

## MONITORING AND CONTROL OF ADULTS AND LARVAE OF THE WESTERN CORN ROOTWORM

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**Abstract.** About 27 years ago, the species with invasive status (at that time) called the western corn rootworm (*Diabrotica virgifera virgifera* Le Conte) (Insecta: Coleoptera: Chrysomelidae) was reported in the corn crops in western Romania. It has expanded considerably since then, so that today it is considered an installed species with double damage, of the adult in the aerial part and the larva in the root. However, the studies have stopped, but the pest continues to cause damage to corn crops (a plant useful for human food and as a basis for feeding various farmed animals). That is why we proposed to update the situation of monitoring the populations and the damages produced in Timis county by analyzing some crops with corn hybrids from different categories of maturity by installing sticky yellow traps and direct observations, in 2 years (2022-2023). Thus, we found that the late hybrid attracted more adults and was much more affected in the silks, cobs and panicle compared to the early one which was affected in the leaves and attracted fewer adults. Also, characteristic bent plants as a sign of larval attack were more present in the early hybrid. The efficiency of the traps was taken into account with the double role of capturing and ecological control of adults. As a conclusion, the pest is still present in crops from July to October, and keeping it under control can also be done by using sticky traps available on the market.

**Keywords:** corn, monitoring, western corn rootworm, damage, traps, control

### INTRODUCTION

*Diabrotica virgifera virgifera* (Coleoptera: Chrysomelidae) was introduced to Europe from Central America (place of origin) (SIVCEV AND DRAGANIC, 1996). The first adults were observed in the maize crop in Yugoslavia, in the period 1990-1992 (SIVCEV AND DRAGANIC, 1996). In time it covered all of Europe (BAZOK ET AL., 2021). It entered in Romania migrating from west to east; the first adults were seen in Arad and then in Timis (during 1996-1997) (VONICA, 1996; PALAGESIU ET AL., 2001).

Monitoring observations at the national level had active and inactive periods, somewhat local or zonal, without an evaluation at the national level. The most intensive monitoring activities were carried out in the western and central areas on conventional corn until 5 years ago (GROZEA 2003A; GROZEA, 2003B; GROZEA, 2010; FLORIAN ET AL., 2010; BUJORA ET AL., 2023) and lately due to the increase in the share of organic crops and Bio corn (GROZEA ET AL., 2024).

The most common traps for monitoring adults were the colored sticky panels, with or without pheromone. They are easy to handle and have proven to be effective in attracting catches (TOTH, 2005).

Both the adults and the larvae of this species are harmful, the adults attack the aerial parts of the plant (leaves, panicle, silk and grains) and the larvae cause damage in the soil environment, more exactly in the roots (MOESER AND HIBBARD, 2005). In order to recognize plants attacked by larvae, a preventive assessment can be made by the characteristic symptomatology on the soil surface, namely the "goose-neck" bend (KRYSAN AND MILLER, 1986).

With the present ones, we have proposed to update the monitoring data of the *Diabrotica* species from 2 counties in the west of the country and to see what is the current

status of the species and the attractiveness of corn hybrids because many farmers have noticed their diverse presence.

## MATERIAL AND METHODS

### Study area

The study sites were diverse, in 3 localities (Șag, Jimbolia, Sântana) from 2 western counties of Romania (Timis and Arad). We looked for the climatic conditions to be somewhat similar, as well as the type of soil which was the same (chernozem).

### The type of hybrid used

The corn hybrids were chosen based on the principle of falling into different groups of maturity, the purpose of the work being to see the population level and the efficiency of the traps by category of hybrids. Thus, we chose for analysis about 6 hybrids (Table 1) by the same producer KWS (KWS, 2024) from the category: semi-early, semi-late and late, according to the FAO maturity categories (CROITORU ET AL., 2020).

Table 1

Technical characteristics of the corn hybrids used in the studies correlated with the analyzed surface and the plant samples for the evaluation of the larval attack

No. crt.	Name of hybrid	FAO Group	Maturity category	Cultivated area (hectares)	Plant samples (with root) (no.)
1.	KWS LAURO	FAO 300	semi-early	1	15
2.	KWS OLTENIO	FAO 360	semi-early	1,5	18
3.	KWS INCANTIO	FAO 390	semi-early	1	15
4.	KWS KAPITOLIS	FAO 410	semi-late	3,5	25
5.	KWS BANATO	FAO 430	semi-late	2	20
6.	KWS ADNANO	FAO 470	late	1,5	18

### Trap type

To evaluate the size of the adult populations of *Diabrotica virgifera*, we chose colored (yellow) sticky trap (panel type), which has a dual role in attracting and capturing both forms (females and males) and pheromone traps (TOTH, 2005). In addition, this is quite common and available on the market, being easy to purchase. The description of the hybrids and the classification in the maturity categories was made in accordance with those mentioned by Croitoru et. al (2020). Traps, by attracting and capturing, are considered effective tools in assessing the population level on the one hand and in controlling adults on the other (it works on the principle of attracting-capturing-killing).

### Organization of the experiment

In 6 field crops with corn from the 6 hybrids, we organized the experience delimiting 500 m<sup>2</sup> for each. Two traps (1 with sexual pheromone and 1 without pheromone) were installed in each crop, between July and October. Previous studies showed that the adults flew including in October when the silk is dry and browned and the cobs are mature (GROZEA, 2003). The traps were changed every 3 weeks and the observations were made bimonthly (usually in the first and third decade of the month).

### Assessment of root attack

In order to evaluate the damage produced by the larvae, we pulled out those plants with goose neck symptoms every month and analyzed them at the root in the laboratory in order to identify the presence of the larvae and the absence of the roots.

**RESULTS AND DISCUSSIONS**

The monitoring results of *Diabrotica* adults expressed by trap catches in different maize hybrids or showed different values. Thus, the bimonthly observations revealed a maximum of the flight curve with the same trend for all hybrids, i.e. in the first decade of August (Figure 1). The most catches were at KWS Banato (405 adults) and the least at KWS Oltenio (145 adults).

The late hybrids had 2 flight curve maxima, 1 in the first decade of August and the first decade of September, respectively. By comparison, the early hybrids had 1 single peak in the first decade of August (Figure 1).

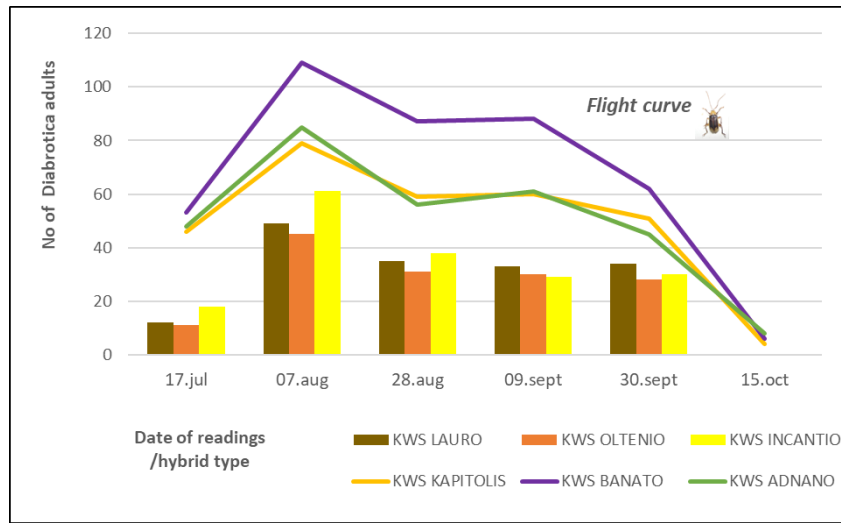


Figure 1. Flight curve of *Diabrotica virgifera* adults based on total catches from July to October, 2022, in the 6 plots with different corn hybrids

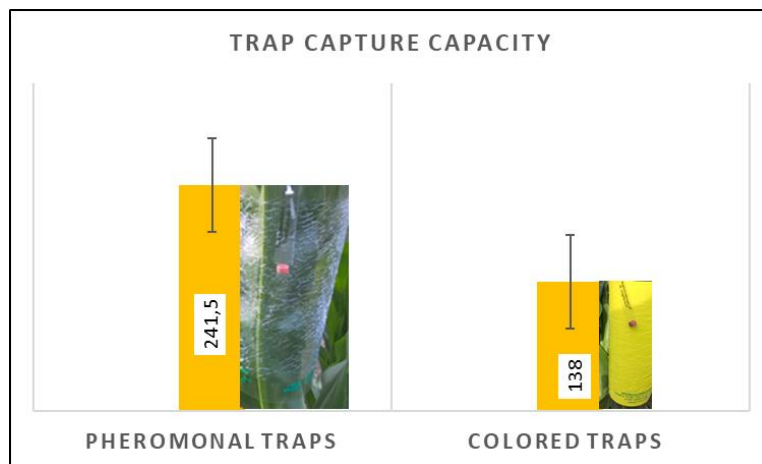


Figure 2. The capture potential of the 2 types of traps (pheromonal and colored)

Figure 2 shows the capture capacity of the 2 types of traps, on the one hand sticky, pheromonal and non-colored, and on the other hand, the sticky, non-pheromonal and colored (yellow).

In the analyzed period, the quantified values from all the traps installed between July and October 2022 showed a big difference between the 2 considered types. Thus, the pheromonal traps attracted and captured almost double the number of *Diabrotica* adults (241.5) compared to the colored ones (138). It is clear that traps with pheromone have an advantage over those without pheromone, as synthetic pheromone is known to capture more males than females. The colored ones have the advantage of attracting the yellow color, which is extremely attractive to insects.

Comparing the catches by maturity category of the hybrids, it was observed that in the 3 early hybrids the values were lower in contrast to the 3 late hybrids with a difference of almost 2.5 times (Figure 3). Thus, at KWS Lauro there were 163, at KWS Oltenio-145, at KWS Incantio-176, at KWS Kapitolis-299, at KWS Banato-405 and at KWS Adnano-303.

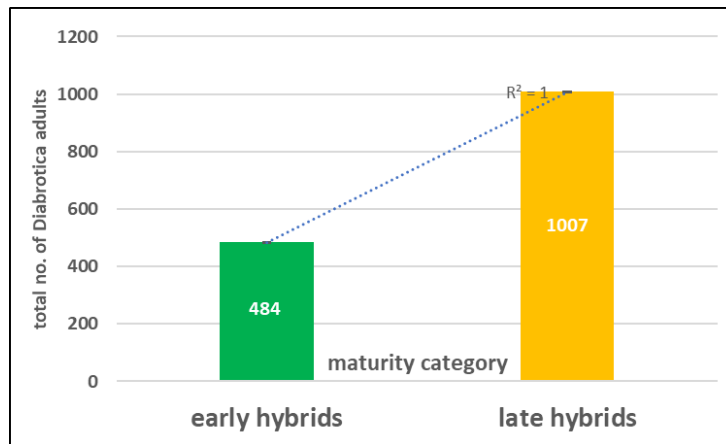


Figure 3. Catches of *Diabrotica* adults according to maturity category of hybrids

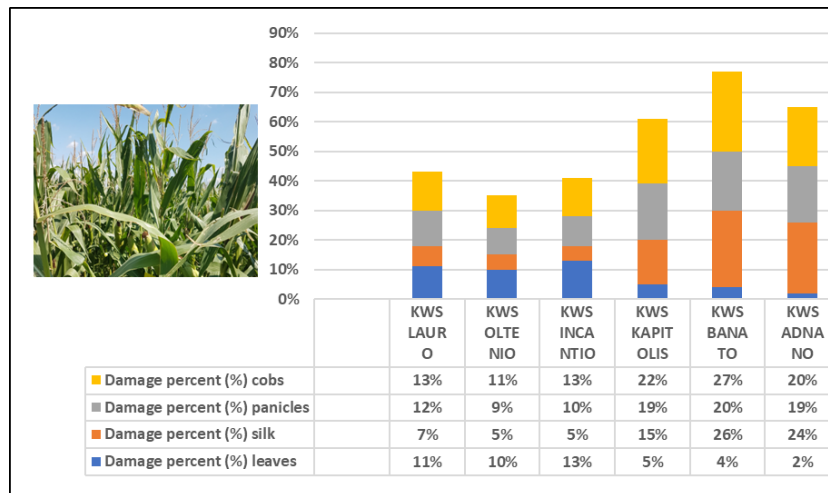


Figure 4. The damage produced by adults in the 6 hybrids depending on the relevant phenophase

The damage produced by adults and larvae in differed depending on the maturity category. In early-hybrids, adult damage was lower and concentrated on leaves (10-13%), while in semi-late and late hybrids it was higher and concentrated on silk, panicle and cobs (15-27%) (Figure 4).

Comparing the damage of adults and larvae by maturity categories of corn hybrids, we found that in early hybrids, throughout the study period (2022-2023), damage to larvae was higher than in late hybrids (respectively 9% and 2%) and in adults was the opposite, higher in the late and semi-late than in the semi-early hybrids (respectively 17% compared to 10%) (Figure 5).

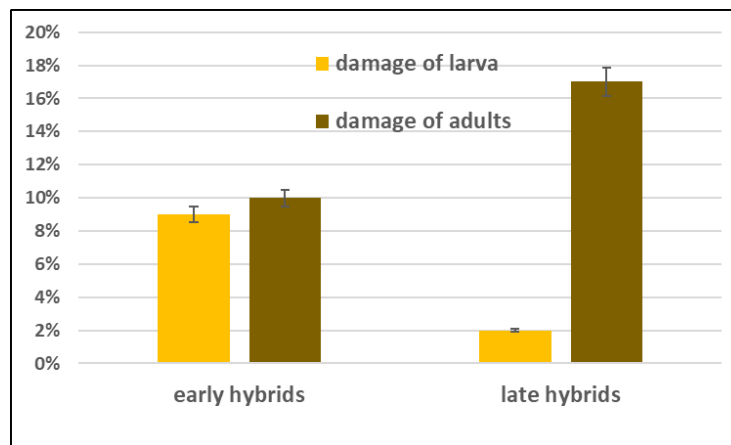


Figure 5. Comparative adult and larval damage by maturity categories of maize hybrids

### CONCLUSIONS

From the results we can conclude that the catches of *Diabrotica* vary quantitatively depending on the maturity category of the hybrid, the phenophase and the type of trap. Thus, the late hybrids attracted more catches of adults than the early ones. Also, more adults were captured in the first decade of August and especially in the later ones at the appearance of the cob, the silk and the panicle. Pheromonal traps were more attractive and effective than non-pheromonal ones. Regarding the damage, the larvae attack the semi-early hybrids more than the later ones, and the adults did the opposite. It is clear that the silk, cobs with grains in milk and pollen from the panicle are the most frequented organs of the plant, and knowing that the adults have a high frequency in August they will be more active on the semi-late and late hybrids. Traps used in monitoring can also have the role of controlling adults in an ecological and inexpensive way.

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