IMPROVING THE PREDICTION OF ADULT CHERRY FRUIT FLY (*RHAGOLETIS CERASI* L.) EMERGENCE IN BUCHAREST-BANEASA AREA

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Abstract: The European cherry fruit fly (*Rhagoletis cerasi L.*) is the most important harmful insect of sweet cherries (*Prunus avium L.*) in Romania. The compulsory condition to establish the optimal timing insecticide applications is the prediction of adult cherry fruit fly spring emergence, as a key factor for a successful pest management in cherry orchards. Observations on *R. cerasi* were carried out in sweet cherry orchard of Research-Development Institute for Plant Protection in Baneasa area during 2005 – 2007. The yellow sticky traps and effective temperature sum were used to predict first adult emergence. The first flies were captured between 14 and 25 May, corresponding to an effective temperature sum of 313.8-403.7°C. The air average temperature and rainfalls data were provided by an agro-expert system placed nearby sweet cherry orchard.

Key words: *pest management, cherry orchards.*

INTRODUCTION

Sweet cherry is one of the most important fruit crops in Romania. Cherries are the earliest fresh fruits available on market each year. The European Cherry Fruit Fly, *Rhagoletis cerasi* L. (Diptera: Tephritidae) is known as the most serious pest of sweet cherries, *Prunus avium*, in almost all cherry growing regions in Romania. Infestations occur especially on the middle and late-ripening cherry cultivars (Şuta, 1969), in some years the percentage of infested fruits in unprotected plantation varied within 40-50 (Perju & Serban, 1996). The adult females attack the ripening cherries shortly before harvest time by laying their eggs inside the fruits, so the larvae are developing in the fruit pulps.

The sweet cherry fly adult population has been fluctuating each year in Băneasa-Bucharest area. The management strategy is a combination of yellow sticky traps and insecticides. The date of spray is mainly predicted by mean of yellow sticky traps combined with visual control of ripening-fruits. Pirethroids are adulticide products which are usually used against cherry fruit fly but because the treatment application time is in pre-harvest (about 2-3 weeks at limit of pause times of insecticides application) is wise to replace them.

Pirethroids provided a satisfactory control of cherry fruit fly, but they are subject to be re-evaluatin (in the future they will be removed from the European Union countries) (Vogt & Kopler, 2004; Kovanci & Kovanci, 2006). Consequently, the pest control is oriented towards the integrated management promoting environmental friendly control strategies and minimum usage of synthetic pesticides (Casagrande et al., 1995, Daniel & Wyss, 2003).

For all control strategies, the prediction of the first adult emergence is the main step for optimal timing control measures.

Romanian earlier investigation reported that the cherry fly first emergence can be assesed by collecting infested cherries, caging them on the ground under orchard trees and observing flies emergence in the cages (Suta, 1969) or in the visual yellow sticky traps (Beratlief et. al., 1981) during the following spring. Suta (1969) reported that the development of pupae phases in soil and the moment of emergence are depending on soil temperature. (e.g. the appearance of first adults is predicted 14-16 days after the rosy eye pupae are found). The 10°C temperature was the base level

measured in soil, 5 cm.depth. Using this soil temperature, Suta found the *R. cerasi* hatches from the pupae after 148.4-247.1°C effective temperatures sum (or 31-48 days with average temperature above 10°C at a soil depth of 5 cm).

Recently, in European Countries, the degree-day (DD) accumulations models based on the relationship between post-diapauses pupae development and air temperatures are more and more used into combination with the yellow sticky traps for the prediction timing of *R. cerasi* adult emergence (Kovanci & Kovanci, 2006).

The purpose of this study was to provide information about the precise of first emergence timing of fruit fly adults, *R. cerasi*, on the basis of the effective temperatures sum in local conditions in Baneasa area and to determine the accurate timing of insecticide applications.

MATERIAL AND METHOD

Observations on *R. cerasi* were carried out in sweet cherry orchard of Research-Development Institute for Plant Protection in Baneasa area during the 2005 – 2007. This orchard of 1.23 ha, includes mature trees about 4-5 m canopy hight, 2 middle and 1 late-ripening cherry, *Boambe de Cotnari* and *Van*, respectively, *Germersdorf* cvar (the most cultivated cvar in Romania). One pirethroid treatment was applied against cherry fruit adults fly every year. The different perennial grasses covered the orchard ground. RDIPP orchard is in the Romanian Plain (altitude of 78 m, 26068609N and 44502200E, WGS84/UTMzone35N)

Five yellow sticky visual traps were coated with adhesive (30x15cm), Attracters-type (Romanian origin-Research Institute for Chemistry "Raluca Ripan", Cluj) were used for monitoring adults period of flight. The traps were hung at about 2 m height in a vertical orientation on the south side of canopy trees according to *R. cerasi* literature (Beratlief et. al., 1981; Perju & Serban, 1996; Voigt, 1999). The traps were placed in the second decade of May and they were checked daily, until the apparition of the first adults, followed by a weekly checking, till the end of adults period of flight.

Besides the yellow sticky traps, the sum of effective temperatures or DD was used to determine the presence of the first adult flies. DD proved to be a very good tool providing accurate information on predicting the first cherry fruit fly adult emergence (www.sopra.info, Kovanci & Kovanci, 2006).

The lower developmental threshold of 7°C was the base temperature for *R. cerasi* (according to European literature), and the temperature accumulation started from the first day with an average temperature above the lower threshold (7°C). The fruit flies researches, mention February,1st and first of March as being the starting date for the accumulation of DDs for *R. cerasi*, and American fruit flies, respectively (Kovanci & Kovanci, 2006; AliNiazee, 1976, 1979). Also, the basal temperature is 7°C, and 4.4°C respectively.

In our study the sum of effective temperatures was calculated according to Savescu's formula (1969, 1978) $\sum$(tn-7°C). Formula utilizes the daily average temperatures above threshold level of 7°C from which is subtracted the lower threshold of cherry fruit fly.

Climatic conditions (air temperatures and rainfalls) were provided by Metrilog's M2M system placed at RDIPP Bucharest, 300m from the experimental orchard.

RESULTS

The Figure 1 presents climatic conditions including: the three days average air temperatures and the rainfall during 2005-2006 (March-June) and 2007 (February–June) period in Baneasa area. These periods are representing for the adult emergence and flight periods.

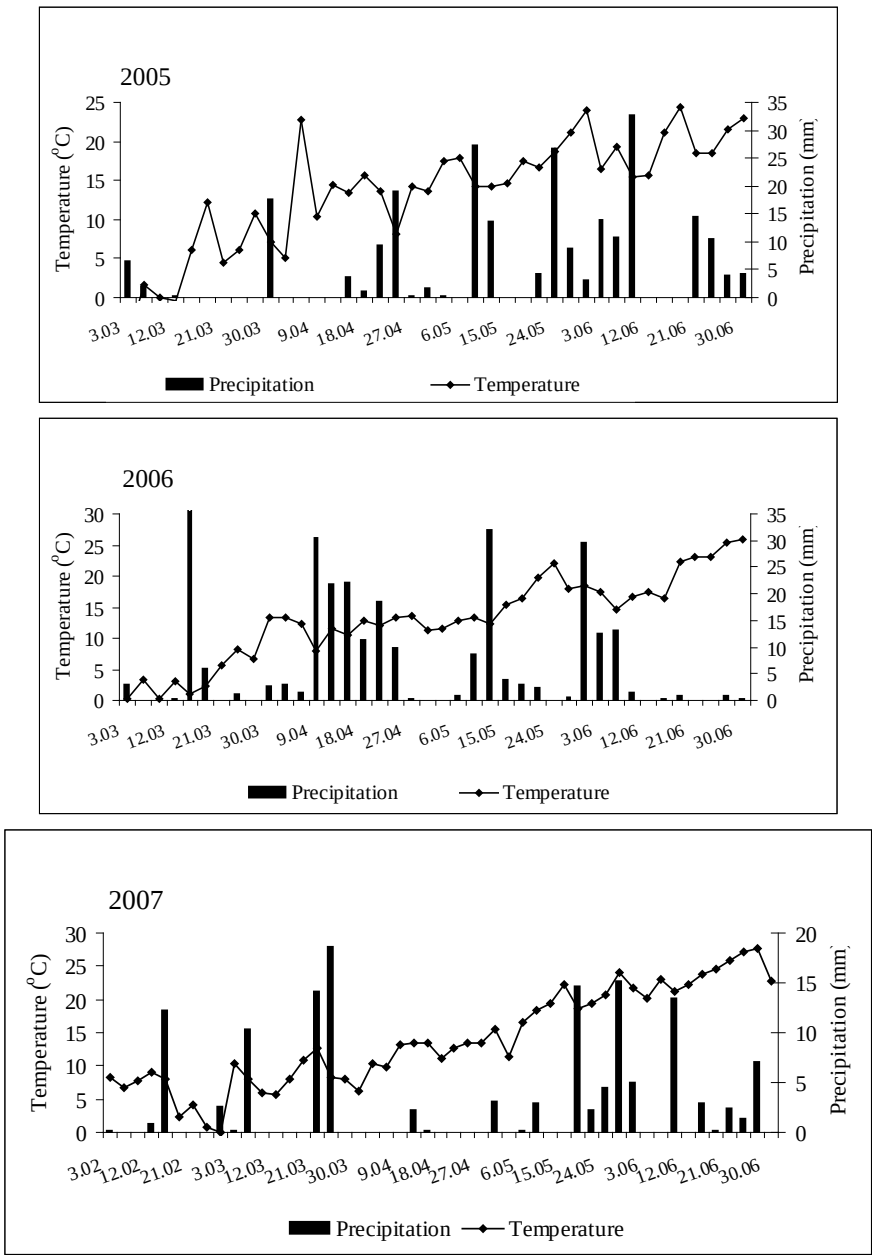

Fig. 1 Average temperatures and precipitation amounts in Baneasa area during 2005-2006 March-June and 2007 February-June.

There are some other useful observations such as, the first day when was registered the average temperature above the low developmental threshold of cherry fruit fly, the values of this average temperature, the date of the yellow sticky traps settings and the date of first adult capture on yellow sticky traps are presented in Table 1.

Table 1

Main observations before the beginning of adult's emergence in sweet cherry orchard in Baneasa area

Year	First day temp. > 7 °C	Avg. temperature (°C)	Date of trap setting up	Date of first adult capture
2005	16.03	8.8	20.05	25.05.
2006	22.03	11.5	15.05.	19.05.
2007	25.01	8.9	11.05.	14.05.

The data listed in Table 1 show that the yellow sticky traps were set up in the second decade of May about 3-5 days before the beginning of the first adult's appearance. The first day presenting the average temperature above the low development threshold (7°C) of *R. cerasi* were recorded in second

part of March, excepting 2007 year. During 2007, the temperature about low development threshold of cherry fruit fly has been observed since 25 January, the average value was 8.9°C. This remark seems to be in accordance with the general trend of higher temperature values in Baneasa area. Temperature changes are in close connection to the global warming including the temperature rise and rainfall variations over the next period.

The first adult captured on yellow sticky traps were recorded on May 25 and May 19 in 2005 and 2006, respectively, depending on climatic conditions of Baneasa area, this date was registered on May 14 in 2007. Adult cherry fruit fly population dynamic showed on yellow sticky trap captured under Baneasa area is represented in Figure 2, during the three years of observations.

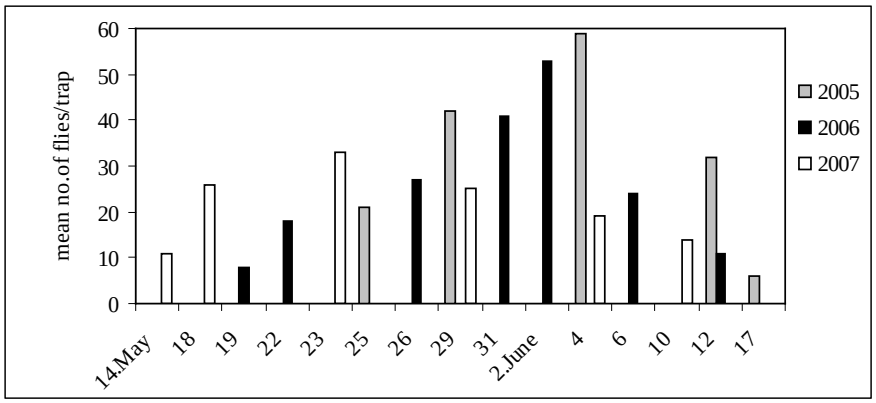

Figure 2 Average density of Cherry Fruit Fly adult captured on yellow sticky trap in Baneasa-Bucharest area

Depending on year and climatic conditions in Baneasa area, the first fly captures on yellow sticky traps were recorded from 14th to 25th of May. During 2007, the adult flight period started about 1-2 weeks earlier than 2006 and 2005, because of the increased air temperature and less rainfall in April-May, favoring the flies' emergence. Every year, the captures on the yellow sticky traps increased in number, at 4-5 days after the emergence. Dynamics of cherry fruit fly adult population reached a peak of captures about 10-14 days following emergence: May 23rd (2007) June, 2nd (2006) and June, 4th (2005), respectively between 33 to 60 average captures per yellow trap. On the second decade of June the adult flight period ended, the time corresponding to cherries harvesting.

In order to establish more accurately the precise moment of first cherry fruit fly adult emergence in cherry orchard, besides the yellow traps, the sum of effective temperature pattern was used. The results showing the connection between the first adult captures on yellow sticky traps and the sum of effective temperatures in Baneasa-Bucharest are presented in Table 2.

Table 2

The sum of effective temperature needed both for the first record of *R. cerasi* adults on yellow sticky traps and the flight peak

Specification	Registered no. of days from the first air temp. >7°C			$\sum(t_n - 7°C)$		
	2005	2006	2007	2005	2006	2007
First adult emergence	70	58	109	403.7	313.8	374.5
Adults emergence peak	78	71	119	522.8	474.3	489.7

Taking into account the sum of effective temperatures calculated from the first day recorded the average temperature above 7°C, we found that in Baneasa area climatic conditions, for emergence the adults of cherry fruit fly needed an average of 364°C (from 313.8 to 403.7). In our study, depending on season, for the first captured adult on yellow sticky traps were necessary 403.7 (2005), 313.8 (2006) and 374.5°C (2007) effective temperature sums. These levels were reached after 70,58 and 109 days from the first air temperature above 7^{o}C. Peak of adult's emergence was reached 8-12 days from the first adults recorded corresponding to an average of 495.6°C. (474.3-522.8).

During 2007, to support cherry orchard observations we carried out two laboratory tests under controlled temperature and relative humidity conditions. Therefore, the laboratory tests established the relationships between air temperature and emergence of cherry fly adults under controlled conditions. Results for two series of pupae are presented in Table 3.

Table 3

Registered number of days and the sum of effective temperatures necessary for cherry fly adults emergence in laboratory conditions (air temperature 22°C; relative humidity 65%)

Specification	% emergence		No.of days after pupae transfer in lab. conditions		$\sum(t_n - 7°C)$ accumulation values	
	Series no. 1	*Series no. 2*	*Series no. 1*	*Series no. 2*	*Series no. 1*	*Series no. 2*
First adults emergence	*75,8*	*68,8*	20(1)	23(1)	300	345
Maximum of adults emergence	*88,5*	*87,7*	26(2)	27 (2)	390	405

(1)first day of emergence; (2)last day of emergence

For the laboratory tests, we used pupae from the local populations sources, the infested cherries collected during harvesting time of the previous year (2006). Before the laboratory tests, pupae were stored in plastic boxes with sieve in sand under optimal conditions (Vallo et al., 1976), later they were transferred to laboratory conditions of 22°C temperature and 65% relative humidity.

The results of the laboratory tests, during the observation period: 22°C and 65% RH, showed that the first cherry fruit fly adults appeared after 20-23 days corresponding to a effective temperatures sum of 300-345°C. The first adults appearance moment, was corresponding to 75,8% emergence for the first pupae series, and 68,8% for the second pupae series. Maximum of adults emergence was registered after 26-27 days corresponding to a sum of effective temperatures of 390-405°C and with 88,5% emergence for the first pupae series and 87,7% for second pupae series. The laboratory results concerning the connection between temperature and adults fly emergence are in accordance with cherry orchard observations.

CONCLUSIONS

The cherry fruit fly *Rhagoletis cerasi* L. (Diptera:Tephritidae) is the most important harmful insect of sweet cherries in Romania.

An important factor for the debut of the cherry fruit fly adult's emergence seems to be the direct influence of climatic conditions, temperatures and rainfall. Based on three years of observations under the climatic conditions on Băneasa-Bucharest area, the first adult captures on yellow sticky traps were recorded from 14th to 25th of May corresponding to an effective temperature sum between 313.8-403.7°C.

The results of the laboratory tests (22°C; 65% RH) showed that the first cherry fruit fly adults appeared after 20-23 days corresponding to an effective temperatures sum of 300-345°C.

The effective temperatures sum pattern is a good tool to establish the precise moment of the first cherry fly adults emergence in order to predict the optimal timing of insecticide treatments.

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