

Comparative study of Cucurbit fly: *Dacus ciliatus* Loew (Diptera: Tephritidae) infestation on Zucchini squash (*Cucurbita pepo* L.) at Huraimila and Diraab, Riyadh Region, Saudi Arabia.

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ABSTRACT

Dacus ciliatus Loew (Diptera: Tephritidae) infestation was studied on regular and hybrid varieties of Zucchini squash (*Cucurbita pepo* L.) in summer growing season at two locations, Huraimila and Diraab educational farm, Riyadh, Saudi Arabia. The experiments were laid down following randomized complete block design (RCBD). Results indicated no *significant differences between the varieties for* fruit fly (*D. ciliatus*) infestation within each location. Huraimila *had* significantly greater fruit fly infestation as compared to Diraab. In Huraimila, infestation peak was observed in the last week of May whereas, in Diraab no significant change was observed during the month of May but a significant reduction in infestation was recorded in the mid of June. Results indicated a correlation ($r = 0.66$ at <0.0001) between average number of zucchini squashes harvested and number of infested squashes per line.

Keywords: *Dacus ciliatus* Loew, Diptera, Tephritidae, infestation, Zucchini squash, *Cucurbita pepo* L., Variety, locations

INTRODUCTION

Zucchini squash (*Cucurbita pepo* L.) is an economically important vegetable crop grown in Saudi Arabia. The crop is heavily infested by fruit fly: *Dacus ciliatus* Loew (Diptera: Tephritidae). Family Tephritidae comprises over 4000 species, around 700 species belonging to Dacine fruit flies (Fletcher, 1987). About 250 species are economically important and widely distributed in temperate, sub-tropical, and tropical regions of the world (Christenson and Foote, 1960). *D. ciliatus* is a serious pest of cucurbits in Saudi Arabia (Fischer and Petersen, 1989).

D. ciliatus was reported in India in 1914 for the first time and was collected first from Ombo, Upper-Egypt, in February 1953 (Weems, 2008). *D. ciliatus* is distributed throughout most of eastern, southern, and central Africa, Malagasy Republic (Madagascar), Mauritius and Reunion Islands, the Arabian Peninsula, Pakistan, India, Bangladesh and Sri Lanka (White and Elson-Harris, 1994).

D. ciliatus generally deposit 4-8 eggs in a single puncture made in the fruit by the ovipositor of the female typically near the stalk and complete life cycle within 19-22 days in which egg stage lasts two to four days, the larval stage four to six days, the pupal stage eight to 10 days, the pre oviposition period takes at least four days (Weems, 2008).

The genus *Dacus* causes heavy damage to fruits and vegetables in Asia (Nagappan *et al.*, 1971). *D. ciliate* is a serious agricultural pest (White and Elson-Harris, 1992) and considered as an important quarantine pest in different countries (European and Mediterranean Plant Protection Organization, 2008). *D. ciliates*

seriously damage cucurbits in many countries, Egypt (Azab *et al.* 1970), South Africa (Hancock, 1989), the Island of Reunion, and other islands in the Indian Ocean (Dehecq, 1995). The female deposit her eggs into the cucurbit fruit where larvae developed inside the fruit leading to the fruit deformation and rotting (El-Nahal *et al.*, 1970; Fletcher, 1987).

The pupation usually takes place on ground inside the upper layer of soil (Malihi, 1998). Greater larval exit from the fruit before pupation and adult emergence occur around morning and are controlled by light and temperature (Malan and Giliomee, 1968; Arai, 1976). Moreover, *Dacus ciliatus* oviposit on shady rather than fruit area exposed to the sun (Syed, 1969). Availability of abundant hosts restrict the movement of mature flies to foraging flights to explore food, water and oviposition sites (Bateman, 1972). Dacine flies exhibit a daily pattern of movement between hosts and surrounding vegetation which is more evident in cucurbit infesting species including *D. ciliatus* (Matanmi, 1975).

The objective of the present study was to determine fruit fly (*Dacus ciliatus*) population density and degree of infestation on Zucchini squash (*Cucurbita pepo* L.) in Huraimila and Diraab areas, Riyadh Region, Saudi Arabia.

MATERIALS AND METHODS

Experiments were carried out during summer growing season of Zucchini squash (*Cucurbita pepo* L.) at Huraimila and Diraab educational farm, Riyadh region, Saudi Arabia.

The experiments were laid down following complete randomized block design (CRBD) with 2-blocks and 2-Zucchini squash (*Cucurbita pepo* L.) varieties as treatments where each treatment had 3-replication lines. Zucchini squash regular and hybrid varieties were grown in each block having three replication lines to study and compare level of fruit fly (*D. ciliatus*) infestation in Huraimila and Diraab.

When the Zucchini plants reached to fruiting stage, all fruits were harvested with one week interval from each replication line, separately. Within each replication large and small size Zucchini fruit were separated to compare the level of infestation between younger and older Zucchini. All samples were collected in marked plastic containers covered with muslin cloth for adequate ventilation and transferred to entomological research laboratory in the department of plant protection at the college of food and agriculture sciences, King Saud University, for processing. In the laboratory, the Zucchini fruit was carefully observed for fruit fly infestation. Infested Zucchini fruits were easily recognized by the presence of puncture hole made by the female fly during oviposition.

Data was analyzed using the analysis of variance (ANOVA) PROC GLM procedure of SAS (SAS 2002) and means were separated using the Duncan's Multiple Range Test ($P = 0.05$).

RESULTS AND DISCUSSION

Comparison of regular and hybrid Zucchini squash (*Cucurbita pepo* L.) varieties for fruit fly (*D. ciliatus*) infestation did not show any significant difference in Huraimila ($F = 0.47$; $df = 1$; $P = 0.50$) and Diraab ($F = 0.11$; $df = 1$; $P = 0.74$) (Table 1). Total infested Zucchini squashes from both varieties were further categorized into large and small size squashes to compare level of fruit fly infestation. Results revealed no significant difference between the varieties for large ($F = 0.09$; $df = 1$; $P = 0.77$)

and small size squashes ($F = 0.68$; $df = 1$; $P = 0.41$) for Huraimila and Diraab ($F = 0.78$; $df = 1$; $P = 0.38$), ($F = 0.23$; $df = 1$; $P = 0.64$), respectively.

Table 1: Variety wise comparison of average *Dacus ciliatus* infested Zucchini squash (*Cucurbita pepo* L.) per line in Huraimila and Diraab.

Varieties	Overall infestation		Large size Zucchini's infestation		Small size Zucchini's infestation	
	Huraimila	Diraab	Huraimila	Diraab	Huraimila	Diraab
Regular	$2.20 \pm 0.44a$	$0.75 \pm 0.20a$	$0.57 \pm 0.17a$	$0.33 \pm 0.14a$	$1.63 \pm 0.47a$	$0.46 \pm 0.09a$
Hybrid	$2.67 \pm 0.52a$	$0.83 \pm 0.19a$	$0.50 \pm 0.14a$	$0.50 \pm 0.14a$	$2.23 \pm 0.56a$	$0.35 \pm 0.07a$

Means within a column followed by the same letter are not significantly different $\alpha = 0.05$

Intensity of fruit fly infestation on large and small size Zucchini squashes was also compared within each variety (Table 2). Results showed a significant difference between large and small size zucchini within both regular ($F = 0.53$; $df = 1$; $P = 0.47$) and hybrid varieties ($F = 3.16$; $df = 1$; $P = 0.08$) in Huraimila. In contrast, no significant difference was observed between large and small size zucchini squashes in both regular ($F = 0.36$; $df = 1$; $P = 0.55$) and hybrid varieties ($F = 1.16$; $df = 1$; $P = 0.28$) in Diraab.

Table 2: Size wise comparison of average *Dacus ciliatus* infested Zucchini squash (*Cucurbita pepo* L.) per line within each variety in Huraimila and Diraab.

Zucchini squashes sizes	Regular Variety		Hybrid Variety	
	Huraimila	Diraab	Huraimila	Diraab
Large size squashes	$0.57 \pm 0.17b$	$0.27 \pm 0.06a$	$0.50 \pm 0.14b$	$0.41 \pm 0.09a$
Small size squashes	$1.63 \pm 0.47a$	$0.34 \pm 0.09a$	$2.23 \pm 0.56a$	$0.29 \pm 0.07a$

Means within a column followed by the same letter are not significantly different $\alpha = 0.05$

Fruit fly infestation on zucchini squashes was also compared for each variety between the blocks (Table 3). No significant difference was observed within the regular ($F = 0.09$; $df = 1$; $P = 0.77$) and hybrid ($F = 0.02$; $df = 1$; $P = 0.90$) varieties at Huraimila and Diraab ($F = 3.62$; $df = 1$; $P = 0.06$), ($F = 1.40$; $df = 1$; $P = 0.25$), respectively.

Table 3: Block wise comparison of average *Dacus ciliatus* infested Zucchini squash (*Cucurbita pepo* L.) per line within each variety in Huraimila and Diraab.

Blocks	Overall Zucchini's Infestation			
	Regular Variety		Hybrid Variety	
	Huraimila	Diraab	Huraimila	Diraab
Block -I	$2.07 \pm 0.47a$	$1.11 \pm 0.34a$	$2.73 \pm 0.85a$	$1.06 \pm 0.32a$
Block-II	$2.33 \pm 0.75a$	$0.39 \pm 0.16a$	$2.60 \pm 0.64a$	$0.61 \pm 0.20a$

Means within a column followed by the same letter are not significantly different $\alpha = 0.05$

Results indicated a significantly greater fruit fly infestation in Huraimila as compared to Diraab, on both, regular ($F = 10.22$; $df = 1$; $P = 0.002$) and hybrid ($F = 12.50$; $df = 1$; $P = 0.0008$) varieties (Table 4).

Table 4: Comparison of average *Dacus ciliatus* infested Zucchini squash (*Cucurbita pepo* L.) per line in Huraimila and Diraab.

Locations	Overall Zucchini's Infestation	
	Regular Variety	Hybrid Variety
Huraimila	$2.20 \pm 0.44a$	$2.66 \pm 0.52a$
Diraab	$0.75 \pm 0.20b$	$0.83 \pm 0.19b$

Means within a column followed by the same letter are not significantly different $\alpha = 0.05$

Date wise comparison of fruit fly infestation in Huraimila on zucchini squashes did not show any significant change except in the last week of May where a significantly high infestation peak was recorded. In Diraab no significant difference was recorded on Zucchini infestation during the month of May but a significant reduction in infestation was recorded in the mid of June (Fig. 1&2).

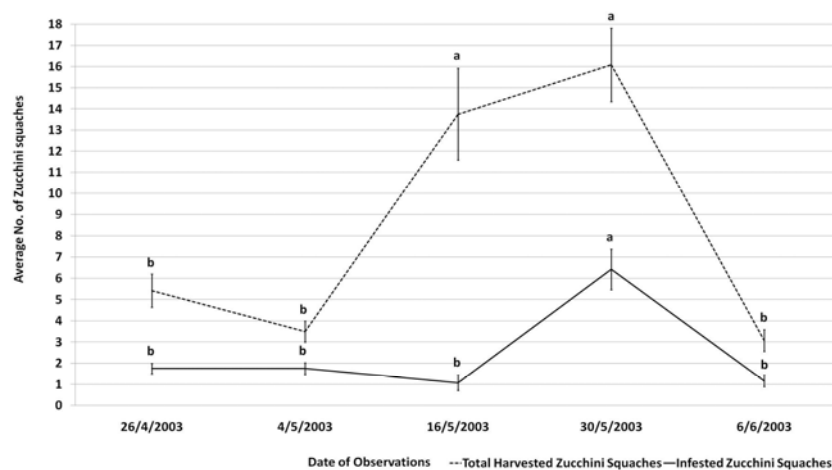


Figure 1. Total and infested number of Zucchini squashes (*Cucurbita pepo* L.) harvested from Huraimila, Riyadh, Saudi Arabia. Significant differences ($P < 0.05$) are indicated by different lower case letters. Bars represent standard errors.

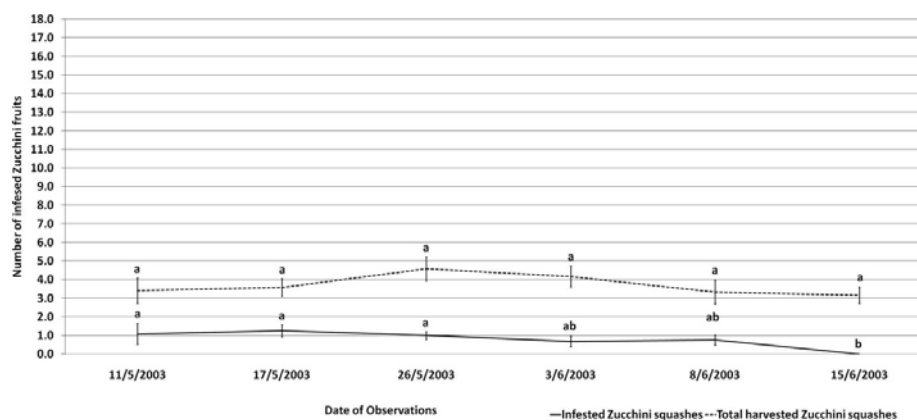


Figure 2. Total and infested number of Zucchini squashes (*Cucurbita pepo* L.) harvested from Dirab educational farm, Riyadh, Saudi Arabia. Significant differences ($P < 0.05$) are indicated by different lower case letters. Bars represent standard errors.

Fruit fly infestation was also correlated with abiotic factors. Results indicated a significant negative correlation with average temperature while positive correlation with average relative humidity in Diraab. Whereas, in Huraimila a significant negative correlation was observed with average relative humidity and wind speed (Table 5).

Results indicated a significant correlation (0.66 at <0.0001) between average number of zucchini squashes harvested and number of infested squashes per line.

Table 5: Pearson correlation coefficient (r) between average *Dacus ciliatus* infestation on Zucchini squash (*Cucurbita pepo* L.) and various abiotic factors in Diraab and Huraimila.

Location	Pearson Correlation Coefficients (r)		
	Abiotic Factors		
	Ave. Temp	Ave. RH	Ave. Wind Speed
Diraab	-0.32*	0.24*	0.24*
Huraimila	0.10	-0.42*	-0.48**

* Indicating significance at $P < 0.05$

** Indicating significance at $P < 0.001$

CONCLUSIONS

There were no significant differences between *Zucchini squash* (*Cucurbita pepo* L.) regular and hybrid varieties for fruit fly (*D. ciliatus*) infestation. Huraimila had significantly greater fruit fly infestation as compared to Diraab. In Huraimila, infestation peak was observed in the last week of May whereas, in Diraab no significant change was observed during the month of May but a significant reduction in infestation was recorded in the mid of June. Results indicated a correlation ($r = 0.66$ at <0.0001) between average number of zucchini squashes harvested and number of infested squashes per line.

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ARABIC ABSTRACT

دراسة مقارنة على إصابة ذبابة القرعيات : داكس سيلياتس لو (ثنائية الأجنحة – تيفريتيدي) لن لنبات الكوسة (كيوكور بيتا بيبول) في منطقتي حريملاء وديراب - الرياض - السعودية

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لقد درست إصابة ذبابة القرعيات داكس سيلياتس لو (ثنائية الأجنحة – تيفريتيدي) على أصناف منتظمة ومهجنة من نبات الكوسة (كيوكور بيتا بيبول) في موسم الصيف في منطقتي حريملاء وديراب بالرياض بالمملكة العربية السعودية.

اتبع في هذه التجارب تصميم (RCBD) الإحصائي العشوائي ولقد أثبتت النتائج عدم وجود اختلافات معنوية بين الأصناف المصابة بهذه الحشرة في كل من المنطقتين. كانت منطقة حريملاء أعلى في الإصابة مقارنة بمنطقة ديراب ولوحظ أن قمة الإصابة كانت في الأسبوع الأخير من شهر مايو بمنطقة حريملاء بينما في منطقة ديراب لم يلاحظ أي تغير معنوي أثناء شهر مايو ولكن سجل نقص ملحوظ في الإصابة في منتصف شهر يونيو.

أثبتت النتائج وجود ارتباط ($t = 0.0001$ $a < 0.66$ $r =$) بين متوسط عدد النباتات التي تم جمعها وبين عدد النباتات المصابة في كل خط.