

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

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ABSTRACT

An experiment to study the effect of different plant extract on wheat and its associated weeds was carried out in the laboratory of Arid Zone Research Institute, Dera Ismail Khan, Khyber Pakhtunkhaw. The experiment was laid out in completely randomized design (CRD) under room temperature (25 °C). Ten fungicide treated seeds of each of wheat, wild oats, canary grass and field bindweed were placed in petri dishes on blotting paper and were replicated four times. The extracts of sorghum, sunflower, brassica and rice were applied as treatments. The data were recorded on germination %, seedling length, 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 and weeds were suppressed in germination and growth. Further research is recommended to probe out the feasibility of commercial exploitation of these extracts as natural herbicides.

Keywords: Allelopathy, water extract, sorghum, sunflower, brassica, weeds.

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 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, reduce water flow in irrigation, drainage channels and increase fire hazards. 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). The problem emerged in the form of herbicide resistance is especially very serious in case of cereal crop. 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, leptospermone, extracted from *Callistemon citrinus*, which was modified for production of the

commercial herbicide named mesotrione (Cheema *et al.*, 2002). In an attempt to discover effectiveness of allelochemicals found in extracts of sorghum, sunflower, brassica and rice against common weeds of wheat crop, current experiment was conducted.

MATERIAL METHODS:

Laboratory based experiment was conducted to investigate the allelopathic potential of sorghum, sunflower, brassica and rice. The experiment was laid out in randomized complete design (CRD). The experiment was conducted under the ambient conditions at 25 °C. Ten seeds each of wheat (*Triticum aestivum* L.), wild oats (*Avena fatua*), canary grass (*Phalaris minor*), fieldbind 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 kept under cover to avoid possible leaching by rain water. Chaffed material was soaked in distilled water (1: 5 w/v) i.e. one kg plant material and five liter water for 72 hours and was filtrated to prepare normal plant water exudates. 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 (Tap 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 was run done by using MSTATC software (Steel and Torrie, 1980).

RESULTS AND DISCUSSION

Germination Percentage %:

The data regarding the germination percentage showed non significant effect of different extract (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 reported 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 was in control (84.54 %) and the least percent germination in case of wild oat was recorded in 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 and 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 (mm):

Being representative of early stage of growth, seedling length has importance. Wheat seedling length ranged from 55.85 to 74.51 mm, being 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.

The 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 from 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 (g):

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).

The 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 retardness 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 (g):

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).

The 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.

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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 ($P \leq 0.05$)

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 ($P \leq 0.05$)

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 ($P \leq 0.05$)

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 ($P \leq 0.05$)