WEED CONTROL IN THE ROTATION SYSTEM OF FIELD CROPS

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ABSTRACT

Herbicide application in the system of wheat, maize and sunflower rotation has priority in weed control with leading crop farming cultures. The problem of herbicide residues and environment protection is connected with crop rotation. Herbicides are applied before sowing, after sowing and after germination. The obtained results speak in favour of the herbicides future in the form of microcapsules and water-soluble packages that are used in the dosage of 1 to 100 g/ha (type of rimsulphuron, primsulphuron, triasulphuron + fluoroglycopen, tribenuron), herbicides with built-in protectant (type of Trophy) or built-in genes in the genotypes as the defensive mechanism against herbicides (type of glyphosate implications are integrated weed control and enable environment preservation). During of transition they are redesignated, because the foreign investments are replaced by the knowledge as regards the intensive technology utilization.

Key words: maize, sunflower rotation, weed, wheat.

INTRODUCTION

In the next 30 years there are four important elements that will change the character of agriculture. The first, public opinion about the agricultural problems must begin from the standpoint of the modern agriculture, which is polarized and which consists of actual status of risk and damages.

The second, we must accept a substitution of existing modern technologies with compensation and subventions for environment and social welfare. The third, the changes must happen by phases without providing of completed technologies, by providing service and knowledge in its environments. By this, external investment dropped. The fourth, agricultural production must be increased with the decrease of profit and flow of funds from agricultural and individual farms.

Modern pesticide industry must offer new and efficient herbicides. Biotechnology will play, further, the complementary role. Modern products like rimsulphuron and sulfonylurea with small dosages and optimum behaviour under environmental conditions and low risk of application will substitute the old products with undesirable properties. There is a great chance for the increased use of herbicides in spite of the great increase of population.

Manpower becomes rare and extremely expensive. Because of that, we must introduce the safe products that do not require a large capital and investments in application (Palm et al., 1989; Markovic, 1987, 1993; Nelson-Smith, 1995).

MATERIALS AND METHODS

The efficiency and selectivity of herbicides in winter wheat varieties, maize and sunflower, was investigated. The trials were carried out during 1993–1996, in the area of Vojvodina (Pancevo, Zrenjanin, Novi Sad, Futog, Bajmok). Microtrials were set-up by random block system with four replications and with application of herbicides:

1. before sowing, with incorporation at the depth of 3–8 cm;
2. after sowing, and before crop germination;
3. after crop and weed germination.

Primary plot size was 25 m^2. Treatments were performed by portable sprayer CP–3 with 400 l water/ha. In the trials, the herbicides rimsulphuron, primsulphuron, dicamba, pendymethaline, fluorochloridone, mixture of chloripalide + mecoprop, acetochlorine, atrazine, EPTC with the protectant, metachlorine, linurone, prometrine, trifluraline and fluorophop-butil, were used. Susceptibility of wheat was showed over the plant structure density, dry matter weight, absolute weight and yield amount. The results are statistically processed by the method of polyfactorial trials.

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RESULTS AND DISCUSSION

Herbicides future is in the molecules with specific effects, small products and great profits. These involve the intensification of production and defensive mechanisms in wheat, maize and sunflower genotypes, on the one hand, and chemical synthesis with new way of influence, on the other hand. With the other words, it is expected the modification of herbicides substances but not herbicides obtaining from plants (Nelson-Smith, 1995). Safety of application and antiresistant strategy will be the decisive factor for the success of the new products. Herbicides amount by hectare will continue to decrease, by which the volume of the charge in nature is going to decrease (Markovic, 1987). Normally, products from 1–10 t/ha are expected. Present trend is to built in resistant genes against herbicides in some plant varieties or antidote in herbicides that protect some genotypes, what is not substitution but the change in use of epochal importance. In such a way, the producers are offered with wide spectrum of tools for simultaneous weed control with more cultures, like acetochlorine with the protectant (Trophy) in sunflower and maize.

In the area of Vojvodina, the dominant weeds in maize and sunflower crops are *Amaranthus retroflexus*, *Sorghum halepense*, *Chenopodium album*, *Setaria* spp. and *Echinochloa crus-galli*.

The largest application in this period is the eradication of wild sorghum, by which great damages to maize, producers, community and nation, are made. For the simultaneous control of sorghum from seeds and from rhizomes there are great number of herbicides, by which, as the combination of acetochlorine and rimsulphuron, technical efficacy of over 95% is realized (Table 1).

By this way, weed control is solved on the best way, in maize, but it is unavoidable the question what happened in the several past years. Modern agriculture and plant protection are polarized, do not bear the status of risks and damages, but accept the new technologies and practices at the individual and social forms, not through completed world technologies but by providing of knowledge and services in its environment. Such agricultural implications make impossible the potential damages of environment, because external inputs are replaced by knowledge and management in intensive technology and use of natural resources. This strategy must be done by qualified people and agricultural services, on the basis of the following criteria: the numerousness and dynamics of weed flora, prognoses and application of performance operations and work control.

The safety of food is the key of the development of each country (Nelson-Smith, 1995). Sunflower for oil and cattle food production belongs to the group of strategic important

Table 1. Herbicides efficiency in weed control in maize (KE %, Bajmok, Futog, Zrenjanin, Pancevo, Novi Sad)

Herbicide	Dosage kg/ha	Weeds										Visual mark (1-9)
		Chenopodium album	*Polygonum persicaria*	*Solanum nigrum*	*Xantium strumarium*	*Datura stramonium*	*Amaranhtus retroflexus*	*Setaria* spp.	*Echinochloa crus- galli*	*Cirsium arvense*	*Sorghum halepense*	
Trophy + Atrazine 50	2 1.5	100	100	100	100	97	100	90	98	56	65	1-2
Trophy + Atrazine 50 + Racer	2 1 1.5	100	100	100	89	91	100	92	100	76	65	1
Trophy + Banvel 480	2 0.7	100	100	100	100	100	100	90	90	95	56	1
Trophy + Tarot + Banvel 480	1.5 0.05 0.5	95	96	100	100	100	100	100	100	100	95	1
Dual + Atrazine	3 2	01	100	93	82	94	100	90	95	50	51	1-2
Eradicane extra + Artrazine	5 2	100	95	100	95	90	100	100	100	50	70	1
Control (no. of weeds /m^2)		20	7	4	7	9	39	15	14	6	28	9
LSD 0.05		3.4	3.8	4.	4.1	5.1	3.0	4.2	5.1	8	7.	
0.01		4.5	5.7	6.	5.9	7.2	8.1	6.0	8.2	9	8.	

crops. In the system of crop rotation of wheat, maize and sunflower, weed control is ideally solved, by the use of herbicide residues from the preceding crop for acetochlorine dosage reduction, so that, after sunflower and maize, in the next year wheat and susceptible cultures can be grown. This is an important progress in crop farming: the use of residues and the same herbicides as natural resources for better weed control in the following crops.

Nowadays, herbicides on the basis of acetochlorine, metochlorine, prometrin, linurone and fluorochloridone and the mutual combinations completely solve the question of weed control, but fluorochloridone successfully controls Canada thistle in sunflower and maize (Tables 1 and 2). *Cirsium arvense* is successfully solved by the herbicides on the basis of 2.4-D, chlopyralydone and dicamba in maize, which emphasizes the relative control of resistant weed species in the system of crop rotation. The weed species *Sorghum halepense* (wild sorghum) is successfully eliminated in sunflower using herbicides on the basis of fluaziphop and haloksyphop and enables safe production of maize without using herbicides, as well as popcorn and sweet corn, and commercial maize. Herbicides use in the system of wheat, maize and sunflower crop rotation, brings profit and environment protection (Markovic, 1993) (Tables 1 and 2).

The largest harmful effect on wheat plants over the soil show herbicides on the basis of primsulphuron metyl. So, the primsulphuron in amount of 15 and 30 g/ha, enters into the soil at 3.5 cm and causes wheat yield decrease of 37.8–39.6 % (Table 3). Application after sowing has a large contribution to biological properties of wheat and at the dosage of 30.0 g/ha, causes total decrease of both aboveground mass and yield, of 80 and 82.8% respectively. Therefore, primsulphuron at the dosages of 15.0–30.0 g/ha, causes important biological changes on winter wheat varieties, leaves, stalk and spike, dry matter decreases, which is manifested in yield decreasing of 37.8–82.8% (Table 3). If we add plant number decreases of 39.3–48.6%, it resulted that primsulphuron methyl must not be found in the soil at the aboveground parts of wheat in any amounts in order to preserve yield. Fluorochloridone, as rimsulphuron, provokes phytotoxic occurences at the aboveground and underground organs, which is reflected in yield decreases of 30%. In addition,

Table 2. Herbicides efficiency in weed control in sunflower (KE %, Bajmok, Futog, Zrenjanin)

Herbicide	Dosage kg/ha	Weeds							Visual mark (1-9)
		Sinapis arvensis	*Amarantus retroflexus*	*Chenopodium album*	*Hibiscus trionum*	*Echionochloa crus-galli*	*Setaria* spp.	*Sorghum halepense*	
Trophy + Racer	1.5 2	100	100	89	92	90	100	77	1-2
Trophy + Racer	2 2.5	100	100	100	100	95	100	79	1-2
Dual + Racer	3 3.5	99	98	94	66	99	84	71	2-3
Treflan + Racer	2 2.5	100	100	100	94	100	99	80	1-2
Trophy + Racer + Fusilade	1.5 2 1.5	100	100	85	85	100	100	100	1
Trophy + Afalon	2 2	100	90	90	90	95	95	50	2
Trophy + Prometrine	2 2	75	90	95	95	95	95	50	2
Control (no. of weeds/m^2)		91	14	19	6	7	8	20	9
	LSD 0.05	6.2	5.1	6.2	5.1	4.5	4.4	5.7	
	0.01	7.3	7.9	7.7	8.2	6.2	6.3	7.2	

Table 3. Herbicide influence on dry matter and wheat yield amount

Time of herbicide application	Herbicides	Dosage l/ha	Dry matter, g/plant				Yield
			Leaf	Stalk	Spike	Above-ground mass	
Application before sowing	Rimsulphuron	5.0	0.23	1.41	1.75	3.39	6.75
	Rimsulphuron	7.5	0.22	1.41	1.67	3.30	5.78
	Rimsulphuron	10.0	0.21	1.40	1.59	3.20	5.63
	Rimsulphuron	15.0	0.19	1.35	1.55	3.09	5.17
	Primsulphuron	15.0	0.14	0.79	1.49	2.41	3.76
	Primsulphuron	30.0	0.06	0.23	0.33	0.62	0.65
	Dicamba	336.0	0.15	0.98	1.32	2.45	5.15
	Control	-	0.18	1.14	1.54	1.86	6.04
Application after sowing and before emergence	Rimsulphuron	7.5	0.26	1.34	1.54	3.14	6.80
	Rimsulphuron	15.0	0.18	0.99	1.07	2.24	5.20
	Primsulphuron	30.0	0.06	0.19	0.29	0.55	1.04
	Control	-	0.18	1.14	1.53	2.86	5.04
Application in the leaf stage of wheat	Rimsulphuron	6.2	0.07	0.72	0.94	1.73	4.08
	Rimsulphuron	12.5	0.03	0.24	0.36	0.63	3.87
	Primsulphuron	30.0	0.06	0.31	0.49	0.86	2.59
	Fluorochloridone	625.0	0.08	0.48	0.71	1.27	4.22
	Pendimethalin	1320.0	0.15	0.98	1.28	2.40	6.26
	MCPP + chlorpyralid	1320 + 64	0.19	1.37	1.49	1.05	6.21
	2.4-D	1000.0	0.20	1.25	1.51	2.97	6.43
	Control	-	0.18	1.14	1.53	1.86	6.04
		LSD 0.05	0.05	0.18	0.24	0.23	0.53
		0.01	0.04	0.15	0.20	0.20	0.47

negative effects of dicamba and 2.4-D over the soil to the root system, dry mass and yield amount, are added, which is warning to the undesirable presence of this herbicides into the soil during the vegetative period development of winter wheat varieties. On the contrary, at the optimum phase of application, at the fifth leaf stage (the second stage), pendymethaline, 2.4-D and the mixture of mecoprop with chloropyralid do not negatively affect the yield amount or, with the other words, herbicides effect are larger than herbicides influence on the biological properties of wheat.

It was established a high dependence of herbicide application time, amount by unit of area and amount of wheat plant damage, growth reduction, dry matter decrease and yield amount. Therefore, if maize or wheat are produced in reseeding, for more consecutive years, than, the right choice in herbicides circulation establishment of appropriate crops in following year should be observed.

Nowadays, only regenerative and conservative resources of technology and practice can bring economic and ecologic benefit for producers, community and nation. Soil use and food production must be based on up-to-date technology and without or by insignificant use of external inputs. Integrated weed control in maize and sunflower is based today on the clever use of herbicides in the system of agricultural and biological measures, by use of fertilizers and biological measures on one hand, and carefully choice of resistant plants from crop rotation, with economic, ecologic and social consequences, on the other hand. This means weed control and management at the level of harmfulness threshold in agrosystem, with the aim of damage prevention and direction of weed flora dynamics in long-expected direction.

CONCLUSIONS

Nowadays the problem of weed control is successfully solved by herbicides in the system of wheat, maize and sunflower rotation. For the achievement of this aim three mutual elements are required:

The first, the using of an authentic conservative technology at the level of region and export of finished products in order to provide herbicides.

The second phase requires changes as regards, substitution or introduction of the new technologies.

The third phase involves fundamental changes in using human and physical resources.

During the transition, production should be redesigned, producers have to be in the center of technological development and studies. The work of expert services should designate the transfer of up-to-date techno-logy to the farmers.

The work of regional services represents the normal way of getting new knowledge and obligatory education of agricultural farmers with mutual use of experiences from practical application of herbicides.

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Table 1. Influence of aluminum ions, in reaction mixture, on the level of saccharasic activity in a reddish-brown soil fertilized with compost with different quantities (glucose+fructose-mg/100 g soil dw/24 hours)

A- Factor	B – Factor – COMPOST (t/ha)								Average (A)	
	b1-0	%	b2-0	%	b3-0	%	b4-0	%		%
a1–without Al^{3+}	b 3287	100	b 4028	100	b 2579	100	b 3472	100	b 3341	100
a2- with Al^{3+}	a 4228	129	a 5019	125	a 3472	135	a 4528	130	a 4312	129
Average (B)	3757 c		4523 a		3025 d		4000 b			

LD P	5%	1%	0,1%
A	291	673*	2143
B	101	142	201*
AB	302	628*	1799
BA	144*	201	284

Table 2. Influence of aluminum ions, in reaction mixture, on the level of saccharasic activity in a chernozem mineral fertilized or manured with farmyard compost (glucose+fructose-mg/100 g soil dw/24 hours)

A- Factor	B – Factor – COMPOST (t/ha)										Average (A)	
	b1-0	%	b2-$N_{32}P_{32}$	%	b3-$N_{94}P_{96}$	%	b4-$N_{128}P_{128}$	%	b5 compost	%		%
a1–without Al^{3+}	b 1564	100	b 1496	100	b 1459	100	b 1401	100	b 1732	100	b 1530	100
a2- with Al^{3+}	a 1686	108	a 1581	106	a 1684	115	a 1589	113	a 1864	108	a 1681	110
Average (B)	1625 b		1538 d		1571 c		1495 e		1798 a			

LD P	5%	1%	0,1%
A	7	17	54*
B	14	20	27*
AB	19	28	45*
BA	20*	28	39