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Original scientific paper

EFFECTS OF CROP DENSITY AND HERBICIDE APPLICATION ON FLORISTIC COMPOSITION AND STRUCTURE OF MAIZE WEED COMMUNITY

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Effects of crop density and herbicide application on distribution of weed species within maize weed community in the location of Zemun Polje were studied. During the maize growing season in 1996 and 1997, floristic composition and structure of weed community were surveyed. Furthermore, number of species, number of plants per species and fresh weight of all weeds per area unit over all densities in both, treated and non-treated variants, were also determined. Changes, occurring under effects of higher maize crop densities and herbicide application, were analysed on the basis of distributed weed species and their plants per species. Moreover, relative distribution of certain weed groups was determined. Significant effects of crop density x herbicide application interaction were observed in reduction of relative distribution of certain broad leafed and perennial weeds within total maize weediness at Zemun Polje.

Key words: maize, weed association, weed species, herbicide application

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INTORODUCTION

Weed communities of agri-ecosystems, especially of row crops, such as maize, are very dynamic and changeable. According to floristic phytocenolic studies of KOJIĆ (1975), ŠINŽAR and DEJOVIĆ (1975) it can be concluded that the row crop weed association Hibisco-Eragrostietum megastachuae Tx 1950 of the alliance Eragrostion Tx. 1950 prevalis in maize crop at the location of investigation. The following species are the most distributed in this association: *Hibiscus trionum, Chenopodium album, Anagalis arvensis, Portulaca oleracea, Amaranthus retroflexus, Solanum nigrum, Convolvulus arvensis, Digitaria sanguinalis, Setaria glauca, Cirsium arvense, etc.* (KOJIĆ and ŠINŽAR, 1985). Although broad leafed weeds, regarding their spread and distribution, prevail in maize crop, a special place in weed communities of this crop belongs to weeds of the family Poaceae, whose distribution has been increased by the long-standing application of herbicides (STEFANOVIĆ and ŠINŽAR, 1992).

Various measures, from preventive to direct (crop rotation, tillage, herbicide application, etc.), are taken in order to control weeds in maize growing (STOJAKOVIĆ *et al.,* 1980; BOŽIĆ, 1980; LOZANOVSKI *et al.*, 1980). The long-standing application of herbicides, has been the most important and main measure of weed control in maize crop. Beside high efficiency in weed control, this measure can lead to many adverse consequences among which the following ones are the most important: alteration of floristic composition and structure of weed communities, spreading of resistant, and especially perennial weed species of the family Poaceae, occurrence of weed species resistant to applied herbicides, detrimental effects on grown plants, accumulation of herbicides and their residues in soil, water and plant parts (LOZANOVSKI *et al,* 1980; ŠINŽAR *et al.,* 1988; AJDER, 1991, SEILER *et al.*, 1992; ŠINŽAR and STEFANOVIĆ, 1993; STEFANOVIĆ *et al.*, 1994). In recent times, in order to avid adverse effects of herbicide application, employment of several measures in weed control, i.e. integrated weed management, has been recommended (SWANTON and WEISE, 1991, 1996; KOVAČEVIĆ and MOMIROVIĆ, 1996). This system implies not only chemical control but also combined employment of all measures that lessen weed abundance, but do not decrease maize yield and do not endanger environment (SWANTON and WEISE, 1996).

Maize growth at the optimum or slightly higher crop density, with no gaps, can greatly contribute to the weed coverage decrease and mitigation of yield reduction due to weed distribution (WALKER and BUCHANAN, 1982; SWANTON and WEISE, 1991). Production technology measures, such as narrow row spacing when genotypes "tolerating" higher density are grown, are based on better utilisation of light by the crop and prevention of weed resurgence (YELVERTON and COBLE, 1991; HOLT, 1995). Morphological and physiological adjustment of crops pertaining to responses to light is the next potential way of control of a crop/weed relationship. It particularly relates to elimination of weed species that are very competitive for light and that cannot develop under conditions of "narrower maize plant spacing". Results obtained by VIDENOVIĆ and STEFANOVIĆ (1994) indicate that the increased maize sowing density can lessen maize weediness by even 22.9 %. According to TOLLENAAR *et al.* (1994) the maize density increase from 4 to 10 plants m-2 results in the weed biomass decrease from 63% to 50%, i.e. 71% to 39% in mid growing season, i.e. at the end of growing season, and due to it maize competitiveness increases with the sowing density increase in comparison to weeds. Naturally, crop density alone, as a cropping practice, affecting reduction of weediness is not sufficient. This measure has its full application and meaning only if it is a part of the integrated weed management.

Considering that maize growth at optimum, higher or lower sowing density can affect weed distribution in this crop, detail studies on effects of different maize sowing densities on floristic composition and structure of maize wed community with and without herbicide application were carried out.

MATERIAL AND METHODS

The 4-replicate trials, with winter wheat as a preceding crop, were carried out on the experimental field of the Maize Research Institute, Zemun Polje, on slightly calcareous chernozem during 1996 and 1997. The level of weed infestation was observed at the following crop densities: 40,816 plants ha-1 (D1), 69,686 plants ha-1 (D_2) and 98,522 plants ha^{-1} (D_3). Inter-row spacing of 70 cm was equal for all three densities. The combination of herbicides atrazine-500 + Dual 720-EC in the amount of 1.0 and 2.88 l active substance ha-1 after planting but prior emergence was applied in the treated variant (T). Herbicides were not applied in the control variant (C).

The weed community composition was analysed in both years. Weed distribution was determined in each density in both treated and control variant. The number of weed species, as well as, the number of their plants were determined per square meter. Then, fresh weight of each weed species individually was determined but cumulative values over particular weed groups were presented. Finally, a relive distribution (%) of plants and fresh weight of particular weed groups (broad leafed, grass, annual and perennial species) in total weediness was analysed. Distribution of each weed group over densities was compared with the total number of their plants or total fresh weight at the lowest density D_1 (100.0%) for each year independently. Grain yield (t ha^{-1}) was determined in each variant at the end of maize growing season and presented with 14% moisture. Obtained data were statistically processed by the factorial analysis of variance, while mean differences were tested by LSD- and t-test.

Meteorological conditions

The average monthly air temperature for the growing period in both years (18.2 ^oC and 18.0 ^oC) did not significantly differ from the long term mean (18.1 ^oC), (Table 1).

Table 1. - Meteorological conditions during maize growing season in 1996 and 1997

Years	Months						$\overline{X}$
	IV	V	VI	VII	VIII	IX	
	Air temperatures (°C)						
Long-term average	11.4	16.7	19.9	21.7	21.2	17.4	18.1
1996.	12.1	19.0	21.5	21.1	21.6	13.8	18.2
1997.	8.3	18.7	21.8	21.4	21.6	16.0	18.0
	Precipitation (mm)						
Long-term average	49.1	62.3	80.1	62.4	50.6	43.5	348.0
1996.	44.6	74.3	72.3	29.0	75.3	98.7	394.2
1997.	87.0	51.0	31.0	131.0	103.0	31.2	434.2

Amounts of rain in the growing period during the investigation years (394.2 mm and 434.2 mm) were above the long-term mean. However, their distribution significantly differ over years. Hence, in 1996, there was only 29.0 mm of rain in July, mid of growing season, which is significantly lower than the long-term mean (62.4 mm). On the other hand, in 1997, the corresponding amounts were 131.0 mm or two fold-higher than the long-term mean for July.

RESULTS AND DISCUSSION

In 1996, 23 weed species with 83.9 plants per m2 were detected in the control variant with the lowest crop density (D_1). The greater density was the lower number of weeds and their plants per m^2 were (Table 2).

Hence, the average number of weeds and their plants m-2 in the density D2, i.e. D3 amounted to 17 and 65.8 m-2, i.e. 14 and 61.3 m-2, respectively. This trend is even more observable under conditions of herbicide application: the greater density was the lower total number of weed plants was - D_1 (47.3 plants m^{-2}), D_3 (24.4 plants m^{-2}). This decrease amounted to 48.4%. In 1996, the following species prevailed: Amaranthus albus, Solanum nigrum and Amaranthus retroflexus (annual species) and Cirsium arvense and Convolvulus arvensis (perennial species). The following species, detected in the lowest density (D_1), were not observed in the density D_2: Senecio vulgaris, Panicum crus-galli, Conolvulus sepium, Stachys annua, Reseda lutea, Abutilon theophrasti and Lamimum purpureum. Beside mentioned species, the following ones were detected in the highest density (D_3): Sonchus oleraceus, Anagallis arvensis and Amaranthus blitoides. Almost all stated weed species have index 4 as a parameter for light. It displays their great light demands, due to which longer periods of shading in greater densities are unfavourable for their development (LANDOLT, 1997). This can serve as an explanation why they were not distributed in maize crops of higher densities, where narrower plant spacing reduced amounts of light penetrating to lower strata in the community. Higher crop densities in 1996 did not lead to the decrease of neither weed plants nor fresh weight per m^2 of the species Digitaria sanguinalis. Only when herbicides were applied the number of weed plants decreased with the maize density increase.

Table 2. - Floristic and quantitative changes within maize weed association in relation to crop density and herbicide application in 1996

LF	Weed speices	Control G_1	G_2	G_3	Treated G_1	G_2
T	*Amaranthus albus* L.	13.8	15.5	13.3	5.3	4.8
T	*Solanum nigrum* L.	15.5	13.3	10.3	8.3	5.5
T	*Amaranthus retroflexus* L.	14.2	10.8	9.3	3.2	3.7
G	*Cirsium arvense* (L.) Scop.	10.2	6.3	8.0	9.3	2.7
G	*Convolvulus arvensis* L.	6.7	5.2	4.7	6.0	3.8
T	*Hibiscus trionum* L.	4.0	4.5	2.3	1.8	0.7
T	*Chenopodium hybridum* L.	5.0	2.2	1.8	1.2	1.7
G	*Sorghum halepense* (L.) Pers.	3.8	2.3	2.2	3.0	1.8
T	*Datura stramonium* L.	3.3	1.2	2.8	1.7	0.3
T	*Digitaria sanguinalis* (L.) Scop.	0.8	2.2	3.7	6.3	5.2
T	*Portulaca oleracea* L.	1.5	0.7	1.7	0.3	0.2
G	*Sonchus arvensis* L.	1.3	0.5	0.7	-	-
T	*Chenopodium album* L.	0.5	0.3	0.2	0.2	-
T	*Senecio vulgaris* L.	0.7	-	-	-	-
T	*Panicum crus-galli* (L.)R et Sch.	0.5	-	-	-	-
G	*Convolvulus sepium* (L.) R.Br.	0.5	-	-	-	-
T	*Sonchus oleraceus* (L.) Gou.	0.3	0.2	-	-	-
T	*Stachys annua* L.	0.2	-	0.3	-	0.2
T	*Anagallis arvensis* L.	0.2	0.2	-	-	-
T	*Sinapis arvensis* L.	0.2	0.2	-	-	-
T	*Reseda lutea* L.	0.3	-	-	-	-
T	*Abutilon theophrasti* Medik.	0.2	-	-	0.2	-
T	*Amaranthus blitoides* S.Watson	-	0.2	-	-	-
T	*Lamium purpureum* L.	0.2	-	-	-	-
T	*Heliotropium europaeum* L.	-	-	-	0.5	-
Total number of weed species		23	17	14	14	12
% of total number of weed species		100.0	73.9	60.9	100.0	85.7
Total number of weed plants per species (number m^{-2})		83.9	65.8	61.3	47.3	30.6
% of total number of we ed plants per species		100.0	78.4	73.1	100.0	64.7
Total fresh weight of weeds (g m^{-2})		1746.8	1319.6	1043.3	413.7	183.0
% of total fresh weight of weeds		100.0	75.5	59.7	100.0	44.2

Effects of higher maize crop density under conditions with and without herbicide application were even more conspicuous in the decrease of fresh weight of distributed weed species. The total fresh weed weight decreased by 40.3% (from 1746 g m^{-2} to 1043.3 g m^{-2} in the density D_1 i.e. the density D_3, respectively) under conditions without herbicide application. The decrease of the total weed fresh weight was even more expressed in the treated variant (66.4% - from 413.7 g m^{-2} in the density D_1 to 139.1g m^{-2} in the density D_3). Such a great decrease of weed weight speaks in favour of the combined application of chemical measures and cropping practices in weed control in maize crops.

Table 3. - Relative distribution of weed plants of certain species (%) over observed crop densities in 1996

Number of weed plants per m^2	Control G_1	Control G_2	Control G_3	Treatment G_1	Treatment G_2	Treatment G_3
Total	83.9	65.8	61.3	47.3	30.6	24.4
Broad leafed species	78.8	61.3	55.4	38.0	23.6	18.6
Narrow leafed species	5.1	4.5	5.9	9.3	7.0	5.8
Annual species	61.4	51.5	45.7	29.0	22.3	19.5
Perennial species	22.5	14.3	15.6	18.3	8.3	4.9
%						
Total	100.0	78.4	73.1	100.0	64.7	51.6
Broad leafed species	93.9	73.1	66.0	80.3	49.9	39.3
Narrow leafed species	6.1	5.3	7.1	19.7	14.8	12.3
Annual species	73.2	61.4	54.5	61.3	47.1	41.2
Perennial species	26.8	17.0	18.6	38.7	17.5	10.4

Table 4. - Relative distribution of fresh weight of certain weed groups (%) over observed crop densities in 1996

Fresh weight (g m^{-2})	Control G_1	Control G_2	Control G_3	Treatment G_1	Treatment G_2	Treatment G_3
Total	1746.8	1319.6	1043.3	413.7	183.0	139.1
Broad leafed species	1640.3	1210.4	923.8	304.7	113.1	75.3
Narrow leafe species	106.5	109.2	119.5	109.0	69.9	63.8
Annual species	1422.3	1045.0	848.3	271.8	127.6	92.1
Perennial species	324.5	274.6	195.0	141.9	55.4	47.0
%						
Total	100.0	75.5	59.7	100.0	44.2	33.6
Broad leafed species	93.9	69.3	52.9	73.7	27.3	18.2
Narrow leafed species	6.1	6.2	6.8	26.3	16.9	15.4
Annual species	81.4	59.8	48.6	65.7	30.8	22.3
Perennial species	18.6	15.7	11.1	34.3	13.4	11.3

Results on effects of maize densities on changes of the number of plants of certain weed groups in 1996 are presented in Table 3. The maize density increase (from D_1 to D_3) resulted in relative lowering of the number of plants of broad leafed weed species by 23.9% (from 93.9% to 66.0%), i.e. 41.0% in non-treated i.e. treat variant, respectively. The higher crop density was the greater reduction of annual and perennial weed species was in both treated and non-treated variants. The application of herbicides alongside with cropping practices led to lowering of a relative distribution of narrow leafed weed species which was not detected in variants without herbicide application.

Relative distribution of fresh weight of certain weed groups in the total weediness in 1996 (Table 4) illustrates even better changes of floristic composition and structure of weed community in dependence on maize densities. The table shows that the increase of maize densities had even greater effect on lowering fresh weight of narrow leafed weeds under conditions of herbicide application.

Table 5. - Floristic and quantitative changes within maize weed association in relation to crop density and herbicide application in 1997

		Control			Treated		
LF	Weed speices	G_1	G_2	G_3	G_1	G_2	G_3
T	*Chenopodium hybridum* L.	29.2	22.0	29.7	6.0	5.5	2.8
T	*Solanum nigrum* L.	26.8	22.6	19.3	4.0	3.0	1.2
T	*Amaranthus retroflexus* L.	22.0	19.0	16.5	2.3	1.5	0.5
G	*Convolvulus arvensis* L.	9.3	7.2	6.8	10.0	9.8	9.0
T	*Stachys annua* L.	10.5	8.3	3.7	0.5	0.7	-
T	*Amaranthus albu s* L.	8.7	6.7	5.5	0.2	0.3	0.2
T	*Chenopodium album* L.	6.8	5.5	6.5	0.5	0.7	0.3
T	*Datura stramonium* L.	5.3	6.5	4.5	2.0	2.8	0.8
G	*Cirsium arvense* (L.) Scop.	3.8	1.7	7.2	2.5	8.0	1.5
G	*Convolvulus sepium* (L.) R.Br.	4.2	5.7	2.0	1.0	0.7	0.7
T	*Digitaria sanguin alis* (L.) Scop.	2.7	3.0	2.2	0.5	0.3	0.2
T	*Hibiscus trionum* L.	2.5	0.8	2.2	1.7	0.2	0.7
T	*Anagallis arvensis* L.	3.0	3.7	1.2	-	-	-
T	*Portulaca oleracea* L.	1.3	0.7	1.0	-	0.2	-
G	*Sorghum halepense* (L.) Pers.	1.0	1.2	0.3	1.0	0.5	0.8
T	*Panicum crus-galli* (L.) R.et Sch.	0.5	0.2	0.3	-	-	-
T	*Sinapis arvensis* L.	0.5	0.3	-	-	-	-
T	*Setaria glauca* (L.) Beauv.	0.3	0.2	0.3	-	-	-
T	*Bilderdykia convolvulus* (L.) Dum.	0.2	-	0.3	-	-	-
T	*Stellaria media* (L.) Vill.	0.5	-	-	-	-	-
G	*Sonchus arvensis* L.	-	0.3	-	-	-	-
T	*Setaria verticillata* (L.) P.B.	-	-	0.3	-	-	0.2
T	*Heliotropium europaeum* L.	0.3	-	-	-	0.2	-
T	*Ambrosia artemisiifolia* L.	0.2	0.2	-	0.2	-	-
T	*Setaria viridis* (L.) Beauv.	-	0.2	0.2	-	-	-
T	*Sonchus asper* (L.) Hill	0.3	-	-	-	-	-
T	*Resead lutea* L.	0.2	-	-	-	-	-
T	*Amaranthus blitoides* S. Watson	0.2	-	-	-	-	-
T	*Abutilon theophrasti* Medik.	-	-	0.2	0.3	-	0.5
G	*Taraxacum officinale* Web.	0.2	-	-	-	-	-
T	*Polygonum aviculare* L.	0.2	-	-	-	-	-
Total number of weed species		27	21	21	15	15	14
% of total number of wee d species		100.0	77.8	77.8	100.0	100.0	9.3
Total number of weed plant per species (number m^{-2})		140.7	116.0	110.2	32.7	34.4	19.4
% of total number of weed plant per species		100.0	82.4	78.3	100.0	1.5.2	59.3
total fresh weight of weeds (g m^{-2})		1834.7	1075.1	807.2	283.7	179.9	123.3
% of total fresh weight of weeds		100.0	58.6	44.0	100.0	63.4	43.5

In 1997 due to greater precipitation and their better distribution, a greater number of species and plants per species occurred in the experimental plot (Table 5). The maize crop density increase showed the similar trend as in 1996: the number of species, their individual plants and fresh weight of weeds per m^2 decreased under conditions with and without herbicide application. Hence, the total number of weed plants per speices lowered to 21 in D_2 and D_3 and to 27 in D_1 in comparison with the control variant. The number of distributed species under conditions without herbicide application and higher maize crop densities decreased from 140.7 to 110.2 plants per m2 or by 21.7%. The corresponding values under conditions with herbicide application decreased from 32.7 to 19.4 plants per m^2 or by 40.7%. The annual species *Chenopodium hybridum, Solanum nigrum, Amaranthus retroflexus*, as well as, the perennial species Convolvulus arvensis prevailed. The following species failed to appear with the increase of crop density from D_1 to D_2: *Bilderdykia convolvulus, Heliotropium europaeum, Stellaria media, Sonchus asper, Reseda lutea, Amaranthus blitoides, Taraxacum officinale* and *Polygonum lapathifolium. Furthermore*, neither the variety Sonatas arvensis nor the variety *Ambrosia artemisiifolia* were observed in the highest crop density D_3. The analysis of the distributed species showed that although these varieties had differed from those in 1996, light demands of the majority was great and had index 4 as a parameter for light. In 1997, the crop density increase had no effects on reduction of the number of plants of species *Cirsium arvense*.

The increase of crop density in 1997 led to the decrease of the total fresh weight of weeds under conditions without herbicide application by 56%, i.e. from 1834.7 g m^{-2} in D_1 to 807.2 g m^{-2} in D_3. The corresponding values in the variant with herbicide application amounted to 56.5% (decreased from 283.7 g m^{-2} in D_1 to 123.3 g m^{-2} in D_3).

Table 6. - Relative distribution of weed plants of certain species (%) over observed crop densities in 1997

Number of weed plants per m^2	Control			Treated		
	G_1	G_2	G_3	G_1	G_2	G_3
Total	140.7	116.0	110.2	32.7	34.4	19.4
Broad leafed species	136.2	111.2	106.6	31.2	33.6	18.2
Narrow leafed species	4.5	4.8	3.6	1.5	0.8	1.2
Annual species	122.2	99.9	93.9	18.2	15.4	7.4
Perennial species	18.5	16.1	16.3	14.5	19.0	12.0
%						
Total	100.0	82.4	78.3	100.0	105.2	59.3
Broad leafed species	96.8	79.0	75.8	95.4	102.7	55.7
Narrow leafed species	3.2	3.4	2.5	4.6	2.5	3.6
Annual species	86.8	71.0	66.7	55.7	47.1	22.6
Perennial species	13.2	11.4	11.6	44.3	58.1	36.7

Table 6 presents distribution of certain weed groups expressed through the number of plants m^{-2} over maize densities under conditions with and without herbicide application.

Presented results point out to deviation in reduction of both, the total number of plants and number of broad leafed weed species occurring with the crop density increase - in density D_2 a number of plants of all weed species is higher by 5.2% and the number of plants of broad leafed species is higher by 2.7% in comparison to D_1. However, the number of plants of these weed groups in the highest density D_3, is significantly lower than in D_1. In 1997, total fresh weight over weed groups regularly reduced in D_2 and D_3 in relation to D_1 (Table 7).

Table 7. - Relative distribution of fresh weight of certain weed groups (%) over observed crop densities in 1997

Fresh weight (g m^{-2})	Control G_1	Control G_2	Control G_3	Treated G_1	Treated G_2	Treated G_3
Total	1834.7	1075.1	807.2	283.7	179.9	123.3
Broad leafed species	1785.5	1037.1	780.6	246.8	166.8	111.4
Narrow leafed species	49.2	38.0	26.6	36.9	13.1	11.9
Annual species	1643.6	911.6	705.4	162.6	66.6	27.6
Perennial species	191.1	163.5	101.8	121.1	113.3	95.7
%						
Total	100.0	58.6	44.0	100.0	63.4	43.5
Broad leafed species	97.3	56.5	42.5	87.0	58.8	39.3
Narrow leafed species	2.7	2.1	1.5	13.0	4.6	4.2
Annual species	89.6	49.7	38.4	57.3	23.5	9.7
Perennial species	10.4	8.9	5.6	42.7	39.9	33.8

In 1997, the crop density increase positively affected reduction of fresh weight of narrow leafed and perennial weeds under conditions with and without herbicide application.

Maize grain yield increased with higher crop densities in both variants, but especially in the treated one, in both years, 1996 and 1997 (Tables 8 and 9).

Table 8. - Effects of maize crop densities and herbicide application on grain yield (t ha^{-1}) in 1996

Herbicide application	Maize crop density G_1	G_2	G_3	$\bar{X}$
T	8.44	9.02	9.94	11.14**
K	10.37	11.08	11.96	9.13**
$\bar{X}$ LSD $_{0.05}$= 0.8582	9.41^b	10.05^b	10.95^a	$t_{0.01}$= 5.464

Statistically significant differences in maize grain yield were determined among observed densities and treated and control variants in both investigation years. In 1997, the density x herbicide application interaction statistically significantly affected maize grain yield (Table 9).

Table 9. - Effects of maize crop densities and herbicide application on grain yield (t ha^{-1}) in 1997

Herbicide application	Maize crop density			$\overline{X}$
	G_1	G_2	G_3	
T	8.39^{c}	10.72^{b}	11.35^{ab}	12.07**
K	11.25^{ab}	13.12^{a}	13.21^{a}	10.18**
		LSD $_{0.01}$= 2.039		
$\overline{X}$ LSD $_{0.01}$= 1.212	9.82^{b}	11.92^{a}	12.28^{a}	t $_{0.01}$= 4.228

A clearly expressed dry spell during maize growing season in 1996 adversely affected growth and development of certain weed species. On the other hand, well-hydrated conditions in mid growing season in 1997 favoured the crop and especially weeds in it. The analysis of results on effects of higher maize crop densities on floristic composition and structure of weed community in both years of investigation points out to justification of application of this measure in weed control. Maize weed community in the investigated location has been getting more and more terophytic and geophytic with ever greater participation of both annual and perennial species of the family Poaceae (ŠINŽAR *et al.*, 1996). The greater maize crop density was the lower number of weed species, as well as, the number of plants per species and weed fresh weight were in both variants (treated and control) over both years of investigation. Weed distribution under observed conditions of maize growth was reduced due to both inter- and intraspecies competition. In other words, crop itself, but also, other weeds compete with each weed species under conditions of increased crop density. The increased maize crop densities affect the amount of light striking weeds and by it affects their development (WALKER *et al.,* 1988; TETIO-KAGHO, 1988; TOLLENAAR *et al.*, 1992; MOHLER and CALLOWAY, 1992). Gained results point out that increased crop density did not affect equally all weed species. Hence, higher crop densities in 1996 did not lead to the decrease of neither weed individuals nor fresh weight per m^2 of the species *Digitaria sanguinalis*. In 1997, the higher crop density did not affect the variety *Cirsium arvense*.

Obtained results indicate that the combined application of increased or at least recommended maize crop densities and herbicides led to better results in reduction of distribution of weeds in this crop. At the same time achieved maize grain yields were high, so such a way of weed control in maize crop in the location of Zemun Polje is justified.

CONCLUSION

The following conclusions can be drawn on the basis of obtained results:

- qualitative and quantitative distribution of certain weed species in the weed community in both years of investigation significantly decreased with the increase of maize crop density and herbicide application,
- the increase of density from D_1 to D_3 affected elimination of weeds in maize crop with great demands for light,
- the maize density increase did not result in a lower number of plants and fresh weight of the species *Digitaria sanguinalis* and *Cirsium arvense* in 1996 and 1997, respectively,
- a relative participation of plants per species and fresh weight of certain weed groups within the total weediness decreased in both years with the maize density increase under conditions without, and especially with herbicide application
- in1997, the increased maize density positively affected the decrease of fresh weight of the narrow leafed weeds under conditions with and without herbicide application, while in 1996 it could be attributed only to conditions with herbicide application,
- the average grain yield in the treated variant was statistically significantly higher (11.14 t ha^{-1} and 12.07 t ha^{-1}) than in the control (9.13 t ha^{-1} and 10.18 t ha^{-1}), which justifies herbicide application in weed control,
- according to the analysis of effects of different crop densities and herbicide application on the number of species, number of plants per species and fresh weight of weeds and certain weed groups, on the one hand, and maize grain yield, on the other hand, it can be established that the weed community was reduced with the crop density increase under conditions of herbicide application. At the same time, high grain yields of maize were achieved, which justifies such a method of weed control in maize growing at the location of Zemun Polje.

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UTICAJ GUSTINE USEVA NA FLORISTIČKI SASTAV I GRAĐU KOROVSKE ZAJEDNICE KUKURUZA U USLOVIMA PRIMENE HERBICIDA

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I z v o d

Proučavan je uticaj gustine gajenja useva i primene herbicida na zastupljenost vrsta korova u korovskoj zajednici kukuruza, na lokalitetu Zemun Polja. Tokom vegetacionog perioda kukuruza u 1996. i 1997. godini, sniman je floristički sastav i građa korovske zajednice i utvrđen broj vrsta, broj njihovih jedinki i sveža masa svih korova po jedinici površine, u svakoj gustini. Na varijanti sa i bez primene herbicida. Na osnovu zastupljenosti vrsta korova i njihovih jedinki analizirane su promene nastale pod uticajem povećanja gustine kukuruza i usled primene herbicida i izračunata relativna zastupljenost pojedinih grupa korova. U obe godine ispitivanja došlo je do redukcije korovske zajednice sa povećanjem gustine useva u uslovima bez, a naročito u uslovima sa primenom herbicida. Značajan uticaj interakcije gustine i primene herbicida je ostvaren kod smanjenja relativnog učešća grupe uskolisnih i višegodišnjih korova u ukupnoj zakorovljenosti kukuruza Zemun Polja.

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