UDC: 631.6; 632.9:633.11
Original scientific paper

EFFECTS OF LOW-INPUT TECNOLOGY ON WEED CONTROL AND YIELD OF SOME WINTER WHEAT CULTIVARS

Dušan KOVAČEVIĆ[1], Dikonije BOŽIĆ[1], Srbislav DENČIĆ[2], Snežana OLJAČA[1], Nebojša MOMIROVIĆ[1], Željko DOLIJANOVIĆ[1] and Života JOVANOVIĆ[3]

[1]Faculty of Agriculture, Zemun
[2]Scientific Institute of Field and Vegetable Crops, Novi Sad
[3]Maize Research Institut Zemun Polje, Zemun

Kovačević Dušan, Dikonije Božić, Srbislav Denčić, Snežana Oljača, Nebojša Momirović, Željko Dolijanović and Života Jovanović (2004): *Effects of low-input tecnology on weed control and yield of some winter wheat cultivars.* - Acta herbologica, Vol.13, No. 2, 393-400, Beograd.

The paper deals with the effects of low input technology on the weed number, composition, biomass and yield of different winter wheat cultivars. Low-input technology consists of the following three tillage systems: conventional tillage system, mulch tillage and no-tillage system.

Six Serbian cultivars were included in the trial. Four of them were chosen as low-input and two as intensive technology cultivars. Plots were fertilized with rational amounts of N, i.e. 60 kg/ha and 120kg/ha.

These tillage systems, and different nitrogen (N) levels and cultivars were applied in four years of crop rotation (maize-winter wheat-spring barley+red clover-red clover).

Low-input tehnology with CT systems had better effect on weed control than both conservation tillage systems. The number of weed individuals and biomass were highest in NT systems.

Corresponding author: Dušan Kovačević, Faculty of Agriculture, Nemanjina 6, 11080 Zemun, SCG

Regarding yield, low-input cultivars of winter wheat (Francuska, Pobeda, Lasta, NS Rana 5) responded more positively to the different tillage systems than high-inputcultivars (Pesma, Rana niska).

Key words: low-input technology, tillage, N fertilization, weed composition, winter wheat, cultivar, crop rotation, sustainable agriculture

INTRODUCTION

Crop production based upon high mechanical and chemical inputs (deep tillage, high fertilizer and pesticide rates, etc.) are becoming less rational because of economic and environmental problems. For current conventional systems we have focused on modification and domination of the production environment, using genetic materials that could maximize productivity from these near-ideal conditions. A significant portion of winter wheat production efforts in Serbia takes place under conventional high input conditions with cultivars which are mostly adapted to these conditions. Economic inputs have decreased and offer many possibilities for a conversion of production systems from the conventional towards low-input systems.

Conversion from conventional high-input to low-input sustainable systems requires changes in management practices (KOVAČEVIĆ *et al.*, 1997, 1998; BARBERI *et al.* 1997). Low-input technology for winter wheat for more sustainable production generally consists of reduces in tillage systems, lower levels of applied chemical fertilizers and pesticides, more diverse crop rotations, etc. Rational technology for winter wheat with all these elements, can protect soil from erosion, more effective and significantly decrease production expenses with no decrease in yield quality and quantity. New technologies combine higher flexibility of cultural practices (soil tillage, crop rotation, fertilization, integrated pest management) with proper choice of wheat cultivars adapted to these conditions. Greater adoption and refinement of low-external input (LEI) farming systems have been proposed as ways to ameliorate economic, environmental and health problems associated with conventional farming systems (LIEBMAN AND DAVIS, 2000).

Agricultural producers have invested their hopes in the development of sustainable agriculture, a concept that should rely on the breeding of low-input cultivars and cutbacks in production costs. As far as wheat is concerned, we have developed several low input cultivars (DENČIĆ, 1996; BOROJEVIĆ 1988).

The aim of this study was to elucidate the effects of cropping systems involving the combination of different input levels on the floristic composition of weed synuzia and grain yield of six Serbian winter wheat cultivars.

MATERIALS AND METHODS

The study was carried out at the Radmilovac Experimental Fields of the Faculty of Agriculture in Zemun during vegetation season from 1997/1998 to 1999/2000. The trial was located on a chernozem soil type.

The experiment was conducted under 4-yr rotations (maize-winter wheat-barley+red clover-red clover) where legumenous red clover was the nitrogen source. Maize was the preceding crop to winter wheat every year.

The following three technologies of winter wheat tillage were investigated:

1. Conventional tillage system - (CT) - traditional, classical tillage moldboard ploughing to the depth of 25 cm + pre-sowing preparation by disking and harrowing
2. Mulch tillage - (MT) - chisel ploughing to the depth of 25 cm + pre-sowing preparation by disking tools
3. No-tillage system - (NT)

The whole amounts of chopped residues where left on the ground after harvesting of maize on the MT and NT plots. Since more than 30 percent of land surface was covered with organic residues those tillage systems could be described as conservation tillage practice.

Six Serbian cultivars were included in the trial. Four of them were chosen for low- input, based on previous experience (Lasta, Pobeda, Francuska, NS Rana-5), and two for intensive technology (Rana niska and Pesma).

The main plot treatments were split into two subplot treatments: (1) no fertilizer (control) and two level inorganic fertilizer, (2) rational amounth of 60/kg/ha N, and (3) high amount of 120 60/kg/ha. N was applied in the tillering stage of growth. The plot size was six square meters with normal seeding density of 650 seeds per square meter. Investigation plots were not treated with herbicides.

Each year, weed number and biomass was assessed at the heading stage. Weed density was assessed by counting the number of plants of each species found in m^2 with four replicates.

After the harvest plant material was measured and then analysed for morphological characteristics and yield components. All data were subjected to analysis of variance.

RESULTS AND DISCUSSION

The main objective of these studies was to determine the effect of three different tillage sistems and levels of N inorganic fertilizer on the weed synuzia of winter wheat as an important segment of low-input technology in interaction with the environment.

Weed communities were the result of the applied technology and crop competition. The dominant species in weed sinuzia in winter wheat were: *Stenactis annua* (L.) Ness. from annuals, and *Agropyrum repens* (L.) Beauv. and *Convolvulus arvensis* from perennial weeds (Tab. 1). In low-input technology, conventional tillage had better efficiency as it decreased the number of perennial weeds and biomass compared with both conservation tillage systems (MT and CT). Higher nitrogen can increase the ability of cereals to suppress weeds, with the result that the number of species and biomass decline. Conservation tillage methods increase the number of perennial weeds and biomass. This tillage makes

weed control difficult (KOVAČEVIĆ *et al.*, 1997). Inorganic N fertilizers increased the number of annual weed individuals and biomass under high level fertilization. However, fertilization with high level inorganic N decreased total number of perennial weed species, but increased their biomass.

Table 1. - Effect of low input technology on the floristic composition of winter wheat weed sinuzia (Average 1997/98 - 1999/2000)

No.	Weed species	Conventional tillage			Mulch tillage			No tillage system		
		control	60 kg	120kg	control	60 kg	120kg	control	60 kg	120kg
1.	*Agropyrum repens* (L.) Beauv.	3.16	3.75	3.91	2.58	3.58	4.00	3.75	3.66	6.66
2.	*Avena fatua* L.	0.16	0.16	0.33	-	-	-	-	-	-
3.	*Bylderdykia convolvulus* L.	0.08	0.16	-	-	0.25	-	-	-	-
4.	*Capsella bursa pasteris* L. Med.	0.66	-	0.25	0.08	0.41	-	0.08	0.16	-
5.	*Chenopodium album* L.	0.41	0..91	1.00	0.33	0.58	0.41	-	0.08	-
6.	*Cirsium arvense* (L.) Scop.	1.08	1..08	1.00	1.00	0.83	0.66	0.66	1.25	0.71
7.	*Convolvulus arvensis* L.	2.33	2.50	2.00	3.08	2.58	2.25	2.58	2.66	2.83
8.	*Gallium aparine* L.	0.08	-	-	1.41	1.25	0.90	0.41	0.25	0..41
9.	*Lepidium draba* L	-	-	-	0.16	0.16	-	0.08	0.25	0.33
10.	*Matricaria chamomilla* L.	0.25	0.33	.0.33	.0.75	.0.58	0.25	0.66	0.66	0.66
11.	*Polygonum aviculare* L.	0.08	0.08	-	0.75	0.08	0.08	-	-	0.41
12.	*Polygonum lapathifolium* L.	0.66	1.41	1.66	-	0.50	0.16	0.16	-	-
13.	*Ranunculus arvensis* L.	-	-	-	-	-	-	0.08	-	0.16
14.	*Sinapis arvensis* L.	0.08	0.75	0.75	-	-0.25	-	-	-	
15.	*Sonchus oleraceus* L.	-	0.08	0.08	-	-	0.16	-	0.16	0.16
16.	*Sonchus arvensis* L.	-	-	-	0.16	0.08	0.25	0.16	0.16	-
17.	*Stenactis annua* (L.) Ness.	0.08	0.16	0.16	0.58	0.16	0.66	0.83	0.83	0.83
18.	*Veronica arvensis* L.	-	0.16	-	0.16	0.25	0.58	-	0.33	
	Total number individuals of weeds	9.11	11.70	11.47	11.04	11.29	10.61	9.45	10.45	13.16
	Number annual weeds	10	10	7	7	9	9	6	7	7
	Number perennial weeds	3	3	4	5	5	4	5	5	3
	Biomass gr/m^2	19.57	30.78	34.35	31.52	34.15	22.05	44.34	42.28	47.21

Table 2. - Effect of low input tecnology on grain yield of winter wheat cultivars (t/ha^{-1})

Tillage systems (A)	N level (B)	Cultivars (C)						Average B	Low-input cv.	High-input cv.
		Francuska	Lasta	Pobeda	NS Rana 5	Pesma	Rana niska			
	control	3.206	3.519	3.367	3.124	3.096	2.902	3.234	3.304	3.096
CT	60 kg/ha	4.250	4.520	4.534	4.043	3.877	3.621	4.183	4.336	3.877
	120 kg/ha	5.294	5.270	4.756	4.945	4.511	4.372	4.881	5.066	4.511
	Average	4.250	4.436	4.219	4.037	4.025	3.828	4.099	4.235	3.828
	control	3.325	3.502	3.128	3.187	2.936	2.857	3.169	3.285	2.936
MT	60 kg/ha	4.595	4.111	3.761	3.830	3.501	3.347	3.883	4.074	3.501
	120 kg/ha	4.772	4.848	5.429	4.963	4.499	4.333	4.835	5.003	4.499
	Average	4.230	4.153	4.106	3.993	3.779	3.645	3.962	4.120	3.645
	control	2.817	2.876	2.870	2.936	2.870	2.684	2.873	2.549	2.870
NT	60 kg/ha	3.675	3.370	3.239	3.963	3.323	3.203	3.482	3.561	3.323
	120 kg/ha	4.802	4.332	4.749	4.617	3.757	3.469	4.335	4.625	3.757
	Average	3.764	3.526	3.619	3.838	3.515	3.316	3.549	3.686	3.316
	control	3.116	3.299	3.121	3.082	2.967	2.814	3.006	3.046	2.967
(BC)	60 kg/ha	4.173	4.000	3.844	3.945	3.567	3.390	3.778	3.990	3.567
	120 kg/ha	4.956	4.816	4.978	4.841	4.256	4.058	4.577	4.898	4.256
	(C)	4.081	4.038	3.981	3.956	3.773	3.596	3.787	4.013	3.596
	%			4.957			3.716			

LSD_A 0.05 0.075 LSD_B 0.05 0.075 LSD_C 0.05 0.107 LSD_{AC} 0.05 0.185
0.01 0.100 0.01 0.100 0.01 0.143 0.01 0.246

LSD_{AB} 0.05 0.131 LSD_{BC} 0.05 0.131 LSD_{ABC} 0.05 0.321
0.01 0.174 0.01 0.174 0.01 0.425

Grain yield results of winter wheat (Tab.2) showed high positive reaction of low-input cultivars (Lasta, Francuska, Pobeda and NS Rana 5) to reduction in tillage systems and level of inorganic N fertilizers, compared with cultivars for

high-input condition (Pesma and Rana niska) which gave significantly lower grain yield in that condition. IN technology with conservation tillage systems (MT and NT), which had crop residue on the soil surface, also generally gave statistically lower grain yield. On the other hand, CT system with rational N level (60 kg ha^{-1}) and high level (120 kg ha^{-1}) exibited better soil conditions and weed control, especially perennials, and gave a higher grain yield. Yield reductions in the technology of conservation tillage systems (MT and NT) were found to be associated with some soil and machinary problems specific to the location. Our results disagreed with earlier conclusions raported by KONSTATINOVIĆ (1982). According to the results obtained on the chernozem soil type, there were no significant differences in wheat yields in reduced tillage compared with conventional tillage.

The results of our investigation show that yield was lower 3.35% in MT and 13.42% in both conservation tillage systems than under conventional tillage practice (100%). The yields in NT system are distinctly lower. This is partly caused by the usually less regular germination in the rough and compacted seedbed of untilled soil.

Amounts of inorganic nitrogen as main factors have effect on the grain yield of winter wheat. Grain yield increased with the level of inorganic nitrogen, especially in CT.

Both groups of cultivars have higher yield in interactions with conventional tillage systems. In winter wheat, the technology of conservation tillage systems signifficantly decreases grain yield, compared with conventional tillage system. Tillage, N level, and cultivars as the main factors in low-input technology show significant differences.

CONCLUSION

Regarding the investigated effects of low-input technology on weed composition and grain yield of winter wheat on chernozem-luvic soil type, the following conclusions are suggested:

Low-input technology which includes conservation tillage, especially no-tillage system, increased the number of perennial weeds and their biomass.

Low-input cultivars positively responded to reduces in tillage systems, and level of inorganic nitrogen fertilizer.

Growing practice involving a certain reduction in tillage and N fertilizers, and weed control is more favorable for low-input cultivars (Lasta, Pobeda, Francuska, NS Rana 5), whose yield positively responded, compared to high-input cvs. This fact shows the significance that cultivar choice has in winter wheat low-input techology .

REFERENCES

BARBERI, P., SILVESTRI, N., BONARI, E. (1997): Weed communities of winter wheat as influenced by input level and rotation. Weed Research, 37: 301-313.

BOROJEVIĆ, S. (1998): Breeding Field Crop Cultivars for Next Century. Proceedings of 2nd Balkan Symposium on Field Crops. Novi Sad, 1: 3-9.

DENČIĆ, S. (1996): Pravci i perspektive u oplemenjivanju pšenice. Zbornik radova. XXX seminar agronoma, Institut za ratarstvo i povrtarstvo, Novi Sad, 25: 237-248.

KONSTANTINOVIĆ, J. (1982): Uporedna ispitivanja klasične, minimalne obrade i direktne setve bez obrade na fizičke osobine zemljišta, razvoj i prinos ozime pšenice i kukuruza u dvopolju. Savremena poljoprivreda, 1-2: 1- 86.

KORRES, E.N., FROUD-WILLIAMS (2002): Effects of winter wheat cultivars and seed rate on the biological characteristics of naturally occuring weed flora. Weed Research, 42: 417-428.

KOVAČEVIĆ, D., OLJAČA S., OLJAČA, M., BROĆIĆ, Z., RUŽIČIĆ, L., VESKOVIĆ, M., JOVANOVIĆ, Ž (1997): Savremeni sistemi zemljoradnje: Korišćenje i mogućnosti za očuvanje zemljista u konceptu održive poljoprivrede. Uređenje, korišćenje i očuvanje zemljišta. Zbornik radova, IX kongres JDPZ, Novi Sad, 101-113.

KOVAČEVIĆ, D., MOMIROVIĆ, N., BROĆIĆ, Z., OLJAČA, S., RADOŠEVIĆ, Ž., RAIČEVIĆ V. (1997): Uticaj sistema obrade zemljišta i đubrenja na zakorovljenost ozime pšenice. Acta herbologica, 6 (2): 69-82.

KOVAČEVIĆ, D., DENČIĆ, S., KOBILJSKI, B., MOMIROVIĆ, N., OLJAČA S. (1988): Effect of Farming System on Dynamics of Soil Physical Properties in Winter Wheat. Proceedings of 2nd Balkan Symposium on Field Crops. Novi Sad, 2: 313-317.

LIEBMAN, M., DAVIS, S.A. (2000): Integration of soil, crop and weed management in low-external-input farming systems. Weed Research, 40: 27-47.

Recieved March 25, 2004
Accepted April 10, 2004

UTICAJ TEHNOLOGIJE NIŽIH ULAGANJA NA KONTROLU KOROVA I PRINOS NEKIH SORATA OZIME PŠENICE

Dušan KOVAČEVIĆ[1], Dikonije BOŽIČ[1], Srbislav DENČIČ[2], Snežana OLJAČA[1], Nebojša MOMIROVIĆ[1], Željko DOLIJANOVIĆ[1] i Života JOVANOVIĆ[3]

[1]Poljoprivredni fakultet, Zemun
[2]Naučni institut za ratarstvo i povrtarstvo, Novi Sad
[3]Institut za kukuruz Zemun Polje, Zemun

Izvod

U radu je ispitivan uticaj tehnologije nižih ulaganja na broj, floristički sastav, biomasu korova i prinos ozime pšenice. Tehnologija nižih ulaganja sastoji se od tri sistema obrade zemljišta: konvencionalnog, zaštitnog i sistema direktne setve tj. bez obrade zemljišta.

Redukcija u obradi, a naročito njeno izostavljanje, dovodi između ostalog do povećanja broja i mase korova, naročito višegodišnjih.

U ispitivanje je bilo uključeno šest srpskih sorti ozime pšenice. četiri od njih su zbog svojih osobina odabrane kao sorte za niža ulaganja i dve kao sorte za visoka ulaganja. U ispitivanje su bile uključene različite količine azota u prihranjivanju, racionalna 60 kg/ha N i veća od 120 kg/ha.

Sistemi obrade zemljišta, količina N u prihranjivanju i različitim sortama uključeni su u četvoropoljni plodored (kukuruz-pšenica-jari ječam+crvena detelina-crvena detelina).

Primenjena tehnologija sa konvencionalnom obradom imala je bolji uticaj na kontrolu zakorovljenosti useva ne toliko po broju već po dobijenoj manjoj biomasi korova.

Sorte ozime pšenice namenjene nižim ulaganjima pozitivno odgovaraju na redukovane uslove obrade zemljišta i smanjene količine azota.

Proizvodnja pšenice u redukovanim uslovima obrade, đubrenja i izostanku zaštite od korova bila je mnogo povoljnija za sorte nižih ulaganja (Lasta, Pobeda, Francuska, NS Rana 5) koje su dale veći prinos u poređenju sa intenzivnim sortama (Pesma, Rana niska). Ova činjenica pokazuje koliko je važan izbor sorte za tehnologije različitog intenziteta gajenja, posebno onu sa nižim ulaganjima.

Primljeno 25. marta 2004.
Odobreno 10. aprila 2004.