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Report of the 3rd Meeting of the EPPO ad hoc Panel on *Diabrotica virgifera* held jointly with the 5th International IWGO Workshop on *Diabrotica virgifera*

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1. Opening

The meeting was opened by Mr Kocar, state secretary of the Slovenian Ministry of Agriculture, Forestry and Food, and by Dr Urek Chairman of the organizing committee of the Workshop. Dr Berger welcomed the participants on behalf of IWGO and Mrs Roy on behalf of EPPO.

2. Situation of *Diabrotica virgifera* in the EPPO region

The situation of *Diabrotica virgifera virgifera* (referred to here as *D. virgifera* for convenience) in Central Europe was reviewed during this joint meeting, and several papers were presented to describe the situation in the countries concerned. In summary, the spread of *D. virgifera* continues in Central Europe but at a slower pace than was observed in previous years. Nevertheless, the numbers of adults trapped in all infested countries indicate that populations densities are increasing. As in previous years, except in the parts of Serbia where the pest was first found, no economic damage has yet been seen on maize in other countries. But the numbers of insects caught in some parts of Romania or Croatia (close to the area in Serbia where economic damage are seen) tend to suggest that economic damage may be expected in the near future. New features in the spread of *D. virgifera* are its first records in Bulgaria and Montenegro (YU), and indeed the capture of 7 adults in Italy (see below), which represents a major 'jump' of the insect towards the western European countries. A map presented in Appendix 1 shows the spread of *D. virgifera* in Europe from 1992 to 1998.

Austria

Dr Berger reported that 44 pheromone traps have been placed along the borders with Slovenia and Hungary and all gave negative results.

Bosnia & Herzegovina

In Bosnia & Herzegovina, maize is an important crop covering approximately 200.000-250.000 ha, mainly in the north and north- east parts of the country. *D. virgifera* was first found in 1997 in areas bordering Serbia and Croatia.

In the Federation of Bosnia & Herzegovina, explained Mr Festi◊, a survey on *D. virgifera* was initiated in July 1998 using pheromone and yellow sticky traps in the cantons of Posavina, Tuzla-Podrinje (which are situated in the north near the borders of Croatia and Serbia) and of Una (western part). *D. virgifera* was only trapped in the cantons of Posavina and Tuzla-Podrinje. The pest was found in the region around Tuzla (near Doboj, Gracanica and around Zvornik) and in the north along the river Sava (near Orasje). Populations have increased compared to last year and particularly in the region near the river Sava (border with Croatia). It is felt that *D. virgifera* is spreading along rivers and roads, from eastern and northern parts towards the centre of the country. No larval damage has been seen. Minor damage caused by adults on maize silks has been observed near Orasje (along river Sava).

Dr Ba◊a presented the monitoring results in the Serbian areas of Bosnia & Herzegovina in 1998. Traps were placed near the following localities: Bijeljina, Zvornik, Br◊ko, Pelagicevo, Doboj and Banjaluka. In total, 2858 adults were caught. The greatest numbers were found in the eastern part (Bijeljina, Br◊ko). Only one adult was found in a single locality near Banjaluka. It is felt that the insect is spreading more rapidly along the river Sava towards the west than southwards. Considering the numbers of insects caught in the eastern part, it is supposed that populations have probably reached the economic level, however no indication of damage was given.

Bulgaria

Ms Ivanova explained that maize is an important crop in Bulgaria and it is grown particularly in the north of the country. In 1997, 480.000 ha of maize was grown. After the first IWGO Workshop in Graz (AT) in 1995, a trapping programme was initiated in Bulgaria. Cucurbitacin traps were used in 1995 and 1996, and pheromone traps were used in 1997. Field inspections were also carried out. During the period 1995-1997, results were all negative. In 1998, 220 pheromone traps and 180 yellow sticky traps were placed along the northern and western borders of Bulgaria. Traps were inspected once or twice a week. The first three adults of *D. virgifera* were trapped in August 7th (the last one was caught in September 30th). In total 156 adults were caught. The insects were found in the north-west near the borders with Serbia (YU) and Romania (along the Danube). The highest numbers of insects were caught near Bregovo. It is estimated that the infested surface in 1998 is 200 km^2. This is the first report of *D. virgifera* in Bulgaria.

Croatia

D. virgifera was first found in the east of Croatia in 1995. One adult was caught in a cucurbitacin trap, but now it is considered that the pest was probably already present on an area extending about 30 km from the Yugoslav border and situated to the south of the river Bosut. In 1996, the pest spread westwards (80 km from the Yugoslav border) and adults were trapped in approximately 6000 km². In 1997, the area where adults were trapped reached 9000 km² and the front line of the outbreak was situated 100 km from the Yugoslav border. In 1998, explained Ms Dobrin◊i◖, pairs of pheromone and yellow sticky traps were placed at 138 sites. 64 sites were located in previously infested land, 37 along the line of spread (according to 1997 data) and 37 deep in the non-infested area. Monitoring started on June 25th , the first catch was made in June 26th and the last in September 21st. A total of 3368 beetles was caught (but this number is likely to increase as all data is not available yet). It is felt that the increase in population density in 1998 compared with 1997 is approximately 1.3. In 1998, *D. virgifera* spread towards the west (found in two new localities Nova Gradi✶ka and Gornji Varo✶) and over a distance of 37 km along the river Sava (up to the village Gornji Varo✶; situated at 150 km from the Yugoslav border and 150 km from Slovenia). In the middle part of the front line (in the middle of Croatia), *D. virgifera* spread only 8 km to the west. In the northern part of Croatia, along the border with Hungary, no further spread was observed. In the north of Croatia, there is a marshland area (Kopa◊ki Rit) near Hungary were beetles have been found for the first time in 1998. This marshland may have slowed down the spread of *D. virgifera* but it has not prevented it. At present, it is estimated that *D. virgifera* can be trapped in an area of approximately 9.500 km^2 (in which 200.000 ha of maize are grown). In 1998, damage on maize roots was assessed in Otok (Slavonia, east of Croatia near Serbia). In an untreated plot the average damage rated 3 (using a scale from 1 to 9). However, no impact was seen on yield. It must be stressed that in Croatia no economic damage has been observed in 1998.

Hungary

D. virgifera was first found in Hungary in 1995 in the south of the country. In 1997, *D. virgifera* spread towards the north (up to 100-120 km from the Yugoslav border). In 1996-1997, it was estimated that the pest has moved 40 km to the north and that approximately 10 000 km² were potentially infested by *D. virgifera*. The pest was present in the following counties: Baranya (Villány, Boly), Bács-Kiskun (Kecskemét), Csongrád (Szeged, Csanádpalota, Maroslele-Makó) and Békes (Mezökovacsháza, Mezöhegyes, Battonya, Csnádapáca). The highest population numbers were found in Békes and Czongrád counties. Larvae were seen for the first time, slightly damaging maize roots near Szeged (Czongrád county), but without any impact on maize yield. The situation in 1998 was presented by Dr Princzinger. The monitoring programme was carried out in infested areas, non-infested areas (according to 1997 results) and along the front line of the spread. It showed that the spread was very slow in 1998 but that populations increased. Increase of populations was registered in the following areas: Baranya (Villány, Boly), Bács-Kiskun (Kunbaja, Bácsalmás), Csongrád (Szeged, Csanádpalota, Nagylak) and Békes (Mezöhegyes). In the area of Szeged, slight larval damage was observed but no impact on yield was recorded. *D. virgifera* did not spread towards the north in 1998

(the front line is still approximately at 120 km from the Yugoslav border), but it has slowly moved towards the west.

Italy

Dr Furlan presented the details of the first report of *D. virgifera* in Italy. Following the establishment and spread of *D. virgifera* in Yugoslavia, an alert programme was set up in Italy in order to be able to take containment and eradication measures as soon as the pest is found. A monitoring programme was set up in the north-eastern part of Italy with 12 trapping sites in 1997 and 20 sites in 1998 (1 to 10 pheromone traps per site). Maize field were selected in regions where maize is often grown continuously and also near potential points of entry (airports, firms trading with infested countries etc.). In 1997, no *D. virgifera* was found. In 1998, the first 7 specimens of *D. virgifera* were trapped between 21st July and 13th August in maize fields in Tessera, near the international airport of Venezia (Marco Polo). 3 adults were caught in one trap and the others in 4 separate traps. The shortest distance from the trapping sites to the airport was 500 m. Measures have been applied to try to eradicate or prevent the spread of the pest. In the area where *D. virgifera* has been found (1000 ha) and in its surroundings (5-10 km around the focus), a trapping grid (1 km x 1 km) will be set up and treatments will be applied if *D. virgifera* is found (however, it must be noted that no registered products are available), and the continuous cropping of maize will be prohibited. 10 km beyond this first trapping area, another trapping grid (5 km x 5 km) will also be established. In addition, it is prohibited to move fresh parts of maize and soil from the infested area. This is the first report of *D. virgifera* in Italy. It is unexpected in the sense that, if the pest is spreading westward from the outbreak in the Danube basin, it would have been expected to occur first in Slovenia, Austria or western Croatia. In fact, the origin of this introduction is not known. Air-borne transport from USA or road-borne transport from the Danube basin are both possibilities.

Romania

The first find of *D. virgifera* was made in 1996 at Nadlac (district of Arad – west of the country near Hungary) on yellow sticky traps. In 1997, *D. virgifera* was caught mostly in Arad, Timis, Caras-Severin and Mehedinti districts and it was estimated that an area of approximately 10000 km² was potentially infested. In 1998, said Mr Vonica, the monitoring programme started in June 25th in 11 districts on 240 trapping sites (each site having both pheromone and yellow sticky traps). Insects were caught in small numbers in two new districts: Bihor and Hunedoara, showing that the pest still continues to spread towards the east, and north-east, particularly along the rivers Mure★, Dun◈rea (Danube) and Timi★. It is estimated that an area of approximately 12000 km² is potentially infested. Increase in population densities has been recorded. Although it was noted that in some areas the numbers of adults caught were approaching the economic thresholds (according to US experience), no economic damage has yet been observed in Romania.

Slovakia

On behalf of Mr Sivi◈ek, Dr Edwards presented the results of the monitoring programme in Slovakia. In 1998, 37 traps were placed along the border with Hungary and **no** *D. virgifera* were caught.

Slovenia

Mr Pajmon presented the monitoring programme which has been in place in Slovenia since 1995 in the north-east and south-east of the country, which are two intensive maize-growing areas near Hungary and Croatia. So far, *D. virgifera* has **not** been found in Slovenia. Due to the findings in Italy, the monitoring programme will be intensified next year.

Yugoslavia

It must be recalled that *D. virgifera* was reported for the first time in Europe in Sur◈in, near Belgrade airport in 1992-1993. On behalf of Dr Siv◈ev, Dr Ewards presented the results of the 1998 survey in Serbia (YU). By using 900 pheromone traps, it was observed that *D. virgifera* continues to spread towards the south. It is estimated that in Serbia the infested area was respectively: 0.5 ha in 1992, 6 ha

in 1993, 60 ha in 1994, 275 ha in 1995, 10.787 ha in 1996, 15.695 ha in 1997 and 21.230 ha in 1998. However, damage was only reported near Belgrade, Pozarevac, Novi Sad, and Vr✶ac. This area has increased since last year and is now extending towards the borders with Croatia (on the west) and Romania (on the east). It is estimated that the area on which damage is observed covers approximately 10.000 ha. Ms Kere✶i presented the results of the monitoring done in southern Backa (region around Novi Sad). Results showed that populations levels are still increasing. High infestations occurred in the eastern part of southern Backa as in 1997, and differences previously observed between the east and west parts of this region tend to disappear. Symptoms in maize fields were visible ("gooseneck" symptoms).
It is important to note that *D. virgifera* has now been found for the first time in Montenegro. A few adults have been trapped at three localities (near Bijelo Polje in the north of Montenegro) along a railway track.

3. FAO project

Dr. Edwards (Purdue University, US - coordinator of the FAO project) presented the FAO/TCP project (Technical Cooperative Project) which was initiated against *D. virgifera* in June 1997 and will terminate in February 1999. The field activities of this FAO project include several aspects: 1) a trapping programme for monitoring, 2) an intensive trapping programme for containment and control, and 3) the evaluation of area-wide pest management programmes using Slam (cucurbitacin bait + low dose of carbaryl). A permanent monitoring network was put in place in several countries in order to determine population levels over time. In 1998, permanent pheromone traps were placed in Bosnia & Herzegovina (10 traps), Croatia (10), Hungary (47), Romania (27) in infested areas, at the border of infested areas and in non-infested areas. Traps were inspected weekly or monthly depending on the numbers of beetles trapped, from July to October. The results have been presented above by each country.
In the intense trapping programme for containment and control, both pheromone and yellow sticky traps were used in order to catch males and females. Two to four trapping sites were set up along the leading edge of the infestation in Croatia, Hungary and Romania. When insects are caught in a trap, 12 sets of additional paired traps are placed within the four directions (the distance between traps being 1 km). It was initially felt that this type of intensive trapping could perhaps be useful in river valleys or near mountains to reduce population levels and spread of the pest. However, there was now some scepticism about the efficacy of such intense trapping activities.
In order to control *D. virgifera*, aerial treatments over large surfaces with the commercial product Slam started to be tested in Hungary in 1997. In 1998, a test site near Mezöhegyes (HU), was chosen and approximately 1,800 ha of maize (for seed) was treated (800 ha of silage maize and sweet maize were the untreated control plots). This treatment was done by aircraft and apparently gave satisfactory results, although it must be noted that populations of *D. virgifera* have not reached economic levels in Hungary.
Finally, in the framework of this project, educational material (information leaflets, slides etc.) has been distributed to participating countries.
Dr Edwards also recalled that studies on the potential for movement of *D. virgifera* through Europe have been done by a specialized group of FAO, using a Geographical Information System and various criteria to try to predict the areas where *D. virgifera* could establish and develop. These studies already presented in 1997, indicated that *D. virgifera* has a great potential to spread and develop in Europe wherever maize is grown. Dr Edwards stressed that as the FAO project will end in 1999, other possible donors have to be found to continue these activities.

4. Research reports

Dr Mikl✱s T✱th (HU) presented the development of new types of traps: 1) a non-sticky trapping device (non-saturable and therefore more adapted for the study of population dynamics, specific to *D. virgifera*); 2) floral bait which can be used to catch both males and females of *D. virgifera*; traps containing this floral bait will be available next year.

Ms Bar◆i◖-Igrc (HR) presented a new analysis of the establishment potential of *D. virgifera* in Croatia, and the results were again that the temperatures prevailing in all maize-growing regions of Croatia are favourable to the development of the insect. It was felt that other bioclimatic data related to soil and air humidity should also be included in further analysis.

Many papers were then presented on the possible means of control of *D. virgifera*. Abstracts of these papers will be published in a forthcoming IWGO Newsletter (which can be obtained from Dr Berger in due course).

The results obtained in USA with 'area-wide' treatments using Slam (cucurbitacin + carbaryl in a special formulation, applied by aircraft) was presented by Drs Edwards, Chandler and Tollefson (US). These treatments resulted in a satisfactory reduction of pest populations. The concept of 'area-wide' treatments using Slam was applied in Hungary, at Mezöhegyes, reported Dr Edwards. Although, *D. virgifera* populations have not reached economic levels in Hungary, it was felt that the treatments could reduce population levels satisfactorily.

Ms Zsellér (HU) presented results on the application of Slam by ground machine in Hungary (as aerial treatments may not be practical in many areas in Europe). The efficacy obtained was satisfactory. Dr Kiss (HU) also presented the application parameters which can be used for aerial treatments (by plane or helicopter) in Hungary.

The efficiency of soil insecticides was studied in Yugoslavia by Dr Siv◆ev, and it was found that tebupyrimfos + cyfluthrin, terbufos and chloropyrifos gave the best results. Ms Keresi (YU) presented field studies which were done in South Backa (YU). All tested products were approximately equivalent (terbufos, chlormefos, fipronil, carbofuran, bifenthrin). The insecticides reduced root damage (rated 3 on a scale from 1 to 6 in treated plots, compared to 4 in untreated plots), and also plant lodging (24 % to 48 % lodging in treated fields, compared to 82% in control plots).

Dr Berger (IWGO) made a review of the possible means of biological control of *D. virgifera* and stressed the need for the development of integrated pest management strategies. Although, natural enemies did not give very good results in USA, it was felt that more research should be carried out in this field in Europe as conditions are likely to be different. Dr Ferenc T✱th (HU) has made preliminary studies on spiders, and it was found that *Theridion impressum* was a promising species which could contribute to the control of *D. virgifera* in Europe.

Dr Barna (HU) presented a study on *D. virgifera* in first-year corn following soybean which was carried out in Indiana (US). It can be recalled that larval damage in first-year maize following soybean has been reported in Indiana and Illinois (US). Results have showed that adults *D. virgifera* are present in soybean and that females can lay their eggs in soybean fields. It is felt that surveys in soybean can be used to predict larval damage in maize the following year. Dr Edwards added that these populations of *D. virgifera* seem to have lost their preference for maize, and this appears to be an inheritable trait. The emergence of this new 'variant' threatens the use of crop rotation (with soybean) as a management tool against *D. virgifera*. It was also added that damage on maize following lucerne has similarly been observed in USA.

Dr Hummel (DE) presented results of research carried out in Illinois (US) on the use of a synthetic kairomone to disrupt the orientation of *D. virgifera* in maize fields. This synthetic kairomone (called MCA) mimics the blossom aroma of Cucurbita flowers and attracts both males and females of *D. virgifera*. By applying granules containing MCA in maize fields (with a special machine), disruption effects (on orientation and mating) were observed. It was felt that these studies are a contribution towards a better understanding of *Diabrotica* olfactory communication, rather than a future concept of control (although it is hoped that some applications could be found there in the future).

On behalf of all participants, Dr Berger warmly thanked Dr Urek and his colleagues for the excellent organization of this meeting in Roga✶ka Slatina. Ms Roy informed the participants that EPPO is creating a special Web page on *D. virgifera* (www.eppo.org) to disseminate information on this important pest. Dr Edwards noted that very good work has been done in Eastern and Central European countries and stressed the need for more international cooperation. The next joint EPPO/IWGO meeting is planned in France at a similar date.

APPENDIX 1

Spread of *Diabrotica virgifera* in Europe from 1992 to 1998 (by GY BARNA and C.R. EDWARDS, based on data from Igrc-Barci◈, Festi◈, Furlan, Ilovai, Ivanova, Maceljski, Princzinger, Siv◈ev, and Vonica).