

# UTJECAJ NAVODNJAVANJA I GNOJIDBE DUŠIKOM NA UROD I KVALITETU ZRNA HIBRIDA KUKURUZA (*Zea mays* L.)

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## SAŽECI DOKTORSKIH DISERTACIJA – *Doctoral thesis summaries*

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### UTJECAJ NAVODNJAVANJA I GNOJIDBE DUŠIKOM NA UROD I KVALITETU ZRNA HIBRIDA KUKURUZA (*Zea mays* L.)

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**Disertacija <sup>(2)</sup>**

Trogodišnje istraživanje (2010.-2012.) provedeno je na pokušalištu Poljoprivrednog instituta iz Osijeka, a dio je dugogodišnjega stacionarnoga pokusa. Istraživan je utjecaj navodnjavanja (glavni čimbenik A), gnojidbe dušikom (podčimbenik B) i genotipa (podčimbenik C) na urod i kvalitetu zrna hibrida kukuruza (*Zea mays* L.).

Navodnjavanje je provedeno u tri varijante, gdje je A1 bila kontrolna varijanta. Na A2 varijanti sadržaj vode u tlu održavan je na razini 60-100% poljskoga vodnoga kapaciteta (PVK), dok je na A3 varijanti sadržaj vode u tlu održavan na razini 80-100% PVK. Gnojidba dušikom provedena je u tri varijante, gdje je B1 bila kontrolna varijanta (0 kg N ha<sup>-1</sup>). Na B2 varijanti dodavano je 100 kg N ha<sup>-1</sup>, a na B3 varijanti 200 kg N ha<sup>-1</sup>. Osnovna gnojidba kukuruza dušikom (1/3 ukupnoga dušika) obavljena je u jesen (UREA). Jednaka količina gnojiva unesena je predstjetveno u tlo. Tijekom razdoblja vegetacije izvršene su dvije prihrane KAN-om. Prva prihrana (1/6) obavljena je kultivacijom kukuruza u fazi 6-8 listova, a druga u fazi 8 do 10 listova (1/6). U istraživanju su korištena četiri hibrida kukuruza (FAO 500 i 600), C1=OSSK596, C2=OSSK617, C3=OSSK602 i C4=OSSK552. Kukuruz je navodnjavao samohodnim sektorskim rasprskivačem, a trenutak početka navodnjavanja određen je mjerenjem vlažnosti tla pomoću *Watermark* senzora. Provedena je uobičajena agrotehnika u proizvodnji kukuruza. Vremenske prilike tijekom istraživanja značajno su se razlikovale, posebice u pogledu količine oborine. Ističe se 2010. godina, kao ekstremno kišna, kada je na području Osijeka proglašena elementarna nepogoda prevelike količine oborine i poplave, što je utjecalo na vrijeme izvođenja radova, kao i rezultate istraživanja.

Analizom varijance utvrđene su statistički vrlo značajne razlike u veličini uroda u sve tri godine istraživanja. Urod je rastao povećanjem norme navodnjavanja,

s iznimkom 2010. godine, kada je najviši urod (9,24 t ha<sup>-1</sup>) ostvaren na kontroli (A1). Najizraženiji učinak navodnjavanja na urod zrna kukuruza bio je u ekstremno toplome i vrlo sušnome vegetacijskome razdoblju 2012. godine. Učinak navodnjavanja na kemijski sastav zrna razlikovao se po godinama istraživanja. Sadržaj proteina u zrnu smanjen je povećanjem sadržaja vode u tlu na obje varijante navodnjavanja u 2010. i 2012. godini. Nasuprot tome, sadržaj škroba i ulja (n.s.) u zrnu rastao je na obje varijante navodnjavanja. Najizraženije povećanje sadržaja škroba zabilježeno je u 2012. godini. Porastom količine dodane vode, rasla je hektolitarska masa kukuruza, dok je apsolutna masa smanjena. Gnojidba dušikom vrlo značajno je povećala urod zrna, sadržaj proteina u zrnu te hektolitarsku i apsolutnu u sve tri godine istraživanja. Utvrđen je vrlo značajan učinak hibrida na sva ispitivana svojstva tijekom trogodišnjeg istraživanja. Smjer i jačina korelacijskih veza između svojstava (međusobno) i čimbenika u istraživanju razlikovali su se po godinama istraživanja, prvenstveno radi specifičnih vremenskih uvjeta 2010. godini.

Ključne riječi: navodnjavanje, gnojidba dušikom, genotip, urod, kemijski sastav zrna

### INFLUENCE OF IRRIGATION AND NITROGEN FERTILIZATION ON YIELD AND QUALITY OF (*Zea mays* L.) MAIZE GRAIN

**Doctoral thesis**

The three years' research (from 2010 to 2012), conducted on a trial field of the Institute of Agriculture in Osijek, is a part of a long stationary experiment. The objective of the research was the impact of irrigation (main factor, A), nitrogen fertilization (second factor, B),

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and the genotype (third factor, C) on the grain yield and the quality of maize hybrids (*Zea mays* L).

The irrigation scheduling was the main factor where A1 treatment was the control, rain-fed plot. In A2 treatment the soil water content was 60-100% of the field water capacity (FWC), while in the A3 treatment the soil water content was 80 to 100% FWC. Nitrogen fertilization as a sub factor, consisted of the three levels where B1 was the control treatment (0 kg N ha<sup>-1</sup>). In B2 treatment 100 kg N ha<sup>-1</sup> was added, while in B3 treatment 200 kg N ha<sup>-1</sup>. Fall application (1/3 of all nitrogen) was in the form of UREA. The same amount of nitrogen was applied in the pre-sowing period. During the vegetation period, two side dressings with CAN were carried out. The first side dressing (1/6 of nitrogen) was done by cultivating the maize in 6-8 leaves phase, while the second one in 8 to 10 leaves phase (1/6 of nitrogen). Four maize hybrids (FAO 500 and 600) were used in the research, C1=OSSK596, C2=OSSK617, C3=OSSK602 and C4=OSSK552. The maize was irrigated by a traveling sprinkler system. The moment of irrigation was set by measuring soil moisture with the Watermark sensor (gypsum block). During the period of the research the weather conditions significantly varied, especially concerning the amount of precipitation. The year 2010 stands out as extremely wet (rainy), when a natural disaster of flood was proclaimed, due to high amount of precipitation, which had an influence on the results of the research.

Analysis of variance showed statistically significant differences in yield in all three years of the research. Grain yield was higher as amount of irrigation water was higher, with an exception of the year 2010, when the highest yield (9.24 t ha) was achieved at the irrigation control plots (A1). The most distinctive impact the irrigation had on maize yield was during the very warm and very dry growth period of the year 2012. The impact of irrigation on grain chemical compounds differed in each year of the research. The amount of protein in grain was reduced by increasing soil water content in both irrigation treatments (2010 and 2012) which is the opposite to starch and oil content. The most distinctive increase of the amount of starch was noted in 2012. With the increase of irrigation water, the hectolitre weight of maize grew, while the absolute weight was decreased. Nitrogen fertilization significantly influenced the grain yield, the protein content, as well as the hectolitre and absolute weights in all three years of research.

Maize hybrid had a highly significant impact on all tested characteristics during the three year research. The course and the strength of correlation was year dependent, most of all on account of the weather conditions in the year 2010.

Key-words: irrigation, nitrogen fertilization, genotype, yield, chemical compounds

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## KRUŠKINA OSA SRČIKARICA (*Janus compressus* Fabricius) – ŽIVOTNI CIKLUS I BIOLOŠKO-MORFOLOŠKE OSOBINE

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Cilj ovoga rada bio je istražiti životni ciklus, biološko-morfološke osobine kruškine ose srčikarice (*Janus compressus* Fabricius, Hymenoptera - Cephidae) te identificirati njezine prirodne neprijatelje. Terenski dio istraživanja obavljen je tijekom 2010., 2011. i 2012. u nasadima kruške na pet lokaliteta. Let imaga praćen je uz uporabu žutih ljepljivih ploča. Laboratorijski dio istraživanja proveden je na Poljoprivrednome fakultetu u Osijeku, Katedri za entomologiju i nematologiju. Istraživanja su pokazala da kruškina osa srčikarica u klimatskim uvjetima istočne Slavonije leti u periodu od četiri tjedna, s početkom leta u trećoj dekadi travnja i vrhuncem leta (štetnosti) oko 1. svibnja. Imago najintenzivnije leti za toplih i sunčanih dana, kada je srednja dnevna temperatura iznad 14°C. Kukac ima vitko tijelo i duga ticala. Duljina tijela varira u rasponu 7-12 mm, uz izraženi spolni dimorfizam. Štetnik ima jednu generaciju godišnje. Osnovna boja imaga je crna. Ticala su nitastog oblika i sastavljena od 20 (mužjak) - 22 (ženka) članka. Boja zatka kod ženki varira od crvene do tamnocrvene boje, dok je kod mužjaka izrazito žute do narančaste boje. Jaja štetnika su mekana, cilindrično-izduženog oblika, duljine 0,8-1,0 mm. Ženka polaže prosječno 30 jaja. Embrionalni razvoj jaja traje 11-14 dana. Ličinke kruškine ose srčikarice duljine su 8-10 mm, bijele do svijetložute boje. Tijekom razvoja, ličinke prolaze tri stadija presvlačenja. Rezultati su pokazali da ličinke kruškine ose srčikarice parazitiraju vrste s utvrđenom razinom parazitizma: *Eurytoma* sp. - 9,83%, *Tetrastichus* sp. - 2,01%, *Eupelmus* sp. - 1,66%, *Pteromalus* sp. - 0,55%, *Ichneumonida* sp. - 0,35% i nepoznata *Hymenoptera* sp. - 0,62%. Fitofagna vrsta *Metopoplax origani* zatečena je u 1,80% napadnutih izbojaka. Ličinke kruškine ose srčikarice parazitiraju i tri roda entomopatogenih gljivica. Mortalitet ličinki prouzročen napadom

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parazitnih kukaca i ptica iznosio je 43,6%, dok je mortalitet ličinki prouzročen napadom gljivica iznosio 4,22%. Istraživanjem je utvrđeno da imago kruškine ose srčikarice u klimatskim uvjetima istočne Slavonije leti 10-12 dana ranije od literaturnih navoda. Svaka ženka uništava prosječno 30 mladih izbojaka kruške. Imago se inaktivira i ne pravi štete za vrijeme kišnih i hladnih dana, kada su srednje dnevne temperature ispod 10°C. Prirodni neprijatelji (parazitne osice i entomopatogene gljivice) vrlo su značajan čimbenik mortaliteta ličinki, dok su temperature zraka ispod 2°C (mraz), značajni čimbenik mortaliteta imaga štetnika.

Gljučne riječi: kruškina osa srčikarica, *Janus compressus* F., životni ciklus, biološko-morfološke osobine, prirodni neprijatelji, mortalitet

## PEAR SHOOT SAWFLY (*JANUS COMPRESSUS* FABRICIUS) – LIFE CYCLE AND BIOLOGICAL AND MORPHOLOGICAL CHARACTERISTIC

### *Doctoral thesis*

The aim of the thesis was to investigate life cycle, biological and morphological characteristics of pear shoot sawfly (*Janus compressus* Fabricius, Hymenoptera - Cephidae), furthermore to identify natural enemies in order to protect pear from this pest. The trial was conducted in the period of three years: 2010, 2011 and 2012 in pear orchards at five localities. Monitoring of adult sawfly was done by yellow sticky traps. Laboratory research was done at the Faculty of Agriculture, Department of Plant Protection, Section of Entomology and Nematology. In this study, pear shoot sawfly in Eastern Slavonia occurred in the period of four weeks, starting from the third decade of April with the peak population at the beginning of the May. Adults flight is the most intensive during warm and sunny days, when temperatures are above 14°C. Adult sawflies are characterized by elongated body and antennae, usually 7-12 mm long and sexual dimorphism is present. Pest is univoltine. Basic colour of adult sawfly is black. Antennae are moniliform and consist of 20 (male) - 22 (female) segments. Females have red or dark red colored abdomen, while males have yellow or orange one. Eggs are cylindrically shaped, 0.8-1.0 mm long. Female lays approximately 30 eggs. Embryonic development of pear shoot sawfly eggs lasts from 11 to 14 days. Larvae are 8-10 mm long, white or pale yellow. Larvae molt three times. Pear shoot sawfly larvae were parasitized by insects from Hymenoptera order, from five identified and one unidentified genera. Level of parasitism by genera is as follows: *Eurytoma* sp. (Hymenoptera: Eurytomidae) – 9.83%, *Tetrastichus*

sp. (Hymenoptera: Eulophidae) – 2.01%, *Eupelmus* sp. (Hymenoptera: Eupelmidae) – 1.66%, *Pteromalus* sp. (Hymenoptera: Pteromalidae) – 0.55%, Ichneumonida sp. (Hymenoptera: Pimplinae) – 0.35% and unidentified genera – 0.62%. Plant parasitic species *Metopoplax origani* (Hemiptera: Lygaeidae) was found in 1.80% of analyzed shoots. Larvae were also parasitized by three genera of entomopathogenic fungi. Insect parasites and birds caused 43.6% of larval mortality, while 4.22% larval mortality was caused by entomopathogenic fungi. This research proved 10-12 days earlier appearance of adult sawfly in climatic conditions of Eastern Slavonia, contrary to other authors findings. Each female damages on the average 30 young pear shoots. Adults sawfly become inactive when average daily temperatures are lower than 10°C and during rainy and windy days. Natural enemies (parasitic wasps and entomopathogenic fungi) significantly affect larvae mortality while temperatures below 2°C (frost) are important factor for adult sawfly mortality.

Key-words: pear shoot sawfly, *Janus compressus* F., life cycle, biological and morphological characteristic, insect parasitism, mortality