Pak. J. Agri. Sci., Vol. 50(2), 169-176; 2013
ISSN (Print) 0552-9034, ISSN (Online) 2076-0906
http://www.pakjas.com.pk

ALLELOPATHIC ACTIVITY OF PAKISTANI WHEAT GENOTYPES AGAINST WILD OAT (*Avena fatua* L.)

Khalid Mahmood[1,*], Abdul Khaliq[1], Zahid Ata Cheema[1] and Muhammad Arshad[2]

[1]Department of Agronomy, University of Agriculture, Faisalabad, Pakistan; [2]Institute of Soil and Environmental Sciences, University of Agriculture, Faisalabad, Pakistan
***Corresponding author's e-mail: khalidansari72@gmail.com**

Wheat allelopathy can be manipulated for sustainable weed management in wheat based cropping systems. Bioassays were conducted to quantify the allelopathic potential of 35 indigenous wheat genotypes against germination and seedling growth of wild oat (*Avena fatua* L.). Foliar application of aqueous extracts of wheat straw, surface mulching and incorporation of wheat straw of different genotypes were employed for bioassays study. Results revealed the suppressive allelopathic activity of different wheat genotypes manifested in the form of impaired germination and retarded seedling growth of wild oat. A highly significant genotypic variation in allelopathic potential was observed for different traits. Germination of wild oat was decreased by 10-84% over control by different wheat genotypes. Likewise, over 70% reductions in seedling root and shoot dry weight of wild oat was also observed in V6007. Wheat genotypes viz. V6007, AS 2000, V6111, V6034, V4611, V7189, Uqab 2000, Chanab 2000, Bhakkar 2002, Pak 81 and Rohtas 90 showed strongly inhibitory allelopathic activity against seedling growth of wild oat. V6007 exhibited highest suppression of wild oat. These studies confirm the suppressive allelopathic potential of indigenous wheat genotypes against wild oat that needs further to be explored under natural conditions.

Keywords: Allelopathy, *Avena fatua* L., phenolics, suppression, wheat straw

INTRODUCTION

Wild oat (*Avena fatua* L.) is the most problematic and troublesome annual weed of wheat fields in many tropical countries including India and Pakistan (Hassan *et al*., 2005). Its competitive ability can cause 30% reduction in wheat yield (Malik and Singh, 1995); in addition to deteriorating quality of produce through seed mixture. Numerous studies reported the control of this weed through herbicides (Hassan *et al.*, 2005; Noor *et al.*, 2007); the continuous and unwise use of such chemicals may cause development of herbicide resistance among weeds (Heap, 2008) and health concerns (Kudsk and Streibig, 2003). Such newly emerging concerns have turned the researcher's attention towards alternative choices for weed management that ensure sustainability in agriculture production system (Weston and Duke, 2003; Tesio and Ferrero, 2010). Allelopathy is the process in which secondary metabolites produced by plants, micro-organisms, viruses and fungi influence the growth and development of other plants and organisms in stimulatory or inhibitory way that is not only species specific but depends upon the concentration and type of secondary metabolites produced.

Allelopathy, an important ecological phenomenon explains interaction among plant species through biochemical pathways and can be manipulated to manage weeds in agro ecosystems (Khanah *et al.*, 2005). Allelochemicals of plant origin can substitute synthetic chemicals as nature's own herbicide (Singh *et al.*, 2003); and utilization of allelopathic properties of native plant/crop species offers promising opportunities for this purpose (Khaliq *et al.*, 2011a). Such an approach can also help bring down the undesirable effects of current agricultural practices and cost of high energy inputs (Singh *et al.*, 2003).

Wheat is globally important food grain crop and has got allelopathic potential that can be utilized for sustainable weed management in agro-ecosystems (Alsaadawi, 2001; Khaliq *et al.*, 2011b). Wheat allelopathy has been subject of great interest among researchers (Ma, 2005) and can be exploited in the area of plant protection, environmen safety and resistance breeding (Kruse *et al.*, 2000). There is ever growing consensus that allelopathic wheat cultivars could impart competitive edge against weeds (Bertholdsson, 2009). Rizvi *et al.* (2004) revealed great diversity among wheat accessions for allelopathic activity against weeds under field conditions with some accession scoring 75% weed suppression. Wu *et al.* (2003) reported such a variation to be positively correlated with the total phenolic content in such accessions. Wheat seedlings, straw and aqueous extracts of residues exerted allelopathic effects on a number of agricultural weeds (Mathiassen *et al.*, 2006; Labbafi *et al.*, 2010; Khaliq *et al.*, 2011b) which was attributed to the presence of hydroxamic acids and related compounds (Blum

et al., 1991; Villagrasa *et al.*, 2006) and phenolic acids (Copaja *et al.*, 1999; Wu *et al.*, 2001a) in wheat tissues.

The identification of wheat cultivars with strong allelopathic potential can contribute directly to weed suppression by inclusion into crop rotation, or these can be used in breeding program to incorporate this as a desirable trait in future genotypes making them compete as well as suppress weeds more effectively. Wu *et al.* (2000b, 2001b, 2002) established genetic variation and the biochemical basis for wheat. The authors concluded that some wheat genotypes were even capable of inhibiting herbicide resistant biotypes of annual rye grass. These encouraging findings compel to explore the allelopathic potential of the indigenous wheat genotypes which remains a neglected area of research particularly in Pakistan till-date. Despite the immense genetic diversity of local varieties, land races and promising lines of wheat, allelopathic potential of these has not yet been realized. It is hypothesized that weed suppression by wheat allelopathy could reduce herbicide usage as an environmentally benign approach. The present work was designed to investigate the allelopathic potential of indigenous wheat cultivars against wild oat, a pernicious weed of wheat fields. Wheat straw as aqueous extracts and mulch were manipulated in pot studies for quantifying allelopathic potential of 35 wheat genotypes against wild oat.

MATERIAL AND METHODS

Seed procurement: Seeds of 35 indigenous wheat cultivars were collected from Wheat Research Institute, Faisalabad, Pakistan. These were sown in field following standard agronomic practices as proposed by Anonymous (2008).

Preparation of aqueous extracts: Wheat plants of all wheat genotypes were harvested at physiological maturity and dried under shade. These were chopped into 2-3 cm pieces and dried in an oven at 70°C for 48 h. The oven-dried material was ground and passed through a 40-mesh screen. Ground herbage was soaked in distilled water (1 g per 10 ml) for 24 h at ambient temperature (25°C ± 2). The extract was obtained by filtering the mixture through a Whatman No 42 filter paper, and the filtrate was subsequently used in bioassays. The pH and electrical conductivity of the extracts were recorded with digital pH and conductivity meters (HI-9811, Hannah, USA). The osmotic potential of different extract concentrations was computed as under:

Osmotic potential (-MPa) = EC (ds m^{-1}) x -0.036

The pH and osmotic potential of aqueous straw extracts ranged between 6.90 to 7.20 and -0.55 bars to -0.85 bars, respectively. Literature shows that these values of pH and osmotic potential were unlikely to avert plant growth and any growth inhibition was thought presumably due to inhibitory compounds present in such extracts (Chon *et al.*, 2003).

Total water-soluble phenolics were determined as per Swain and Hillis (1959) using Folin-cicalteu reagent and are expressed as Vanillic acid equivalents that occurs as a potential allelochemical in wheat straw (Lodhi *et al.*, 1987).

Lab experiment

Experiment-I: Influence of aqueous straw extract of different wheat genotypes on germination of wild oat: Wild oat seeds were collected from previously infested wheat fields and cleaned manually to ensure physical purity. These were surface sterilized with water: bleach solution (sodium hypochlorite 10:1) (Matloob *et al.*, 2010) for 15 minutes and rinsed with distilled water four times. Seeds were placed evenly between two layers of moist paper in sterilized Petri plates. Aqueous extract (5 ml) of respective wheat genotype was added to each Petri plate. Half of the solution was used as moisture for the filter paper receiving the seeds, while remaining was applied to the covering filter paper. A control with same volume of distilled water was maintained. Germination of wild oats was counted on daily basis according to AOSA (1990) till a constant count was achieved.

Pot experiments

Plant residues: Straw of field grown mature plants of each wheat genotype was collected and chopped into 3-5 cm pieces and dried in an oven at 70°C for 48 h.

Bioassay: Plastic pots (29 × 18 cm, 6 kg capacity) were filled with air dried, sieved, well mixed soil taken from the Agronomic Research Area. Soil belongs to Lyallpur soil series (Aridisol-fine-silty, mixed, hyperthermic Ustalfic, Haplargid in USDA classification and Haplic Yermosols in FAO classification (Cheema and Khaliq, 2000). Soil pH was 7.6 and total soluble salts were 0.85 dS m^{-1}. Organic matter, total N, available P and K were 0.71%, 0.062%, 13.1 mg kg^{-1} and 179 mg kg^{-1}, respectively. Wild oat seeds (10) of uniform size (95% germination) were sown in each pot which was placed in a screen house under natural solar radiation with an average temperature of 25 ± 5°C. The pots were irrigated when required to maintain soil moisture. Plants were uprooted at 28 DAS (days after sowing) after wetting the pots with water. These were washed under tap and separated into roots and shoots. Harvested plant material was oven-dried at 70°C for 48 h and dry biomass of root and shoot was recorded. Percentage change over control was calculated using formula:

$$\% \text{ change over control} = \frac{\text{Treatment - Control}}{\text{Control}} \times 100$$

Experiment-I: Influence of aqueous straw extract of different wheat genotypes on early seedling growth of wild oat: Foliar application of aqueous straw extract of each wheat genotype was evaluated for its suppressive activity on seedling growth of wild oat. Ten seeds of wild oat were sown. After germination, five seedlings (2 leaf stage) were maintained in each pot. Aqueous extract of wheat straw of

respective genotype at 18 L ha^{-1} (60 ml L^{-1} of water) were sprayed on wild oat seedling 10 days after sowing with hand held sprayer. Volume of spray solution (300 L ha^{-1}) was determined by using water. Control pots were sprayed with same volume of distilled water.

Experiment-II: Influence of straw mulch of different wheat genotypes on early seedling growth of wild oat: Chopped wheat straw was spread as surface mulch (2.5 cm in thickness) *in situ* in each pot at 5 g kg^{-1} of soil (10 t ha^{-1}) while pots without mulch were maintained as control.

Experiment-III: Influence of straw incorporation of different wheat genotypes on early seedling growth of wild oat: Chopped wheat straw of each genotype was mixed uniformly into pots *in situ* at 5 g kg^{-1} of soil (10 t ha^{-1}). Control pots received no straw. Wild oat seeds were sown after 5 days of wheat straw incorporation in each case.

Experimental design and statistical analysis: All the experiments were conducted using a completely randomized design with replicated four times. Data were pooled as the results of two runs were similar. All experimental data were subjected to Fischer's analysis of variance technique using DSAASTAT (Onofri, 2006) and treatment's means were compared by employing Duncan's Multiple Range Test at $P \leq 0.05$. Dendrogram was prepared using STATISTICA statistical package (Statistica 8.0.360).

RESULTS AND DISCUSSION

Lab experiment

Experiment-I: Influence of aqueous straw extract of different wheat genotypes on germination of wild oat: Aqueous wheat straw extracts had a variable inhibitory influence on the germination of wild oat (Fig. 1). A perusal of data revealed that based on differential germination inhibition of wild oat by aqueous extract of different wheat genotypes, these can be identified as four distinct groups. Group one comprising of 9 wheat genotypes (V6007, V6034, V6111, Bhakkar 2002, Uqab 2000, Chanab 2000, V7189, V4611, AS 2000) was highly inhibitory wherein germination inhibition was in the range of 62 to 83%. Only two wheat genotypes (Pak 81, Rohtas 90) fell in second group with moderate germination inhibition of 40 to 45%. Another group (17 genotypes) exhibited a low germination inhibition (17 to 28%). In remaining 7 wheat genotypes germination inhibition did not reach significant level ($P \leq 0.05$) as compared with control (distilled water). . Wheat genotypes with higher tissue concentration of phenolic compounds exhibited greater suppression of wild oat and regression accounted for 88% variation in germination inhibition owing to phenolic content in straw of wheat genotypes (Fig. 2)

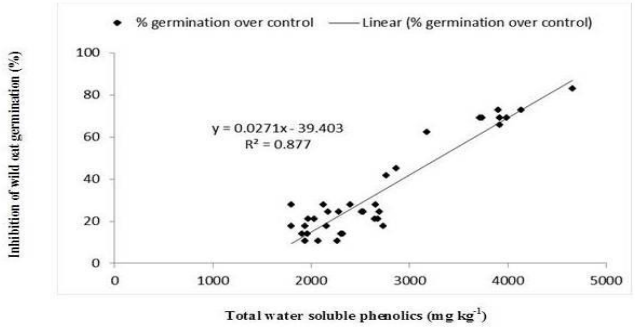

Figure 2. Relationship of wild oat germination inhibition to total water soluble phenolic in wheat straw.

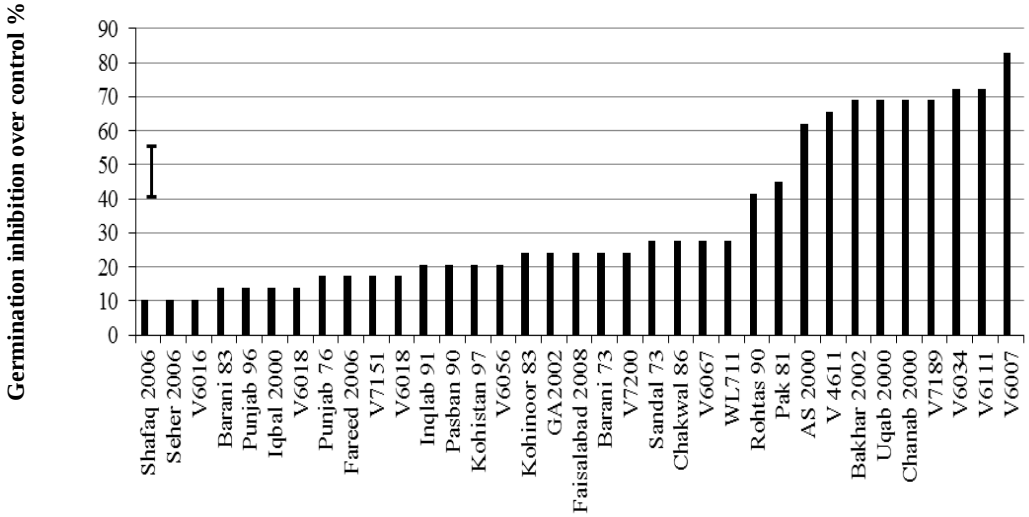

Figure 1. Influence of aqueous straw extracts of different wheat genotypes on germination inhibition of wild oat over control; capped bar show the critical value for comparison as determined by Duncan's multiple range test at *P≤0.05*.

Pot experiments

Experiment-I: Influence of foliar application of wheat straw aqueous extracts of different genotypes on seedling growth of wild oat: Foliar application of aqueous straw extract of different wheat genotypes had a significant bearing on seedling growth of wild oat (Table 1). Different aqueous extracts had a negative effect on root and shoot mass accumulation in wild oat seedling and genotypic variation regarding dry matter accumulation was evident by differential biomass in different wheat genotypes. Wheat genotype V6007 inhibited dry matter accumulation in root (89%) and shoot (76%) to the maximum extent. Aqueous straw extract of Fareed 2006 was promoted shoot dry biomass (53%) over control.

Table 1. Influence of straw of different wheat genotypes on seedling biomass of wild oat

Genotypes	Straw aqueous extract (foliar application)		straw surface mulch		straw mulch incorporate	
	Root dry wt. (g)	Shoot dry wt. (g)	Root dry wt. (g)	Shoot dry wt. (g)	Root dry wt. (g)	Shoot dry wt. (g)
T_1(control)	0.71 a*	0.43 bc	0.12 jk	0.30 de	0.29 cd	0.35 cde
T_2	0.46 cd (-35)**	0.44 bc (2)	0.24 bc (97)	0.30 de (-1)	0.19 fgh (-35)	0.21 jk (-40)
T_3	0.34 fg (-52)	0.47 b (9)	0.26 b (119)	0.23 hij (-23)	0.15 g-l (-47)	0.24 hij (-32)
T_4	0.52 bc (-27)	0.33 d-g (-22)	0.15 ij (22)	0.24 ghi (-20)	0.34 b (16)	0.53 a (52)
T_5	0.46 cd (-35)	0.42 bcd (-3)	0.18 ghi (47)	0.29 d-g (-4)	0.26 de (-12)	0.43 b (22)
T_6	0.65 a (-9)	0.60 a (40)	0.16 hi (31)	0.24 f-i (-19)	0.19 fg (-35)	0.28 f-i (-20)
T_7	0.52 bc (-27)	0.48 b (12)	0.23 cd (94)	0.46 a (53)	0.30 c (5)	0.35 cd (-1)
T_8	0.16 klm (-77)	0.34 def (-20)	0.21 c-f (75)	0.39 bc (30)	0.13 j-m (-54)	0.20 j-m (-44)
T_9	0.22 ijk (-69)	0.20 i-l (-53)	0.32 a (167)	0.43 ab (42)	0.24 e (-16)	0.28 ghi (-21)
T_{10}	0.12 lmn (-84)	0.14 klm (-66)	0.08 l (-33)	0.12 m (-60)	0.11 mn (-62)	0.12 nop (-66)
T_{11}	0.38 ef (-47)	0.44 bc (2)	0.33 a (172)	0.40 bc (34)	0.38 a (32)	0.53 a (51)
T_{12}	0.42 de (-40)	0.58 a (34)	0.21 c-f (75)	0.31 de (2)	0.28 cde (-3)	0.36 c (3)
T_{13}	0.54 b (-24)	0.64 a (50)	0.22 cde (81)	0.28 d-g (-6)	0.26 de (-9)	0.36 c (3)
T_{14}	0.46 cd (-36)	0.66 a (54)	0.21 c-f (78)	0.38 c (26)	0.18 f-i (-39)	0.32 cg (-9)
T_{15}	0.45 cd (-37)	0.64 a (48)	0.20 efg (64)	0.31 d (4)	0.12 k-n (-59)	0.16 k-o (-54)
T_{16}	0.19 jkl (-73)	0.25 g-j (-42)	0.08 l (-33)	0.16 klm (-47)	0.13 j-m (-54.0)	0.18 j-m (-49)
T_{17}	0.13 lmn (-82)	0.17 j-m (-61)	0.08 l (-33)	0.13 m (-57)	0.12 lmn (-60)	0.18 j-n (-50)
T_{18}	0.11 mn (-85)	0.14 lm (-68)	0.08 l (-33)	0.12 m (-61)	0.09 n (-69)	0.11 op (-69)
T_{19}	0.22 ijk (-69)	0.37 cde (-15)	0.15 I (25)	0.26 e-i (-14)	0.29 cd (-1)	0.31 c-g (-11)
T_{20}	0.47 bcd (-33)	0.37 cde (-15)	0.12 jk (0)	0.29 def (-2)	0.14 j-m (-53)	0.22 jk (-37)
T_{21}	0.19 jkl (-73)	0.25 g-j (-41)	0.11 k (-6)	0.21 ij (-30)	0.13 j-m (-54)	0.19 j-m (-46)
T_{22}	0.18 j-m (-75)	0.22 h-l (-48)	0.11 kl (-8)	0.18 jkl (-39)	0.12 lmn (-60)	0.15 l-o (-58)
T_{23}	0.31 fgh (-56)	0.27 f-i (-36)	0.20 d-g (69)	0.28 d-g (-7)	0.28 cde (-5)	0.46 b (31)
T_{24}	0.08 n (-89)	0.10 m (-77)	0.03 m (-72)	0.05 n (-82)	0.08 n (-72)	0.07 p (-79)
T_{25}	0.18 j-m (-75)	0.23 h-k (-47)	0.11 kl (-8)	0.16 klm (-47)	0.12 k-n (-57)	0.12 nop (-66)
T_{26}	0.29 ghi (-60)	0.31 e-h (-28)	0.18 ghi (47)	0.31 d (4)	0.16 g-k (-46)	0.23 ij (-34)
T_{27}	0.43 de (-40)	0.20 i-l (-54)	0.21 c-f (78)	0.42 abc (39)	0.20 f (-31)	0.29 d fgh (-17)
T_{28}	0.16 klm (-77)	0.27 f-i (-38)	0.24 bc (97)	0.41 bc (37)	0.35 ab (22)	0.45 b (30)
T_{29}	0.11 mn (-85)	0.17 j-m (-61)	0.09 kl (-25)	0.12 m (-60)	0.12 lmn (-60)	0.14 mno (-61)
T_{30}	0.12 lmn (-84)	0.22 h-l (-48)	0.08 l (-33)	0.13 m (-57)	0.13 j-m (-54)	0.18 j-m (-49)
T_{31}	0.13 lmn (-81)	0.14 klm (-67)	0.10 kl (-17)	0.16 klm (-47)	0.13 j-m (-54)	0.16 k-o (-54)
T_{32}	0.23 ijk (-67)	0.31 e-h (-28)	0.18 fgh (53)	0.21 ij (-30)	0.11 mn (-62)	0.34 c-f (-4)
T_{33}	0.26 hij (-64)	0.31 e-h (-28)	0.12 k (-3)	0.19 jk (-37)	0.16 g-j (-45)	0.21 jkl (-41)
T_{34}	0.18 j-m (-74)	0.48 b (11)	0.16 hi (33)	0.26 e-i (-14)	0.20 f (-32)	0.28 f-i (-20)
T_{35}	0.25 hij (-65)	0.47 b (9)	0.20 efg (67)	0.26 d-h (-12)	0.14 j-m (-52)	0.23 ij (-35)
T_{36}	0.25 hij (-65)	0.21 i-l (-52)	0.21 c-f (75)	0.14 lm (-53)	0.28 cde (-5)	0.19 j-m (-45)
CV	13.03	13.36	9.94	10.32	10.35	11.82

*Means with different letters differ significantly at 5% level of probability. ** Figures given in parenthesis show percent change over control,T_1 - (control), T_2 -Shafaq 2006, T_3 -Inqlab 91, T_4 -Punjab 76, T_5 -Kohinoor 83, T_6 -Pasban 90, T_7 -Barani 83, T_8 -Seher 2006, T_9 -Punjab 96, T_{10} -Bhakkar 2002, T_{11} -GA2002, T_{12} -Kohistan 97, T_{13} -Sandal 73, T_{14} -Fareed 2006, T_{15} -Iqbal 2000, T_{16} -AS 2000, T_{17} -Uqab 2000, T_{18} -Chanab 2000, T_{19} Chakwal 86, T_{20} -Faisalabad 2008, T_{21} -Rohtas 90, T_{22} -Pak 81, T_{23} -Barani 73, T_{24} -V6007, T_{25} -V6034, T_{26} -V6067, T_{27} -V7151, T_{28} -V6056, T_{29} -V7189, T_{30} -V6111, T_{31} -V 4611, T_{32} -V7200, T_{33} -V6018, T_{34} -V6018, T_{35} -V6016, T_{36} -WL711.

Experiment-II: Influence of straw surface mulching of different wheat genotypes on seedling growth of wild oat: Surface mulch application of straw of most of the wheat genotypes studied in these investigations had inhibitory influence on early seedling growth of wild oat and genotypic differences regarding different seedling growth attributes were apparent (Table 1). Some of the genotypes exhibited a strong inhibition while several others were moderately inhibitory. There were still others with a positive bearing as well. Root and shoot dry weight of wild oat was inhibited to upper limit of 72 and 86% by surface mulch of V6007. Barani 83 and Sehar 2006 were identified for their promotive effect on these traits of wild oat seedling.

Experiment-III: Influence of straw mulch incorporates of different wheat genotypes on seedling growth of wild oat: Soil incorporation of wheat straw imposed a significant inhibition of initial seedling growth of wild oat and the genotypic variation was evident (Table 1). Drastic reduction was recorded for seedling dry weight of wild oat by soil incorporation of wheat straw of different genotypes (Table 1) so that V6007 scored 72 and 79% reduction in root and shoot dry weight of the seedling. GA2002 recorded a positive bearing on root dry weight (32% higher over control) which was similar ($P \leq 0.05$) with that observed for V6056. Punjab 76, GA2002, Barani 73, Seher 2006 and Kohinoor 83 also enhanced shoot dry weight of wild oat.

The analysis and interpretation of the data acquired from bioassays carried out in present work demonstrated the differential allelopathic activity of wheat genotypes against germination and biomass production of wild oat. Wheat has been recognized as a potent allelopathic crop (Bertholdsson, 2004) and such activity is attributed to the presence of a number of phytotoxic compounds. Three main classes of potent bioactive compounds as phenolics, cyclic hydroxamic acids (a class of alkaloids) and short chain fatty acids have been reported to occur in wheat (Wu *et al.*, 2001a; Ma, 2005). Most of the allelochemicals are water soluble compounds that can leach from surface straw by rainfall, and imbibed by either the germinating weed seeds or absorbed by roots in the immediate vicinity. Present studies demonstrated impaired germination and retarded seedling growth of wild oat (Tables 1). Such an inhibition is attributed to allelopathic activity mediated by the presence of such compounds in the aqueous straw extracts and their release from decomposing wheat straw (Wu *et al.*, 2003; Khaliq *et al.*, 2011a). These compounds when present in proper combination and concentration can cause phytotoxicity in the locality (Liebl and Worsham, 1983). Suppressive phytotoxic effects of wheat straw against grassy and broad leaved weeds are also reported by many researchers (Li *et al.*, 2000; Wu *et al.*, 2002; Mathiassen *et al.*, 2006; Labbafi *et al.*, 2010). Ben-Hammouda *et al.* (1995) and Wu *et al.* (2002) also concluded that allelopathic potential was positively correlated with the phenolic content of the donor species. Several other factors also influence the magnitude of allelopathic activity, i.e., the donor and receiver (biological response capacity) species, duration of cover, soil texture, substratum ecology, microbial population and nutrient dynamics.

The differential expression of allelopathic potential by different genotypes of a species has been documented elsewhere (Wu *et al.*, 2001b; Anjum and Bajwa, 2010). The variable allelopathic inhibition of wild oat seedling by wheat straw in present studies can be attributed to differences for type and concentration of allelochemicals present in different genotypes. Nicol *et al.* (1992) and Copaja *et al.* (1991) reported qualitative and quantitative variation determining allelopathic potential of different wheat accessions. Wu *et al.* (2000a) while screening the allelopathic potential of a collection of 453 wheat accessions from 50 countries noticed immense genetic diversity regarding allelopathic potential with some genotypes providing control to a level previously achieved with herbicides. Such variation in allelopathic potential is believed to be genetically controlled and identification and transfer of allelopathic traits from novel genotypes into modern cultivars offers potential for weed suppression (Anjum and Bajwa, 2010). Although crop cultivars with greater allopathic potential are not expected to provide a complete weed control, yet their introduction can have a long term impact on weed management (Wu *et al.*, 2003).

Beside inhibitory allelopathic activity generally observed throughout these studies, some instances of improved seedling growth were also observed (Table 1). The stimulatory action of some genotypes might be due to the presence of allelochemicals in those genotypes in a lower concentration, and can be regarded as an indication of allelochemically induced stimulatory effect (Anjum and Bajwa, 2010). Promotory effects of allelochemicals at lower concentration are not uncommon (Hoffman *et al.*, 1996). Contrarily, Rice (1984) attributed such an activity to the enrichment of substratum with organic matter instead of allelopathic compounds. Some species also possess the ability to beneficially utilize allelochemicals for their nutrition and metabolism at lower concentration. Improved germination of *Brassica kaber* in response to cereal root exudates can be taken as a documented example (Baghestani *et al.*, 1999). Dhumal and Ghayal (2004) also reported increased root and shoot length of wheat due to leaf leachates of *Cassia uniflora* at lower concentrations.

Dendrogram prepared on the basis of germination and dry biomass of both root and shoot as influenced by different wheat genotypes (Fig.3) revealed that that a group of 11 wheat genotypes V6007, AS 2000, V6111, V6034, V4611, V7189, Uqab 2000, Chanab 2000, Bhakkar 2002, Pak 81 and Rohtas 90 strongly inhibited this traits of wild oat. V6007 exhibited highest suppression of wild oat. Rests of

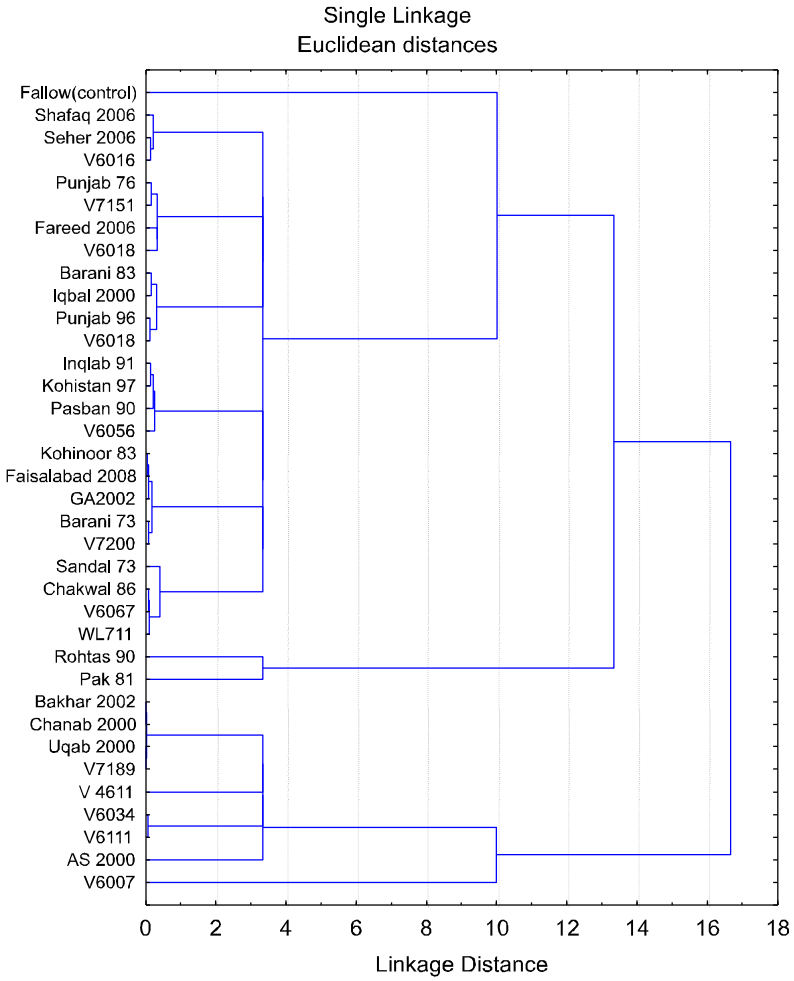

Figure 3. Dendrogram showing similarity between wheat genotypes for allelopathic potential against wild oat

the genotypes were either weak or non allelopathic to wild oat germination or early seedling growth.

In the present work, soil was used as a medium to carry out bioassays as it possess the ability to adsorb/detoxify bioactive compounds. Moreover, pots were placed in screen house under natural environment. Inderjit and Weiner (2001) argued that in order to accomplish better insight into the subject matter; allelopathy should be conceptualized in terms of soil ecology. Whether or not such results can be reproduced under field conditions necessitates the significance of field trials. Interaction of soil microbes with wheat straw amendments should also be considered. Moreover, threshold concentration affecting the individual of a community also needs to be worked out. Moreover, the inclusion of potent allelopathic wheat genotypes into cropping sequence and their effect on weed dynamics in current and following crops needs to be addressed further.

Conclusions: Results revealed a highly significant genotypic variation in allelopathic potential for different traits. Wheat genotypes viz. V6007, AS 2000, V6111, V6034, V4611, V7189, Uqab 2000, Chanab 2000, Bhakkar 2002, Pak 81 and Rohtas 90 showed strongly inhibitory allelopathic activity against germination and seedling biomass of wild oat that needs further to be explored under natural settings.

Acknowledgements: The financial support of Higher Education Commission, Government of Pakistan under indigenous Ph.D. fellowship programme is highly acknowledged.

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