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Evaluation the effect of micronutrients on herbicide mixture 2, 4-D + MCPA, Bromoxynil + MCPA and Tribenoron-methyl efficacy in wheat (*Triticum aestivum*)

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ABSTRACT: In order to investigate the effects of different micronutrients on Bromoxynil, 2,4-D + MCPA, Bromoxynil + MCPA and Tribenoron-methyl efficacy in wheat, a field study was conducted in Research farm of Islamabad Research center, Kermanshah, Iran during 2009-2010. The first factor was three levels of herbicides including 2, 4-D + MCPA at 1.5 lit.ha^{-1}, Bromoxynil + MCPA at 1.5 L ha^{-1} and tribenoron-methyl at 20 g ha^{-1}. The second factor was seven levels of several micronutrients including iron, Molybdenum, nitrogen, zinc, copper and manganese. Experiment was carried out as randomized complete block design with four replications. The fertilizers and herbicides were applied in at tiller stage of wheat. The results of this study showed that the efficacy of Bromoxynil + MCPA on broadleaf weeds was partially better followed by 2,4-D + MCPA and tribenoron-methyl. Tank-Mixturing of fertilizers with examined herbicides had no negative effects on herbicide phytotoxicity. Therefore, the tank mixture of above-mentioned fertilizers and herbicides is possible without adverse effect on weed control.

Keywords: Iron, Molybdenum, Nitrogen, Zinc, Copper and Manganese

INTRODUCTION

Wheat (*Triticum aestivum* L.) is one of the most important cereal crops of the world and has great effect on the economic stability of the developing countries which its yield decreased by 30 to 80% due to weeds (Tawaha *et al.*, 2002; Zimdahl, 2007).Chaudhry *et al.* (2008) reported that when weeds are allowed to compete for 50 days after sowing of crop, they can reduce grain yield significantly. About 22 different herbicide ingredients have been registered in Iran to control weeds in wheat fields from which eight of them are suitable for broadleaf killer and five of them are dual purpose (Zand *et al.*, 2007). All of the herbicide that which have been registered for application in wheat fields of Iran are post emergence (at tillering stage) which is coincide with utilization of microelements. Generally, Zn and Fe deficiencies have been reported as the most widespread micronutrient deficiencies world-wide (Lucca *et al.*, 2001; Welch, 2002). Micronutrients deficiency has became a major constraint for wheat productivity in many Iranian farmlands. The deficiency of micronutrients may be due to their low total contents or decreasing availability of them by soil aggregate fixation and organic matter of soil (Jafari Moghadam, 2008 ; Ranjbar *et al.*, 2007).

The co-application of micronutrients with other agrochemicals is a common practice aimed at reducing production costs and soil compaction by reducing the number of trips made across the field (Hatzios and Penner 1985). Welch *et al* (2000) found that the lack of micronutrients in crops is worldwide and several hectares of arable land in the world are encountered with micronutrient deficiency. In another study has shown that the use of zinc in wheat varieties not only increase yields, but also enrich the seed of this element (Yilmas *et al.* 1997). Makvandi *et al* (2007) showed that simultaneous application of fertilizers copper, iron, manganese, magnesium and a mixture of herbicides Clodinafope propargyle and tribenoron-methyl did not reduce the efficiency of both herbicides. Another study showed that the application of micronutrients wheat tolerance to saline conditions increases (Hu & Schimidhalter 2001). They believe that the average salinity of the soil, using sand and salt consumption is higher using these elements as a solution sprayed on wheat yield and performance.

Research on coapplication of herbicide and plant nutrients and the effects on weed control has been limited. For instance, control of a number of weed species was reduced when manganese was added to herbicide solutions of glyphosate (Bailey *et al.* 2002; Bernards *et al.* 2005). It has been reported that addition of nitrogen and boron to glyphosate spray tank has no adverse effect on control of pitted morningglory (*Ipomoea lacunosa* L.), hemp sesbania [*Sesbania herbacea* (P. Mill) McVaugh], sicklepod [*Senna obtusifolia* (L.) H. S. Irwin & Barneby], barnyardgrass [*Echinochloa crus-galli* (L.)] and johnsongrass [*Sorghum halfpence* (L.) Pers.] (Scroggs *et al.* 2005). Therefore the aim of this study was to evaluate the possibility of co-applying of common used herbicide and fertilizers in wheat production and investigation its subsequent effects on weed control and wheat yield.

MATERIAL AND METHODS

In order to investigate the effects of different micronutrients on Bromoxynil, 2,4-D + MCPA, Bromoxynil + MCPA and Tribenoron-methyl efficacy in wheat, a field study was conducted in Research farm of Islamabad Research center, Kermanshah, Iran during 2009-2010.

The first factor was applying three herbicides including 2, 4-D + MCPA at 1.5 L ha^{-1}, Bromoxynil + MCPA at 1.5 L ha^{-1} and tribenoron-methyl at 20 g ha^{-1} from commercial product. The second factor was using complete fertilizer including Liberl- BMX, containing micronutrients chelate of iron, zinc, manganese, copper, boron and Molybdenum at 1.5 kg ha^{-1}; Biomin 235; containing chelate of iron, Molybdenum, nitrogen, zinc, copper and manganese as at 2 L ha^{-1}; Biomin 466-sp, containing iron, Molybdenum, nitrogen, zinc, copper, magnesium, cobalt and manganese at 1.0 kg ha^{-1}; Liberl Fe, chelate of iron at 1.0 kg ha^{-1}; Liberl Mn, chelate of Manganese at 1.0 kg ha^{-1} and Liberl Zn, chelate of zinc at 1.0 kg ha^{-1}. The fertilizers and herbicides were mixed in spray tank and applicated at tillering stage of wheat. Herbicide treatments were applied with a backpack sprayer equipped with an 8001 Teejet flat-fan nozzle delivering 180 L ha^{-1} at 300 kPa. Treatments were laid out in a complete block design in a factorial arrangement with four replications. Ratings were taken from 14 to 28 DAT to assess foliar injury to the weeds and are expressed as percent in comparison to an untreated check where 0 = no injury and 100 = all plants dead. Dry weight of weeds and wheat yield also were recorded at crop harvest. Data were subjected to ANOVA and means were separated using multiple ranges Duncan test at the 0.05 level of significance.

RESULTS AND DISCUSSION

Dominant weeds in the experiment site were as chamomile (*Anthemis altissima* L.), bedstraw (*Galium tricornutum* Dandy.), hairy vetch (*Vicia villosa* Roth.). Among the broadleaf weed herbicides applied in this study, Bromoxynil + MCPA had the highst effect on hairy vetch and chamomile. (Table 1). 2,4-D + MCPA did not have any effect on chamomile control. In general, herbicide mixture, bromoxynil + MCPA was more effective than 2,4-D + MCPA and Tribenoron-methylin controlling weeds (Table 1). As evident from table 1, presence of micronutrients in spray tank mixture had no effect on chemical control of hairy vetch while control of Chamomile was improved by application of nutrients with herbicides so that herbicide efficacy increased about 10 to 15%.

Table 1: Effect of mixing herbicides Bromoxynil + MCPA, 2, 4-D + MCPA and tribenoron-methyl with various fertilizers on controlling different weeds.

Herbicide	Fertilizer	Control (%)			
		A. altissima	*G. tricornutum*	*V. villosa*	Total
Bromoxynil +MCPA	Liberl BMX	88.60 a	59.03 ab	82.28 ab	75.96 ab
	Biomin 235	83.03 a	50.93 bc	71.81 b-e	68.80 ab
	Biomin 446-sp	93.66 a	50.36 bc	77.18 a-d	72.27 ab
	Liberl Fe	90.55 a	60.57 ab	72.090 b-e	73.67 ab
	Liberl Mn	82.19 ab	63.03 a	79.26 a-d	76.33 a
	Liberl Zn	81.49 ab	62.65 ab	81.47 abc	75.14 ab
	Whithout Fertilizer	79.21 abc	38.55 cd	62.92 e	60.03 cd
2, 4-D +MCPA	Liberl BMX	61.66 de	0.36 i	46.48 f	33.15 h
	Biomin 235	61.29 de	0.0 i	71.05 b-e	dd47.53 fg
	Biomin 446-sp	72.51 bcd	0.0 i	77.22 a-d	54.35 def
	Liberl Fe	67.47 vde	0.0 i	68.36 de	47.91 fg
	Liberl Mn	60.85 de	0.25 i	68.14 de	45.35 g
	Liberl Zn	68.37 b-e	0.0 i	71.23 b-e	51.25 d-g
	Whithout Fertilizer	67.47 b-e	0.0 i	76.31 a-d	55.28 def
Tribenoron-methyl	Liberl BMX	52.34 e	32.26 de	79.24 a-d	60.16 cd
	Biomin 235	64.19 cde	5.34 hi	70.08 cde	49.16 efg
	Biomin 446-sp	56.21 de	17.47 fgh	78.35 a-d	57.00 de
	Liberl Fe	58.99 de	15.12 gh	78.57 a-d	56.38 def
	Liberl Mn	69.81 bcd	30.10 def	87.63 a	67.31 bc
	Liberl Zn	60.54 de	23.60 efg	85.72 a	59.83 cd
	Whithout Fertilizer	69.11 bcd	7.06 hi	76.84 a-d	54.60 def

*Meanss within each column followed by the same letter, are not significantly different at 0.05 probability level according to LSD test.

Utilizing Liberl Zn improved the performance of herbicide on bedstraw by 7%. The use of the herbicide mixture bromoxynil + MCPA tank mixed with Liberl Fe, Biomin 446-sp, Liberl Zn, Biomin 235 and Liberl Mn was the best treatments to reduce weed dry weight (Table 1). On the other hand, mixing MCPA + bromoxynil with Liberl Zn and Liberl Mn showed the highest performance on weed weight reduction (Table 1), respectively. Mixing these two micronutrients fertilizer with either MCPA + bromoxynil or tribenoron-methyl was very effective for control of bedstraw. Totally, tank mixing MCPA + bromoxynil with all three tested fertilizers in this study resulted in reduction of weed dry weight. In other word incorporating fertilizer to MCPA + bromoxynil not only reduced herbicide performance but increase in effectiveness.

This could be explained as that the use of fertilizer increased wheat growth and this leads to better competition of wheat with weeds. This conclusion also is true about the use of fertilizers Liberl Zn and Liberl Mn. Other works also have reported that using fertilizers with herbicide can play either negative or positive role on their efficacy depending on herbicide and crop tested (Bernards *et al.* 2005). Some time tank mixing fertilizer especial those containing metal could antagonize herbicide efficacy as the bind to herbicide molecule and they are no longer available to uptake by plant tissues (Hartmann *et al.* 1998). In deed in this circumstances, fertilizer elements simulate hard water and can be of seted somehow by using appropriate adjuvants (Anonymous. 2006). Using fertilizer in wheat and other crop have great effect on its growth which in turn will increase its competitive ability against weeds. This combined with removing and suppressing weeds with herbicide can have a synergistic effect on crop yield (Gauvrit *et al.* 2003).

The ANOVA indicated that the effect of herbicides, micronutrients, and the interaction on seed, grain, straw and harvest index was significant. A comparison of harvest index data obtained from treated plots compared to the control treatment showed that the grain yield in the presence of herbicide increased by 12 to 15 percent, but significant difference was not observed between herbicide treatments (Table 2). The highest yield of wheat was related to plots treated with 2,4-D + MCPA followed by MCPA + bromoxynil and tribenoron-methyl. Due to having the highest straw yield, its total biomass also was high and showed significant different with two other used herbicides (Table 2).

Table 2: Effect of mixing herbicides Bromoxynil + MCPA, 2, 4-D+MCPA and tribenoron-methyl with varius fertilizers on wheat yield components.

Herbicide	Fertilizer	Yield ($Kg.ha^{-1}$)	Biomass ($Kg.ha^{-1}$)	Strw Yield ($Kg.ha^{-1}$)
Bromoxynil +MCPA	Liberl BMX	4574 kl	13081 de	8507 c
	Biomin 235	4866 c-h	11728 kl	6860 f
	Biomin 446-sp	4927 b-f	14140 a	9213 a
	Liberl Fe	5138 a	12074 ijk	6936 f
	Liberl Mn	4557 kl	13260 cd	8703 bc
	Liberl Zn	4578 kl	12177 ij	7599 e
	Whithout Fertilizer	4753 g-j	12310 hi	7557 e
2, 4-D +MCPA	Liberl BMX	5035 ab	11832 jkl	6797 f
	Biomin 235	4819 d-i	10939 mn	6120 h
	Biomin 446-sp	4712 h-j	12722 efg	8010 d
	Liberl Fe	4886 b-f	13974 a	9088 a
	Liberl Mn	4958 b-e	12345 ghi	7387 e
	Liberl Zn	4974 bcd	12584 fgh	7610 e
	Whithout Fertilizer	4604 jkl	12016 i-l	7412 e
Tribenoron-methyl	Liberl BMX	4834 d-i	11650 l	6813 f
	Biomin 235	4997 abc	13591 bc	8594 bc
	Biomin 446-sp	4792 f-i	13561 bc	8769 b
	Liberl Fe	4789 f-i	11206 m	6417 g
	Liberl Mn	4676 ijk	12859 ef	8183 d
	Liberl Zn	4814 e-i	13864 ab	9050 a
	Whithout Fertilizer	4506 l	10769 n	6263 gh

*Means within each column followed by the same letter are not significantly different at 0.05 probability level according to LSD test.

The results showed the highest increase in yield compared to the control was related to Liberl Fe. The highest yield was harvested from plots that were treated with the micronutrient Biomin 235. In contrast, biomass and straw yield harvested from plots treated with fertilizer Biomin446-sp were higher than other treatments (Table 2).The interaction of herbicide by micronutrients on wheat yield indicated that the highest yield in plots treated with MCPA + bromoxynil + Liberl Fe 20% increase in grain yield of a wheat) which resulted in 5138 kg ha^{-1}. This treatment has no significant difference with 2,4-D + MCPA + Liberl BMX and tribenoron-methyl+ Biomin 235 (Table 2). In contrast, mixing MCPA + bromoxynil with Biomin 446-sp led to hiest wheat straw yield and total biological biomass 2,4-D + MCPA mixture with Liberl Fe and tribenoron-methyl Liberl Zn had no statistically significant difference (Table 2). Bromoxynil + MCPA, 2, 4-D+MCPA and tribenoron-methyl with evaluated micronutrients showed that these tank mixing had no reverse effect on weed killing ability of herbicides and growth and yield of wheat and in some cases increased wheat yield component.

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