EUROPEAN AND MEDITERRANEAN PLANT PROTECTION ORGANIZATION

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Report of the 4th meeting of the EPPO ad hoc Panel on *Diabrotica virgifera* held jointly with the 6th International IWGO Workshop on *Diabrotica virgifera*

Paris, 1999-11-04/05

PARTICIPANTS

1. Opening

The meeting was opened by Mr Vernède, head of the French NPPO, Ministry of Agriculture. Dr Berger welcomed the participants on behalf of IWGO and Dr Edwards as the coordinator of the previous FAO/TCP project and of a new FAO donor-assisted project.

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, and, in 1999, it has mainly spread northward and southwards. An additional area of about 31000 km^2 was infested. *D. virgifera* has not spread to new countries but is approaching the borders of Slovakia, Slovenia, Austria and Ukraine. Economic damage has been seen on maize in Serbia, as in previous years. The numbers of insects caught in some parts of Romania, Bosnia Herzegovina and Croatia (close to the area in Serbia where economic damage is observed) tend to suggest that economic damage may be expected in the near future. The map in Appendix 1 shows the spread of *D. virgifera* in Europe from 1992 to 1999.

Albania

Mr Çota presented the first year of monitoring for *D. virgifera* in Albania. The monitoring was carried out in the district of Shkodra (north of Albania, near the Former Rep. of Macedonia), in Tirana (near the international airport) and in the area of Durres, with pheromone traps and yellow sticky traps at 12 locations. *D. virgifera* has **not** been found in Albania.

Austria

In 1999, Dr Berger reported that pheromone traps had been placed along the borders with Hungary (in Burgenland and Styria) and near Vienna international airport. *D. virgifera* has not been found in Austria. In 2000, monitoring would extend to counties with fewer maize-growing.

Bosnia & Herzegovina

In Bosnia & Herzegovina, maize is an important crop covering approximately 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 1998, the monitoring was done in the cantons of Posavina and Tuzla-Podrinje (which are situated in the north near the borders of Croatia and Serbia) and Una (western part). It was found only in the first two, in the region around Tuzla (near Doboj, Gracanica and around Zvornik) and in the north along the river Sava (near Orasje). Populations had increased compared to the previous year. particularly in the region near the river Sava (border with Croatia). Minor damage caused by adults on maize silks had been observed in 1998 near Orasje (along river Sava).

In 1999, in the Federation of Bosnia & Herzegovina, explained Mr Berberovic, the survey was done using pheromone traps, yellow sticky traps, PALs traps (with flower volatile bait) and colour traps in the cantons of Posavina, Tuzla, Zenica-Doboj and Una. *D. virgifera* was not found in canton Una. It was found for the first time in the canton Zenica-Doboj (municipalities of Tešanj and Doboj Jug Zenica). Most captures concerned the cantons of Tuzla and Posavina. In canton Tuzla, it was found around Tuzla, Živinice and Lukavac. In canton Posavina (Oraske, Odsak), densities were especially high and it is expected that economic damage might occur in the near future, although no larval damage has been seen this year. The pest is spreading from eastern and northern parts towards the centre of the county, now passing from the plains to more mountainous areas. Future control will mainly be based on avoidance of monoculture.

In the Serbian areas of Bosnia & Herzegovina, in 1998, the greatest numbers of *D. virgifera* were trapped in the eastern part (Bijeljina, Brčko). Only one adult was found in a single locality near Banjaluka. It was felt that the insect was spreading more rapidly along the river Sava towards the west than southwards. Dr Baca presented the results of monitoring for 1999. Pheromone and yellow sticky traps were placed in pairs at 51 locations of 24 communities. 3749 adults were caught at 31 locations. At some of them, populations had reached the level of economic damage and such damage might be observed in 2000, especially at Amajlija, Brodac, Bijeljinan Brezovo Polje and Karakaj, and to a lesser extent at Trnovi, Dragljevac, Tabus and Plazulja. The pest has now reached the central region of Banjaluka.

Bulgaria

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, the insects were found in the north-west near the borders of with Serbia (YU) and Romania (along the Danube). The highest numbers of insects were caught near Bregovo. The estimated infested area was 200 km^2. On behalf of Mrs Ivanova, Dr Edwards presented the results of surveys in 1999 in Bulgaria. 300 pheromone traps and yellow sticky traps were used. The first three adults of *D. virgifera* were trapped on August 2nd (the last one was caught in October 4^{th}). In total, 303 adults were caught (against 156 in 1998). The insect has moved between 25 and 35 km inwards from the Serbian and Romanian borders.

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, *D. virgifera* spread towards the west (found in two new localities Nova Gradiška and Gornji Varoš) and over a distance of 37 km along the river Sava (up to the village Gornji Varoš; 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 (Kopački Rit) near Hungary where beetles were found for the first time in 1998. This marshland may have slowed down the spread of *D. virgifera* but it has not prevented it.

In 1999, Mrs Igrc Barčić reported, pheromone and yellow sticky traps were placed in pairs on 117 sites and were replaced every 25 days. 30% of traps were situated in areas which were not infested in June 1999. About 12000 adults were caught (preliminary results). The Infested area is evaluated at 12750 km^2 in 1999 (against 10500 in 1998, 9000 in 1997, 6500 in 1996) on which 165000 ha of corn are grown. The population densities were much higher and high densities (25 adults) were trapped at locations where the pest was not present last year. Two more counties have been infested in 1999: Koprivnicko-Krizevacka next to Hungary and at its south, Bjelovarsko-Bilogorska. *D. virgifera* spread mainly in the North of the country next to Hungary, and in the middle part of the frontline. It spread to the west along the rivers Sava (120 km from Slovenia) and Drava (100 km from Austria). Despite a very strong traffic from east to west, no spread by vehicles was registered. Damage was assessed in a trial on insecticides carried out at the border with Yugoslavia. The highest damage was 5.5 (Iowa scale), with yield losses of 15-20% in this plot. However, it should be stressed that no economic damage has been reported on farmers' crops in 1999.

France

Maize is grown on approximately 3 million hectares in France (both for grain and silage), with about 25% in monoculture, explained Mr Reynaud, and he presented the theoretical cycle of *D. virgifera* in France obtained using CLIMEX. In 1999, official monitoring was carried out at 16 locations at risk, near airports and in representative maize-growing areas. *D. virgifera* has **not** been found in France.

Germany

Dr Baufeld reported that monitoring for *D. virgifera* started in Germany in 1998 in Baden-Württemberg. In 1999, it extended to Bayern, Sachsen, Nordrhein-Westfalen, Baden-Württemberg, using 161 pheromone traps and 18 MCA (plant kairomone) traps at 53 locations. *D. virgifera* has **not** been found in Germany.

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 km^2 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. In 1998, 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 but that populations increased 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.

In 1999, Dr Princzinger explained, the permanent monitoring network was set up at 19 sites of 9 infested counties with pairs of pheromone and yellow sticky traps. Scout trapping was also done in areas previously not infested using pheromone traps at 105 locations. The two trapping systems caught 9304 adults in total (against 1895 in 1998). *D. virgifera* was trapped in 12 counties: Bács-Kiskun, Baranya, Csongrád, Békes, Fejer, Somogy (up to the southern shore of lake Balaton), Pest, Jász-

Nagykun-Szolnok, Hajdú-Bihar, Nógrád (close to the river Ipoly, near the Slovakian border), Budapest, Tolná, Komaróm-Esztergom (northern part of the country; not far from the Danube and the Slovakian border). *D. virgifera* spread northwards through the valleys and along the Danube. Larval damage was observed in Békés and Csongrád counties, and the economic damage level was reached near Szeged (Csongrád county) in an experimental field grown in monoculture. No damage was reported in farmers' fields in Hungary.

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 fields 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). It was 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.

Mr Furlan presented the eradication strategy developed following this outbreak. A focus area was delimited where *D. virgifera* had been found (1100 ha) and a safety area was defined in the surroundings (7-14 km around the focus, 35000 ha in all). In the focus area, a trapping grid (0.5 km × 0.5 km) was set up using pheromone traps. It was planned that, in this area, treatments would be applied to all the maize if *D. virgifera* was found early in the season, and treatments would nevertheless be applied at the beginning of July. Finally, continuous cropping of maize would be prohibited. In the safety area, a second trapping grid (1 km × 1 km) was established. It was planned that maize fields would be treated within 1 km of the trap if adults were caught and trapping would be intensified.

Mr Vettorazzo presented the implementation of this programme in 1999. Official checks were made to verify that specific restrictions on maize cropping had been respected. Fenitrothion and chlorpyrifos were used for the above-mentioned treatments. In addition, it was prohibited to move fresh parts of maize and soil in which corn was grown in the previous year outside the focus area outside. It was also forbidden to thresh corn before the 1st of October to prevent possible spread of adults. These measures were funded through regional funds to cover farmer's costs caused by the prohibition and costs of treatment and monitoring.

In 1999, only 2 adults were caught, in one trap on July 6th and 26th near the airport. This trap was situated at the limit of the focus area and 11 ha of maize in the safety area was also treated. The eradication strategy therefore seems to have been effective. There was no increase in the number of males captured, and no spread outside the focus area. In the rest of the country, 26 traps were set up in the Veneto region, and 26 in Friuli Venezia Giulia, and no *D. virgifera* was caught. Monitoring in Lombardia, Emilia Romagna and Piemonte also gave negative results.

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, approximately 12000 km² was potentially infested. Increase in population densities was recorded. In 1999, said Mr Vonica, 241 sites were studied (each site having both pheromone and yellow sticky traps). The spread continued towards the east and the north-east within the districts of Bihor, Arad and Hunedoara. In the south, *D. virgifera* spread towards the south-east, along the Danube, near the Bulgarian border, and it reached the district of Dolj. The potentially

infested area is approximately 14000 km^2. Although it was noted that in some areas the numbers of adults caught were approaching the economic thresholds, no economic damage has yet been observed in Romania.

Slovakia

In 1998, 37 traps were placed along the border with Hungary and no *D. virgifera* were caught. In 1999, 39 traps were used along the southern border of Slovakia and near Bratislava and Kosice airports. **No** *Diabrotica virgifera* were caught.

Slovenia

A monitoring programme 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. Mr Pajmon said that the monitoring programme was intensified in 1999 due to the findings in Italy. Trapping was carried out at 50 locations, mainly near the Hungarian and Croatian borders, but also near the Italian border and Ljubljana international airport. So far, *D. virgifera* has **not** been found in Slovenia. The spread in Europe will determine the future monitoring programmes in Slovenia.

Yugoslavia

It must be recalled that *D. virgifera* was reported for the first time in Europe in Surčin, near Belgrade airport in 1992-1993. In 1998, 900 pheromone traps were used and it was observed that *D. virgifera* continued to spread towards the south. In 1998, damage was only reported near Belgrade, Pozarevac, Novi Sad, and Vršac, this area extending towards the borders with Croatia (on the west) and Romania (on the east). In 1998, the area where damage was observed covered 45525 ha. Monitoring done in southern Backa (region around Novi Sad) in 1998 showed that populations levels were 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 tended to disappear. Symptoms in maize fields were visible ("gooseneck" symptoms). In 1998, *D. virgifera* was also 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.

In 1999, Dr Sivcev reported that trapping was done at 282 sites. Populations were denser in the north-east than in the hilly areas of the centre. *D. virgifera* continued to spread southwards along the rivers Ibar (approximately 60 km) and Morava (approximately 20-30 km, to Leskovac). Damage occurred in the same counties as in 1998, and also in the neighbouring areas of Middle Banat and Middle Backa. The mean yield reduction was estimated at 30% (from 5 to 80% damage was observed).

3. New FAO project

Dr. Edwards (Purdue University, US - coordinator of the FAO project) explained that the original FAO/TCP project (Technical Cooperative Project) which was initiated against *D. virgifera* in June 1997 terminated in February 1999. A new project was being planned as a donor-assisted FAO project. It would involve the same countries as the TCP project. It would still consider containment, control and monitoring but would also include research on biology, population dynamics, economic thresholds and management, in particular area-wide management. A meeting of the countries concerned was held after the workshop.

4. Research reports

Dr Imrei (HU) presented the development of non-saturable traps for the quantitative monitoring of *D. virgifera*. An upturned funnel trap was developed for this purpose and was compared to the widely use sticky trap baited with sex pheromone and the newly developed sticky trap baited with flower volatile bait. The design of the funnel trap still needs to be improved. Traps with the pheromone are best used

for detection purposes, whereas traps with flower volatile bait can be used if the capture of females is needed.

Dr Benedek (HU) presented results of sex trapping studies carried out in Hungary in 1997-1999 at four localities to study population development and field damage. The rate of increase varied between years, from 3-6 times between 1997-1998 and 5-25 times between 1998-1999. Two peaks of population were observed, the earliest corresponding to local population emerging from the field or its immediate vicinity, and the latter from invading adults. The absence of the earlier peak might indicate that the area trapped was probably free from the pest.

Dr Kiss (HU) presented the adaptation of the concept of SLAM-based area-wide pest management to the control of *D. virgifera* in Hungary, in order to keep the populations below economic threshold levels in defined areas over multiple years, and to promote a better and safer pest management. Control targets the adults to reduce egg laying. This method has proved effective and should be further developed in Europe.

Mrs Zsellér (HU) presented research on the control of the pest in Hungary for studying the effect of soil and seed-applied insecticides against the larvae in fields grown continuously in maize for 20 years. Neither treatment substantially reduced root damage to plants. It was concluded that effective control of the larvae is very difficult using insecticides, and that rotation seems the most reliable way to avoid economic damage.

Dr Hummel (DE) presented results of research on the use of a plant kairomone for various applications (trapping and monitoring or killing, communication disruption, modifiers of oviposition behaviour). This 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).

Dr Kuhlmann (CH) presented the EU shared-cost RTD action on western corn rootworm that will assess the possibilities for control of *D. virgifera* in Europe by using a multidisciplinary sustainable crop management approach. The main axes of research would be: ecology of the pest; monitoring and crop rotation; survey for natural enemies and possibilities of mating disruption, and analysis of potential dispersal rate, risk of establishment as well as cost benefit of containment strategies.

Several papers were presented on the specific problems linked to the development in the USA of populations of a variant of *D. virgifera* which has adapted to rotation by laying its eggs in soybean fields. This is threatening rotation as the main control strategy and requires other control methods to be developed or improved

Dr Chandler (US) presented adult control strategies against *D. virgifera* to reduce egg-laying capabilities. In particular in the situation where rotation has been overcome, this could be an alternative to soil and foliar insecticides which generally do not allow suitable management. The control of adults proved to be a valuable strategy, although it is labour-intensive and requires a great degree of knowledge of various pest and environmental parameters.

Dr Edwards (US) explained that variant populations are now present in Indiana, Illinois, Michigan and Ohio. This had the effect of increasing the reliance of farmers on pre-planting soil applications. It was

intended to provide tools for adapting treatments to the needs and avoid negative effects. For this, it is felt that surveys in soybean can be used to predict larval damage in maize the following year. Economic thresholds are under development for defining the need of treatment. Under the conditions of the years 1998-1999 there was a strong relationship between the populations in soybean in one year and maize injury the next (but neither in 96-97 nor 97-98).

Various other papers on control were presented. Dr Tollefson (US) presented results obtained on sampling for determining beetle densities to forecast larval populations. A model to predict critical sampling periods was defined. Dr Wilde (US) described the area-wide management of *D. virgifera* in Kansas, using monitoring and treatment thresholds.

From the industry, Dr Staetz (FMC Corporation) presented the strategies and problems encountered when developing insecticides against *D. virgifera*. Dr Ulvé (Pioneer) and Dr Head (Monsanto) presented the results obtained with transgenic rootworm-resistant maize in the USA. The results are promising and could have a practical application in the future.

Finally, Ms Grousset (EPPO) presented the various activities of EPPO in relation to *D. virgifera*, including its listing as an A2 quarantine pest following pest risk assessment, development of recommended specific quarantine requirements, recent approval of an EPPO guidelines for the efficacy evaluation of insecticides against *D. virgifera* and maintenance of various documentation services to inform member countries on *D. virgifera* (in particular a specific page on EPPO's Web site: www.eppo.org).

5. Close

On behalf of all participants, Dr Berger warmly thanked the French plant protection service and ANPP for organizing the meeting, in particular Mrs de Guénin for the pre-workshop organization, and Mrs Petter and her colleagues for relaying her during the meeting.

APPENDIX 1

Spread of Western Corn Rootworm in Europe from 1992-1999 (by C. R. EDWARDS, J. KISS and Gy. BARNA; based on data from Igrc-Barcic, Festic, Furlan, Ilovai, Ivanova, Maceljski, Princzinger, Sivcev and Vonica)