INFLUENCE OF METEOROLOGICAL FACTORS ON THE APPEARANCE AND DYNAMICS OF DEVELOPMENT OF CEREAL LEAF BEETLE

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ABSTRACT: The dynamics of development and influence of meteorological conditions on the appearance of cereal leaf beetle (CLB) were investigated during two years, which differed according to temperature regime. Cumulative values of average daily temperature were registered 7, 14, 21 and 28 days before appearance of adult of CLB. The cumulative temperature was the most similar about 14th day (108,4^{0}C 1st-year, and 106,2^{0}C 2nd-year), while identical values of cumulative temperate (102,0^{0}C) was registered on 13 days before stop of hibernation and can use as basic indicator in prognostication of appearance of CLB in spring. The period from beginning of oviposition to the appearance of larva varied between 11 to 19 days during two experimental years and sum temperature was from 203,3^{0}C to 232,6^{0}C. Period of larva development was 17-19 days and cumulative temperatures in that period were between 258,9 and 283,3^{0}C. The period from cocoon to appearance of first adult of new generation was between 13 and 15 days at the sum temperature from 245,3^{0}C to 247,2^{0}C.

Key words: cereal leaf beetle, meteorological factors, dynamics of development

INTRODUCTION

Thanks to bright ecological valence and area of living, CEREAL LEAF BEETLE causes economically important damage in wheat production (Wellso and Wetzel, 1987). Fenophase of the plant development in which the larvae attacks the plant is very important, because the youngest the plants are – the damages are bigger (Bes et al., 1986-b).

Cereal leaf beetle (Coleoptera, Chrysomelidae: *Lema melanopus* L.) has one generation yearly. In diapauses, insect is in imago stadium. In moderately-continental climate the adult of the cereal leaf beetle appears at the end of March and the beginning of April. Imago appearance time in the spring depends on a weather conditions, primarily temperature and the precipitation (Teofilovic, 1969). Imago activation time is successive and it reaches the greatest number in the first half of May.

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The purpose of these investigations was to determine the appearance time and dynamics of the development stadiums of the cereal leaf beetle – economically most important pest of the wheat since the beginning of '80s (Stamenkovic and Pankovic, 1991).

Registering of the meteorological data and their comparing them with the development stadiums of this pest can lead to different conclusions concerning the temperature influence and the amount of precipitation on a pest dynamics. Follow-up and analysis of the temperature change and the amount of precipitation can lead to better understanding of the cereal leaf beetle plant attack problem and the relation of this problem with the wheater conditions.

MATERIALS AND METHODS

Research was conducted on the experimental field of the Center for small grains in Kragujevac, during 1996/97. and 1997/98. Meteorological data were obtained in Agrometeorological Station of the Center.

Experiment was conducted in controlled field (plant in cages) conditions. The cages were set on the filed parcels one meter size each, dimensions 1×1×1 m. After setting up the cages, 90 imagoes of the cereal leaf beetle were put in each cage, collected from the experimental parcels right after the diapauses. The dynamics of the cereal leaf beetle development stadiums was investigated in relation to the meteorological factors.

RESULTS AND DISCUSSION

Imago appearance time depends on the time of the year. Cereal leaf beetle imago appears between the first of April and tenth of June (Bes et al., 1986-a). Intensity of the imago appearance strongly depends on the weather conditions. Sunny and warm weather positively influences imago activity and the population density. Rainy and cold weather influences negatively the number of cereal leaf beetle imagos.

Adult activates itself on a relatively low temperatures (*L. melanopus* is active starting at 4,2^{o}C average daily temperature, Teofilovic, 1969, and *L. cyanella* at approximate 7,0-8,0^{o}C air temperature, Shurovenkov, 1977). On low temperatures adults do not move from the place where they spend winter. They stay and feed themselves with the different grasses leafs. When the air temperature becomes higher and stable, above 15,0^{o}C, imago starts to move towards the fields with small grains.

In our research in the first experimental year, the presence of imago has been discovered at the end of April, and in the second year at the beginning of April. The first appearance of imago occurred at the average daily temperatures between 13,3-17,2^{o}C. The further development stages dynamics depended on weather conditions mainly temperature.

Because of the bad weather conditions that occurred during April 1997. (Average daily temperature was 4,3^{o}C less than a year average), the first adults were registered on the 29th April, when the average daily temperature was 13,3^{o}C, and the fifteen days period mean temperature before imago appeared was 7,5^{o}C. In 1998. year the first imagos appeared on the sixth of April when the mean daily temperature was 17,2^{o}C, and the fifteen days period mean temperature before imago appeared was 7,1^{o}C.

Analysis of the cumulative values of the mean daily temperatures for the periods of 7, 14, 21 and 28 days before cereal leaf beetle imago appearance in spring (Tab. 1) shows that the cumulative values of temperature in given years were most similar (108,4°C in first year and 106,2°C in second year) on the fourteenth day. Identical cumulative values were obtained during the thirteenth day before the hibernation was interrupted. The sum of temperatures of 102,0°C can be used as a basic indicator for a cereal leaf beetle prognosis in spring.

Minimal temperature measured 5 cm over the ground surface was 8,5 in first and 6,2°C in second experimental year – the day when adults appeared and was the highest temperature during the 28 days period. During the investigation no connection between the relative air humidity and total amount of precipitation with *L. melanopus* diapauses break was found.

Table 1. The sum of mean daily temperatures, the sum of minimal daily temperatures on a 5 cm above the ground surface, average relative air humidity and total amount of precipitation during one, two, three and four weeks before adult came out of diapauses - in both experimental years

Time before adult appeared	The mean daily temperatures sum (°C)	The min. temp. sum on 5 cm above the ground (°C)	Mean humidity (%)	Total of precipitation (mm)
28 days	157.1	-73.0	65.4	40.0
21 days	131.9	-59.7	63.7	18.8
14 days	107.3	-28.8	64.6	14.8
7 days	76.6	-0.65	64.4	11.1

The period from oviposition to first larvae appearance was 11 to 19 days in both experimental years; sums of effective temperatures were 203,3 - 232,6°C. The larvae development period was between 17 to 19 days, where the cumulative temperatures were between 258,9 and 283,3°C in mentioned period. Time interval from cocoon instar until the first adults appeared was 13 to 15 days – the temperature sum was between 245,3 and 247,2°C.

According to obtained results from Teofilovic (1969) it can be seen that the cumulative temperatures sum needed for larvae and cocoon instar development was approximately equal. According to Teofilovic (1969) the mean of the daily temperatures for the whole larvae development instar was 272,0°C and for the cocoon instar 253,0°C, what is almost equal to our research results in which the cumulative temperatures sum for a larvae instar was 271,1°C, and for a cocoon instar 264,3°C (Tab. 2).

The cereal leaf beetle female sets eggs during the whole spring. The climate influences differences in larvae development time between larvae that were obtained on the beginning and at the end of oviposition period. The age structure is the most equal at the beginning of oviposition and it becomes more heterogeneous later - every larvae instar and every development stadiums are present in June.

If the eggs are set in the early spring, when the temperatures are lower, embryonic development takes longer. Eclosion of larvae is different for the eggs set on a different

dates. The most of the larvae goes out in the first three days from the beginning of the oviposition. The eclosion period lasts shorter if the eggs were set later.

Table 2. The sum of mean daily temperatures, the sum of minimal daily temperatures on a 5 cm above the ground surface, average relative air humidity and total amount of precipitation during the life stadium of the cereal leaf beetle in both experimental years

Stadium	Interval (days)	The mean daily temperatures sum (^oC)	The min. temp. sum on 5 cm above the ground (^oC)	Mean humidity (%)	Total of precipitation (mm)
Egg-larvae	15	217.9	45.3	62.6	13.6
Larvae-cocoon	18	272.0	112.1	71.6	38.1
Cocoon-imago	14	246.3	86.3	64.8	26.9

The larvae that went out at the beginning or during the first April decade develop three days longer from the larvae that went out at the end of April, and more than seven days longer from larvae that came out in may. This behavior causes presence of less life stadiums of cereal leaf beetle at the same time, what is almost the rule for insects that have more generations during the year.

Meteo conditions during the experiment were without variations in average yearly temperatures and total amount of precipitation. Nevertheless, it is to say that for the plants, the year 1997/98. was more convenient compared to 1996/97. The fact itself influenced some of the morfo-fisiological factors and yield.

In 1996/97. year, the conditions for cereal leaf beetle development were better, because each development stadium (except for cocoon-imago) were over in less time and under lower temperature sum, compared to 1997/98. year. That fact influenced a damage level of the observed plants too.

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SUMMARY

According to obtained experimental results, it can be concluded, that if the cumulative temperature in 14 days period before imago appears in spring raises above 100,0^{o}C it is to expect that *L. melanopus* will appear. If this condition is satisfied, for more precise determination of the datum of the cereal leaf beetle appearance it is necessary to mark the highest minimal daily temperature on 5 cm above the ground. The relation between the relative humidity, the total amount of precipitation and diapauses stop datum is not yet obtained.

The relation between the development stadium duration and temperatures is already determent: the two year research shown that the average time interval from the oviposition begin until the first larvae eclosion was 15 days, while the average temperature sum was 217,9°C. Larvae instar lasted 18 days, while cumulative temperature was 272,0°C. The cocoon instar lasted 14 days and the cumulative temperature was 246,3°C.

The results given above can be used for more precise determination of dynamics of development stadiums of this pest and for determination of time of the imago appearance in spring. Rational and optimal application of insecticides is recommended.

REFERENCES CITED

BES, A., DIMIC, N., TRIFKOVIC, S.: *Dinamika zastupljenosti vrsta Lema melanopa L. i Lema cyanella L. na podrucju Semberije*, Radovi Poljoprivrednog fakulteta Univerziteta u Sarajevu, XXXIV(38), 133-145, Sarajevo, 1986-a.

BES, A., DIMIC, N., TRIFKOVIC, S.: *Prilog izucavanju stepena stetnosti zitnih buba listara* (*Lema melanopa* L. i *Lema cyanella* L.) *na psenici*, Radovi Poljoprivrednog fakulteta Univerziteta u Sarajevu, XXXIV(38), 147-152, Sarajevo, 1986-b.

SHUROVENKOV, H: *Sinyaya pyavitza, pshenichni trips i ikh entomofagi*, Zashita rasteny, 10, 44-45, Moskva, 1977.

STAMENKOVIC, S., PANKOVIC, L.: *Testiranje psenice i jecma na otpornost prema zitnoj pijavici (Lema melanopus L.)*, Zbornik radova Instituta za ratarstvo i povrtarstvo, sv. 19, 247-251, Novi Sad, 1991.

TEOFILOVIC, Z.: *Prilog proucavanju morfologije i razvi}a zitne pijavice (Lema melanopus L.) i uticaj ekoloskih cinilaca na njene zivotne aktivnosti (skraceni tekst doktorske disertacije)*, Zbornik radova Zavoda za strna zita, 4, 29-124, Kragujevac, 1969.

WELLSO, G. S., WETZEL, T.: *Economic thresholds for Central European and North American Wheat insects*, The Great Lakes Entomologist, 20, 1, 51-57, 1987.