Azarian J. Agric. VOL (4) ISSUE 3, 2017: 74-79

Azarian Journal of Agriculture

www.azarianjournals.ir

Azarian Journals

Research article

ISSN:2383-4420

Evaluation of the effectiveness of different herbicides against a new weed Japanese brome (*Bromus japonicus* Houtt.) in wheat crop

Muhammad Asghar*[1], Sana Ullah Chauhdary[1], Muhammad Afzal[2], Mirza Muhammad Qadeer Baig[1], Masood Qadir Waqar[3], Abdul Gafoor[3], Syed Zafaryab Haider[4]

Article Info

Accepted:
17 June 2017

Keywords:
Japanese broom,
Salaai sitti,
herbicides, weed competition, weed control, wheat *(Triticum aestivum L.)*

ABSTRACT

A field experiment was conducted to evaluate the efficacy of different post emergence herbicides for the control of monocot weed the *Japanese broom* (*Bromus japonicus*) in wheat crop. Five herbicides viz., metribuzin, isoproturon, metribuzin plus isoproturon, Atlantis and sulfosulfuron were used at their recommended doses in RCBD with three replications. The weedy check was kept as control where no herbicide was sprayed. All the herbicides were applied as post-emergence after second irrigation at 60 days after sowing the crop. The lowest weed counts per m^2 (0.583) and highest percent of weed mortality (99.07%) were observed where metribuzin plus isoproturon was used. This was followed by Atlantis with 3.26 weeds per m^2 with 95.14% mortality of weeds. However, significantly higher 1000 grain weight was noted with Atlantis (29.50 g) and metribuzin plus isoproturon (28.58 g). The treatments did not differ significantly with respect to 1000 grain weight. All the herbicide helped to increase the yield from 16 to 22%, but did not differ significantly with respect to yield gain. The highest yield (3759.40 kg ha^{-1}) was produced by Atlantis followed by sulfosulfuron (3757.20 kg ha^{-1}). On the basis of cost benefit ratio sulfosulfuron (34.95) proved to be the best followed by metribuzin (16.78). Therefore, sulfosulfuron and metribuzin are recommended for the control of Bromus weed in wheat crop.

INTRODUCTION

Wheat (*Triticum aestivum* L.) is the most popular and a staple food crop in Pakistan. It is cultivated on an area of 9260 thousand hectares with a production of 25.5 MT in 2016. This yield is far below the yield obtained in the other wheat growing countries of the world. The average wheat yield in country is almost 70% less of its optimum potential (Jarwar et al. 2005; Noorka 2013; GOP 2016; PABA 2016; Anonymous, 2017).

[1]Adaptive Research, Gujranwala, Pakistan.
[2]Faculty of agriculture, University of Sargodha, Sargodha, Pakistan
[3]Adaptive Research, Punjab, Pakistan
[4]Agri.Extension and Adaptive Research, Punjab, Pakistan
*Email: muhammad-asghar@gmail.com

There are many factors responsible for this decline in wheat crop yield. Among them the late sowing of crop, low seed rate with poor germination leading to inadequate plants density, imbalance use of fertilizers, unavailability of irrigation at critical stages of crop, straw burning, pest insect, disease attack and weeds infestation are important. The most important factor among these is the infestation of crop with weeds (Guttieri et al. 2011). According to Amare et al. (2014) and Mehmood et al. (2014) crop losses throughout the world as a whole due to weeds are greater than those resulting from combined effect of pest insects and diseases. The weeds can cause yield reduction in wheat crop ranging from 10- 65% (Mehmood et al. 2014.)

Wheat crop in Pakistan is infested by the broad and narrow leaf weeds. Among the narrow leaf weeds *Bromus japonicus* is a new and invasive alien species. It offers severe competition with wheat crop due to similarities in growth pattern and morphology of wheat plant and thus is most difficult to control (Mehmood et al. 2014). It alone can cause yield reduction upto 30% or even failure of crop if not controlled (Wei 2010; Reddy et al.

2013). This weed is becoming a serious problem in arable farms of Punjab, Pakistan by emerging as a major challenge for wheat crop production.

Successful weed control is most important factor for fruitful wheat production. But the methods of weed control other than chemical weed control are not much effective. Therefore chemical weed control has become necessary (Marwat et al. 2008). However, the selection of most appropriate herbicide, correct dose, proper method and time of application are important consideration for lucrative returns (Sherawat et al. 2005; Khalil et al. 2008; Marwat et al. 2008; Abbas et al. 2009). At the same time with the increasing use of herbicides, the concerns about possible harmful effects on the biodiversity and sustainability of natural agroecosystems have been raised (Andreasen and Andresen 2011; Andreasen and Stryhn 2012).

An effective and reliable solution for chemical control of brome grasses have been the focus of much research but still no such efforts has bearded fruitful. Thus the farmers are using various herbicides to counter this menace without internalizing the externalities of pesticide use. Resultantly this malpractice in not only increasing cost of their production but also leads to enhance environmental and biodiversity conservation issues (Aktar et al. 2009; Schafer et al. 2012)

Keeping in view the importance of this weed as a threat to wheat production the present study was designed to evaluate the performance of four commonly used and locally available herbicides and a mixture on broom grass and their effect on wheat grain yield. Thus the present study reports results evaluating chemical treatments for *Japanese brome* (locally called salaai sitti) control in wheat crop.

MATERIALS AND METHODS

The experiment was laid out in District Gujranwala following RCBD with three replications. The plot size was 20 x 6 m. The herbicides (Table 1) were sprayed about 60 DAS with the help of knapsack sprayer fitted with flat fan nozzle in moist field condition after 2^{nd} irrigation when the weeds were at 3 to 4- leaf stage (Alvi et al. 2001; Abbas et al. 2016).

The weed population was recorded before and four weeks after application of herbicides. In order to record weed population a quadrate of 1 m^2 was used. This quadrate was placed randomly at three spots in each treatment to count the weed plants. After four weeks of spray the same procedure was repeated to record the mortality of the Bromus plants. The mortality of weeds and yield gain was calculated by using the following equations A and B respectively.

$$\text{Efficacy (\%)} = \frac{\text{pre spary count} - \text{post spray count}}{\text{pre spray count}} \times 100 \quad \text{(A)}$$

$$\text{Yield gain (\%)} = \frac{\text{protectected treatment} - \text{control}}{\text{protected treatment}} \times 100 \quad \text{(B)}$$

These all spots of one meter square area were randomly selected from each plot each time. The data on tiller per meter square, number of grains per spike, 1000- grain weight and grain yield were recorded at and corrected to 12% moisture content by harvesting of matured crop. The data were analyzed statistically by using statistical software "STATISTICS". The LSD test at 5% level of significance was used to compare the treatment means.

The net income was obtained after deducting cost of weeds control from the value of the produce. The additional return was, however, carried out on the basis of additional income obtained from the particular treatment compared to that of untreated check. Benefit cost ratio (BCR) for each treatment was obtained by dividing additional returns by expenditure incurred for the cost of control.

RESULTS AND DISCUSSION

From Table 2 it is clear that before application of herbicides all the treatments were statistically ($p<5$, $F=0.78$) at par with each other with respect to weed count. It means weeds population was almost uniform in all the treatments. After four weeks of the application of herbicides weed density m^{-2} changed significantly. It was highest (67.710) in control plots where no herbicide was applied to control *Bromus japonicus,* whereas it was low in all treated plots as compared to control. Among all the treatments applied weed density per m^2 was lowest (0.583) where metribuzin+isoproturon was sprayed

Table 1. Herbicides with active ingredients and recommended doses

Treatments	Active ingredient	Dose gm ha^{-1}
T1	Control	-
T2	Metribuzin 70WP	250
T3	Isoproturon 50WP	2000
T4	Metribuzin70WP +Isoproturan 50WP	250+2000
T5	Atlantis (Mesosulfuron+Ideosulfuron) 3.5 WG	400
T6	Field Guard (Sulfosulfuron) 75 WDG	33.75

Table 2. Density m^{-2} of *Bromus japonicus* before and four week after the application of herbicides in wheat crop

Treatments No.	Treatment names	Density m^{-2} of *Bromus japonicus*		Mortality %age
		Before application	After four weeks of application	
T1	Control	63.488 A	67.710 A	-6.65
T2	Metribuzin 70WP	63.361 A	12.653 B	80.03
T3	Isoproturon 50WP	62.349 A	11.333 B	81.82
T4	Metribuzin70WP +Isoproturon 50WP	62.806 A	00.583 B	99.07
T5	Atlantis (Mesosulfuron+Ideosulfuron)	67.123 A	03.264 B	95.14
T6	Sulfosulfuron 75 WDG	67.404 A	13.985 B	79.25
	LSD	8.0069	25.883	
	CV	6.83	77.49	
	F	0.78	9.13	
	P	0.5877	0.0017	

Note: The means with similar letters are not significantly different at $p \leq 0.05$

followed by Atlantis (3.264) and isoproturon alone (11.333). On the other hand mortality of weeds was also maximum (99.07%) in treatment with metribuzin plus isoproturon followed by Atlantis (95.14%) and isoproturon (81.82%) alone.

The results are in line with those of Baghestani et al. (2008) in Iran who studied that dual purpose herbicide iodosulfuron-methyl-sodium plus mesosulfuron-methyl was a good option in controlling grass and broad leave weeds in winter wheat. Zand et al. (2010) observed that sulfosulfuron caused greater control of grasses compared to broadleaved weeds. Its application provided less than 80% reduction in weed numbers and in present a control of 79.25% was obtained with it. The grain yield of weed free control was not significantly different with the plots treated with bromoxynil plus MCPA with clodinafop propargyl followed by mesosulfuron-methyl plus iodosulfuron methyl-sodium, and sulfosulfuron plus metsulfuron-methyl. The result are partially in accordance with those of Amare et al. (2014) who studied the effect of herbicides rates on weed dynamics of wheat and found hand weeding followed isoproturon in reducing weeds density.

The results are against the findings of Dastgheib et al. (2003) who evaluated that chlorsulfuron and isoproturon were less effective on brome grass in wheat and barley but in present study isoproturon had significant results as compared to control.

As for as 1000 grain weight (g) and yield per hectare is concerned, all the treatments were superior to control but at par with each other statistically (Table 3). The maximum 1000 grain weight was recorded for Atlantis (29.504 g) followed by sulfosulfuron (28.578 g), metribuzin70WP+isoproturan (28.184 g),

Table 3. Effect of herbicides application for the control of *Bromus japonicus* in wheat crop on 1000 grain weight (g) and yield kg ha^{-1}

Treatments No.	Treatment names	1000 grain weight (g)	Yield (kg ha^{-1})
T1	Control	22.572 B	3058.30 B
T2	Metribuzin 70WP	27.086 A	3575.00 A
T3	Isoproturon 50WP	27.952 A	3602.80 A
T4	Metribuzin70WP+Isoproturan 50WP	28.184 A	3711.10 A
T5	Atlantis (Mesosulfuron+Ideosulfuron)	29.504 A	3759.40 A
T6	Sulfosulfuron	28.578 A	3757.20 A
	LSD	3.3482	307.6
	CV	6.74	4730
	F	5.33	7420
	P	0.012	3.8

Note: The means with similar letters are not significantly different at $p \leq 0.05$

Table 4. Economics of chemical control of *Bromus japonicus*

Treatments	Cost of weed control ha^{-1} (Rs.)	Yield (kg ha^{-1})	Increase in yield over control (%)	Total Income ha^{-1} (Rs)	Net income ha^{-1} (Rs)	Additional return over the control	CBR
			According to Equation B	Avg. price per 40 kg wheat was Rs.1200	Total income per ha - cost of control per ha	Net income per ha-income from control	Add. return/ cost of control
T1	0	3058.30	0	91749	91749	0	0
T2	924	3575.00	16.90	107250	106326	14577	15.78
T3	1787.5	3602.80	17.804	108084	106297	14548	8.14
T4	2711	3711.10	21.35	111333	108622	16873	6.22
T5	2675	3759.40	22.92	112782	110107	18358	6.86
T6	600	3757.20	22.85	112716	112116	20367	33.95

isoproturon (27.952 g), metribuzin (27.086 g) and lastly the control (22.572 g) with corresponding yield of 3759.40, 3757.20, 3711.10, 3602.80, 3570.00, 3058.30 kg ha1 respectively.

The results are partially in agreement with those of Malekian et al. (2013) who investigated that the herbicides sulfosulfuron, metsulfuron-methyl plus sulfosulfuron, mesosulfuron-methyl plus iodosulfuron-methyl, iodosulfuron plus mesosulfuron increased wheat and grain yield as compared with the weedy check. Among herbicides treatment maximum grain yield was observed with metsulfuron-methyl plus sulfosulfuron. Weeds biomass was reduced by sulfosulfuron and mesosulfuron-methyl plus iodosulfuron-methyl herbicides as compared to weedy check but grain yields were less than metsulfuron-methyl plus sulfosulfuron treatments. Similarly, Amare et al. (2014) studied the effect of herbicides rates on yield of wheat and found recorded highest grain yield in hand weeding followed by isoproturon.

From the Table (4) it is clear that maximum cost of control ha1 (Rs) was with the use metribuzin plus isoproturan (2711) followed by Atlantis (2675), isoproturon (1787.5), metribuzin (924) and sulfoslfuron (Rs.600). There was maximum per cent increase in yield over the control with the use of sulfosulfuron (22.85) followed by Atlantis (22.92), metribuzin plus isoproturan (21.35), isoproturon (17.804) and metribuzin (16.90). Similarly additional return (Rs.) over the control was highest with sulfosulfuron (20367), Atlantis (18356), metribuzin plus isoproturon (16873), metribuzin (14577) and isoproturn (14548). The maximum cost to benefit ratio was obtained with sulfosulfuron (1:33.95) followed by metribuzin (1:15.78) and Isoproturon (1:8.14), whereas maximum mortality of weed (Table 2) was obtained with metribuzin plus isoproturan (99.07%) followed by Atlantis (95.14%), isoproturon (81.82%), metribuzin (80.03%) and the least mortality was obtained with sulfosulfuron (79.25%). Beside sulfosulfuron and metribuzin other herbicides which no doubt also gave good weed control but due to higher market prices they gained comparatively lower cost benefit ratio and thus failed to achieve the attention to be recommended for brome control.

The findings of present study are in agreement with those of Dastgheib et al. (2003) who reported that *Brome sp*. can reduce yield of wheat crop upto 25-30% in present study it is clear that by control of *Bromus Japonicus* yield of wheat crop can be increased upto23%. Jarwar et al. (2005) obtained upto 40% increased yield with the help of chemical control against grassy weeds. Similar type of results were also obtained by Tunio et al.,(2004) who got higher yield of wheat crop by chemical weed control.

CONCLUSION

It can be concluded that all the herbicides that were evaluated in this study controlled the *Bromus japonicus* excellently and led towards increase in yield of wheat crop. On the basis of cost benefit ratios sulfosulfuron and metribuzin have proved to be the best against this weed. Therefore, these two herbicides can be recommended for the economical control of Brome in wheat crop. As these herbicides are inexpensive and easily available to the farmers, consequently, due to their increased use the concerns about the possible effects on the biodiversity and sustainability of natural agro-ecosystems could be raised. Therefore, by adopting non chemical control options to avoid unnecessary use of herbicides, selecting proper herbicides and taking precautionary measures during their application can reduce this risk.

REFERENCES

Abbas S.H M. Saleem M. Maqsood M. Mujahid M.Y. Hassan M. Saleem R. (2009) Weed density and grain yield of wheat as affected by spatial arrangements and weeding techniques under rain fed conditions of Pakistan. Journal of Agricultural Science, 46(4): 354-359.

Abbas T. Nadeem M.A. Tanveer A. and Ahmad R. (2016) Evaluation of fenoxaprop-p-ethyl resistant littleseed canarygrass (Phalaris minor) IN PAKISTAN. Planta Daninha, Viçosa-MG, 34(4): 833-838.

Aktar M.W. Sengupta D and Chowdhury A. (2009) Impact of pesticides use in agriculture: their benefits and hazards. Interdisciplanry Toxicology, 2(1): 1-12.

Amare T. Sharma J.J. Zewdie K. (2014) Effect of Weed control methods on weeds and wheat (*TriticumAestivum* L.) yield. World Journal of Agricultural Research, 2(3): 124-128.

Andreasen C. and Stryhn H. (2012) Increasing weed flora in Danish beet, pea and winter barley fields. Crop Protection, 36:11-17. In Li1 Q. Du1 L. Yuan G. Guo1 W. Li1 W. and Wang J. 2016. Density effect and economic threshold of Japanese brome (*Bromus japonicus* Houtt.) in wheat. Chilleeaan Jourrnal of Agricultural Research, 76(1): 1441-447.

Andreasen C. Andresen L.C. (2011) Managing farmland flora to promote biodiversity in Europe. CAB Reviews: Perspectives in Agriculture, Veterinary Science, Nutrition and Natural Resources. 6: 1-11. In Li1 Q. Du1 L. Yuan G. Guo1 W. Li1 W. and Wang J. 2016. Density effect and economic threshold of Japanese brome (*Bromus japonicus* Houtt.) in wheat. Chilleeaan Jourrnal of Agricultural Research, 76(1): 1441-447.

Anonymous. (2017) Pakistan wheat production by year. URL: http://www.indexmundi.com/agriculture/?country=pk&commodity=wheat. [Accessed 13 May, 2017].

Baghestania M.A. Zanda E. Soufizadehb S. Beheshtiand M. Haghighie A. Barjastehf A. Birganig D.G. Deihimfard R. (2008) Study on the efficacy of weed control in wheat (*Triticum aestivum* L.) with tank mixtures of grass herbicides with broadleaved herbicides. Crop Protection, 27: 104-111.

Dastgheib F. Rolston M.P. Archie W.J. (2003) Chemical control of brome grasses (*Bromus* spp.) in cereals. New Zealand Plant Protection, 56: 227-232.

FAO. (2011) The State of Food Security in the World. Rome. www.fao.org. In Mehmood Z. Ashiq M. Noorka I.R. Ali A. Tabasum S. Iqbal M.S. (2014) Chemical Control of monocot weeds in wheat (*Triticum aestivum* L.). American Journal of Plant Sciences, 5: 1272-1276.

Government of Pakistan. (2016) Ministry of Finance. Pakistan Economic Survey. Economic Advisor Wing, Islamabad, pp.28-29.

Guttieri M.J. Stark J.C. C., O'Brien K. Souza E. (2001) Relative sensitivity of spring wheat grain yield and quality parameters to moisture deficit. Crop Science, 41: 327-335.

Jarwar A.D. Arain M.A. Rajput L.S (2005) Chemical weed control in wheat. Pakistan Journal of Weed Science Research, 11(1-2): 11-15.

Khalil G.H. Ahmad G. Sha N.H. (2008) Individual and combined effect of different weed management practices on weed control in wheat. Pakistan Journal of Weed Science Research, 14(3-4): 131-139.

Schiesari1 L. Waichman A. Brock T. Adams C. Grillitsch B. (2013) Pesticide use and biodiversity conservation in the Amazonian agricultural frontier. Philosophical Transaction of the Royal Society B, 368: 20120378.

Malekian B. Ghadiri H. Kazemeini S.A. Edalat M. (2013) Efficacy evaluation of sulfosulfuron, metsulfuron-methyl plus sulfosulfuron, mesosulfuron-methyl plus iodosulfuron-methyl and iodosulfuron plus mesosulfuron herbicides in winter wheat (*Triticum aestivum* L.). Journal of Biological and Environmental Sciences, 7(21): 177-182.

Marwat K.B. Saeed M. Hussain Z. Gul B. Rashid H. (2008) Study of various weed management practices for weed control in wheat under irrigated conditions. Pakistan Journal of Weed Science Research, 14(1-2): 1-8.

Marwat K.B. Saeed M. Hussain Z. Gul B. and Rashid H. (2008) Study of various weed management practices for weed control in wheat under irrigated conditions. Pakistan Journal of Weed Science Research, 14(1-2): 1-8.

Mehmood Z. Ashiq M. Noorka I.R. Ali A. Tabasum S. Iqbal M.S. (2014) Chemical control of monocot weeds in wheat (*Triticum aestivum* L.). American Journal of Plant Sciences, 5: 1272-1276.

Noorka I.R. Tabasum, S. (2013) An empirical approach to get the vitality of a genotype to water stress tolerance in yield and yield contributing traits. American Journal of Plant Sciences, 5: 999-1003.

Pakistan American Business Association (PABA). 2016. Pakistan's wheat production in 2015-16. URL. https://pabausa.org/1013/pakistans-wheat-production-in-2015-16-estimated-at-25-5-million-tons/. [Accessed 13 May, 2017].

Reddy S.S. Stahlman P.W. Geier P.W. (2013) Downy Brome (*Bromus tectorum* L.) and broadleaf weed control in winter wheat with acetolactate synthase-inhibiting herbicides. Agronomy, 3: 340-348.

Schafer R.B. von der Ohe P.C. Rasmussen J. Kefford B.J. Beketov M.A. Schulz R. Liess M. (2012) Thresholds for the effects of pesticides on invertebrate communities and leaf breakdown in stream ecosystems. Environment Science and Technology, 46: 5134-5142.

Sherawat S.M. Inayatand M. Ahmad M. (2005) Bio-efficacy of different graminicides and their effect on the growth and yield of wheat crop, International Journal of Agriculture and Biology, 7(6): 438-440.

Tunio S.D. Kaka S.N. Jarwar A.D. Wagan M.R. (2004) Effect of integrated weed management practices on wheat. Pakistan Journal of Agriculture, Engineering and Veterinary Sciences, 20(1): 5-10.

Wei M. (2010) Biological characteristics of Japanese brome observed in the wheat of Zhuanglang country. Gansu Agricultural Science Technology, 8:30-31.

Zand E. Baghestani M.A. khani M.A. Soufizadeh S. Khayami M.M. Azar R.P. Sabeti P. Jamali M., Bagherani N. Forouzesh S. (2010) Chemical control of weeds in wheat (*Triticum aestivum* L.) in Iran. Crop Protection 29: 1223-1231.

Journal sponsorship

Azarian Journal of Agriculture is grateful to the ***University of Maragheh*** and its faculty members for their ongoing encouragement, support and assistance.