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ALLELOPATHIC EFFECT OF BRASSICA AND BARLEY EXTRACTS ON WEED SUPPRESSION AND GRAIN YIELD OF WHEAT

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ABSTRACT

The objective was to evaluate the allelopathic upshot of brassica and barley herbage water extracts on weed suppression and grain yield of wheat. The experiment was conducted during 2007-2008 at Pir Mehr Ali Shah Arid Agriculture University, Rawalpindi using Randomized Complete Block design. The treatments were; control/un-weed check (T_0), hand weeding at 30 and 60 DAS (Days after sowing) (T_1), brassica herbage water extract @12 L ha^{-1} at 30 DAS (T_2), brassica herbage water extract @12 L ha^{-1} at 30 and 60 DAS (T_3), barley herbage water extract @12 L ha^{-1} at 30 DAS (T_4), barley herbage water extract @ 12L ha^{-1} at 30 and 60 DAS (T_5), brassica + barley herbage water extract @ 6+6 L ha^{-1} at 30 DAS (T_6), brassica + barley herbage water extract @ 6+6 L ha^{-1} at 30 and 60 DAS (T_7). Brassica and barley extracts in mixture exhibited significant inhibitory alleopathic effects by suppressing the weeds. Weed density was reduced significantly in T_7 by 20.44% and 21.45% over control when data was recorded at 65 and 95 DAS, respectively. The maximum increase in grain yield was 17% over control caused by hand weeding. After hand weeding, 9.63% grain yield increase was recorded in T_5. Treatment T_6 caused 8.92% wheat yield increase which was followed by T_7 that enhanced grain yield by 8.5% over un-weed check.

Key words: Allelopathy, brassica and barley herbage extracts, Weed, Wheat.

INTRODUCTION

Weed infestation is a major cause of low wheat yield in rain-fed areas of the Punjab. Weeds decrease wheat yield by 15-50% and even may cause crop failure under rain-fed conditions (Gill and Walia, 1979). Wheat yield could be increased by 37% if weeds are properly controlled (Baloch, 1993). Weeds are one of most important problems in crop production. They compete for light, moisture and nutrients with the main crop. The control of weeds is a prerequisite and key component in most crop production systems (Marwat *et al.* 2003).

Generally, two methods are used for weed control in wheat i.e. cultural and chemical methods. Manual weeding is labor intensive and chemical weed control is not environment friendly. Injudicious use of herbicides can create environmental hazards (Blair *et al*., 1992) and can also affect the nutritive value of many crops (Nazarko *et al*., 2003). Moreover researchers have reported herbicide resistance in previously susceptible weeds (Doug *et al*., 2002). Weeds, therefore, need to be controlled in a judicious manner.

Employing allelochemicals for weed management is likely to be valuable approach to control weeds being a natural, low-cost, environmentally safe and an organic way while conserving the ecosystem. Extracts of brassica and barley contain a number of allelochemicals which are more effective and economical to control weeds in many field crops (Crocker, 1998). Brassica contains water-soluble allelochemicals that inhibit the germination and growth of other species. This characteristic could be used in weed management plan (Tawaha and Turk, 2003). Erin and Gallandt (2005) reported that allelopathic effect of brassica may contribute to weed management in agricultural systems due to the presence of glucosinolates which hydrolyze to form compounds toxic to weeds. Barley contains certain allelochemicals that inhibit the germination and growth of other plant species (Chon and Kim, 2004). Allelopathic chemicals are found in different parts of barley plant. The allelopathic potential of barley increases near physiological maturity (Ben-Hammouda *et al*., 2001).

This study was, therefore, planned with the objective to investigate the individual and combined effect of brassica and barley extracts on weed suppression and grain yield of wheat.

MATERIALS AND METHODS

An experiment was conducted at Koont Research Farm, Pir Mehr Ali Shah Arid Agriculture University, Rawalpindi, Pakistan during Rabi season 2007-2008 to find out the allelopathic effects of brassica and barley herbage water extract on wheat and its associated weeds under rainfed conditions. Rainfall and temperature data have bee presented in Table I. The experiment was laid out in Randomized Complete Block Design (RCBD) with eight treatments and four replications. Wheat variety GA-2002 was planted in November, 2007 using seed rate of 120 kg ha^{-1} with a hand drill by maintaining a row to row distance of 25 cm. The crop was fertilized @ 58-58 N-P_2O_5 kg ha^{-1}. The individual plot size was 6 ×5 m. The treatments were; control/un-weed check (T_0), hand weeding at 30 and 60 DAS (T_1), brassica herbage water extract @12 L ha^{-1} at 30 DAS (T_2), brassica herbage water extract @12 L ha^{-1} at 30 and 60 DAS (T_3), barley herbage water extract @12 L ha^{-1} at 30 DAS (T_4), barley herbage water extract @ 12L ha^{-1} at 30 and 60 DAS (T_5), brassica + barley herbage water extract @ 6+6 L ha^{-1} at 30 DAS (T_6), brassica + barley herbage water extract @ 6+6 L ha^{-1} at 30 and 60 DAS (T_7). Barssica (*Brassica nigra* L.) and barley (*Hordeum vulgare* L.) plants were uprooted from soil at maturity and were dried under shade and then chaffed with fodder cutter into 2 cm pieces. Chaffed brassica and barely were separately soaked in water in 1:10 (1 kg plant material and 10 liters of water) for 24 hours at room temperature. The herbage water extracts were attained by filtering the mixture (herbage and water) through a screen to collect the extracts of barley and brassica separately. The volume of filtrate was reduced twenty times by continuous boiling to prepare the extracts. The brassica and barley extracts were sprayed using knap sack sprayer in accordance with the treatments. Following parameters were studied during the course of experiment:

Weed density was recorded twice from randomly selected area measuring 1 m^2 at 65 and 95 days after sowing (DAS). Two samples were taken from each plot and then averaged. Weeds were cut at ground level from randomly selected areas of 1 m^2 at 65 and 95 DAS to record fresh biomass. The samples were then dried in an oven at 70^0 C for 72 hours and dry biomass was recorded. Sun dried samples of wheat were threshed manually and grain yield per plot was recorded and converted into kg ha^{-1}.

The data were subjected to analysis of variance and the means obtained were compared by Duncan's multiple range tests at 5% level of significance (Montgomery, 2001) by using the MSTATC statistical computer software package.

RESULTS AND DISCUSSION

Weed density (m^{-2})

Barley and brassica extracts suppressed the weeds on 65 and 95 DAS (Table II). The dominant weeds in the experimental area were *Chenopodium album* L. (Bathu), *Anagallis arvensis* L (Billi booti), *Fumaria indica* L. (Shahtra) and *Medicago indica* L. (Maina).

Maximum decrease in weed density was caused by hand weeding i.e. 76% over control. Brassica herbage water extract exhibited less effect on weed population as compared to barley herbage water extract and combined spray of both barley and brassica extracts. One foliar spray of barley herbage water extract @ 12 L ha^{-1} applied 30 DAS reduced weed density by 7.41% than control when recorded 65 DAS. Two sprays of barley herbage extract applied 30 and 60 DAS reduced 8.33% weed population over control. Two foliar sprays of barley + brassica herbage water extract @ 6 + 6 Liter ha^{-1} applied at 30 and 60 DAS reduced weed density by 21.45% in relation to control when recorded 95 DAS (Table 2) and proved as an effective allelopathic treatment.

Table 1. Meteorological data (rain-fall and average temperature) during the growth period of wheat (November 2007 to April 2008).

Month	Rainfall (mm)	Average temperature (^oC)
November, 2007	16	25.6
December, 2007	1.0	18.4
January, 2008	40.6	14.2
February, 2008	29.2	18.7
March, 2008	2.9	29.3
April, 2008	68.3	29.5

Source: Meterological Centre, Soil and Water Conservation Research Institute, (SAWCRI) Chakwal, Pakistan

The inhibitory effects of barley and brassica illustrated the existence of water soluble allelochemicals in the species studied. Jason *et al.* (2005) and Fujii (2001) reported the presence of allelopathic chemicals in brassica and barley that caused decrease in weed density.

Fresh weed biomass (g m^{-2})

Barley and brassica treatments significantly reduced the fresh biomass of weeds. One spray of barley + brassica herbage water extract @ 6+6 liter ha^{-1} 30 DAS reduced fresh weed biomass by 15.63% (Table II) in comparison to control when recorded on 65 DAS. However brassica treatments did not reduce fresh weed biomass significantly.

The fresh biomass of weeds recorded 95 DAS was generally higher in all the treatments. The results specified that weeds continued to grow up to 95 DAS. Maximum reduction in fresh weed biomass was recorded in hand weeding i.e. 53% over control. Out of the remaining treatments, two sprays of barley + brassica herbage water extract applied @ 6+6 liter ha^{-1} at 30 and 60 DAS, when recorded after 95 days of sowing, resulted in significant decrease in weeds fresh biomass i.e. by 24.22%.

These findings were in line with those of Cheema and Khaliq (2000) who concluded that two foliar sprays of sorghum residues suppressed weed flora due to increased allelopathic influences. The results of this study revealed the inhibitory effect of barley and brassica herbage water extract on various weed species. Dhima *et al.* (2006) also described the presence of allelopathic chemicals in barley and brassica.

Table 2. Allelopathic effects of barley and brassica herbage water extract on weed density, fresh weed and dry weed biomass and grain yield

Treatments	Weed Density		Fresh weed biomass (g m^{-2})		Dry weed biomass (g m^{-2})		Grain yield (kg. ha^{-1})
	65 DAS	95 DAS	65 DAS	95 DAS	65 DAS	95 DAS	
Control	54 a	60.00 a	60.28 a	68.12 a	8.61 a	9.71 a	2460 f
Hand weeding at 30 and 60 DAS	13 f (76.03)	28.87 f (53)	15.5 e (74.27)	33.5 f (53)	3.10 e (64)	4.65 e (52.11)	2878 a (17.00)
Brassica WE @12 L ha^{-1} at 30 DAS	50 b (7.41)	56.13 b (6.45)	56 b (7.1)	60 b (6.45)	7.78 b (9.64)	8.5 b (12.46)	2651 e (7.76)
Brassica WE @12 L ha^{-1} at 30 and 60 DAS.	49.5 b (8.33)	51.5 d (14.17)	55.5 b (7.93)	54.5 d (4.17)	7.6 bc (11.73)	7.8 cd (19.67)	2645 e (8.00)
Barley WE @12 L ha^{-1} at 30 DAS	45.88 c (15)	53.88 c (10.2)	55.60 (7.76)	57.62 c (10.2)	7.50 bc (12.89)	8.11 bc (16.48)	2657 de (9.63)
Barley WE @ 12 L ha^{-1} at 30 and 60 DAS	44.5 cd (17.6)	48.39 e (19.35)	52.85 (12.41)	52.5 e (19.35)	7.41 bc (13.94)	7.5 d (22.76)	2697 b (9.63)
Brassica + barley WE @ 6+6 L ha^{-1} at 30 DAS	43 de (0.37)	50.38 d (16.03)	51.20 cd (15.63)	52.48 e (16.03)	7.21 cd (16.26)	7.6 d (21.73)	2669 cd (8.5)
Brassica + barley WE @ 6+6 L ha^{-1} at 30 and 60 DAS.	41.88 e (20.44)	47.13 e (21.45)	50.50 d (16.22)	51.62 e (21.45)	7.02 d (18.47)	7.37 d (24.10)	2679 c (8.92)
$LSD_{0.05}$	2.18	1.13	2.04	1.13	0.46	0.40	15.45

Any two means not sharing a letter in a column differ significantly at P<0.05.
Values given in parenthesis show percent decrease over control.
DAS = Days after sowing; WE = Water extract.

Dry weed biomass (gm^{-2})

Dry weed biomass recorded 65 and 95 DAS revealed that foliar spray of barley and brassica herbage water extract either suppressed dry weed biomass production as compared to control (Table II). Single spray of barley +

brassica herbage water extract applied @ 6+6 liter ha^{-1} on 30 DAS reduced dry weed biomass by 16.26% as compared to control when recorded 65 DAS.

Maximum dry weed biomass reduction was observed in hand weeding that was 64% over control and out of the remaining treatments; the effect of two sprays was significantly greater than single spray on decreasing weeds dry biomass. Double spray of brassica herbage water extract + barley herbage water extract @ 6+6 liter ha^{-1} applied 30 and 60 DAS decreased the dry weed biomass by 24.10% than that of control.

These outcomes evidently specify the allelopathic potential of barley and brassica herbage water extract on weeds dry biomass. Presence of allelopathic chemicals in barley and brassica affect the weeds dry biomass (Fujii, 2001; Haramoto and Gallandt, 2005; Dhima *et al.* 2006).

Grain yield (kg ha^{-1})

Grain yield is the product of the combined effect of interaction of various genetic and environmental factors. Any variation in these factors may fetch difference in grain yield. Barley and barssica herbage extracts enhanced the grain yield (Table II).

The maximum add to grain yield was 17% over control caused by hand weeding. After that of hand weeding, 9.63% yield increase was recorded in the plots where barley herbage water extract @ 12 L ha^{-1} at 30 and 60 DAS was sprayed. Spray of brassica + barley herbage water extract @ 6+6 liter ha^{-1} applied 30 DAS improved 8.92% wheat yield which was followed by spray of brassica + barley herbage water extract @ 6+6 liter ha^{-1} applied 30 and 60 DAS (8.5%). The increased grain yield of wheat was achieved as a consequence of better control over weeds. These findings recognized the work of Ashraf and Naeem (2005) who documented that increased grain yield may owe to reduced weeds infestation. Decrease in weed density by hand weeding and adopting apposite barley and brassica herbage extracts, resulted in higher grain yield. These conclusions are in steadiness with the results of Weiner *et al.* (2001) who studied a negative linear association between above-ground weed biomass and crop yield harvest.

CONCLUSION

Maximum weed control was recorded in hand weeding plots, however, on a large scale; it will be costly to control weeds by hand weeding. Relatively higher economical wheat crop yields can be achieved under rain-fed conditions of Rawalpindi, Pakistan, when the crop is sprayed with barley and brassica herbage water extracts in three different ways (barley herbage water extract @ 12 L ha^{-1} at 30 and 60 DAS, brassica + barley herbage water extract @ 6+6 liter ha^{-1} applied 30 DAS and brassica + barley herbage water extract @ 6+6 liter ha^{-1} applied 30 and 60 DAS) by suppressing the weeds effectively over the left over treatments under study.

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