POPULATION DYNAMICS OF WCR AND ECB IN MAIZE FIELD IN BEČEJ, VOJVODINA PROVANCE

Branka Popović[1], Snežana Tanasković[1], Sonja Gvozdenac[2], Zsolt Kárpati[3], Csengele Bógnar[3], Matthias Erb[4]

Abstract: WCR and ECB are maize pest present worlwide in Corn Belt. The documented economic level of looses and plant damages of this two pests vary up to 100 %. Experiment was carried out in Vojvodina provance, region Bačka, during vegetation 2014-2015, from Jun until September. During weekly inpection for tree month we recorded present of WCR and ECB in pheromone traps. Both pests shows fluctuating flight during experimental years. The higest catch of WCR (71 specimens - 8 August 2015) and ECB (14 specimens - 14 August 2014). WCR flight shows similarity over the two years. But, ECB flight is more extended in 2015.

Key words: WCR, ECB, population dynamic, maize, Vojvodina

Introduction

Diabrotica virgifera spp. *virgifera* LeConte, Western corn rootworm (WCR) and *Ostrinia nubilalis*, European corn borer (ECB) represents the most destructive maize pests worldwide (Tollefson, 2007; Raspudić et al., 2013). WCR is oligophagous pest, native in USA (Krysan and Smith, 1987). First report of WCR in Europe dates back in 1992 in Serbia, loc. near international airport Surčin (Bača, 1993). Beside the maize as most important host plant, WCR also can be feeding on same grasses (Strand and Dunn, 1990). For WCR maize represent the only reproductive plant (Spencer et al., 2009). Larvae of WCR feeding on maize can cause root injury, reduce plant growth and yield (Meinke et al, 2009). Root damages and yield losses in maize field of WCR are from 2% to 90% (Wesseler and Fall, 2010).

First report of ECB as economically important pest in maize field was in 1835 in France (Coffrey and Worthley, 1927). For ECB maize represent the most attractive nutritive and reproductive plant, but beside the maize ECB can feed and reproduce on more than 220 plant (Lewis, 1975; Ponsard et al., 2004). In XX century indentified three pheromone races of ECB i.e. Z, E and hybrid (Klun et al., 1975). Differences in the sexual pheromone races make the mix of 11-tetradecenil acetate as a pheromone or lure (Kochansky et al., 1975). ECB whit it present can cause plant damages up to 100% and yield losses up to 60% (Bereś, 2012b).

[1]University of Kragujevac, Faculty of Agronomy, Cara Dušana 34, Čačak, Serbia (stanasko@kg.ac.rs);
[2]Faculty of Agriculture, University in Novi Sad, Serbia Trg D. Obradovića 6-8, Novi Sad, Serbia;
[3]Department of Zoology, Plant Protection Institute Hungarian Academy of Sciences, Budapest, Hungary;
[4]Functional Plant Biology, Institute of Plant Sciences, University of Bern, Switzerland.

Material and methods

The experiment was set up in the Northern Serbia, in Bečej, PIK Bečej, locality Breg-Poljanice, Vojvodina province. It was carried out for two years 2014 and 2015 from the 2nd June until the 19th September. In both experimental years we used the Serbian cultivar NS-640.

During both experimental years we selected and labeled 96 maize plants and arranged them into pairs. Every pair contents two plants. One plant in each pair was artificially infested with 4 mL of WCR eggs suspension. One mL of suspension contains 136 WCR eggs. These artificially infested plants were marked with D. The other plant from the pair was the control plant which was marked with C. The C plant was injected whit the same amount of distilled water.

We set up the pheromone traps in corn filed for both species WCR and ECB. Flight monitoring for WCR started by setting traps (Biocontrol, Switzerland) in 26th June 2014 i.e. 2nd July 2015 up to September. ECB traps installed at 16th July 2014 i.e. 11th Jun 2015 up to end of vegetation. Pheromone traps (Csalomon, Hungary) for all three pheromone races of ECB (Z, E and H) and empty traps as a control.

The field was inspected weekly from date of deployment to September i.e. harvest. Each field inspection meant inspection and counting number of caught specimens. Sticky bases in both traps are changing or specimens removing (if small number caught on sticky surface).

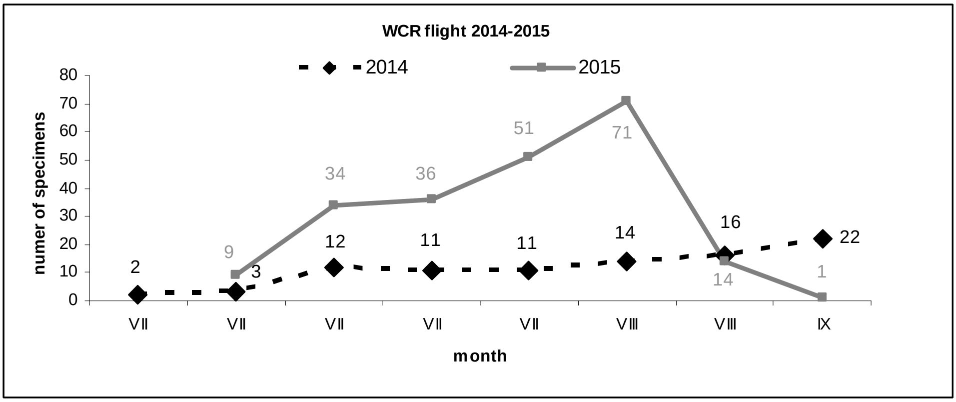
Results and discussion

Behavior and flights of both pests were different as a consequence of different climatic conditions. In general, 2015 represents very dry vegetation with extremely high temperature over the summer part of season (especially during July and August). In the first experimental year the inspections shows that the number of WCR flights was progressing during the vegetation. The least number of caught specimens (Graph 1) registered at the beginning of vegetation i.e. 2.7.2014 - 2 specimens. The highest registered catch with 22 specimens on sticky bases was at end of vegetation (18.9.2014).

During 2015 vegetation year we have more caught specimens then the previous year (Graph 1). Inspection of sticky bases in 2015 shows that the number of WCR flight was fluctuates during vegetation period. The highest number of caught specimens was in middle of vegetation (6.8.2015) when we recorded presents of 71 WCR adults. In the end of vegetation period (10.9.2015) we recorded the smallest number of WCR adult's whit only 1 catch specimens.

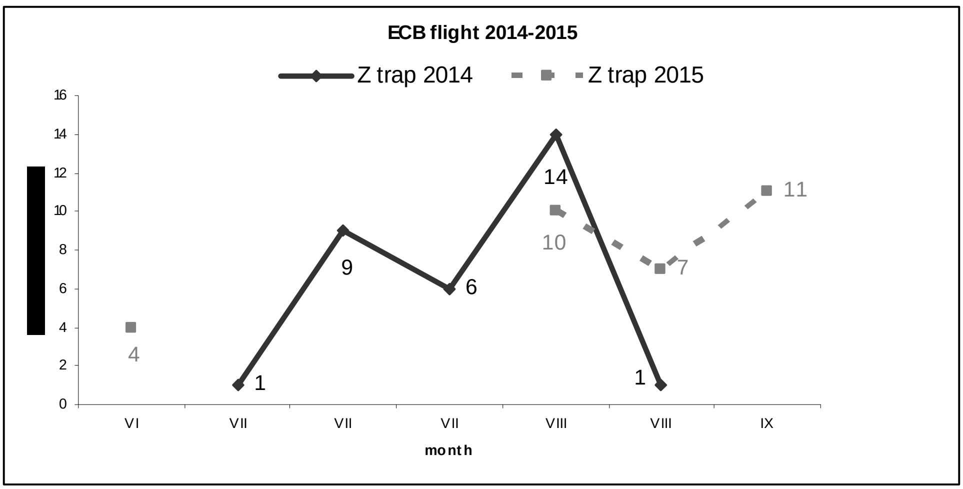
Results of Sivcev et al. (2009) indicate that the highest number of caught adults in pheromone traps was in the period of 25 July until 15 August in Serbia. Largest number of caught WCR adults (22) locality Bečej in 2014 was on September 19, but in 2015 was in August 6 when we caught 71 adults (graph 1). In 2015 the first catch in Bečej was on 9 July and the last was on 10 September. Investigation (Toth et al., 1996; Tollefson, 2007) shows that the highest efficiency of pheromones traps was in mid vegetation, with daily caught of 6 WCR. In the other hand, during the vegetation period from August 27 to September 10 did not register non one imago in traps in Zemun polje

(Tančić et al., 2006). Our experiments and many other studies indicate to progressive and fluctuating catch of adults of WCR in different vegetation period.



Graf. 1. Dinamika populacije Kukuruzne zlatice
Graph. 1. Population dynamic of WCR

According to obtained data in the field we can conclude that the number of ECB fluctuating during vegetation period. The highest catch registered (Graph 2) i.e. 14.8.2014 (14 specimens). The least, 1 specimen were caught at the end of vegetation period (20.08.2014).



Graf. 2. Dinamika populacije plamenca kukuruza
Graph. 2. Population Dynamics of ECB

The inspection of sticky bases in pheromone traps during 2015 vegetation period shows that number of ECB specimens was progressive. First catch was at the beginning vegetation when we catch 4 specimens (23.6.2015). The last catch was at the end of vegetation period when we catch and recorded the biggest number of ECB 11 specimens (1.9.2015). All specimens belong to Z race. Only one specimen of H race caught in observation at the end of August 2015.

In Poland light and pheromone traps are one of the most popular traps for monitoring of ECB flight (Bereś, 2012a). Three years investigations in Poland shows that the first ECB catch in pheromone traps registered on 27 i.e. 28 June (2007-2008). The latest documented catch was on 3 July 2006 (Bereś, 2012a). Obtained results in loc. Bečej (Graph 2) pinpoint that ECB flight period is longer then in Poland even regions have different climatic conditions. ECB flight in cold period was longest than in warm, rainy period whit hot and drought weather (Kania, 1961). Empirical date indicate that climatic factors having the big influence of population dynamic of ECB flight (Cordero, 1998). This is completely accorded with our results.

The number of ECB moths catch in light traps was significantly higher than in the pheromone traps in the same region (Żołnierz and Hurej, 2007). But, population peak in Poland for ECB on maize field was on 3 July, 5 days earlier then in the light trap according to data obtained from phero-traps (Bereś, 2012a). First catch of ECB in 2014, loc. Bečej, was on 24 July and the latest was on 20 August. In 2015 we recorded the first catch on 26 June and the latest on 10 September. In our conditions data obtained from light traps are opposite with data from phero-traps. It is completely expected, because light trap working as attractant for moth in wider region. This indicates necessity of installment phero-traps according to precise prediction for application of insecticides in maize field (Tanasković et al., 2015). Practically, phero traps represent confirmation of ECB presence in the field.

Conclusion

During our further research we will continue monitoring flight activity of WCR and ECB and also we will follow the yield and plant damages on maize caused by larvae and adults of both pest.

Acknowledgment

Research in this work are the part of SCOPES project IZ73Z0_152613/1 funded by CNF Switzerland.

References

Bača F. (1993). New member of harmful entomofauna of Yugoslavia *Diabrotica virgifera virgifera* Le Conte (Coleoptera: Chrysomelidae*)*. IWGO, News Letter, vol. XII(1-2), 21.

Bereś P.K. (2012a). Flight Dynamics of *Ostrinia nubilalis* Hbn (Lep.,Crambidae) based on the light and pheromone trap catches in Nienadowka (South-Eastern Poland) in 2006–2008. DOI: 10.2478/v10045-012-0021-8.

Bereś K. P. (2012b). Damage caused by *Ostrinia nubilalis* Hbn. to fodder maize (*Zea mays* L.), sweet maize (*Zea mays* var. *saccharata* [sturtev.] l.h. bailey) and sweet sorghum (*Sorghum bicolor* [L.] Moench) near rzeszów (south-eastern Poland) in 2008-2010. Acta Sci. Pol., Agricultura 11(3): 3-16.

Caffrey D., Worthley L. H., (1927). A progress report on the investigation of the European corn borer (USDA) Bull. 1476,155pp.

Cordero A., Malvar R.A., Butrón A., Revilla P., Velasco P., Oradás A. (1998). Population dynamic and life-cycle of Corn Borers in South Atlantic European cost. Maydica 43. 5-12.

Kania C. (1961). Zbadań nad omacnicą prosowianką - *Pyrausta nubilalis* (Hbn.) na kukurydzy w okolicach Wrocławia w latach 1956–1959 [Investigations on European corn borer - *Pyrausta nubilalis* (Hbn.) preying on maize in environs of Wrocław in 1956-1959]. Pol. Pismo Entomol., Seria B, 3–4 (23–24): 165–181.

Klun J.A., Cooperators. (1975). Insect sex pheromone intraspecies variability of *Ostrinia nubilalis* in North America and Europe. Environ. Entomol 4. 891-894.

Kochansky J., Card R.T., Liebherr J., Roelofs W.L. (1975). Sex pheromone of the European corn borer, *Ostrinia nubilalis* (Lepidoptera: Pyralidae), in New York. J. Chem. Ecol 1: 225-231.

Krysan J.L., Smith R.F. (1987). Systematics of the virgifera species group of Diabrotica (Coleoptera: Chrysomelidae: Galerucinae). Entomography, 5, 375 – 484.

Lewis L. C. (1975). Natural regulation of crop pests in their indigenous ecosystems and in Iowa agrosystems: bioregulation of economic insect pests. Iowa State J. Res. 49: 435-445.

Meinke L.J., Sappington T.W., Onstad D.W., Guillemaud T., Nicholas J., Miller, N.J., Komáromi J., Levay N., Furlan L.,Kiss, J., Toth F. (2009). Western corn rootworm (*Diabrotica virgifera virgifera* LeConte) population dynamics. Agricultural and Forest Entomology (2009), 11, 29–46.

Ponsard S., Bethenod M. T., Bontemps A., Pélozuelo L., Souqual M. C., Bourguet D. (2004). Carbon stable isotopes: a tool for studying the mating, oviposition, and spatial distribution of races of European corn borer, *Ostrinia nubilalis*, among host plants in the fieldCanadian Journal of Zoology, 82(7): 1177-1185.

Raspudić E., Sarajlić A., Ivezić M., Majić I., Brmež M., Gumze A. (2013). Učinkovitost kemijskoga suzbijanja kukuruznoga moljca u sjemenskome kukuruzu. Poljoprivreda/Agriculture, 19: 11-15.

Sivcev I., Stankovic, S., Kostic, M., Lakic, N., Popovic, Z. (2009): Population density of *Diabrotica virgifera virgifera* LeConte beetles in Serbian first year and continius maize fields. Journal of Applied Entomology, 133: 430-437

Spencer J.L., Hibbard B.E., Moeser J., Onstad D.W. (2009): Behaviour and ecology of the western corn rootworm (Diabrotica virgifera virgifera LeConte) (Coleoptera: Chrysomelidae). Agricultural and Forest Entomology, 11, 9–27.

Strand S.P., Dunn P.E. (1990). Host search behaviour of neonante western corn rootworm (Diabrotica virgifera virgifera) Department of Entomology. Purdue University, West Lafayette, IN 47907. U.S.A. J. lnsecr Ph.uio/. Vol. 36, No. 3, pp. 201-205.

Tanasković S., Popović B., Radovanović M., Gvozdenac S., Vuković S., Prvulović D. (2015): Novija saznanja o kukuruznom plamencu (*Ostrinia nubilalis)*. Biljni lekar. 43 (5):425-433.

Tančić S., Bača F., Gošić Dondo S. (2006): Seasonal Dynamic of the *Diabrotica virgifera virgifera* Leconte (Coleoptera Chrysomelidae) in Zemun Polje (Serbia) Acta Entomologica Serbica, 11 (1/2): 45-50

Tollefson J.J. (2007): Evaluating maize for resistance to *Diabrotica virgifera virgifera* Leconte (Coleoptera:Chrisomelidae). Department of Entomology, Iowa State University, 110 Insecary Bldg., Ames, IA 50011, USA Maydica 52, 311-318.

Toth M., Toth V., Ujvary I., Sivčev I., Manojlović B., Ilovai Z. (1996). Sex pheromone trapping of *Diabrotica virgifera virgifera* Le Conte in Central Europe. Novenyvedelem 32(9), 447-452.

Wesseler J., Fall E.H., (2010). Potential damage costs of *Diabrotica virgifera virgifera* infestation in Europe – the "no control" Scenario. Online at http://mpra.ub.uni-muenchen.de/33231/ MPRA Paper No. 33231.

Żołnierz R., Hurej M. (2007). Porównanie odłowów omacnicy prosowianki przy użyciu pułapek świetlnej i feromonowych [Comparison of European corn borer catches in Ligot and pheromone traps]. Prog. Plant Protection/Post. Ochr. Roślin. 47 (4): 267–271.