ORIGINAL ARTICLE

FLIGHT OF THE EUROPEAN CORN BORER (OSTRINIA NUBILALIS HBN.) AS FOLLOWED BY LIGHT- AND PHEROMONE TRAPS IN VÁRDA AND BALATONMAGYARÓD 2002

A KUKORICAMOLY (OSTRINIA NUBILALIS HBN.) RAJZÁSÁNAK MEGFIGYELÉSE FÉNY- ÉS FEROMON CSAPDÁK SEGÍTSÉGÉVEL 2002 - BEN VÁRDÁN ÉS BALATONMAGYARÓDON

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ÖSSZEFOGLALÁS

Vizsgálatunkat 2002-ben a zala megyei Balatonmagyaród, és a somogy megyei Várda települések határában végeztük. Az ott található egybefüggő kukoricatáblákhoz Jermy-tipusú fény-, és Arco-Pheron MZ feromon csapdákat helyeztünk ki a rajzás nyomon követése érdekében. A hozzánk beérkezett anyagból a kukoricamolyokat elkülönítettük és nemek szerint szétválogattuk. Meghatároztuk a területeken megjelenő populációk nemzedékszámát és a rajzás jellegzetességeit. Keszthelyről és Kaposvárról lekértük a területek adott időtartamára vonatkozó meteorológiai adatokat, és ezeket egybevetettük a rajzásadatokkal. Így meg tudtuk állapítani, hogy az egyes meteorológiai elemek milyen hatással voltak a rajzásra és a nőstény arány alakulására.

Az eredmények mindkét helyen kétnemzedékes kukoricamoly jelenlétét igazolták. Balatonmagyaródi populációnál az első, míg Várdán a második nemzedék bizonyult népesebbnek. A vizsgált meteorológiai elemek szignifikánsan befolyásolták a csapdázhatóságot, amely mindkét nem tekintetében igazolódott. A nőstény ivararánynál szoros összefüggéseket tapasztaltunk a minimum- (P=100%; r=0,297), a maximum- (P=99,9%; r=0,267),az átlag hőmérséklet (P=100%; r=0,308) és a csapadék vizsgálatánál (P=98,2%; r=-0,187). Jelentős aszinkronítást tapasztaltunk a két prognosztikai eszköz által szolgáltatott adatok között, amelyet a feromon csapda megbízhatatlanságának tulajdonítottunk.

KULCSSZAVAK: kukorica, kukoricamoly, előrejelzés, fénycsapda, feromon csapda

ABSTRACT

The investigations were made in 2002 in the outskirts of two settlements: Balatonmagyaród (Zala county) and Várda (Somogy county). In the corn fields Jermy's light- and Arco-Pheron MZ pheromone traps were placed in order to follow up the course of flight. From the material collected the corn borer specimens were isolated, then separated by sex. The generation number of the populations appearing on the respective areas, and the characteristics of the flight were determined. The meteorological data of the areas obtained from Keszthely and Kaposvár for the period concerned were compared woth the data of flight. In that way the effect of the different meteorological elements on the flight and on the trend of the female ratio could be established.

The results showed the presence of two-generation corn borer populations in both places. In Balatonmagyaród the first- while in Várda the second generation proved larger. The meteorological elements significally influenced the possibility of trapping in the case of both sexes. As for the female sex ratio close correlations were found with the minimum (P=100%; r=0.297)-, maximum (P=99.9%; r=0.267)-, average (P=100%; r=0.308) temperature and precipitation (P=98.2%; r=0.187) data. Considerable asynchrony was observed between the data obtained with the two prognostic means that we ascribed to the unreliability of the pheromone trap.

KEY WORDS: maize, European corn borer, forecast, light-trap, pheromone trap

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DETAILED ABSTRACT

The European corn borer (*Ostrinia nubilalis* HÜBNER) is one of the most important pests of corn in Hungary. Its appearance in Hungary and the number of its generations show a varied pattern. In the north-western parts of the country the one-generation- while in the southern, south-eastern areas the two-generation populations do damages in general. To choose the optimum time of control we need a correct prognosis of the corn borer which can be solved with the help of light- and pheromone traps. We wanted to know what the course of flight of the corn borer on the areas studied was like, and how the abiotic factors influenced the possibility of trapping.

The investigations were made in 2002 in the outskirts of two settlements: Balatonmagyaród (Zala county) and Várda (Somogy county). In the corn fields Jermy's light- and Arco-Pheron MZ pheromone traps were placed in order to follow up the course of flight. From the material collected the corn borer specimens were isolated, then separated by sex. The generation number of the populations appearing on the respective areas, and the characteristics of the flight were determined. The meteorological data of the areas obtained from Keszthely and Kaposvár for the period concerned were compared woth the data of flight. In that way the effect of the different meteorological elements on the flight and on the trend of the female ratio could be established.

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INTRODUCTION AND LITERARY REVIEW

The economic importance of the European corn borer has increased with the spread of monocultures and the expansion of the sowing area, so it is easy to see how important the prognosis of this pest and its control are.

The development cycle of the corn borer varies. According to (MÉSZÁROS, 1969) the limit of dispersion of the one- and two-generation biotypes is the annual 3200ºC isotherm. The difference in generation number between the warmer and cooler parts of the country is due to their different temperature and photoperiodic conditions (SÁRINGER, 1976). Beside the temperature and photoperiod the different range of feed plants may also cause physiological, ecological and population dynamic changes to the European corn borer (NAGY, 1985).

The prognosis of the corn borer has but a limited importance since the biological effects produced on the overwintering larvae, and the success of flight and oviposition, which is highly dependent on the climatic conditions cannot be analyzed in advance (MANNINGER, 1971).

Signalization pointing to the immediate appearance of the pest supplies useful data in the case of the corn borer too concerning the necessity and the right time of control (NAGY, 1961). HANO (1984) found that by the optimum time of control, the mass hatching of larvae, 80% of the adults flew out.

In the course of light trap observations of the corn borer in Hungary BALÁZS (1965) was the first to take the climatic factors into consideration. He compared the daily results of light trapping to the meteorological data of the respective days. On the basis of results of previous investigations the modifying effect of 25 environmental factors on the outcome of collection was proved (NOWINSZKY, 2000).

The literary data are inconsistent when the sexual index is to be determined on the basis of collecting by light trap. While JÁRFÁS (1978) found less males and more females in both generations, LESZNYÁK et al. (1993) established male dominance in the early stage of flight in the case of the first generation. The female sex ratio of light-trapped one-generation corn borers was found to be 47.3% by CORDILLOT (1989) in Switzerland.

Though the opinions vary as to the prognostic reliability of the sexual attractant traps, the latter are prognostic means applied (JÁRFÁS, 1978) and proposed for use (SZEÖKE, 1994) by several authors. This suggests that the difference between the one- and two-generation populations considered two different ecotypes manifests itself in sexpheromone polymorphism too (PENA et al., 1988). The varying attraction of the sexual attractant traps was described in the USA too (HARRISON - VAWTER, 1977). This asynchrony can also be detected between the data supplied by the pheromone- and light-traps (LESZNYÁK et al., 1993).

MATERIAL AND METHOD

With the view of making prognostic surveys we placed Jeremy's light- and Arco Pheron MZ type pheromone traps in a 100 ha one-piece hybrid corn field of the Mezőgazdasági Szövetkezeti Rt. (Agricultural Cooperative share company) Balatonmagyaród, Zala county, and a farmer's 50 ha corn field in Várda, Somogy county. The surveys were made in 2002, from April to September. In the above mentioned fields no control of the corn borer took place. Data were collected every second day with both prognostic instruments. From the material obtained we isolated the corn borer specimens and separated them by sex.

We asked Keszthely and Kaposvár to submit the meteorological data of the areas in question for the period concerned. The required data were: precipitation (mm), relative humidity (could not be obtained from Kaposvár) and temperature. With the help of the temperature and precipitation data we calculated in both places the value of SELJANINOV's hydrothermic coefficient for each month, whereby the precipitation conditions of the given period could be characterized. We compared the meteorological data with the data of flight and in this way determined the effect of each meteorological element on the flight and on the trend of the female ratio.

From the data supplied by the two light traps we computed the relative individual number (RIN) and relative female number (RFN) per day: 1RIN = Gin (Gday; 1RFN = GFn) Gday, where GIn = individual number per generation; GFn = female number per generation; Gday = number of days per generation.

Comparing the total-, male- and female catching data with the meteorological elements we made statistical evaluation using the SPSS for Windows 9.0 program.

RESULTS

Results of flight supplied by the light traps:

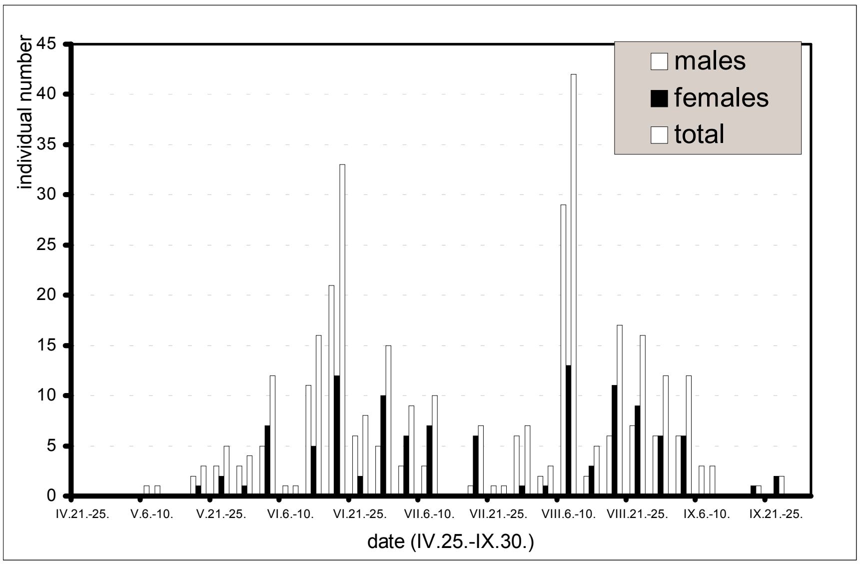
In Table 1. the different meteorological values are compared with the data of flight. As seen from the table in both places monthly changes in the individual number of corn borer were proportionately followed by a change in the number of males, in contrast with the monthly change of the female number. In Várda the recession in July – due to the pause between the disappearance and appearance of the two generations – was minimum. In Balatonmagyaród the female number in the same period of time formed transition between the individual number of females observed in June and August, respectively.

Table 1: Monthly totalled meteorological- and light trapping data of the places of survey

	months	∑ precipitation(mm)	∑ temperature(°C)	HTC	Precipitation conditions	∑corn borer number	male number	female number
Várda	April	100,4	340,75	2,94	extremely rainy	-	-	-
	May	55	609,1	0,9	dry	9	7	2
	June	95	672,65	1,41	optimum	99	60	39
	July	77,2	740,9	1,04	optimum	48	15	33
	August	37,1	687,8	0,53		81	40	41
	September	50,8	481,6	1,05	extremely rainy	19	8	11
Balatonmagyaród	April	116,5	315,6	3,69	extremely rainy	-	-	-
	May	33,9	570	0,59	dry	13	9	4
	June	44,2	623,3	0,7	dry	61	39	22
	July	59,1	685	0,86	dry	45	16	29
	August	47,4	649,8	0,72	dry	95	52	43
	September	27,9	452,4	0,61	dry	18	9	9

Note:.HTC = Seljaninov's hydrotermic coefficient: the precipitation conditions of the period concerned were determined according to its threshold values

Figure 1: Course of corn borer flight observed in 2002, Balatonmagyaród



It is worth mentioning that the high individual number of June in Várda was associated with a higher hydrothermic coefficient. In July – even if to a minimum extent – the amount of precipitation in Várda was associated with a higher individual number. The dry weather dominant in the last two months of flight influenced the number of individuals caught by the light traps almost in the same measure in the two places.

However, farreaching conclusions cannot be drawn from the results, because the course of flight is affected by other population dynamic rules too.

In Figures 1., 2. the diagrams prepared by using the data collected with the light traps represent the course of flight. As seen from the figures two definite generations appeared both in Várda and Balatonmagyaród.

The effective heat sum required for the flight of the corn borer (MANNINGER, 1971) was reached at different times in the two places, in Balatonmagyaród on 13 June, in Várda on 5 June. The flight diagrams clearly show a definite rising in the above mentioned points of time.

Figure 2: Course of corn borer flight observed in 2002, Várda

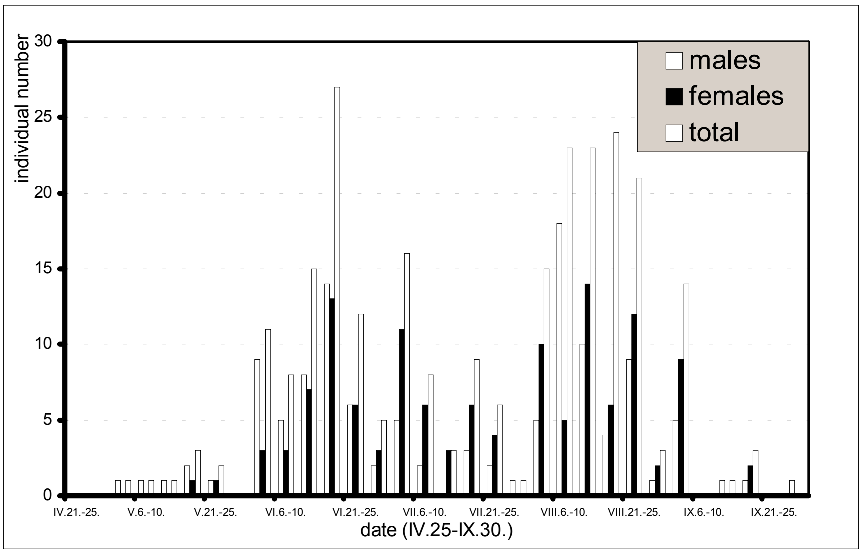


Table 2: Flight periods of corn borer in the places of survey, number of individuals trapped and their comparison by generation (from light trap collection)

		Balatonmagyaród	difference (%)		Várda
flight period (day)	1. generation	72	<	12,5	81
	2. generation	62	1,63	>	61
presence of corn borer (day)		134	<	5,97	142
Individual number	1. generation	122	0,81	>	121
	2. generation	120	<	10,83	133
	∑	244	<	3,68	253
Female number	1. generation	57	<	7,01	61
	2. generation	53	<	28,3	68
	∑	110	<	17,27	129
Male number	1. generation	65	8,33	>	60
	2. generation	67	3,07	>	65
	∑	132	5,6	>	125

The border between the two generations was determined in a subjective manner on the horizontal axis of the diagrams, the values seen in Tables 2. and 3. are given accordingly. In Balatonmagyaród it was on 21 July, in Várda on 25 July.

In Balatonmagyaród similar values were obtained for the trapped individuals in the case of the two generations, and the same trend appeared in the individual number of the sexes. In the generation appearing in the second part of the summer a minimum increase in the individual number of males was associated with a negligible extent of decrease in the female number. The totaled results when taken into consideration suggest that in Balatonmagyaród the presence of corn borer in that year showed a male dominance, as indicated by the relevant value of the generation coefficient too. The comparative ratio of the generations shows differences in the case of the sexes too. The decrease here did not involve the same rate and direction of change in the sexes, since the increase in the number of males was associated with a ruffly twofold decline in the female number.

As regards the relative individual number per day and the relative female number per day the values calculated for the second generation outnumbered these of the first generation. On the other hand, the extent of increase was lower, that is, the increased individual number vas the result of an increase in the number of males.

Table 3: Generation coefficients of corn borer in the places of survey, relative individual numbers and their comparison (from light trap collection)

		Balatonmagyaród	difference		Várda
generation coefficient		0,98	<	0,07	1,09
generation coefficient for males		1,03	<	0,05	1,08
generation coefficient for females		0,92	<	0,03	1,11
1 RIN	1.generation	1,69	0,2	>	1,49
	2.generation	1,93	<	0,17	2,1
	∑	1,81	0,03	>	1,78
1RFN	1.generation	0,79	0,04	>	0,78
	2.generation	0,85	<	0,26	1,11
	∑	0,82	<	0,08	0,9

Note: In the case of the generation coefficients the differences are those of the absolute values of deviation from 1. 1RIN = relative individual number per day; 1RFN = relative female number per day

In Várda an inverse ratio was found between the number of trapped individuals and the period of flight in contrast with the values of Balatonmagyaród where the shorter period of flight went together with a decrease in the individual number. The number of individuals caught in the second half of trapping was higher by 10% compared to the individual number of the first generation corn borer, manifest also in the individual number of the sexes. The generation coefficients indicated the presence of a stronger second generation.

The relative female number per day which represents a „damaging stress" on the plant stand of corn also indicates a 0.36 increase. The value of 1.11 calculated for the second generation shows considerable reserves concerning the damage expected for the next year in the country-side.

Statistical analysis of the light trap observations:

The changes in the individual number of the corn borer males showed significant correlation with the abiotic factors; they were closely correlated with the maximum temperature (P=99.9%; r=0.267), the minimum temperature (P=99.6%; r=0.226), the average temperature (P=100%; r=0.277) and with the precipitation (P=99.3%; r=0.299).

The number of females was remarkably influenced by the maximum temperature (P=100%; r=0.371), the minimum temperature (P=100%; r=0.292), the average temperature (P=100%; r=0.375) and by the precipitation (P=99.8%; r=0.276). This correlation was determined at higher significance level and closeness than in the case of the male number.

The correlation between the air humidity data and the results of trapping could not be statistically proved. Only the female number was significantly though less closely correlated with the relative humidity (P=95.1%; r=0.254).

The female ratio showed significant correlation with the maximum temperature (P=99.9%; r=0.267), the minimum temperature (P=100%; r=0.297), the average temperature (P=100%; r=0.308), and in inverse ratio to the amount of precipitation (P=98.2%; r=0.187). Thus, within the decreasing number of corn borer individuals observed with the higher amount of precipitation the reaction of the sexes was different: the number of females decreased in a greater measure.

Results of flight as supplied by the pheromone traps:

The data collected by the pheromone traps indicate damages done by two-generation populations in both places.

The period of flight was divided in two (according to the points of time given in the Section on light traps), and the values of generation coefficient and relative individual (male) number per day were determined for both places. The results are seen in Table 4.

Table 4: Flight data of corn borer collected by sexual attractant traps

		Balatonmagyaród	difference (%)		Várda
flight period (day)	1.generation	51	<	5,88	54
	2.generation	42	5	>	40
presence of corn borer (day)		93	<	1,07	94
Individual number	1.generation	61	35	>	45
	2.generation	31	<	25,8	39
	∑	92	9,52	>	84
generation coefficient		0,51	<	0,35	0,86
1 RIN	1.generation	1,19	0,36	>	0,83
	2.generation	0,73	0,32	>	0,41
	∑	1,02	0,13	>	0,89

Note: Under the double line differences are given in absolute value. 1RIN = relative individual number per day / in this case male number

As seen from the table the data registered by the pheromone traps greatly differ from those obtained by the light traps. From the first generation the pheromone trap of Balatonmagyaród, from the second one that of Várda collected more individuals. In total, the material collected by the Balatonmagyaród trap was larger. This result is consistent with the data registered by the light traps.

The generation coefficients indicate the dominance of the first generation in both places, a result by all means different from those described in the Section on light traps. A comparison of the two places gives a higher value for Várda. The relative individual number per day for males represents a higher value in Balatonmagyaród. Owing to the heterogeneity of the trapping results of pheromone traps we did not think the statistical analysis necessary.

CONCLUSIONS

In Balatonmagyaród and Várda two definite generations were found to appear in spite of the fact that the Zala area was near to those parts of Hungary where the European corn borer had only one generation. Between the two corn borer generations we observed differences in the course of flight, due to the different weather conditions of the two places. In Balatonmagyaród the first, while in Várda the second generation was larger in individual number.

In Balatonmagyaród male dominance was pointed out for the whole year, which means that the increased number of individuals was not coupled with higher fecundity. In Várda the initial male dominance ceased, and the females were in excess all over the year. Thus, in the southerly population higher fecundity values were observed, which may explain the decisive presence of corn borer this year.

As regards the relative individual- and female number higher values were obtained in Várda, which also proves the more positive appearance of the second generation.

Knowing the flight peaks in both places we can determine the optimum time for controlling the L_1 larvae. In Balatonmagyaród spraying ought to have been carried out between 23 and 28 June, and 10-25 August. In Várda the corresponding dates would have been 25 June - 5 July and 25-30 August. For purely financial reasons the control operations did not take place, but to determine the optimum time of control is theoretically possible. The trend of the amount of precipitation was in inverse ratio to, but in very close significant correlation with changes in the individual number of the corn borer and its sexes.

The data of air humidity showed significant correlation only with the change of the female number, due perhaps to the short period of observation.

The close correlation between the female ratio and the average- and maximum temperature suggested a strong influence of the high daytime temperature on the female ratio.

It can be established that the abiotic factors have a greated influence on the female number than on the number of males.

The prognosis by light- and pheromone traps, respectively, displayed a considerable asynchrony. The inconsistence and variety of the data supplied by the pheromone-trap investigations is ascribed to the unreliability of the prognostic instrument. The polymorphism of the pheromone attracted male corn borer individuals is not a new problem, it may serve as an objective of further investigations.

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