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Studies on parasitism preference of *Dirhinus giffardii* (SILV.) on *Bactrocera cucurbitae* (COQ.) pupae reared on different host vegetables

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Abstract
The Melon fruit fly *Bactrocera cucurbitae* (Coquillett) is a severe pest of different vegetables and fruits in Pakistan inflicting economical damages. It has been widely documented that food is positively correlated with the biological parameters of the insects. Therefore an experiment was conducted to determine the parasitism preference of pupal parasitoid *Dirhinus giffardii* on *B. cucurbitae* pupae reared on different vegetables including Bottle gourd (*L. siceraria*), Bitter gourd (*M. charantia*), Ridge gourd (*L. acutangula*), Round gourd (*P. fistulosus*) and Cucumber (*C. Sativus*) under no choice and free choice experiments. Results revealed that significantly higher ($P<0.05$) parasitization (24.8±0.48) and female (12.4±0.68) were yielded when the pupae of *B. cucurbitae* were reared on *Cucumis sativus* under no choice test. Similarly maximum number of parasitized pupae (10.0±0.31) and female (4.4±0.24) were recovered from pupae reared on *C. sativus* under free choice test. Furthermore studies showed that pupae of *B. cucurbitae* were more preferred for parasitization when reared on *C. sativus* followed by *L. siceraria* and *L. acutangula* under no choice test whereas pupae of *B. cucurbitae* less preferred for parasitization when supplied with *L. acutangula* and *L. siceraria* under free choice test.

Keywords: Bottle gourd, *Cucumis sativus*, *Bactrocera cucurbitae*, free choice, parasitism preference

Introduction
Insect pests are the most important factors, and is responsible for the low yield and poor quality of vegetables from Pakistan. Many types of insects are attacking and sabotaging vegetables. It includes some agricultural pests the most dangerous in the world. Among them fruit flies are the serious pests of different vegetables and fruits [5]. The melon fruit fly, *Bactrocera cucurbitae* (Coquillett), is noxious pest of vegetable crops and commonly distributed throughout the Oriental and the Pacific regions [3]. The insect pests harshly affecting agricultural crops mainly controlled by pesticides [6]. Because of common use of pesticides insect pests develop resistance that deteriorate the environment [8]. Thus it is necessary to find the pest control strategies would reduce the wide range use of pesticides for the suppression of pests [9]. In recent decades, biological control offers environmentally safe and sustainable tool for the pest management [7]. It is therefore imperative that biological control also be exploited for the management of fruit flies in Pakistan. The importance of parasitoids in the augmentative release of biological control of many pests has been reported by various workers [11]. The fruit flies pupal parasite, *Dirhinus giffardii* (Hymenoptera: Chalcididae) has the potential to be exploited as bio-control agents against different fruit fly species of Pakistan but its parasitism on different hosts may be variable and needs to be determined. *D. giffardii* could attack *D. dorsalis* puparia previously parasitized and have slight preference for un-parasitized over parasitized puparia [2]. A *D. giffardii* is very important parasitoid, therefore present studies were planned to evaluate the parasitism preference and development of parasitoid on *B. cucurbitae* pupae reared on variety of vegetables, the economical and predominant fruit fly species in Pakistan.

Materials and Methods
The study was conducted in the Fruit flies and their parasitoids laboratory Plant Protection Division, Nuclear Institute of Agriculture (NIA) Tando Jam under controlled laboratory conditions. In the First phase, Fresh vegetables were brought from the Tando Jam city, five

vegetable hosts, viz. Bottle gourd (*L. siceraria*), Bitter gourd (*M. charantia*), Ridge gourd (*L. acutangula*), Round gourd (*P. fistulosus*) and Cucumber (*C. Sativus*) were selected. Each vegetable weighed 500 grams. Eggs of *B. cucurbitae* were collected through egg laying receptacles and were removed from the receptacles very gently with the help of camel hair brush 200 eggs seeded over the each vegetable for the collection of pupae. Seeded vegetables were kept separately in plastic jars (5" × 12") containing fine sawdust at the bottom (for pupation) were covered with muslin cloth. After 4th day of larval emergence, Full grown larvae popped out from each vegetable and pupated in pupal substrate. Pupae were sieved with iron mesh (18 mesh) then collected and counted. In second phase five pairs of newly emerged pupal parasitoid *Dirhinus giffardii*, were kept in each cage (30 × 25 × 11cm) and provided with water and 1: 3 honey. During No Choice Test 50 pupae of *B. cucurbitae* reared on each vegetable offered separately in each cage for parasitization. Whereas, for free choice test 15 pupae from all vegetables were collectively offered for parasitization. After 24 hours all pupae were collected and kept separately in Petri dishes (11 × 11.2 cm). After 4 to 5 days Adult Melon flies emerged from un-parasitized pupae and on 15th day adult wasps of *D. giffardii* were emerged. Total number of parasitized pupae, Male, Female and un-emerged parasitized pupae were recorded on each treatment.

The experiment was conducted under laboratory conditions maintained 28 ± 2 °C temperature and 60 ± 5% relative humidity. These treatments were replicated five times.

All statistical analyses were done with the help of Statistix® Version 8.1, Analytical Software, Inc., and Tallahassee, FL, USA.

Results

Results on pupal preference of *D. giffardii* on *B. cucurbitae* pupae reared from different vegetables revealed that pupal parasitoid *Dirhinus giffardii* parasitized maximum number of pupae reared on cucumber (*Cucumis sativus*) under free choice and no choice test.

Results revealed that pupal parasitoid *Dirhinus giffardii* has shown significantly higher (P<0.05) parasitization when the pupae of *B. cucurbitae* were reared on cucumber (*Cucumis sativus*) (24.8±0.48) followed by Bottle gourd (*L. siceraria*) (21.2±1.28) and ridge gourd (*L. acutangula*), (19.4±1.12) whereas lower parasitization was observed on Round gourd (*P. fistulosus*) under no choice experiment (Table 1). Regarding sex ratio significantly maximum number of female (12.4±0.68) and male (10.4±0.51) were recorded on cucumber while minimum male yielded on round gourd (3.8±0.37) and least number of female were recovered from ridge gourd (6.0±0.71). However significantly lowest number of un-emerged parasitized pupae were recorded on cucumber (2.0±0.32) and bitter gourd (2.0±0.32) respectively (Figure 1). Similarly significantly higher (P<0.05) parasitization were recorded when pupae were supplied with *C. sativus* under free choice experiment (Table 2). Whereas, lower parasitization observed on ridge gourd (*L. acutangula*) (8.2±0.58) under free choice test. Furthermore results revealed that high number of males (4.2±0.37) and females (4.4±0.24) were yielded on cucumber and low number of male and female were recovered on bottle gourd (1.4±0.51) and ridge gourd (3.0±0.00) respectively (Figure 2). In addition lowest un-emerged parasitized pupae were recorded on cucumber (1.6±0.51) under free choice test.

Discussion

In parasitism preference experiment, pupal parasitoid *D. giffardii* preferred *B. cucurbitae* pupae reared on cucumber under no choice and free choice test as compared to pupae reared on other vegetables. Our studies are in line with those carried out by [11] they observed that body size of host species always has positive correlation with host size similarly in our studies we observed that *B. cucurbitae* pupae recovered from cucumber showed positive correlation with host species because the *B. cucurbitae* pupae recovered from cucumber was little small in size than those recovered from other vegetables. Furthermore, they observed that parasitoids consumed almost all the host resource when emerged from the host puparia the parasitoid gained more fitness when reared on larger host. However they did not observe any effect on development time of male and female of *D. giffardii* when reared on different sizes of host species whereas in our studies host pupae positively affected the development time of female than male. Their studies also showed that *D. giffardii* preferred to parasitize larger host pupae than the pupae of *Ceratitis capitata* on contrary our findings suggested that *D. giffardii* preferred to parasitize pupae of *B. cucurbitae* reared on cucumber which was smaller in size than those yielded from other vegetables. Our studies are similar with studies carried out by [4] who reported that fruit flies preferred fruit hosts because of nutrient contents as we observed the more pupae were parasitized by *D. giffardii* when reared on cucumber might suggesting the preference of fruit flies to use it as a favorite host because of the nutrient contents. In case of choice of parasitism preference of *D. giffardii* on *B. cucurbitae* pupae recovered from different vegetables one host over other may be suggesting nutritional status and physiological effects carried out by pupae from host vegetables. Whereas molecular and biochemical studies can further exploit this relationship between host pupae and natural enemy.

Conclusion

Our findings determined that *B. cucurbitae* pupae reared on Cucumber (*C. sativus*) are more preferred by *D. giffardii* for parasitization under no choice and free choice test.

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Table 1: Showing (Mean±SE) parasitism preference of *D. giffardii* on *B. cucurbitae* pupae reared on different vegetables under no choice test.

Treatment	No. of Parasitized Pupae	Sex Ratio		No. of Un-Emerged Pupae
		Male	Female	
Cucumber	24.8±0.48 a	10.4±0.51 a	12.4±0.68 a	2.0±0.32 d
Bottle gourd	21.2±1.28 b	4.0±0.71 c	8.4±0.51 bc	8.8±0.37 b
Ridge gourd	19.4±1.12 bc	6.0±0.58 c	6.0±0.71 d	10.6±0.51 a
Bitter gourd	17.0±0.89 cd	6.0±0.45 b	9.0±0.55 b	2.0±0.32 d
Round gourd	15.6±0.92 d	3.8±0.37 c	7.0±0.45 cd	4.8±0.37 c

Values in the columns followed by different letters are significantly different according to Fisher's Least Significant Difference (LSD) test at (P<0.05).

Table 2: Showing (Mean±SE) Parasitism preference of *D. giffardii* on *B. cucurbitae* pupae reared on different vegetables under free choice test.

Vegetable	No. of Parasitized Pupae	Sex Ratio		No. of Un-Emerged Pupae
		Male	Female	
Cucumber	10.0±0.31 a	4.2±0.37 b	4.0± 0.32 ab	1.6±0.51 b
Bottle gourd	9.8±0.58 a	1.4±0.51 b	4.4±0.24 a	2.8±0.37 ab
Round gourd	9.6±0.67 ab	2.6±0.24 b	3.2±0.58 b	3.8±0.37 a
Bitter gourd	9.2±0.37 ab	2.4±0.40 b	3.4±0.51 ab	3.4±0.60 a
Ridge gourd	8.2±0.58 a	2.4±0.75 b	3.0±0.00 b	4.2±0.86 a

Values in the columns followed by different letters are significantly different according to Fisher's Least Significant Difference (LSD) test at (P<0.05).

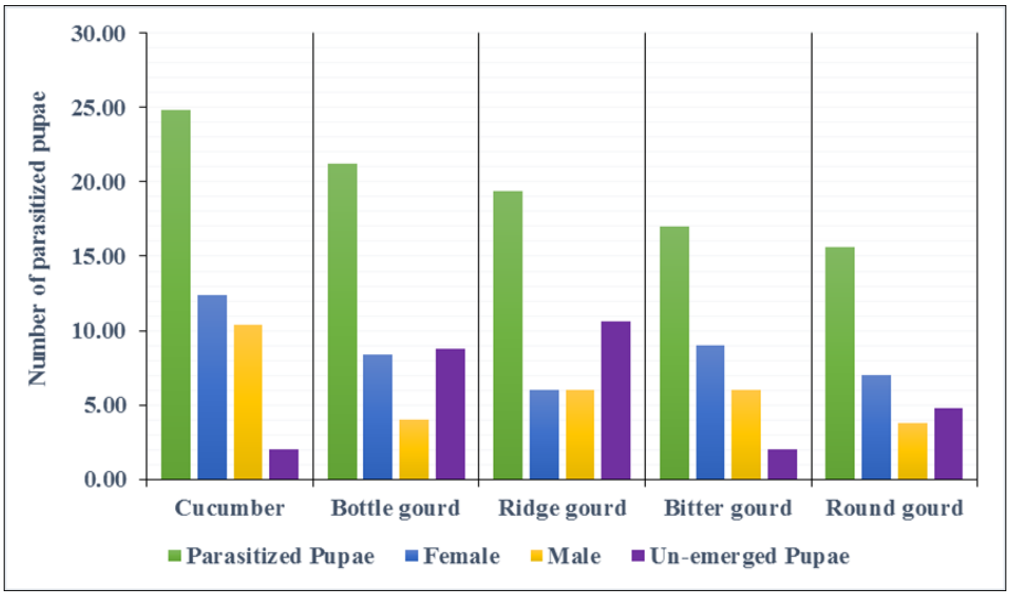

Fig 1: Showing parasitism preference of pupal parasitoid *D. giffardii* on *B. cucurbitae* pupae reared on different vegetables under No Choice Test.

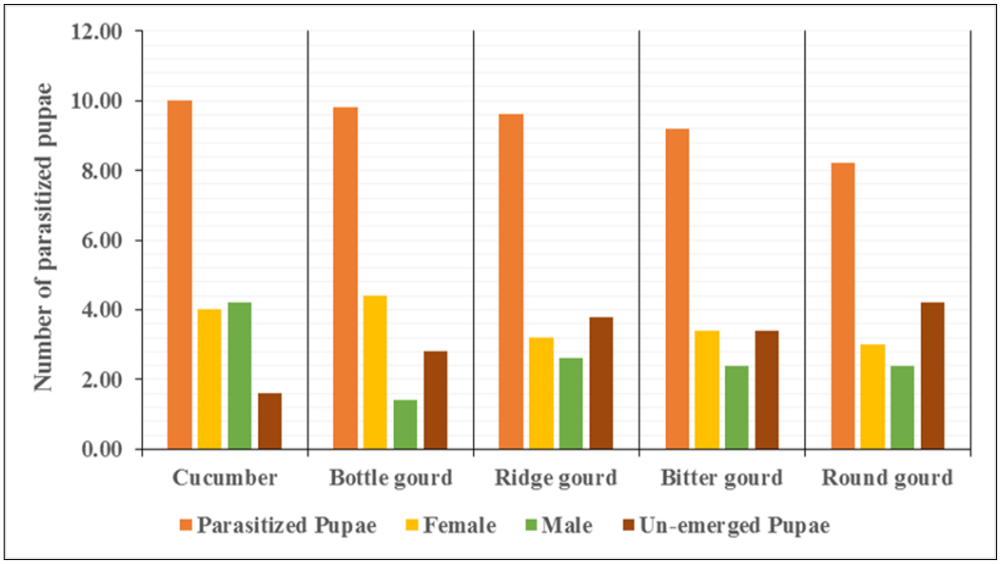

Fig 2: Showing parasitism preference of pupal parasitoid *D. giffardii* on *B. cucurbitae* pupae reared on different vegetables under Free Choice Test.

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