Pak. J. Weed Sci. Res., 21(4): 483-490, 2015

EFFECT OF DIFFERENT PLANT EXTRACTS ON GERMINATION AND GROWTH OF WHEAT AND ITS ASSOCIATED WEEDS

Asghar Ali Khan[1], Ejaz Ahmad Khan[1], Muhammad Mansoor[2], Iqtidar Hussain[1] and Sairah Syed[3]

ABSTRACT

An experiment was carried out in the laboratory of Arid Zone Research Institute, Dera Ismail Khan, Khyber Pakhtunkhwa to study the effect of different plant extracts on wheat and its associated weeds. The design of experiment was completely randomized (CRD) under room temperature (25 °C). Ten seeds of wheat, wild oats, canary grass and field bindweed treated with fungicide were placed in petri dishes on blotting paper. All the treatments were replicated four times. The extracts of sorghum, sunflower, brassica and rice were applied and data were recorded on germination %, seedling length, and fresh and dry biomass (g) plant^{-1}. Wheat crop was the most tolerant among all species under test. The findings revealed that the allelopathic potential of extracts tested could be exploited for weed management in wheat as the wheat crop remained most resistant, while weeds were suppressed in germination and growth. In order to conclude meaningful results, further research is suggested to investigate the feasibility of commercial exploitation of these extracts as natural herbicides.

Key words: Allelopathy, water extract, sorghum, sunflower, brassica, weeds.

Citation: Khan, A.A., E.A. Khan, M. Mansoor, I. Hussain and S. Syed. 2015. Effect of different plant extracts on germination and growth of wheat and its associated weeds. Pak. J. Weed Sci. Res. 21(4): 483-490.

INTRODUCTION

Wheat (*Triticum aestivum* L.) is the major staple food used in Pakistan. It is estimated that 5-10% wheat grain is now being consumed as poultry and livestock feed (Heyne, 1987). Area under wheat cultivation in Pakistan during 2010-2011 was 8.90 million ha

[1]Faculty of Agriculture, Gomal University, Dera Ismail Khan, Pakistan
[2]Arid Zone Research Institute, Dera Ismail Khan, Pakistan.
[3]Department of Agronomy, The University of Poonch, Rawlakot, Azad Jammu and Kashmir, Pakistan
*Corresponding author's email: joyadkpk@googlemail.com

with grain production of 25.21 million tons. In Khyber Pukhtunkhwa area was 0.724 million ha and had a production of 1.155 million tons, respectively (Anonymous, 2012). Wheat production in Pakistan is comparatively low due to various factors including the problem of weeds. Weeds compete with crop plants for light, air, moisture and nutrients. Weeds increase harvesting costs, requires costly cleaning of seeds and reduce water flow in irrigation channels. It also deteriorates quality of farm produce, which results in decreased market value (Pervaiz and Quazi, 1999). The injudicious use of synthetic herbicides as weed controlling strategy has resulted in much concerns over the last five decades, like their effect on human health and environment in the form of pollutants and the development of herbicide resistance (HR) in weeds (Batish *et al*., 2002). Herbicide resistance is the inherited ability of a plant to survive and reproduce following exposure to a dose of herbicide normally lethal to the wild type.

Some naturally occurring chemical compounds (allelochemicals) extracted from plants offer a greater and multidirectional solution of the weeds problem i.e. could be leading compounds for formulation of new bio-herbicides (Duke *et al*., 2002). Allelochemicals have environmental friendly nature and volatile characteristics; moreover, their potential provides a chance for utilization as herbicide. The explorations are on the way for discovering the new allelochemicals and for formulation of natural herbicides. The example of which is the phyto-toxic triketone, lepto-spermone, extracted from Callistemon citrinus, which was modified for production of the commercial herbicide named mesotrione (Cheema *et al*., 2002). Several crops and weeds have shown allelopathic effects on germination of other weeds and crops (Afridi *et al.* 2014; Afridi and Khan, 2014; 2015). In an attempt to discover effectiveness of allelochemicals found in extracts of sorghum (*Sorghum vulgare*), sunflower (*Helianthus annus*), rapeseed (*Brassica napus*) and rice (Oryza sativa) against common weeds of wheat crop, current experiment was conducted.

MATERIALS AND METHODS

Laboratory based experiment was conducted to investigate the allelopathic potential of sorghum, sunflower, brassica and rice. The experiment was laid out in completely randomized design (CRD). The experiment was conducted under the ambient conditions at 25 ^{0}C. Ten seeds each of wheat (*Triticum aestivum* L.), wild oats (*Avena fatua*), canary grass (*Phalaris minor*), field bind weed (*Convolvulus arvensis*) were placed in the petri dishes on blotting paper. To avoid the fungal attack the seeds were treated with fungicide Topsin-M 70 % @ 2 g kg^{-1}. The exudates of sorghum, rice, sunflower and brassica were prepared by taking dried chaffed plant stalks at maturity and were stored at safe place to avoid possible leaching by rain water. The plant

materials were soaked in distilled water at ration of 1: 5 w/v, i.e. for 72 hours. After soaking, the mixture of plant materials and water were filtrated to prepare plant extracts. The prepared plant water exudates were then concentrated twenty times through boiling at 100°C on a gas burner. The experiment comprised of 4 species and 4 extracts along with control (Tape water was applied). After 45 days, the data on seed germination %, seedling length (mm), fresh biomass and dry biomass (mg) were recorded. The statistical analyses of the experiment for each trait were done by using MSTATC software (Steel and Torrie, 1980).

RESULTS AND DISCUSSION

Germination Percentage

Data regarding the germination percentage showed no significant effect of different extracts (Table-1). However, it the maximum germination 98.17% was recorded in the treatment where brassica extract was applied, followed by control treatment (96.44%) where only tape water was applied. It indicated that the effect of brassica extract on seed improved the germination %. Resistance of wheat to plant extracts has been reported by Noor *et al*. (1995) who opined that leaf extracts of *Prosopis juliflora* (mesquite) have no effect on wheat seed germination. Statistical analysis of data further showed that concentrated plant extracts from different species had significant ($P<0.05$) effect on germination of canary grass, field bind weed and wilt oat. All weed species showed maximum germination in control treatment (Tape water only). In case of canary grass maximum germination was 77.86 % recorded in control treatment followed by germination percentage (59.21 %) recorded in rice extract and the lowest value was recorded in sunflower treatment showing strong inhibition caused due to allelochemicals and 43.25% germination was recorded. Field bind weed showed 88.81% germination in control treatment and it was followed by germination percentage of 65.57% in brassica extract applied treatment and most inhibitory effects were noticed in sunflower extract treated seeds of field bind weed (42.29%). Wild oat germination in control (84.54 %) and the lowest germination percentage was recorded in case of wild oat while applied with sunflower extract.

Overall view of germination % indicated that weeds species under testing were moderately tolerant to rice and brassica extracts as compared to other extracts. The inhibition effect was noticed in sunflower extract applied treatment in case of all weeds. This may be due allelochemicals inhibitory effect as reported by Chellamuthu *et al*., (1997) who reported that the allelopathic effect of *Prosopis juliflora* (mesquite) leaf litter is due to the presence of phenolic compounds.

Seedling length

Being representative of early stage of growth, seedling length has importance. Wheat seedling length ranged from 55.85 to 74.51 mm, higher in control treatment and the lowest in sunflower extract applied treatment. It indicated that the sunflower's allelochemicals though not able to affect the germination of wheat crop as discussed in germination % parameter yet it retarded the growth of wheat crop. Statistically at par values of seedling lengths were observed in rice and brassica extract applied treatment (Table-2). The brassica and rice extracts remained friendlier in this regards as the seedling length was more among extracts applied.

Mean data showed that plant Extracts from different species, had significant ($P<0.05$) effect on seedling length of canary grass, field bind weed and wild oat. The minimum seedling length in case of canary grass (30.31 mm) was recorded in sunflower extract applied treatment and the maximum seedling length was recorded in control treatment (76.08 mm) (Table-2). The inhibition of seedling length is clearly visible in these treatments. The findings of Khan *et al*. (2003) exhibit the inhibitory effect of *E. camaldulensis* on the growth parameters of maize.

As for as the seedling length of field bind weed is concerned maximum length was noticed in control (66.85 mm) and numerically lowest seedling length was recorded form sunflower extract treated samples (32.86 mm) which was statistically at par with seedling length found in sorghum extract applied (35.58 mm). Maximum seedling length in wild oat (76.68 mm), second highest value of seedling length was recorded from rice extract applied treatment (60.43 mm). The smallest seedlings were noticed in sunflower Extract (39.95 mm) indicating the inhibitoriest effect of allelochemicals found in this extract. Pawar and Chawan (1999) reported that allelochemicals reduced nutrient up-take in sorghum resulting in reduced growth. Our inferences are further supported by the findings of Schumann *et al*. (1995) whom reported that water extract of E. grandis significantly reduced weed establishment.

Fresh biomass

All species were significantly affected by different concentrated extracts application and the analysis of data showed that the species varied in their genetic potential of biomass accumulation. The highest fresh biomass (36.81) was recorded in wheat crop in control treatment. It was followed by (32.79) recorded in brassica extract treated sample. The most affected regarding reduced fresh biomass (26.94) were the wheat plants in sorghum Extract treatment, this was interesting to note as the allelochemicals found in sorghum were more instrumental in reducing fresh biomass (Table 3).

Lowest biomass (20.22 g) in case of canary grass was obtained in sorgaab Extract applied treatment. The highest biomass of canary grass was found in control treatment (25.12 g) in which only tape water was applied (Table 3). Indicating the growth retarding caused due application of allelochemicals (sorgolane) in sorghum water extract. As for as the field bind weed is concerned its biomass ranged from 21.60 to 26.23 g, the maximum biomass was recorded in rice extract applied treatment followed by biomass (25.86 g) observed in control treatment, showing the stimulatory effect of rice extract which was already noticed in some other cases in this study.

However, the least value of biomass (21.60 g) was noticed in sorgaab treated sample. Wild oat biomass was also significantly affected by application of different concentrated extracts, the most vigorous plants were noticed in brassica and rice treated Extracts, again showing stimulatory effect of these extracts, however, the inhibitoriest effect was noticed in sorgaab treated samples. These findings are in analogy with those reported by El-Fadl (1997), who reported that water extracts of Prosopis retard seedling development. The varying response of wheat, canary grass, field bind weed and wild oats to the concentrated extracts exhibits the potential of the tested extracts as natural herbicides for weed management in wheat.

Dry biomass

The wheat and associated weeds were significantly affected by different concentrated extracts application. The mean data showed that wheat crop varied in its biomass accumulation and maximum dry biomass was recorded in rice extract 14.87, closely followed by brassica (14.71) and control (14.01) treatments. The least dry biomass (10.68) was recorded in sorghum extract treatment, showing thereby the impact of allelochemicals found in this extract (Table-4).

Lowest dry biomass (10.10 g) in case of canary grass was obtained in sunflower extract applied treatment, which was closely followed by 10.44 g recorded in sorgaab applied samples. The highest dry biomass of canary grass was found in brassica extract treatment (12.56 g). Field bind weed's least dry biomass (6.07 g) was found in sunflower extract treatment followed by 6.63 and 6.97 g in rice and sorgaab extract treatment respectively. While the wild oat numerically maximum dry biomass was 11.07 g was recorded in brassica extract treatment and least value of 9.97 g. These results indicate that the growth inhibition caused due application of allelo-chemicals found in these extracts. However, some stimulatory effects of extracts also promoted the growth of wild oat, wheat, canary grass like rice and brassica extracts. These results are in line with the Rafique *et al*. (2003) whom reported stimulatory effect of lower concentration of extracts**.**

Table-1. Germination % as affected by different plant Extracts on growth of wheat and its associated weeds.

Treatment	Wheat	Canary Grass	Field Bind weed	Wild Oat
Control	96.44 ^{NS}	77.86 a	88.81 a	84.54 a
Sorgaab alone	94.48	46.09 d	46.90 d	52.78 d
Sunflower alone	96.33	43.25 d	42.29 e	47.72 e
Rice alone	96.16	59.21 b	62.46 c	68.58 b
Brassica alone	98.17	54.17 c	65.57 b	62.84 c
LSD	NS	4.717	2.361	3.221

Different letters represent significant differences according to least significant difference (P≤0.05)

Table-2. Seedling length (mm) as affected by different plant Extracts on growth of wheat and its associated weeds

Treatment	**Wheat**	**Canary Grass**	**Field Bind weed**	**Wild Oat**
Control	74.51 a	76.08 a	66.85 a	76.68 a
Sorgaab alone	61.59 c	34.93 d	35.58 c	45.37 d
Sunflower alone	55.85 d	30.31 e	32.86 c	39.95 e
Rice alone	69.24 b	49.74 c	47.75 b	60.43 b
Brassica alone	69.32 b	55.80 b	43.56 b	54.70 c
LSD	3.572	2.489	4.989	3.834

Different letters represent significant differences according to least significant difference (P≤0.05)

Table-3. Fresh Biomass (g) as affected by different plant Extracts on growth of wheat and its associated weeds

Treatment	**Wheat**	**Canary Grass**	**Field Bind weed**	**Wild Oat**
Control	36.81 a	25.12 a	25.86 b	33.08 b
Sorgaab alone	26.94 e	20.22 e	21.60 e	29.31 d
Sunflower alone	29.35 d	21.34 d	23.99 d	31.68 c
Rice alone	31.15 c	23.03 c	25.67 c	33.38 ab
Brassica alone	32.79 b	23.58 b	26.23 a	33.93 a
LSD	0.0487	0.049	0.0487	0.668

Different letters represent significant differences according to least significant difference (P≤0.05)

Table-4. Dry Biomass (g) as affected by different plant Extracts on growth of wheat and its associated weeds

Treatment	Wheat	Canary Grass	Field Bind weed	Wild Oat
Control	14.01 c	11.10 c	7.51 a	10.73 a
Sorgaab alone	10.68 e	10.44 d	6.97 c	11.00 a
Sunflower alone	12.98 d	10.10 e	6.07 e	9.97 b
Rice alone	14.87 a	11.44 a	6.63 d	10.77 a
Brassica alone	14.71 b	12.56 b	7.24 b	11.07 a
LSD	0.129	.01254	0.0154	0.408

Different letters represent significant differences according to least significant difference (P≤0.05)

CONCLUSION

Allelopathic potential of extracts tested could be exploited for weed management in wheat as the wheat crop remained comparatively more resistant than weeds and research for exploitation these extracts as natural herbicides.

REFERENCES CITED

Afridi, R.A., M. A. Khan, H. Gul and M.K. Daud. 2014. Allelopathic influence of rice extracts on phenology of various crops and weeds. Pak. J. Bot. 46(4): 1211-1215.

Afridi, R.A. and M. A. Khan. 2014. Reduced herbicide doses in combination with allelopathic plant extracts suppress weeds in wheat. Pak. J. Bot. 46(6): 2077-2082.

Afridi, R.A. and M.A. Khan. 2015. Comparative effect of water extract of *Parthenium hysterophorus, Datura alba, Phragmites australis* and *Oryza sativa* on weeds and wheat. Sains Malays. 44(5): 693-699.

Anonymous. 2012. Economic survey. Government of Pakistan, Finance Division, Economic Advisor Wing, Islamabad.

Batish, D. R., H. P. Singh, D. B. Saxena and R. K. Kohli. 2002. Weed suppressing ability of parthenin - a Sesquiterpene lactone from *Parthenium hysterophorus*. New Zealand Plant Protec. 55. Proc. Conf. 13-15 August 2002. New Zealand Plant Prot. Soc., Rotorua, New Zealand, pp. 218-221.

Cheema, Z.A., H. M. I. Sadiq and A. Khaliq. 2000. Efficacy of sorgaab as natural weed inhibitor in wheat. Int. J. Agric. Biol. 1(2): 144-146.

Chellamuthu, V., T.N. Balasusbramanian, A. Rajarajan and S.N. Palaniappan. 1997. Allelopathic influence of *Prosopis juliflora* (Swartz) DC. on field crops. Allelopathy J. 4: 291-302.

Duke, S. O., A. M. Rimando, S. R. Baerson, B. E. Scheffler, E. Ota and R. G. Belz. 2002. Strategies for the use of natural products for weed management. J. Pesticide Sci. 27(3): 298-306.

El-Fadl, M.A. 1997. Management of *Prosopis juliflora* for use in agroforestry systems in the Sudan. Tropical Forestry Report, Deptt. Forest Ecol., Univ. Helsinki. 16:107.

Heyne, K. 1987. Tumbuhan Berguna Indonesia II. Badan Litbang Departement Kehutanan. Jakarta. Pp. 1126 - 1128.

Khan, B.A. 2003. Eucalyptus seen as threat to Environment. Dawn, Tuesday, 12th August, 2003.

Noor, M., U. Salam and M.A. Khan. 1995. Allelopathic effects of *Prosopis juliflora* Swartz. J. Arid Environ. 31: 83-90.

Pawar, K.B. and P.D. Chawan. 1999. Influence of leaf leachates of plant species on mineral nutrition of *Sorghum bicolor* L. Moench. Allelopathy J. 6:87-92.

Pervaiz, K. and M. H. Quazi. 1999. Status of food production in Pakistan. Prog. Farm. 12:5.

Putnam, A. R. and C.S. Tang. (ed). The science of allelopathy. NY John Willey and Sons.

Rafique, H., R. Ahmed, M. B. Uddin and M. K. Hossain. 2003. Allelopathic Effect of different concentration of water extracts of *Acacia auriculiformis* leaf on some initial growth parameters of five common agricultural crops. Pak. J. Agron. 2 (2): 92-100.

Schumann, A.W., K.M. Little and N.S. Eccles. 1995. Suppression of seed germination and early seedling growth by plantation harvest residues. South Afr. J. Plant and Soil, 12: 170-172.

Steel, R. and J.H. Torrie. 1984. Principles and procedures of statistics. Mc. Graw Hill Book Co. Inc. New York, USA.