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Temperature Threshold and Thermal Constant of *Dacus frontalis* (Beker) (Order: Diptera: Tephritidae) on Three Cucurbit Hosts

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A B S T R A C T

The aim of this work was to determination of the threshold temperature and the required degree days for development represent the fundamental base for prediction of phenology of the insect annually as well as integrated with the other methods. The time needed for 50% of individuals to achieve development from egg stage to adult stage was recorded at the following constant temperatures: 15, 20, 25, and 30 $\pm 1C°$. The results revealed that there are significant differences of development periods of *Dacus frontalis* at the different temperatures and hosts, the shortest period of development to adult's stage was at the 30°C on Zucchini reached 15.207 days and the longest period was at the 15°C on Cucumber. The threshold temperatures were 11.7, 11.47 and 12.8 for crop Armenian cucumber, cucumber and Zucchini respectively. This is the first work on threshold temperature and development periods of *D. frontalis*.

Introduction

The fruit flies are one of the most important insect pest groups of horticulture production and export throughout the world. The economical loss by this group of insect is about 30-70% of yield (Gillani *et al.*, 2002; Royer and Hancock, 2012).

Over 4000 species that occur worldwide, 700 species belong to Sub family: Dacine and from most important genus are *Dacus* and *Bactrocera* which have about 50 species are regarded as major pest species on Cuccurbitaceaein addition to the other wild species like *Citrullus colocynthus*s chard and *Luffa aegytiaca* Miller (Mahdi, 2000).

In taxonomical study for Tephritidae species in Iraqi provinces (Al Safar, 2011) was recorded three species attack cucurbit plants in different area in Iraq, which are *Dacus ciliatus* Loew, *Dacus frontalis* Becker and *Myiopardalis pardalina* (Bigot) (Al saffar, 2011).

D. frontalis distributed in most Africa countries, Yaman, Saudi arabia and Jordan: attacks all cucurbit fruits causes loss in yield about 20-100% in some regions (Ekesi and Billah, 2007; Ba-Angood, 1977; El-sabah and Fetoh, 2010) The most dominant species is *Dacus frontalis* Becker in iraq (Al Jorani, 2013).

D. frontalis is qualitative pest on cucurbit fruits causes economic lose annually in Iraq. *Cucurbita pepo* Zucchini (summer squash) and *Cucumis sativus* L (Cucumber) have been planting in two growing seasons (spring, autumn). The spring growing season start from March to the end of June and the autumn growing season start from September to the end of November.

The trials of control this pest varies from chemical pesticides to biological control in addition to the bait traps (Steffens, 1983).

This pest had been studied from different research goals; one of them is the threshold temperature for development and thermal constant (K) expressive by heat degree days which describe a relationship between the temperature with development rate

The aim of this work was to determination of the threshold temperature and the required degree days for development represent the fundamental base for prediction of phenology of the insect annually as well as integrated with the other methods specially using the insect pheromone for determination of accurate date to conduct the control means and included in the integrated pest control.

Material and Methods

A culture of adult flies of *Dacus frontalis* was maintained in the laboratory in plant protection Department, Agriculture College / Baghdad University, Iraq in growing season from May to December 2015. The strain was reared simultaneously in an environmental chamber maintained at $25 \pm 1C$ with $75 \pm 10\%$ relative humidity under a 12:12 (L:D)-h photoperiod using natural light supplemented by artificial light. Adults were fed with enzymatic yeast hydrolysate and sugar in addition to three fruits of each

cucurbit host put at the top of the three cages after 24h the fruits were transferred to incubators. Although the temperature development rate curve obtained with constant temperatures. The time needed for 50% of individuals to achieve development from egg stage to adult stage was recorded at the following constant temperatures: 15, 20, 25, and $30 \pm 1C°$. Each experiment at 15, 20, 25, and $30 \pm 1 C$ was duplicated four times. Four incubators were used (one per temperature). Each repetition for the hosts was observed simultaneously to record the time development in each incubator. The same procedure was used for the Zucchini and The Armenian cucumber, *Cucumis melo* var. flexuosus, the lower development threshold (t; the temperature at which there is no development) was determined by extrapolation of the regression line back to the x-axis. The threshold temperature was calculated from the regression equation (Y= a + b x): between temperature and daily development rate (Arnold, 1960).

Where:

y = daily rate of development
x= threshold temperature
a = intercept
b = regression factor (slope)

Thermal units were calculated as the reciprocal of regression coefficient as follow:

$$K=1/b$$

Where (b) = regression coefficient

(Campbell and Machauer, 1975)

Statistical analyses were performed using the life test procedure (GenStat 2009) and analysis of variance (ANOVA). ANOVA was used to analyze developmental time;

means were compared by multiple range tests (P _ 0.05).

Results and Discussion

Development periods

On cucumber at temperatures 15°C, 20°C, 25°C and 30°C, the development from egg to adult period was 86.85, 35.1, 20.04 and 16.25 days respectively. On Armenian cucumber the periods were 85.225, 33.970, 18.666 and 15.250 respectively. On the Zucchini the periods were 82.369, 33.150, 18.888 and 15.207 respectively. The results show (table 1) significant differences of development periods of *Dacus frontalis* at the different temperatures and hosts, the shortest period of development to adults stage was at the 30°C on Zucchini reached 15.207 days and the longest period was at the 15°C on Cucumber.

Table.1 Development time of *Dacus frontalis* in deferent hosts and deferent temperature from egg to adults

Hosts Temperature °C	Average of developing time (Days)			
	Cucumber	The Armeniancucumber	Zucchini	Average
15	86.855	85.225	82.369	84.816
20	35.139	33.970	33.150	34.086
25	20.041	18.666	18.888	19.198
30	16.250	15.250	15.207	15.569
Average	39.571	38.278	38.154	
L.S.D P<0.05	Hosts: 0.1539 Temperature: 0.1777 Host × Temp.: 0.3078			

Fig.1 Show the relationship between the temperature and the development rate of *Dacus frontalis* on Zucchini
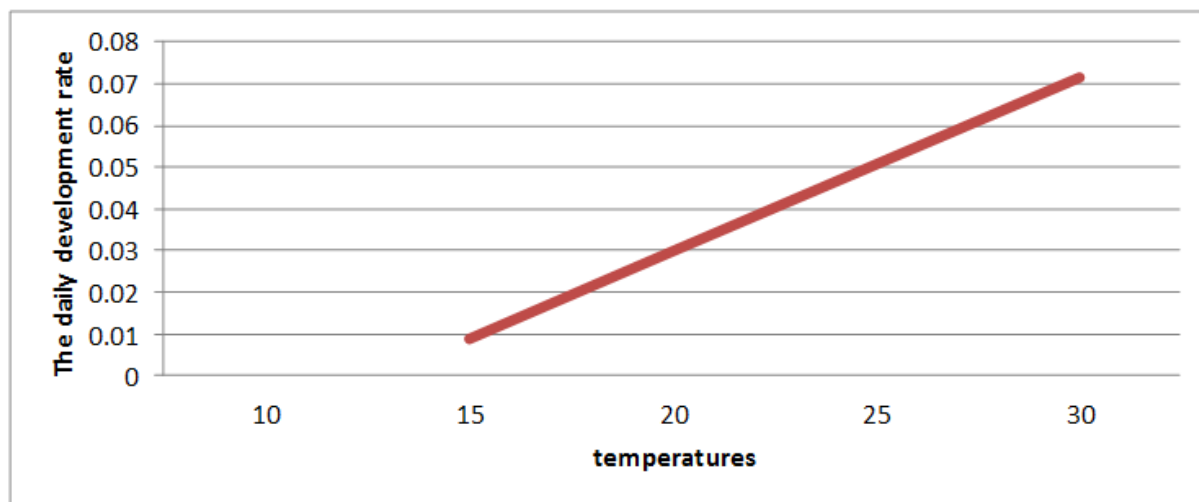
Fig.2 Show the relationship between the temperature and the development rate of *Dacus frontalis* on Cucumber
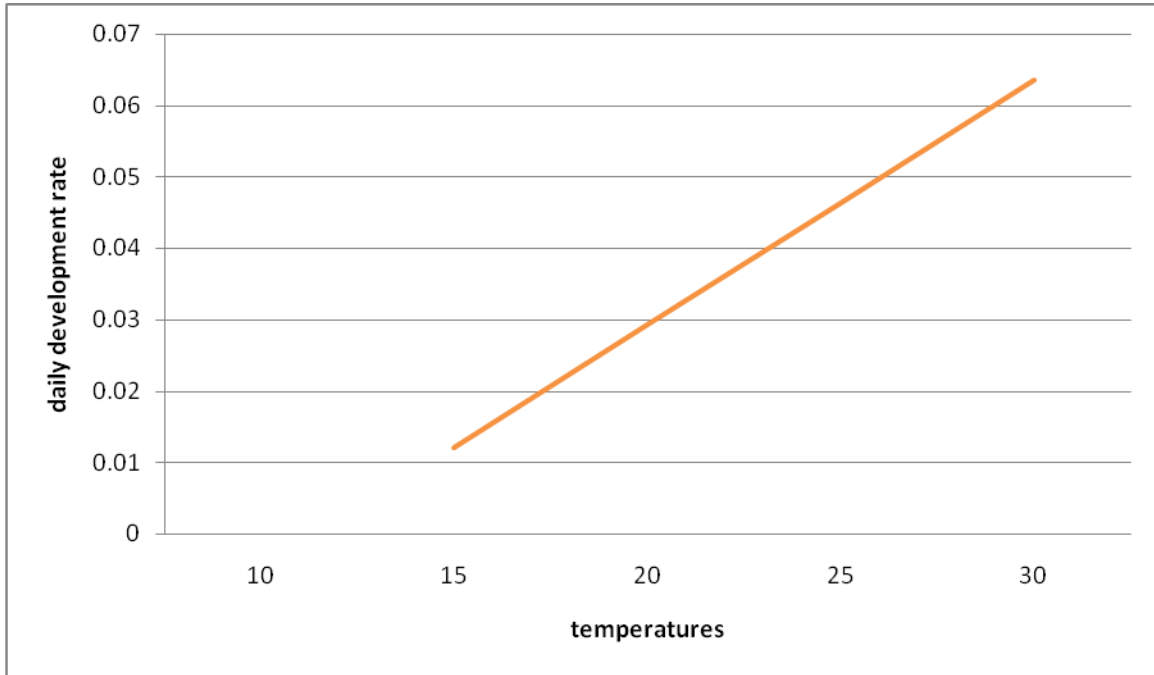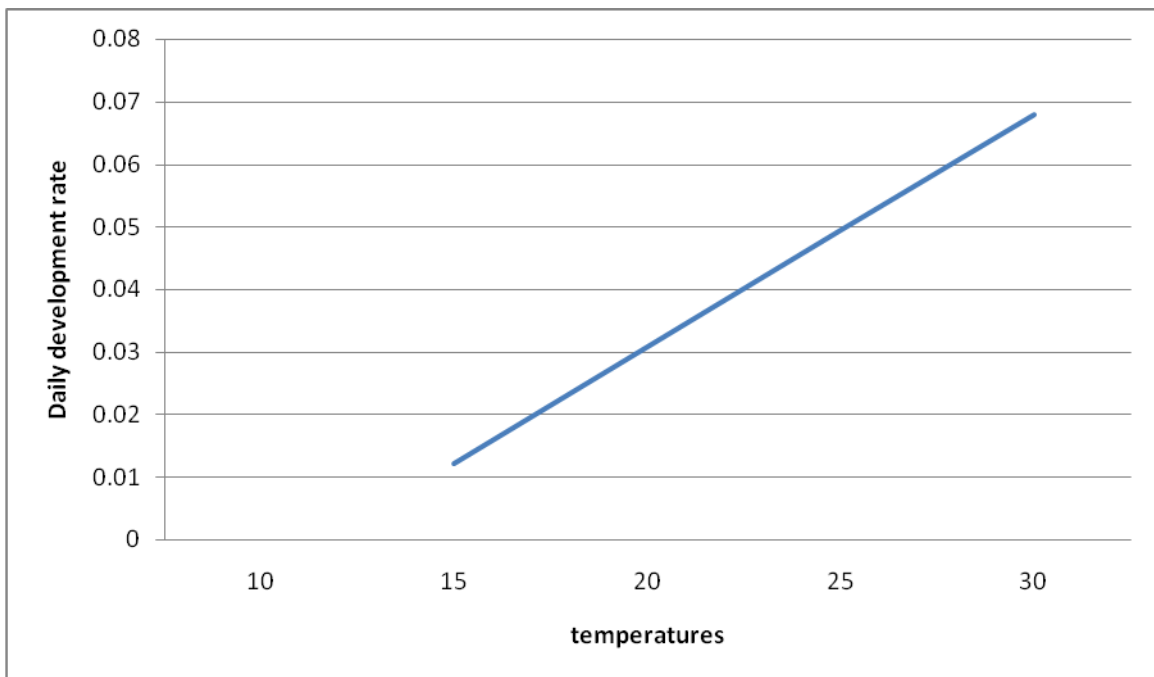

Fig.3 Show the relationship between the temperature and the development rate of *Dacus frontalis* on Armenian cucumber

There are significant differences among development periods (DP) under different temperatures on the same host (Cucumber, Zucchini and Armenian cucumber) where

the (DP) reached on Zucchini 15.207 days and 18.888 days under 30°C and 20°C respectively. These data can be explained that the temperature and the host plant affect the growing velocity and activity of the insect, because whenever the temperature is optimum the development is faster when the insect feed on her preferred host plant. These data is a pioneer on this insect the previous researches did not referred in any work which have devoted on *Dacus frontalis*.

Threshold temperature

The figures (1,2,3) show the relationship between the temperature and the development rate of *Dacus frontalis* on the host plants Zucchini, Cucumber and American cucumber where the linear relationship and high significant correlation. The threshold temperatures were 11.7, 11.47 and 12.8 for crop Armenian cucumber, cucumber and Zucchini respectively. This is the first work on threshold temperature and development periods of *D. frontalis*. As for the required degree days summation (DDS) for insect development were 269.3, 291.6, and 240.7 degree day on the host plants referred respectively also calculated based on contrary of regression factor (1/b), up on the calculation of accumulated degree days and the temperature exist in that period, the date of insect's adults presence in the field on May as (Shawket *et al.,* 2011) show same date of presence.

References

Arnold, C.Y. 1960. Maximum – minimum temperatures as a basis for computing heat units. *Proc. Am. Sco. Hortic. Sci.,* 74: pp430 – 445.

AL-Jorany, Redha, S. 2013. Relative incidence of greater melon fly, *Dacus frontalis* Becker and Cucurbit fly, Dacus ciliates Loew on Cucumber *Cucumis sativus* (L.). *Mesopotamia J. Agri.,* Vol. (41) Suppl. (1).

Badr El-Sabah, A., *et al.* 2012. Temperature-Dependent Development and Degree-Days Models of the Peach Fruit Fly *Bactrocera zonata*(Saunders) and the Cucurbit Fly *Dacus ciliatus*(Loew) *Int. J. Environ. Sci. Engi., (IJESE)* Vol. 3: pp 85- 96.

BA-Angood, S.A.S. 1977. Control of the melon fruit fly, *Dacus frontalis* Becker (Diptera :Tephritidae), on cucurbits. *J. Hort. Sci.,* 52: pp545- 547.

Campbell, A. and Machauer, M. 1975. Thermal constants for the development of the pea aphid and some of its parasites. *Can. Ent.,* 107: 419-423.

Ekesi, S. and M.K. Billah. 2007. A Field Guide To the Management Press, Nairobi, Kenya. Of Economically Important Tephritid Truit Flies In Africa. ICIPE Science Press, Nairobi, Kenya.

El-Sabah, B. and A. Fetoh. 2010. Effect of fruit size on the infestation by cucurbit fly *Dacus ciliatus* and the melon fly *Dacus frontalis*. Fourth Saudi Science Conference. March 21-24. Page 254.

Gillani, W.A., Bashir, T. and Ilyas, M. 2002. Studies on population dynamics of fruit flies (Diptera: Tephritidae) in guava and nectarine orchards in Islamabad. *Pak. J. Biol. Sci.,* 5(4): pp 452-454.

Mahdi, Hassan Suleiman Ahmed. 2000. Environmental and lifestyle study Insecticides Dacusciliatus (Loew) (Diptera:Tephritidae) And some methods of control. A Thesis of Doctor, Plant Protection Department, College of Agriculture - University of Baghdad. Page 102.

Royer, J.E., Hancock, D.L. 2012. New distribution and lure records of

Dacinae (Diptera: Tephritidae) from Queensland, Australia, and description of a new species of Dacus Fabricius. *Aust. J. Entomol.,* 51: pp 239–247.

Steffens, R.J. 1983. Ecology and approach to integrated control *of Dacus frontalis*on the Cape Verde Islands. Fruit fly of economic important, edited book, pp (632-638).

Shawkit, M.A., AL –Neamey, B., Hussian, F., Edan, L.H., Mahmood, A.R. 2011. Population Density and Biological Studies of Two Cucucrbit Flies Species:Dacus ciliates Loew and *Dacus frontalis* Beecker (Diptera: Tephritidae. *J. Madinatalilm Univ.,* Vol (3) pp(71-75).