

THE INFLUENCE OF WEATHER CONDITIONS ON SELECTIVITY OF SULFONYLOUREA HERBICIDES TO THE SELECTED MAIZE VARIETIES

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Abstract: *Zea mays* originate from warm and tropical region of the world and needs high sum of effective temperature throughout vegetative period. On the Polish market varieties of maize differ in early maturing, provenance and temperature requirements. The foreign varieties react stronger to the sulfonylurea herbicides (nicosulfuron, rimsulfuron, foramsulfuron + jodosulfuron) than Polish maize varieties under unfavorable weather conditions.

The trials were conducted in field conditions using 8 maize varieties. The aim of this experiment was evaluation of the influence of sulfonylurea herbicides on foreign and Polish varieties of maize under different weather conditions. The reaction of foreign maize varieties on herbicides was compared with reaction of Polish maize varieties in the years 2001–2002. Four early maturing varieties of maize were testing: AVENUE (FAO 220)-FR, JANNA (FAO 190)-USA, WIARUS (FAO 220)-PL, FIDO (FAO 220)-PL. It was proved that Polish maize varieties showed a higher toleration towards sulfonylurea herbicides. The later maturing varieties KRÓL (FAO 280)-PL, IMAN (FAO 300)-PL, KANZLER (FAO 300)-FR, MAGISTER (FAO 280)-CH responded in a similar way. In 2002 there were no differences in plant development between foreign and Polish maize varieties.

Key words: Polish maize varieties, foreign maize varieties, reaction of maize varieties on herbicides, sulfonylurea herbicides

INTRODUCTION

Zea mays originate from warm and tropical region of the world and need high amount of effective temperature throughout vegetative period. Available on the Polish market maize varieties differ in early maturing, provenance and temperature requirements.

The weather conditions in May are often unfavorable for the emergence and the period of growth of maize varieties. Applications of sulfonylurea herbicides cause

the additional stress for the plants. The favorable character of cultivated variety is quick growth ability in this initial period of growth and tolerance on the sulfonylurea herbicides in lower temperature and higher humidity (Doohan et al. 1998; Rola et al. 1993).

According to the experiments carried out in the years 1995–1997 the foreign varieties of maize that were bred in different weather conditions reacted stronger to the sulfonylurea herbicides than Polish maize varieties (Rola et al. 1998; Rola and Gołębiowska 2000).

The aim of this experiment was the evaluation of the influence of sulfonylurea herbicides (nicosulfuron, rimsulfuron, foramsulfuron + jodosulfuron) on maize varieties of different origin under unfavorable weather conditions in the years 2001–2002.

METHODS AND MATERIALS

The trials were established in split-block method with three replications in 2001 and 2002 years. Each experimental plot size was 2.25×5.0 m.

The trials were conducted in field conditions with four early maturing varieties of maize AVENUE, JANNA, WIARUS, FIDO and four later maturing varieties KRÓL, IMAN, KANZLER, and MAGISTER. Those varieties differed in origin, early maturing and tolerance on the sulfonylurea herbicides.

On the experimental plots the plants in a row were counted. Next an observation of the condition of each variety followed by emergence and before applied of herbicides was carried out. Sulfonylurea herbicides were applied when maize was at growth stage 3–4 of leaves: Titus 25 WG (nicosulfuron – DU PONT) at dose 60 g/ha, Milagro 040 SC (rimsulfuron – Syngenta Crop Protection) at a dose of 1.5 l/ha, MaisTer 310 WG (foramsulfuron + jodosulfuron – Aventis CropScience) at a dose of 150 g/ha. Evaluation of herbicide phytotoxicity to maize varieties was conducted in 1, 2 and 3 weeks after the application of herbicides in scale 1–9. The measurements of a height of plants after the conopy stage were conducted on the experimental plots. In full maturity stage harvesting was conducted by hand. Yield of grain and weight of 1000 seeds were calculated for 15% humidity.

RESULTS AND DISCUSSION

In 2001 year weather conditions were unfavorable for the growth and development of maize varieties. This year was wet and cold with stormy rainfalls in July and August, therefore harvest was delayed (III decade of September) (Tab. 5). High temperatures and moderate humidity occurred in the similar period of 2002 year. It caused that most of maize varieties matured quicker and were harvested earlier (I decade of September) (Tab. 6). The sum of effective temperature reached 1593.7°C and the sum of rainfall reached 481.9 mm in 2001 year. In the tested periods of 2002, the sum of effective temperature reached 1845.5°C and the sum of rainfall was 313.5 mm.

The foreign maize varieties, both the early (JANNA, AVENUE) and late (KANZLER, MAGISTER), were weak and the plant growth delayed in unfavorable period of 2001. The condition of those varieties was worse than the Polish varieties

Table 1. Evaluation of phytotoxicity of herbicides on early maturing maize varieties (Wrocław 2001)

Early maturing maize varieties	Evaluate of emergence	Phytotoxicity of sulfonylurea herbicides /1-9/ and damages	Yield of grain
JANNA FAO 190	3 weak vigor of plants	2-3 growth retardation, deformation of plant and leaves twisted leaves, decolorization of plant	CONTROL 9.08 8.63
		3 growth retardation, deformation of plant and leaves twisted, decolorization of plant and wrinkles	CONTROL 9.60 7.89
FIDO FAO 210	1-2 strong vigor of plants	1-2 growth retardation, decolorization of plant	CONTROL 8.77 8.65
		1-2 growth retardation, decolorization of plant	CONTROL 11.08 10.98
LSD (0.05)			0.86

Table 2. Evaluation of phytotoxicity of herbicides on early maturing maize varieties (Wrocław 2002)

Early maturing maize varieties	Evaluate of emergence	Phytotoxicity of sulfonylurea herbicides /1-9/ and damages	Yield of grain
JANNA FAO190	2 weak vigor of plants	2 growth retardation, decolorization of plant	CONTROL 9.55 9.62
		2-3 growth retardation, deformation of plant and leaves twisted, decolorization of plant	CONTROL 12.44 12.35
FIDO FAO 210	1 strong vigor of plants	no symptoms	CONTROL 11.41 11.48
		no symptoms	CONTROL 11.33 11.27
LSD (0.05)			0.69

(FIDO, WIARUS, IMAN, KRÓL). The different injuries of plants were observed two weeks after treatment of sulfonylurea herbicides. The late foreign varieties (KANZLER, MAGISTER) responded severely to applied herbicides and occurred being sensitive (Tabs. 3, 4). The decolorization of leaves, wrinkles, chlorosis and deformation of plants were observed on these varieties. These injuries were durable and resulted in decrease of yield. The Polish maize varieties were resistant to sulfonylurea herbicides. They only responded to lower growth retardation and light decolorization of leaves, which did not influence on the yielding.

Table 3. Evaluation of phytotoxicity of herbicides on late maturing varieties of maize (Wrocław 2001)

Late maturing maize varieties	Evaluate of emergence	Phytotoxicity of sulfonylurea herbicides /1-9/ and damages	Yield of grain
KANZLER FAO 300	4 weak vigor of plants	4-5 growth retardation, chlorosis, necrosis, deformation of plant and leaves twisted, decolorization of plant, wrinkles	CONTROL 10.54 8.88
MAGISTER FAO 280		3-4 growth retardation, chlorosis, necrosis, deformation of plant and leaves twisted	CONTROL 11.82 10.11
KRÓL FAO 280	1-2 strong vigor of plants	2 growth retardation, decolorization of plant	CONTROL 8.79 8.01
IMAN FAO 300		1-2 growth retardation, decolorization of plant	CONTROL 10.71 9.98
LSD (0.05)			0.69

Table 4. Evaluation of phytotoxicity of herbicides on late maturing maize varieties (Wrocław 2002)

Late maturing maize varieties	Evaluate of emergence	Phytotoxicity of sulfonylurea herbicides /1-9/ and damages	Yield of grain
KANZLER FAO 300	3 weak vigor of plants	3 growth retardation, deformation of plant and leaves twisted, decolorization of plant,	CONTROL 11.93 11.54
MAGISTER FAO 280		2-3 growth retardation, deformation of plant and leaves twisted, decolorization of plant,	CONTROL 12.73 12.36
KRÓL FAO 280	1 strong vigor of plants	1-2 growth retardation	CONTROL 12.71 11.00
IMAN FAO 300		no symptoms	CONTROL 11.67 11.92
LSD (0.05)			0.78

The weather conditions in 2002 year were favorable for growth and plant development of all the maize varieties. The examined varieties responded weakly but the late foreign varieties: KANZLER and MAGISTER did not.

In the growing seasons of 2001 and 2002 the Polish varieties FIDO and WIARUS were the most resistant to sulfonylurea herbicides. The described symptoms that were detected in 2001 year were temporary and there was no effect of applied herbicides on maize varieties yield (Tabs. 1, 2).

Table 5. Weather conditions in vegetation season of 2001
Effective temperature – °C, ET*

Month	May			June			July			August			September		
	I	II	III	I	II	III	I	II	III	I	II	III	I	II	III
Decade															
Total per decade	92	99.5	117	70.5	91.5	107.5	127.5	137	27	126	168.5	126	66	63	75
Total per month	308.7			269.5			391			420.5			204		

*)ET = 0.5 (temp. max. + temp. min.) –6°

Total: 1593.7°C

Rainfall mm

Month	May			June			July			August			September		
	I	II	III	I	II	III	I	II	III	I	II	III	I	II	III
Decade															
Total per decade	3.0	9.1	24.4	16.7	43.4	25.1	18.8	68.0	97.0	69.5	0.0	18.6	33.6	30.2	24.5
Total per month	36.5			85.2			183.8			88.1			88.3		

Total: 481.9 mm

Table 6. Weather conditions in vegetation season of 2002
Effective temperature – °C, ET*

Month	April			May			June			July			August			September
	III	I	II	III	I	III										
Decade																
Total per decade	36.0	125	118.5	126	120	140.5	139	152	144.5	147	163	144.5	160	127.5	127.5	
Total per month	36.0			369.5			399.5			443.5			467.5			127.5

*)ET = 0.5 (temp. max. + temp. min.) –6°

Total: 1843.5°C

Rainfall mm

Month	April			May			June			July			August			September
	III	I	II	III	I	II	III	I	II	III	I	II	III	I	III	
Decade																
Total per decade	4.8	7.7	6.3	12.5	34.7	42.6	8.0	15.9	16.8	6.6	23.2	124.4	0.0	10.0	10.0	
Total per month	4.8			26.5			85.3			39.3			147.6			10.0

Total: 313.5 mm

CONCLUSIONS

1. In the growing seasons of 2001 and 2002 the Polish early maize varieties FIDO and WIARUS were the most resistant to sulfonylurea herbicides.
2. The late foreign varieties: KANZLER and MAGISTER responded severely to sulfonylurea herbicides displaying decolorization of leaves, wrinkles, chlorosis and deformation of plants in both years of carrying out the trials.
3. The injuries caused by the herbicide treatments on the late foreign varieties were durable and resulted in decrease of maize varieties yield.

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POLISH SUMMARY

WPLYW WARUNKÓW POGODOWYCH NA SELEKTYWNOŚĆ
HERBICYDÓW SULFONYLOMOCZNIKOWYCH DLA WYBRANYCH
MIESZANCÓW KUKURYDZY

Kukurydza należy do roślin wymagających dobrego nasłonecznienia oraz dużej sumy efektywnych temperatur w całym okresie wegetacyjnym. Istniejące na polskim rynku mieszance różnią się pod względem pochodzenia i wczesności oraz wymagań klimatycznych. Mogą one, zatem w warunkach niekorzystnego dla ich rozwoju przebiegu pogody, reagować silniej niż rodzime mieszańce na herbicydy sulfonilomocznikowe (nicosulfuron, rimsulfuron, foramsulfuron + jodosulfuron metylosodowy). W doświadczeniu przedstawiono wyniki badań przeprowadzonych w warunkach polowych nad reakcją 8 odmian kukurydzy pochodzenia krajowego i zagranicznego różniących się wczesnością i traktowanych herbicydami sulfonilomocznikowymi na tle zróżnicowanego w latach 2001–02 przebiegu pogody. Spośród porównywalnych czterech odmian wczesnych AVENUE, JANNA, WIARUS, FIDO, wyraźnie niekorzystne oddziaływanie badanych herbicydów stwierdzono w niekorzystnym dla wegetacji roku 2001 w stosunku do odmian pochodzenia zagranicznego. Podobnie późne odmiany krajowe KRÓL, IMAN, były mniej wrażliwe na działanie badanych herbicydów w roku 2001 od mieszańców pochodzenia zagranicznego. KANZLER, MAGISTER. W roku 2002 nie stwierdzono istotnych różnic między badanymi odmianami.