Volume 15(4), 55- 59, 2011
JOURNAL of Horticulture, Forestry and Biotechnology

Impact of soil works on the dynamics of the population of *Diabrotica virgifera virgifera* Le Conte

Rancov I.[1]*, Cârciu G.[1]

[1]Banat University of Agricultural Sciences and Veterinary Medicine Timişoara, Faculty of Horticulture and Forestry;

*Corresponding author. Email: cristi_rancov@yahoo.com

Abstract *Diabrotica virgifera* is mainly a pest of maize (*Zea mays*), but other plants can occasionally be its hosts, such as some plants belonging to the Family Poaceae for larvae and to the Families Poaceae, Asteraceae, Fabaceae, and Cucurbitaceae for adults. There are over 22 host plant species, but maize is the most important plant host economically. Western corn rootworm can seriously damage maize roots and can result in yield losses (11). In order to determine the dynamics of the population of *Diabrotica virgifera virgifera* Le Conte, we have chosen as a research method ploughing, grubbing, and disking. Working the soil makes conditions favourable to plant development which in most cases makes them more tolerant to the attack by some pests (4). In the trial fields in Grabat and Lenauheim we set 48 isolators to determine visually the way in which these works influence the population of *Diabrotica virgifera virgifera* Le Conte. Results show that there is a correlation between the chosen soil work and the pest attack degree. Research show that grubbing had the least significant effects on the population of *Diabrotica virgifera virgifera* Le Conte, while ploughing had significantly stronger diminishing effects on this pest.

Key words

Diabrotica, pest, population, isolator, plough, disc, grubber

Preliminary studies concerning the setting potential of the western corn rootworm and carried out by researchers from Croatia, France, Germany, and FAO for Europe show that this insect pest can survive and thrive wherever maize is cultivated. Researches aimed at clarifying the main aspects concerning the biology and the ecological factors favouring the development and mass multiplication turning it into a key-pest of maize crops (1, 2, 3, 6, 7, 9, and 10). The Western Corn Rootworm (*Diabrotica virgifera virgifera* Le Conte) is economically the most important corn pest worldwide. In the U.S.A. and in Canada the western corn rootworm causes annual losses of about one billion U.S. $ due to yield loss and expenditure on pest control (5, 8)

Materials and Methods

Due to the fact that *Diabrotica virgifera virgifera* Le Conte is a quarantine pest, we need to develop pest control measures and strategies. To do so, we monitored the behaviour of the population of *Diabrotica virgifera virgifera* Le Conte in a maize monoculture. The trials were carried out in two localities: one in Grabaţ, and the other one in Lenauheim, in the near vicinity of Grabaţ, with 56 m between the two trials. Each trial had 4 replicates on 12 plots. In each replicate we set 2 isolators 10 m from the replicate margin and 12 m between them. This meant 24 isolators equally distributed on 24 plots. Determining the dynamics of the population of *Diabrotica virgifera virgifera* Le Conte was done visually on a weekly basis. The procedure consisted in checking the isolators (the cages) in all replicates and in numbering the specimens caught in the isolators; we destroyed and removed the specimens each time we made observations to get conclusive results the following week. The data collected after each observation were noted down in a table that supplied, in the end, information related to the number of individuals present in each replicate.

Results

The main objective of our research was the impact of soil works on the dynamics of the population of the Western corn rootworm. To do so, we worked the soil with such agricultural equipment as the plough and the grubber. Their distribution within the plots was as follows: in replicate 1 in both trials, soil work was done with a plough 25-30 cm deep in the soil; in replicate 2, soil work was done with a grubber 25-30 cm deep in the soil; in replicate 3, in both trials, we worked the soil with a disc 20 cm deep in the soil, in the spring of 2010 and in the

spring of 2011. Monitoring the adults of *Diabrotica virgifera virgifera* Le Conte was done on a weekly basis with the isolators set on the plots worked in the fall and in the spring.

In 2010, we made a total number of observations: in the first week, we found a low number of adults; starting with the second week, the number of adult insects captured increased significantly; in the third week, we recorded the largest number of adults captured, i.e. on July 24, 2010, we found 967 insects (Tabel 1 and Table 2) while in the first week we found only 26 adult insect pests. On August 20, 2010, we monitored the population of *Diabrotica virgifera virgifera* Le Conte for the last time, and we found 8 adult insects captured. This last observation means that the flight period of the Western corn rootworm had just ended at that time.

Table 1

Impact of soil works on the dynamics of the population of *Diabrotica virgifera virgifera* Le Conte in Lenauheim 2010

Entry Variante	Observations date														
	10.07.2010		17.07.2010		24.07.2010		31.07.2010		06.08.2010		13.08.2010		20.08.2010		total
	I	II	I	II	I	II	I	II	I	II	I	II	I	II	
1	0	0	5	3	3	5	2	3	0	0	0	0	0	0	21
2	2	0	11	15	83	23	0	2	6	1	0	0	0	0	143
3	0	0	2	1	18	1	4	3	5	0	2	1	1	0	38
1	0	0	4	0	5	3	7	0	0	0	0	0	0	0	19
3	1	0	9	5	3	2	1	0	0	0	1	1	0	0	23
2	1	0	14	22	9	15	3	4	0	0	0	0	0	0	68
3	1	0	16	10	30	2	1	2	1	1	2	0	1	1	68
1	0	0	30	5	24	5	3	0	2	0	0	0	0	0	69
2	0	0	25	0	19	5	10	0	2	0	0	0	0	0	61
3	0	1	33	9	37	28	21	9	5	3	1	1	0	0	148
2	0	1	10	20	85	64	4	19	7	5	0	2	1	0	218
1	1	0	81	18	21	37	10	15	0	0	0	1	0	0	184

Table 2

Impact of soil works on the dynamics of the population of *Diabrotica virgifera virgifera* Le Conte in Grabat 2010

Entry Variante	Observations date														
	10.07.2010		17.07.2010		24.07.2010		31.07.2010		06.08.2010		13.08.2010		20.08.2010		total
	I	II	I	II	I	II	I	II	I	II	I	II	I	II	
2	2	0	37	2	20	4	8	0	0	0	1	0	0	0	74
1	0	0	12	12	44	34	2	18	1	3	1	2	1	0	130
3	0	2	11	6	22	12	9	0	2	2	1	1	0	0	68
1	1	1	13	7	17	23	3	10	5	6	0	2	1	1	90
3	0	0	2	24	7	47	3	40	1	9	0	0	0	0	133
2	0	0	5	43	9	50	2	3	1	2	0	1	0	1	117
3	2	0	30	9	14	16	0	1	0	0	0	0	0	0	72
1	1	1	7	7	12	15	2	3	3	0	1	0	0	0	52
2	1	3	8	68	5	50	1	5	2	1	0	0	0	0	144
3	0	0	5	12	3	14	1	4	0	0	1	0	0	0	40
2	1	1	4	7	3	8	1	2	2	0	0	0	0	0	29
1	1	1	7	5	4	7	6	1	2	0	0	0	0	0	34

The number of adult *Diabrotica virgifera virgifera* Le Conte counted in the cages in 2010 was higher than in 2011. We can therefore assume that the high precipitation level in 2010 caused a lower *Diabrotica virgifera virgifera* Le Conte population density and a reduced number of eggs.

In 2011, we made observations over 9 weeks. In the first week, the number of insects found was rather low; it increased in the second week, while on July 22, 2011, i.e. in the fourth week, we found the largest number of adult insect pests – 262 (Table 3 and Tabel 4. After this time, the number of *Diabrotica virgifera virgifera* Le Conte adults started to decrease significantly; on August 29,. 2011, when the last observation was made, we found a single specimen.

Table 3

Impact of soil works on the dynamics of the population of *Diabrotica virgifera virgifera* Le Conte in Lenauheim 2011

Entry Variante	Observations date																		total
	02.07. 2011		09.07. 2011		16.07. 2011		22.07. 2011		28.07. 2011		05.08. 2011		13.08. 2011		23.08. 2011		29.08. 2011		
	I	II	I	II	I	II	I	II	I	II	I	II	I	II	I	II	I	II	
2	0	0	0	9	6	5	7	2	2	0	0	1	0	0	0	0	0	0	32
1	0	1	13	3	5	3	6	3	4	2	3	3	1	1	0	1	0	0	49
3	0	0	1	5	0	13	3	33	5	8	0	4	0	3	1	1	0	0	77
1	0	1	2	15	0	18	1	10	4	2	1	2	1	0	1	0	0	0	58
3	0	0	1	0	0	5	4	13	0	0	0	0	0	0	0	0	0	0	23
2	0	0	0	22	1	50	4	48	0	12	2	0	0	1	0	1	1	0	142
3	0	0	8	3	4	17	20	15	2	2	0	0	0	0	0	0	0	0	71
1	1	2	11	8	5	5	9	0	3	0	0	0	0	0	0	0	0	0	43
2	0	1	0	7	2	4	1	1	0	3	4	0	1	0	1	0	0	0	25
3	0	0	0	6	0	2	0	3	0	1	0	0	0	0	0	0	0	0	12
2	0	0	8	3	4	17	20	15	2	2	0	0	0	0	0	0	0	0	71
1	0	0	0	6	0	2	0	3	0	1	0	0	0	0	0	0	0	0	12

Table 4

Impact of soil works on the dynamics of the population of *Diabrotica virgifera virgifera* Le Conte in Grabat 2011

Entry Variante	Observations date																		total
	02.07. 2011		09.07. 2011		16.07. 2011		22.07. 2011		28.07 .2011		05.08. 2011		13.08 2011		23.08. 2011		29.08. 2011		
	I	II	I	II	I	II	I	II	I	II	I	II	I	II	I	II	I	II	
2	0	0	0	9	6	5	7	2	2	0	0	1	0	0	0	0	0	0	32
1	0	1	13	3	5	3	6	3	4	2	3	3	1	1	0	1	0	0	49
3	0	0	1	5	0	13	3	33	5	8	0	4	0	3	1	1	0	0	77
1	0	1	2	15	0	18	1	10	4	2	1	2	1	0	1	0	0	0	58
3	0	0	1	0	0	5	4	13	0	0	0	0	0	0	0	0	0	0	23
2	0	0	0	22	1	50	4	48	0	12	2	0	0	1	0	1	1	0	142
3	0	0	8	3	4	17	20	15	2	2	0	0	0	0	0	0	0	0	71
1	1	2	11	8	5	5	9	0	3	0	0	0	0	0	0	0	0	0	43
2	0	1	0	7	2	4	1	1	0	3	4	0	1	0	1	0	0	0	25
3	0	0	0	6	0	2	0	3	0	1	0	0	0	0	0	0	0	0	12
2	0	0	8	3	4	17	20	15	2	2	0	0	0	0	0	0	0	0	71
1	0	0	0	6	0	2	0	3	0	1	0	0	0	0	0	0	0	0	12

In 2010, we could see that in the variant worked with the grubber there was the largest number of specimens of *Diabrotica virgifera virgifera* Le Conte, while the lowest number of specimens was I the variant worked with a disc, which means that the disc had the strongest effect on the population of *Diabrotica virgifera virgifera* Le Conte. (Figure 1).

In 2011, the situation was quite different. The least specimens of *Diabrotica virgifera virgifera* Le Conte were in the variant worked with a plough, while the largest number of specimens was in the variant worked with a disc.

The mean of the two years of observations shows that the most significant effect in reducing the population of *Diabrotica virgifera virgifera* Le Conte was in the variant worked with a plough, followed by the variant worked with a disc; when the work was done with a grubber, the number of specimens of *Diabrotica virgifera virgifera* Le Conte was the largest.

Fig.1

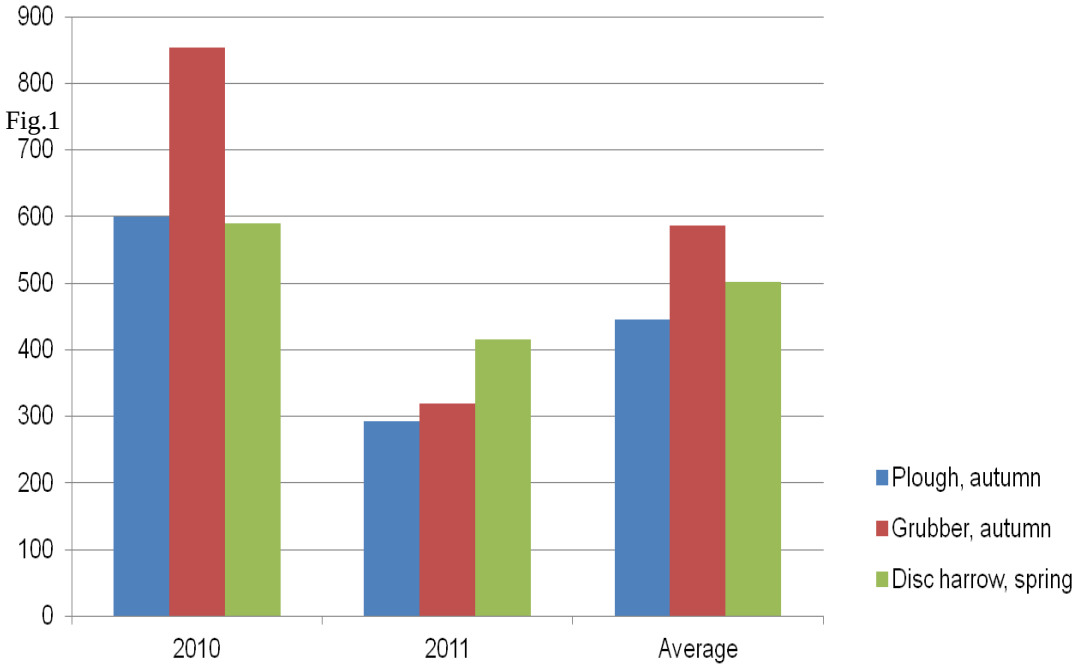

Fig. 1 Evolution of the insects in 2010 - 2011

Conclusions

1. In terms of soil cultivation in the first year a higher number of beetles was found in plots were the Grubber was used in autumn. This result could not be confirmed in 2011 were all cultivation varieties showed nearly the same number of adult *Diabrotica.*
2. The number of adult D. virgifera counted in the cages in 2010 was higher than in 2011. It can be assumed, that the high precipitation in 2010 caused a lower *Diabrotica* population density and a reduced number of eggs.
3. There is a certain correlation between the soil working method and the diminution of the population of *Diabrotica virgifera virgifera* Le Conte.
4. Monoculture maize results in a strong attack by *Diabrotica virgifera virgifera* Le Conte, which asks for crop rotation.

References

1. Ball, H. J., 1957- On the biology and egg laying habits of the western corn rootworms in Nebrasca. J. Econ. Entomol., 50 (2): 126-128.
2. Bărbulescu, A., Popov, C., Mateiaş, M. C., 2002 - Bolile şi dăunătorii culturilor de câmp. Edit. Ceres, 376 pag., Bucureşti.
3. Camprag, D., 1998 - Occurrence, harfulness and control of western corn rootworm Diabrotica virgifera virgifera Le Conte. Drustvo za Zastitu bilja Serbie, 135 pag., Beograd.
4. Cârciu G., 2006 .- Managementul lucrărilor solului,ed.Eurobit,Timişoara.
5. Chandler, L.D.; Sutter, G.R.; Hammack, L.; Woodson, W.D.(1995) Semiochemical insecticide bait management of corn rootworms, Clean water – clean environment. 21st century:team agriculture – working to protect water resources.Volume 1: Pesticides. Proceedings Kansas City, Missouri,USA, 5–8 March 1995, pp. 29–32.

6. French, B. W., 2004 - Spatial distribution of Diabrotica in the South Dakota arewide management site. Abstracts of the papers presented at the Xth IWGO - Diabrotica Sobgroup Meeting in Engelberg, Switzerland; January 14-17, 2004: 38
7. Grozea, Ioana, 2003 - Biologia, ecologia şi combaterea viermelui vestic al rădăcinilor de porumb (Diabrotica virgifera virgifera Le Conte) în condiţiile Câmpiei de Vest. Teză de doctorat, USAB Timişoara, 215 pag.
8. Krysan, J. L., Miller, T. A. 1986- Methods for study of Pest Diabrotica. Springer Verlag, New York, 260pp.
9. Popov, C., Bărbulescu, A., Raranciuc, Steluţa, Mateiaş, M. C., 2007 - Rezultate obţinute în domeniul protecţiei plantelor, în perioada 1957-2007, în cadrul cercetărilor privind bolile şi dăunătorii cerealelor, leguminoaselor pentru boabe, plantelor tehnice şi furajere. Probleme de protecţia plantelor, XXXV (1): 22-78
10. Roşca, I., 1997 - Implicatiile prezentei speciei Diabrotica virgifera virgifera Le Conte asupra tehnologiei culturii porumbului in Romania. Lucrări Ştiinţifice U.S.A.M.V. Iaşi, ISSN 0379-8364, 40, Seria Agronomie: 551-560.
11. (http://www.madr.ro/pages/fitosanitar/plan-de-monitorizare-diabrotica-virgifera.pdf).