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Relative Incidence of *Bactrocera cucurbitae* (Coquillett) and *Dacus ciliatus* Loew on Cucurbitaceous Vegetables

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ABSTRACT: The melon fly, *Bactrocera cucurbitae* (Coquillett) is a major pest of cucurbitaceous vegetables and fruits in many parts of the world. Infestation of an another species, the lesser pumpkin fly, *Dacus ciliatus* Loew is reported on a few cucurbits in the Indian sub-continent and Africa. While extensive work on seasonality, infestation percent, host preference, attraction to parapheromone on *B. cucurbitae* has been reported, little is known of *D. ciliatus*. Field experiments were carried out at the Indian Institute of Horticultural Research (IIHR), Bangalore (12^{0}58'N; 77^{0}35'E) from June 2002-October 2003. Cucumber (*Cucumis sativus* L), ridge gourd (*Luffa acutangula* (L.) Roxb), bitter gourd (*Momordica charantia* L.) and pickling cucumbers [*C. sativus* L (variety. Ijax)] were raised at monthly interval. Cue lure baited bottle traps were hung to monitor *B. cucurbitae* and other related species. *Bactrocera cucurbitae* was present all through the year and maximum number of adults was trapped during August (14.14/trap/week). *Dacus ciliatus* was trapped only from May to October but in relatively less numbers (~ 1/week). Maximum fruit fly infestation was 77.03 % on bitter gourd (August 2003), 75.65 % on ridge gourd (Nov. 02), 73.83 % on cucumber (October, 02) and 63.31 % on pickling cucumber (October, 02). Trap catches of *B. cucurbitae* was significantly and positively correlated with relative humidity. Maximum and minimum temperature, RH (%), rainfall (mm), evaporation (mm) and wind speed (km/h) collectively determined 44 % of *B. cucurbitae* trap catches. Maximum fruit fly emergence of 494.64/ kg fruit was on bitter gourd (October, 2002) followed by cucumber (431.97, November, 2002), pickling cucumber (307.51, October 2002) and ridge gourd (210.74, October, 2003). *Dacus ciliatus* formed only 4.5% of the total number of fruit flies on bitter gourd and 0.2% on pickling cucumber. Its infestation was not observed on cucumber and ridge gourd. Parasitism by the larval-pupal parasitoid, *Opius fletcheri* was 4.4% and 3.2 % in bitter gourd and pickling cucumber, respectively. It could not be determined if the host was *D. ciliatus or B. cucurbitae*. Fruit flies infesting ridge gourd and cucumber did not yield any parasitoid. There was no correlation between percent fruit damage and number of fruit flies that emerged across host plants. The significance of *D. ciliatus* in IPM of fruit fly is discussed.

INTRODUCTION

Bactrocera cucurbitae (Coquillett) or melon fly is a major pest of cucurbitaceous vegetables and fruits in many parts of the world. Crop loss is often >60% (Kapoor, 2000). The lesser pumpkin fly, *Dacus ciliatus* Loew a serious pest of cucurbits in Saudi Arabia (Fischer and Petersen, 1989) is distributed in Africa, Atlantic Islands, and oriental Asia (White and Elson–Harris, 1992). In India, this species generally infests a large number of melons and wild cucurbits to a relatively lesser extent though, in patches serious damage is reported (Bhatia 1939, Viraktamath *et. al*., 2003). *Dacus ciliatus* is relatively smaller than *B. cucurbitae,* orange in colour, with facial spots. Costal band is apically expanded to form a small apical spot and a basal oblique spot. Abdomen has two black spots especially in females (White and Elson-Harris, 1992). Though, there are many reports on seasonality, host preference, degree of infestation for *B. cucurbitae*, the same are lacking for *D. ciliatus*. Pest-risk analysis and pest-free (fruit fly) areas are vital in coming years to ensure sustained import/ export of vegetables and fruits. Hence studies were carried out to know.

1. Relative incidence of *B. cucurbitae* and *D. ciliatus* on cucumber (*Cucumis sativus)*, ridge gourd (*Luffa acutangula*), bitter gourd (*Momordica charantia*) and pickling cucumber (*C. sativus*).
2. Effect of weather parameters on *B. cucurbitae* & *D. ciliatus* trap catches.
3. Extent of parasitism

MATERIAL AND METHODS:

Studies were conducted at IIHR, Bangalore, South India (12^0 58' N; 77^0 35' E) from June 2002 to October 2003. Cucumber, ridge gourd, bitter gourd and pickling cucumber were raised once a month in 300 m^2.

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Bottle trap: A plywood (3cm x 3cm x 1cm) soaked in cue lure 6:1 v. v (cue lure: malathion) was suspended from the top of a plastic water bottle (capacity 1 litre). Each bottle had four windows to facilitate pheromone dispersion and entry of fruit fly adults. Two such bottle traps were placed above the crop canopy. Trap collections were sorted out every 24 hours and number of each fruit fly species was recorded. For analyzing seasonal incidence, pooled mean of number of fruit flies trapped at weekly interval was correlated with weekly mean temperature (^{0}C maximum and minimum), RH (%), evaporation (mm), wind speed (km/ h) and rainfall (mm).

Fruit fly emergence: At each harvest, damaged and healthy cucumber, ridge gourd, bitter gourd and pickling cucumber fruits were sorted and weighed separately. Damaged fruits were placed in separate cages on a thin layer of sand to facilitate pupation and adult emergence. *B. cucurbitae and D. ciliatus* adults that emerged were counted.

Parasitoid emergence: Number of *Opius fletcheri* Silv. (Hymenoptera: Braconidae), a larval-pupal parasitoid that emerged with *B. cucurbitae* and *D. ciliatus* were recorded.

Fig1. Cue lure baited bottle trap

RESULTS AND DISCUSSION

Bactrocera cucurbitae adults was trapped throughout the study period (June 2002 to October 2003) whereas *D. ciliatus* only from May to October (Fig. 2). Kapoor, 1993, reported that *D. ciliatus* attacks ivy gourd (*Coccinia indica* Wight and Arn.), cucumber and long melon along with *B. cucurbitae* during May-June in northern parts of India and the infestation on ivy gourd continued up to November. In the present study, cucumber and ridge gourd were not infested by *D. ciliatus* contrary to observations of Kapoor, (1993), who reported *D. ciliatus* infestation on ridge gourd and cucumber in north India. India is a large country with regional and climatic diversity and it may be inappropriate to compare south to the northern parts of the country. In our study all the four cucurbitaceous vegetables were infested by *B. cucurbitae* and maximum infestation was 73.83 % on cucumber (Oct. 02), 75.65 % on ridge gourd (Nov. 02), 77.03 % on bitter gourd (Aug. 03), and 63.31 % on pickling cucumber (Oct. 02).

Peak catches of *B. cucurbitae* was recorded in August 2002/ September 2003 (14.14 and 11.14 /trap/week) (Fig. 1). December recorded lowest *B. cucurbitae* catch. Kapoor (1993) attributed low catch to low temperature during December in North India. Mean number of *D. ciliatus* trapped from May to October was around 1/trap/week though Kapoor (1993) noticed *D. ciliatus* all through the year with at least six generations in subtropical North India. Further, he observed that the number of generations reduced with decrease in temperature. Pumpkin flies become active from April onwards till the end of November in northern parts of India. During winter the plains of North India experience a maximum of 12-14^{0}C and minimum temperature may hover anywhere from 0-5^{0}C. Bangalore, where the present studies were carried out, enjoys a salubrious weather for most parts of the year. Maximum summer temperature is observed in April-May (37^{0}C). Winter is mild with a minimum temperature of 10-12^{0}C.

Annual precipitation is ~800 mm mostly between July-October.

In the present study, trap catches of *B. cucurbitae* and *D. ciliatus* were not significantly correlated. However, number of *B. cucurbitae* trapped showed significant, positive correlation with mean weekly RH (r = 0.29). In a large geographical area, localized rainfall can influence the relative humidity over adjacent patch due to air circulation. Further, rainfall as measured in this study is a mean of seven days. More than the total precipitation, the intensity and duration of rainfall influence RH. Thus, it is not surprising that rainfall was not positively correlated in the present study where as RH was significantly positively correlated with trap catches. Drew *et al*., (1983, 1984) suggested that environmental moisture may indirectly affect survival and fecundity by affecting food supply. Further, he stated that leaf surface bacteria as a source of protein required for maturation of tropical fruit flies is important and the abundance of these bacteria is reduced in dry conditions causing reduced fecundity, and possibly reduced survival rates and increased emigration rates.

Weather parameters collectively determined 44% of *B. cucurbitae* trap catches. [Coefficient of determination (R^2) for *B. cucurbitae* was 0.44]. A total of sixty seven harvests were made between July 2002-October 2003. (Table 3). Maximum fruit fly emergence of 494.64/ kg fruit was on bitter gourd (October, 2002) followed by cucumber (431.97, November 2002), pickling cucumber (307.51, October 2002) and ridge gourd (210.74, October 2003). There was no significant correlation between percent fruit fly damage and the number of fruit flies that emerged across host plants. *Dacus ciliatus* formed only 4.5% of the total number of fruit flies emerging on bitter gourd and 0.2% on pickling cucumber. *Dacus ciliatus* infestation was not observed on cucumber and ridge gourd though reported by Kapoor (1993). White and Elson- Harris (1992) reported that *D. ciliatus* infests fruits that are over ripe. Cropping pattern in south India is different from the North, which receives only southwest monsoon, unlike parts of south which receives both southwest and northeast monsoons. As discussed earlier, it may be inappropriate to compare south to the northern parts of the country. Poor representa-

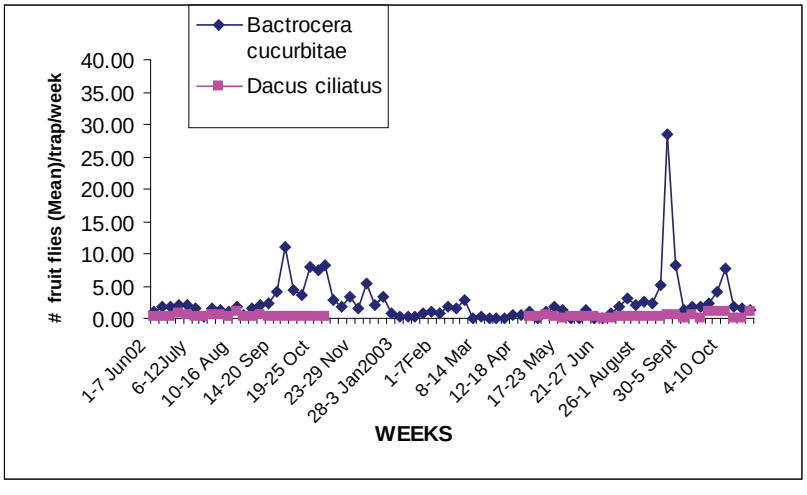

Fig. 2 Number of B. cucurbitae and D. ciliatus trapped in cuelure traps

tion of *D. ciliatus* in the emerging population is also attributed to competition with its ecological homologue, *B. cucurbitae*. *Bactrocera cucurbitae* termed 'R' strategist is large, has great mobility, high fecundity, fertility, long life span and a short egg eclosion period. Further, it spends more energy than *D. ciliatus* in effectively using environmental resources (Vayssieres et. al., 2002). Contrastingly *D. ciliatus* termed 'K' strategist is smaller and has a lower mobility, fecundity, fertility, a shorter life span and a longer egg eclosion period. Such significant differences in demographic parameters and main biotic factors between the two fruit flies explain the predominance of *B. cucurbitae* (Vayssieres *et. al*. 2002). This further justifies the distribution and potential of *B. cucurbitae* to colonize new areas (Vayssieres, 2000).

D. ciliatus is not attracted to any parapheromone lures (White and Elson- Harris, 1992). However, in the present study *D. ciliatus* was trapped along with *B. cucurbitae* in cue lure traps but in very small numbers. It may be accidental or a reflection of very low numbers of *D. ciliatus* in nature. This aspect needs further investigation.

Parasitism by the larval-pupal parasitoid *Opius fletcheri* was 4.4% and 3.2 % on bitter gourd and pickling cucumber, respectively. It could not be determined if the host was *D. ciliatus or B. cucurbitae*. Fruit flies infesting ridge gourd and cucumber did not yield any parasitoid. There is a need for pest-risk analysis, mapping regional and host influenced distribution, natural enemy complex and orientation to cue lure of *D. ciliatus*.

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Table 1. Correlation between weather parameters and trap catches (weekly mean)

Fruit fly species	1	2	3	4	5	6	7
B. cucurbitae	-0.2782*	NS	0.2915*	0.2978*	-0.2948*	NS	NS

1-Mean maximum temperature, 2- Mean minimum temperature, 3- Relative humidity 7 AM, 4. Relative humidity 1 PM, 5 Wind speed (km), 6- Evaporation (mm), 7- Rainfall (mm), NS= Non-significant (p= 0.05)

Table 2. Percent damage to cucurbits by B. cucurbitae (BC) and D. ciliatus (DC) and number of adults emerged

Month	No. Harvests	Cucumber (% damage)	# BC /kg	Bitter gourd (% damage)	# BC /kg	Ridge gourd (% damage)	# BC /Kg	Gherkin (%) damage	# BC /Kg
2002									
July	6	25.22	83.31	45.95	122.43 (0)	27.41	209.6	4.11	100
Aug	5	51.87	106.99	70.99	88.07 (0)	27.25	177.78	45.25	149.74
Sep	5	61.99	99.06	76.65	151.77 (0)	36.91	126.77	33.36	177.25
Oct	4	73.83	134.72	71.67	494.64 (0)	66.04	147.87	63.31	307.51
Nov	3	23.08	431.97	73.26	164.48 (0)	75.65	167.86	44.67	129.69
Dec	3	7.19	217.65	41.16	91.74 (0)	48.73	4.34	53.03	42.5
2003									
January	5	14.95	214.41	44.96	88.48 (0)	7.22	110	40.77	77.97
February	6	40.15	215.29	18.74	85.33 (0)	12.1	53.85	9.94	42.86
March	4	31.87	32.26	20.56	28.24 (0)	0	0	0.91	30
April	4	12.82	58.48	0	0 (0)	0	0	22.47	4.6
May	4	39.59	105.59	21.46	84.62 (11.11)	3.78	0	12.3	51.78(0.16)
June	4	30.44	232.39	46.88	40.15 (9.48)	63.28	51.02	21.75	45.71 (0)
July	3	36.88	92.09	40.26	191.18 (7.35)	10	12	25.68	20.29 (0.197)
August	3	33.13	101.43	77.03	208.19 (7.60)	54.37	97.52	17.32	24.1 (0)
September	4	44.19	67.06	36.95	184.44 (4.28)	30.02	76.62	22.99	15.01 (0.345)
October	4	37.75	85.14	33.51	210.49 (4.96)	17.18	210.74	0	0 (0)

BC=*B. cucurbitae*, Figures in parentheses indicate number of *D. ciliatus*