

## WESTERN CORN ROOTWORM (*Diabrotica virgifera virgifera* Le Conte) - APPEARANCE AND DISTRIBUTION IN CENTRAL-SOUTH BULGARIA

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### Abstract

From a plant-protection point of view, corn is attacked by many enemies (multivorous and specialized), which significantly reduce the yield, in individual years they multiply massively and are able to completely compromise the harvest. In recent years, a new corn enemy has appeared, the western corn rootworm (*Diabrotica virgifera virgifera* Le Conte), which is causing significant problems. For this purpose, the appearance and population dynamics of the species were followed. The studies were conducted during the period 2022-2023 in corn fields in the region of Chirpan and Plovdiv on an area of 1000 ha. Carrying out monitoring in the region of Central- South Bulgaria is important for establishing the spread of the species and organizing a whole complex of phytosanitary measures to limit the spread of the western corn rootworm.

**Key words:** *Diabrotica virgifera virgifera*, monitoring, Central-South Bulgaria, maize.

### INTRODUCTION

Maize is attacked by a number of enemies, of which the western corn rootworm (*Diabrotica virgifera virgifera* Le Conte) is an economically important species. Costs in the US for control of this enemy and production losses are over US\$1–2 billion annually and are among the largest for insect control (Metcalf, 1986; Steffey et al., 1994; Sappington et al., 2006). Losses of €300 billion are currently looming, with forecasts of as high as €500 billion.

338 species belong to the genus *Diabrotica* (Wilcox, 1972). Of these, 10 species are of economic importance (Krysan & Mileer, 1986), and three species damage maize (McDonald, 1989): *Diabrotica barberi* Smith & Lawrence, *Diabrotica undecimpunctata howardi* Barber and *Diabrotica virgifera virgifera* Le Conte (Smith & Lawrence, 1967). The species: *Diabrotica barberi* and *Diabrotica virgifera virgifera* are of greatest economic importance. In the USA, out of 32000000 ha of corn areas, 12000000 ha are affected by *Diabrotica virgifera virgifera* (Frolov, 2012).

In 1909, damage by *Diabrotica virgifera virgifera* was first recorded on corn in the United States. In Europe, the species entered in 1992 from America (Krysan & Smith, 1987)

and was first discovered in the area of Surčin, near Belgrade Airport in 1992 on an area of nearly 60 ha by the Serbian entomologist Franja Baća (Baća, 1994; Miller et al., 2005). In the following years, the expansion grew and the pests entered a number of European countries, such as: Hungary (1995), Croatia (1995), Romania (1996), Bosnia and Herzegovina (1997), Montenegro (1998), Bulgaria (1998), Italy (1998) ) and others. (Edwards et al., 1998; Edwards et al., 2010).

In Bulgaria, the western corn rootworm (*D. virgifera virgifera*) was detected for the first time in 1998 in the western part of the country in Vidin region (Orsoya village), and later in Montana region (Bregovo city, Archar village). Today the species can be found in many regions of our country.

Both adults and larvae cause damage to plants. At first the adults make damage that resembles that of the wheat leech (*Lema melanopa* L.), later they feed on the silk by gnawing at the tip and it stands as if cut with scissors. This is the reason for the poor pollination of the cobs. Initially, the larvae feed on the young roots of the plants, later they enter the root system and the root collar, and as a result of feeding, the plants lag behind in their development, the damage site resembles a goitre because growth occurs in the ground part, the stems become

unstable and in rain or wind the plants lie down.

According to Chaing (1973), at 29 larvae on the roots, the plant died.

A special place in the fight against the western corn rootworm (*D. virgifera virgifera*) is monitoring for adults and larvae. In adults, it is carried out by visual observations, using pheromone and pheromone traps.

The density of the larvae is established through soil excavations and observations during the growing season for the appearance of "goose neck" damage.

To limit the spread and multiplication of this enemy, a number of measures are carried out such as: crop rotations, soil treatments, optimal fertilization and use of resistant varieties.

According to Lance & Sutter (1990); Metcalf et al. (1987) plants of the family *Cucurbitaceae* attract adults. For this reason, they are one of the main ingredients in granular food baits for adult forms. When organizing a timely fight against adults, their density and multiplication is significantly reduced, as a result of which losses are reduced and the harvest is preserved.

## MATERIAL AND METHODS

The studies were conducted during the period 2022-2023 in corn fields with hybrid DEKALB® in the region of the city of Plovdiv and hybrid DKC 4709 in the city of Chirpan on a total area of 1000 ha.

For adult monitoring the standard entomological methods were used: visual observations and placement of pheromone traps (Figure 1).



Figure.1 Pheromone traps

Visual observations were carried out on all areas sown with maize during the emergence period. Through them, the phase and state of the surveyed culture were established, as well as the moments of appearance of the individual stages of the enemy. They also give an idea of the density of the species

Pheromone traps were placed during July and counted once every 10 days. They were used to track the appearance of adult individuals in corn fields, as well as their density during the growing season. One pheromone trap is placed every 0.6 ha.

The degree of larval attack was reported on the Iowa scale (1 to 6).

## RESULTS AND DISCUSSIONS

The first adult forms of the enemy in the pheromone traps were detected on July 12 - three in the Plovdiv area and one in Chirpan.

As the weather warmed, the species increased its numbers and in the second half of August, the species reached its highest density, 14 in the fields in Plovdiv and 10 in Chirpan. At the end of August, the density of beetles decreased (Figure 2).

In 2023, the first adults were detected three days earlier than the previous year - the first ten days of July, due to the higher average day-night temperatures for the period in both regions. They reached 27.4°C for Plovdiv and 26.4°C for Chirpan and are a consequence of the higher maximum temperatures for the month (Figure 3, Table 1).

The density of the species began to increase in both areas, with a peak in the multiplication of the species being registered during the first ten days of August. 19 adults were found for the Plovdiv region, respectively 11 for Chirpan. Extremely high temperatures for the period combined with prolonged droughts led to the early harvesting of maize, which explains the lower density of the species at the end of August.

For the period of the study in 2022, 93 adults were caught in Plovdiv and 60 in the corn fields in Chirpan (Figure 4).

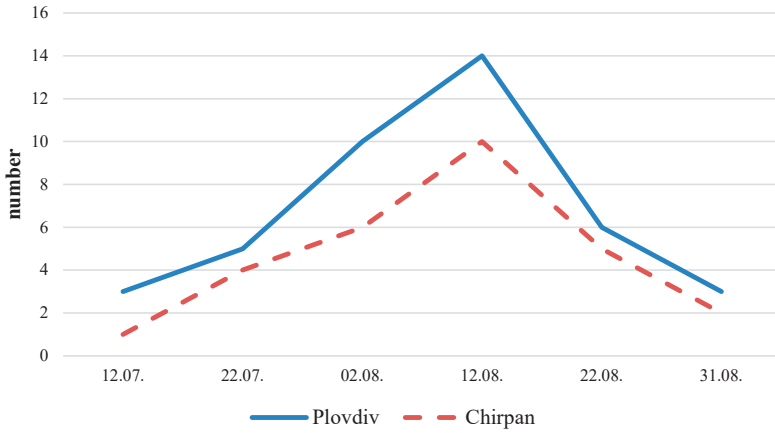


Figure 2. Population dynamics of western corn rootworm in 2022 in corn fields in the regions of Plovdiv and Chirpan

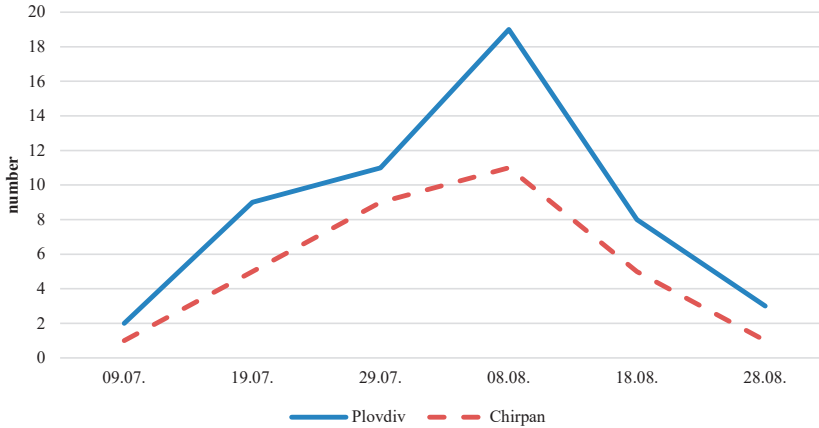


Figure 3. Population dynamics of western corn rootworm in 2023 in corn fields in the regions of Plovdiv and Chirpan

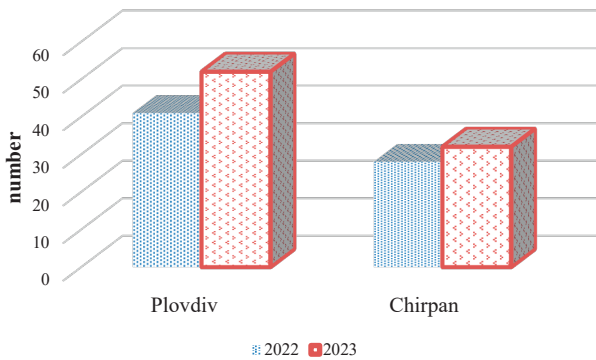


Figure 4. Captured adults of western corn rootworm established in 2022-2023 in corn fields in Plovdiv and Chirpan regions

Damage from the larvae and adults of the western corn rootworm was also reported during the surveys. In 2022,  $5 \pm 0.01\%$  damage by larvae was recorded, and in 2023, respectively,  $10 \pm 0.01\%$  (Figure 5). It's a 2 on the assault. Iowa scale. In 2022, *Diabrotica virgifera virgifera* was

lower in abundance, resulting in  $25 \pm 0.01\%$  damaged plants by adults.

The conditions of the environment in 2023 favored the development of the species, as a result of which the established damages from the adult forms reached  $35 \pm 0.01\%$  (Figure 6).

Table 1. Weather conditions in 2022-2023

		Chirpan			Plovdiv		
Year	Month	VII	VIII	IX	VII	VIII	IX
	Rainfall, mm						
2022		7.7	68.8	34.9	37.3	27.4	16.8
2023		25.4	26.4	30.1	20.4	25.3	35.8
Average T <sup>o</sup> C							
2022		25.1	25.2	18.9	25.3	25.2	19.7
2023		26.4	26.2	21.9	27.2	26.4	21.9
Min T <sup>o</sup> C							
2022		15.4	17.8	12.1	14.7	13.8	5.2
2023		18.0	17.8	14.8	13.9	13.1	10.9
Max T <sup>o</sup> C							
2022		33.1	33.2	27.2	38.6	36.8	35.8
2023		34.8	33.6	29.5	40.8	41.7	35.0

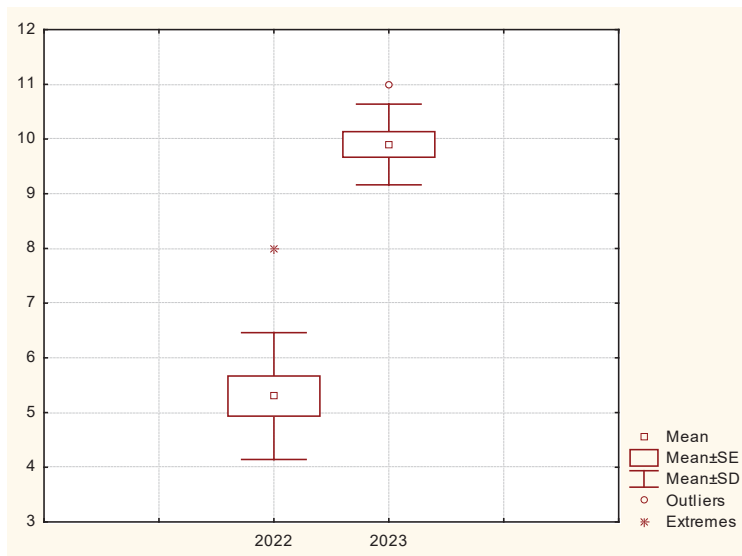


Figure 5. Larval damage (%) in 2022-2023

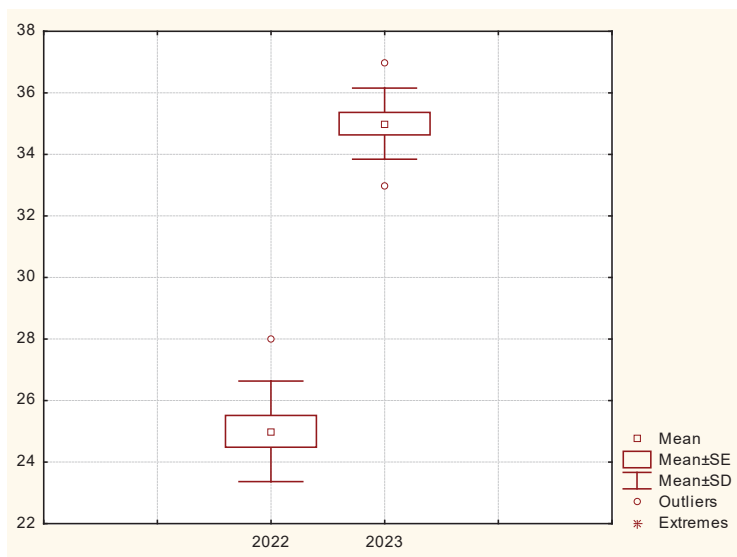


Figure 6. Adult damage (%) in 2022-2023

## CONCLUSIONS

As a result of the observations, the following conclusions and recommendations can be made:

- In recent years, a significant increase in the density of the western corn rootworm (*Diabrotica virgifera virgifera* Le Conte) has been observed in the region of Central- South Bulgaria.

- The first adult individuals in the corn fields were found on July 12, 2022 and on July 9, 2023. The peak in the multiplication of the species was found in the middle of August in both years of the study.

- In 2022, the registered damage from the larvae of *Diabrotica virgifera virgifera* was  $5 \pm 0.01\%$ , and in 2023, respectively,  $10 \pm 0.01\%$ .

- In 2022, *Diabrotica virgifera virgifera* was found in a lower density, as a result of which  $25 \pm 0.01\%$  damaged plants were reported from the adults. The environmental conditions in 2023 favored the development of the species, with  $35 \pm 0.01\%$  of the damage recorded by the adult forms.

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