African Journal of Biotechnology Vol. 11(7), pp. 1567-1573, 24 January, 2012
Available online at http://www.academicjournals.org/AJB
DOI: 10.5897/AJB11.154
ISSN 1684–5315 ©2012 Academic Journals

Full Length Research Paper

Weed biomass and economic yield of wheat (*Triticum aestivum*) as influenced by chemical weed control under rainfed conditions

Muhammad Azim Malik[1], Faisal Zahoor[1], Muhammad Ramzan Anser[1], Muhammad Rasheed[1], Umarah Aslam[1], Khalid Mehmood[2] and S. H. Raza[3]

[1]Department of Agronomy, Pir Mehr Ali Shah-Arid Agriculture University, Rawalpindi, Pakistan.
[2]Department of Agronomy, Faculty of Agriculture, Rawalakot, Pakistan.
[3]Faculty of Agriculture and Nutritional Science Institute of Nature and Resource Protection CAU Kiel, Germany

Accepted 18 July, 2011

A study to investigate the efficacy of different herbicides on rainfed wheat was carried out at the experimental farm, of the University of Arid Agriculture, Rawalpindi during 2004 to 2007. Wheat variety GA-2002 was planted as a test crop. The experiment was carried out in randomized complete block design (RCBD) with three replications. Among different treatments, the lowest weed biomass was achieved in hand weeding treatment. Plots treated with herbicide Buctril super (Bromoxonil + MCPA) also produced excellent results in reducing weed biomass. The highest grain yield was recorded in plots where Buctril Super was sprayed. Weedy check treatment was at the bottom with the lowest grain yield. Economic analysis indicated that Buctril super was the best treatment with the highest benefit cost ratio.

Key words: Wheat, weed control, herbicides, rainfed conditions.

INTRODUCTION

Wheat plays a vital role in Pakistan's economy and social life. It is grown on an area of 9.062 million ha with a total production of 23.42 million tonnes in Pakistan with an average yield of 2585 kg ha^{-1}. Pakistan is the 9th biggest wheat producer, contributing about 2% of the global wheat supply. It contributes 13.1% to the value added in agriculture and 2.8% to gross domestic product (GDP) in Pakistan (Government of Pakistan, 2008 to 2009). Weed infestation is one of the main causes of low wheat yield in Pakistan that reduces its yield by 25 to 30% (Nayyar et al., 1995). According to Baluch (1993), grain yield in Pakistan may be increased by up to 37%, if weeds are properly controlled in wheat. Shamsi and Ahmed (1984) reported that the major weeds of wheat in Pakistan causing huge economic losses are canarygrass (*Phalaris minor* R.), wild oats (*Avena fatua* L.) and lambsquarters (*Chenopodium album* L.). The weeds with relatively less economic importance include wild medic (*Medicago polymorpha* L.), field bindweed (*Convolvulus arvensis* L.), blue pimpernel (*Anagallis arvensis* L.), fumitory (*Fumaria parviflora* L.), broadleaf dock (*Rumex dentatus* L.) and swincress (*Coronopus didymus* L.). Weed density, type of the weeds, their persistence and crop management practices determine the magnitude of yield loss. Wheat crop usually suffers from stress created by weeds through competition for water, nutrients, space and sunlight (Anderson, 1983).

Weeds also cause interference by releasing toxic substances into the rhizosphere of the crop plants (Rice, 1984). The weed problem is getting from bad to worst in wheat. The cropping intensity is rapidly increasing with the result that weed management through traditional methods has become difficult due to non-avalibility of labour. The principal component of modern weed control constitutes herbicide usage. The advent of herbicides gave a new direction to the farmers to realize the maximum yield potential of the crop at lower input costs

*Correspondingauthor. E-mail: ramzan.anser@gmail.com.

Table 1. Physico-chemical properties of experimental site.

Characteristic	1st year	2nd Year	3rd Year
Textural class	Loam	Loam	Loam
pH	7.60	7.70	7.50
Organic matter (%)	0.55	0.41	0.75
Total nitrogen (%)	0.063	0.068	0.066
Available phosphorus (ppm)	5.0	5.5	5.1
Extractable potassium (ppm)	90	99	91

which has never been possible (Rao, 2000). Weed management is not accomplished by using cultural practices exclusively. Herbicides offer an additional tool to control weeds in conjunction with cultural practices. Jarwar et al. (1999) observed that chemical weed control is effective in controlling weeds. Similarly, Shah et al. (1989) reported that chemical control of weeds aimed at shifting the balance of agro-ecosystem in favour of cultivated crop has proved to be relatively efficient and economical in controlling weeds. They further noted that application of broad-leaf herbicide decreased weed population and increased economical yield significantly.

The success of herbicide application is dependent upon weed species, the timeliness and thoroughness of application, condition at the time of application, herbicide rate and crop management after the application. As a matter of fact, with the rising cost of labour and power, the judicious use of herbicide is the only acceptable way for effective weed management in future (Marwat et al., 2005). Currently, many herbicides are available in the local market and their manufacturers claim that their product is the best one to control monocot weeds. Keeping in view the claim of manufacturers and importance of weed control in field crops, this study was undertaken to identify the most effective and economical post-emergence herbicide for weed control in wheat under rainfed conditions.

MATERIALS AND METHODS

The proposed study was conducted at the Experimental Farm of Pir Mehr Ali Shah, Arid Agriculture University, Rawalpindi during 2005 to 2008. The experiment was laid out in randomized complete block design (RCBD) with three replications. The net plot size was 3 x 2 m. Soil samples were collected from both locations before crop sowing to a depth of 15 cm and were analyzed for its various physio-chemical properties at the Soil Science Department, Pir Mehr Ali Shah, Arid Agriculture University, Rawalpindi (Table 1). Wheat cultivar GA-2002 was sown as test crop. Sowing was done on the 3rd week of November, 2005, 2nd week of November, 2006 and last week of October 2007. The crop was sown as 110 kg seed ha^{-1}.

The herbicides were sprayed with the help of Knapsack hand sprayer fitted with T-Jet nozzle at a pressure of 207 kp. Herbicide at the three to four leaf stage of the weeds; 30 days after sowing (DAS) was applied. The fertilizer NPK was applied at the time of sowing the 110, 80 kg ha^{-1} and 60 kg ha^{-1} as basal dose, respectively. Crop was harvested manually at physiological maturity. Threshing of each plot was done separately. The experimental fields were infested with broad-leaved weeds that is field bindweed (*C. arvensis* L.), Lamb's quarter (*C. album* L.), Fumitory (*Fumria indica* (L.) Hausskn.), Black medic (*M. polymorpha* (L.) Willd.), Borad leaved dock (*Rumex obtusifolius* L.), Sow thistle (*Sonchus asper* (L.) Hill.), and Blue pimpernel (*A. arvensis* L.). The following weed control treatments were evaluated: T_1: weedy (unweeded control); T_2: hand weeding; T_3: Agroxone at 1200 ml ha^{-1}(4-chloro-2-methylphenoxy acetic acid); T_4: Chwastox at 1200 ml ha^{-1} (4-chloro-o-tolyloxyacetic acid); T_5: Buctril super at 750 ml ha^{-1} (3,5-dibromo-4-hydroxybenzonitrile + 2-methyl-4-chlorophenoxyacetic acid); T_6: Bromoxonil at 1200 ml ha^{-1} (3,5-dibromo-4-hydroxybenzonitrile); T_7: MCPA at 1200 ml ha^{-1} (2-methyl-4-chlorophenoxyacetic acid); T_8: Aim at 50 g ha^{-} (chlorfluazuron); T_9: Logran at 2.50 g ha^{-1} (traisulfuron + terbutryn)

RESULTS AND DISCUSSION

Weed biomass (g m^{-2})

Total weed biomass reflects the growth potential of weeds and is a good indicator of its competitive ability with crop plants (Sarwar, 1994). The data pertaining to weed biomass as influenced by various herbicides are presented in Figure 1 which indicate that various herbicides differed significantly from one another for weed biomass yield. Among the different herbicides, the lowest weed biomass (32.66 g m^{-2}) was recorded in hand weeding treatment that was at par with the application of Buctril super. This could be due to the reason that the highest weed mortality occurred in these plots due to application of herbicides, which suppressed weed growth and ultimately reduced weed biomass over the rest of the treatments. While among other treatments, MCPA and Aim was the next best treatments that suppressed weed growth and development. The highest weed biomass (127.22 g m^{-2}) was recorded in the weedy plots over three the years of field study. These results are in agreement with the findings of Cheema and Akhtar (2005), Khan et al. (2000) and Salarazi et al. (2002) who reported that the herbicides significantly suppressed the weed population and weed biomass per unit land area.

1000 grain weight (g)

The examination of the data presented in Figure 2

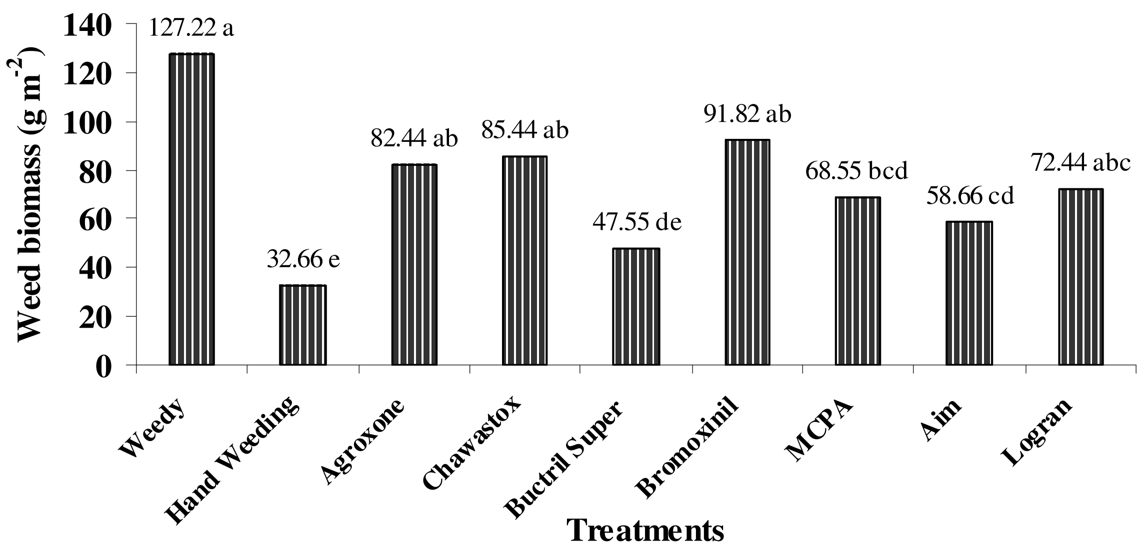

Figure 1. Weed biomass as influenced by various herbicides over the three years (2004 to 2007).

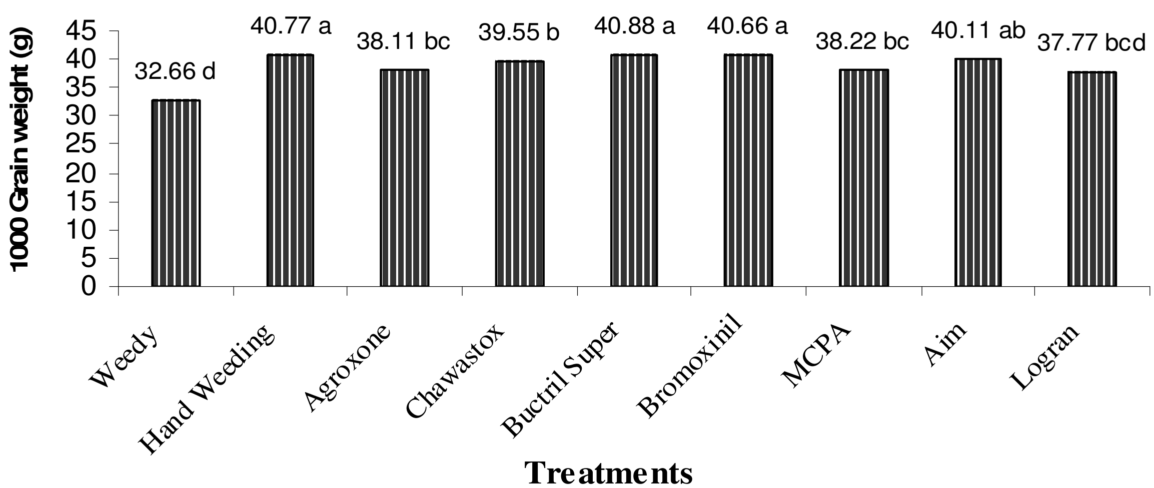

Figure 2. 1000 Grain weight of wheat as influenced by various herbicides over the three years (2004 to 2007).

showed the performance of various herbicides regarding 1000-grain weight over the three years of field study. It indicated that among different herbicides, the highest 1000-grain weight (40.88 g) was recorded with the application of Buctril super that was at par with hand weeding, application of Bromoxinil and Aim. It may be due to the reason that weed control at proper time provided favourable environment for the crop growth and development. Ultimately, the optimum crop stand produced a maximum 1000-grain weight in these treatments while the lowest 1000-grain weight was recorded in weedy plots over the three years of field study. It may be attributed to severe weed-crop competition in these plots that led to inadequate supply of moisture and nutrients to the crop. Similarly, a negative relationship between weed biomass and 1000 grain weight was observed indicating 60% of their linear determination coefficient, during the three years of field study (Figure 5). These results are in line with the findings of Cheema and Akhtar (2005), Khan and Noor-ul-Haq *(*1998) and Shah et al. (1989), who reported the highest 1000-grain weight in herbicide treated plots.

Grain yield (kg ha^{-1})

Wheat grain yield is an interplay of yield components especially 1000-grain weight. Moreover, grain yield greatly depends on seasonal availability of moisture in rainfed areas. The data pertaining to grain yield as influenced by various herbicides presented in Figure 3 showed the significant differences among different

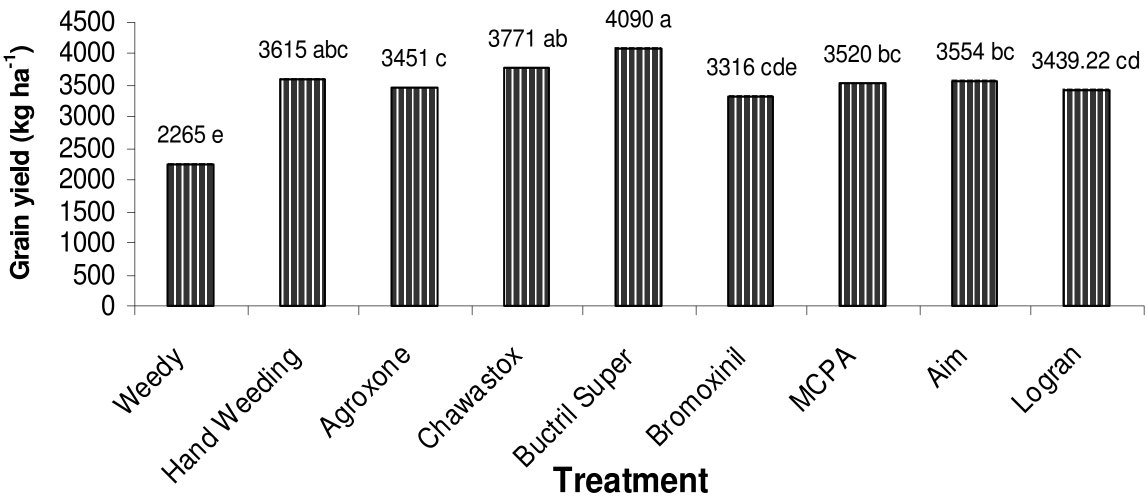

Figure 3. Grain yield of wheat as influenced by various herbicides over the three years (2004 to 2007).

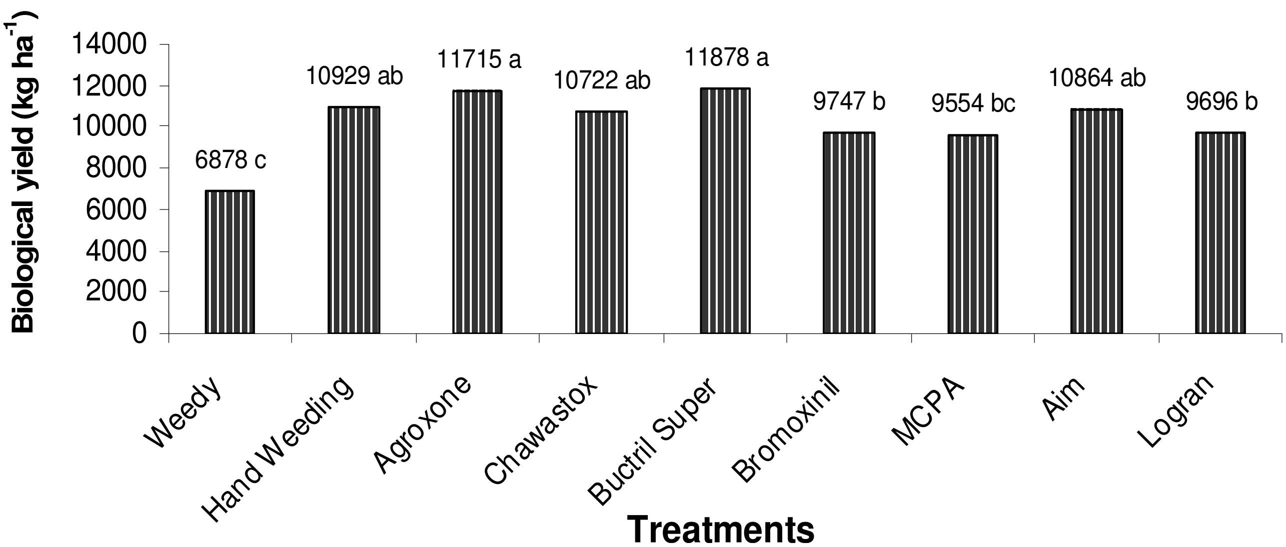

Figure 4. Biological yield of wheat as influenced by various herbicides over the three years (2004 to 2007).

treatments. Among the different herbicides, the highest grain yield (4090 kg ha^{-1}) was recorded with the application of Buctril super that was at par with the application of Chwastox while hand weeding, MCPA and Aim were the other best treatments for grain yield. It may be attributed to efficient weed control achieved in these treatments. Wheat grain yield was negatively associated with weed biomass having 64% of their linear determination of coefficient for pooled data of the three years (Figure 6). Similar results were reported by Cheema and Akhtar (2005), Marwat et al. (2005) and Salarazi et al. (2002). The lowest grain yield of 2265 kg ha^{-1} was recorded in weedy plots over the three years of field study. It may be due to the reason that weeds probably robbed the crop of nutrients and moisture and resulted in the lowest grain yield of wheat in these treatments.

Biological yield (kg ha^{-1})

The biological yield expresses the overall growth of crop. The result pertaining to the efficacy of various herbicides presented in Figure 4 revealed that mean for different treatments differed significantly among themselves for biological yield. Among the different herbicides, the highest biological yield of 11878 kg ha^{-1} was recorded with the application of Buctril super that was at par with Agroxone, hand weeding and Aim treatment. The highest biological yield was probably due to the optimum crop

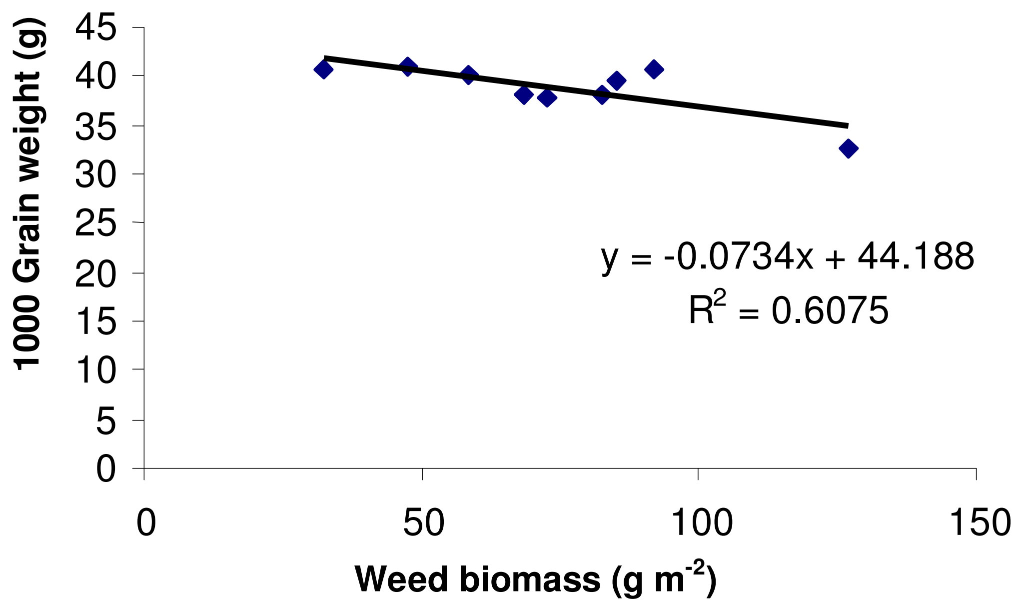

Figure 5. Relationship between weed biomass and 1000-grain weight.

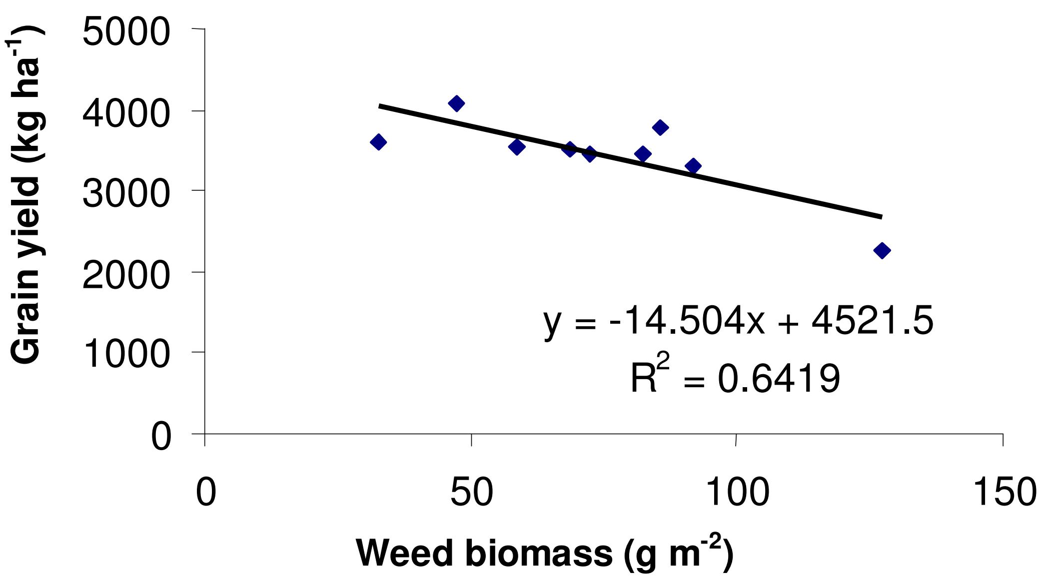

Figure 6. Relationship between weed biomass and grain yield.

growth in these treatments that may be attributed to better weed control and lesser weed crop competition. Khan et al. (2003), Marwat et al. (2005) and Kortu et al. (1999) also reported that application of broad-spectrum herbicides increased biological yield in wheat. The lowest biological yield of 6878 kg ha^{-1} was recorded in weedy plots where no weeds were controlled. Similarly, a negative relationship between weed biomass and biological yield was observed, indicating 55% of their linear determination coefficient during the three years of the field study (Figure 7).

Economic analysis

Both the feasibility and profitability of herbicide use can be depicted in terms of economic returns. The economic analysis of the experimental data is essential to look at the experimental results for farmers view point, as they are often interested in low cost production technology. The results pertaining to economic returns in terms of benefit cost ratio (BCR) of various herbicide treatments are given in Table 2. It is evident from the data that all the weed control treatments provided sufficient monetary

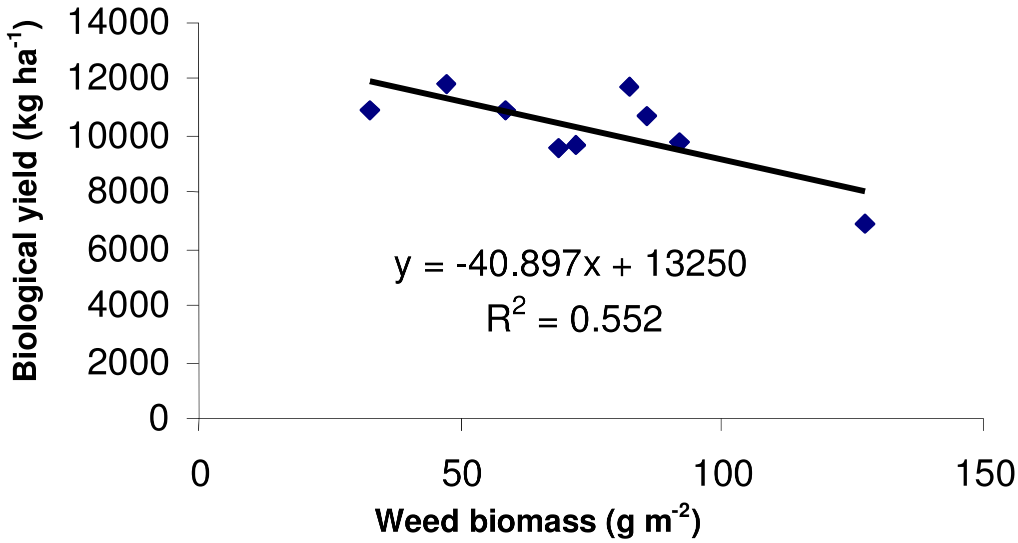

Figure 7. Relationship between weed biomass and biological yield.

Table 2. Economic analysis showing BCR of various herbicides in wheat at Rawalpindi.

Parameter	Weedy	Hand weeding	Agroxone	Chawxtox	Buctril Super	Bromoxinil	MCPA	Aim	Logran
Cost of weedicide and hand weeding (Rs. ha^{-1})	Nil	4500	1500	2000	1500	1000	700	1000	1000
Total cost (Rs. ha^{-1})	30500	35000	32000	32500	32000	31500	31200	31500	31500
Grain yield (kg ha^{-1})	2265	3615	3451	3771	4090	3316	3520	3554	3439
Grain yield value (Rs ha^{-1})	53794	85856	81961	89561	97137	78755	83600	84407	81676
Straw yield (kg ha^{-1})	6878	10929	11878	10722	11715	9747	9554	10864	9696
Straw yield value (Rs ha^{-1})	17195	27322	29695	26805	29287	24367	23598	26834	23949
Gross income (Rs.)	70989	113178	111656	116366	126424	103122	107198	111271	105625
Net benefit (Rs.)	40489	78178	79656	83866	94424	71622	75998	79771	74125
Benefit cost ratio	1.32	2.23	2.48	2.58	3.00	2.27	2.43	2.53	1.35

Grain yield value, Rs. 23.75 kg^{-1}; straw yield value, Rs 2.50 kg^{-1}.

returns, but farmers are interested in cost effective weed control treatment. Hence, on the basis of the three consecutive years of field study, it can be recommended that Buctril super was the most economical herbicide with the highest BCR (3.00) and was followed by Chawastox (2.58) and Aim (2.53) and is recommended for use under rainfed conditions. These results are in line with the findings of Tanveer et al. (2003), who reported more yield and net monetary returns in the treated plots than in the weedy check.

Conclusions

From the results of the experiments, the following conclusions were drawn:

i) For effective and quicker weed control, herbicides may be applied;

ii) Herbicides are useful tools for minimizing weed competition with the wheat crop for nutrients, light, space and water;

iii) Buctril Super, hand weeding and Chawastox can increase the yield of wheat significantly;

iv) Buctril Super proved to be the best in terms of economic returns with the highest benefit cost ratio under rainfed conditions.

REFERENCES

Anderson WP (1983). Weed-crop competition. In: Weed Science Principles, 2nd Ed. West Pub. Co., St. Paul Minn, USA. pp. 33-42.

Baluch GM (1993). Biological control of weeds. Progressive Farming. Pakistan Agricultural Research Council, Islamabad. 3(5): 10-18.

Cheema M, Akhtar M (2005). Efficacy of different post-emergence herbicides and their application methods in controlling weeds in wheat. Pak. J. Weed Sci. Res. 11(1-2): 23-29.

Government of Pakistan (2008-09). Economic Survey 2008-2009. Economic Advisor's Wing, Finance Div., Islamabad.
Jarwar AD, Tunio SD, Majeedano HI, Kaisrani MA. (1999). Efficacy of different weedicides in controlling weeds of wheat. Pak. J. Agric. Eng. Vet. Sci. 15(2): 17-20.
Khan MH, Hassan G, Khan N, Khan MA. (2003). Efficacy of different herbicides for controlling broadleaf weeds in wheat. Asian J. Plant Sci. 2(3): 254-256.
Khan, MA, Zahoor M, Ahmad I, Hassan G, Baluch MS (2000). Efficacy of different herbicides for controlling broadleaf weeds in wheat (*Triticum aestivum*). Pak. J. Biol. Sci. 2(3): 732-734.
Kotru R, Azad BS, Singh H (1999). Chemical control of weeds in wheat (*Triticum aestivum*). Environ. Ecol. 17(3): 646-649.
Marwat KB, Hussain Z, Saeed M, Gul B (2005). Chemical weed management in wheat in rainfed areas. Pak. J. Weed Sci. Res. 11(1-2): 31-36.
Nayyar MM, Shafi M, Shah ML, Mahmood T (1995). Weed eradication duration studies in wheat. In: Weed management for sustainable agriculture. Proceedings of 40th Pakistan Weed Science Conference. p. 147-153.
Rao VS (2000). Principles of Weed Science. Mohan Primlani, New Delhi. p. 59-60.
Rice EL (1984). Allelopathy. 2nd (ed.) Acad. Press. Inc. Orlando. Florida, U. S. A.
Salarzai AU, Maqsoos M, Wajid A, Shawani N, Ahmad M (2002). Effect of different herbicides on weed population and yield of wheat *(Triticum aestivum* L.*)*. Pak. J. Biol. Sci. 2(2): 350-351.
Sarwar M (1994). Studies on wild oat interference, nutrient competition and economic threshold level in wheat. Ph.D. thesis, Dept. of Agro., Uni. Agri. Faisalabad.
Shah ML, Jalis A, Ramzan M, Iqbal M (1989). Chemical weed control in broadcast sown wheat under irrigated conditions. J. Agric. Res. 27(3): 195-199.
Shamsi SRA, Ahmad B (1984). Eco-physiological studies on some important weeds of wheat. Final Technical Report Pak. Sci. Found Res. Pro. P-PU/Agr. (64). Dept. Bot., Univ. Punjab, Lahore, Pakistan.
Tanveer A, Chaudhry NH, Ayub M, Ahmad R (2003). Effect of cultural and chemical weed control methods on weed population and yield of cotton. Pak. J. Bot. 35(2): 161-166.