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Occurrence of the Western Corn Rootworm (*Diabrotica virgifera virgifera* Le Conte) in Slovenia

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ABSTRACT

Official monitoring of the spreading of *Diabrotica virgifera virgifera* in Slovenia has been organized since 1997. Every year it was carried out by the Agricultural Institute of Slovenia together with Phythosanitary Inspection. To determine the WCR population Hungarian pheromone traps (Csalomon) and yellow sticky traps were placed out in pairs on 58 localities at the end of June 2003. Four additional pheromone traps were placed out at the end of July (Pomurje - 2) and at the beginning of August (Northern Primorska - 2) when the first beetles of WCR were detected. The traps were monitored from July 7th to the end of August every 7 - 10 days. While pheromone traps were changed at intervals of 30 days, the yellow sticky traps were changed more frequently. In 2003 the occurrence of Western Corn Rootworm (WCR) was registered for the first time in the eastern part of Slovenia (Pomurje, Podravje) and its western part (Northern Primorska) too. From the total number of 62 inspected localities in the territory of Slovenia the pest was registered in 14 of them (22.6 %). Fifteen specimens altogether were caught in the eastern part of Slovenia (Gibina, Benica, Mostje, Jastrebcji, Pince, Domanjševci, Loperšice, Motvarjevci, Grabe, Žitkovci, Gaberje) and four specimens in its western part (Vogrsko, Ajševica, Bukovica). We caught 19 specimens altogether. The monitoring was financed by Ministry of Agriculture, Forestry and Food.

Key words: Western Corn Rootworm, *Diabrotica virgifera virgifera*, monitoring, Slovenia

IZVLEČEK

NAVZOČNOST KORUZNEGA HROŠČA *DIABROTICA VIRGIFERA VIRGIFERA* LE CONTE V SLOVENIJI

Sistematično ugotavljanje navzočnosti koruznega hrošča *Diabrotica virgifera virgifera* poteka v Sloveniji že od leta 1997 dalje. Spremljanje je organizirano v okviru Kmetijskega inštituta Slovenije v sodelovanju z Inšpektoratom RS za kmetijstvo, gozdarstvo, lovstvo in ribištvo, Fitosanitarna inšpekcija. Nalet koruznega hrošča smo spremljali s pomočjo madžarskih feromonskih vab (Csalomon) in s pomočjo rumenih lepljivih plošč, ki smo jih postavili v parih na 58 lokacijah konec junija 2003. Ko smo na obstoječe vabe ujeli prve hroščke smo s

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pomočjo feromonskih vab dodatno vzpostavili še štiri opazovalna mesta in sicer konec julija v Prekmurju (2) in v začetku avgusta na Primorskem (2). Vabe smo pregledovali vsakih 7 – 10 dni in sicer od 7. julija do konca avgusta. Feromonske vabe smo z novimi zamenjali po tridesetih dneh, rumene lepljive plošče pa smo menjali pogosteje. V letu 2003 smo v Sloveniji koruznega hrošča zasledili prvič in sicer v vzhodni (Pomurje, Podravje) pa tudi v zahodni (Severna Primorska) Sloveniji. Na skupno 62 opazovalnih mestih smo hroščke ugotovili na 14 mestih (22,6 %). V vzhodni Sloveniji (Gibina, Benica, Mostje, Jastrepci, Pince, Domanjševci, Loperšice, Motvarjevci, Grabe, Žitkovci, Gaberje) smo skupno ujeli 15 hroščkov, v zahodni Sloveniji (Vogrsko, Ajševica, Bukovica) pa 4 hroščke. Skupno je bilo ujetih 19 hroščkov. Sistematično spremljanje koruznega hrošča je finančno podprlo Ministrstvo za kmetijstvo, gozdarstvo in prehrano.

Ključne besede: Koruzni hrošč, *Diabrotica virgifera virgifera*, monitoring, Slovenija

1 INTRODUCTION

Western Corn Rootworm (WCR), *Diabrotica virgifera virgifera* Le Conte, is one of the major maize pests. The beetle was first described in 1868 in Colorado, USA by Le Conte. It is believed the origin of the WCR is in Central America from where it was spread in the northern parts of the continent by maize (Krysan, 1982). As a pest it was referred for the first time in 1909 (Gillette, 1912).

WCR is the most important pest which threatens the maize growing areas in Western USA (Edwards, 1995). Up to 2 t/ha yield losses are recorded. It is estimated that the expenses of chemical control together with yield losses amount to about 1 billion USD/year (Edwards et al., 1999). Maize plants can be damaged by WCR adults and larvae. The most important damages are caused by larvae, which feed on the roots of maize. The eggs are deposited from mid June to September, mostly from the beginning towards the middle of August, in the ground around the roots of maize. Eggs overwinter in the soil. Larvae hatch from the eggs rather late in the spring. They feed on the maize roots and reduce supply of the young plants with water and nutrients. Plants are undersized and frequently fall over after a heavy rains. When the worms are full-grown, they leave the roots and pupate in the soil. The beetles emerge at the end of June or at the beginning of July, depending on the current year. Males appear about one week earlier than females. The beetles feed on the silk and pollen of maize and also on the very young grain and leaf tissue. They are not so injurious and the damages caused by them are mostly negligible except when they occur in greatest abundance. The beetles leave the maize fields and move to the other plants when the silk turns brown and the maize start withering.

In Europe WCR was first discovered in 1992 in Yugoslavia (Bača, 1993). The way WCR entered Yugoslavia is not known, but it was supposed that it was introduced by plane (Sivčev et al., 1996). Since 1992, WCR has been spreading continuously and by the end of 1997 the pest has infested many countries of the South-Eastern Europe: Serbia, Bosnia and Hercegovina, Croatia, Hungary and Romania. In 1998, the first appearance of WCR was also registered in Bulgaria. The first captures in Italy in the vicinity of Venezia airport, Veneto, were recorded in 1998 (Furlan et al., 1999). Beside this, three specimens were also captured for the first time in Italy in 2000 near Milan-Malpensa Airport (Varese) (Boriani & Gervasini, 2000) and numerous WCR specimens in the province Novara (Furlan et al., 2001). In 2000, *D. virgifera virgifera*

beetles were caught in Switzerland near Lugano-Agno Airport and in the Slovak Republic too (Sivicek, 2002). In 2001, WCR specimens were caught in Ukraina (Sadlyak et al., 2001), in 2002, *D. virgifera virgifera* was also discovered in France (Reynaud, 2002), Austria (Cate, 2002) and Czech Republic (Ruzicka, 2003). For Slovenia, very important information about the spreading of WCR came from Croatia in 2000 since the first beetles were captured near the town of Varaždin, only 27 km away from Slovenian-Croatian border (Barčič-Igrc, 2000). Because of that finding WCR was expected to enter Slovenia in that region, so we intensified the monitoring there.

2 MATERIAL AND METHODS

The monitoring of Western Corn Rootworm was carried out by Agricultural Institute of Slovenia in co-operation with the inspectors of Phytosanitary inspectorate. At the selection of control spots representatives of KGZS Nova Gorica (Chamber of Agriculture and Forestry of Slovenia: Agricultural and Forestry Institute Nova Gorica) and M-KŽK (Mercator – Agricultural and food combine) Kranj were consulted.

The control spots were set at regions in which, according to our opinion, the probabilities of the appearance of WCR were the most expressed. Geographically, the control spots were defined by GPS 3000 XL apparatus (Magellan), which helped us define accurate coordinates of the northern latitudes and eastern longitudes. In 2003, the control spots were set in maize fields (53) and pumpkin fields (5) between 23 and 26 June in the regions of Pomurje, Podravje, Posavje, Gorenjska, Northern Primorska. When the first beetles were caught in the region of Pomurje on 23 July two additional control spots were established in Veščica and Velika Polana using only one pheromone traps per spot. Similarly, two additional spots were established in Northern Primorska (Ajševica and Vogrsko) when WCR was caught in Vogrsko on 6 August.

Table 1: The number of the control spots used for the monitoring of WCR (*Diabrotica virgifera virgifera* Le Conte) in Slovenia in 2003 - regionaly

| Region Območje | Number of control spots Število kontrolnih točk |
|--|--|
| Pomurje (M. Sobota, Lendava, Ljutomer) | 20 + 2 additional |
| Podravje (Ptuj, Ormož, Središče ob Dravi) | 16 |
| Posavje (Krško, Brežice) | 8 |
| Gorenjska (Brnik) | 6 |
| Northern Primorska (N. Gorica, Ajdovščina) | 8 + 2 additional |
| Total | 58 + 4 additional |

The monitoring was carried out from the end of June (23. 06.) to the end of August. During that time, pheromone and yellow sticky traps were checked regularly in 7 – 10 day intervals. At the end of July pheromone traps were replaced. Yellow sticky traps were replaced more frequently.

At each control spot (altogether 58), one pheromone trap and one yellow sticky trap were set 50 meters away from each other. Identification of the beetles caught was based on morphological characteristics (Krysan, J. L., Miller, T. A. (1986) Methods for study of Pest *Diabrotica*. Springer Verlag, New York, 260 pp.)

The monitoring of *D. virgifera virgifera* finished in 2003 at the end of August since the maize was harvested one month earlier than in previous years because of very dry weather conditions in the summer.

3 RESULTS

A total 58 principal and four additional control sites were established in the eastern Slovenia along the border with Hungary and Croatia where the maize production in our country is the most intensive (Pomurje: 20 principal + 2 additional, Podravje: 16 and Posavje: 8), and also in the vicinity with Italian border (8 principal + 2 additional) and finally in Gorenjska, around the International Airport of Ljubljana (Brnik) (6).

Table 2: A review of the locations, northern latitudes and eastern longitudes of the control spots for the monitoring of WCR (*Diabrotica virgifera virgifera* Le Conte) in Slovenia in 2003 (Map projection: Gauss Krüger; projected coordinates; $Y = Y' - 5.000.000$)

| Region Območje | Location Kraj | Y | X |
|-------------------|-----------------------|-----------|------------|
| Pomurje | Gibina | 600157.20 | 5153595.00 |
| | Dolnja Bistrica | 599957.10 | 5156855.00 |
| | Hotiza | 602893.10 | 5157121.00 |
| | Kot | 606573.30 | 5157462.00 |
| | Gaberje (pumpkins) | 610359.80 | 5155461.00 |
| | Gaberje | 608535.30 | 5156169.00 |
| | Benica | 613457.30 | 5153942.00 |
| | Pince | 616886.90 | 5154100.00 |
| | Dolga vas (pumpkins) | 612135.50 | 5162010.00 |
| | Mostje | 610559.40 | 5162043.00 |
| | Žitkovci | 605426.40 | 5167047.00 |
| | Malo Kobilje | 608403.70 | 5173030.00 |
| | Motvarjevci | 604399.30 | 5174781.00 |
| | Pordašinci | 601839.90 | 5177888.00 |
| | Prosenjakovci | 599525.80 | 5180444.00 |
| | Domanjševci | 599236.60 | 5182539.00 |
| | Krplivnik | 599236.60 | 5182539.00 |
| | Hodoš | 601498.30 | 5188074.00 |
| | Matjaševci | 583316.30 | 5190821.00 |
| | Kuzma | 583211.50 | 5190940.00 |
| | Velika Polana* | 602323.60 | 5159304.00 |
| | Veščica* | 597278.90 | 5153786.00 |
| Podravje | Dornava | 573196.60 | 5144493.00 |
| | Markovci | 572880.20 | 5142389.00 |
| | Borovci | 574441.80 | 5142161.00 |
| | Cunkovci | 576563.00 | 5141600.00 |
| | Zagojčiči (pumpkins) | 576131.60 | 5140236.00 |
| | Prvenci | 576472.50 | 5140303.00 |
| | Sobetinci | 574458.80 | 5139012.00 |
| | Videm | 570077.70 | 5137231.00 |
| | Loperšice (pumpkins) | 593993.90 | 5140084.00 |
| | Loperšice | 592994.70 | 5139760.00 |
| | Obrež | 596001.30 | 5140146.00 |
| | Grabe | 598589.90 | 5138612.00 |
| | Grabe | 599440.50 | 5138873.00 |
| | mejni prehod Središče | 599302.70 | 5139458.00 |

| | | | |
|--------------------------|------------------|-----------|------------|
| | Vodranci | 596718.40 | 5143431.00 |
| | Jastrebeci | 596757.00 | 5145836.00 |
| Posavje | Dornovo | 536529.90 | 5085395.00 |
| | Skopice | 543199.90 | 5084880.00 |
| | Rigonce | 553248.90 | 5083489.00 |
| | Podgračeno | 550793.30 | 5081317.00 |
| | Jesenice na Dol. | 553595.10 | 5078973.00 |
| | Figerjev most | 554946.20 | 5092605.00 |
| | Gregovce | 554550.60 | 5092602.00 |
| | Orešje | 556884.90 | 5100296.00 |
| Gorenjska | Voglje 1 | 459097.00 | 5119836.00 |
| | Voglje 2 | 458629.80 | 5120457.00 |
| | Voglje 3 | 458655.40 | 5121074.00 |
| | Voglje 4 | 457425.10 | 5119547.00 |
| | Spodnji Brnik | 459348.50 | 5122181.00 |
| | Lahovče | 461432.00 | 5119697.00 |
| Severna Primorska | Šempeter | 394352.10 | 5087969.00 |
| | Vrtojba | 394032.30 | 5086848.00 |
| | Bilje | 393436.30 | 5084564.00 |
| | Bukovica | 396417.30 | 5084187.00 |
| | Vogrsko1 | 399908.30 | 5086870.00 |
| | Vogrsko2 | 399986.30 | 5088604.00 |
| | Vogrsko3 | 400438.50 | 5088795.00 |
| | Ajdovščina | 415192.90 | 5083359.00 |
| | Šempas* | 402282.20 | 5087870.00 |
| | Ajševica* | 399560.30 | 5090433.00 |

* - additional control spots

A total of 62 pheromone traps and 58 yellow sticky traps in the Slovenian regions of Pomurje, Podravje, Posavje, Gorenjska and Primorska were monitored. Male beetles were confirmed in 14 of them; altogether, 19 beetles were caught by pheromone traps and no beetles by yellow sticky traps.

The pest was found for the first time in Slovenia on 23 July 2003 near the villiages Gibina (1 beetle), Benica (2 beetles) and Mostje (1 beetle) in Pomurje and on 24 July 2003 near the villiage Jastrebeci (1 beetle) in Podravje, not far away from the border of Hungary and Croatia. Further monitoring showed that the pest was not yet extended in Slovenia since only few beetles were caught in Pomurje afterwards. WCR was also confirmed on 30 July in pheromone traps placed in maize fields in Pince (2) and Domanjševci (1), on 6 August 2003 in Domanjševci (1), Loperšice (1), Motvarjevci (1) and Grabe (2), on 13 August 2003 in Žitkovci (1) and finally on 20 August 2003 in Gaberje (1).

On 6 August 2003, males of *Diabrotica virgifera virgifera* were caught for the first time in pheromone traps placed in Vogrsko (1), Northern Primorska, 10 km from the Slovenian-Italian border and afterwards in Ajševica (1) on 19 August and in Bukovica (1) on 27 August 2003.

Table 3: Localities and dates of *D. virgifera virgifera* cathe

| Region Območje | Location Kraj | Catching date Datum ulova | No. of beetles caught Št. ujetih hroščkov |
|--------------------|------------------|---|--|
| Pomurje | Gibina | July 23 rd , 2003 | 1 |
| | Benica | July 23 rd , 2003 | 2 |
| | Mostje | July 23 rd , 2003 | 1 |
| | Pince | July 30 th , 2003 | 2 |
| | Domanjševci | July 30 th , August 6 th 2003 | 1 |
| | Loperšice | August 6 th , 2003 | 1 |
| | Motvarjevci | August 6 th , 2003 | 1 |
| | Grabe | August 6 th , 2003 | 2 |
| | Žitkovci | August 13 th , 2003 | 1 |
| | Gaberje | August 20 th , 2003 | 1 |
| Podravje | Jastrebc | July 24 rd , 2003 | 1 |
| Northern Primorska | Vogrsko | August 6 th , 2003 | 2 |
| | Ajševica | August 19 th , 2003 | 1 |
| | Bukovica | August 27 th , 2003 | 1 |

4 COMMENT

The occurrence of *Diabrotica virgifera virgifera* beetles and damages caused by their larvae were registered in Europe in the vicinity of the International Airport Surčin in Belgrade for the first time in 1992. According to the damage registered on maize plants since 1992 it is believed that WCR entered Europe much earlier, probably in 1988 – 1990 (Ilovai, 1997). In 1993 and 1994, the distribution of *D. virgifera virgifera* moved forward for about 50 km from the site it was first detected. The economic damage was found on 60 ha of maize fields, WCR was spread on about 200.000 ha (Edwards et al., 1999). In 1995, WCR has moved forward north- and westwards, so that the pest immigrated to Hungary and Croatia (http://www.eppo.org/QUARANTINE/Diabrotica_virgifera/first_reports.html#hr-dia).

In 1996, the pest spread significantly fast and relatively uniform all over Yugoslavia where it first appeared in 1992. The spreading of WCR continued in Yugoslavia, Hungary and Croatia; adults were first caught in Romania and Bosnia and Hercegovina (Edwards et al., 1999). At the end of the growing season a total of 100.000 km² of maize fields were attacked in Yugoslavia in 1997. About 10.000 km² were attacked with populations which caused economical damages. In 1998, WCR was detected in Bulgaria; few beetles were also caught in Montenegro and even in Italy, in the vicinity of Venezia Airport (Marco Polo di Tessera) (Edwards et al., 1999). On 7 August 2000 the first adult of *D. virgifera virgifera* was found in Slovak Republic in Kosiň nad Iprom (district Veľký Krtis), near the border with Hungary (Siviček, 2000) and in Switzerland near the Airport of Lugano/Agno, in Ticino (Bertossa et al., 2001). The spread of WCR in Europe continued in 2001. The total area infested increased by approximately 37 % from 182.000 km² in 2000 to 250.000 km² in 2001. In 2001, WCR was first observed in the Ukraine (Kiss et al., 2001). In 2002, *D. virgifera* was found for the first time in Austria near the towns of Deutsch Jahrndorf and Andau in Burgenland (near the borders with Hungary and Slovakia) (Cate, 2002), in France, near Roissy and Le Bourget Airports (North of

Paris), and later near Orly Airport (South of Paris) (Reynaud, 2002) and in Czech Republic, in the village of Cejc (district Hodonín) (Ruzicka, 2003). In 2002, 31 WCR specimens were captured in the fields around military Airport of Aviano in Italy (Furlan et al., 2002) which is only about 70 km away from Slovenian-Italian border.

Since maize is one of the major crops in Slovenia covering about 40 % of all arable fields (Urek & Pajmon, 1998) and since the weather conditions in Slovenia are favourable for development and spreading of WCR (Milevoj & Urek, 1996), we joined a project team which is active in frame of EPPO by monitoring the spreading of WCR in 1995 and started its monitoring in Slovenia in 1997. Since some specimens of WCR were found near the town of Varaždin in Croatia (Barčič-Igrc et al., 2000), which is only 27 km from the Slovene-Croatian border, in 2000 we expected that the pest would break out in Slovenia in 2001 or 2002. Surprisingly, we have not detected any WCR despite a rather intensive monitoring mainly in the area bordering Hungary and Croatia until summer 2003. In July and August 2003 we detected some specimens caught by pheromone traps not only at eastern part of Slovenia (which looked like WCR entered our country from Hungary and Croatia), but also in its western part, to which beetles of *D. virgifera virgifera* flew from Italy, most likely from the direction of Aviano. According to our findings it can be stated that WCR entered Slovenia in 2003, but it has not expanded all over Slovenia yet. As far as data about WCR spreading in Europe known until 2002 and the results of our monitoring are concerned, it can be concluded that the movement of beetles in 2003 in Central Europe was much more intensive from the west to the east (from Aviano to Slovenia) than from the east towards the west (from Hungary and Croatia to Slovenia).

5 CONCLUSIONS

Maize is one of the major crops in Slovenia covering about 40 % of all arable fields. Western Corn Rootworm (WCR), *Diabrotica virgifera virgifera* Le Conte, is one of the major maize pests. Slovenia has suitable climatic and trophic conditions for the establishment of *D. virgifera virgifera*. In Europe, WCR was first discovered in Yugoslavia in 1992 and has spread continuously all over the South-Eastern and Western Europe since then. In western Europe the WCR was detected mostly around the international airports from where it was spread in maize fields in their vicinity. The monitoring of WCR started in Slovenia in 1997. In Slovenia, WCR was not discovered at any of control spots established every year until summer 2003. In July 2003, the pest was found in Slovenia for the first time in regions Pomurje, Podravje and Northern Primorska.

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