COMPARISON OF EFFICACY OF DIFFERENT POSTEMERGENCE HERBICIDE TREATMENTS IN MAIZE IN HUNGARY

KÜLÖNBÖZŐ POSZTEMERGENS GYOMIRTÁSI TECHNOLÓGIÁK HATÉKONYSÁGÁNAK ÖSSZEHASONLÍTÁSA MAGYARORSZÁGON

Maria TORMA*, I. KOVÁCS, J. SIMON*****

**University of Szeged, Faculty of Agriculture, Hódmezővásárhely, Hungary*
***BASF Hungaria Ltd., Budapest, Magyarország*
****Plant and Soil Protection Service of Csongrád County, Hódmezővásárhely, Hungary*
Corresponding auctor: Maria TORMA, e-mail: torma@mfk.u-szeged.hu

Abstract: *In South-East Hungary the weather conditions generally are dry in spring so the efficacy of preemergence weed control methods is not sufficient. Most preemergence herbicide requires 10-20 mm of precipitation within 2 weeks after application to increase their effectiveness. Experiments were conducted in Hódmezővásárhely, southern part of the Great Hungarian Plain in 2005 and 2006 to study different postemergence weed control technologies in small plots in maize. The characteristic weeds on the experimental plots were the Sorghum halepense, Datura stramonium, Chenopodium album, C. hybridum, and Amaranthus retroflexus. The efficacy of the herbicide combinations against dicotyledonous weeds was very similar in the two years. Herbicide treatments contain nicosulfuron combined dicamba + bentazone or mesotrione or tritosulfuron + dicamba and rimsulfuron + dicamba combination controlled dicot weeds with a very good result. The efficacy of foramsulfuron + isoxadifen-ethyl against Chenopodim species was moderate, while florasulam + 2,4 D killed these weeds with a low level of efficacy. In 2005 - when the weather was hot and rainy 2 weeks before and after the treatment - we observed an excellent weed control result against Sorghum halepense. The efficacy of the herbicides was a bit poorer in 2006 because of the cold and too rainy weather. None of the examined herbicide combinations injured maize. At harvesting yield was measured and the data was analysed by variance analysis. Significant yield loss of maize was observed caused by the high weed infestation on those plots where the herbicide effect against weeds was low and on the untreated plots.*

Összefoglalás: *Délkelet Magyarországon a tavaszi időjárás rendszerint száraz, így a preemergens gyomirtások nem biztosítanak megfelelő eredményt. A legtöbb preemergens herbicid a permetezést követő két héten belül 10-20 mm csapadékot igényel a megfelelő hatékonyság eléréséhez. 2005 és 2006-ban az Alföld déli részén kisparcellás kisérletekben vizsgáltuk különböző posztemergens gyomirtási technológiák hatékonyságát. A kísérleti terület jellemző gyomnövényei a Sorghum halepense, Datura stramonium, Chenopodium album, C. hybridum, Amaranthus retroflexus és az Abuthilon theophrasti voltak. A kétszikű gyomnövények elleni hatás mindkét évben közel azonos volt. Jó eredménnyel pusztította a kétszikű gyomnövényeket a nikoszulfuron + dikamba + bentazon, a nikoszulfuron + mezotrion, a tritoszulfuron + dikamba és a rimszulfutron + dikamba kombináció. A foramszulfuron + izoxadifen-etil mérsékelt hatást adott a Chenopodium fajok ellen, míg a florasulam + 2,4D gyenge hatékonysággal pusztította ezeket a gyomokat. 2005-ben – amikor a permetezést megelőző és azt követő 2 hétben az időjárás meleg és csapadékos volt – kiváló hatékonyságot tapasztaltunk a fenyércirok ellen. 2006-ban a vizsgált herbicidek hatékonysága kissé gyengébb volt, ami vélhetően a túlzottam csapadékos és hüvös időjárás következménye. Fitotoxicitást egyik évben tapasztaltunk.*
A termésmérés adatait variancia analízissel feldolgoztuk. Szignifikáns termésveszteséget csak a kezeletlen kontroll, valamint azokon a parcellákon kaptunk, ahol a herbicidek gyenge hatékonysága miatt jelentős volt a gyomborítás mértéke.

Keywords: *maize, postemergence weed control, adjuvant, Sorghum halepense, dicot weeds*
Kulcsszavak*: kukorica, posztemergensd gyomirtás, adjuváns, Sorghum halepense, kétszikű gyomnövények*

INTRODUCTION

The weed flora is very diverse in Hungary. *Sorghum halepense* is one of the worst perennial weeds in maize field. It can be found all around the world and regarded as a serious problem in 53 countries (HOLM *et al*. 1977). Based on the data of the 4th National Weed Survey *S. halepense* is on the 9th place in Hungary. The characteristic annual weeds of maize fields, which cause most of the problem in Hungary are *Echinochloa crus-galli, Amaranthus retroflexus, Ambrosia artemisiifolia, Chenopodium album, Datura stramonium, Amaranthus chlorostachys* (TÓTH and SPILÁK 1998).

The performance of preemergence herbicides is affected by many factors, but rainfall and soil moisture during the early part of the growing season have the greatest impact on weed control efficacy. Most preemergence herbicides require 10-20 mm of precipitation within two weeks after application to increase their effectiveness (KÁDÁR 2001). In the Great Hungarian Plain the weather conditions generally are dry in spring so preemergence herbicide applications do not provide good effects against weeds. This is one of the reasons why maize fields treated only by postemergent herbicides increase year by year (REISINGER 2000).

The aim of this study is to compare the efficacy of different postemergence herbicide treatments in maize.

MATERIALS AND METHODS

In 2005 and 2006 experiments were carried out using a plot size of 20 m^2 and 3 replications in Hódmezővásárhely, southern part of the Great Hungarian Plain. The herbicide treatments were performed with a PP-01 back-sprayer fitted with TeeJet TJ-60 100 03 VS nozzles at 3 bars and a spray volume of 300 l/ha. Sprayings were carried out at 4-6 leaf-development of maize. The weeds of the experimental plots can be found in Table 1. The dicot weeds had 4-6 leaves and *S. halepense* was 10-30 cm high at the time of the treatments.

Table 1

Important weeds of experimental area

Name of weeds	Weed cover %			
	2005		2006	
	at treatments	at harvest	at treatments	at harvest
Sorghum halepense	20	28	4	10
Amaranthus retroflexus	5	10	20	40
Chenopodium album	22	30	8	15
Chenopodium hybridum	5	10	3	8
Datura stramonium	3	7	3	6
Abuthilon theophrasti	-	-	2	6
Total weed cover	55	85	40	85

In 2005 the temperature at the time of spraying was 25°C, the precipitation within the first 2 weeks after spraying was 52,3 mm and in 2006 the temperature was 24 °C, and 89,4 mm precipitation was measured. Meteorological data during the period of experiment can be seen in Table 2. The efficacy of weed control was expressed in percentage, as compared to the untreated control plots 3 and 7 week after treatment, and right before harvesting. The assessment of crop phytotoxicity was carried out as a description of the symptoms at same date of weed control efficiency test. In 2006 at harvest the yield was recorded. Data were analysed statistically by a variance analysis. Table 3 contains data of studied herbicides and adjuvants.

Table 2

Weather conditions during the experimental period.

Months	Decade	Precipitation mm		Average temperature °C	
		2005	2006	2005	2006
May	1.	2,9	3,3	14,9	14,6
	2.	18,6	7,5	15,1	17,8
	3.	0	28,3	19,5	20,0
June	1.	52,6	80,8	16,1	13,6
	2.	5,7	0,5	20,8	21,7
	3.	3,7	25,8	22,6	254,3
July	1.	78,2	42,5	20,4	22,4
	2.	5,8	1,0	22,4	23,3
	3.	1,4	45,8	23,9	26,6
August	1.	22,4	55,3	20,4	18,7
	2.	70,1	20,6	20,1	19,5

Table 3

Data of studied herbicides and adjuvants

Herbicides	Active ingredients	%, $g.l.^{-1}$
Motivell Turbo D (Motivell+ Cambio+ Dash HC)	nicosulfuron + bentazon + dicamba + methyloleat + methylpalmitat	40 + 320 + 90 + 18,5 + 18,5
Clio	topramazone	360
Callisto	mesotrione	480
Calaris	mesotrione + terbuthylazin	70 + 330
Mustang	florasulam + 2,4-D ester	6,25 + 452
Mester	foramsulfuron + izoxadifen-ethyl + jodosulfuron-methyl-Na	30 + 30 + 1
Monsoon	foramsulfuron + izoxadifen-ethyl	22,5 + 22,5
Titusz Plusz	rimsulfuron + dicamba	3 + 60
Break Thru	polyether-polymethylsiloxane-copolimer	100
Extravon	etoxylated oktilfenol	100
Mero	rapeseed oil	85
Trend	etoxylated izodecil-alcohol	90

RESULTS AND DISCUSSION

The efficacy of the herbicide combinations and yield data are given in Table 4. In 2005 Motivell (nicosulfuron) are combined with different herbicide active ingredients and adjuvants controlled Johnsongrass (*S. halepense*) and dicot weeds with a very good result. Dash, Break Thru and ammonium –nitrate helped the penetration of herbicides in nearly the same level. On those plots where the herbicides were combined ammonium-nitrate the germination and the development of dicot weeds were observed during the rainy summer time. The effect of Titus Plus (80%), Mester (83%) and Monsoon (90%) was a little bit slighter than the efficacy of Motivell, but the result of weed control of these treatments could be acceptable

in agricultural practice. All the tested herbicide combinations provided a good effect against the dominant dicot weed species of the experimental area except Mustang and Monsoon. Neither in 2005 or in 2006 these two herbicides killed *Chenopodium album* effectively. TORMA *et al.* (2006) observed the same result in their experiments in 2003 and 2004.

In the second experimental year all the herbicide treatments gave a quick and excellent effect against *Amaranthus retroflexus*, *Datura stramonium*, *Abuthilon theophrasti* and *Chenopodium hybridum.* This year the efficacy of treatments against *S. halepense* was moderate. After spraying the development of weed stopped, the symptoms of herbicides appeared on its leaves but only those *S. halepense* died, which were developed by seeds and a few-leaf ones, which were developed by rhizomes. During the rest of the vegetation period the growing of *S. halepense* was slow and it developed 2-3 flowering steams only. At the end of September the seeds of *S. halepense* were at the beginning of ripening, while in the hoeing plots this weed had already spread its ripening seeds.

Neither in 2005 nor in 2006 the studied herbicides damaged the maize.

Table 4

The effect of different postemergence herbicide treatments in maize

Treatments	Rate l.kg/ha	T.	Herbicide effect %												Yield kg/10^2
			SORHA		CHEAL		CHEHY		AMARE		DATST		ABUTH		
			05	06	05	06	05	06	05	06	05	06	05	06	06
1. Motivell Turbo D	3.6	1.	100	80	100	100	100	100	100	100	100	100	-	100	
		2.	98	75	98	100	98	100	98	100	98	100	-	100	
		3.	95	70	95	100	95	100	95	100	95	100	-	100	10.61
2. Motivell Turbo + Break Thru	3.2	1.	100	80	100	100	100	100	100	100	100	100	-	100	10.7
		2.	100	75	98	100	98	100	98	100	100	100	-	100	
		3.	98	70	95	95	95	100	95	100	100	100	-	100	
3. Motivell + Cambio +Ammonnitrát	1.0+2.0+ 5.0	1.	100	80	100	100	100	100	100	100	100	100	-	100	
		2.	99	75	95	100	95	100	95	100	95	100	-	100	
		3.	98	70	85	95	88	100	90	100	90	100	-	100	10.74
4. Motivell + Clio + Dash HC	1.0+0.15 +0.5	1.	-	80	-	100	-	100	-	100	-	100	-	100	
		2.	-	75	-	100	-	100	-	100	-	100	-	100	
		3.	-	70	-	100	-	100	-	98	-	100	-	100	10.57
5. Motivell + Callisto + Extravon	1.0+0.3+ 0.1%	1.	100	85	100	100	100	100	100	100	100	100	-	100	
		2.	100	80	100	100	100	100	100	100	100	100	-	100	
		3.	98	75	98	100	98	100	100	100	100	100	-	100	10.62
6. Motivell + Calaris	0.5+2.0	1.	-	80	-	100	-	100	-	100	-	100	-	100	
		2.	-	75	-	100	-	100	-	100	-	100	-	100	
		3.	-	70	-	100	-	100	-	98	-	100	-	100	10.56
7. Mustang	0.6	1.	60	0	60	70	65	-	95	98	-	98	-	98	
		2.	55	0	45	65	50	-	90	98	-	98	-	98	
		3.	40	0	30	60	40	-	85	95	-	95	-	95	8.90
8. Mester + Mero	0.15+2.0	1.	90	80	98	98	100	98	100	100	100	98	-	98	
		2.	85	75	95	98	100	98	100	100	100	95	-	98	
		3.	83	70	95	95	98	95	98	98	98	93	-	95	10.26
9. Monsoon	2.5	1.	95	80	85	85	95	93	100	100	100	100	-	100	
		2.	95	75	80	80	90	90	98	100	95	100	-	100	
		3.	90	70	75	75	90	85	95	95	93	100	-	98	9.25
10. TituszPlusz + Trend	0.383+ 0.1%	1.	90	80	100	98	100	100	100	98	98	100	-	100	
		2.	85	75	98	98	95	100	100	98	98	100	-	100	
		3.	80	70	95	95	93	100	95	95	95	98	-	100	10.15
11. hoeing control															10.96
12. untreated control															5.89

$SD_{5\%}$= 0.9476

T=time of evaluation: 1. one week after treatments, 2. five weeks after treatments, 3. before harvest

The yield in the percentage of the hoeing control is shown in Figure 1. No negative herbicide side effect on the yield was measured. The high weed infestation in the untreated plot decreased the yield to 54 % and the yield loss was 19 % on the plots treated by Mustang and 16 % on the parcels sprayed by Monsoon due to *S. halepense* and *C. album.*

On the base of the analysis of variance significant yield loss of maize was measured on these three parcels.

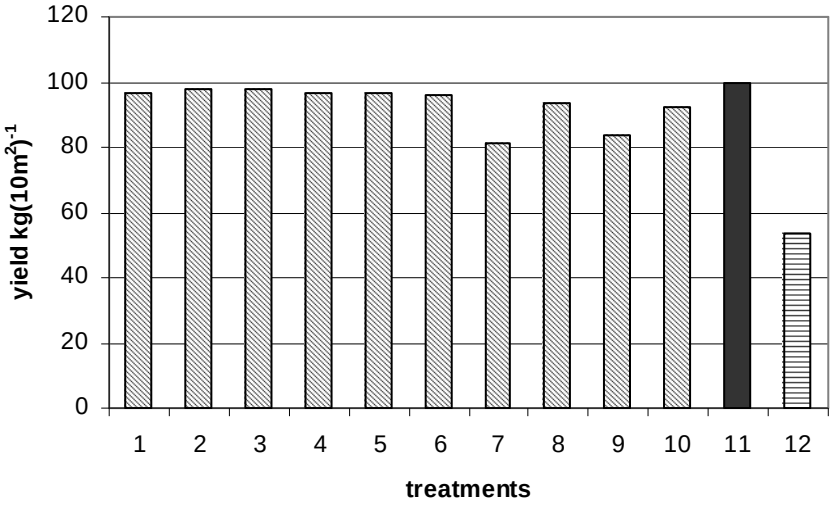

Figure 1. Yield in the percentage of the hoeing control

CONCLUSIONS

In the conventional weed management in order to reduce the herbicide applications we have to apply herbicides once (preemergence or postemergence) in a vegetation period. The choosing of weed control technology depends on the weed infestation and the weather conditions in spring. Preemergent herbicides have no effect against *S. halepense* developing by rhizome. Nicosulfuron and rimsulfuron can be used selectively in maize for control of *S. halepense* (ELEFTHEROHORINOS and KOTOULA-SYKA 1995).

On the base of our results nicosulfuron, rimsulfuron and foramsulfuron combined one of the dicot killer herbicides can be recommended for postemergence weed control in maize fields infested with *S. halepense* and broadleaf weeds. Cold weather inhibits the penetration of herbicides into the weeds so in this kind of weather conditions it is better to carry out divided treatment, which means we use a dose of 50%-50% of herbicides twice. Growers can make their decision which technology to choose on the base of the cost of the herbicide-combinations.

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