

Dominance of Fruit Fly Species (Diptera : Tephritidae) in Cucumber under Foot Hills of Nagaland

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ABSTRACT

Dominance of fruit fly species (Diptera : Tephritidae) was studied in cucumber under Nagaland condition during 2022. A total of seven species of fruit flies were identified viz., *Bactrocera dorsalis*, *B. divenderi*, *B. aethriobasis*, *B. tuberculata*, *B. bhutaniae*, *Zeugodacus tau* and *Z. cucurbitae* of all these species, the most dominant species was *B. dorsalis* with individual population count of 1731 followed by *B. bhutaniae* (504), *B. tuberculata* (357), *B. divenderi* (258), *B. aethriobasis* (203), *Z. tau* (78) and the lowest population count was recorded in *Z. cucurbitae* (58). The peak incidence of *B. dorsalis*, *B. divenderi*, *B. aethriobasis* and *B. bhutaniae* was observed in 5th August (31st SW) with mean of 140.33, 31.67, 14.67 and 46.33 flies/trap respectively. The population of *B. tuberculata* and *Z. tau* peaked during 12th August (32nd SW) with 32.67 and 8.67 flies/trap, respectively, while *Z. cucurbitae* was highest on 19th August (33rd SW) with mean of 8.67 flies/trap. Correlation studies indicated that all the species were non-significant with all the weather parameters except *B. tuberculata* ($r=0.858$) and *B.*

bhutaniae ($r=0.813$) which showed positive significant correlation with maximum relative humidity.

Keywords Fruit flies, Dominance, Cucumber, Methyl eugenol, Trap.

INTRODUCTION

Cucumber (*Cucumis sativus*) popularly known as 'Khira' is one of the most important cucurbit vegetables. It is a widely cultivated creeping vine plant in the Cucurbitaceae family which usually bears cylindrical fruits, primarily grown for its tender fruits and is used for salad purpose or for pickling. Cucumber (*Cucumis sativus*) is an extremely important vegetable crop not only for internal consumption but also as the highest foreign exchange earner among the horticultural crops. India has exported 1.23.846 metric tonnes with a value of USD 114 million during April-October, 2021. Presently, China is the largest producer of cucumber in the world with production of 61.949.09 tonnes and area 1.155.84 ha followed by Russia and Turkey. India is ranked at 27th with production of 1608 thousand MT and area 116 thousand hectare (Anonymous 2021). In India, West Bengal is the highest producing state with production of 326.82 thousand tones followed by Madhya Pradesh and Haryana. In North-Eastern region, Assam is the leading producer of cucumber with production of 90.23 thousand tones. In Nagaland, the total production is 9.47 thousand tones, contributing only 0.59% share of the nation's total production (<https://apeda.in>).

Cucurbits are attacked and infested by various pests which results in adversely affecting the quality

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Table 1. List of fruit fly species in cucumber recorded during July 2022 to August 2022.

Sl. No.	Scientific name/order/family	Crop phenology	Feeding site	No. of individuals
1.	<i>Bactrocera dorsalis</i> (Diptera : Tephritidae)	Fruit formation stage till harvest	Fruit	1731
2.	<i>Bactrocera divenderi</i> (Diptera : Tephritidae)	Fruit formation stage till harvest	Fruit	258
3.	<i>Bactrocera aethriobasis</i> (Diptera : Tephritidae)	Fruit formation stage till harvest	Fruit	203
4.	<i>Bactrocera tuberculata</i> (Diptera : Tephritidae)	Fruit formation stage till harvest	Fruit	357
5.	<i>Bactrocera bhutaniae</i> (Diptera : Tephritidae)	Fruit formation stage till harvest	Fruit	504
6.	<i>Zeugodacus tau</i> (Diptera : Tephritidae)	Fruit formation stage till harvest	Fruit	78
7.	<i>Zeugodacus cucurbitae</i> (Diptera : Tephritidae)	Fruit formation stage till harvest	Fruit	58

and quantity of produce. The crop might be damaged with different insect-pests infestation throughout their life cycle. Fruit flies, *Bactrocera* spp. are known as the most damaging pest in many parts of the world. Two species namely *B. cucurbitae* and *B. tau* commonly called as melon fruit flies are the major species found infesting cucurbits. The fruit flies are widely distributed in temperate, tropical and sub-tropical regions of the world. The damage caused by fruit fly infestation is a major constraint in profitable farming of cucurbits.

MATERIALS AND METHODS

The study on the dominance of fruit fly species (Diptera : Tephritidae) in cucumber was conducted during *kharif* season 2022 in the experimental farm, Department of Entomology, SASRD, Nagaland University during 2022. Three different shaped traps were used viz., cylindrical, triangular and spherical. These different shaped traps were colored with white, yellow and green and was replicated three times. Each trap had four holes of 1 inch in size on four sides and a cotton wad charged with 0.4 ml methyl eugenol and 1 ml of Malathion 50 EC, placed inside the trap in a loop made of iron wire. Each trap was serviced with these chemicals at fortnightly intervals. The lures were prepared mixing ethyl alcohol, methyl eugenol and Malathion 50 EC in the ratio of 6:4:2. The cut cotton pieces were dipped in the lure for 24 hrs and were then covered with aluminium foil until use. Only one third of aluminium foil was removed at the time of use and tied the lure to the thin wire in the lid. The traps were hanged in the shade at 3-4 feet above ground level at different location and 1 trap per plot were placed and left for 30–40 days.

The trap count of adult *Bactrocera* species was recorded at weekly interval by emptying the traps and the constituent (i.e., methyl eugenol and Malathion 50 EC) was refilled. The number of flies received from each trap determined the population build up of the pest during the week.

•No. of species of fruit flies.

•No. of fruit flies attracted per trap plot was counted and identified.

All the data collected were subjected to statistical analysis by applying two-way analysis of variance (ANOVA) using Factorial Randomized Block Design (FRBD) as described by Gomez and Gomez (1984).

RESULTS AND DISCUSSION

The adult fruit flies were collected at regular standard weeks throughout the fruiting period through different shapes and colored traps of methyl eugenol.

Table 2. Relative abundance of fruit fly species in cucumber.

Sl. No.	Species abundance	Percentage (%)
1	<i>Bactrocera dorsalis</i> (Hendel)	54.20%
2	<i>Bactrocera bhutaniae</i> (Drew and Romig)	15.80%
3	<i>Bactrocera tuberculata</i> (Bezzi)	11.19%
4	<i>Bactrocera divenderi</i> (Maneesh <i>et al.</i> 2022)	8.09%
5	<i>Bactrocera aethriobasis</i> (Hardy)	6.36%
6	<i>Zeugodacus tau</i> (Walker)	2.44%
7	<i>Zeugodacus cucurbitae</i> (Coquillett)	1.82%

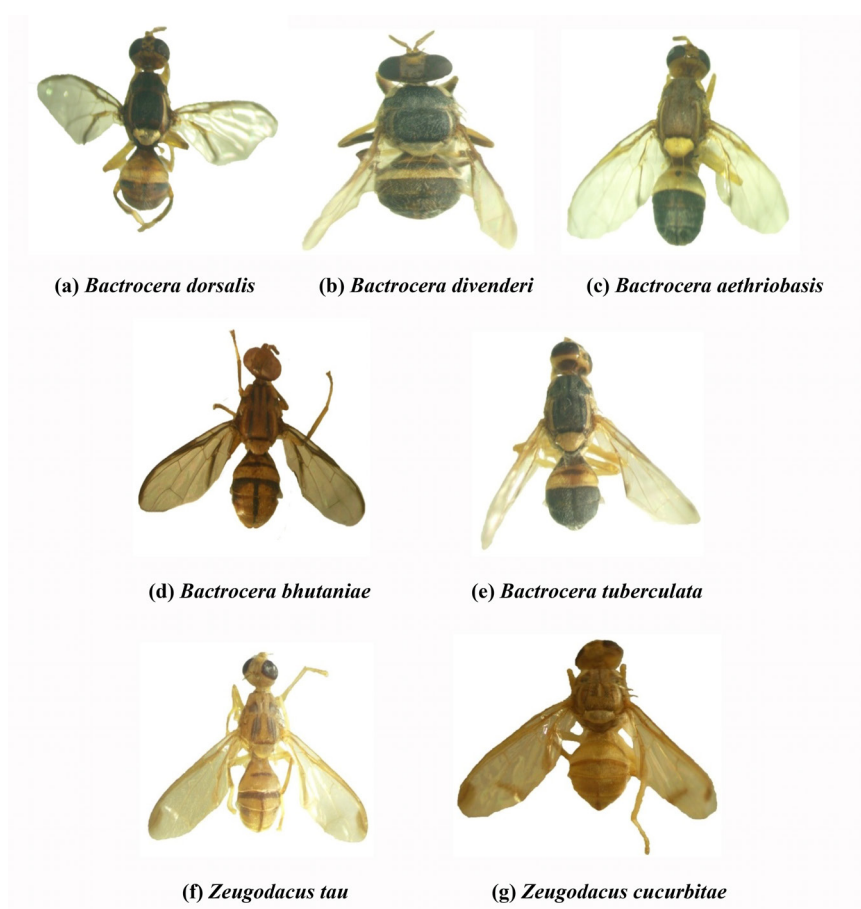


Fig. 1. Different species of fruit fly collected during the period of study.

The collected specimens were identified based on morphological characters using the keys given by David and Ramani (2011), Leblanc *et al.* (2014), Drew and Raghu (2002), Maneesh *et al.* (2022) and also by referring Plant Health Australia, The Australian handbook for identification of fruit flies 2016. The specimens were also identified by KJ David, Senior Scientist, ICAR-National Bureau of Agricultural Insect Resources (NBAIR), Bangalore.

Fruit fly species recorded during the present study are presented in Table 1. Total of seven species of fruit fly were identified viz., *Bactrocera dorsalis* (Hendel), *Bactrocera divenderi* (Maneesh *et al.* 2022), *Bactrocera aethriobasis* (Hardy), *Bactrocera tuberculata* (Bezzi), *Zeugodacus tau* (Walker), *Zeugodacus cucurbitae* (Coquillett) and *Bactrocera*

bhutaniae (Drew and Romig). Amongst the species, the most abundant species was *B. dorsalis* (Hendel) with population count of 1740 individuals, followed by *B. bhutaniae* (509), *B. tuberculata* (370), *B. divenderi* (258), *B. aethriobasis* (203), *Z. tau* (89) and *Z. cucurbitae* (65). Similar identification was recorded by Nakahara *et al.* (2019) who reported twenty species of *Bactrocera* including major serious fruit flies such as *B. dorsalis*, *B. correcta* and *B. cucurbita* from Myanmar.

Abundance of fruit fly species in cucumber

Among the observed species (Table 1), *B. dorsalis* was recorded as the most dominant and abundant with relative abundance of 54.20% followed by *B. bhutaniae* (15.80%), *B. tuberculata* (11.19%), *B.*

Table 3. Abundance of fruit fly species collected from all the traps of methyl eugenol in cucumber during July 2022 to August 2022.

Standard week	Date of observation	Temperature °C		Relative humidity (%)		Rainfall (mm)	<i>B. dorsalis</i>	<i>B. divenderi</i>	<i>B. aethriobasis</i>	<i>B. tuberculata</i>	<i>B. bhutaniae</i>	<i>Z. tau</i>	<i>Z. cucurbitae</i>
		Max	Min	Max	Min								
28	15.07.22	34.13	24.49	90.00	68.86	22.90	54.33	0.67	8.67	8.33	7.33	0.00	0.00
29	22.07.22	33.89	24.46	91.71	75.00	135.30	103.67	6.67	9.00	12.33	16.67	0.00	0.00
30	29.07.22	31.79	23.17	96.00	69.71	135.30	133.00	18.33	11.67	23.00	39.67	6.33	2.33
31	05.08.22	33.64	23.86	93.43	67.57	48.80	140.33	31.67	14.67	29.33	46.33	5.67	3.33
32	12.08.22	33.27	23.89	96.00	71.43	114.70	85.00	22.67	12.33	32.67	36.33	8.67	5.00
33	19.08.22	33.61	24.24	91.00	72.29	27.50	60.67	5.67	11.33	13.00	21.67	5.33	8.67

divenderi (8.09%), *B. aethriobasis* (6.36%) and *Z. tau* (2.44%). *Z. cucurbitae* had the lowest population with a relative abundance of 1.82% as shown in Table 2.

Dominance of fruit fly species in cucumber

Though the growing season of cucumber in the study area was for a period of 4 months from May-August 2022, the fruit flies population were observed and recorded during the fruiting period starting from 28th SW-33rd SW. The data collected at weekly intervals using methyl eugenol traps from the experimental field revealed that seven (7) species of fruit flies viz., *B. dorsalis*, *B. divenderi*, *B. aethriobasis*, *B. tuberculata*, *B. bhutaniae*, *Z. tau* and *Z. cucurbitae* were observed as shown in Fig. 1. Among these species, the population count of *B. dorsalis* was significantly higher than the population count of other species with total of 1731 individuals, which was followed by *B. bhutaniae* (504), *B. tuberculata* (357), *B. divenderi* (258), *B. aethriobasis* (203), *Z. tau* (78) and the lowest population count was recorded in *Z. cucurbitae* (58) as shown in Table 1.

The activity of *B. dorsalis*, *B. bhutaniae*, *B. tuberculata*, *B. aethriobasis* and *B. divenderi* were found to be prevalent throughout the fruiting period of the crop, i.e., from 28th SW to 33rd SW whereas the activity of *Z. tau* and *Z. cucurbitae* initiated from 30th SW and the population count was low throughout the growing period of the crop. The details of the weekly observations of abundance of fruit fly species recorded are presented in Table 3.

The population of *B. dorsalis* started to appear in the mid of July when the crop reached fruiting stages

and it was found to be lowest with a initial population of 54.33 flies/trap when the mean maximum temperature and minimum temperature, maximum RH, minimum RH and rainfall were 34.13°C, 24.49°C, 90%, 68.86% and 22.90 mm, respectively. The population gradually started to increase from the following week and reached its highest peak trap in the first week of August i.e., 5th August 2022 with a mean population count of 140.33 when the weekly mean temperature, relative humidity and rainfall ranged from 33.64°C, 23.86°C, 93.43%, 67.57% and 48.80 mm. Thereafter, there was a drastic reduction in the fruit fly activity from the second week of August with a mean population of 85.00 flies/trap on 32nd SW followed by 60.67 flies/trap on 33rd SW. The result of the current study was in conformity with the findings of Kumar *et al.* (2018) who reported that the maximum population of *B. dorsalis* caught through methyl eugenol traps was found in the month of August. In contrast to the present study, Stanley *et al.* (2015) found the maximum population of *B. dorsalis* in the month of December. Sowmiya *et al.* (2020) also noticed the maximum population of the fruit fly in 35th SMW which was contrary to the present study. This could be due to different environmental conditions at two locations.

The activity of *B. divenderi* was observed to be very low at initial stage with the mean catch of 0.67 flies/trap during 15th of July. The peak activity was observed during 1st week of August (31st SW) with the mean adult catch of 31.67 flies/trap. There was a moderate reduction in the activity of the fruit fly during the 2nd week of August (32nd SW) with the mean adult catch of 22.67 flies/trap and the population was found to decrease with the mean adult catch of 5.67 flies/trap, during the period of harvesting on

Table 4. Correlation coefficient (r) of fruit flies with weather parameters recorded during July 2022 to August 2022. Note : df = (6-2) = 4, $r_{0.05} = 0.811$, $r_{0.01} = 0.917$. * = Significant at 5% level of significance, NS = Non-significant at 5% level of significant.

Pests	Pearson's correlation coefficient				
	Temperature (°C)		Relative humidity (%)		Rainfall (mm)
	Max	Min	Max	Min	
<i>Bactrocera dorsalis</i>	-0.542 ^{NS}	-0.684 ^{NS}	0.612 ^{NS}	-0.270 ^{NS}	0.512 ^{NS}
<i>Bactrocera divenderi</i>	-0.381 ^{NS}	-0.644 ^{NS}	0.740 ^{NS}	-0.464 ^{NS}	0.246 ^{NS}
<i>Bactrocera aethriobasis</i>	-0.319 ^{NS}	-0.586 ^{NS}	0.577 ^{NS}	-0.510 ^{NS}	-0.046 ^{NS}
<i>Bactrocera tuberculata</i>	-0.431 ^{NS}	-0.649 ^{NS}	0.858*	-0.340 ^{NS}	0.346 ^{NS}
<i>Bactrocera bhutaniae</i>	-0.595 ^{NS}	-0.804 ^{NS}	0.813*	-0.415 ^{NS}	0.310 ^{NS}
<i>Zeugodacus tau</i>	-0.576 ^{NS}	-0.704 ^{NS}	0.794 ^{NS}	-0.254 ^{NS}	0.184 ^{NS}
<i>Zeugodacus cucurbitae</i>	-0.113 ^{NS}	-0.150 ^{NS}	0.133 ^{NS}	0.059 ^{NS}	-0.307 ^{NS}

33rd SW. In contrast to the present study, Ukey *et al.* (2014) found the peak population of *Bactrocera* spp. in the month of June and July.

The population of *B. aethriobasis* during the fruiting stage of the crop showed that the mean population ranged from 8.67 flies/traps to 14.67 flies/trap. The population of the fruit flies was moderate throughout the fruiting period of the crop showing its peak in the first week of August and lowest in the mid-July. During the present study period, the maximum temperature, minimum temperature, maximum RH, minimum RH and rainfall ranged from 31.79–34.13°C, 23.17–24.49°C, 90–96%, 67.57–75% and 22.92–135.30 mm, respectively.

The mean trap catch of *B. tuberculata* was 8.33 flies/trap in the mid-July i.e., 28th SW and increased gradually till the second week of August i.e., 32nd SW with a mean catch of 32.67 flies/trap which was the highest trap count for the fruit fly when the maximum temperature, minimum temperature, maximum RH, minimum RH and rainfall were 33.27°C, 23.89°C, 96.00%, 71.43% and 114.70 mm, respectively. Thereafter, the population decreased upto a mean catch of 13.00 flies/trap on 33rd SW. Similar findings was reported by Khan and Naveed (2017) who observed the highest mean population of fruit fly in the month of August.

The lowest activity of *B. bhutaniae* was observed during fortnight of July i.e., 28th SW with the mean adult catch of 7.33 flies/trap followed by 3rd week of July with 16.67 flies/trap. The highest peak activity was observed during 1st week of August with the mean

adult catch of 46.33 flies/trap followed by 39.67 flies/trap and 36.33 flies/trap in the last week of July i.e., 30th SW and second week of August i.e., 32nd SW, respectively.

The population of *Z. tau* started to appear only in last part of July with a mean trap catch of 6.33 trap on 30th SW reaching its peak on 32nd SW (8.67 flies/trap). The population was found to be low till the harvesting of the crop. Devi and Mehta (2015) found the maximum population of *Z. tau* in the first week of June i.e., 22nd SW which was at variation with the present study.

The activity of *Z. cucurbitae* was started to appear from 30th SW with a mean trap catch of 2.33 flies/trap and it increased gradually till the harvesting of the crop reaching its maximum with a mean trap catch of 8.67 flies/trap at the time of harvesting i.e., 33rd SW. Patel and Das (2021) observed the highest population of *B. cucurbitae* during 33rd SMW both in 2016 and 2017 which was in conformity to the present study. In contrary to the present study, Devi and Mehta (2015) observed its highest population in the first week of June. Puri *et al.* (2021) also reported that the maximum peak incidence of *B. cucurbitae* was found on 41st SMW. The variation may be due to difference in climatic conditions.

Correlation between different species of fruit flies with abiotic factors

The study of correlation between the population of fruit flies and weather parameters revealed that the populations of fruit fly species i.e. *B. dorsalis*, *B.*

divenderi, *B. aethriobasis*, *Z. tau* and *Z. cucurbitae* had a non-significant negative correlation with all the weather parameters. While, the population of *B. tuberculata* and *B. bhutaniae* showed a positive correlation with the maximum relative humidity but was non-significant with other weather parameters as shown in Table 4.

The findings of the present study were in conformity with the findings of Shinde *et al.* (2018) who reported that the correlation between fruit flies with various meteorological parameters were non-significant. It was also in tune with the findings of Sowmiya *et al.* (2020), who concluded that all the parameters like maximum and minimum temperature, relative humidity and rainfall are non-significant to fruit fly catches. Raghuvansi *et al.* (2012) reported that the temperature (maximum and minimum) showed a significant positive correlation with abundance of *Z. cucurbitae* in bitter melon which was in contrast with the present finding. However, the report of Kumar *et al.* (2022) who found that the population of *Z. cucurbitae* was negatively non-significant with the rainfall supported the present study.

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