

EFFICACY OF NATURAL POPULATION OF Trichogramma WASPS AGAINST EUROPEAN CORN BORER IN FIELD MAIZE

Sarajlić, Ankica; Raspudić, Emilija; Majić, Ivana; Ivezić, Marija; Brmež, Mirjana

Source / Izvornik: **Poljoprivreda, 2014, 20, 18 - 22**

Journal article, Published version

Rad u časopisu, Objavljena verzija rada (izdavačev PDF)

Permanent link / Trajna poveznica: <https://urn.nsk.hr/urn:nbn:hr:151:438071>

Rights / Prava: [In copyright](#)/[Zaštićeno autorskim pravom.](#)

Download date / Datum preuzimanja: **2025-03-03**



Sveučilište Josipa Jurja
Strossmayera u Osijeku

**Fakultet
agrobiotehničkih
znanosti Osijek**

Repository / Repozitorij:

[Repository of the Faculty of Agrobiotechnical
Sciences Osijek - Repository of the Faculty of
Agrobiotechnical Sciences Osijek](#)



EFFICACY OF NATURAL POPULATION OF *Trichogramma* WASPS AGAINST EUROPEAN CORN BORER IN FIELD MAIZE

Ankica Sarajlić ⁽¹⁾, Emilija Raspudić ⁽¹⁾, Ivana Majić ⁽¹⁾, Marija Ivezić ⁽¹⁾, Mirjana Brmež ⁽¹⁾, M. Josipović ⁽²⁾

Original scientific paper
Izvorni znanstveni članak

SUMMARY

The aim of this study was to determine the natural infestation of European corn borer (ECB) eggs by *Trichogramma* wasps (Hymenoptera: Trichogrammatidae) under field conditions. The experiment was set up in Osijek, Croatia in 2013. The experiment included two levels of irrigations, two nitrogen rates and two maize genotypes. Parameters of ECB feeding activity and maize tolerance (cob mass, tunnel length, number of ECB larvae per plant), as well as number of parasitized ECB eggs by *Trichogramma* wasps were evaluated. Genotypes were significantly different in terms of tolerance to ECB injury. In treatments with nitrogen fertilization, ECB feeding activity was increased at both nitrogen rates. Agricultural practices did not significantly affect parasitism of ECB eggs by *Trichogramma*. Correlation between parameters of ECB feeding activity and parasitism by *Trichogramma* was slight to moderate and not significant. Natural occurrence of *Trichogramma* wasps were not significantly affected by agricultural practices in maize, and population of these parasitoids was low significantly affect ECB feeding activity.

Key-words: *Trichogramma* wasps, irrigation, hybrid, nitrogen fertilization

INTRODUCTION

The two most important pests on maize in Croatia are European corn borer and western corn rootworm (Raspudić et al., 2013; Brkić et al., 2012; Ivezić et al., 2009; Ivezić et al., 2011; Šimić et al., 2007). Biological control of European corn borer, *Ostrinia nubilalis* (Hübner) with *Trichogramma* wasps (Hymenoptera: Trichogrammatidae) had a lot of attention in recent years (Kuhar et al. 2002; Wang et al., 1999; Wright et al., 2001, 2002; Hoffmann et al., 2002). Beneficial insects such as *Trichogramma* wasps can be used as part of an integrated management program for European corn borer to reducedamage. *Trichogramma* spp. showed promise as *biocontrol* agents against European corn borer (Gardner et al. 2012). Many authors have hypothesized that greater plant surface area results with lower parasitism rate of the host plant (Ables et al. 1980; Burbutis and Koepke 1981; Wang et al. 1997; Gingras and Boivin 2002). *Trichogramma* wasps show certain level of control against the European corn borer in field maize, sweet corn, potatoes and sweet peppers (Kuhar et al. 2002; Wright et al. 2002; Hoffmann et al. 2006). Since in Croatia there are no reports on natural population of *Trichogramma* in maize, these ones are the first findings.

The aim of this investigation was to determine influence of natural population of *Trichogramma* wasps against European corn borer under different irrigation and fertilization rates in maize field.

MATERIAL AND METHODS

An experiment was set up during 2013 growing season under field conditioned of Agricultural Institute in Osijek. Two maize hybrids have been tested in order to determine the influence of *Trichogramma* wasps on European corn borer damage. Irrigation and nitrogen fertilization treatments were also included in the experiment. The experiment was set up as split-split plot design with three repetitions. The treatment includes three irrigation levels, A1 - control variant, only natural precipitation, A2 - 60% -100% field water capacity (FWC), and A3 - 80%-100% FWC. Three rates of the nitrogen fertilizer (B1 - control variant, B2 - 100 kg N ha⁻¹ and B3 - 200 kg N ha⁻¹) were used. Two different genotypes with

(1) MSc Ankica Sarajlić (ankica.sarajlic@pfos.hr), Prof. DSc. Emilija Raspudić, DSc. Ivana Majić, Prof. DSc. Marija Ivezić, Prof. DSc. Mirjana Brmež – Josip Juraj Strossmayer University of Osijek, Faculty of Agriculture in Osijek, Kralja Petra Svačića 1d, HR-31000, Osijek; (2) DSc Marko Josipović - Agricultural Institute Osijek, Južno predgrađe 17, HR-31000, Osijek

similar vegetation group were tested: C1 = OSSK 596; C3 = OSSK 602. At the end of vegetation, before harvest, dissection parameters were determined from ten maize plant on each variant of the experiment. Tested variables were MC - mass of cob (g), TL - tunnel length (cm), LS - number of larvae in stalk, LES - larvae in ear shank and ESD - ear shank damage. During the vegetation season parasitized eggs with *Trichogramma* wasps were also monitored on ten maize plants of each variant. Only the second generation of ECB eggs was infested with natural population of *Trichogramma* wasps. For the analysis of variance, an ANOVA was carried out with the Tukey test. Statistical Software Package (SAS, 2009) procedure.

RESULTS AND DISCUSSION

The most parasitized ECB egg masses were on 23 August (Figure 1). 14 parasitized egg masses by *Trichogramma* were found on hybrid OSSK 596 at higher level of irrigation and lower level of nitrogen fertilization (A3B2C1). Only one parasitized egg mass was found on few variants on 7th August (A3B1C3, A1B1C3 and A3B1C1). Hybrid C1 had higher number of parasitized egg masses than hybrid C3 in all tested variants. We can say that the peak of the *Trichogramma* wasp flight was in the second half of August in this area.

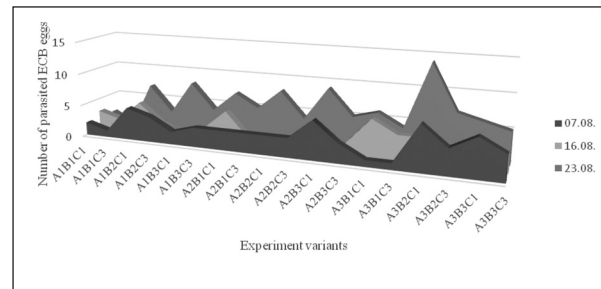


Figure 1. Parasitized ESB eggs by *Trichogramma* wasps

*Slika 1. Parazitirana jajašca kukuruznoga moljca *Trichogramma osicama**

Influence of nitrogen fertilization on tested variables is presented in Table 1. Nitrogen fertilization increased mass of cob in all the tested variants but also increased ECB attack and damage. All the tested variables had greater damage and more larvae number in fertilized variants than the control (Szulc et al., 2008; Yanni et al., 2010). There were no big differences in tested parameters between the two nitrogen fertilization rates. *Trichogramma* wasp infestation was also higher in the variant with higher level of nitrogen but there were no statistically significant differences (Wang et al., 1997).

Table 1. Nitrogen fertilization influence on the tested variables between different hybrids

Tablica 1. Utjecaj dušične gnojidbe po hibridu na ispitivanim varijablama

| Genotype - C1 <i>Genotip – C1</i> | | | | | |
|--------------------------------------|---------------------|--------------------|-------------------|--------------------|-------------------|
| | MC | TL | TLN | ESD | T |
| B1 | 196.81 ^b | 22.27 ^b | 2.05 ^b | 1.53 ^b | 4.00 ^a |
| B2 | 314.11 ^a | 40.70 ^a | 2.51 ^a | 2.20 ^{ab} | 6.00 ^a |
| B3 | 350.48 ^a | 44.85 ^a | 3.52 ^a | 2.68 ^a | 4.66 ^a |
| Genotype - C3 <i>Genotip – C3</i> | | | | | |
| B1 | 192.80 ^b | 16.87 ^b | 1.78 ^b | 1.98 ^a | 2.33 ^a |
| B2 | 318.22 ^a | 31.01 ^a | 2.08 ^b | 1.86 ^a | 3.44 ^a |
| B3 | 356.21 ^a | 33.95 ^a | 2.53 ^a | 2.55 ^a | 3.44 ^a |

Values with different letter in the same column are statistically different ($P < 0.05$)

Plant complexity may have been a factor for pests attraction (Gingras and Boivin, 2002). Hybrid C1 had higher mass of cob than hybrid C3 in all the tested variants except in A2B3 – 343.90; A3B1 – 214.10 and A3B2 – 295.20 (Table 2). By raising nitrogen level mass of cob increased. All B3 variants had high influence on the mass of cob especially interact with irrigation. C1 hybrid was more susceptible to corn borer attack than hybrid C3. In all the tested variants tunnel length was higher at C1 hybrid than C3. Maximum tunnel length was in the variant without irrigation at both levels fertilization at hybrid C1 (A1B2C1-54.17; A1B3C1-51.23) and in the variant with the highest irrigation level and also both levels of nitrogen fertilization (A3B2C1- 40.47; A3B3C1-

50.17). Hybrid C3 had the highest value tunnel length in variant A3B3 (39.16). Number of ECB larvae per plant was also higher on hybrid C1 than C3 in all variants except A3B1 – 1.60. Number of ECB larvae was higher in variants with nitrogen fertilization (B2, B3) than in the control (B1). Ear damage was higher at C3 hybrid than C1 and this can be the reason for smaller mass of cob C3 hybrid. Number of parasitized ECB egg masses was higher in C1 than C3 hybrid in all the tested variants.

Table 2. Influence of all the tested variants on European corn borer damage parameters

Tablica 2. Utjecaj ispitivanih varijanti na parametre oštećenja od kukuruznoga moljca

| | Mass of cob (g) Masa klipa (g) | Tunnel length (cm) Dužina oštećenja stabljike (cm) | Larvae Ličinke | Ear shank damage Oštećenje drške klipa | <i>Trichogramma</i> parasitized eggs Jajašca parazitirana s <i>Trichogramma</i> |
|--------|-----------------------------------|--|----------------------|---|--|
| A1B1C1 | 197.07 ^{cd} | 21.23 ^{defg} | 2.07 ^{abcd} | 1.16 ^{def} | 2.33 ^{bc} |
| A1B1C3 | 181.20 ^d | 17.53 ^g | 1.67 ^{bcd} | 1.70 ^{abcdef} | 1.00 ^c |
| A1B2C1 | 305.13 ^{ab} | 54.17 ^a | 2.67 ^{abcd} | 2.93 ^{abcd} | 5.66 ^{ab} |
| A1B2C3 | 296.67 ^{abc} | 31.70 ^{abcde} | 2.00 ^{abcd} | 2.13 ^{abcde} | 3.00 ^{bc} |
| A1B3C1 | 323.33 ^a | 51.23 ^{ab} | 3.27 ^{abc} | 3.10 ^{abc} | 3.66 ^{bc} |
| A1B3C3 | 305.80 ^{ab} | 36.80 ^{abcdef} | 2.67 ^{abcd} | 3.43 ^a | 3.00 ^{bc} |
| A2B1C1 | 179.27 ^d | 28.23 ^{abcdefg} | 2.50 ^{abcd} | 2.00 ^{abcdef} | 5.33 ^{ab} |
| A2B1C3 | 161.60 ^d | 16.30 ^{fg} | 2.00 ^{abcd} | 2.06 ^{abcdef} | 3.00 ^{bc} |
| A2B2C1 | 342.00 ^a | 27.47 ^{bcdefg} | 2.30 ^{abc} | 1.00 ^{ef} | 4.00 ^{bc} |
| A2B2C3 | 325.27 ^a | 25.57 ^{cdefg} | 2.03 ^{bcd} | 0.63 ^f | 3.00 ^{bc} |
| A2B3C1 | 343.90 ^a | 33.17 ^{abcd} | 3.67 ^{ab} | 1.23 ^{cdef} | 5.66 ^{ab} |
| A2B3C3 | 387.93 ^a | 25.90 ^{bcdefg} | 2.50 ^{abcd} | 1.30 ^{bcdef} | 3.33 ^{bc} |
| A3B1C1 | 214.10 ^{bcd} | 17.37 ^g | 1.60 ^d | 1.45 ^{bcdef} | 4.33 ^{abc} |
| A3B1C3 | 235.60 ^{bcd} | 16.80 ^{efg} | 1.70 ^{cd} | 2.20 ^{abcde} | 3.00 ^{bc} |
| A3B2C1 | 295.20 ^{ab} | 40.47 ^{abc} | 2.57 ^{abcd} | 2.66 ^{abcde} | 8.33 ^a |
| A3B2C3 | 332.73 ^a | 35.77 ^{abcde} | 2.23 ^{abcd} | 2.83 ^{abcd} | 4.33 ^{abc} |
| A3B3C1 | 384.20 | 50.17 ^{abc} | 3.63 ^a | 3.73 ^{ab} | 4.66 ^{abc} |
| A3B3C3 | 374.90 | 39.17 ^{abc} | 2.43 ^{abcd} | 2.91 ^{abcde} | 4.00 ^{bc} |

Values with different letter in the same column are statistically different ($P < 0.05$)

There was no statistically significant and strong correlation between tested parameters and parasitized ECB eggs by *Trichogramma* wasps (Table 3). There was a moderate relationship in the control variant of irrigation between mass of cob and *Trichogramma* wasps but no

statistically significant (0.572). Also, results suggest negative weak correlation between mass of cob and *Trichogramma* wasps in both variants of nitrogen fertilization (-0.424 and -0.416) but not statistically significant.

Table 3. Correlation coefficient between dissection parameters and *Trichogramma* wasps infection in different variantsTablica 3. Korelacijski koeficijent između parametara oštećenja kod disekcije izraženosti jaja *Trichogramma* osicama na različitim varijantama

| | Irrigation levels Varijante navodnjavanja | | | Nitrogen fertilization Varijante dušične gnojidbe | | | Genotype Genotip | |
|---------------|--|--------|--------|--|--------|--------|---------------------|--------|
| | A1 | A2 | A3 | B1 | B2 | B3 | C1 | C3 |
| $r_{mc;t}^1$ | 0.572 | -0.378 | -0.133 | -0.424 | -0.416 | -0.245 | 0.063 | 0.284 |
| $r_{tl;t}^2$ | 0.278 | -0.043 | 0.009 | 0.019 | 0.054 | -0.130 | -0.183 | 0.166 |
| $r_{ls;t}^3$ | 0.120 | 0.225 | 0.247 | 0.455 | 0.147 | 0.021 | 0.214 | 0.066 |
| $r_{les;t}^4$ | 0.023 | -0.018 | -0.161 | 0.043 | -0.080 | 0.054 | -0.163 | 0.206 |
| $r_{tln;t}^5$ | 0.132 | 0.167 | 0.221 | 0.428 | 0.118 | 0.062 | 0.193 | 0.118 |
| $r_{esd;t}^6$ | -0.166 | 0.337 | 0.028 | -0.477 | 0.491 | 0.249 | 0.202 | -0.002 |

¹mc-mass of cob, ²tl-*Trichogramma* infected egg masses, ³ls- number of larvae in maize stalk, ⁴les-number of larvae in ear shank, ⁵tln-total larvae number per plant, ⁶esd-ear shank damage

CONCLUSION

Hybrid C1 was more susceptible than hybrid C3 on European corn borer attack, but this hybrid also had satisfactory yield. In all the tested ECB damage parameters, values were higher in hybrid C1 than hybrid C3. By raising nitrogen fertilization rate ECB damage also increased. *Trichogramma* infected eggs were more in C1 hybrid than C3. Different levels of nitrogen fertilization

and irrigation didn't have high influence on occurrence of the *Trichogramma* wasps. These results suggest that efficacy of *Trichogramma* wasps might be constrained by field corn planted at a greater density, and is typically a taller crop with greater leaf area than other crops. *Trichogramma* activity was not enough strong in natural conditions and it is necessary to apply artificial infestation against this pest.

ACKNOWLEDGMENTS

This work was supported by the Ministry of Science, Education and Sport of Republic of Croatia.

REFERENCES

1. Ables, J.R., Mc Commas, Jr., D.W., Jones, S.L. Morrison, R.K. (1980): Effect of cotton plant size, host egg location, and location of parasite release on parasitism by *Trichogramma pretiosum*. *Southwest. Entomol.*, 5: 261 - 265.
2. Brkić, I., Brkić, A., Ivezić, M., Ledenčan, T., Jambrović, A., Zdunić, Z., Brkić, J., Raspudić, E., Šimić, D. (2012.): Alokacija resursa u programu oplemenjivanja kukuruza za prirodnu otpornost na kukuruznu zlaticu. *Poljoprivreda*, 18: 3.-7.
3. Burbutis, P.P., Koepke, C.H. (1981): European corn borer *Ostrinia nubilalis* control in peppers by *Trichogramma nubilale*. *J. Econ. Entomol.*, 74: 246 - 247.
4. Gardner, J., Wright, M.G., Kuhar, T.P., Pitcher, S.A., Hoffmann, M.P. (2012): Dispersal of *Trichogramma ostriniae* in field corn. *Biocontrol Science and Technology*, 22(10): 1221-1233.
5. Gingras, D., Boivin, G. (2002): Effect of plant structure, host density and foraging duration on host finding by *Trichogramma evanescens* (Hymenoptera: Trichogrammatidae). *Environ. Entomol.*, 31: 1153 - 1157.
6. Hoffmann, M.P., Wright, M.G., Pitcher, S.A. Gardner, J. (2002): Inoculative releases of *Trichogramma ostriniae* for suppression of *Ostrinia nubilalis* (European corn borer) in sweet corn: Field biology and population dynamics. *Biol. Control*, 25: 249 – 258.
7. Hoffmann, M.P., Pitcher, S.A., Cheever, S.A., Gardner, J., Losey, J.E., Kuhar, T.P., Laub, C.A., and Youngman, R.R. (2006): Efficacy of Inoculative Releases of *Trichogramma ostriniae* (Hymenoptera: Trichogrammatidae) Against European Corn Borer *Ostrinia nubilalis* (Lepidoptera: Crambidae) in Field Corn. *Biological Control*, 36: 345 - 349.
8. Kuhar, T.P., Wright, M.G. Hoffmann, M.P. Chenus, S.A (2002): Lifetable studies of European corn borer (Lepidoptera: Crambidae) with and without inoculative releases of *Trichogramma ostriniae* (Hymenoptera:Trichogrammatidae). *Environ. Entomol.*, 31: 482 – 489.
9. Ivezić, M., Raspudić, E., Brmež, M., Majić, I., Brkić, I., Tollefson, J. J., Bohn, M., Hibbard, B.E., Šimić, D. (2009): A review of resistance breeding options targeting western corn rootworm (*Diabrotica virgifera virgifera* Le Conte). *Agricultural and Forest Entomology*, 11: 307-311.
10. Ivezić, M., Raspudić, E., Majić, I., Tollefson, J., Brmež, M., Sarajlić, A., Brkić, A. (2011): Root compensation of seven maize hybrids due to western corn rootworm (*Diabrotica virgifera virgifera* Le Conte) larval injury. *Bulgarian Journal of Agricultural Science*, 17: 107-115.
11. Raspudić, E., Sarajlić, A., Ivezić, M., Majić, I., Brmež, M., Gumze, A. (2013.): Učinkovitost kemijskoga suzbijanja kukuruznoga moljca u sjemenskome kukuruzu, *Poljoprivreda*, 19(1): 11.-15.
12. Szulc, P., Waligóra, H., Skrzypczak, W. (2008): Susceptibility of two maize cultivars to diseases and pests depending on nitrogen fertilization and on the method of magnesium application, *Nauka Przyr. Technol.*, 2(2): 11.
13. Šimić, D., Ivezić, M., Brkić, I., Raspudić, E., Brmež, M., Majić, I., Brkić, A., Ledenčan, T., Tollefson, J.J., Hibbard, B. (2007): Environmental and genotypic effects for western corn rootworm tolerance traits in American and European maize trials. *Maydica*, 52(4): 425-430.
14. Wang, B., Ferro, D.N. and Hosmer, D.W. (1997): Importance of Plant Size, Distribution of Egg Masses, and Weather Conditions on Egg Parasitism of the European Corn Borer, *Ostrinia nubilalis*, by *Trichogramma ostriniae* in Sweet Corn. *Entomologia Experimentalis et Applicata*, 83: 337-345.
15. Wang, B., Ferro, D.N., Hosmer, D.W. (1999): Effectiveness of *Trichogramma ostriniae* and *T. nubilale* for controlling the European corn borer *Ostrinia nubilalis* in sweet corn. *Entomol. Exp. Appl.*, 91: 297-303.
16. Wright, M.G., Hoffmann, M.P., Chenus, S.A., Gardner, J. (2001): Dispersal behavior of *Trichogramma ostriniae* (Hymenoptera: Trichogrammatidae) in sweet corn fields: implications for augmentative releases against *Ostrinia nubilalis* (Lepidoptera: Crambidae). *Biol. Control*, 22: 29-37.
17. Wright, M.G., Kuhar, T.P., Hoffmann, M.P. (2002): Effect of inoculative releases of *Trichogramma ostriniae* on populations of *Ostrinia nubilalis* and damage to sweet corn and field corn. *Biol. Control.*, 23: 149 - 155.
18. Yanni, S.F., Whalen, J.K., Ma, B., Gelinias, Y. (2010): European corn borer injury effects on lignin, carbon and nitrogen in corn tissues. *Plant Soil*, 341: 165–177.

UČINKOVITOST PRIRODNE POPULACIJE OSICA *Trichogramma* U SUZBIJANJU KUKURUZNAGA MOLJCA U POLJSKIM UVJETIMA

SAŽETAK

*Cilj rada bio je utvrditi parazitiranost jajašaca kukuruznoga moljca s osicama roda *Trichogramma* (Hymenoptera: Trichogrammatidae) u prirodnim uvjetima. Pokus je postavljen u Osijeku, Hrvatska, 2013. godine. U pokus su uključene dvije razine navodnjavanja i gnojidbe i dva hibrida kukuruza. Mjereni su parametri oštećenja te tolerantnost hibrida (masa klipa, dužina oštećenja stabljike kukuruza, broj ličinki kukuruznoga moljca po biljci), kao i broj parazitiranih jajašaca osicom *Trichogramma* na oštećenost od kukuruznoga moljca. Hibridi su se značajno razlikovali u pogledu tolerantnosti na parazitaciju kukuruznim moljcem. Parazitacija kukuruznim moljcem povećana je u obje razine gnojidbe dušikom. Poljoprivredna praksa nije značajno utjecala na parazitaciju jajašaca osicom *Trichogramma*. Korelacija između parametara oštećenja od kukuruznoga moljca i parazitiranih jajašaca *Trichogrammom* bila je slaba do umjerena te nije bila statistički značajna. Parazitacija jajašaca kukuruznoga moljca osicom *Trichogramma* u prirodnim uvjetima nije značajno utjecala na oštećenja kukuruza od kukuruznoga moljca, jer je populacija bila malobrojna.*

Ključne riječi: *Trichogramma* osice, hibrid, dušična gnojidba, navodnjavanje

(Received on 25 September 2014; accepted on 20 October 2014 - *Primljeno 25. rujna 2014.; prihvaćeno 20. listopada 2014.*)