CHEMICAL WEED MANAGEMENT IN WHEAT INTERCROPPED WITH SUGARCANE*

Khan Bahadar Marwat[1], Zahid Hussain, Bakhtiar Gul and Muhammad Saeed

ABSTRACT

To assess the effect of various herbicides to control weeds in wheat intercropped with sugarcane, a field trial was conducted at Sugar Crops Research Institute, Mardan during rabi season 2003–04, using randomized complete block (RCB) design having four replications. The experiment consisted of eight treatments viz; seven herbicides and a weedy check. The herbicides included were; terbutryn + triasulfuron @ 0.16 kg, 2,4-D @ 0.7 kg, fenoxaprop-p-ethyl @ 0.93 kg, clodinafop @ 0.05 kg, bromoxynil + MCPA @ 0.49 kg, carfentrazon-ethyl @ 0.02 kg and isoproturon @ 1.0 kg a.i ha^{-1}. The data were recorded on weeds kill percentage, fresh weed biomass, plant height, spike length, number of spikes m^{-2}, number of grains spike^{-1},1000 grain weight, biological yield, grain yield and harvest index. Parameters like weed kill percentage, weed biomass, number of spikes m^{-2} and grain yield were significantly affected by the herbicides. Maximum weed kill percentage (96.2%) and minimum weed biomass (179 kg ha^{-1}) were recoded in terbutryn + triasulfuron as compared to weedy check having values of 0 % and 1381 kg ha^{-1}, respectively. Similarly spike length (12.6 cm), number of spikes (490 m^{-2}), number of grains spike^{-1}(52.25), 1000 grain weight (44.8 g), biological yield (18240 kg ha^{-1}), grain yield (4453 kg ha^{-1}) and harvest Index (29.3%) were the highest in Logran extra 64 WG treatments as compared to weedy check having (11.0 cm), (342 m^{-2}), (41.0), (40.23 g), (16260 kg), (3575 kg ha^{-1}) and (24.3 %), respectively.

Key words: Wheat, *Triticum aestivum*, weed control, herbicides, chemical control.

INTRODUCTION

Wheat (*Triticum aestivum* L.) is the major staple food crop of our country. The prosperity of our people depends to a large extent on good wheat harvests. Wheat contributes 72% of the calories and proteins in our diet. In NWFP, the climatic conditions are suitable for spring wheat production. However, winter type wheat can also be grown at higher elevations like Chitral, Swat and Hazara. The average annual temperature1 ranges from 18^{0}C in Northern area to 22^{0}C in Southern area. Similarly the average annual rainfall varies from less than 30 mm in D.I. Khan in the extreme south to over 1000 mm in Abbottabad. At the national level, during 2004-05, the area under wheat cultivation was 8.358 million ha, with a production of 21.612 million tons. At provincial level, in NWFP, the area under wheat cultivation was about 0.749 million ha. One third of this area in NWFP is irrigated, while two third is rainfed giving a total production of 1.091 million tons at the rate of 1458 kg ha^{-1} (MINFAL, 2005).

[1]Department of Weed Science, NWFP Agricultural University, Peshawar – Pakistan
E- mail: kbmrwat@yahoo.com.

*The research was funded through PSF Project on "Management of Weeds in wheat in NWFP."

Improvement of wheat genotypes by exploiting the genetic potential has given us high yielding cultivars, yet the problem of weeds in those improved genotypes has become more severe and needs to be addressed because weeds not only reduce the crop yield but also deteriorate the farm produce quality, and have a bad effect on market value along with rising costs of labor and power through which cost of production also increase (Khan and Haq, 2002) and (Herath and Takeya, 2003). Thus, it is necessary to devise methods that could reduce the cost of production and save time and labor as well. The control of weeds is basic requirement and major component of management in the production system (Young *et al.* 1996; Young and Greaves 1940.

Changes in aggregate land productivity are associated structurally with inter-cropping. Weeds in wheat have become a serious problem which reduces yields by 20-30% depending upon weed species and their densities (Kurosaki, 2003; Ehui and Pender, 2005). Wheat is commonly grown on small pieces of land for their own use in NWFP and intercropping is practiced in some areas of district Mardan. Akhtar and Silva (1999) worked on intercropping of wheat in sugarcane. Similarly Abrar *et al.* 2004 concluded that intercropping appears most suitable to certain agro-climatic regions where wheat is grown. Weeds share resources with crop plants aggregated by the efforts of farmer in the form of time, money and the natural resources present in the soil which should be utilized by wheat crop to give fruitful output. Now it is a challenge for the scientists to divert those resources towards wheat yield. Improving wheat performance under irrigated conditions lead us study chemical weed control to find out the relative efficiency of chemical weed control in controlling the weeds and increasing wheat yield.

Among the weed control methods, the chemical control is one of the recent origins, which is being emphasized, in modern agriculture (Taj *et al.* 1986). The chemical method of weed control can provide us abrupt and promising results. Furthermore, if the chemical control is tested in areas where wheat is intercropped with sugarcane, it may provide fruitful results. Isoproturon @ 1.0 kg ha^{-1} was most effective against the grass weeds and gave satisfactory control of broadleaved weeds (Pandey and Singh, 1994). The experiment was conducted with the objectives to evaluate different herbicides for weed control in wheat intercropped with sugar cane, to study the effect of different herbicides on yield of wheat and to assess the effect of herbicides on sugar cane.

MATERIALS AND METHODS

An experiment was conducted at Sugar Crops Research Institute (SCRI), Mardan, Pakistan to study the effect of different herbicides on Wheat- sugarcane. The variety Inqilab-91 was sown during mid-November 2003. The experiment comprised of eight treatments replicated four times, using Randomized Complete Block (RCB) design. The sub-plot size was 2.7 x 4.5 m^2, having 6 rows of wheat intercropped in 3 rows of sugar cane each 30 cm apart (one sugar cane row after each three rows of wheat) with row length 4.5 m. The treatments have seven herbicides applied as post-emergence and a weedy check. The detail of the treatments is given Table-1.

Data were recorded on weed kill efficiency (%), Fresh weed biomass (kg ha^{-1}), plant height at maturity (cm), spike length (cm), number of spikes m^{-2}, grains $spike^{-1}$, thousand grains weight (g), biological yield (kg ha^{-1}), grain yield (kg ha^{-1}) and harvest index (%). Data was subjected to the ANOVA technique by using MSTATC and means were separated by using Fisher's LSD test (Steel and Torrie, 1980).

Table-1. Herbicides used in wheat intercropped with sugarcane during 2003-04.

S. No.	Trade name	Common name	Rate (kg a.i. ha^{-1})
1	Topik 15 WP	clodinafop-propargyl	0.04
2.	2, 4-D 70 SL	2,4-D	0.70
3.	Buctril M 40 EC	bromoxynil + MCPA	0.49
4.	Isoproturon 50 WP	isoproturon	1.00
5.	Logran extra 64 WG	terbutryn + triasulfuron	0.16
6.	Aim 40 DF	carfentrazone-ethyl	0.02
7.	Puma Super 75 EW	Fenoxaprop-p-ethy	0.93
8.	Weedy check	---	---

RESULTS AND DISCUSSION

The data recorded on weed kill percentage (%), weed biomass (kg ha^{-1}), number of spikes m^{-2} and grains yield (kg ha^{-1}) were significantly affected by the different herbicide treatments, while remaining trait means were found non-significant. The results and discussion for the individual traits are presented as under:

Weed kill percentage

Maximum weed kill percentage (96.2) was recorded in Logran extra 64WG as compared to weedy check (Table-2). However, it was statistically at par with Isoproturon, Buctril-M and 2, 4-D. The lowest weed kill efficiency was shown by Topik. This means that Logran extra 64WG has effectively controlled weeds and resulted in increased yield. Similar results are reported by Khan *et al.* (2003).

Fresh weed biomass (kg ha^{-1})

The data regarding fresh weed biomass in Table-2, indicated that minimum and statistically at par fresh weed biomass was recorded in Logran extra 64 WG (179 kg ha^{-1}) and Isoproturon 50 WP (210 kg ha^{-1}) due to effective weed control. These were followed by Buctril-M 40 EC and Aim 40 DF. However, maximum fresh weed biomass (1381 kg ha^{-1}) was recorded in the weedy check due to no weed control. The difference in the weed biomass in different treatments was due to phytotoxic effect of different herbicides. The findings were in analogy with the results of Khan *et al.* 2003 and Pandey and Singh (1994).

Plant height (cm)

Data in Table-2 revealed that the mean difference were non-significant, however, maximum plant height was recorded in weed control (117 cm) which was gollowed by Topik 15 WP (116.3 cm) and Bucril-M 40 EC (114 cm). Maximum plant height in weed control was due to competition of the wheat plants with weeds which forced the crop plants to rise higher than their normal heights for photosynthesis etc. Similar results have been reported by Khalil *et al.* (2000) who stated that there was non-significant increase in the plant height with the application of herbicides.

Spike length (cm)

ANOVA revealed that the mean difference were non-significant, however, maximum spike length (12.6 cm) was observed in Buctril-M 40 EC followed by Isoproturon (12.1 cm) and 2, 4-D (12.0 cm). The perusal of data in Table-2 further revealed that the lowest spike length (11.0 cm) was recorded in weedy check.

Number of spikes m^{-2}

Data pertaining to number of spike m^2 in Table-2 reflected that all the herbicides attained at par spikes m^2 except 2,4-D. However, maximum and statistically at par number of spikes m^2 (490) was recorded in Logran extra 64 WG and Puma super followed by Buctril-M and Topik. The lowest value (342) was observed in the weedy check. The results are supported by Khan *et al.* (2003) who stated that number of spikes m^{-2} increases with the application of some herbicides.

Table-2. Weeds kill efficiency, fresh weed biomass, plant height, spike length and number of spikes as affected by different herbicides in wheat intercropped with sugarcane during 2003-04.

Treatments	Weed kill efficiency (%)	Fresh weed biomass (kg ha^{-1})	Plant height (cm)	Spike length (cm)	Spikes m^{-2}
Topik 15 WP	18.8 d	831 b	116.3	11.4	463 ab*
2, 4-D 70 SL	79.0 ab	410 cd	105.5	12.0	453 b
Buctril M 40 EC	86.7 ab	283 de	114.0	12.6	467 ab
Isoproturon 50 WP	91.8 ab	210 e	111.3	12.1	438 b
Logran extra 64 WG	96.2 a	179 e	112.3	11.5	490 a
Aim 40 DF	76.5 b	362 cde	111.8	11.9	447 ab
Puma Super 75 EW	51.1 c	520 c	113.3	11.9	473 a
Weedy check	---	1381 a	117.3	11.0	342 c
$LSD_{0.05}$	17.7	185.8	NS	NS	79.8

* Means followed by a common letter in the respective column do not differ by $LSD_{0.05}$

Number of grains $spike^{-1}$

Data in Table-3 revealed that the mean difference were non-significant for number of grains $spike^{-1}$. However, the highest (52.2) number of grains $spike^{-1}$ were recorded in Logran extra 64 WG, Buctril-M and Weedy check. These results are in line with findings of Marwat *et al.* (2003) who stated that number of grains $spike^{-1}$ increases with the application of some herbicides.

1000- grain weight (g)

Analysis of the data revealed that herbicides had non-significant effect on 1000 grains weight. However, Table-3 showing that the highest 1000 grains weight (44.8 g) was recorded in Logran extra 64WG followed by Puma super (43.1 g) as compared to weedy check (40.2 g). The results are similar to those reported by Khalil *et al.* (2000).

Biological yield (kg ha^{-1})

ANOVA revealed that the mean difference were nonsignificant. However, maximum biological yield of (18240 kg ha^{-1}) was recorded in Logran extra 64 WG followed by Topik (18140 kg ha^{-1})) and Puma super (17140 kg ha^{-1}). The lowest biological yield of 16260 kg ha^{-1} was noticed in weedy check (Table-3). Pandey and Singh (1994) reported comparable results.

Grain yield (kg ha^{-1})

According to grain yield the maximum grain yield of 4453 kg ha^{-1} was recorded in Logran extra 64 WG (Table-3) and was found statistically at par with three other herbicides like Isoproturon 50 WP (4383 kg ha^{-1}), Buctril-M 40 EC (4150 kg ha^{-1}) and Puma super 75 EW (4020 kg ha^{-1}). Minimum grain yield of 3575 kg ha^{-1} was attained in weedy check. The best performance of Logran extra and the above three other herbicides can be attributed to the best control of weeds which reduced weed competition and enable increased flow of nutrients towards the grains and ultimately increased the grain yield. The results are supported by Pandey and Singh (1994), Khan *et al.* (2003) and Marwat *et al.* (2003). Akhtar and Silva (1999) also worked on intercropping of wheat in sugarcane.

Harvest index

Analysis of variance of the data exhibited that herbicides had non-significant effect on the harvest index. However, Table 3 exhibited that the maximum harvest index (31.1 %) was calculated in Isoproturon 50 WP followed by Buctril M 40 EC (25.4%) and Logran extra 64 WG (24.4%). Minimum harvest index (21.8 %) was computed in Topik 15 WP treated plots.

CONCLUSION

Results manifest that Logran extra 64WG is the best herbicide controlling weed flora in wheat crop intercropped with sugar cane at Sugar Crops Research Institute (SCRI) Mardan and resulted in maximum grain yield. However, it was closely followed by Buctril M 40EC and Isoproturon 50WP in performance.

Table-3. Number of grains spike^{-1}, 1000-grain weight, biological yield, grain yield and harvest index as affected by different herbicides in wheat intercropped with sugarcane during 2003-04.

Treatments	No. of grains Spike^{-1}	1000-grain weight (g)	Biological yield (kg ha^{-1})	Grains yield (kg ha^{-1})	Harvest index (%)
Topik 15 WP	50.7	41.0	18140	3945 a-d	21.8
2, 4-D 70 SL	41.0	40.0	16560	3850 cd	23.2
Buctril M 40 EC	52.0	41.4	16310	4150 abc	25.4
Isoproturon 50 WP	48.0	41.4	14070	4383 ab	31.1
Logran extra 64 WG	52.2	44.8	18240	4453 a*	24.4
Aim 40 DF	43.0	42.6	16350	3900 bcd	23.8
Puma Super 75 EW	48.0	43.1	17140	4020 a-d	23.4
Weedy check	52.0	40.0	16260	3575 d	24.3
$LSD_{0.05}$	NS	NS	NS	513	NS

* Means followed by a common letter in the respective column do not differ by $LSD_{0.05}$

REFERENCES CITED

Abrar, S., O. Morrissey and T. Rayner. 2004. Crop-Level Supply Response by Agro-Climatic Region in Ethiopia. J. Agric. Econ. 55(2): 289-311.

Akhtar, M. and J.A. Silva. 1999. Assessment of crop residue cover with photographic slide and point intercept methods. Trop. Agric. 76(3): 205-207.

Ehui, S., and J. Pender. 2005. Resource degradation, low agricultural productivity, and poverty in sub-Saharan Africa: pathways out of the spiral. Agric. Econ. 32(1): 225-242.

Herath, P.H.M.U. and H. Takeya. 2003. Factors determining intercropping by rubber smallholders in Sri Lanka: a logit analysis. Agric. Econ. 29(2): 159-168.

Khalil, S. K., A.Z. Khan, P. Shah, A.R. Baloch and M.F. Malik. 2000. Herbicides and row spacings effect on leaf characteristics and grains per spike of wheat. Sarhad J. Agric. 16(1): 13-17.

Khan, M. and N. Haq. 2002. Wheat crop yield loss assessment due to weeds. Sarhad J. Agric. 18(4): 443-448

Khan, M. H., G. Hassan, N. Khan and M.A. Khan. 2003. Efficacy of different herbicides for controlling broadleaf weeds in wheat. Asian J. Plant Sci. 2(3): 254-256.

Kurosaki, T. 2003. Specialization and Diversification in Agricultural Transformation: The Case of West Punjab, 1903 -92. American J. Agric. Econ. 85(2): 372-386.

Marwat, M. I., H. K. Ahmad, K. B. Marwat and G. Hassan. 2003. Integrated weed management in wheat-II. tillers m^{-2}, productive tillers m^{-2}, spikelets $spike^{-1}$, grains $spike^{-1}$, 1000 grain weight and grain yield. Pak. J. Weed Sci. Res. 9(1-2): 23-31.

MINFAL. 2005. Agriculture Statistics of Pakistan, Pp. 3-4.

Pandey, J. and R.P. Singh, 1994. Effect of sulfonyl urea herbicides on weed control in wheat (*Triticum aestivum*). Indian J. Agron. 39 (4): 565-568.

Steel, R.G.D. and J.H. Torrie. 1980. Principles and procedures of statistics. McGraw Hill Book Co., Inc. New York. 481. pp.

Taj, F.H., A. Khattak and T. Jan. 1986. Chemical weed control in wheat. Sarhad J. Agric. 2:15-21.

Young, F.L., A.G. Ogg (Jr.), D.L. Young and R.I. Papendick. 1996. Weed management for crop production in the northwest wheat (*Triticum aestivum*) region. Weed Sci. 44 (2):429-36.

Young S.M. and J.S. Greaves. 1940. Influence of variety and treatment phytin content of wheat. Food Res. 5: 103-105.