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Diabrotica virgifera virgifera LECONTE, A NEW SUNFLOWER PEST FROM AMERICA

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SUMMARY

The occurrence and subsequent damage caused by *Diabrotica virgifera virgifera* LeConte in the corn belt of Northern Bácska have been monitored since 1995. Pheromone traps first indicated the presence of imagoes in 1997. In 1999, imagoes appeared in great numbers in cornfields. In 2000, their swarming was massive again, but not as massive as in 1999. Assessments were performed in 2001, too.

In 1999, surprisingly, the imagoes attacked both commercial cornfields and hybrid seed plots, both with very high intensity. Commercial sunflowers adjacent to the cornfields, even sunflower hybrid seed plots, were attacked by the pest. In 2000, again, it attacked sunflower field with in significant numbers.

Investigations conducted so far have made it unambiguous that sunflower fields are primarily visited by female imagoes. The extent of damage and population density showed decreasing intensities going from the edge of a field towards its center. In 1999 (12 July), for instance, even 10 to 12 imagoes could be seen feeding on sunflower at the edge of a field, while he count was only 4 imagoes per plant 50 m inside the field.

Female imagoes peel or sometimes punch the petals of the sunflower. While pollen is their favorite feed, they also consume nectar (this form of damage becomes clear on sterile female plants). In fertile flowers of the male rows, the imagoes reduce the fertilizing potential by consuming pollen. Thus they probably cause quantifiable economic loss as well. With regard to the high proportion of female imagoes (80% to 85%) we should assume that the sunflower as nourishing plant has favorable physiological effects on egg count, intensity of egg laying and the fecundity of the clear that the story may be about a kind of "finishing' step of the ovulation nourishment. However, no egg laying was observed in the sunflower field. Further studies are necessary to better understand how this species causes damage in sunflower crops.

Key words: ***Diabrotica virgifera virgifera*, *Acanthoscelides pallidipennis*, "Csalomon", LEM and PAL**

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INTRODUCTION

Sunflower growing has intensified again in recent years. Concentrated and valuable stocks, *e.g.* hybrid propagation of the sunflower, have shed a new light on the aspect of plant protection.

To meet the domestic demand for seed and the fluctuating export markets, not much more than 2500 ha are needed due to the high propagation ratio of the sunflower. Thus it is extremely important to know the pest species that live around and how they contribute to pollination, which is an economically assessable process. Among the many pests of the sunflower, *Diabrotica virgifera virgifera* LeConte causes local but increasingly significant damage together with the *Acanthoscelides pallidipennis* Motsch. Both of these species come from the American continent. They play similar roles, but *Acanthoscelides pallidipennis* Motsch. primarily consumes pollen, while *Diabrotica virgifera virgifera* LeConte may also cause significant damage to the stigma. Studying this aspect of its harmfulness may give a good model of fecundation damages (or occasionally even a complete lack of fecundation) caused by the injuries and discontinuities in the styles of the corn flower. Comprehensive understanding of the biology of this pest attracts attention of domestic and foreign base institutes that are interested in sunflower hybrid seed production.

Following the occurrence of the first specimens of *Diabrotica virgifera* LeConte (Mórahalom, 1995), several excellent publications warned the croppers of the dangerous situation. Extensive studies done by Benedek (1998) are worth mentioning here. The author studied several districts (Hódmezõvásárhely, Bácsalmás, Majs, Lippó) upon request by IKR Rt. In addition to recording the spread of *Diabrotica virgifera virgifera* LeConte, the purpose of the study was to test various types of traps ("Csalomon", LEM and PAL). Prior studies worth mentioning are those of Dusan *et al*. (1994), Tóth *et al*. (1995), Princzinger *et al*. (1997), Hataláné Zsellér I. (1997), Barna *et al*. (1998), Ripka *et al*. (2000), Kiss *et al*. (2000), Hataláné Zsellér I. and Ripka (2001). Data that may apply to our region appeared in a monograph of Camprag (1994).

There is little reference in the literature to *Diabrotica virgifera virgifera* LeConte as a pest of the sunflower. Charlet *et al*. (1997) made such reference for continental America and Hataláné Zsellér I. and Ripka (2001) for Hungary. In this respect, Horváth and Hatvani (2002) and Agrodivision of BASF Hungária Kft roused the attention of the research community. In Yugoslavia, Prof. Čamprag mentions the pollen consumption of this pest (Čamprag, 1994).

MATERIALS AND METHODS

The study of the damage caused by *Diabrotica virgifera virgifera* LeConte in the commercial sunflower fields in Northern Bácska and in the sunflower hybrid seed plots Bácsalmás Agráripari Rt. started in 1999.

In the sunflower seed plots adjacent to cornfields, 7 sampling areas were assigned at 10-m intervals towards the center of the sunflower field, up to 70 m from the edge, both in years 1999 and 2000. In each sampling location, flowers of 100 sunflower specimens (from 100 neighboring rows) aligned with one another, were thoroughly scrutinized. Such observations were performed 4 times, at 5-day intervals after the start of flowering.

RESULTS AND DISCUSSION

The extent of infestation of *Diabrotica virgifera virgifera* LeConte in the sunflower plots can be seed in Tables 1, 2 and 3 (for the years 1999, 2000 and 2001, respectively), while the damage situation caused by the injures is shown in Table 4. The following conclusions can be drawn from the data in the Tables.

Table 1: Changes in the number of imagoes of *Diabrotica virgifera virgifera* (Katymár, 1999)

Sampling location	Study period				Total	Mean per plant (x)
	12 July	17 July	22 July	27 July		
	No. of imagoes/plant	No. of imagoes/plant	No. of imagoes/plant	No. of imagoes/plant		
1	1700	2750	2980	3730	11160	27.9
2	640	1170	2190	3020	8020	20.0
3	1690	1620	2360	3640	9310	23.2
4	780	1070	1170	2880	5900	14.7
5	400	970	650	1150	3170	7.8
6	360	110	280	730	1480	3.7
7	210	230	360	480	1280	3.2
Total	6780	7920	9980	15630	48320	

Note: each sampling location represents 100 sunflower plants

The infestation of the sunflower seed plots by the pest showed a relatively balanced tendency. According to our assessment, the largest number of specimens occured in 1999. The generations of 2000 and 2001 showed similarities in many respects. This also indicates that the biology of this pest can be monitored well, based on tendencies repeated each year (Tables 1, 2, 3).

On the basis of the studies performed so far, it has become clear that the sunflower plots are visited primarily by female imagoes. Both the extent of damage and population density showed a decreasing tendency towards the center of the plot. On 12 July 1999, for example, 15 to 20 specimens could be seen feeding on a single sunflower plant at the edge of the plot, while the number of imagoes deeper in the plot (50 m from the edge) was only 3 to 4 imagoes per plant (Tables 1, 2, 3).

Female imagoes peel or sometimes punch the petals of the sunflower and sometimes they chew the edges of the petals (Anonymous, 2002). Pollen is their favorite feed, but they also consume nectar (this form of damage becomes clearly visible on sterile female plants). In fertile flowers of the male rows the imagoes

reduce the fertilizing potential by consuming pollen. Thus they probably cause quantifiable economic loss as well (though it should be added that this form of damage is least worrying owing to the high pollen production by male plants).

Table 2: Changes in the number of imagoes of *Diabrotica virgifera virgifera* (Mátételke, 2000)

Sampling location	Study period				Total	Mean per plant (x)
	12 July	17 July	22 July	27 July		
	No. of imagoes/plant	No. of imagoes/plant	No. of imagoes/plant	No. of imagoes/plant		
1	1430	2046	2610	2970	9056	22.64
2	1537	2020	2411	2840	8806	22.02
3	1610	1410	1980	2010	7010	17.52
4	660	883	1740	1710	4993	12.48
5	415	711	411	226	1763	4.40
6	218	204	312	110	644	2.11
7	113	164	163	43	483	1.20
Total	5983	7438	9627	9909	32957	

Note: each sampling location represents 100 sunflower plants

With regard to the high proportion of female imagoes (80 to 85%), we should assume that the sunflower as nourishing plant has favorable physiological effects on egg count, intensity of egg laying and the fecundity of the eggs. The abdomen of the female imagoes was extremely swollen, which makes it clear that the story may be about a kind of "finishing" step of the ovulation nourishment.

Table 3: Changes in the number of imagoes of *Diabrotica virgifera virgifera* (Mosztonga, 2001)

Sampling location	Study period				Total	Mean per plant (x)
	12 July	17 July	22 July	27 July		
	No. of imagoes/plant	No. of imagoes/plant	No. of imagoes/plant	No. of imagoes/plant		
1	1643	3010	3322	4012	11987	29.9
2	1710	2713	2803	3324	10550	26.2
3	1630	1880	1615	2043	7168	17.9
4	615	1030	1314	1611	4570	14.4
5	483	611	422	346	1862	4.6
6	117	343	263	419	1142	2.8
7	211	204	116	228	759	1.8
Total	6409	9791	9865	11983	38038	

Note: each sampling location represents 100 sunflower plants

Despite the large numbers of female imagoes visiting the edge of the plots, no egg laying could be found in 1999 or 2000 (this may be in relation with the fact that during the three weeks of weeding and flower selection works, the space between the rows is significantly reduced that makes it practically unsuitable for egg laying). However, in the year 2000, an intensive egg laying activity was observed after stub-

ble striping in a 5 to 10 m strip in a winter wheat field adjacent to a sunflower hybrid seed plot.

Inadequate fecundation of achenes is a discernible consequence of the ovulation time nourishment of female imagoes (Table 4). Unlike in corn, the damage to the style and the resulting inadequacy of fecundation can be traced well in the sunflower. Injured flowers or those with a chewed off styles (achene fundaments) could be readily marked, thus the direct effect (empty achene, abnormal germination) of the injury could be easily detected.

Table 4: Shortcomings of fecundation due to injury to the style caused by *Diabrotica virgifera virgifera* (Mosztonga, 2001)

Sampling location	Damaged styles, total	Of this, empty achenes, total	Extent of damage, % of damaged styles
1	276	107	38
2	148	65	43
3	193	48	24
4	111	73	66
5	55	8	14
6	10	0	0
7	0	0	0

Note: 5 sunflower disks were marked and examined in each sampling location (35 in total)

In addition to recording the number and frequency of occurrence of style injuries and empty achenes, studying the germination percentages also becomes indispensable. By this method-though there are significant differences between the biological factors of the two plant species-a reassuring answer could also be given for assessing the germination problem originating from the extent of the injury of the corn style (dilemmas of the 2 to 3 cm long style, the so-called “chew off to brush size”, etc.).

However, it cannot be excluded that *Diabrotica virgifera virgifera* may become a “real’ pest of the sunflower. The steady settlement of the pest into the sunflower seed plots in the years of the study (1999, 2000, 2001) supports this assumption. At the same time, it is surprising that we cannot find corroborating results on the damage caused by this insect on the American continent, which is genetic the center of origin of the sunflower.

It is not known whether this has causes determined by ecology or other environmental factors.

The settlement processes (which are still “spontaneous” at the moment, especially in the neighborhood of cornfields) should also provide an answer to the question if there are significant differences between the genotypes (species) in relation to the damage caused by *Diabrotica virgifera virgifera*. If so, which groups of species are most affected. Among the many pests of the sunflower there are certain species (*e.g., Anomala vitis* L.), which prefer to feed on certain sunflower varieties and not on others. As far as the feeding habit of *Diabrotica virgifera virgifera* is concerned,

the extensive 4-repetition species studies might give a reassuring answer in the future. should provide a reliable answer in the future.

CONCLUSION

New insect pests appeared in Hungarian sunflower fields in the past 15 years (*e.g.*, *Acanthoscalides pallidipennis* Motsch), which are native to the American continent and thus their natural hosts are either completely absent in Europe, or - after a certain period of time - the role of host is taken by European species (Horváth, 1987a, 1987b; Horváth and Wittmann, 1990). Such a new sunflower pest is *Diabrotica virgifera virgifera* LeConte, which was previously known as a devastating pest of the corn. The experiments set up in the district of Bácsalmás indicated that its role is increasing. Although its settlement, as well as the damage caused in commercial sunflower fields is still insignificant, its increasing damaging activity in sunflower seed fields should be a warning for the professionals to take heed about. The intention of this paper was to provide useful information for their work.

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NUEVA PLAGA DE GIRASOL: LA TORTUGUILLA DEL MAÍZ (*Diabrotica virgifera virgifera LeConte*)

RESUMEN

La aparición y el impacto, causados por la tortuguilla del maíz (*Diabrotica virgifera virgifera* LeConte) se vigilan en la faja de maíz de Bachka del Norte, desde el año 1995. La presencia del imago de este insecto, fue registrada por la primera vez en el año 1997, utilizando las trampas de feromonas. En el año 1999, fue notada una aparición del imago a gran escala de esta especie en los campos de maíz, mientras que en el año 2000, la aparición del imago también fue grande, pero no tanto como en el 1999. La evaluación se hizo también en el año 2001.

El ataque del imago de la tortuguilla de maíz, en el año 1999, era de una intensidad sorprendentemente alta, como en los campos de producción comercial de maíz, tanto en los campos de reproducción de híbridos. Esta plaga se alimentaba con el girasol comercial, que se encontraba al lado de los campos de maíz mencionados, hasta también con el girasol de las parcelas de reproducción de híbridos. También en el año 2000, la tortuguilla de maíz atacó todas las plantaciones de girasol en gran número.

Las investigaciones realizadas hasta el momento, indudablemente demuestran que los campos de girasol, en el primer lugar, los visitan las hembras de la tortuguilla de maíz. La intensidad del impacto y la densidad de población, decrece desde el borde de parcela hacia el centro. Así, por ejemplo, en el 1999, en las plantas del borde de la parcela, se encontraba hasta 10-12 imagos, mientras que en la distancia de 50 m del borde de parcela, había tan solo 3 a 4 imagos por planta.

Los individuos adultos de hembra de la tortuguilla de maíz, pelan, o a veces penetran los pétalos de girasol. Su preferido es polen, aunque se alimentan con néctar, también (ese tipo de daño es visible en las plantas estériles de la madre). En las plantas fértiles de las filas del padre, los individuos de la tortuguilla del maíz, se alimentan con polen, y con esto disminuyen su potencial para fertilización. Esto probablemente causa unas significantes pérdidas económicas adicionales. En lo que concierne la alta participación de imagos femeninos (80-85%), se puede suponer que el girasol, como una planta nutritiva, tiene un efecto fisiológico favorable en el número de huevos, intensidad de colocación de huevos, y su fertilidad. Los abdómenes de los imagos femeninos eran marcadamente hinchados, lo que claramente indica que posiblemente se trata de algún tipo de fase final de la alimentación ovulatoria. La colocación de huevos, mientras tanto, no fue registrada en los campos de girasol. Para un mejor entendimiento del impacto que causa esta especie en las plantaciones de girasol, es imprescindible realizar unas investigaciones adicionales.

UN NOUVEL INSECTE NUISIBLE AU TOURNESOL: LE DORYPHORE DU MAÏS (*Diabrotica virgifera virgifera* LeConte)

RÉSUMÉ

L'apparition et les dégâts causés par le *Diabrotica virgifera virgifera* LeConte sont observés dans les champs de maïs du nord de la région de Bacska depuis 1995. La présence d'imagos de cet insecte a été enregistrée la première fois en 1997 au moyen de pièges à phéromones. En 1999 un grand nombre d'imagos a fait son apparition dans les champs de maïs. En 2000 leur nombre était élevé mais pas autant qu'en 1999. Une estimation a aussi été faite en 2001.

En 1999 l'attaque des doryphores du maïs a été d'une surprenante intensité autant dans les champs de production commerciale que dans ceux destinés à la reproduction des hybrides. Cet insecte s'est nourri aussi du tournesol commercial qui se trouvait près des champs de maïs mentionnés et même du tournesol des parcelles de reproduction des hybrides. En 2000 un grand nombre de doryphores a aussi attaqué les plants de tournesol.

Les recherches actuelles montrent de façon certaine que les champs de tournesol sont surtout attaqués par les doryphores du maïs femelles. L'intensité des dégâts et la densité de la population diminuent en allant du bord des parcelles vers le centre. Ainsi, par exemple, en 1999 pouvait-on trouver jusqu'à 10-12 imagos par plante au bord des parcelles tandis qu'à une distance de 50 mètres du bord on n'en trouvait que 3 à 4 par plante.

Les doryphores du maïs femelles adultes épluchent ou quelquefois perforent les pétales du tournesol. Ils préfèrent le pollen mais se nourrissent aussi de nectar (cette forme de dégât est apparente sur la plante mère stérile). Dans les fleurs fertiles des rangées pères, les imagos se nourrissent de pollen et diminuent ainsi le potentiel de fécondation. Cela est sans doute la cause d'importantes pertes économiques. Pour ce qui concerne la grande participation des imagos femelles (80-85%), on peut supposer que le tournesol en tant que plante nourricière a un effet physiologique favorable sur le nombre d'œufs, l'intensité de la ponte et la fertilité. Les abdomens des imagos femelles étaient significativement enflés ce qui indique clairement qu'il s'agit d'une sorte de phase finale d'alimentation ovulatoire. La ponte des œufs, cependant, n'a pas été constatée dans les champs de tournesol. Si on veut mieux comprendre les dégâts que cette espèce d'insecte cause aux plants de tournesol, il est nécessaire de faire des études supplémentaires.