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EFFECT OF DIFFERENT HERBICIDES AND PLANT EXTRACTS ON YIELD AND YIELD COMPONENTS OF WHEAT (*TRITICUM AESTIVUM* L.)

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Abstract

Studies different herbicides and plant extracts for controlling weeds in wheat crop were conducted at Malakander Research Farm, Khyber Pukhtunkhwa Agricultural University Peshawar, during Rabi season 2008. The experiment was laid out in randomized complete block design having four replications. The experiment was comprised of two herbicides and two weeds extracts each with different doses and a weedy check. The treatments were Affinity (carfentrazone ethyl ester) 50 WDG (Full dose) @ 1.6 kg ha^{-1}, Affinity (carfentrazone ethyl ester) 50 WDG (Half dose) @ 0.8 kg ha^{-1}, Puma super (fenoxaprop-p-ethyl) 75 EW (Full dose) @ 1.2 L ha^{-1}, Puma super (fenoxaprop-p-ethyl) 75 EW (Half dose) @ 0.6 L ha^{-1}, *Sorghum helepense* (Full dose) @ 125g L^{-1}, *Sorghum helepense* (Half dose) @ 62.5 g L^{-1}, *Partheinum hysterophorus* (Full dose) @ 125 g L^{-1}, *Partheinum hysterophorus* (Half dose) @ 62.5 g L^{-1}. The data were recorded on weed density m^{-2} before and after herbicides application, number of spikes m^{-2}, 1000 grain weight (g), grain yield (tons ha^{-1} and harvest index (%). All the parameters were significantly affected by different treatments. For controlling weeds, Affinity 50 WDG (Full dose) proved to be the best treatment giving only 12.50 as compared to 193.96 weeds m^{-2} in weedy check plots followed by plots receiving Puma super 75 EW (Full dose). Similarly maximum grain yield (4.585 tons ha^{-1}) was recorded in Affinity 50 WDG (Full dose) followed by Puma super 75 EW (Full dose) with grain yield of 4.413 tons ha^{-1}. The minimum yield 2.54 tons ha^{-1} was observed in *Partheinum hysterophorus* (Half dose) plots. Affinity 50 WDG had significant effect on increasing number of spikes m$^{-2,}$ 1000 grains weight (g) and also out yielded all other treatments included in the studies.

Introduction

Wheat (*Triticum aestivum* L.) is a major source of food for the population of the whole world. It has rightly been called "The King of Cereals, besides food, a large population of the world consumes wheat in a number of ways. 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 2007-2008 was 8.54 million ha with grain production of 20.95 million tons. In Khyber Pukhtunkhwa area was 0.747 million ha and had a production of 1.071 million tons, respectively (Anon., 2008).

Wheat production is still insufficient to fulfill the consumptive requirements of rapidly growing population of the country. The low yield acre^{-1}, besides many other factors could be attributed to serious weed infestation in the crop. Weeds compete with crop plants for light, air, moisture and nutrients. It increase harvesting costs, requires costly cleaning of seeds, reduce water flow in irrigation and drainage channels and increase fire hazards. It also deteriorates quality of farm produce, which results in decreased market value (Pervaiz & Quazi, 1999).

Wheat has always been subjected to extensive research work to maximize its production. However, a major breakthrough occurred in wheat production with green revolution of 1960. Although the total production of wheat in Pakistan has increased many folds over the past few decades, yet we are still facing food shortage. To overcome food shortage, we need to increase the yield of wheat per unit area. Yield per unit area can thus be increased through the continuous use of high yielding varieties with improved weed management practices (Khan & Noor, 1995; Iftikhar *et al*., 2010; Babar *et al.*, 2011). Considerable evidence suggests that some of the more aggressive perennial weed species including *Cirsium arvense, Sorghum helepense* and *Cyperus rotundus* impose allelopathic influences particularly through toxins released from their residues. Extracts of several important weed species e.g. *Digitaria sanguinalis* inhibit the nodulation of legumes (Rizvi *et al*., 1992). Keeping in view the importance of weed problem in wheat crop an experiment was conducted with the following objectives. a. To find out the most suitable herbicide for weed control in wheat crop. b. To utilize allelopathic materials for control of weeds. c. To quantify the relative tolerance of different weeds species to different doses of herbicides and weeds extracts. d. To find out the most effective and economical weed control method in wheat crop.

Materials and Methods

An experiment was conducted at Malakandher Research Farm, Khyber Pukhtunkhwa Agricultural University, Peshawar during rabi season 2008. Peshawar lies between 71^0-27 and 72^0-47 east longitude and 33^0-40 and 34^0-31 north latitude. It is located at 317 (m) in height above sea level. The experimental site has mean soil pH of 7.47 with 22.8, 55.7 and 21.5% clay silt and sand respectively.The experiment was laid out in randomized complete block (RCB) design, having four replications. Each replication consisted of nine treatments. Okab wheat variety was seeded on a plot size of 270 m^2. The size of each plot was 5 × 1.5 m^2 while row-to-row distance was 25 cm. All other agronomic practices were kept constant for all the treatments. The details of treatments were as under:

S.#	Treatments	Concentrations
1.	Affinity 50 WDG	Full dose 1.6 kg ha^{-1}
2.	Affinity 50 WDG	Half dose 0.8 kg ha^{-1}
3.	Puma Super 75 EW	Full dose 1.2 L ha^{-1}
4.	Puma Super 75 EW	Half dose 0.6 L ha^{-1}
5.	*Sorghum halepense* L.	Full dose 125 g L^{-1}
6.	*Sorghum halepense* L.	Half dose 62.5 g L^{-1}
7.	*Partheinum hysterophorus* L.	Full dose 125 g L^{-1}
8.	*Partheinum hysterophorus* L.	Half dose 62.5 g L^{-1}
9.	Weedy check	------------------------

The plants used for extraction were first dried, cleaned, ground and weighed on electrical balance. Then soaked in water for 72 hours for extractions subsequently these were filtered through muslin cloth. All the herbicides and extracts were applied with the help of a knap sack sprayer, 35 days after planting of wheat. The following parameters were recorded during the course of study.

1. Weed density m^{-2} before herbicidal application
2. Weed density m^{-2} after herbicidal application
3. Number of tillers $plant^{-1}$
4. Spike length (cm)
5. Number of spikelets $spike^{-1}$
6. Number of grains $spike^{-1}$
7. Grain yield (t ha^{-1})
8. Biological yield (t ha^{-1})
9. Harvest index (%).

1. Weed density m^{-2} (before herbicidal application): Weed density m^{-2} at three randomly selected sites in each plot was counted before the herbicidal spray with the help of 1x1m^2 quadrate. Subsequently average was computed.

2. Weed density m^{-2} (after herbicidal application): Weed density m^{-2} after three to four weeks of the herbicidal application was randomly counted at three places in each treatment with the help of 1x1m^2 size quadrate Subsequently averages were and recorded.

3. Number of tillers $plant^{-1}$: The number of tillers in two central rows were counted and the data were converted to tillers m^{-2}.

4. Spike length (cm): Ten representative randomly selected spikes were measured in each plot, summed and later averaged and recorded.

5. Number of spikelets $spike^{-1}$: To record the number of spikelet's $spike^{-1}$, ten representative spikes were randomly taken from each treatment and the number of spikelet's $spike^{-1}$ were counted, averaged and recorded.

6. Number of grain $spike^{-1}$: For recording number of grain $spike^{-1}$, ten representative spikes were randomly taken from each treatment and the number of grain $spike^{-1}$ were counted, averaged and recorded.

7. Biological yield (t ha^{-1}): For biological yield, central two rows were selected and harvested from each treatment, bundled, dried and then weighed in kg and recorded as biological yield. Then the data were subsequently converted into ton ha^{-1}.

8. Grain yield (t ha^{-1}): For grain yield two central rows were harvested, threshed, cleaned and weighed. Finally the grain yield per hector was converted into ton ha^{-1} by the following formula:

$$\text{Grain yield (t ha}^{-1}\text{)} = \frac{\text{Grain yield from net plot (kg)}}{\text{Area harvested (m}^2\text{)}} \times 10{,}000$$

9. Harvest index (%): The harvest index (%) was calculated by using the following formula.

$$\text{Harvest index (\%)} = \frac{\text{Grain yield ha}^{-1}}{\text{Biological yield ha}^{-1}} \times 100$$

Statistical analysis: The data recorded for each trait was individually subjected to the ANOVA technique by using MSTATC computer software (Steel & Torrie, 1980).

Results and Discussion

The data recorded according to the procedure as outlined under "Material and methods" were statistically analyzed. The analysis of variance and Means are presented in Tables 1-4. The results and discussion for individual traits are presented as under.

Weed density m^{-2} before herbicides and weed extracts application in wheat crop

Statistical analysis of the data showed that there were non-significant differences among all the treatments before the application of herbicides and extracts. The data in table 1 showed that the maximum (261.47) weed density m^{-2} was recorded in Affinity 50 WDG Full dose however it was numerically comparable with Puma Super 75 EW Full dose, *S. helepense* Full dose, *P. hysterophorus* Full dose, Affinity Half dose, Puma Super Half dose, S. *halepense* Half dose and *P. hysterophorus* Half dose. The minimum (227.99) number of weeds was recorded in *P. hysterophorus* half dose. Thus it is concluded that there has been a random spread in data prier to the application of treatment.

Weed density m^{-2} after of herbicides and weed extracts application in wheat crop

The data regarding weed density m^{-2} after application of herbicides and extracts are also presented in table 1. The minimum (12.50) weeds m^{-2} were observed in Affinity 50 DG Full dose treated plots followed by Puma Super 75 EW Full dose (18.0) where as the maximum weeds m^{-2} (199.11) were observed *P. hysterophorus* Half dose which was statistically at par with the weedy check. The variability in weed population in different treatments can be attributed to the fact that some herbicides are more effective for weed control than the others. These results are in conformity with those of Hossain *et al*., (2008), who stated that for controlling weeds in wheat crop Affinity 50 WDG proved to be the best.

Table 1. Weed density m^{-2} before and after herbicidal application in wheat.

Treatments	Weed density m^{-2} before herbicidal application	Weed density m^{-2} after herbicidal application
Affinity 50WG (Full dose)	261.48	12.50 d*
Puma Super 75 E W (Full dose)	245.71	18.01 cd
S. halepense L. (Full dose)	245.20	35.20 b
P. hysterophorus L. (Full dose)	250.32	32.50 b
Affinity 50 WDG (Half dose)	239.43	28.76 bc
Puma Super 75 E W (Half dose)	240.01	32.26 bc
S. halepense L.(Half dose)	237.24	195.38 a
P. hysterophorus L. (Half dose)	227.99	199.11 a
Weedy check	230.91	193.96 a
LSD (0.05) value		14.37

* Means followed by different letters in the respective column are significantly different at 5 % probability level according to LSD test

Number of tillers plant^{-1}: Statistical analysis of the data showed that the Number of tillers plant^{-1} were significantly affected by different treatments (Table 2). The highest (9.03) number of tiller plant^{-1} was observed in Affinity 50 WDG Full dose treated plots. However, it was statistically at per with Puma super 75 EW Full dose (8.90). The lowest (5.18) number of tillers plant^{-1} were recorded in *S. helepense* Half dose which was statistically at par with *P. hysterophorus* and weedy check. The highest number of tillers plant^{-1} as obtained from Affinity 50 WDG Full dose were perhaps due to the best phytotoxic effect by it on weeds, while the lowest number of tillers plant^{-1} obtained from the *S. helepense* Half dose, *P. hysterophorus* Half dose and weedy check were probably due to their low phytotoxity on weeds and consequently higher weed competition. The results are in agreement with the work of Khan *et al*., (2003), who reported that there has been a significant increase in the number of tillers with the application of some herbicides in their studies.

Spike length (cm): Statistical Analysis of the Data (Table 2) showed significant effect of different treatments on spike length. The maximum (11.35) and (11.29) spike length was recorded in those plots to which Affinity 50 WDG Full Dose and Puma super 75 EW Full dose were respectively applied. The minimum (8.72) value was observed in weedy check. The maximum 11.35 and 11.29 cm spike length as recorded in Affinity 50 WG Full Dose and Puma Super 75 EW Full dose can be attributed to the best weed management by the chemical treatments under reference, which enabled the flow of nutrients into the crop to enhance the spike length. While, the minimum (8.72) spike length as recorded in weedy check can be due the competition for nutrient offered by weeds. These findings have also been observed by Bibi *et al*., (2005), who concluded that pre-emergence particularly Affinity 50 WDG herbicides significantly improves the spike length in wheat crop.

Table 2. Number of tillers plant^{-1} and plant height at maturity (cm) as effected by different treatments in wheat.

Treatments	Number of tiller plant^{-1}	Spike length (cm)
Affinity 50 WDG (Full dose)	9.35 a*	11.29 a
Puma Super 75 E W (Full dose)	8.90 a	11.35 a
S. helepense L. Full dose)	6.85 b	9.79 bc
P. hysterophorus L. (Full dose)	7.53 b	10.62 ab
Affinity 50 WDG (Half dose)	8.30 a	10.22 b
Puma Super 75 E W (Half dose)	7.11 b	10.45 ab
S. helepense L.(Half dose)	5.18 c	8.92 cd
P. hysterophorus L. (Half dose)	5.63 c	9.14 cd
Weedy check	5.38 c	8.81 cd
LSD (0.05) value	0.7667	0.9952

* Means followed by different letters in the respective column are significantly different at 5 % probability level according to LSD test

Number of spikelets spike^{-1}: Statistical analysis of the data showed that different control measures had significant effect on the number of spikelets spike^{-1}. The data in table 3 exhibited that the highest 15.58 number of spikelets spike^{-1} were obtained from Affinity 50 WDG Full dose followed by 14.93 in Puma Super 75 E W (Half dose) treated plots. The minimum (12.26) number of spikelets spike^{-1} were recorded in weedy check. The highest number of spikelets spike^{-1} obtained from Affinity 50 WDG Full dose treatment was perhaps due to its best phytotoxic effect on weeds, while the lowest number of spikelets spike^{-1}obtained from weedy check plots were probably due to the weed competition against the wheat crop which might have greatly reduced the flow of nutrients towards the spikelets spike^{-4}.

Number of grains spike^{-1}: Analysis of variance of the data revealed that different treatments had significant effect on number of grains spike^{-1} (Table 3). From the perusal of data in Table 3, it was observed that plots treated with Affinity 50 WDG Full dose had the highest (53.78) number of grains spike^{-1} followed by Puma Super 75 E W Full dose 52.80. The minimum 40.0 numbers of grains spike^{-1} were recorded in *S. helepense.* The reason for increased number of grain spike^{-1} is attributed to the effective weed control in those treatments and consequently wheat crop efficiently utilized all the available resources. Sohail (2009) has communicated the analogous finding in wheat. They reported that herbicidal treatments significantly increase the number of grains spike^{-1}.

Table 3. Number of spikelet's spike^{-1} and Number of grains spike^{-1} as affected by different treatment in wheat.

Treatment	Number of spikelets spike^{-1}	Number of grains spike^{-1}
Affinity 50 WDG (Full dose)	15.58 a*	53.78 a
Puma Super75 E W (Full dose)	14.71 b	52.81 ab
S. helepense L. Full dose)	14.53 b	47.43 bc
P. hysterophorus L. (Full dose)	14.73 b	42.26 cd
Affinity 50 WDG (Half dose)	14.33 b	40.06 d
Puma Super 75 E W (Half dose)	14.93 ab	43.51 cd
S. helepense L.(Half dose)	12.31 c	40.01d
P. hysterophorus L. (Half dose)	12.36 c	44.11 cd
Weedy check	12.26 c	45.36 cd
LSD (0.05) value	0.826	5.879

* Means followed by different letters in the respective column are significantly different at 5% probability level according to LSD test

Biological yield t ha^{-1}: Statistical analysis of the data showed that different weed control measure had significant effect on the biological yield t ha^{-1}. The data in table 4 indicated that maximum (8.79) biological yield ton ha^{-1} was produced by those plots to which Affinity 50 WDG Full dose was applied. However, it was statistically at par with Puma Super 75 EW Full dose 8.66. The minimum (4.63) biological yield was observed in weedy check plots. Biological yield of the top scoring treatments is due to the better weed control by the treatments under reference, which enabled the better utilization of the resources (nutrients, solar radiations, water and space) by the wheat crop. These findings are in accordance with the work of Hassan *et al*., (2005) and Naseer-ud-Din *et al*., (2011) found that post-emergence herbicides affect the biological yield of wheat crop.

Table 4. Grain yield (ton ha^{-1}) and Harvest index (%) affected by different treatments in wheat.

Treatments	Biological yield ton ha^{-1}	Grain yield (ton ha^{-1})	Harvest index (%)
Affinity 50 WDG (Full dose)	8.79a	4.59a	51.84
Puma Super 75 E W(Full dose)	8.66a	4.42a	50.95
S. helepense L.(Full dose)	5.28c	3.89bc	69.07
P. hysterophorus L. (Full dose)	5.09c	3.76c	76.39
Affinity 50 WDG (Half dose)	6.99b	3.88bc	55.69
Puma Super 75 E W (Half dose)	7.16b	4.14abc	58.18
S. helepense L.(Half dose)	4.66c	2.87d	61.88
P. hysterophorus L. (Half dose)	4.78c	2.54d	54.05
Weedy check	4.63c	2.82d	59.56
LSD (0.05) value	1.007	220.57	

* Means followed by different letters in the respective column is significantly different at 5% probability level according to LSD test

Grain yield (tons ha^{-1}): Statistical analysis of the data showed that different control measures had significant effect on grain yield ton ha^{-1}. The data in table 4 show the effect of different treatments on grain yield (ton ha^{-1}). The data indicate that maximum (4.59) grain yields (tons ha^{-1}) was produce by Affinity 50 WDG Full dose treated plots. The minimum (2.54) grain yield was observed in *P. hysterophorus* half dose. However, the result from the best treatment was statistically similar with Puma Super 75 EW Full dose (4.42) grain yield. The best performance of Affinity 50 WDG Full dose and Puma Super 75 EW Full dose can be attributed to the best control of weeds due to which weed competition was reduced thus enabling increased flow of nutrients towards the grain and ultimately the grain yield was significantly increased. The results are supported by Hossain *et al*., (2008), who stated that maximum grain yield (4.28 t ha^{-1}) was obtained with Affinity 50 WG. Khan & Marwat (2006) investigated That crop density alone could not suppress the weed below threshold level. The weed reduced wheat yield chiefly by the indirect effect of decreasing wheat tillers, the earliest formed yield component. The weed density, which resulted in yield losses varied greatly with density and season. So chemical and non chemical weed management strategies should be adopated for better yield and yield components of wheat. Khan *et al*., (2008) concluded that with increasing crop plant population m-2 suppress weeds and increase per hectare yield. Khan *et al*., 2011(a, b) are of the view that herbicides suppress weed growth and increase the yield of a crop.

Harvest index %: Analysis of variance of the data (Table 4) showed that different treatments are non significant statistically, where as the grain yield t ha^{-1} and biological yield t ha^{-1} showed highly significant differences. It is evident that different treatment did not effect on the partitioning of photosynthetic towards the grain yield. The data indicate that maximum (76.39%) harvest index was recorded in those plots to which *P. hysterophorus* Full dose was applied. The top scoring treatment was followed by *S. helepense* Full dose (69.06). While the minimum numerical harvest index was recorded in Puma Super 75 EW Full dose (50.95).

Conclusions

Herbicidal treatments should be applied for effective weed control in wheat crop. Affinity 50 WDG, Puma Super 75 EW controlled the weeds effectively. Besides herbicides, application of weeds extracts is an important strategy for effective weed control and has a positive effect on yield and yield components of wheat. Further research is recommended on different rates of the tested herbicides and weeds extracts for the economy and sustainability of the agro-ecosystem.

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