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Distribution of *Bactrocera cucurbitae* (Coquillett) and its Natural Enemies in Sindh

Muhammad Ibrahim Kubar

Department of Entomology, Sindh Agriculture University, Tandojam, Sindh, Pakistan

Email: mikubar@sau.edu.pk

Madiha Bhurgri

Institute of Plant Protection, Agriculture Research Sindh, Tandojam

Fatima Nizamani

Department of Entomology, Sindh Agriculture University, Tandojam, Sindh, Pakistan

Tanzeela Ul Zahra

Institute of Plant Protection, Agriculture Research Sindh, Tandojam

Zakia Panhwar

Southern-zone, Agricultural Research Centre, Pakistan Agricultural Research Council, Karachi

Sajjad Hussain Rind

Institute of Plant Protection, Agriculture Research Sindh, Tandojam

Jam Ghulam Mustafa Sahto

Department of Plant Protection, Sindh Agriculture University, Tandojam, Sindh, Pakistan

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Corresponding Author:

Muhammad Ibrahim Kubar

Email:

mikubar@sau.edu.pk

ABSTRACT

The Melon fruit fly *Bactrocera cucurbitae* (Coq.) is considered as one of the major insect pests of cucurbit vegetables throughout the world which mostly depends on host cues for its feeding and development. A proper monitoring and host suitability is key for its management. Hence, the present study was undertaken to assess the population fluctuation of *B. cucurbitae* and its natural enemies on different cucurbit vegetables at Hyderabad and Shaheed Benazirabad, two main vegetable growing areas of Sindh. Eight cucurbit vegetables i.e., pumpkin gourd, bottle gourd, sponge gourd, ridge gourd, Indian squash, bitter melon, pointed gourd and cucumber were tested against *B. cucurbitae* and its parasitoids population because of their key role in its management. The obtained data indicated that the highest population of *B. cucurbitae* was recorded at district Shaheed Benazirabad as compared to district Hyderabad as relatively higher population of *B. cucurbitae* was observed during the year 2022 than 2023. Correlation results revealed that temperature ($r=0.56$ to 0.75) and relative humidity % ($r=0.13$ to 0.27) showed significant and positive effect on the population build-up of the flies on the cucurbits during both years. Moreover, two parasitoids, i.e., *Trybliographa daci* (Weld) and *Diachasmimorpha longicaudata* (Ashmead) were also recorded from the collected pupae of fruit flies. *Trybliographa daci* was found the dominant parasitoids over *Diachasmimorpha longicaudata*. It was also noted that maximum population of natural enemies were found at Hyderabad than Shaheed Benazirabad. As per correlation results, temperature showed a significant and positive influence on the *B. cucurbitae* population recorded on various vegetables, whereas as weak to moderate effect of relative humidity was recorded. Therefore, it was concluded that maximum population of *B. cucurbitae* during both years was recorded on bottle gourd and sponge gourd, whereas Shaheed Benazirabad area suffered more damage than Hyderabad.

Introduction

The Fruit flies (Diptera: Tephritidae) are a major pest of fruits and vegetables, causing significant quality and quantity loss (Zafar-ul-Hye *et al.*, 2020; Opoku *et al.*, 2025). Tephritidae contains approximately 4000 species organized into 500 genera (Chen & Huang, 2019). Due to the high nutritional contents present in the cucurbitaceous vegetables, they have often been included in everyone's daily diet (Slavin & Lloyd, 2012; Tarimo *et al.*, 2025). Mostly the cucurbit fruits are consumed afresh as a dessert or salad in daily life, mainly because of their rich contents, especially vitamins and easy availability. The use of fresh leafy cucurbits provides taste, palatability, increases need to eat and provides fibre for quick digestion and to protect weakness and constipation (Park *et al.*, 2011; Tarimo *et al.*, 2025).

Fruit flies caused the most damage to cucurbit crops out of all harmful insect pests, rendering more than half of the cucurbit crops unfit for human consumption (Vijayan *et al.*, 2020; Opoku *et al.*, 2025; Tarimo *et al.*, 2025). Among them, the Melon fruit fly *Bactrocera cucurbitae* (Coquillett) (Tephritidae: Diptera) has been considered as the one of the most damaging fruit fly species that is reported to damage 81 host plants (Shivangi & Swami, 2017; Tarimo *et al.*, 2025). It can cause a yield loss of about 30-100% in cucurbitaceous vegetables depending upon the hosts, season and other climatic factors (Dhillon *et al.*, 2005; Gyawali *et al.*, 2026). Adult females lay eggs in soft and tender fruits by puncturing fruit skin with their sharp ovipositor. Infested fruits show brown resinous deposit at the side of oviposition as the maggots start feeding on internal pulp contents of the fruits immediately after their emergence. Damaged fruits also fall off rapidly due to secondary infection by bacteria and fungi or they become unfit for consumption (Arya *et al.*, 2022). *Bactrocera cucurbitae* is a serious pest of cucurbitaceous vegetables, particularly bitter melon (*Momordica charantia*), muskmelon (*Cucumis melo*), snap melon (*C. melovar*, *momordica*), and snake gourd (*Momordica charantia*) (Sorifa, 2018). Different strategies are used to attract and kill the adults of fruit flies (Celik & Topcu, 2006). More than 50% of the cucurbit vegetables and fruits are under the influence of *B. cucurbitae* by reducing quantity as well as quality losses.

Considering the huge economic losses of *B. cucurbitae* to various vegetables, many management strategies have been applied against fruit flies and include food bait, sex attractant lures, botanical pesticides, bagging of fruits, field sanitation, and synthetic insecticides (Opoku *et al.*, 2025; Tarimo *et al.*, 2025). However, the reliance on a single source of management is not considered enough for the better management of *B. cucurbitae* as it is capable of attacking a wide range of fruits and vegetables of economic importance (Tian *et al.*, 2023). During the off-season, when its main cucurbit hosts are not available, *B. cucurbitae* is capable of surviving by infesting alternative hosts such as papaya (*carica papaya*) (Hsu *et al.*, 2018). Thus, the wide host range of *B. cucurbitae* helps it to maintain its population throughout the year (Mcquate & Teruya, 2015; Opoku *et al.*, 2025; Tarimo *et al.*, 2025). Considering the economic and quarantine importance of this pest, its timely and frequently management is always required in most of the countries (Heather & Hallman, 2008; Opoku *et al.*, 2025). Moreover, as the flies bear invasive biological characteristics, so controlling these noxious flies is quite difficult only through the application of chemical pesticides. It is also established that before developing insect pest management program for a specific agro-ecosystem, it is necessary to have basic information on the incidence of the pest concerning weather parameters which help in determining the appropriate time of action and suitable method of control (Opoku *et al.*, 2025; Tarimo *et al.*, 2025). Accordingly, the pest population monitoring throughout the year is one of the most vital and basic information that could help in designing an IPM strategy for the sustainable management of *B. cucurbitae* in vegetable (Bose *et al.*, 2021). Despite the economic importance of *B. cucurbitae*, limited information is available on its biodiversity, host association, and naturally occurring parasitoids on different cucurbit vegetables under the agro-climatic conditions of Sindh, Pakistan. Therefore, the present study was conducted to investigate the biodiversity of *B. cucurbitae* and its associated natural enemies on various cucurbit vegetables as the obtained information could help to devise an appropriate management program for its control

Materials and Methods

The studies were carried out various locations of Hyderabad and Shaheed Benazirabad during cropping seasons of 2022 and 2023 to monitor the population fluctuation of melon fruit fly, *Bactrocera cucurbitae* and its associated parasitoids species. The separate fields were managed for different cucurbit vegetables, each measuring one acre, as plantation of various cucurbit vegetables was done during the first week of March during both study years. The cucurbit vegetables used in the study were pumpkin gourd (*Cucurbitia pepo* L.), bottle gourd (*Lagenaria siceraria* Molina), sponge gourd (*Luffa cylindrica* L.), ridge gourd (*Luffa acutangula* L.), Indian squash (*Prae citrullus fistulosus* Stocks.), bitter melon (*Momordica charantia* L.), pointed gourd (*Trichosanthis dioica* Roxb) and cucumber (*Cucumis sativus* L.). All the vegetables were established using their standard seed rates as the plant spacing (hill x row) of 0.5 m x 2.0 m was maintained during their cultivation.

The standard Steiner type traps (1000 ml size) were used for the monitoring of *B. cucurbitae* flies in individual vegetables. The cotton wick dipped using a disposable syringe with four ml cue lure [4-(p-acetoxypheyl) -2-butanone] along with 5% Malathion was placed inside each traps for fruit fly attraction. Two holes of 1.30 cm diameter were made at the opposite ends of the traps to ensure maximum attraction and killing of the captured flies. The traps were hung at a height of 5 feet above the ground in each vegetable. Moreover, the cue lure in the traps was replaced on fortnightly basis to retain their attractiveness for the fruit flies.

The experiment was conducted in a Randomized Complete Block Design (RCBD) as five replications were maintained for each treatment. The data was collected on weekly basis to count the number of dead flies attracted in each vegetable replication as the identification was based on the characteristic key features available in the published scientific literature. The data was also collected on the number of parasitoids emerged by sampling the infested vegetables with *B. cucurbitae* with visual symptoms. The infested vegetables were brought to the laboratory of Department of Entomology, Faculty of Crop Protection, Sindh Agriculture University, Tandojam and insepctd for the emergence of parasitoids or flies from the infested vegetables. The data was also obtained for the temperature and relative humidity from the regional meteorological stations to determine their influence the population of *B. cucurbitae* on various vegetables.

The collected data was analysed using Analysis of Variance at 5% probability level as means with significant differences were determined using the Least Significant Difference test. Moreover, Pearson's correlation was used to determine the influence of temperature and relative humidity on the population of *B. cucurbitae* on the studied vegetables. The computer software, STATISTIX 8.1 was used to run all the analysis.

Results and Discussion

Monitoring the seasonal activity of *B. cucurbitae* (Coq.) at Hyderabad during 2022

The population fluctuation of *B. cucurbitae* showed a significant difference on cucurbit vegetables ($F = 19.76$, $P < 0.001$) and dates ($F = 188.14$, $P < 0.001$) at district Hyderabad during 2022 (Table 1). After sowing, adult's *B. cucurbitae* appeared first during the 1st week of April and then remained active throughout the cropping season until the harvesting of vegetables. Initially, the highest (18.80 ± 2.06 flies) and the lowest (7.60 ± 1.36 flies) population were recorded on bottle gourd and pointed gourd in the first week, respectively. Afterwards, the population exhibited rapid growth in all the vegetables and reached at peak during the month of June 2022. The results are in line with Denny and Buttriss (2007), who observed in increasing trend in trapping of flies with the growth of vegetables. Accordingly, the highest population of *B. cucurbitae* was recorded on bottle gourd (260.0 ± 23.23 flies) on 11th week. However, the maximum population on remaining vegetables were 209.40 ± 23.69 flies on ridge gourd, 208.80 ± 24.13 flies on bitter gourd, 200.80 ± 20.33 flies on pointed gourd, 197.20 ± 24.03 flies on pumpkin gourd and 193.40 ± 16.22 flies on cucumber, respectively in different weeks. These findings are consistent with the earlier observations of Abro et al. (2017), who conducted population magnitude studies on cucurbit crops in district Hyderabad during 2015 and reported significantly higher population densities during the 4th week of May on ridge gourd (339.4 ± 22.59 flies), with the lowest populations recorded during the 1st week of January (11.0 ± 0.45 flies). Later, such population trend started to decline in 12th week of observation in all vegetables. These results further confirmed that the overall maximum population of fruit flies (148.06 ± 10.37 flies) on bottle gourd and the lowest (101.29 ± 7.87 flies) on cucumber were recorded. According to weekly data given in Table 1, the population of *B. cucurbitae* indicated that minimum number of flies (11.20 ± 1.29 flies) trapped at the start of season (1st week). Later, a continuous increase in population started from 9th week was observed throughout the growth of cucurbit vegetables and reached at its peak (208.90 ± 10.04 flies) in 10th week of observation.

Melon fruit fly population at Shaheed Benazirabad during 2022

The population fluctuation of *B. cucurbitae* showed a significant difference on various cucurbit vegetables ($F = 16.54$, $P < 0.001$) and dates ($F = 202.07$, $P < 0.001$) at Shaheed Benazirabad district during 2022 (Table 2). After sowing adults *B. cucurbitae* had appeared first during the 1st week of April and then remained active throughout the cropping season till harvesting of vegetables. Initially, the highest (17.80 ± 1.65 flies) and lowest (10.40 ± 1.56 flies) flies' population were recorded on sponge gourd and pumpkin gourd, respectively. Afterwards, the population exhibited rapid growth in all the vegetables and reached at peak during the month of June 2022. The similar trend was reported by Hussain (2002) that demonstrated the peak population of the pest from April to mid-November. Accordingly, the highest population of *B. cucurbitae* was recorded on sponge gourd (276.00 ± 26.54 flies) on 11th week, followed by maximum population on rest of vegetables were 256.20 ± 23.08 flies on bottle gourd, 245.20 ± 25.45 flies on Indian squash, 226.00 ± 23.20 flies on bitter gourd, 223.20 ± 21.94 flies on pumpkin gourd, 218.40 ± 23.48 flies on ridge gourd, 214.80 ± 23.44 flies on pointed gourd and 214.00 ± 24.54 flies on cucumber respectively during different weeks of observation. Afterwards, population trend started to decline during 12th week of observation in all the vegetables. The

results further confirmed that overall, the highest mean population of fruit flies (157.28 ± 11.10 flies) on sponge gourd and the lowest (111.84 ± 9.13 flies) on pointed gourd were recorded. Overall weekly data (Table 2) showed that mean population of *B. cucurbitae* remained very low (15.33 ± 0.83 flies) at the start of season (1st week of observation). However, later a continuous increase in population started from 10th week was observed throughout the growth of cucurbit vegetables reached at its peak (226.05 ± 10.34 flies) during 11th week of observation.

Table 1: Weekly population of male Melon fruit fly *B. cucurbitae* (Mean±S.E) on cucurbit vegetables during 2024 at Hyderabad district

Weeks	Pumpkin gourd	Bottle gourd	Sponge gourd	Ridge gourd	Indian squash	Bitter gourd	Pointed gourd	Cucumber
1	8.20 ±1.24 ^{yz}	18.80±2.06 ^{u-z}	13.80±1.85 ^{w-z}	10.60±1.57 ^{x-z}	11.60±1.03 ^{w-z}	10.20±1.50 ^{x-z}	7.60±1.36 ^z	8.80±1.24 ^{y-z}
2	16.40± 2.09 ^{u-z}	24.40±2.27 ^{u-z}	19.80±2.11 ^{u-z}	16.60±1.78 ^{u-z}	18.40±1.96 ^{u-z}	14.60±2.01 ^{v-z}	14.40±2.16 ^{v-z}	13.00±1.52 ^{w-z}
3	25.20±3.12 ^{t-z}	48.20±6.55 ^{q-y}	41.00±4.29 ^{q-z}	30.40±3.26 ^{t-z}	36.60±4.77 ^{r-z}	29.40±6.04 ^{t-z}	33.40±4.65 ^{t-z}	27.20±5.14 ^{t-z}
4	41.40±6.46 ^{q-z}	76.60±8.47 ^{j-r}	64.80±6.82 ^{l-t}	51.60±6.90 ^{o-w}	56.40±7.20 ^{m-u}	54.40±7.43 ^{n-v}	49.40±7.92 ^{p-x}	36.20±6.03 ^{s-z}
5	78.60±10.62 ^{i-q}	125.60±14.17 ^{v-Za-g}	114.40±11.99 ^{a-k}	95.40±11.91 ^{f-m}	92.00±13.91 ^{g-n}	94.40±12.39 ^{f-n}	90.20±10.58 ^{g-o}	75.60±7.73 ^{k-s}
6	96.00±12.88 ^{f-m}	148.20±15.99 ^{O-Za-c}	137.20±12.04 ^{T-Za-e}	104.20±13.61 ^{d-l}	118.40±12.90 ^{Y-Za-i}	116.20±15.20 ^{Za-j}	111.20±16.32 ^{b-k}	93.80±9.13 ^{f-n}
7	122.20±17.01 ^{X-Za-g}	181.40±16.82 ^{H-Q}	163.40±16.29 ^{L-W}	120.20±17.30 ^{Y-Za-h}	153.40±14.45 ^{NZa}	144.80±17.97 ^{P-Za-c}	138.20±17.53 ^{S-Za-d}	124.00±10.17 ^{W-Za-g}
8	146.00±18.84 ^{P-Za-c}	216.20±19.33 ^{B-I}	172.20±17.32 ^{J-U}	152.40±18.75 ^{O-Za}	180.20±15.97 ^{H-Q}	160.60±19.69 ^{L-X}	179.20±19.76 ^{H-R}	150.20±11.71 ^{O-Zab}
9	177.60±19.24 ^{I-S}	241.20±20.71 ^{A-C}	230.20±22.48 ^{A-F}	182.40±19.23 ^{G-Q}	215.80±22.75 ^{B-I}	182.60±21.13 ^{G-Q}	200.80±20.33 ^{D-L}	173.40±14.25 ^{J-T}
10	197.20±24.03 ^{D-M}	247.80±20.99 ^{A-C}	236.60±24.05 ^{A-D}	209.40±23.69 ^{B-K}	234.80±24.64 ^{A-E}	195.80±23.46 ^{E-M}	169.20±17.98 ^{K-U}	180.40±15.32 ^{H-Q}
11	184.80±19.64 ^{G-P}	260.0±23.23 ^A	249.40±24.99 ^{AB}	186.60±21.73 ^{G-O}	222.20±23.74 ^{A-G}	208.80±24.13 ^{C-K}	162.80±16.56 ^{L-W}	193.40±16.22 ^{F-N}

12	158.60±18.51 _{M-Y}	218.0±18.97 ^{B-H}	211.60±21.30 ^{B-J}	154.80±19.65 ^N _{-Z}	197.00±20.35 ^{D-M}	180.80±18.06 ^{H-Q}	142.40±14.41 ^{Q-} _{Za-d}	164.60±12.21 ^{L-} _V
13	109.40±14.82 _{c-k}	154.80±14.13 ^{N-Z}	146.80±15.61 ^{O-Za-} _c	114.20±16.24 ^{a-} _k	139.20±14.45 ^{R-} _{Za-d}	132.40±14.31 ^{U-Za-} _f	97.40±11.11 ^{e-l}	96.40±9.48 ^{f-m}
14	77.60±7.30 ^{j-q}	111.60±8.61 ^{b-k}	103.60±9.82 ^{d-l}	89.20±8.46 ^{g-p}	96.40±9.65 ^{f-m}	91.60±9.29 ^{g-o}	76.40±8.76 ^{j-s}	81.40±7.70 ^{h-q}

Means followed by similar letters are not significantly different from each other at $P>0.05$; Means followed by similar letters in last row (overall mean) are not significantly different from each other at $P>0.05$.

Table 2: Weekly population of male Melon fruit fly *B. cucurbitae* (Mean±SE) on cucurbit vegetables during 2024 at Shaheed Benazirabad

Weeks	Pumpkin gourd	Bottle gourd	Sponge gourd	Ridge gourd	Indian squash	Bitter gourd	Pointed gourd	Cucumber
1	10.40±1.56 ^s	17.80±1.51 ^{rs}	17.80±1.65 ^{rs}	16.40±1.63 ^{rs}	15.80±1.65 ^{rs}	16.20±1.52 ^{rs}	13.60±1.50 ^{rs}	15.40±1.50 ^{rs}
2	15.80±2.39 ^{rs}	22.40±2.11 ^{q-s}	27.40±3.51 ^{q-s}	20.20±2.05 ^{rs}	22.80±2.05 ^{q-s}	20.00±2.46 ^{rs}	17.20±1.77 ^{rs}	20.60±2.03 ^{q-s}
3	23.80±3.12 ^{q-s}	43.40±4.11 ^{n-s}	53.40±6.80 ^{l-r}	28.00±2.66 ^{q-s}	41.00±4.47 ^{n-s}	34.80±3.76 ^{p-s}	23.00±3.64 ^{q-s}	31.40±4.17 ^{p-s}
4	38.80±6.28 ^{n-s}	71.60±6.50 ^{j-p}	77.80±7.06 ^{i-o}	37.80±6.25 ^{o-s}	62.60±5.81 ^{k-q}	53.00±4.39 ^{l-r}	38.40±5.13 ^{o-s}	45.20±5.92 ^{m-s}
5	85.80±10.16 ^{g-} _m	125.60±12.31 ^{X-Za-g}	133.40±12.35 ^{V-Za-} _e	90.60±8.17 ^{f-l}	111.60±12.43 ^{Za-j}	104.00±9.66 ^{c-k}	81.00±11.83 ^{h-n}	99.20±10.73 ^{e-k}
6	107.80±12.66 ^a _j	147.40±13.72 ^{R-Zab}	155.40±14.55 ^{p-y}	117.00±13.67 ^{YZa} _{-i}	149.00±13.16 ^{Q-Zab}	126.00±15.25 ^{W-Za-} _g	86.20±13.73 ^{g-m}	120.60±11.74 ^{YZa-} _h
7	134.60±15.69 ^U _{-Za-e}	182.40±17.34 ^{I-S}	190.40±20.20 ^{H-Q}	143.80±16.77 ^{S-} _{Za-c}	168.20±18.01 ^{N-W}	156.00±19.95 ^{O-Y}	137.60±16.02 ^{T-Za-e}	151.80±16.27 ^{Q-} _Z
8	170.40±19.55 ^M _{-v}	214.80±19.70 ^{C-L}	229.80±21.63 ^{B-H}	168.40±20.27 ^{N-} _v	198.20±20.08 ^{G-O}	182.80±20.70 ^{I-S}	169.20±19.97 ^{N-V}	154.20±16.85 ^P _{-y}

9	204.20±20.70 _{E-N}	237.00±21.81 ^{A-G}	257.00±22.08 ^{A-C}	194.80±21.76 ^{G-P}	216.40±24.71 ^{C-K}	226.00±23.20 ^{B-H}	194.60±19.69 ^{H-P}	214.00±24.54 _{D-L}
10	223.20±21.94 ^B _{-I}	244.00±22.33 ^{A-F}	262.20±23.64 ^{AB}	218.40±23.48 _{C-J}	227.80±24.90 ^{B-H}	212.40±22.15 ^{E-M}	201.80±21.92 ^{F-N}	202.80±23.72 _{F-N}
11	201.20±20.29 _{G-N}	256.20±23.08 ^{A-D}	276.00±26.54 ^A	212.80±18.06 ^{E-} _L	245.20±25.45 ^{A-E}	206.20±16.82 ^{E-N}	214.80±23.44 ^{C-L}	196.00±22.60 _{G-P}
12	174.0±19.07 ^{L-V}	219.40±20.29 ^{C-J}	237.00±21.36 ^{A-G}	175.80±17.57 ^{K-U}	207.00±20.82 ^{E-N}	190.40±14.76 ^{H-Q}	178.20±19.70 ^{J-T}	189.40±16.91 ^H _{-R}
13	115.20±12.93 ^{YZ} _{a-i}	149.80±14.42 ^{Q-Za}	166.80±15.30 ^{N-X}	125.00±13.66 ^{X-} _{Za-g}	143.40±14.45 ^{S-Za-d}	132.60±11.59 ^{V-Za-f}	121.40±14.98 ^{YZa-h}	132.40±11.24 ^{V-} _{Za-f}
14	88.40±8.31 ^{g-l}	107.00±10.32 ^{b-j}	117.60±9.77 ^{YZa-i}	86.80±8.00 ^{g-m}	101.80±9.56 ^{c-k}	101.40±8.46 ^{d-k}	88.80±8.71 ^{g-l}	90.60±10.91 ^{f-l}

Means followed by similar letters are not significantly different from each other at P>0.05; Means followed by similar letters in last row (overall mean) are not significantly different from each other at P>0.05.

Melon fruit fly population at Hyderabad during 2023

The population fluctuation of *B. cucurbitae* showed a significant difference on various cucurbit vegetables ($F= 19.82$, $P < 0.001$) and dates ($F= 216.38$, $P < 0.001$) at Hyderabad district during 2023 (Table 3). Further results showing that adult flies appeared during first week of April and continue up to harvest of all cucurbit vegetables crop. In initial observations the maximum (12.00 ± 1.48 flies) and the lowest (6.80 ± 0.75 flies) population were noted on sponge gourd and cucumber during initial week respectively. Afterward the population showing rapid increase in all vegetables. However, the highest population of *B. cucurbitae* was recorded during the Month of June, 2023. Moreover, the highest population of flies was noted on sponge gourd (249.40 ± 23.88) on 11th week, however maximum population on remaining vegetables were 238.60 ± 24.65 flies on bottle gourd, 224.80 ± 23.77 flies on Indian squash, 212.60 ± 20.18 flies on bitter gourd, 198.80 ± 19.56 flies on ridge gourd, 190.60 ± 19.63 flies on pointed gourd, 187.20 ± 21.10 flies on pumpkin gourd and 181.40 ± 18.29 flies on cucumber, respectively during various weeks. The results published by Abro *et al.* (2017) are also same as of this study, which reported the *B. cucurbitae* from Yunnan Province, China and revealed the highest abundance of *B. cucurbitae* observed from May to November. In this study, the most preferred vegetable was sponge gourd, while the most resistance vegetable was pointed gourd. Population trend gradually declining from 12th week of observation in all the cucurbit vegetables. The results also further showed that overall, the highest mean population of fruit flies (*B. cucurbitae*) (134.96 ± 10.13) on sponge gourd and the lowest (93.23 ± 7.37) on cucumber were recorded. Accordingly, the weekly data (Table 3) population remained very low (9.90 ± 0.61) at the start of season (1st week of observation). However, a continuous increase in population from 10th week was observed through the growth of various cucurbit vegetables reaching at its peak (202.53 ± 10.96) on 11th week.

Melon fruit fly population at Shaheed Benazirabad during 2023

The population fluctuation of *B. cucurbitae* showed a significant difference on various cucurbit vegetables ($F= 13.77$, $P < 0.001$) and dates ($F= 208.91$, $P < 0.001$), at Shaheed Benazirabad district during 2025 (Table 4). The results further indicated that adult *B. cucurbitae* were appeared during 1st week of April and then remained active throughout the cropping season till harvesting of cucurbit vegetables. Initially, the maximum (14.20 ± 1.39) and lowest (10.60 ± 1.12 flies) population was recorded on sponge gourd and pointed gourd, respectively. Afterwards, the population exhibited rapid growth in all the vegetables and reached at peak during the month of June, 2023. These results are not lined with the results reported by De Meyer *et al.* (2010) which revealed that bitter gourd is the most preferred vegetable under the field conditions. The reasons behind the difference in results that they did not cultivate sponge gourd. Accordingly, the highest population of *B. cucurbitae* was recorded on bottle gourd (256.60 ± 22.00 flies) during 10th week, followed by 250.00 ± 23.29 flies on sponge gourd, 233.40 ± 21.84 flies on Indian squash, 223.20 ± 21.69 flies on bitter gourd, 216.00 ± 22.20 flies on pumpkin gourd, 213.80 ± 24.14 flies on ridge gourd, 210.00 ± 22.20 flies on cucumber and 207.00 ± 22.44 flies on pointed gourd. Afterwards, population of fruit flies started declining from 12th week of observation in all the vegetables. The results also showed that overall, the highest mean population of fruit flies was recorded on bottle gourd (146.01 ± 10.26) and the lowest (105.86 ± 12.65 flies) on cucumber were recorded. Moreover, on various dates (Table 4) initially population remained very low (12.18 ± 0.44 flies) at the start of season. However, a continuous increase in population was observed through the growth of vegetables reaching at its peak (218.80 ± 6.33 flies) on 11th week.

Table 3: Weekly population of male Melon fruit fly *B. cucurbitae* (Mean±S.E) on cucurbit vegetables during 2023 at Hyderabad

Weeks	Pumpkin gourd	Bottle gourd	Sponge gourd	Ridge gourd	Indian squash	Bitter gourd	Pointed gourd	Cucumber
1	9.00±1.22 ^{xy}	11.20±1.24 ^{x-y}	12.00±1.48 ^{xy}	10.20±1.24 ^{xy}	10.40±1.33 ^{xy}	11.00±1.30 ^{xy}	8.80±1.07 ^{xy}	6.80±0.75 ^y
2	14.40±1.75 ^{xy}	16.40±1.63 ^{w-y}	17.20±1.85 ^{w-y}	14.00±1.90 ^{xy}	18.00±1.84 ^{w-y}	15.80±1.77 ^{w-y}	15.00±1.58 ^{w-y}	10.20±1.24 ^{xy}
3	28.40±4.58 ^{u-y}	37.60±3.83 ^{t-y}	39.00±4.92 ^{s-y}	26.00±3.58 ^{v-y}	32.20±4.76 ^{u-y}	32.40±4.86 ^{u-y}	27.60±2.16 ^{v-y}	27.20±3.07 ^{v-y}
4	41.80±5.36 ^{r-y}	61.60±5.70 ^{n-v}	62.00±7.70 ^{n-v}	39.60±4.33 ^{s-y}	57.00±7.23 ^{o-v}	51.20±6.68 ^{p-w}	44.60±5.32 ^{q-x}	44.40±5.16 ^{q-x}
5	72.40±7.97 ^{k-t}	107.80±10.30 ^{b-k}	110.80±13.91 ^{a-j}	74.80±8.34 ^{j-s}	90.20±8.75 ^{f-o}	81.80±9.46 ^{g-p}	89.40±10.34 ^{f-o}	65.00±7.67 ^{m-u}
6	89.80±10.78 ^{f-o}	130.20±12.35 ^{V-Za-e}	133.20±14.39 ^{U-Za-d}	100.80±8.18 ^{d-m}	116.60±11.03 ^{YZ a-g}	103.60±10.78 ^{c-l}	92.60±11.71 ^{f-o}	87.00±8.50 ^{f-p}
7	121.60±15.65 ^{X-Za-f}	155.40±16.51 ^{M-X}	159.40±15.09 ^{L-W}	122.80±24.91 ^{W-Za-f}	148.80±12.50 ^{PZ}	132.60±11.44 ^{U-Za-d}	113.20±15.39 ^{Za-i}	115.60±15.48 ^{YZa-h}
8	151.60±16.66 ^{O-Y}	196.60±20.00 ^{C-K}	188.80±19.51 ^{D-N}	154.00±13.55 ^{M-X}	178.80±14.09 ^{F-R}	165.20±16.00 ^{J-V}	153.60±15.99 ^{N-X}	138.60±14.67 ^{T-Za-c}
9	187.20±21.10 ^{E-O}	216.80±20.65 ^{A-E}	225.00±21.93 ^{A-D}	179.40±16.36 ^{F-R}	205.60±21.62 ^{B-H}	184.00±18.79 ^{E-P}	190.60±19.63 ^{D-M}	156.00±15.30 ^{L-X}
10	172.60±17.25 ^{H-T}	230.80±22.15 ^{A-C}	236.60±22.36 ^{AB}	198.80±19.56 ^{C-J}	224.80±23.77 ^{A-D}	192.60±19.88 ^{D-L}	180.20±17.26 ^{E-Q}	168.40±17.79 ^{I-Q}
11	164.80±16.23 ^{I-V}	238.60±24.65 ^{AB}	249.40±23.88 ^A	183.20±18.17 ^{E-P}	214.60±22.49 ^{A-F}	212.60±20.18 ^{B-G}	176.40±16.97 ^{G-S}	181.40±18.29 ^{E-Q}
12	150.60±8.62 ^{O-Y}	205.0±15.86 ^{B-I}	209.60±19.97 ^{B-G}	161.60±15.47 ^{K-V}	188.60±17.34 ^{D-N}	171.80±17.57 ^{H-T}	155.20±16.02 ^{M-X}	143.40±14.66 ^{R-Zab}

13	100.40±10.51 ^{d-m}	140.80±11.94 ^{S-Zab}	144.80±13.61 ^{Q-Za}	103.80±9.41 ^{c-l}	131.80±14.97 ^{U-Za-d}	116.00±13.28 ^{YZa-h}	100.60±11.80 ^{d-m}	91.20±9.52 ^{f-o}
14	80.40±8.39 ^{g-q}	97.60±9.87 ^{d-n}	101.60±9.03 ^{d-m}	79.80±8.09 ^{h-q}	94.00±7.11 ^{e-n}	82.80±8.14 ^{g-p}	77.80±7.19 ^{i-r}	70.20±7.02 ^{l-t}

Means followed by similar letters are not significantly different from each other at $P>0.05$; Means followed by similar letters in last row (overall mean) are not significantly different from each other at $P>0.05$.

Table 4: Weekly population of male adult Melon fruit fly *B. cucurbitae* (Mean±S.E) on cucurbit vegetables during 2023 at Shaheed Benazirabad

Weeks	Pumpkin gourd	Bottle gourd	Sponge gourd	Ridge gourd	Indian squash	Bitter gourd	Pointed gourd	Cucumber
1	11.00±1.30 ^v	13.40±1.43 ^v	14.20±1.39 ^v	12.20±1.39 ^v	12.40±1.28 ^v	12.60±1.28 ^v	10.60±1.12 ^v	11.00±1.14 ^v
2	14.40±1.50 ^{uv}	23.60±3.60 ^{u-v}	20.20±2.08 ^{uv}	14.40±1.53 ^{uv}	16.80±1.15 ^{uv}	17.60±1.98 ^{uv}	14.80±1.71 ^{u-v}	12.60±1.20 ^v
3	21.20±2.90 ^{uv}	50.20±4.56 ^{m-v}	41.60±4.70 ^{o-v}	21.40±4.17 ^{uv}	33.00±4.13 ^{s-v}	26.20±2.74 ^{t-v}	21.60±2.95 ^{u-v}	19.00±2.70 ^{u-v}
4	39.20±5.58 ^{p-v}	76.40±5.98 ^{i-q}	65.40±6.36 ^{l-t}	36.80±5.68 ^{q-v}	55.20±6.60 ^{m-u}	44.20±7.63 ^{n-v}	35.40±4.83 ^{r-v}	31.60±6.45 ^{s-v}
5	82.00±10.39 ^{g-o}	122.60±11.90 ^{X-Za-g}	115.40±11.68 ^{YZa-j}	98.40±14.85 ^{c-l}	101.20±9.99 ^{b-l}	88.40±12.33 ^{e-m}	67.60±9.53 ^{k-s}	75.20±8.77 ^{j-r}
6	103.60±12.11 ^{b-l}	144.80±13.24 ^{R-Za}	138.00±12.28 ^{S-Za-c}	104.40±15.50 ^{a-l}	123.00±12.26 ^{X-Z a-f}	112.20±13.86 ^{Za-j}	107.00±16.30 ^{Za-k}	97.40±12.03 ^{c-l}
7	137.00±14.62 ^{T-Za-c}	178.40±16.05 ^{H-S}	164.20±15.43 ^{M-W}	139.80±15.96 ^{S-Zab}	178.20±18.19 ^{H-S}	146.00±17.51 ^{Q-Z}	134.60±16.65 ^{U-Za-c}	128.60±16.13 ^{W-Za-e}
8	191.20±21.11 ^{F-o}	211.00±19.52 ^{B-K}	172.80±16.76 ^{J-U}	187.40±20.18 ^{G-p}	188.40±18.21 ^{G-P}	178.00±20.21 ^{H-S}	159.60±18.21 ^{N-X}	164.00±18.95 ^{M-W}
9	198.40±21.89 ^{D-N}	238.00±20.79 ^{A-D}	230.80±21.06 ^{A-F}	195.60±22.35 ^{E-o}	216.60±20.70 ^{A-H}	223.20±21.69 ^{A-G}	185.40±19.46 ^{G-R}	178.00±19.77 ^{H-s}

10	216.00±22.20 _{A-H}	256.60±22.00 ^A	250.00±23.29 ^{AB}	204.00±23.71 _{C-M}	222.20±21.51 ^{A-G}	210.60±20.53 ^{B-L}	207.00±22.44 ^{C-L}	186.60±20.21 _{G-Q}
11	216.00±22.20 _{A-H}	243.60±20.69 ^{A-} _C	237.60±22.06 ^{A-D}	213.80±24.14 ^{B-I}	233.40±21.84 ^{A-E}	204.60±20.45 ^{C-M}	191.40±20.45 ^{F-O}	210.00±22.20 _{B-L}
12	177.20±18.16 ^{H-} _T	219.60±19.80 ^{A-G}	212.40±20.40 ^{B-J}	174.60±18.78 ^{I-U}	197.60±19.69 ^{D-N}	189.00±19.91 ^{G-O}	173.60±19.35 ^{I-U}	171.40±17.36 ^{K-} _V
13	120.60±12.46 ^X _{-Za-g}	155.80±13.36 ^{O-Y}	147.80±13.65 ^{P-Z}	103.00±15.65 ^{b-l}	136.40±13.26 ^{T-Za-c}	131.20±14.11 ^{V-Za-d}	119.80±13.42 ^{X-Za-h}	117.20±11.91 ^{YZ} _{a-i}
14	84.60±8.68 ^{f-n}	110.20±10.17 ^{Za-j}	104.40±9.77 ^{a-l}	84.80±8.91 ^{f-n}	99.60±9.61 ^{b-l}	90.40±9.56 ^{d-m}	83.00±7.25 ^{f-n}	79.40±7.24 ^{h-p}

Means followed by similar letters are not significantly different from each other at P>0.05; Means followed by similar letters in last row (overall mean) are not significantly different from each other at P>0.05.

Overall population of *B. cucurbitae* at Hyderabad and Shaheed Benazirabad during 2022 and 2023

The overall population of *B. cucurbitae* on cucurbit vegetables indicated the highest population at district Shaheed Benazirabad as compared to district Hyderabad (Figure 1). Among the years, maximum population of *B. cucurbitae* was noted during the year 2022 in contrast to 2023. Further, it was noted in both years and at both area, the maximum population of flies were captured from bottle gourd and sponge gourd in comparison to other studied cucurbit vegetables. In addition to direct losses, the infestation could decrease the worth of the fruiting body that ultimately affects the export opportunities due to the strict quarantine policies in different regions of the world (Chen & Ye, 2007).

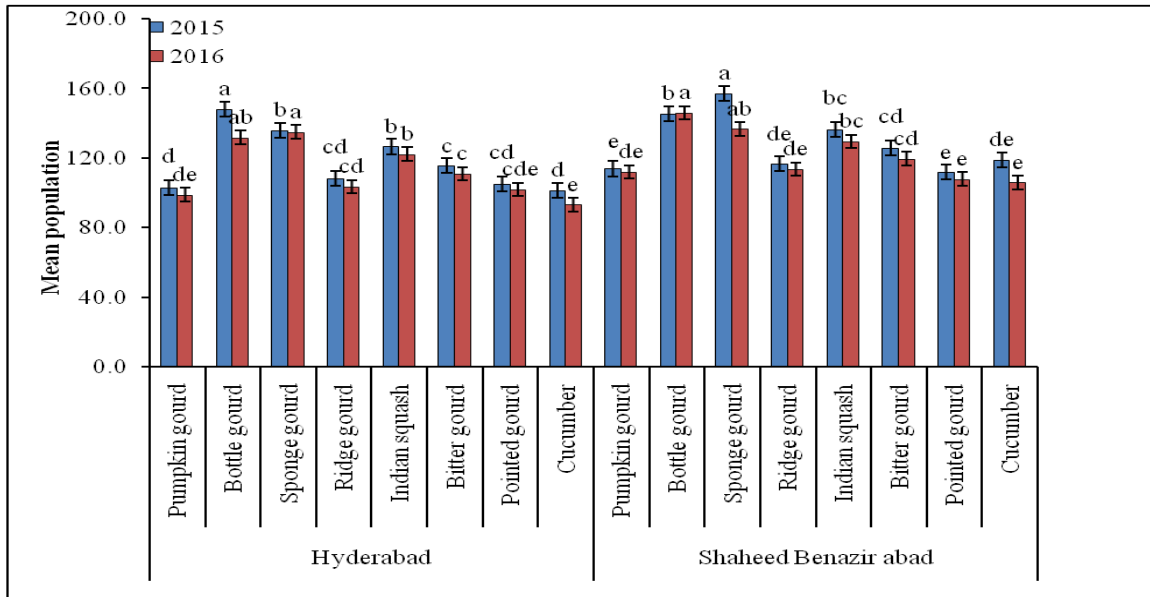


Figure 1 Overall mean population of *B. cucurbitae* on various cucurbit vegetables at Hyderabad and Shaheed Benazirabad during 2022 and 2023

Table 5 showed the relationship of population of *B. cucurbitae* attacking various cucurbit vegetables with temperature and relative humidity. During 2022, population of *B. cucurbitae* showed a moderate but highly significant relation ($r = 0.5615$; $P < 0.001$) with temperature, whereas a weak but significant relationship ($r = 0.1306$; $P < 0.0020$) was recorded with relative humidity. Similarly, during 2023 a highly significant and moderate correlation ($r = 0.6865$; $P < 0.001$) of fruit fly population was observed with temperature and a weak but highly significant relationship ($r = 0.2770$; $P < 0.001$) was recorded with relative humidity. The variation in population of *B. cucurbitae* may be due to variation of temperature because Shaheed Benazirabad location considered as high temperature ecological zone, whereas Hyderabad district is considered as low temperature ecological zone. According to Kumar *et al.* (2006) *B. cucurbitae* was positively correlated with temperature and relative humidity. Moreover, variation in infestation levels of the *B. cucurbitae* was influenced by fruit availability and environmental factors. The environmental factors (such as temperature, humidity and rainfall) directly associated with population densities of melon fruit fly were obtained using cue lure baited traps (Naqvi, 2005). According to Wazir *et al.* (2019) fruit fly population was highly significant and positively correlated with mean relative morning humidity, relative evening humidity and rainfall but highly negatively correlated with maximum temperature. In the study of Patel and Das (2021) a significant positive correlation was observed with maximum ($r = 0.63$) and minimum temperature ($r = 0.82$), and rainfall ($r = 0.69$). The maximum temperature led to 39.4% variation, and it was 67.1% with minimum temperature and 47.3% with rainfall. Ganie *et al.* (2013) reported that fruit fly populations on cucurbits in Kashmir Valley, India, were significantly correlated with minimum and maximum temperature, reinforcing the role of thermal factors in regulating *B. cucurbitae* population dynamics.

Table 5 Correlation of population of *B. cucurbitae* with temperature and relative humidity at Hyderabad during 2022 and 2023

	Hyderabad 2022	Hyderabad 2023	Shaheed Benazirabad 2022	Shaheed Benazirabad 2023
Temperature	r= 0.5615 P < 0.001	r= 0.6865 P < 0.001	r= 0.7596 P < 0.001	r= 0.7338 P < 0.001
Relative humidity	r= 0.1306 P < 0.002	r= 0.2770 P < 0.001	r= 0.1459 P < 0.05	r= 0.2688 P < 0.001

Diversity of melon fruit fly *B. cucurbitae* and its parasitoids collected at Hyderabad during 2022

The infested fruits provided maximum numbers of *B. cucurbitae* pupae (2053) were obtained from sponge gourd (Table 6). However, the convergence of all these pupae to adults was not successfully pursued and resulted in variable percentage of natural death. The higher percentage of adult flies of *B. cucurbitae* 1769 (86.17%) was recorded on sponge gourd but on the hand, maximum parasitism percentage of 9.65% was noted in both ridge gourd and bottle gourd, respectively. Meanwhile, the emergence of two different parasitoids was also significant finding of this study in which *Trybliographa daci* was more abundant as compared to *D. longicaudata*. The parasitoids play an important role for management of melon fruit flies (Bhuvaneswari & Nagini, 2005), determined the importance of *Aganaspis daci* (*Trybliographa daci*) and *Diachasmimorpha longicaudata* parasitoids in the use of fruit fly control. The higher abundance of *B. cucurbitae* in sponge gourd indicates that this cucurbit host provides suitable conditions for larval development and successful adult emergence. However, differences in adult emergence and parasitism among host fruits suggest that host characteristics may influence both fruit fly development and parasitoid performance. Recent studies have shown that host fruit characteristics, including fruit volatiles and larval habitat, significantly influence the host-searching behaviour and parasitism efficiency of *Diachasmimorpha longicaudata* (Hossain *et al.*, 2023; Pagadala Damodaram *et al.*, 2023). Similarly, biological control programmes have demonstrated that parasitoids are effective natural enemies of tephritid fruit flies and their successful establishment and parasitism may vary with host fruit species and environmental conditions (Garcia *et al.*, 2020). Therefore, the occurrence of both *Trybliographa daci* and *D. longicaudata* in the present study indicates their potential role in the natural suppression of *B. cucurbitae* populations and supports their conservation as an important component of integrated pest management (IPM).

Diversity of melon fruit fly *B. cucurbitae* and its parasitoids collected at Shaheed Benazirabad during 2022

The infested fruits provided maximum numbers of *B. cucurbitae* pupae (2064) were obtained from sponge gourd (Table 7). However, the convergence of all these pupae to adults was not successfully pursued and resulted in variable percentage of natural death. The higher percentage of adult flies of *B. cucurbitae* 1799 (87.16%) was recorded on sponge gourd but on the hand, maximum parasitism percentage of 8.27% was noted in bottle gourd. Meanwhile, the emergence of two parasitoids was also significant finding of this study in which *T. daci* was more abundant as compared to *D. longicaudata*. The findings obtained from Shaheed Benazirabad were generally consistent with those recorded in Hyderabad, where sponge gourd also yielded the highest number of *B. cucurbitae* pupae and adult emergence. This consistency indicates that sponge gourd is a highly suitable host for the development and survival of *B. cucurbitae* under the agro-climatic conditions of Sindh. Host preference and successful immature development are known to vary among cucurbit species owing to differences in fruit morphology, nutritional composition, and physicochemical characteristics, which directly influence oviposition and larval performance (Khuhro *et al.*, 2023).

Diversity of melon fruit fly *B. cucurbitae* and its parasitoids collected at Hyderabad during 2023

The infested fruits provided maximum numbers of *B. cucurbitae* pupae (2002) were obtained from sponge gourd (Table 8). However, the convergence of all these pupae to adults was not successfully pursued and resulted in variable percentage of natural death. The higher percentage of adult flies of *B. cucurbitae* 1778 (88.81%) was recorded on sponge gourd but on the hand, maximum parasitism percentage of 8.33% was noted in Indian squash, respectively. Meanwhile, the emergence of two different parasitoids was also significant finding of this study in which *Trybliographa daci* was more abundant as compared to *D. longicaudata*. Findings of Khuhro *et al.* (2023) confirmed the presence and effectiveness of the parasitoids *Trybliographa daci* and *Diachasmimorpha longicaudata* against *Bactrocera* fruit flies when integrated with mass trapping. Moreover, the absence of other potent parasitoids such as *Dirhinus giffardii* and *Spalangia endius* in our study, which have demonstrated 45.66% and significant parasitism potential under controlled laboratory conditions (Awais *et al.*, 2020; Liu *et al.*, 2024).

Diversity of melon fruit fly *B. cucurbitae* and its parasitoids collected at Shaheed Benazirabad during 2023

The infested fruits provided maximum numbers of *B. cucurbitae* pupae (2033) were obtained from sponge gourd (Table 9). However, the convergence of all these pupae to adults was not successfully pursued and resulted in variable percentage of natural death. The higher percentage of adult flies of *B. cucurbitae* 1799 (88.48%) was recorded on sponge gourd but on the hand, maximum parasitism percentage of 5.92% was noted in bottle gourd. However, the field parasitism rate recorded in our study is substantially lower than the 13.52% to 69.10% reported by Rahmawati *et al.* (2024) for *Opius* sp. parasitizing *Bactrocera* spp. on citrus varieties, suggesting that parasitoid efficacy is heavily modulated by host plant type, crop phenology, and the surrounding agro-ecosystem. Meanwhile, the emergence of two parasitoids was also significant finding of this study in which *T. daci* was more abundant as compared to *D. longicaudata*. The previous studied revealed that the presence of parasitoids in the field can reduce the application of insecticides for controlling the fruit fly species infesting the vegetables and fruits (Bateman, 1977; Saiqa Andleeb *et al.*, 2010; Zhao *et al.*, 2013).

Table.6 Biodiversity of melon fruit fly *B. cucurbitae* and its parasitoids collected through infested cucurbit vegetables at Hyderabad 2022

Vegetable	Total pupae (n)	Natural Death	Emergence (<i>B. cucurbitae</i>)	Emergence of Parasitoids		Other flies
				<i>T. daci</i>	<i>D. longicaudata</i>	
Pumpkin gourd	1900	71 (3.73%)	1621 (85.31%)	58 (3.05 %)	40 (2.10 %)	110 (4.13%)
Bottle gourd	2029	36 (1.77%)	1719 (84.72%)	106 (5.22%)	90 (4.43%)	78 (3.84%)
Sponge gourd	2053	28 (1.36%)	1769 (86.17%)	93 (4.52%)	86 (4.18%)	77 (3.75%)
Ridge gourd	1979	29 (1.46%)	1683 (85.04%)	102 (5.15%)	89 (4.49%)	76 (3.84%)
Indian squash	1990	58 (2.91%)	1732 (87.04%)	74 (3.71%)	54 (2.71%)	72 (3.61%)

Bitter gourd	2012	60 (2.90%)	1729 (85.93%)	79 (3.92%)	64 (3.18%)	80 (3.97%)
Pointed gourd	1948	54 (2.71%)	1650 (84.70%)	90 (4.62%)	71 (3.64%)	83 (4.26%)
Cucumber	1956	44 (2.24%)	1642 (83.94%)	100 (5.11%)	74 (3.78%)	96 (4.90%)

Results presented in percentage from individual taken sample (n)

Table 7. Biodiversity of *B. cucurbitae* and its parasitoids collected through infested cucurbit vegetables during 2022 at Shaheed Benazirabad

Vegetables	Total pupae	Natural Death	Emergence(<i>B. cucurbitae</i>)	Emergence of Parasitoids		Other flies
				<i>T. daci</i>	<i>D. longicaudata</i>	
Pumpkin gourd	1961	86 (4.38%)	1701 (86.74%)	56 (2.85%)	38 (1.92%)	80 (4.07%)
Bottle gourd	2043	53 (2.59%)	1742 (85.26%)	95 (4.65%)	74 (3.62%)	79 (3.86%)
Sponge gourd	2064	43 (2.08%)	1799 (87.16%)	83 (4.02%)	74 (3.58%)	65 (3.14%)
Ridge gourd	1995	53 (2.65%)	1699 (85.16%)	85 (4.25%)	79 (3.95%)	79 (3.95%)
Indian squash	2019	93 (4.60%)	1732 (85.78%)	67 (3.31%)	49 (2.42%)	78 (3.86%)
Bitter gourd	2027	69 (3.40%)	1751 (86.38%)	72 (3.55%)	55 (2.71%)	80 (3.94%)
Pointed gourd	1964	61 (3.10%)	1680 (85.53%)	75 (3.81%)	62 (3.15%)	86 (4.37%)
Cucumber	1991	57 (2.86%)	1687 (84.73%)	84 (4.21%)	66 (3.31%)	97 (4.86%)

Table 8. Biodiversity of melon fruit fly *B. cucurbitae* and its parasitoids collected through infested cucurbit vegetables at Hyderabad 2023

Vegetable	Total pupae	Natural Death	Emergence(<i>B. cucurbitae</i>)	Emergence of Parasitoids		Other flies
				<i>T. daci</i>	<i>D. longicaudata</i>	

Pumpkin gourd	1898	67 (3.53%)	1667 (87.82%)	55 (2.89%)	43 (2.26%)	66 (3.47%)
Bottle gourd	1974	45 (2.27%)	1720 (87.13%)	71 (3.59%)	70 (3.54%)	68 (3.44%)
Sponge gourd	2002	14 (0.69%)	1778 (88.81%)	92 (4.59%)	66 (3.29%)	52 (2.59%)
Ridge gourd	1941	22(1.13%)	1722 (88.71%)	83 (4.27%)	60 (3.09%)	54 (2.78%)
Indian squash	1967	46 (2.33%)	1699 (86.37%)	87 (4.42%)	77 (3.91%)	58 (2.94%)
Bitter gourd	1959	39 (1.99%)	1719 (87.74%)	74 (3.77%)	68 (3.47%)	59 (3.01%)
Pointed gourd	1896	52 (2.74%)	1651 (87.07%)	70 (3.69%)	53 (2.79%)	70 (3.69%)
Cucumber	1909	41 (2.14%)	1673 (87.63%)	67 (3.50%)	61 (3.19%)	67 (3.50%)

Table 9. Biodiversity of *B. cucurbitae* and its parasitoids collected through infested cucurbit vegetables during 2023 at Shaheed Benazirabad

Vegetable	Total pupae	Natural Death	Emergence (<i>B. cucurbitae</i>)	Emergence of Parasitoids		Other flies
				<i>T. daci</i>	<i>D. longicaudata</i>	
Pumpkin gourd	1917	57 (2.97%)	1680 (87.63%)	52 (2.71%)	34 (1.77%)	94 (4.90%)
Bottle gourd	2007	95 (4.73%)	1696 (84.50%)	70 (3.48%)	49 (2.44%)	97 (4.83%)
Sponge gourd	2033	67 (3.29%)	1799 (88.48%)	59 (2.90%)	55 (2.70%)	53 (2.59%)
Ridge gourd	1964	99 (5.04%)	1650 (84.01%)	66 (3.36%)	50 (2.54%)	99 (5.04%)
Indian squash	1982	95 (4.79%)	1703 (85.92%)	60 (3.02%)	47 (2.37%)	77 (3.88%)
Bitter gourd	1995	98 (4.91%)	1707 (85.56%)	49 (2.45%)	37 (1.85%)	104 (5.21%)
Pointed gourd	1931	96 (4.97%)	1640 (84.93%)	54 (2.79%)	43 (2.22%)	98 (5.07%)
Cucumber	1954	100 (5.11%)	1652 (84.54%)	59 (3.01%)	45 (2.30%)	98 (5.01%)

Conclusion

In present studies, sponge gourd and bottle gourd were found to be more susceptible host for *B. cucurbitae* as the peak population were observed during the month of June. Comparatively more *B. cucurbitae* was recorded during 2022 than 2023 as fields of Shaheed Benazirabad recorded comparatively higher population than Hyderabad. Two parasitoid species i.e., *Trybliographa daci* and *D. longicaudata* was also recorded from the *B. cucurbitae*, with comparatively higher population recorded for *T. daci*. In comparison to relative humidity, temperature showed a highly significant and positive relationship with the *B. cucurbitae* in various

cucurbit vegetables at both the studied locations. Therefore, it is suggested that a continuous monitoring and crop rotation policies should be adopted for the better management of *B. cucurbitae* to reduce its losses to cucurbit vegetables

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