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Original scientific paper

Influence of growing measures on weed interference and water status in maize

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SUMMARY

Growing modern hybrids in narrow plant spacing together with nitrogen and herbicide application gives an advantage to maize crops over weeds. The aim of the present investigation was to evaluate the effect of nitrogen form, maize row spacing and herbicide treatment on weed and maize biomass and water usage, as well as maize yield.

The investigation was conducted at the Maize Research Institute Zemun Polje, Belgrade during 2014-2016. A field experiment was set up as a split-split-plot block design with four replications. The maize hybrid ZP388 was planted, and a standard and a slow-release form of urea were applied. For each N source, maize was grown at two row spacings: narrow of 50 cm, and standard of 70 cm, while weed control treatments included: C - without herbicide application, T - application of a pre-emergence mix of herbicides. Sowing was done in the second decade of April, 2014, 2015 and 2016. Six weeks after herbicide application, the fresh biomass of weeds uprooted from 1 m^2 and aboveground biomass of ten crop plants per plot were measured together with dry matter after drying in a laboratory oven. Water content (%) in weed and maize plants was calculated as a relation between fresh and dry biomass. Maize yield was measured at the end of each growing season and calculated with 14% of moisture. All data were processed by ANOVA.

The fresh and dry biomass of weeds were significantly ($P>0.05$) higher in untreated control than in the treated variant, while differences in water content were not significant between the two treatments. Row spacing and urea form did not cause significant differences in weed parameters. Related to this, maize fresh and dry biomass, as well as water content, were higher in herbicide-treated variants than in control but differences were insignificant. Maize biomass was somewhat higher in 50 cm rows and after application of the slow-release urea fertilizer. Yield was higher from 70 cm rows and after application of the slow-releasing urea and the herbicides.

Keywords: Weeds; Maize; Row space; Herbicides; Water

INTRODUCTION

Maize is grown on the largest percent of arable land in Serbia. Common technology for its production includes mechanical planting in 70 cm-wide rows, the use of herbicides for weed control, and mineral, primarily nitrogen fertilizers to achieve higher yield (Dragičević et al., 2015). Row spacing at 70 cm apart with 20 to 25 cm between plants within each row, results in 57.000 to 72.000 plants per ha. However, intensive technology and newly developed genotypes allow an introduction of higher densities and more uniform space arrangement of plants in order to increase competition with weeds and achieve higher yield (Simić et al., 2012). In central parts of Serbia, weather conditions are often characterized by small amounts of precipitation during early spring, so pre-emergence herbicide applications usually do not ensure the desired effects. Herbicide application needs to be combined with other measures, such as crop planting pattern and nitrogen fertilisation that are able to create favourable conditions for maize development.

Weeds are a limiting factor to successful maize production and need to be controlled and kept under threshold level. Yield losses are usually connected to weed competition (Rajcan & Swanton, 2001; Simić & Uludag, 2007) because weeds are stronger competitors than crops for the main resources and usually determine the outcome of crop-weed interactions. Competition for resources between crop and weed plants are the main reason for growing maize at reduced row spacing or in a more equidistant arrangement (Simić et al., 2012). A more uniform plant arrangement supports competition against weed plants and reduces competition among crop plants. Maize grown in narrow rows is able to suppress weed development and biomass production and increase the effectiveness of weed control with herbicides (Simić & Stefanović, 2007; Simic et al., 2012). At the same time, it contributes to a better use of resources and higher biomass and yield production of maize (Acciares & Zuluaga, 2006; Fanadzo et al., 2010). These alternative measures, i.e. row spacing and crop density, are coupled with herbicide treatments in integrated weed management (IWM) programs (Swanton & Weise, 1991). Narrow rows of maize have proved equally successful in reducing aboveground dry matter of early and later emerging weeds under wet and dry seasons (Acciares & Zuluaga, 2006). Using an equidistant row arrangement has enabled maize crops grown under rainy conditions to compete better with natural weed populations, while improving grain yield (Acciares & Zuluaga, 2006). Higher green biomass (11%) and grain yield (30%) of maize can be achieved by reducing inter-row space from 90 to 45 cm, i.e. by increasing plant population from 40000 to 60000 plants ha^{-1}, while reducing weed biomass by 58% (Fanadzo et al., 2010).

Weed interference with maize crop is often associated with competition for light, water and nutrients, especially nitrogen (N), which is essential for plant growth (Lindquist et al., 2007). Poor water content in soil due to low rainfall affects most of maize production in Serbia (Videnović et al., 2013). Some results have shown that negative effects of highly stressful conditions (only 35% of field water capacity) on maize plants were evident in vegetative and yield parameters (Ge et al., 2012). Water stress reduces both crop and weed biomass production (Acciaresi & Guiamet, 2010). Combinations of land use and vegetation type can also have effects on soil moisture content. To produce a unit of dry matter, weeds require more water than most crop plants (Lehoczky et al., 2012; Shen et al., 2014). Another important factor for maize growth and yield, which also influences water availability during vegetation season, is fertilization. A good supply of macronutrients, especially nitrogen, is essential for development of maize shoot and root system, which leads to absorption of more water by plants under water deficit conditions (Wang et al., 2013). An invasive weed species, *Arundo donax*, produced 50-100% more biomass when it was grown under conditions with enriched CO_2 and N (Nackley et al., 2017).

Rainfall and soil moisture during the early part of the growing season have the greatest impact on the performance of pre-emergence herbicides and weed control efficacy. Most pre-emergence herbicides require 10-20 mm of precipitation within two weeks after application to increase their effectiveness (Kádár, 2001). Mesotrione is increasingly used under dry conditions as a pre-emergence herbicide, mostly in a mixture with S-metolachlor. Herbicide effectiveness against weed species varies depending on soil N level and may change weed community structure (Cathcart et al., 2003).

The fertilization - herbicide application – planting pattern relations are complex and essential for weed control and maize productivity. The aim of the present investigation was to evaluate the effect of nitrogen form, maize row spacing and herbicide treatment on weed and maize biomass and dry matter, as well as water uptake during the early stage of maize development. Maize yield as the most important parameter for its production, was also analysed at the end of each season.

MATERIAL AND METHODS

The investigation was conducted at the Maize Research Institute, Zemun Polje, Belgrade, Serbia, on a slightly calcareous chernozem soil type under different rainfall conditions. The field experiment was set up using a split-split-plot block design with four replications. Maize was planted with application of a standard and a slow-release urea fertilizer. In plots treated with either N source, maize was grown at two inter-row spacings (50 cm and 70 cm) and with 24 cm intra-row space resulting in two plant densities: 59.500 plants per ha and 83.333 plants per ha, respectively. Herbicide treatment, as a third factor, included a herbicides mix for grass and broadleaved pre-emergence weed control (s-metolachlor 960 g ha^{-1} + mesotrione 120 g ha^{-1}) – T, and untreated control – C. The elementary plot size was 28 m^2 and has been determined by nitrogen form application, row spacing and herbicide treatment.

A newly developed maize hybrid ZPSC 388 of a medium maturity group (FAO 400) was sown in the second decade of April, 2014, 2015 and 2016. Urea was applied in standard form with 46% of N (N1), and its slow-release form with the same amount of N but with a possibility to release this macronutrient throughout the period of maize vegetation (N2). That form contains a urease inhibitor - NBPT [N-(n-butyl)] thiophosphoric triamide, Eurochem Agro, Germany. Broadcast application of the fertilizers was carried out at their recommended rates (375 kg urea ha^{-1}, and 170 kg of N ha^{-1}, respectively) at the beginning of maize development. The herbicide mixture was applied with a hand sprayer calibrated to deliver 15 l at 300 kPa (3 bar) with a flat-fan nozzle (Teejet, 1.4 mm E 04-80).

Six weeks after herbicide application, fresh biomass of uprooted weeds from 1 m^2 was measured. At the same time, the aboveground biomass of whole crop plants (g plant^{-1}) was evaluated by measuring ten plants per plot. After that, weed and maize plants were collected in paper boxes and dried in a laboratory oven at 60 °C/24h. The dry matter of both was measured after drying. Water content (%) in weed and maize plants was calculated as a relation between fresh biomass and dry matter.

The experimental data of maize and weed biomass were statistically processed by the analysis of variance (ANOVA) and analyzed by the LSD-test (5 %).

Meteorological conditions

Meteorological conditions – including average air temperatures and sum of precipitation over the vegetation seasons of the experiment, were considerably variable. In 2014, the sum of precipitation was almost double the sum in 2015 and 2016. The 2015 vegetation season was actually droughty and with a higher average temperature (21.1 °C) and low amount of precipitation (285 mm). The other two seasons, 2014 and 2016, were favourable and in 2014 an exceptionally high amount of precipitation was recorded.

RESULTS

The dominant weeds in the experimental field included *Chenopodium album*, *Ch. hybridum* and *Solanum nigrum* as broadleaved annual species, and *Sorghum halepense* as a grass perennial weed. Throughout the three years, species in the genus *Chenopodium* participated with up to 50% in the total number of weed individuals in untreated control. The annual broadleaved species *Solanum nigrum* was a subdominant weed (Simić et al., 2017).

The data show that neither spacing between maize rows nor nitrogen form significantly influenced total biomass of the present weeds when pre-emergence herbicides were applied (Table 1). Weed biomass, considering the average for all three seasons,

Table 1. Influence of growing measures on weed fresh biomass (FB, g m^{-2}), weed dry matter (DM, g m^{-2}) and water content (W, %), average 2014-2016

Year		N1		N2		Average		Average		Average
		50 cm	70 cm	50 cm	70 cm	50 cm	70 cm	N1	N2	
FB	T	71.0	73.9	123.4	73.1	97.2a	73.5a	72.5a	98.3a	87.7
	C	916.0	972.7	973.8	996.0	944.9b	984.4b	944.4b	984.9b	964.7*
DM	T	13.2	13.3	22.0	11.2	17.6a	12.3a	13.1a	16.6a	14.9
	C	139.9	160.4	144.3	159.7	142.1b	160.1b	150.2b	152.0b	151.1*
W	T	23.1	18.8	18.3	19.0	20.7	18.9	21.0	18.7	19.9
	C	16.4	17.5	16.5	17.3	16.5	17.4	17.0	16.9	17.0

T - herbicide treatment; C- control; N1-standard urea; N2-slow-release urea was significantly higher in the untreated control (964.7 g m^{-2}) than the treated variant (87.7 g m^{-2}) (Table 2). Reduced row spacing of maize influenced weed fresh and dry biomass production on untreated plot where weed biomass was lower in narrow 50 cm rows (944.9 and 142.1 g m^{-2}, respectively) than in standard 70 cm rows (984.4 and 160.1 g m^{-2}, respectively). After herbicide application, weed biomass was lower in wider rows (73.5 and 12.3 g m^{-2}, respectively). Weed biomass was slightly higher after the application of slow-release urea (N2) even at the early stage of maize development.

Fresh biomass and dry matter of maize were higher after the application of herbicide mixture and the slow-released urea – 146.3 and 18.7 g plant^{-1}, respectively. Water content in weed plants was a little higher in the treated variant (19.9%) than in untreated control (17.0%) and the highest percent of water was found in weeds from the treated plot and 50 cm row distance (29.7%) and after standard urea application (21%).

Regarding the influence of the investigated measures on maize parameters, maize biomass and water content were not observed to be significantly influenced by row space, herbicide treatment and urea form (Tables 3 and 4).

Fresh biomass and dry matter of maize plants were higher in herbicide-treated plots (140.5 and 18.1 g m^{-2}, respectively) in comparison to untreated control (95.0 and 12.8 g m^{-2}, respectively). However, differences

Table 2. Significance of differences between analysed parameters of weeds, LSD $_{0.05}$

Parameters	Fresh biomass	Dry matter	Water content
Urea, U	694.8	103.8	5.9
Herbicide, H	534.5	77.8	9.2
Row distance, RD	695.0	103.8	9.6
U x H	540.0	78.6	5.8
U x RD	702.2	104.9	6.0
H x RD	540.0	78.8	9.3

Table 3. Influence of growing measures on maize fresh biomass (FB, g plant^{-1}), dry matter (DM, g plant^{-1}) and water content (W, %), average 2014-2016

Year		N1		N2		Average		Average		Average
		50 cm	70 cm	50 cm	70 cm	50 cm	70 cm	N1	N2	
FB	T	144.8	124.4	150.5	142.1	147.6	133.3	134.6	146.3	140.5
	C	101.3	88.3	96.8	93.4	99.1	90.9	94.8	95.1	95.0
DM	T	18.3	16.4	19.0	18.4	18.7	17.4	17.4	18.7	18.1
	C	13.7	12.4	11.7	13.0	12.7	12.7	13.1	12.4	12.8
W	T	13.9	14.6	14.3	13.9	14.1	14.3	14.2	14.1	14.2
	C	14.4	15.8	14.86	16.0	14.6	15.9	15.1	15.4	15.3
Y	T	8.4	10.1	7.7	11.3	8.1ab	10.7a	9.3a	9.5a	9.4*
	C	5.6	6.0	5.6	6.3	5.6b	6.2b	5.8b	6.0b	5.9

T - herbicide treatment; C- control; N1-standard urea; N2-slow-release urea

Table 4. Significance of differences between analysed parameters of maize, LSD $_{0.05}$

Parameters	Fresh biomass	Dry matter	Water content	Yield
Urea, U	83.3	9.6	3.8	3.5
Herbicide, H	80.2	9.2	3.7	3.0
Row distance, RD	83.2	9.6	3.8	3.4
U x H	80.9	9.3	3.8	3.1
U x RD	84.0	9.7	3.8	3.4
H x RD	80.8	9.3	3.7	2.9

were not statistically significant six weeks after the pre-emergence herbicide application. On the other hand, water content was higher in untreated (15.3%) than in treated (14.2%) maize plants. Despite statistical significance, maize biomass and dry matter were slightly higher in plots with 50 cm row distance, while water content was higher in plots with 70 cm row spacing, which probably indicates that intraspecific competition was stronger than interspecific competition at that stage of maize development.

Considering the average maize yield for the three years, it was significantly higher in the treated (9.4 t ha^{-1}) than untreated control (5.9 t ha^{-1}) plots. Yield was higher from the 70 cm row distance plots, and the differences compared to 50 cm row distance were higher after herbicide application. Maize yield was the highest when the herbicides and U2 were applied (11.3 t ha^{-1}). It is interesting that even in the untreated plots exposed to weed pressure, row distance and urea form showed their effects on maize yield as a final and the most important parameter in maize production.

DISCUSSION

The average biomass of weeds was slightly lower and maize biomass was a little higher in plots with 50 cm row distance, compared to 70 cm row distance, on the average for all three years. The results of some previous studies had shown that row spacing of maize had different effects on weed biomass, depending on crop development stage. Weed biomass decreased almost twice when maize was grown in 45 cm rows instead of 90 cm at the point of eight weeks after crop emergence, but differences were not significant three weeks after emergence of maize (Fanadzo et al., 2010). Increased weed biomass can negatively affect maize plants and their competitiveness for water during the critical competition period at the early development stages of 4-6 and 12-14 leaves (Kazinczi et al., 2008). Field experiment results also showed that differences in aboveground dry matter of weeds between planting patterns, i.e. narrow and wide rows, together with herbicide application, were highly significant at the flowering and maturity stage of maize, showing a lower weed aboveground dry weight in the narrow row arrangement (Acciares & Zuluga, 2006). In the same experiment, a greater ($p< 0.05$) weed aboveground dry matter weight was observed in wide row arrangement at the later stages of maize development and with application of herbicides.

The results of previous investigations had shown that herbicide application also influenced biomass production of maize plants as it was higher compared to control plants. The differences were not too obvious at the beginning of vegetation season (BBCH 13-15) when maize plants were small, but later (BBCH 22-24) maize biomass production was seriously influenced by weeds (Simić et al., 2017). According to data reported by Lehoczky et al. (2013), weed competition can reduce the biomass of maize plants up to 64% in the early growth stage of the crop. Other factors, such as row spacing and nitrogen form, showed no significant influence on maize biomass production per plant even though maize biomass was higher in plots treated with standard urea and with 50 cm row distance for both herbicide applications. In another study, grain yield of maize showed a more evident response to the nitrogen form and row space (Crozier et al., 2014).

According to meteorological data, 2014, 2015 and 2016 were years with quite different weather conditions; 2015 was especially dry, while 2016 was completely the opposite with high precipitation. Restrictions in resources cause stronger competitive interactions between crops and weeds (Jones & Walker, 1993) and usually, under drought stress due to climate change, the competitive balance would shift in favour of deep-rooted plants (Stratonovitch et al., 2012). Earlier reports have also suggested that weed species probably use water resources more efficiently than maize crop, especially in the early stages of development when maize root system has not developed yet. Higher water content in maize plants, observed in 70 cm row spacing, probably indicated a stronger intraspecific competition which is in accordance with previous studies (Kivuva et al., 2014), inferring that water use efficiency under high crop density depletes soil water content through transpiration faster than lower crop density.

Nitrogen form influenced weed biomass on average but without a true regularity. Both weed and maize biomass, as well as dry matter contents, were higher after the slow-releasing form of urea, the U2, was applied. Higher maize biomass and dry matter after a combined application of U2 urea and herbicide mixture clarified that N is essential for organic matter accumulation in maize plants, as well as for increasing grain yield (Marschner, 1995). But water content in weed plants was higher in the variant with standard urea application, while total maize biomass was very similar under both forms of applied urea. The row spacing x N timing interaction demonstrated an importance of later-season N supply, at least for narrow row maize.

Cropping system affected maize biomass production. As weed biomass decreased with the level of herbicide application, maize biomass per plant increased to a greater extent in maize planted at 70 and especially 50 cm inter-row distance and under application of both nitrogen fertilizer forms. Reduced row spacing significantly suppressed weed density and biomass. Maximum reductions in weed density (9%) and dry weight (34%) have been recorded at 55 cm row spacing as compared with 75 cm row spacing (Maqbool et al., 2006). In another study, weed biomass was reduced 28% by reducing row spacing to 56 cm, and 16% to 29% in 38 cm rows (Begna *et al*., 2001; Tharp & Kells, 2001). Various management methods for weed control may be useful for maize crop, including cultural weed control (Begna et al., 2001), cultivation of competitive varieties under changed spatial arrangement of crop plants (Simić & Stefanović, 2007; Evers & Bastiaans, 2016), manual weed control (Abouziena et al., 2008), chemical weed control (Kir & Dogan, 2009), etc. The most effective are combinations of different methods incorporated into the system of Integrated Weed Management, which provide beneficial, long-lasting and environmentally safe control of different weeds and minimize production losses of maize crop.

CONCLUSION

The data obtained in the present experiment infer that weed interference with maize crop highly depends on herbicide application. Six weeks after the pre-emergence application of herbicides, both fresh and dry weed biomass were significantly (P>0.05) higher in the untreated control than in the treated variant, while differences in water content were not significant between those two treatments. Neither row spacing nor nitrogen form caused significant differences in the measured weed parameters during early stages of maize development. On the other side, maize fresh biomass and dry matter, as well as water content, were higher in the herbicide treated variant than in the control plots. Maize biomass was somewhat higher in 50 cm rows and after the application of slow-release urea. Maize yield was also higher in the treated variant than in the untreated control, and at 70 cm row distance, especially after herbicide application. The highest yield in average for all three years, was obtained when the herbicides and slow-releasing urea were applied (11.3 t ha^{-1}).

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REFERENCES

Abouziena, H.F., El-Metwally, I.M., & El-Desoki, E.R. (2008). Effect of plant spacing and weed control treatments on maize yield and associated weeds in sandy soils. *American-Eurasian Journal of Agricultural and Environmental Sciences, 4*(1), 9-17.

Acciares, H.A., & Zuluaga, M.S. (2006). Effect of plant row spacing and herbicide use on weed aboveground biomass and corn grain yield. *Plantha daninha*, *24*(2), 287-293. doi 10.1590/S0100-83582006000200011

Acciaresi, H.A., & Guiamet, J.J. (2010). Below- and above-ground growth and biomass allocation in maize and *Sorghum halepense* in response to soil water competition. *Weed Research, 50*(5), 481-492. doi 10.1111/j.1365-3180.2010.00794.

Begna, S.H., Hamilton, R.I., Dwyer, L.M., Stewart, D.W., Cloutier, D., Assemat, L. . . . Smith, D.L. (2001). Morphology and yield response to weed pressure by corn hybrids differing in canopy architecture. *European Journal of Agronomy, 14*, 293-302. doi 10.1016/S1161-0301(01)00092-2

Cathcart, R.J., Chandler, K., & Swanton, J.C. (2003). Fertilizer nitrogen rate and the response of weeds to herbicides. *Weed Science, 52*(2), 291-296. doi:http://dx.doi.org/10.1614/WS-03-049R

Crozier, C.R., Gehl, R.J., Hardy, D.H., & Heiniger, R.W. (2014). Nitrogen management for high population corn production in wide and narrow rows. *Agronomy Journal, 106*(1), 66-72.

Dragičević, V., Kresović, B., Videnović, Ž., Spasojević, I., & Simić, M. (2015). Fitting cropping technology in a changing climate. *Agriculture and Forestry, 61*(3), 171-180.

Evers, J.B., & Bastiaans, L. (2016). Quantifying the effect of crop spatial arrangement on weed suppression using functional-structural plant modelling. *Journal of Plant Research,* 129(3), 339-351. pmid 27000875. doi:10.1007/s10265-016-0807-2

Fanadzo, M., Chiduza, C., & Mnkeni, P.N.S. (2010). Effect of inter-row spacing and plant population on weed dynamics and maize (*Zea mays* L.) yield at Zanyokwe irrigation scheme, Easter Cape, South Africa. *African Journal of Agicultural Research, 5*(7), 518-523.

Ge, T., Sui, F., Bai, L., Tong, C., & Sun, N. (2012). Effects of water stress on growth, biomass partitioning, and water-use efficiency in summer maize (*Zea mays* L.) throughout the growth cycle. *Acta Physiologiuae Plantarum, 34*(3), 1043-1053. doi 10.1007/s11738-012-1018-7.

Jones, R.E., & Walker, R.H. (1993). Effect of interspecific interference, light intensity, and soil moisture on soybean (*Glycine max*), common cocklebur (*Xanthium strumarium*), and sicklepod (*Cassia obtusifolia*) water uptake. *Weed Science, 41*(4), 534-540.

Kádár, A. (2001). *Vegyszeres gyomirtás és gyomszabályozás*. (pp 178-191). Budapest, Hungary: Factum BT.

Kazinczi, G., Béres, I., Torma, M., & Kovács, I. (2008). Critical competition period of maize. *Magyar gyomkuttats és technológia, 9*, 23-30.

Kir, K., & Dogan, M.N. (2009). Weed control in maize (Zea mays L.) with effective minimum rates of foramsulfuron. *Turkish Journal of Agriculture and Forestry, 33*(6), 601-610. doi 10.3906/tar-0903-23.

Kivuva,.B.M, Mburu, M.W.K., Maina, J.M., & Murdoch, A.J. (2014). The effects of maize planting density and weeding regimes on light and water use. *Journal of Agricultural Science, 6*(12), 215-229. doi 10.5539/jas.v6n12p215.

Lehoczky, É., Busznyák, J., Gólya, G., & Pálmai, O. (2012). Green water: *Ambrosia artemisiifolia* L. on winter wheat stuble. *Crop Production, 61*(Suppl.), 259-262.

Lehoczky, É., Marton, L., & Nagy, P. (2013). Competition for nutrients between cold-tolerant maize and weeds. *Communications in Soil Science and Plant Analysis, 44*(1-4), 526-534. doi 10.1080/00103624.2013.744156.

Lindquist, J.L., Barker, D.C., Knezevic, S.Z., Martin, A.R., & Walters, D.T. (2007). Comparative nitrogen uptake and distribution in corn and velvetleaf (*Abutilon theophrasti*). *Weed Science, 55*(2), 102-110.

Maqbool, M.M., Tanveer, A., Ata, Z., & Ahmad, R. (2006). Growth and yield of maize (*Zea mays* L.) as affected by row spacing and weed competition durations. *Pakistan Journal of Botany, 38*(4), 1227-1236.

Marschner, H. (1995). *Mineral nutrition of higher plants*. London, UK: Academic Press.

Nackley, L., Hough-Snee, N., & Kim, S.H. (2017). Competitive traits of the invasive grass *Arundo donax* are enhanced by carbon dioxide and nitrogen enrichment. *Weed Research, 57*(2), 67-71.

Rajcan, I., & Swanton, C.J. (2001). Understanding maize-weed competition: Resource competition, light quality and the whole plant. *Field Crops Research, 71*(2), 139-150. doi 10.1016/S0378-4290(01)00159-9.

Shen, Q., Gao, G., Fu, B., & Lü, Y. (2014). Soil water content variations and hydrological relations of the cropland-treebelt-desert land use pattern in an oasis-desert ecotone of the Heihe River Basin, China. *Catena, 123*, 52-61. doi http://dx.doi.org/10.1016/j.catena.2014.07.002

Simić, M., & Stefanović, L. (2007). Effects of maize density and sowing pattern on weed suppression and maize grain yield. *Pesticides* & *Phytomedicine, 22*(2), 93-103.

Simić, M., & Uludag, A. (2007). Interakcija korov-gajena biljka: kompeticija i alelopatija (Crop-weed interactions: Competition and alelophaty). In Zbornik rezimea XIII simpozijuma sa savetovanjem o zaštiti bilja sa međunarodnim učešćem (Proceedings of the 13th Symposium of Plant Protection), Zlatibor, Serbia. 34-36. Beograd: Društvo za zaštitu bilja.

Simić, M., Dolijanović, Ž., Maletić, R., Stefanović, L., & Filipović, M. (2012). Weed suppression and crop productivity by different arrangement patterns of maize. *Plant, Soil and Environment, 58*(3), 148-153.

Simić, M., Brankov, M., & Dragičević, V. (2017). Effects of nitrogen form, row spacing and herbicide application on weed control and maize biomass production. *Herbologia (Sarajevo, BiH), 16*, (in press).

Stratonovitch, P., Storkey, J., & Semenov, M.A. (2012). A process-based approach to modelling impacts of climate change on the damage niche of an agricultural weed. *Global Change Biology, 18*(6), 2071-2080. doi 10.1111/j.1365-2486.2012.02650.

Swanton, C.J., & Weise, S.F. (1991). Interated weed management: The rationale and approach. *Weed Technology, 5*(3), 657-663.

Tharp, B.E., & Kells, J.J. (2001). Effect of gluphosinate-resistant corn (*Zea mays*) population and row spacing on light interception, corn yield and common lambsquarters (*Chenopodium album*) growth. *Weed Technology, 15*(3), 413-418.

Videnović, Ž., Dumanović, Z., Simić, M., Srdić, J., Babić, M., & Dragicević, V. (2013). Genetic potential and maize production in Serbia. *Genetika (Belgrade), 45*(3), 667-677. doi 10.2298/GENSR1303667V.

Wang, J., Liu, W.Z., Dang, T.H.., & Sainju, U.M. (2013). Nitrogen fertilization effect on soil water and wheat yield in the Chinese Loess Plateau. *Agronomy Journal, 105*(1), 143-149.

Uticaj sistema gajenja na zastupljenost korova i status vode u kukuruzu

REZIME

Gajenje novostvorenih hibrida kukuruza uz smanjeno međuredno rastojanje i primenu đubriva i herbicida, daje prednost usevu u odnosu na korove. Cilj istraživanja je bio da se ispita uticaj forme azotnog đubriva, međurednog rastojanja i primene herbicida na biomasu korova i kukuruza i status vode, kao i na prinos zrna kukuruza.

Istraživanje je sprovedeno u Institutu za kukuruz Zemun Polje, Beograd, tokom 2014-2016. godine. Hibrid kukuruza ZP388 je sejan uz primenu standardne i spororazgradive uree. U okviru svake forme azotnog đubriva, kukuruz je gajen u međurednom rastojanju od 70 cm i smanjenom rastojanju od 50 cm, uz primenu kombinacije herbicida posle setve a pre nicanja (T) i bez primene herbicida, kontrola (C). Setva je obavljana u drugoj dekadi aprila u 2014, 2015 i 2016. godini. Šest nedelja posle primene herbicida, merena je sveža masa korova sa površine od 1 m^2 i nadzemna masa 10 biljaka kukuruza po svakoj varijanti, zatim su biljke korova i useva sušene u laboratorijskoj sušnici, nakon čega je izmerena njihova suva masa. Sadržaj vode (%) u biljkama korova i kukuruza je određen iz odnosa sveže i suve mase. Prinos kukuruza je meren na kraju vegetacionog perioda i obračunat sa 14% vlage u zrnu. Svi dobijeni podaci su statistički obrađeni analizom varijanse (ANOVA).

Sveža i suva masa korova su bile značajno ($P>0.05$) veće u kontrolnoj nego u herbicidima tretiranoj varijanti, dok se sadržaj vode u biljkama nije značajno razlikovao između ova dva tretmana. Međuredno rastojanje i forma azotnog đubriva nisu uticali na pojavu značajnih razlika u merenim parametrima korova. U vezi sa navedenim, sveža i suva masa kukuruza kao i sadržaj vode u biljkama, su bili veći na tretiranoj u odnosu na kontrolnu površinu ali razlike nisu bila satistički značajne. Sveža masa kukuruza je u izvesnom stepenu bila veća pri međurednom rastojanju od 50 cm i nakon primene spororazgradive uree, dok je prinos zrna kukuruza bio veći na međurednom rastojanju od 70 cm i nakon primene spororazgradive uree i herbicida.

Ključne reči: Korovi; Kukuruz; Međuredno rastojanje; Herbicidi; Voda