CURRENT SITUATION AND EVOLUTION OF MAIZE PEST *DIABROTICA VIRGIFERA VIRGIFERA LE CONTE* IN ROMANIA

Ioana GROZEA[1], Alina Maria COSTEA[1]
Banat's University of Agricultural Sciences and Veterinary Medicine "King Michael I of Romania" Timisoara, Romania
Corresponding author: ioanagrozea@usab-tm.ro

Abstract. *The status of the harmful Chrysomelidae species Diabrotica virgifera virgifera Le Conte (1831), also known as the western corn rootworm (WCR) or "Colorado" corn beetle, has changed during the 30 years since its installation in Europe and almost 26 years since its first report in Romania. In the first years after entering the territory of the European Union and implicitly in Romania, the insect was included in the category of quarantine species, then in 2013 it was removed from the list. Thus, the attention of specialists, responsible bodies at national level and farmers regarding the tracking and monitoring of the species has decreased or been diminished. However, isolated studies have shown that the species continues to appear frequently, although not officially reported, even in large populations in maize crops and experimental plots, especially in western Romania. At the same time, being a pest with a double attack on plants, the focus on the species required an analysis in a different way on the two active stages (larvae, adults) and in different phenophases. Thus, we set out to bring to attention the importance of the species through an up-to-date analysis of the country's presence and economic importance from personal observations of other researchers or owners of maize crops and relevant press articles. From our results we found that it is still present in considerable populations with aggressive manifestations on plant organs, being reported (on traps, direct or accidental observations) since installation (1996) and until now (2021) with continuity in western crops. country and not only. An updated map of the pest Diabrotica virgifera virgifera is provided through this study so that the scientific and academic world as well as farmers or other interested bodies can get an idea of the status and evolution of the species in Romania.*

Keywords*: Diabrotica, pest, maize, situation, Romania.*

INTRODUCTION

Thirty years ago, in 1992, a new pest appeared in Europe that appeared to be an invasive species called an alien pest at the time. This was spotted near an airport in Belgrade, Serbia (SIVCEV AND DRAGANIC, 1996). Even today it is not known exactly how to enter the European territory, only a few hypotheses support the accidental transport, possibly with the help of airplanes, excluding transmission through the seed's material or soil (CAMPRAG, 1995). This species was immediately identified as the insect *Diabrotica virgifera virgifera* Le Conte from the family Chrysomelidae, order Coleoptera, which comes from the American continent (KRYSAN AT AL., 1980). In the following years, the expansion took place in all directions (EDWARDS ET AL., 1998), implicitly towards the east, thus reaching Romania (PALAGESIU, 1995; VONICA 1996; HANCU ET AL., 2003; GROZEA 2003; OLTEAN ET AL., 2004).

The pest has spread rapidly in Europe in the absence of prevention and control measures, so according to EPPO Report (2003) by Directive 2000/29/ EC it becomes a quarantine pest being included in List A2/ EPPO.

After about 10 years of monitoring and assessing the situation, the European Commission also recommends removing the pest *Diabrotica virgiere virgifera Le Conte* from the list of quarantine pests on the grounds that control measures have not been effective, already occupying 13 European countries (EPPO GLOBAL DATABASE, 2012; REPORT, 2014).

A complete picture of the history of pest evolution in Europe is provided by BAŽOK ET AL. (2021).

The evolution of the pest on the Romanian territory has been continuous and controlled through monitoring (either through the competent national bodies or through research projects) starting with 1996 and continuing until 2010 (GROZEA, 2010). After this period, the interest in the species has suddenly decreased, perhaps due to the European directives that recommended removing the species from the quarantine list. Therefore, all the results following this decision were individual or small group without national coordination.

The monitoring studies, from what we know, in the western (the first occurrence point), central, northern, southern and eastern areas started after 2010 were managed by some doctoral theses (PĂRĂU, 2009; TRUSCĂ, 2013; HORGOS, 2015), scientific papers (FLORIAN ET AL., 2013; MANOLE ET AL., 2017; HORGOS AND GROZEA, 2020), articles in the press (BASF, 2020), reports (BULLETIN ONF DOLJ, 2018) own work or personal observations (Grozea, unpublished data).

Through this work we will bring current information about a pest species that had an evolution worthy of consideration, being initially considered an extremely dangerous quarantine species for corn in Europe, then its status has changed into a well-known pest due to its rapid spread. The focus of our study is primarily on the evolution in Romania and on the knowledge of the current status on this territory. There is few scientific data in the last 10-12 years, however, *Diabrotica virgifera virgifera* is still present and continues to surprise, being more and more often observed both in established areas and in areas where it did not excel.

MATERIAL AND METHODS

The studies of this work are a combination of monitoring information collected from reports, revealed articles in the press, relevant scientific papers but also unpublished personal data from 2011-2021 (obtained through individual activities or coordinated monitoring using Csalomon pheromone traps).

All these led to the elaboration of distribution maps from 3 monitoring periods 1996-2000, 2001-2010 and 2011-2021.

Our study had as a benchmark and comparative factor the distribution map from the research report from 1996-2010 (www.diabrotica.ro). Starting from this, 2 other distribution maps were created, on the same model of Grozea (2010).

The directions of movement were also estimated taking into account the geographical, climatic factors and the availability of the food source at the level of the Romanian territory.

The direct observations on the damages caused by the active stages were made in the period 2011-2021 by traveling and gathering information from locals or farmers, in the areas where the pest was newly reported. The exception is the western, south western and north western areas where the pest has been permanently monitored by doctoral thesis, dissertation and license coordinated by Grozea.

RESULTS AND DISCUSSION

The data collected and combined with own studies showed that the entire surface of Romania was invaded by the corn pest *Diabrotica virgifera virgifera Le Conte*. Thus, almost 26 years have passed since the first signalling in the western part of the country (Nadlac locality, Arad County; 1996) and 25 years since the second signalling in the second western county (Grabat locality, Timis County, 1997) (figure 1).

Regarding the current national status (2021), it is shown in table 1 and shows that in all 7 geographical areas of Romania where maize is grown, the pest was present.

In the western areas, where it was first observed in Romania, the active stage (adult or larva) was present in continuous populations (year by year) even under treatments, also was present everywhere and the damage was obvious on corn plants. The same situation was found for the South East.

In the Central and North-East area, the situation was slightly different in the sense that the adults were present in discontinuous populations (years in which it appears alternating with years in which it does not appear); also, were partially present depending on geographical factors (altitude) or climatic. In the south, the larvae were in a similar situation. For the northeast the larvae were present in small populations, the attack was isolated and this is probably because the pest was recently installed (table 1).

Table 1

The current national status of *Diabrotica virgifera virgifera Le Conte* in maize growing regions from Romania

Maize growing regions	*Diabrotica virgifera virgifera* Le Conte		
	Current status in Romania		
	Adult	Larva	Damage
West	***	***	+
South West	***	***	+
North West	***	**	+
Center	**	**	+
South	***	**	+
South East	***	***	+
North East	**	*	+

*** The stage is present in continuous populations (year by year) even under treatments; present everywhere
** The stage present in discontinuous populations (years in which it appears alternating with years in which it does not appear); partially present depending on geographical factors (altitude) or climatic
* Pest present in small populations; isolated; recently installed
+ The damage is obvious on corn plants

Table 2

The current status of the damage caused by the active stages of the species *Diabrotica virgifera virgifera Le Conte* in maize growing regions from Romania

Maize growing regions	*Diabrotica virgifera virgifera* Le Conte		
	Damage caused by the active stages		
	Damage on root	Damage on leaf	Damage on silk and pollen
West	+	+	+
South West	+	+	+
North West	+	+	+
Center	+	+	+
South	+	+	+
South East	+	+	+
North East	+	+	+

+ The pest is present and causes damage to various plant organs

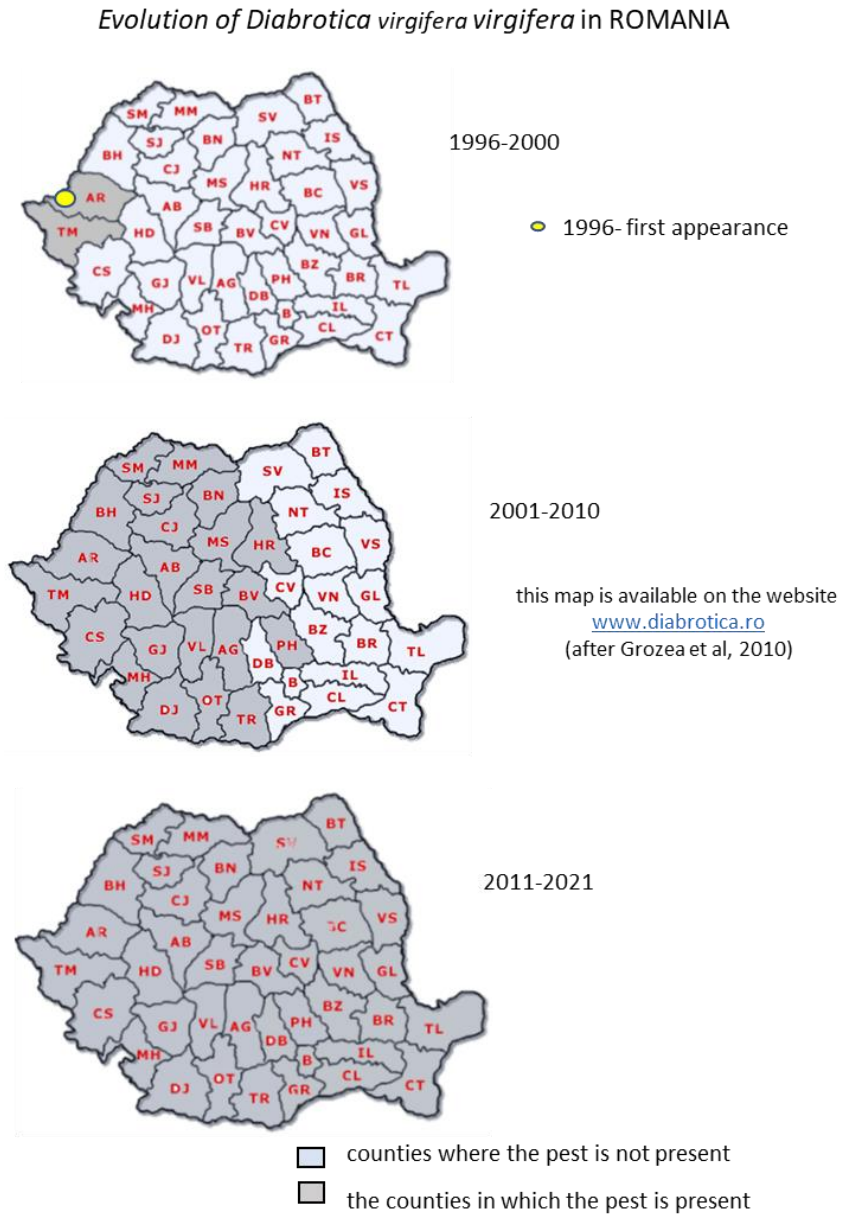

Fig. 1. The evolution of the species *Diabrotica virgifera virgifera* Le Conte in Romania from the moment of the first report (1996, Arad County) until now (2021-2022); The maps were divided into 3 periods: 1996-2000: after data from Vonica I (first report in Arad) and Grozea, 2003 (Timis County); period 2001-2010: after Grozea, 2003, Grozea 2010 (results of national research project-map available at www.diabrotica.ro) and period 2011-2021: after Grozea I (unpublished personal data)

Related to damage caused by the active stages in all maize-growing areas in Romania, the pest caused damage that was observed on plants, either at the root (by larvae) or on leaves or silk and pollen (by adults) (table 2).

In figure 1 it can see the evolution of the pest in Romania in 3 periods of analysis.

In 1996 - 2000 was considered the first period, or reporting period when the species was reported. The map marks the 2 pioneer counties, the first Arad County and the second (Timis county) (first map/figure 1).

The period 2001-2010 is the installation period and the map includes marked counties from more than half of the Romanian territory (middle map/figure 1).

The period 2011-2021 is the period of extension on the whole surface of the country (map bellow/figure 1).

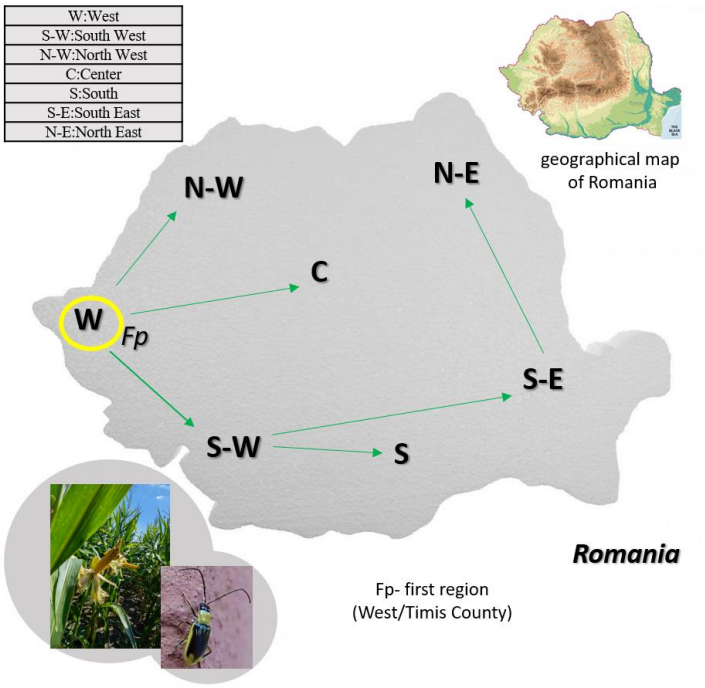

Fig. 2. Possible movement followed by adults of the pest *Diabrotica virgifera virgifera Le Conte* in flight in various directions and corn-growing regions of Romania (taking into account the barriers of high mountainous areas)

The directions of movement of *Diabrotica virgifera virgifera* populations are shown in Figure 2. These show that from the western area (as the first signaling point) the pest has spread inside the country through 3 directions of flight: south east, center and north. The mountains were a barrier that limited the extension, so the only direction that allowed them to pass was through the south. Then the pest continued to move south east, then climbed northeast depending on food availability and climatic factors.

CONCLUSIONS

The pest *Diabrotica virgifera virgifera* Le Conte has been observed in corn crops throughout Romania. This is sounding the alarm to all farmers and cultivators of large and small areas, from areas of various altitudes (from the plains to the plateau) who are likely to face this aggressive corn pest in the future.

ACKNOWLEDGEMENT

We express our gratitude to the farmers and locals who allowed us to install traps and observations on the corn plants.

BIBLIOGRAPHY

BASF (2020). Viermele vestic al rădăcinilor de porumb a devenit spaima producătorilor din întreaga țară. Article in Press./ The western corn rootworm has become a scare for growers across the country. Article in Press. https://www.agro.basf.ro/ro/stiri/basf-in-camp/editorial-viermele-vestic-radacini-porumb.html.

BAŽOK R. LEMIĆ D., CHIARINNI F, FURLAN L. (2021). Western Corn Rootworm (*Diabrotica virgifera virgifera LeConte*) in Europe: Current Status and Sustainable Pest Management. Insects. 12, 195. https://doi.org/ 10.3390/insects12030195.

BULLETIN NATIONAL PHYTOSANITARY OFFICE, DOLJ (2018). Warning bulletin. Nr. 67. https://www.primariacraiova.ro/pozearticole/userfiles/files/01/18930.pdf.

EDWARDS C.R., IGRC-BARĆIC J., BERGER H.C., FESTIC H., KISS J., PRINCZINGER G., SCHULTEN G., VONICA I. (1998). Overview of FAO Western Corn Rootworm containment and control program. IWGO Newsletter. 18 (1): 13-14.

EPPO (2014). *Diabrotica virgifera virgifera* is no longer a quarantine pest for the European Union Reporting Service no. 02 – 2014.

EPPO GLOBAL DATABASE (2012). Current pest situation evaluated by EPPO on the basis of information dated 2011. https://gd.eppo.int/taxon/DIABVI/distribution/RO.

FLORIAN T., OLTEAN I., BUNESCU H, TODORAN F.C., FLORIAN V. (2013). Results obtained in the biological control of western corn root worm, Diabrotica virgifera virgifera Le Conte (2007-2010). Journal of Food, Agriculture & Environment Vol.11 (1): 306-308.

GROZEA I. (2003). Biology, ecology and control of the western worm of maize roots (*Diabrotica virgifera virgifera Le Conte*) in the conditions of the Western Plain. Doctoral thesis, USAB Timişoara 215 p.

GROZEA I. (2003). Some aspects of corn plants damaged by *Diabrotica virgifera virgifera Le Conte* species. USAMVB, Scientific Paper of Agriculture. 35:503-507.

GROZEA I. (2010). Western Corn Rootworm (WCR), *Diabrotica virgifera virgifera Le Conte*-Several Years of Research in Western Part of Romania. Bulletin USAMV-Agriculture. 67(1): 122-129.

HANCU M., ROSCA I., PALAGESIU I., GROZEA I. (2003). Monitoring of the western corn rootworm (*Diabrotica virgifera virgifera Le Conte*) in Timis county, from 1997 to 2002. 9th IWGO Diabrotica Subgroup Meeting and 8th EPPO ad hoc Panel, Belgrade. p 9.

HORGOS H. (2018). Evidenţierea variabilităţii fenotipice din populaţiile adulte de *Diabrotica virgifera virgifera Le Conte* în condiţii bioecologice diverse. Teza de Doctorat.USAMV Regele Mihai I al Romaniei Timisoara./ Highlighting the phenotypic variability in adult populations of Diabrotica virgifera virgifera Le Conte in various bioecological conditions. Doctoral Thesis. USAMV King Mihai I of Romania Timisoara.

KRYSAN J., SMITH R.F., BRANSON T.F., GUSS P.L. (1980). A new subspecies of *Diabrotica virgifera* (Coleoptera: Chrysomelidae): description, distribution, and sexual compatibility. Annals of the Entomological Society of America. 73(2) : 123-130.

MANOLE T, CHIRECEANU C., TEODORU A (2017). Current Status of Diabrotica virgifera virgifera LeConte, 1868 (Coleoptera: Chrysomelidae) in Romania. Acta Zool. Bulg. 9, 143–148.

OLTEAN I., PĂRĂU T., PREJA A., INOAȘ V., TELEGARU M., VOICHIN N., (2004). Monitorizarea speciei de Diabrotica virgifera virgifera Le Conte, în judeţul Alba. Rev. Protecţia Plantelor XIV (55-56): 23-28.

PĂLĂGEȘIU I. (1995). Diabrotica virgifera Le Conte un dăunător potenţial al porumbului în ţara noastră. Agricultura Banatului II. 6, 20/ *Diabrotica virgifera Le Conte* a potential pest of corn in our country. Agriculture of Banat II. 6, 20.

PĂRĂU T. (2009). Cercetări privind răspândirea, morfologia, biologia şi combaterea dăunătorului *Diabrotica virgifera virgifera Le Conte* în conditiile ecologice din Transilvania şi influenta acestuia asupra infectiilor cu unele boli parazitare, Teză de Doctorat. USAMV Cluj Napoca./ Research on the spread, morphology, biology and control of the pest *Diabrotica virgifera virgifera Le Conte* in the ecological conditions of Transylvania and its influence on infections with some parasitic diseases, Doctoral Thesis. USAMV Cluj Napoca.

SIVCEV I., DRAGANIC M. (1996). Kukuruzova zlatica (DvvLC) rasprostranjenost I stete u Srbji u 1996 I zastita kukuruza u monokulturi. XXV Savetovanje Zovka.

VONICA I. (1996). Monitoring for Diabrotica virgifera in Romania. IWGO News Letter XVI. 2, 15.

www.diabrotica.ro. *Diabrotica virgifera virgifera Le Conte*.