

## RIMSULFURON – METHYL FOR WEED CONTROL IN MAIZE STANDS

Ona AUŠKALNIENĖ

Lithuanian Institute of Agriculture  
Akademija, Dotnuva, Kėdainiai distr.  
E-mail: ona@lzi.lt

### Abstract

Over the period 2002-2003 three field experiments, designed to test the sulfonilurea group herbicide rimsulfuron - methyl and compare it with primsulfuron methyl, were conducted in maize crops at the Lithuanian Institute of Agriculture.

The soil of the experimental site is endocalcary - endohypogleyic cambisol, sandy light loam with a  $P_2O_5$  value of 130-142 mg kg<sup>-1</sup>,  $K_2O$  – 150-195 mg kg<sup>-1</sup>. Maize was fertilized with  $N_{150}P_{35}K_{166}$  pre-sowing. The seeding rate was 90 thousand viable seeds per ha, distance between rows 75 cm. Herbicides of the sulfonilurea group were spray – applied post-emergence of maize, at growth stage 13-14 BBCH and in split application: at 13-14 BBCH of maize, and two weeks later. Efficacy of herbicides on weed number and weed weight were estimated 6 weeks after herbicide application.

The weed species differed between fields. The most frequent weed species in maize stands were *Elytrigia repens*, *Chenopodium album*, *Polygonaceae* – *Fallopia convolvulus* and *Polygonum aviculare*.

The tested herbicides were effective against *Elytrigia repens*. The effect on total weed weight was 66-86 %, and on *Elytrigia repens* weight – 66-91 %.

The maize green matter yield in treated plots was 2 – 4 times higher, grain number per cob 37.6-64.2 %, 1000 grain weight 59.2-85.2 % and grain weight per cob 2-2.5 times higher compared with the untreated. Grain moisture was by 13.6-21 % higher in the herbicide - untreated plots.

Key words: maize, yield, weeds, *Elytrigia repens*, sulfonilurea herbicides.

### Introduction

Weeds cause problems in all crops in Lithuania. The weed species of the greatest economic importance in Lithuania are *Elytrigia repens*, *Tripleurospermum inodorum*, *Stellaria media*, *Chenopodium album* and others /Kavoliūnaitė, 2001/.

It is well understood, that the timing of final cultivations has a major impact on the weed flora of arable crops. Winter-sown crops support an autumn-germinating flora, while spring-sown crops are dominated by spring germinating species /Chancellor, 1985; Hald, 1999/. Maize being late-spring sown supports a particular weed flora of those species that either germinates in the late spring and early summer or all year round. About 40 weed species occur in maize crops in Lithuania /Auškalnienė, Auškalnis, 2006/. The most frequent weeds were *Elytrigia repens* and *Chenopodium album* – which were found in 80-100 % of maize fields. The analysis of weed weight showed that

perennial weeds accounted for 20 to 80 % of the total weed weight, and *Elytrigia repens* accounted for 60-100 % of all perennial weed weight. Perennial grasses are often the most difficult weeds to control as they possess characteristics similar to the desired species /Christians, 2004/.

Maize is very sensitive to the weed competition. Due to the weed competition the grain yield of spring barley decreased by 10-15 %, while maize green material yield decreased by 2-10 times /Auškalnienė, 2006/. *Elytrigia repens* can reduce maize yield by on average 37 % and significantly reduce corn height and ear length /Young et al., 1984/.

The need to control weeds during the early stages of the crop is known to be critical, /Evans et al., 2003/. To avoid decreasing of maize yield, maize should grow weedless one month after emergence. /Harzler et al., 2002/.

Sulfonylurea herbicides have shown selective herbicidal activity against grassy weeds in grass crops /Bruce, Kells, 1997; Rabaey, Harvey, 1997/.

Low application rates, broad spectrum of weed control and favourable toxicological properties of sulfonylurea have contributed to the success of this group of herbicides /James, Rahman, 1994/. Rimsulfuron is sulfonylurea herbicide for post emergence weed control in maize /Palm et al., 1989; Nalevaja et al., 1991/. Primisulfuron is sulfonylurea herbicide which controls troublesome perennial grass such as couch (*Elytrigia repens*) at the same rates required for annual grass weeds and many broadleaf weeds in maize /Maurer et al., 1987; Bhowmik et al., 1990/. On the other hand, other researchers stated that the weed species controlled by sulfonylurea herbicides are limited: rimsulfuron gives poor control of the spring-germinating species of the Polygonaceae, such as knotgrass (*Polygonum aviculare*), black bindweed (*Fallopia convolvulus*) and redshank (*Persicaria maculosa*) /Marshall, 2002/.

Primisulfuron - methyl was tested in the field trials conducted at the Lithuanian Institute of Agriculture. The split application of 15 plus 15 g ha<sup>-1</sup> provided 99 % control of *Elytrigia repens* and 94 % control of *Chenopodium album* /Auškalnienė, Auškalnis 2005/.

The aim of the present study was to investigate the efficacy of rimsulfuron – methyl used in one and in split application on weed weight and biomass and maize cob yield.

### **Materials and methods**

Three field trials designed to test sulfonylurea group herbicides: primisulfuron – methyl (Tell 75WG) and rimsulfuron – methyl (Titus 25 DF) were conducted in 2002 (two trials) and 2003 (one trial) in the central part of Lithuania. Trial 1 had low incidence (3-5 sprouts per m<sup>2</sup>), trial 2 – high incidence of *Elytrigia repens* – more than 300 sprouts per m<sup>2</sup>. The incidence of *Elytrigia repens* in trial 3 (2003) was also high. The soil of the experimental site is endocalcary – endohypogleyic cambisol, sandy light loam with a P<sub>2</sub>O<sub>5</sub> value of 130-142 mg kg<sup>-1</sup>, K<sub>2</sub>O – 150-195 mg kg<sup>-1</sup>.

The growing conditions were favourable for maize, especially in 2002, when the spring was early and warm, the summer was hot and dry, the amount of rainfall in May was 3 times as low as long-term mean and the temperature during the maize growing season was noticeably higher than long-term mean. In 2003 the mean air temperature in May was close to long-term mean, and rainfall was 69 % of the long-term mean.

Maize cultivation practices were the same for all trials. Maize was sown in the last ten-day period of April and fertilized with  $N_{150}P_{35}K_{166}$  pre-sowing. The seed rate was 90 thousand of viable seeds per ha, distance between rows 75 cm. Herbicides were spulit- applied post-emergence of maize, at growth stage 13-14 BBCH for the first time and two weeks later at 15-16 BBCH. Annual dicotyledonous weeds had 2-3 leaves, *Elytrigia repens* was 15-20 cm in height. Herbicides were sprayed with a compressed nitrogen gas sprayer using a 2.5 m wide boom, at a pressure of 250 kPa, nozzle type 4110-12, spraying speed  $1\text{ m s}^{-1}$  and a volume rate of  $200\text{ L ha}^{-1}$ . Weed assessments were conducted on individual weed species in  $4 \times 0.25\text{ m}^2$  per plot 6 weeks after the herbicide application.

In all treatments surfactant Kemiwett  $0.2\text{ l ha}^{-1}$  was added. Maize was harvested manually in the last ten-day period of September. In 2003 biometrical analyses of maize were made and grain number, weight per cob, grain moisture, 1000 grain weight were estimated. Ten maize cobs per plot were measured.

The experimental data were compared by using an analysis of variance (ANOVA) and, where the F-ratio was significant, the least significant difference (LSD) was calculated for  $P < 0.05$ .

## Results and discussion

In 2002 two field trials were conducted to estimate the efficacy of rimsulfuron methyl and compare it with primsulfuron methyl. Trials differed in weed occurrence and species composition (Table 1).

**Table 1.** The weed occurrence and diversity in maize crops  
**1 lentelė.** Kukurūzų pasėlių piktžolėtumas

Dotnuva, 2002-2003

Weeds / Piktžolės	Number of weeds $\text{m}^{-2}$ / Piktžolių skaičius $\text{m}^{-2}$		
	Trial 1 <i>1 bandymas</i>	Trial 2 <i>2 bandymas</i>	Trial 3 <i>3 bandymas</i>
<i>Amaranthus retroflexus</i> L.	0	0	6.3
<i>Brassica napus</i> L.	3.8	0	0
<i>Capsella bursa pastoris</i> (L.) Medik.	0	0	3.4
<i>Chenopodium album</i> L.	11.3	45.0	146.3
<i>Echinochloa crus – galli</i> (L.)P. Beauv.	0	0	10.6
<i>Elytrigia repens</i> (L.) Nevski	2.3	332.2	159.5
<i>Euphorbia helioscopia</i> L.	4.3	0	0
<i>Fallopia convolvulus</i> (L.) Löve	1.3	1.4	0
<i>Galium aparine</i> L.	0	0	6.5
<i>Lamium purpureum</i> L.	0	2.0	0
<i>Polygonum aviculare</i> L.	0.8	4.7	0
<i>Stellaria media</i> (L.) Vill.	1.8	0	0
<i>Tripleurospermum inodorum</i> Sch. Bip	0	0	6.3
<i>Veronica spp.</i>	0.8	0	0
<i>Viola arvensis</i> Murray	0	3.3	0
Other / Kitos	4.8	0	0
Total number / Bendras skaičius	31.2	388.6	340.3

In trial 1 most frequent were *Chenopodium album* and *Brassica napus* – volunteer rape. *Elytrigia repens* was found in small numbers, about 2.3 sprout per m<sup>-2</sup>. In trial 2 *Elytrigia repens* was found about 10 times more, over 332.2 weeds m<sup>-2</sup>. In 2003 (trial 3) there was recorded the highest number of weed species. The total weed number differed between trials from 31.2 (trial 1) to 388.6 (trial 2).

Weed weight differed between trials from 473 to 2176 grams m<sup>-2</sup> (Table 2). The largest part in the total weight in trial 1 had volunteer rape (*Brassica napus*) and *Chenopodium album* about 35-48 % from the total weed weight. The most frequent in trial 2 was *Elytrigia repens* – 77.8 % from the total weed weight. The most important weed in trail 3 was *Chenopodium album* – 74.7 from the total weed weight.

**Table 2.** The amount and portion of fresh weed weight in untreated control plots  
**2 lentelė.** Piktžolių kiekis ir dalis bendros masės %  
Dotnuva, 2002-2003

Weeds / Piktžolės	Weed weight g m <sup>-2</sup> Piktžolių masė g m <sup>-2</sup>			Portion of weight % Dalis bendros masės %		
	Trial 1 1 bandymas	Trial 2 2 bandymas	Trial 3 3 bandymas	Trial 1 1 bandymas	Trial 2 2 bandymas	Trial 3 3 bandymas
<i>Elytrigia repens</i>	4.3	367.0	349.0	0.6	77.6	16.0
<i>Chenopodium album</i>	267.8	73.0	1624.6	35.2	15.4	74.7
<i>Polygonaceae</i>	25.4	22.6	0	3.3	4.9	0
<i>Brassica napus</i>	361.0	0	0	47.5	0	0
Other / Kitos	101.5	10.6	202.7	13.4	2.1	9.3
Total fresh weight Bendra masė	760.0	473.2	2176.3	100	100	100
Air dry weight Orasausė masė	129.4	150.2	621.8	100	100	100

The efficacy of the herbicides tested on the total weed weight was moderate to high. The weed weight in treated plots decreased by 25 to 96 % (Table 3).

**Table 3.** The comparison of the efficacy of different rimsulfuron – methyl doses on the total weed weight 6 weeks after herbicide application

**3 lentelė.** Skirtingų rimsulfuronmetilo normų efektyvumas bendrai piktžolių masei  
Dotnuva, 2002-2003

Treatment / Variantas	Decrease in % / Sumažėjimas %		
	Trial 1 1 bandymas	Trial 2 2 bandymas	Trial 3 3 bandymas
Untreated / Nepurkšta	760.0*	473.2*	2176.3*
Rimsulfuron 12.5g ha <sup>-1</sup>	85	41	25
Rimsulfuron 6.25 + 6.25 g ha <sup>-1</sup> in split	88	55	26
Rimsulfuron 25g ha <sup>-1</sup>	93	35	31
Primisulfuron 30 g ha <sup>-1</sup>	96	58	71

\* Weed weight g m<sup>-2</sup> in untreated plots / Piktžolių masė nepurkštuose laukeliuose g m<sup>-2</sup>

The tested herbicides were effective against *Elytrigia repens*. In treated plots the weight of *Elytrigia repens* decreased by 70-100 % (Table 4).

**Table 4.** The comparison of the efficacy of different rimsulfuron – methyl doses on *Elytrigia repens* 6 weeks after herbicide application.

**4 lentelė.** Skirtingų rimsulfuronmetilo dozių efektyvumas varpučio masės sumažėjimui % 6 savaitės po purškimo.

Dotnuva, 2002-2003

Treatment / <i>Variantas</i>	Decrease of <i>Elytrigia repens</i> weight %		
	<i>Varpučių masės sumažėjimas %</i>		
	Trial 1	Trial 2	Trial 3
	<i>1 bandymas</i>	<i>2 bandymas</i>	<i>3 bandymas</i>
Untreated / <i>Nepurkšta</i>	4.3*	367.0*	349.0
Rimsulfuron 12.5g ha <sup>-1</sup>	100	66	100
Rimsulfuron 6.25 + 6.25 g ha <sup>-1</sup> in split	100	81	100
Rimsulfuron 25g ha <sup>-1</sup>	100	76	100
Primisulfuron 30 g ha <sup>-1</sup>	99	91	100

\* Weight g m<sup>-2</sup> of *Elytrigia repens* in untreated plots / *Paprastųjų varpučių masė nepurkštuose laukeliuose*

In trial 3 there was found *Echinochloa crus – galli*. Rimsulfuron – methyl was effective against this weed, while primisulfuron – methyl did not have any effect.

The maize green matter yield was significantly higher in treated plots (Table 5). An especially high increase in maize yield was obtained in trial 3, because weed weight in untreated plots in this trial was higher compared with the other trials.

**Table 5.** The influence of herbicide application on maize green matter yield

**5 lentelė.** *Herbicidų įtaka kukurūzų žaliosios masės derliui*

Dotnuva, 2002-2003

Treatment / <i>Variantas</i>	t ha <sup>-1</sup>		
	Trial 1	Trial 2	Trial 3
	<i>1 bandymas</i>	<i>2 bandymas</i>	<i>3 bandymas</i>
Untreated / <i>Nepurkšta</i>	23.6	1.7	6.1
Rimsulfuron 12.5g ha <sup>-1</sup>	36.1	3.1	9.4
Rimsulfuron 6.25 + 6.25 g ha <sup>-1</sup> in split	41.0	2.8	15.7
Rimsulfuron 25g ha <sup>-1</sup>	37.8	2.8	13.4
Primisulfuron 30 g ha <sup>-1</sup>	32.3	2.8	24.9
LSD <sub>05</sub> / <i>R<sub>05</sub></i>	4.29	0.7	3.19

Maize was grown for grain. Grain number and weight per cob in treated plots were significantly higher compared with the untreated. (Table 6).

**Table 6.** The influence of herbicide application on maize biometrical indicators  
**6 lentelė.** *Herbicidų įtaka kukurūzų biometrijos rodikliams*  
 Dotnuva, 2003

Treatment <i>Variantas</i>	Grain number per cob <i>Grūdų skaičius burbuolėje</i>	Grain weight per cob g <i>Burbuolės grūdų masė g</i>	Grain moisture % <i>Grūdų drėgmė %</i>	1000 grain weight g <i>1000-čio grūdų masė g</i>
Untreated	229.4	36.6	47.7	160.4
Rimsulfuron 12.5g ha <sup>-1</sup>	349.4	84.1	41.2	255.4
Rimsulfuron 6.25 + 6.25 g ha <sup>-1</sup> in split	315.6	89.4	36.9	264.7
Rimsulfuron 25g ha <sup>-1</sup>	339.8	85.3	39.4	297.1
Primisulfuron 30 g ha <sup>-1</sup>	376.8	95.4	36.6	271.2
LSD <sub>05</sub> /R <sub>05</sub>	36.02	23.60	3.85	99.40

Grain number per cob in treated plots was 37.6-64.2 %, 1000 grain weight 59.2-85.2 % and grain weight per cob 2-2.5 times higher compared with the untreated. Conversely, grain moisture in untreated plots was 13.6-21 % higher compared with the treated.

Similar trends were observed by other researchers /Bhowmik et al., 1990; Nalevaja et al., 1991/.

### Conclusions

1. Weed number differed between fields from 32 to 390 and weed weight from 470 to 2200 g m<sup>-2</sup>. *Chenopodium album* and *Elytrigia repens* accounted for 36-93 % of the total weed weight.

2. The efficacy of rimsulfuron – methyl on different weed species was diverse: from high to low. High efficacy was exerted on *Echinochloa crus galli*, *Elytrigia repens*, *Galium aparine*, *Stellaria media*, moderate to low on *Chenopodium album*, *Polygonaceae* - *Polygonum aviculare*, *Fallopia convolvulus*.

3. In treated plots maize green matter yield was significantly, 2-4 times higher than in the untreated.

4. Grain number per cob in treated plots was 37.6-64.2 %, 1000 grain weight 59.2-85.2 % and grain weight per cob 2-2.5 times higher compared with the untreated. Grain moisture was by 13.6-21 % higher in the herbicide-untreated plots.

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## RIMSULFURONO EFEKTYVUMAS PIKTŽOLĖTUMO KONTROLEI KUKURŪŽŲ PASĖLYJE

O. Auškalnienė

### Santrauka

Lietuvos žemdirbystės institute 2002-2003 metais daryti trys lauko bandymai rimsulfurono efektyvumui kukurūžų pasėliuose nustatyti ir palyginti jį su kitu sulfonilurėjos grupės herbicidu primisulfuronu.

Bandymo dirvožemis – giliau karbonatingas, sekiau glėjiškas rudžemis, lengvas priemolis, judriųjų  $P_2O_5$  – 130-142  $mg\ kg^{-1}$ ,  $K_2O$  – 150-195  $mg\ kg^{-1}$ . Kukurūžai prieš sėją buvo tręšiami  $N_{150}P_{35}K_{166}$ . Sėklos norma – 90 tūkst. daigių sėklų į hektarą, tarpueilių plotis – 75 cm. Sulfonilurėjos grupės herbicidai pirmą kartą išpurkšti kukurūžams esant BBCH 13-14, o antrą – praėjus dviem savaitėms po pirmo purškimo.

Piktžolių skaičius kvadratiname metre, piktžolių masė ir herbicidų efektyvumas buvo nustatomi praėjus 6 savaitėms po purškimo herbicidais.

Piktžolių rūšinė sudėtis įvairiuose laukuose buvo skirtinga. Daugiausiai augo šios piktžolės: paprastieji varpučiai (*Elytrigia repens*), baltosios balandos (*Chenopodium album*), rūgtys: vijokliniai pelėvirkščiai (*Fallopia convolvulus*) ir takažolės (*Polygonum aviculare*).

Tirtieji herbicidai buvo efektyvūs varpučiams naikinti. Herbicidų efektyvumas bendram piktžolių skaičiui buvo 66-86 %, o nuo varpučių – 66-100 %.

Kukurūžų žalia masė purkštuose pasėliuose buvo 2-4 kartus, burbuolės grūdų skaičius – 37,6-64,2 %, svoris – 2-2,5 karto, 1000-čio grūdų masė – 59,2-85,2 % didesnė nei nepurkštuose. Grūdai buvo 13,6-21,0 % drėgnesni nepurkštuose pasėliuose.

Reikšminiai žodžiai: kukurūžai, derlius, paprastieji varpučiai, sulfonilurėjos grupės herbicidai.