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EVALUATION OF THE EFFECTIVENESS OF DIFFERENT HERBICIDES ON WEED INVASION IN THE FIELDS OF TRITICALE

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Abstract: One of the factors limiting crop growth is weeds. The weeds lead to a reduced performance of the crops. Chemical control methods are considered appropriate for controlling weeds. Therefore, in the fight to control weeds in triticale, the performance of the dual-purpose herbicide sulfosulfuron(Apirus®), mesosulfuron + idosulfuron(Atlantis®), metsulfuron methyl+sulfosulfuron(Total®) with surfactant and isoproton + diflufenican(Panther®) from the sulfonylurea group, and narrow leaf herbicides clodinafob-propargyl(Topik®), pinoxaden(NewAxial®), diclofop-methyl(Iloxan®), pinoxaden + clodinafob-propagyl(Traxos®), fenoxaprop-p-ethyl + mefen-pyper-d-ethyl(PumaSuper®), tralkoksidim(Grasb®) with 1 liter oil, flam-prop-m-isopropyl(Suffix BW®), and control treatment without herbicides were evaluated. The test was carried out in a randomized complete block design with four replications. Spraying was carried out using a back sprayer. For evaluation of ocular damage, the European Weed Research Council (EWRC) standard method was used. According to the performed studies, the narrow leaves of wild oat and barnyard grass were the dominant weeds. Results showed that all herbicide, except the herbicide tralkoksidim, were effective in weed control. The triticale yield was maintained with the use of these herbicides and none of herbicide had an adverse effect on the crop. In the first weeks of herbicide use, the triticale leaves appeared pale but this problem resolved over time. It seems that the herbicides discussed in this paper can be used on the triticale plant.

Key words: the control, herbicide, narrow-leaf weeds, triticale

INTRODUCTION

Triticale (trit-ah-kay-lee) (*Triticum rimpaui* Wittm.) is a close relative of wheat that results from pollinating durum wheat with rye pollen. That cross is then used in a breeding program to produce stable, self-replicating varieties (Feizabadi Zare 1993). With the triticale crop, plant breeders must physically make crosses and then manipulate the resultant offspring to obtain a self-fertile plant. Triticale is also used in grain production or more commonly as forage (Kumlehn *et al.* 2010). Triticale is used as feed for swine, cows and poultry and is generally higher in protein and amino acids than wheat or barley. The use of corn is reduced when triticale is used as a finishing diet for livestock. Triticale is becoming a major part of nutritional management plans for dairies. The use of triticale can provide dairies with a good alternative to wheat silage, permitting year round silage feeding (Stankowski and Maciorowski 1996). Triticale is a major agricultural product in Iran. The area cultivated with wheat was about 8,220 hectare in 2006 (Anonymous 2006).

Despite the use of costly inputs and improved cultural practices, the average yield of wheat is very low. The reasons for low yield are many, but one of the most serious though less obvious is the competition of weeds (Qureshi *et al*. 2002). Weeds compete with crop plants for nutrients, moisture, space, light, and many other growth factors. Such competition not only reduces crop yield but also deteriorates the quality of farm produce and thereby reduce the market value of the produce (Qureshi 1982). For hundreds of years, the fight against weeds has been mainly based on controlling them using mechanical and agrotechnical methods (Adamczewski 2000). A breakthrough took place when chemical plant protection agents were discovered (Adamczewski and Praczyk 1999). Herbicides have been shown to be a beneficial, very effective, and efficient means of controlling weeds in wheat (Azad *et al.* 1997). The herbicides currently used for controlling these weeds are sulfonylurea herbicides such as sulfosulfuron, metsulfuron methyl+sulfosulfuron, clodinafob-propargyl, diclofop-methyl, fenoxaprop-p-ethyl+mefen-pyper-d-ethyl (Zand *et al.* 2008).

Several studies have been conducted to evaluate the effects of herbicides on weeds. Ahmad *et al.* (1993) observed that herbicide application and hand weeding decreased the dry weight of weeds significantly. Also, Akhtar *et al.* (1991) found that application of grassy and broad leaf herbicides increased grain yield and yield components.

There is a lack of comprehensive studies dealing with the possibility of using conventional herbicides. In our study, the number of sulfonylurea herbicides and the number of narrow-leaf weed herbicides used in the

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triticale fields were evaluated to determine which of the tested herbicides showed the best performance for weed control of these crops.

MATERIALS AND METHODS

The experiments were carried out in the research field of the Agricultural Research Center of Moghan (Ardabil) in the 2010–2011 crop years. This area has clay-limey soil with pH = 7.1 and Electrical Conductivity (EC) = 2. The treatments tested were sulfosulfuron(Apirus®), mesosulfuron + idosulfuron(Atlantis®), metsulfuron methyl + sulfosulfuron(Total®), isoproton + diflufenican(Panther®), clodinafob-propargyl(Topik®), pinoxaden(New Axial®), diclofop-methyl(Iloxan®), pinoxaden + clodinafob-propagyl(Traxos®), fenoxaprop-p-ethyl + mefen-pyper-d-ethyl(PumaSuper®), tralkoksidim(Grasb®), flam-prop-m-isopropyl (Suffix BW®), and the control which was without herbicides (Table 1).

Experiments were performed on land which had been dominated by weeds (wild oat and barnyard grass). After the land preparation and seedbed operations, the triticale seeds were planted in plots 3x8 m. A back sprayer with a pressure of 2 to 2.5 bars was used to spray against weeds in the 3–4 leaf stage. The weeds were cut 30 days after spraying. To calculate the dry weight of weeds, the weed species were counted in a square box, and dried in an oven at 75°C. To assess ocular damage, the European Weed Research Council (EWRC) standard method was used (Wilkinson 1971) (Table 2). Analysis of variance and comparisons were conducted using SPSS (2004) and MSTATC software.

Table 1. Profile of herbicides used in the study

Treatments	Trade name	Dosage of treatment	Consuming time
Sulfosulfuron	Apirus	26.6 gr/ha	tillering stage of plant
Mesosulfuron + idosulfuron	Atlantis	1.5 l/ha	tillering stage of plant
Metsulfuron methyl + sulfosulfuron	Total	40 gr/ha	tillering stage of plant
Isoproton + diflufenican	Panther	2 l/ha	pre-eruption
Clodinafob-propargyl	Topik	0.8 l/ha	tillering stage of plant
Pinoxaden	New Axial	1.5 l/ha	tillering stage of plant
Diclofop-methyl	Iloxan	2.5 l/ha	tillering stage of plant
Pinoxaden+clodinafob-propagyl	Traxos	1.5 l/ha	tillering stage of plant
Fenoxaprop-p-ethyl + mefen-pyper-d-ethyl	PumaSuper	0.8 l/ha	tillering stage of plant
Tralkoksidim	Grasb	1 l/ha	tillering stage of plant
Flam-prop-m-isopropyl	Suffix BW	4 l/ha	tillering stage of plant

Table 2. Classification of damage to crops and weeds on the basis of the EWRC method

Rating	Weed reaction		Triticale reaction	
	weed control [%]	description*	damage to tiricale [%]	description
1	100	weed total loss	0	No. damage or without yield loss
2	99–96.5	very good control	1–3.5	damage or less necroses
3	96.5–93	good control	3.5–7	inconsistent less damage
4	93–87.5	favorite control	7–12.5	average damage and more consistent on triticale
5	87.5–80	less favorite control	12.5–20	average damage and consistent on triticale
6	80–70	unfavorable control	20–30	heavy damage on triticale
7	70–50	light control	30–50	very heavy damage on triticale
8	50–1	very light control	50–99	damage resulting in total loss to triticale
9	0	effective	100	total loss

*Wilkinson 1971

RESULTS AND DISCUSSION

Analysis of variance of the number and dry weight of weeds showed that weed populations and total dry weight as well as the percent from the control (in which no herbicides were used) ($p < 0.0001$) was significantly affected by the treatments (Table 3). In comparing the results, all treatments, except the tralkoksidim treatment, significantly reduced the percentage of the total density of narrow-leaf weeds. All treatments, except the tralkoksidim treatment, were in a statistical group and had the greatest impact in reducing the percentage of weed population density (about 100–50 percent) (Table 4).

Tralkoksidim was the weakest treatment in the reduction of weed density and dry weight and this treatment was only able to inhibit 7% of the weeds. After tralkoksidim, the weakest treatments in terms of reducing in the dry weight of weeds were clodinafob-propargyl and isoproton + diflufenican. The results of our study are in contradiction with the results of Fernandez-Quintanilla *et al.* 2006. They reported that this herbicide has a good effect on narrow leaves such as wild oat. On the other hand, several studies indicate that the effect of herbicides on wild oat is desirable which is consistent with the results of the present study. The studies of Vencill (2002) and Tomlin (2003) proved that a total herbicide treatment controlled narrow-leaf weeds, such as wild oat, very well. It was reported by Tabib *et al.* (2007) (the effect of sulfosulfuron on weeds in wheat fields) and Jamali *et al.* (2010) (the effect of mesosulfuron + idosulfuron on weeds) that these herbicides have a high capacity to control wild oat. Also, it has been reported that clodinafob-propargyl was the most important and the most consumed herbicide in Moghan and it controls wild oat very well (Montazeri *et al.* 2005).

Analysis of variance related to herbicide treatments on triticale crop showed that the number of triticale plants in treatments, the percentage from the control and also triticale dry weight and percentage from the control, was not affected by treatments (Table 5).

Table 3. Analysis of variance for treatment effects on weed density and total dry weight in Moghan

		Mean squares			
changed source	df	density of weeds[a]	dry weight of weeds[b]	percentage of density of control without weeding	dry weight percent of the control without weeding
Block	3	0.001*	0.292	0.012	0.291
Treatment	11	0.035**	0.538**	0.302**	0.534**
Error	33	0.006	0.104	0.045	0.096
CV [%]		7.37	24.60	17.65	23.98

The data are normalized as log 10 (x+10). *significant at 5% level; **significant at 1% level; [a] number/m^2; [b] gr/m^2; df – degrees of freedom; CV – coefficient of variation

Table 4. Comparing the mean of the number and total dry weight of weeds in Moghan

Treatments	Total number of weeds	Percent of control	Total dry weight of weeds	Percent of control
Sulfosulfuron	1.5 b	17.188 cd	8 b	8.174 cd
Mesosulfuron + idosulfuron	0 b	0 d	0 b	0 d
Metsulfuron methyl + sulfosulfuron	1 b	33.33 cd	5.4 b	26.24 cd
Isoproton + diflufenican	2 b	39.24 bc	13.19 b	48.74 bc
Clodinafob-propargyl	1.75 b	58.33 cd	11.32 b	55.03 cd
Pinoxaden	0.25 b	3.125 cd	1.125 b	1.177 d
Diclofop-methyl	0 b	0 d	0 b	0 d
Pinoxaden + clodinafob-propagyl	0 b	0 d	0 b	0 d
Fenoxaprop-p-ethyl + mefen-pyper-d-ethyl	0.5 b	16.67 cd	1.862 b	9.05 cd
Tralkoksidim	8.5 a	91.49 ab	43.8 a	93.35 ab
Flam-prop-m-isopropyl	0 b	0 d	0 b	0 d
The control	9 a	100 a	64.93 a	100 a
LSD	0.114	0.4639	0.3052	0.4457

Similar letters in each column indicate no significant difference (least significant difference % = α)

Table 5. Analysis of variance for treatment effects on crop triticale in Moghan

		Mean squares			
changed source	df	total bushes triticale[a]	percentage of total bushes of control	dry weight of triticale[b]	dry weight percent of the control[1]
Block	3	3 705.521	1 308.541	0.185	0.152
Treatment	11	1 926.733 ns	94.583 ns	0.039 ns	0.036 ns
Error	33	1 946.900	97.795	0.035	0.032
CV [%]		10.97	10.82	5.96	8.34

[1]the data are normalized as log 10 (x+10); ns – not significant; [a] number/m^2; [b] gr/m^2

Table 6. Comparing the mean of the number and total dry weight of triticale in the m^2 unit

Treatments	Number [m^2] of triticale bushes	Percent of the control	Triticale dry weight [gr]	Percent of the control
Sulfosulfuron	395.3 ab	90.01 ab	1 356.1 ab	130.30 ab
Mesosulfuron+ idosulfuron	384 ab	87.22 ab	1 227.17 ab	117.86 ab
Metsulfuron methyl+sulfosulfuron	396.8 ab	89.93 ab	3 425.52 a	322.83 a
Isoproton+ diflufenican	374 b	85.57 b	1 164.52 ab	112.024 ab
Clodinafob-propargyl	395 ab	89.99 ab	1 515.52 ab	142.26 ab
Pinoxaden	375.5 b	84.63 b	3 253.5 a	306.64 a
Diclofop-methyl	428.3 ab	97.35 ab	1 250.75 ab	119.02 ab
Pinoxaden+clodinafob-propagyl	403.8 ab	91.53 ab	1 323.9 ab	126.3 ab
Fenoxaprop-p-ethyl+mefen-pyper-d-ethyl	399.3 ab	91.09 ab	1 777.77 ab	170.02 ab
Tralkoksidim	399.8 ab	91.37 ab	1 103.87 b	103.47 b
Flam-prop-m-isopropyl	433 ab	98.28 ab	1 292.25 ab	124.38 ab
Control	443.3 a	100 a	1 049.6 b	100 b
LSD	63.48	14.23	0.2691	0.2573

Similar letters in each column indicate no significant difference (least significant difference % = α)

Table 7. Assessment of ocular damage survey of triticale and herbicide performance using standard EWRC

		Mean squares		
changed source	df	ocular assessment of damage to triticale	ocular evaluation of herbicide efficacy	grain yield [kg/m^2]
Block	3	0.41	0.243 *	0.004
Treatment	11	0.597 *	20.748 **	0.011 **
Error	33	0.243	0.925	0.003
CV [%]		31.55	42.35	10.18

*significant at a 5% level; **significant at a 1% level

Table 8. Comparison of ocular assessment and triticale crop grain yield in Moghan

Treatments	Ocular assessment of damage to triticale	Ocular evaluation of herbicide efficacy	Grain yield [kg/m^2]
Sulfosulfuron	1.25 bc	1 d	0.5893 ab
Mesosulfuron+ idosulfuron	2.25 a	1.25 cd	0.4837 de
Metsulfuron methyl+sulfosulfuron	1.75 ab	1 d	0.4953 de
Isoproton+ diflufenican	1.25 bc	2.25 bcd	0.5757 abc
Clodinafob-propargyl	1.5 bc	1 d	0.6055 a
Pinoxaden	2.25 a	1 d	0.5092 cd
Diclofop-methyl	1.75 ab	1.25 cd	0.5220 bcd
Pinoxaden+clodinafob-propagyl	1.5 bc	2.5 bc	0.5612 abcd
Fenoxaprop-p-ethyl+mefen-pyper-d-ethyl	1.25 bc	2.5 bc	0.56 abcd
Tralkoksidim	1.5 bc	3.5 b	0.4277 e
Flam-prop-m-isopropyl	1.5 bc	1 d	0.5102 cd
Control	1 a	9 a	0.4848 de
LSD	0.7092	1.384	0.0788

Similar letters in each column indicate no significant difference (least significant difference % = α)

Some herbicides used in this study are sensitive to temperature and environmental conditions at the time of application. The application of the clodinafob-propargyl herbicide at temperatures below 4.5°C, caused damage in wheat (Hallgren 1991). Also, the application of the herbicides with the ingredient diclofop-methyl caused wheat to have a deficiency of color. This deficiency disappears after 3 to 4 weeks (Anonymous 2010). Also, for the comparison of the results all treatments were put in one group (Table 6).

An ocular assessment of the treatments' effects on triticale crop showed little influence other than paleness. Analysis of variance was significant (Table 7). The amount of damage from the treatments causing deficiency of color was not more than 1 to 3 percent.

The treatments affected triticale grain yield at a 5% level (Table 7). The tralkoksidim treated yield was lower than the control. The triticale yield after the mesosulfuron + idosulfuron treatment was like the control. Other treatments had good performance (Table 8). Yassin *et al.* (2010) reported that herbicides fenoxaprop-p-ethyl + mefenpyper-d-ethyl increased grain yield in the product. Vaici *et al.* (2008) also proved that the performance of the crops which had been contaminated by wild oat increased after application of the herbicides pinoxaden and clodinafob-propargyl, 218 and 181%, respectively, which confirms our results.

In this study, it can be concluded that all herbicides except tralkoksidim, showed efficiency in controlling weeds and maintaining the triticale yield in the region of Moghan. None of the tested herbicides had an adverse affect on the product.

Finally, it seems that the herbicides discussed in this paper can be used with triticale.

REFERENCES

Adamczewski K. 2000. Weed control method development and perspectives of reduction of weed density. Prog. Plant Prot./Post. Ochr. Roślin 40 (1): 101–112.

Adamczewski K., Praczyk T. 1999. Strategy of weed control in small grain cereals. Pam. Puł. 114 (1): 5–13.

Ahmad K., Shah Z., Khan I., Khan M., Khan M.Q. 1993. Effect of post-emergence herbicides application and hand weeding on wheat and weed pressure. Pak. J. Weed Sci. Res. 6 (1–2): 40–45.

Akhtar M., Hamayoun Q., Gill M.B., Nazir M.S. 1991. Comparative study of various crop management practices on the weed growth and wheat yield. Sarhad J. Agric. 7 (2): 91–94.

Anonymous. 2006. Establishing self-sufficiency in wheat production. http://www.spac.ir/barnameh/Barnameh%20232/p-8.htm. Accessed: May 16, 2010.

Anonymous. 2010. Extension Toxicology Network. http://pmep.cce.cornell.edu/profiles/extoxnet/carbaryl-dicrotophos/diclofop-methyl-ext.html. Accessed: May 12, 2010.

Azad B.S., Singh H., Gupta S.C. 1997. Effect of plant density, dose of herbicide and time onitrogen application on weed suppression and its efficiency in wheat (*Triticum aestivum L.*). Env. Ecol. 15 (3): 665–668.

Faizabad Zare L. 1993. Effect of different times of harvesting forage crop characteristics, nutritional value of forage and grain yield of several varieties of barley and Triticale. Master's thesis, Ferdowsi University of Mashhad, 95 pp.

Fernandez-Quintanilla C., Leguizamon E.S., Navarrete L., del Arco M.J.S., Torner C., Lucas C. 2006. Integrating herbicide rate, barley variety and seeding rate for the control of sterile oat (*Avena sterilis spp. Ludoviciana*) in central Spain. Eur. J. Agron. 25 (3): 223–233.

Hallgren E. 1991. New herbicides for control of annual grass weeds (and dicotolidon weeds) in cereals. Swedish Crop Protection Conference Weeds and Weeds Control 32: 173–189.

Jamali M.R., Baghestani M.A., Fereydonfar M. 2010. Efficacy of two herbicides of Traxus and Axial in weed control barley fields in Fars province. 19th Conferences of Plant Protection of Iran. Plant Protection Institute, Tehran, Iran, 30 July – 1 August. 190 pp.

Kumlehn J., Zimmermann G., Berger C., Marthe C., Hensel G. 2010. Triticeae cereals. Genetic Modification of Plants 64 (3): 287–306.

Montazeri M., Zand E., Baghestani M.A. 2005. Weed control in wheat fields of Iran. Plant Pests and Diseases Research Institute, Ministry of Agriculture, 85 pp.

Qureshi F.A. 1982. Weed problem of Pakistan. Identification and Control of Weed Manual, PARC, Islamabad: 5–8.

Qureshi M.A., Jarwar A.D., Tunio S.D., Majeedano H.I. 2002. Efficacy of various Weed Management practices in wheat. Pak. J. Weed Sci. Res. 8 (1–2): 63–69.

SPSS. 2004. SPSS for Windows. SPSS INC., Chicago, Illinois.

Stankowski S., Maciorowski R. 1996. Successive effect of herbicides on triticale seed germination and plant growth. p. 743–747. In: "Triticale: Today and Tomorrow" (H. Guedes-Pinto, N. Darvey, V.P. Carnide, eds.). Springer, 912 pp.

Tabib M.H., Lorzadeh Sh., Arian nia N. 2007. Comparison of soil applied herbicides to control weeds in wheat leaves drawn in Khozestan Northern climates. Thesis of M.Sc. College of Agriculture, Islamic Azad University, Shoshtar Branch, 102 pp.

Tomlin C.D. 2003. The Pesticide Manual. Bcpc (British Crop Protection Council), 1399 pp.

Vaici M., Baghestani M.A., Sabeti P., Mohammadi A.R. 2008. Assess the impact of the new dual purpose herbicides of Total® (metsulfuron methyl+sulfosulfuron), to control weeds in wheat in Kermanshah. 18th Conferences of Plant Protection of Iran. 24–27 August, Bu ali sina University, 213 pp.

Vencill W. 2002. Herbicide Handbook. 8th ed. Weed Science Society of America, 217 pp.

Wilkinson R.E. 1971. Research Methods in Weed Science. Southern Weed Science Society, 40 pp.

Yasin M., Tanveer A., Iqbal, Z., Ali A. 2010. Effect of Herbicides on Narrow Leaved Weeds and Yield of Wheat (*Triticum aestivum* L.). World Ac. Sci. Eng. Technol. 68 (2): 1280–1282.

Zand E., Baghestani M.A., Dastaran F., Atri A.R., Labbafi M.R., Khaiyami M.M., Porbaig M. 2008. Investigation efficacy of some graminicides in control of resistant and susceptible ryegrass biotypes (*Lolium rigidium* L.) to acetyl-CoA carboxylase inhibiting herbicides. J. Plant Prot. 22 (2): 129–145.