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EFFECT OF INDIVIDUAL AND TANK MIXED HERBICIDES ON YIELD OF WHEAT CROP

Muhammad Farooq Khalil[1], Gul Hassan[1], Zahid Hussain[1], Nazeer Hussain Shah[2] and Muhammad Mumtaz Khan[3]

ABSTRACT

To find out the individual and combined effect of different herbicides on weed control and grain yield of wheat crop, an experiment was carried out at Cereal Crops Research Institute (CCRI) Pirsabak, Nowshera during Rabi season 2006-07. A total of eight treatments were kept in the experiment consisting of six herbicidal, one hand weeding and a weedy check. The experiment was replicated four times in RCBD. The herbicidal treatments were carnfentrazone ethyl + isoproturon @ 0.016, bromoxynil octanovate + heptanovate ester @ 1.23, fenoxaprop-P-ethyl @ 0.94, clodinafop propargyl @ 0.04, clodinafop propargyl + bromoxynil octanovate + heptanovate ester @ 0.04 +1.23, fenoxaprop-P-ethyl + bromoxynil octanovate + heptanovate ester @ 0.94 + 1.23 kg a.i. ha^{-1}. Data were recorded on fresh weed biomass (g m^{-2}), number of tillers plant^{-1}, number of spikes m^{-2}, plant height, number of grains spike^{-1}, 1000 grain weight (g) and grain yield (t ha^{-1}). Carnfentrazone ethyl + isoproturon resulted in the lowest fresh weed biomass (57 g m^{-2}) as compared to weedy check (276 g m^{-2}). However, the best treatment of carnfentrazone ethyl + isoproturon was at par with hand weeding. Similarly, maximum number of tillers (8 plant^{-1}), number of spikes (365 m^{-2}), plant height (113 cm), number of grains (52 spike^{-2}), 1000 grain weight (36g) and grain yield (4.18 t ha^{-1}) were recorded in carnfentrazone ethyl + isoproturon; however it was at par with the hand weeding treatment in most of the parameters. The herbicide combinations were better than other treatments except carnfentrazone ethyl + isoproturon and hand weeding in most of the parameters. Minimum values of the above mentioned parameters were recorded in the weedy check plots. In the light of our data the herbicide carnfentrazone ethyl + isoproturon @ 0.016 kg a.i ha^{-1} is recommended as post emergence herbicide for wheat crop.

Key words: Wheat, *Triticum aestivum* L., weed control, herbicides, herbicide combination, tank mixing, herbicide mixture, yield.

[1]Department of Weed Science, KPK Agricultural University Peshawar, Pakistan.
[2]Agrricultural Research Station, Swabi, Pakistan
[3]University of Peshawar, Peshawar, Pakistan

INTRODUCTION

Wheat is the most important staple food crop in Pakistan. It was grown on an area of 9.046 million ha with total production of 24.033 million t and average yield of 2657 kg ha^{-1} in Pakistan and 0.7695 million ha, 1.2045 million t and 1565 kg ha^{-1}, respectively in Khyber Pakhtunkhwa (MINFAL, 2009). The average yield of wheat in the country does not go beyond 30-35% of its optimum potential (Khan *et al.,* 2004). Weeds are the most serious yield limiting factor in wheat. Hassan and Marwat (2001) reported the annual losses in wheat amounted to more than Rs. 28 billion at national and Rs. 2 billion at provincial level. Weeds use the soil fertility, available moisture, nutrients and compete for space and sunlight with crop plants which result in yield reduction.

The weed management practices including manual weeding or animal drawn implements are cumbersome and time consuming. However, the use of herbicides brought revolution in agricultural production due to their effective and quick action but with the passage of time the non-judicious use of herbicides rather started harming the crop and environment. Therefore, the choice of herbicide, time of application and dose of herbicide are the important considerations for lucrative returns (Fayad *et al.*, 1998). Consequently the use of herbicide rotation and herbicide combination is helpful in avoiding the chances of herbicide resistance in weeds.

In this connection, a study was designed to investigate the individual and combined effect of herbicides commonly used by the farmers in order to get higher grain yield of wheat crop.

MATERIALS AND METHODS

The field experiment was carried out at Cereal Crops Research Institute (CCRI) Pirsabak, Nowshera during wheat sowing season 2006-07 and was laid out in a Randomized Complete Block (RCB) design, replicated four times. The trial consisted of eight treatments randomly allotted to each replication with the individual plot size of 5m x 1.8m. There were 6 rows each 5m long and 30cm apart in each treatment. The wheat variety 'Pirsabak 2005' was used in this study. The herbicides were applied as post emergence i.e. after complete germination of crop and weeds. The hand weeding treatment was done three times, the first being done a month after sowing and the rest at three weeks interval throughout the trial. The fertilizers Nitrogen (N), Phosphorus (P) and Potassium (K) were applied in the form of Urea, DAP and SOP (Sulfate of potash) at the rate of 120, 60, and 60 kg ha^{-1}, respectively. Phosphorus, K and half N were applied prior to sowing while half of the N was applied with the second irrigation. The crop

was irrigated five times throughout its growing season. The treatments details are furnished in Table-1.

Table-1. Detail of treatments used in the experiment.

S.No	Trade Name	Common name	Rate (kg ha^{-1})
1.	Affinity 50 WDG	carnfentrazone ethyl + isoproturon	0.016
2.	Buctril super 60 EC	bromoxynil octanovate + heptanovate ester	1.23
3.	Puma super 75 EW	fenoxaprop-P-ethyl	0.94
4.	Topik 15 WP	clodinafop propargyl	0.04
5.	Topik 15 WP + Buctril super 60 EC	clodinafop propargyl + bromoxynil octanovate + heptanovate ester	0.04 + 1.23
6.	Puma super 75 EW + Buctril super 60 EC	fenoxaprop-P-ethyl + bromoxynil octanovate + heptanovate ester	0.94 + 1.23
7.	Hand weeding	---	---
8.	Weedy check	---	---

All the herbicides were applied as post emergence with a knap sack sprayer. The crop was harvested after physiological maturity when the grains were fully mature. The data were recorded on fresh weed biomass, tillers plant^{-1}, spikes m^{-2}, plant height (cm), grains spike^{-1}, 1000 grain weight (g) and grain yield (t ha^{-1}).

For fresh weed biomass, fresh weeds were collected from between the central two rows in each treatment with the help of 50cm x 50cm quadrate then weighed and subsequently converted to g m^{-2}. In each treatment, ten representative plants were selected randomly and number of tillers plant^{-1} was counted, then averages were taken. Number of spikes m^{-2} at three randomly selected places in each treatment was counted with the help of a quadrate 50cm x 50cm in size. Subsequently averages were computed for each treatment and data were converted to the number of spikes m^{-2}. For recording plant height (cm) at maturity, ten representative plants were selected randomly from each treatment and the height of these plants were measured from the ground surface to the tip of spike excluding awns at physiological maturity. To record the number of grains spike^{-1}, ten representative spikes were randomly selected in each treatment and the number of grains spike^{-1} were counted in each spike and their average was recorded. For 1000-grain weight (g), the number of kernels was randomly taken from each treatment, counted and then weighed with the help of electronic balance. Each treatment was fully harvested, dried and threshed with the help of single plant thresher and cleaned. The seeds obtained were weighed with the help of digital balance for data on grain yield. The data were subsequently converted into kg ha^{-1}. The grain yield (t ha^{-1}).

Statistical analysis

The data recorded for each parameter were analyzed statistically using ANOVA technique by MSTATC computer software and the significant means were separated using Fisher's protected LSD test (Steel and Torrie, 1980).

RESULTS AND DISCUSSION

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

The statistical analysis of the data showed that there was a significant effect of the herbicides on fresh weed biomass (Table-2). The data regarding fresh weed biomass are presented in Table-3. Minimum fresh weed biomass (57 g m^{-2}) was recorded in Affinity 50 WDG treated plots followed by hand weeded plots (65 g m^{-2}); whereas maximum fresh weed biomass (276) was recorded in weedy check followed by Topik alone (70 g m^{-2}). The Topik in combination with Buctril super had less fresh weed biomass (89 g m^{-2}). The mixture of Buctril super + Puma super produced less fresh weed biomass than their application alone. The findings are in conformity with that of Shahid (1994) and Arif *et al.,* (2004) who reported that herbicides and hand weeding significantly reduced weed density and weed biomass. Dadari and Mani (2005) reported that herbicides suppressed weed weights as compared to untreated plots.

Number of tillers $plant^{-1}$

The data indicated that tillers $plant^{-1}$ was significantly affected by various herbicidal treatments (Table-2). The effects of various herbicides on number of tillers $plant^{-1}$ are shown in Table-3. The highest number of tillers $plant^{-1}$ (8) was observed in Affinity 50 WDG treated plots followed by hand weeded plots (7). The mixture of Buctril super + Puma super produced higher number of tillers $plant^{-1}$ (7) than their alone application (5). Similarly, the mixture of Topik and Buctril super also produced more (6) tillers $plant^{-1}$ than their alone application. The lowest (4) number was obtained in weedy check and the highest (8) in Affinity 50WDG that might be due to its best phytotoxic effect on weeds. These results are in agreement with the work of Baldha *et al.,* (1992) and Cheema *et al*., (2005) who reported significant increase in the number of tillers $plant^{-1}$ with the application of herbicides.

Number of spikes m^{-2}

Analysis of the data exhibited that the herbicides had significant effect on number of spikes m^{-2} (Table-2). The highest number of spikes m^{-2} (365) was recorded in Affinity 50 WDG followed by hand weeding (353) spikes m^{-2}. The lowest number (232) was recorded in weedy check followed by Buctril super alone (285) as given in Table-3. However, Buctril super in combination with Puma super produced 337

spikes m^{-2} which is higher than their alone application. Similar results were also reported by Khalil *et al.,* (1999), who concluded that the application of post emergence herbicides in wheat significantly increased number of spikes m^{-2}.

Plant height at maturity (cm)

The ANOVA of the data revealed that herbicidal treatments had non-significant effect on plant height (Table-2). However, taller plants (113 cm) were obtained in Affinity 50 WDG followed by hand weeding (111 cm), while short statured plants (103 cm) were noted in weedy check and Puma super treated plots.

Table-2. Mean squares for fresh weed biomass, No. of wheat tillers plant^{-1}, No. of spikes m^{-2} and plant height (cm) of wheat as affected by herbicides

Source	D.F	Fresh weed biomass (g m^{-2})	Number of tillers plant^{-1}	Number of spikes m^{-2}	Plant height (cm)
Replications	3	1184.78**	0.82**	22.96.58*	17.69 ^{NS}
Herbicides	7	20764.51**	11.12**	8049.43**	63.14*
Error	21	200.65	0.254	495.15	18.22
CV %		14.08	8.77	7.12	4.01

* = Significant at 5% level of probability ** = Significant at 1% level of probability

Table-3. Fresh weed biomass (g m^{-2}), No. of tillers plant^{-1}, No. of spikes m^{-2} and plant height (cm) of wheat as affected by different herbicidal treatments

Treatments	Fresh weed biomass (g m^{-2})	Number of tillers plant^{-1}	Number of spikes m^{-2}	Plant height (cm)
Affinity 50 WDG	57 e	8 a	365 a	113 a
Buctril super 60 EC	80 bcd	6 c	285 b	103 b
Puma Super 75 EW	97 b	4 e	290 b	108 ab
Topik 15 WP	70 cde	5 d	295 b	103 b
Topik 15 WP + Buctril Super 60 EC	89 bc	6 c	344 a	108 ab
Buctril Super 60 EC+ Puma Super 75 EW	70 cde	7 b	337 a	103 b
Hand weeding	65 de	7 b	353 a	111 a
Weedy check	276 a	4 e	232 c	103 b
$LSD_{0.05}$	20.83	0.74	32.72	6.28

Means not followed by the same letters are significantly different by LSD test at 5 % level of probability.

It shows that application of post-emergence herbicides has no significant effect on plant height as this trait is more controlled by the genetic makeup of plants. However, Khan *et al*., (2004) reported that herbicides had significant effect on plant height which might be due to the use of different varieties.

Number of grains spike^{-1}

The data showed that the application of different herbicides had significant effect on number of grains spike^{-1} (Table-4). Among the treatments, Affinity 50 WDG had the highest grains spike^{-1} (52) followed by hand weeding (51). The minimum number of grains spike^{-1} (42) was recorded in weedy check followed by Topik (45). However, Topik in combination with Buctril super produced higher grains spike^{-1} (49). The reason for increased number of grains spike^{-1} might be attributed to effective weed control in these treatments that allowed wheat crop to utilize all available resources efficiently. Arif *et al.* (2004) reported that higher numbers of grains were produced by herbicidal treatments as compared to weedy check plots.

Thousand grain weight (g)

The analysis of the data showed that herbicide treatments significantly affected 1000 grain weight (Table-4). The data in Table-5 exhibited that the highest 1000 grain weight (36g) was obtained in Affinity 50 WDG plots followed by hand weeded plots (33g). The lowest 1000 grain weight (29g) was recorded in weedy check plots followed by Buctril super alone (30g). However, Buctril super in combination with Puma super provided better results and produced higher 1000 grain weight than their individual application (32g). Similarly the mixture of Topik + Buctril super produced higher 1000 grain weight (32) than their individual application (30). The increased grain weight in herbicide treatments might be attributed to the availability of resources to the wheat crop. Hassan *et al.* (2004) obtained maximum 1000 grain weight in plots treated with mixture of herbicides. Marwat *et al.* (2005) reported that herbicide treated plots gave higher 1000 grain weight than the weedy check.

Grain yield (t ha^{-1})

Analysis of the data indicated that herbicidal treatments had a significant effect on grain yield (Table-4). Maximum grain yield was recorded in Affinity 50 WDG plots (4.18 t ha^{-1}) followed by hand weeding and mixture of Buctril super + Puma super (3.65 and 3.33 t ha^{-1}, respectively). Minimum grain yield was recorded in weedy check plots (2.78 t ha^{-1}) followed by Buctril super alone (2.95 t ha^{-1}). Maximum grain yield observed in Affinity 50 WDG was because of its more toxic eefect on both grassy and broad leaf weeds than other herbicides. Punia *et al.* (1996) concluded that herbicides applied in combination provided better weed control and higher grain yield.

Table-4. Mean squares for number of grains spike^{-1}, thousand grain weight (g) and grain yield (t ha^{-1}) as affected by different herbicides.

Source	D.F	Number of grains spike^{-1}	Thousand grain weight (g)	Grain yield (t ha^{-1})
Replications	3	31.74 ^{NS}	3.956 ^{NS}	0.22 ^{NS}
Herbicides	7	48.12*	21.99*	0.77**
Error	21	17.26	6.63	0.15
CV %		8.52	8.12	11.65

NS = Non significant at 1% level of probability * = Significant at 5% level of probability
** = Significant at 1% level of probability

Table-5. Number of grains spike^{-1}, thousand grain weight (g) and grain yield (t ha^{-1}) as affected by different herbicidal treatments.

Treatments	Number of grains spike^{-1}	Thousand grain weight (g)	Grain yield (t ha^{-1})
Affinity 50 WDG	52 a	36 a	4.18 a
Buctril super 60 EC	50 ab	30 bc	2.95 c
Puma Super 75 EW	51 ab	31 bc	3.10 bc
Topik 15 WP	45 bc	30 bc	3.15 bc
Topik 15 WP + Buctril Super 60 EC	49 ab	32 bc	3.25 bc
Buctril Super 60 EC+ Puma Super 75 EW	50 ab	32 bc	3.33 bc
Hand weeding	51 ab	33 ab	3.65 ab
Weedy check	42 c	29 c	2.78 c
$LSD_{0.05}$	6.11	3.79	0.57

Means not followed by the same letters are significantly different by LSD test at 5 % level of probability.

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