975-979.

El-khatib AA, Hegazy AK, Galal HK. 2004. Does allelopathy have a role in the ecology of *Chenopodium murale*. Annales Botanici Fennici **41,** 37-45.

Genstat. 2008. Discovery edition 3. VSN International Ltd. 5 The water house, waterhouse street, Hemel Hempstead, HP1 1ES UK.

Guarda G, Padovan S, Delogu G. 2004. Grain yield, nitrogen use efficiency and baking quality of old and modern Italian bread wheat cultivars grown at different nitrogen levels. European Journal of Agronomy **21,** 181-192.

Haung CH, Yuan L, Ming Y, zhi–D H. 1999. Allelopathic effect of aqueous extracts of *Eucalyptus citriodora* L. and *Eucalyptus tereticornis* L. on germination and growth of cereals. Environmental and Experimental Botany **41(2),** 47-25.

Herro JL, Callaway RM. 2003. Allelopathy and exotic plant invasion. Plant and Soil **256,** 29-39.

Khan MA, Hussain I, Khan EA. 2008. Allelopathic effects of eucalyptus (*Eucalyptus camaldulensis* L.) on germination and seedling growth of wheat (*Triticum aestivum* L.). Pakistan journal of Weed Science Research **14(1-2),** 9-18.

Khan MA, Hussain I, Khan EA. 2009. Allelopathic effects of eucalyptus (*Eucalyptus camaldulensis* L.) On germination and seedling growth of wheat (*Triticum aestivum* L.). Pakistan Journal of Weed Science Research **15(2-3),** 131-143.

Khan MA, Marwat KB, Hassan G. 2004. Allelophathic Potential of Some Multipurpose Tree Species (MPTS) on wheat and some of its associated weeds. International Journal of Biology Biotechnology **1(3),** 275-278.

Little TM, Hills FJ. 1978. Agricultural experimentation, Design and analysis. John Willey and Sons, New York 350 p.

Nandal DPS, Birla SS, Narwal SS. 1999b. Allelopathic influence of Eucalyptus litter on germination, yield and yield components of five wheat varieties. Proc. 1st Nat. Symp, Allelopathy in Agric Systems 12-14 Feb.

Nandal DPS, Rana P, Kumar A. 1999. Growth and yield of wheat (*Triticum aestivum*) under different tree spacing of *Dalbergia sissoo* based agrisilviculture. Indian Journal of Agronomy **44,** 256-260.

Phiri C. 2010. Influence of *Moringa oleifera* leaf extracts on germination and early seedling development of major cereals. Agriculture and Biology Journal of North America **1(5),** 774-777.

Putnam AR, Tang CS. 1986. Allelopathy: State of the science. In A. R. Putnam and C-S. Tang Eds, The Science of Alle1opathy. John Wiley & Sons, New York 1-19.

Raza MAS, Zaheer MS, Saleem MF, Khan IH, Khalid F, Bashir MU, Awais M, Iqbal R, Ahmad S, Aslam MU, Haider I. 2017. Investigating drought tolerance potential of different wheat (*Triticum aestivum* L.) varieties under reduced irrigation level. International Journal of Biosciences **11,** 257-265.

Rice EL. 1984. Allelopathic Growth Stimulation. In: The Science of Allelopathy (Eds.): AR. Putnam and CS. Tang, John Wiley and Sons, New York.

Siddiqui ZS, Zaman AU. 2005. Effects of capsicum leachates on germination, seedling growth and chlorophyll accumulation in *Vigna radiate* L. willczek seedlings. Pakistan Journal of Botany **37(4),** 941-947.

Singh H, Singh AK, Kushwaha HL, Singh A. 2007. Energy consumption pattern of wheat production in India. Energy **32,** 1848-1854.

Singh S, Singh HS, Mishra SS. 1992. Wheat response to Allelopathic. Effects of some *Eucalyptus citriodora* L. and their residues. Indian Journal of Agronomy **43(2),** 256-259.

Stamp N. 2003. Out of the quagmire of plant defense hypotheses. The Quarterly Review of Biology 78(1), 23-55.

Steel RGD, Torrie JH. 1992. Principles and procedures of statistics. McGraw Hill Book Company Inc. New York.

Tanveer A, Rehman A, Javaid MM, Abbas RN, Sibtain M, Ahmad A, Sahid ibin-i-zamir M, Chaudhary KM, Aziz A. 2010. Allelopathic potential of *Euphorbia helioscopia* L. against wheat (*Triticum aestivum* L.), chickpea (*Cicer arietinum* L.) and lentil (*Lens culinaris* Medic.). Turkish Journal of Agriculture and Forestry **34,** 75-81.

Verma RK, Verma SK, Kumar S, Kumar V, Patra DD. 2012. Phytotoxic effects of sweet basil (*Ocimum basilicum* L.) extracts on germination and seedling growth of commercial crop plants. European Journal of Experimental Biology **2(6),** 2310-2316.

Willis RJ. 2010. The History of Allelopathy, Dordrecht, The Netherlands: Springer.

Yang CM, Chang F, Lin SJ, Chou CH. 2002. Effects of three allelopathic phenolics on chlorophyll accumulation of rice (*Oryza sativa* L.) seedlings: I inhibition of supply orientation. Botanical bulletin of Academia Sinica **43,** 299-304.

Yarnia M, Benam MBK, Tabrizi EFM. 2009. Allelopathic effects of sorghum extracts on *Amaranthus retroflexus* seed germination and growth. Journal of Food, Agriculture and Environment **7,** 770-774.