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Seasonal Abundance of Melon Fruit Fly (*Zeugodacus cucurbitae*) in different Cucurbit Fields of Nagaland

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ABSTRACT: One of the major insect pests of vegetables that affects both the amount and quality of fruit output is the melon fruit fly. Seasonal abundance of Melon fruit fly (*Zeugodacus cucurbitae*) was observed on Cucumber, Pumpkin and Ash gourd during the summer season of 2020 and 2021 in different isolated experimental fields of School of Agricultural Sciences and Rural Development (SASRD), Nagaland University, Medziphema Campus, Nagaland. Furthermore, investigation was done to find out the correlation between meteorological variables and fruit fly abundance. During the year 2020, the highest incidence of melon fruit fly was recorded on 31st May from all cucurbit fields with a mean population 2.30 numbers per trap from cucumber and pumpkin, while 2.65 numbers per trap from ash gourd. However, during the year 2021, the highest incidence was on 6th June in cucumber (1.85 numbers per trap), while in pumpkin and ash gourd on 30th May with a mean population of 2.15 and 2.50 numbers per trap, respectively. The correlation of melon fruit fly populations with abiotic factors was found to have non-significant in both the years. However, in the year 2021 their populations were found to have a positive significant correlation with morning relative humidity (r= 0.631). The lack of a substantial relationship between fruit fly population and the majority of abiotic parameters in the current study might be due to some other factors like availability of tender fruits with soft skin. In the present investigation during the last week of May upto middle of June, the population of fruit flies species was observed highest in different cucurbits and during that period maximum number of tender fruits with soft skin was available in the fields. Therefore, the population might be increasing with the increase of tender fruits in the field during that period.

Keywords: Seasonal abundance, Abiotic factors, *Zeugodacus cucurbitae*, Cucurbits.

INTRODUCTION

The biggest contributing factors to the low production and inferior quality of vegetables are insect pests. Fruit flies are one of the worst insect pests of many fruits and vegetables. More over 4,000 different species of Dipteran fruit flies make up the Tephritidae family, with nearly 700 of those species being Dacine fruit flies (Fischer and Busch 1989). Among them is the melon fly, *Bactrocera cucurbitae* (Coq.), a fruit fly that attacks 125 different plant species, the majority of which are members of the Cucurbitaceae and Solanaceae families (Bezzi, 1913). Melon flies cost growers 8 to 10 million US dollars each year in losses. Additionally, it restricts the growth of agriculture in ma ny nations due to the quarrying industry's rigorous regul ations intended to stop the spread of this nasty pest (Dhi llon *et al*., 2005).

Vegetables are a major source of protein and minerals necessary for human nutrition and vitamins. According to the Indian Horticulture Database, National Horticulture Board (NHB), the total production of vegetables in million tonnes is 183.17 (2018–2019) and 188.91 (2019–20), whereas the total production of vegetable crops under Nagaland in thousand metric tonnes during 2018–19 is 561.61 (Anonymus, 2019). Increased vegetable production and quality benefits jobs, business opportunities and food security. To control fruit flies, vegetable growers in India sometimes spray vegetables with a mixture of poisons and insecticides. The repeated use of pesticides has wreaked havoc on the environment, soil, water and wildlife, as well as on human health. Numerous fruit fly species have been identified, including *Bactrocera cucurbitae* which is the most dangerous pest of pumpkin, sponge gourd, bitter gourd, Indian pumpkin and other fleshy vegetables. This species directly harms vegetables, which can result in yield losses of up to 90–100%. Due to the tight quarantine

restrictions, in addition to direct losses, the frequency of this kind could lower the value of the trading and export chances (Naqvi, 2005). Fruit fly population size is effectively investigated using pheromone and para-pheromone traps in several parts of the world (Marwat and Baloch, 1986; Gillani *et al*., 2002). Cue lure traps offer a convenient and efficient technique to research *B. cucurbitae* population densities, which is crucial for the effectiveness of an anti-pest programme (Alyokhun *et al*., 2000). The potential significance of sex (male) attractants is indicated by the various sex attractant mixes employed to draw male fruit flies (Tephritidae), such as pheromones and lures. Fruit flies naturally have a one-to-one sex ratio; however, partial fluctuations in the male-to-female population ratio of *B. cucurbitae* have been seen over time (Bhagat and Koul 1999). According to estimates made by Sapkota *et al*. (2010), each male fly that the attractant removes from the wild fly population will represent one unmated female. Pheromones and lures have been used for years to attract adult male fruit flies, which has proven effective in comparison to food temptation for assessing and measuring fruit fly population densities (Jang *et al*., 2007). Cue-lure traps are also successfully utilised in vegetable agro-ecosystems globally for the detection and mass capture of melon flies (Pawar *et al*., 1991; Nath and Bhusan 2006). Using cue-lure-baited traps, environmental variables (such as temperature, humidity and rainfall) directly related to population densities of melon fruit flies were collected. According to Lee *et al*. (1997); Jha *et al*. (2007), fruit fly species collected using cue-lure baited traps were positively correlated with meteorological variables such as temperature, humidity and rainfall. Meena *et al*. (2019) reported that Melon fruit flies have been causing an outbreak on bottle gourds since the third week of May. The peak infestation was seen in the first week of June, and there was a strong positive link between maximum and minimum temperatures and fruit fly infestations. According to Alim *et al*. (2012), the months of May and June saw the highest frequency of this pest. Luskar and Chatterjee (2010) reported peak fruit fly activity on cucurbitaceous crops during April, July, and August. A strong positive correlation exists between the occurrence of fruit flies and the maximum and minimum temperature (Kate *et al*., 2009; Laskar and Chatterjee 2010; Raghuvanshi *et al*., 2012; Bhowmik *et al*., 2014).

Given the commercial significance of cucurbit vegetables and the losses brought on by the melon fruit fly incursion, it is necessary to study the population fluctuations of the melon fruit fly, *Zeugodacus cucurbitae*, as well as the effects of ecological factors on its capture in order to develop a sustainable pest management strategy against its invasion in the cucurbit agro-ecosystem.

MATERIAL AND METHODS

Three different cucurbit crops *viz.*, cucumber, pumpkin and ash gourd were grown following recommended agronomic practices in three different experimental farms of School of Agricultural Sciences and Rural Development, Nagaland University, Medziphema Campus during summer season of 2020-21.

At the start of flowering, fruit fly bottle traps were placed in various plots of three distinct cucurbit farms. This trap was constructed from a transparent, 1L mineral water bottle with four 20 mm-wide openings on each side. In a loop formed of iron wire, a cotton wad was inserted inside the trap and impregnated with Cue lure @ 40 ml + 60 ml ethyl alcohol + 20 g malathion, i.e., in the ratio of 4: 6: 2. The impregnation of these substances was done on a weekly basis. Preparation procedure was followed from the booklet by Latha and Sathyanarayana (2015), National institute of plant health management, Hyderabad.

The adults of the melon fruit fly (*Zeugodacus cucurbitae*), which were drawn to installed traps, were collected and brought to the lab on a weekly basis. There, their numbers were counted and the individual specimens were stored in various glass vials (8×0.75 cm^2) containing 95% alcohol. In order to determine the relationship between *Zeugodacus cucurbitae* abundance and abiotic parameters including maximum and minimum temperatures, morning and evening relative humidity and rainfall, *Zeugodacus cucurbitae* abundance was recorded from traps in various cucurbits at weekly intervals on different Standard Meteorological Weeks (SMW). The different weather parameters during the study period were collected from Meteorological observatory, ICAR NEH Region, Nagaland Centre, Medziphema. Correlation studies were done with the help of SPSS 16.0 Version, Analytical Software.

RESULTS AND DISCUSSION

Table 1 and Fig. 1 show the seasonal occurrence of *Z. cucurbitae* for the year 2020. The information so obtained shows that the average number of flies caught in traps ranged from 0.20 to 2.65 flies per trap. With a mean population of 2.30 flies per trap in cucumber and pumpkin but 2.65 flies per trap in ash gourd, the highest occurrence was noted on May 31st (i.e., 22 SMW). After that, the trap catches began to decline, with the lowest populations being seen on May 3 (18 SMW) and July 5 (27 SMW), respectively, with mean populations of 0.20, 0.25 and 0.45 flies/trap in cucumber, pumpkin and ash gourd.

The seasonal incidence of *Z. cucurbitae* during the year 2021 is presented in Table 2 and illustrated in Fig. 2. The data thus recorded depicts that the mean number of flies captured in traps was in the range of 0.20 to 2.50 flies per trap. The highest incidence was recorded on June 6 (23 SMW) in cucumber with 1.85 flies per trap, while in pumpkin and ash gourd on May 30 (i.e., 22 SMW) with mean populations of 2.15 and 2.50 flies per trap, respectively. The lowest population was recorded on May 9 (19 SMW) and July 11 (28 SMW), with a mean population of 0.30 and 0.25 flies per trap in cucumber and ash gourd, respectively and 0.20 flies per trap in pumpkin on May 2 (18 SMW) and July 4 (27 SMW).

The current observation is also consistent with the findings of Abro *et al*. (2017), who noted the year-

round activity of *Z. cucurbitae* species. However, the peak fly species population was observed from mid-May to mid-June. According to Hossain *et al.* (2019), *Z. cucurbitae* reached its peak population in March 2017 (early in the rainy season) and May 2018 (middle of the wet summer season). Ye (2001) also stated that the Yunnan Province of China only has high *Z. cucurbitae* abundance from May through November each year. The results of the current experiment, however, did not support Lee *et al.* (1992); Mahmood *et al.* (2007) who found that *Z. cucurbitae* populations rose from July to October.

The correlation of *Z. cucurbitae* populations in three cucurbits with abiotic factors was found to have non-significant relationship in both the years (Table 3). However, in the year 2021 their populations in cucumber were found to have a positive significant correlation with morning relative humidity (r= 0.631).

The current results partially agree with those of Wazir *et al.* (2019), who found that the population of *B. cucurbitae* was highly significant and positively correlated with relative humidity in the morning, relative humidity in the evening and rainfall but highly and negatively correlated with maximum temperature. Similar findings were reported by Syed (1971); Ye (2001); Vargas *et al.* (2003), who claimed that the largest number of *B. cucurbitae* was recorded in the warm months of every year and that relative humidity was seen as a significant element that impacts the pest incidence. On the other side, Abhilash *et al.* (2017) discovered that the population of melon fruit fly was adversely connected with relative humidity and rainfall but significantly and positively correlated with maximum and minimum temperatures. Similar findings were made by Khan and Naveed (2017), who discovered a positive association between temperature and fruit fly population and a negative correlation with relative humidity.

The non-significant correlation of *Z. cucurbitae* populations in three cucurbits with most of the abiotic factors in the present investigation might be due to some other factors like availability of tender fruits with soft skin. In the present investigation during the last week of May upto middle of June, the population of fruit flies species was observed highest in different cucurbits and during that period maximum number of tender fruits with soft skin was available in the fields. Therefore, the population might be increasing with the increase of tender fruits in the field during that period. Liu and Yeh (1982); Tariq *et al.* (2002) also correlated the population of fruit flies with the ripening of fruit crops which facilitated easy oviposition inside the soft skin of fruits by the female fruit fly. This statement is also in agreement with the finding of Ye (2001); Nahid *et al.* (2020) who reported that the fruiting duration and age of fruit have significant effects on the fruit fly abundance. In contrary, Stanley *et al.* (2015) reported that the fruit fly incidence have positive correlation with maximum and minimum temperature.

Table 1: Seasonal abundance of *Z. cucurbitae* recorded during May-July 2020 on different cucurbit crops.

Standard Meteorological weeks	Date of observation	Temperature (ºC)		Relative humidity (%)		Rainfall (mm)	Numbers/trap		
		Max.	Min.	Morning	Evening		Cucumber	Pumpkin	Ash gourd
18	03.5.2020	30.07	20.30	90.00	60.00	20.05	0.20	0.25	0.45
19	10.5.2020	32.22	23.90	87.00	56.00	22.60	0.30	0.35	0.55
20	17.5.2020	32.00	21.50	92.00	61.00	4.10	0.60	0.60	0.70
21	24.5.2020	30.50	22.90	92.00	79.00	38.60	1.30	1.30	1.45
22	31.5.2020	30.10	21.20	92.00	63.00	74.00	2.30	2.30	2.65
23	07.6.2020	31.90	22.70	94.00	68.00	16.50	1.60	1.35	1.85
24	14.6.2020	33.20	24.70	92.00	80.00	67.10	1.05	1.05	1.15
25	21.6.2020	33.10	24.30	92.00	71.00	111.90	0.70	0.80	0.95
26	28.6.2020	31.80	23.90	92.00	73.00	53.60	0.60	0.50	0.55
27	05.7.2020	32.90	24.60	94.00	78.00	79.50	0.20	0.25	0.45
28	12.7.2020	32.90	24.80	93.00	71.00	29.70	0.30	0.35	0.55

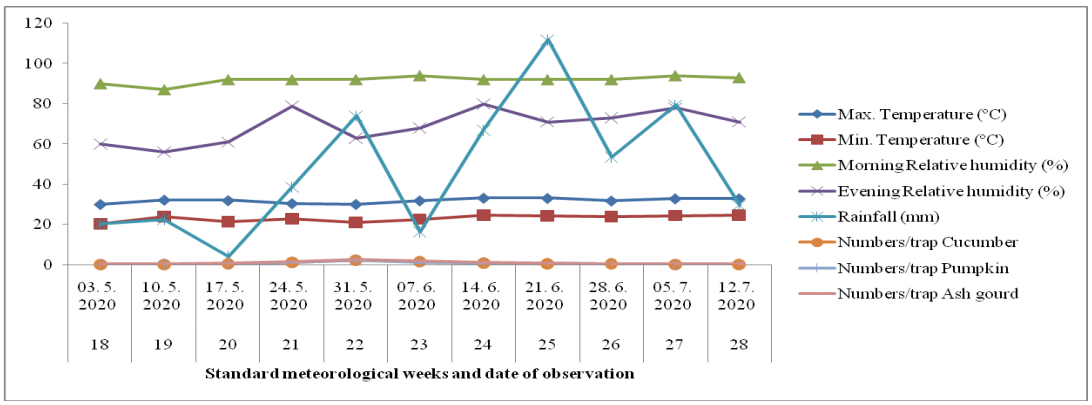

Fig. 1. Seasonal abundance of *Z. cucurbitae* recorded during May-July 2020 on different cucurbit crops.

Table 2: Seasonal abundance of *Z. cucurbitae* recorded during May-July 2021 on different cucurbit crops.

Standard Meteorological weeks	Date of observation	Temperature (ºC)		Relative humidity (%)		Rainfall (mm)	Numbers/trap		
		Max.	Min.	Morning	Evening		Cucumber	Pumpkin	Ash gourd
18	02.5.2021	32.20	20.05	85.00	49.00	31.10	0.35	0.20	0.35
19	09.5.2021	30.03	20.06	89.00	62.00	19.40	0.30	0.25	0.25
20	16.5.2021	31.70	21.60	91.00	58.00	3.20	0.35	0.60	0.70
21	23.5.2021	35.60	23.90	92.00	60.00	31.10	0.85	1.35	1.45
22	30.5.2021	33.10	22.90	91.00	61.00	17.40	1.15	2.15	2.50
23	06.6.2021	33.60	23.60	92.00	63.00	39.10	1.85	1.60	1.75
24	13.6.2021	33.00	24.80	95.57	75.00	19.50	1.65	0.90	1.00
25	20.6.2021	33.00	24.50	93.00	67.00	43.30	1.55	0.75	0.70
26	27.6.2021	33.00	25.00	93.00	69.00	37.60	1.30	0.45	0.55
27	04.7.2021	33.20	24.70	89.00	73.00	19.20	0.35	0.20	0.35
28	11.7.2021	32.40	24.70	93.00	70.00	105.70	0.30	0.25	0.25

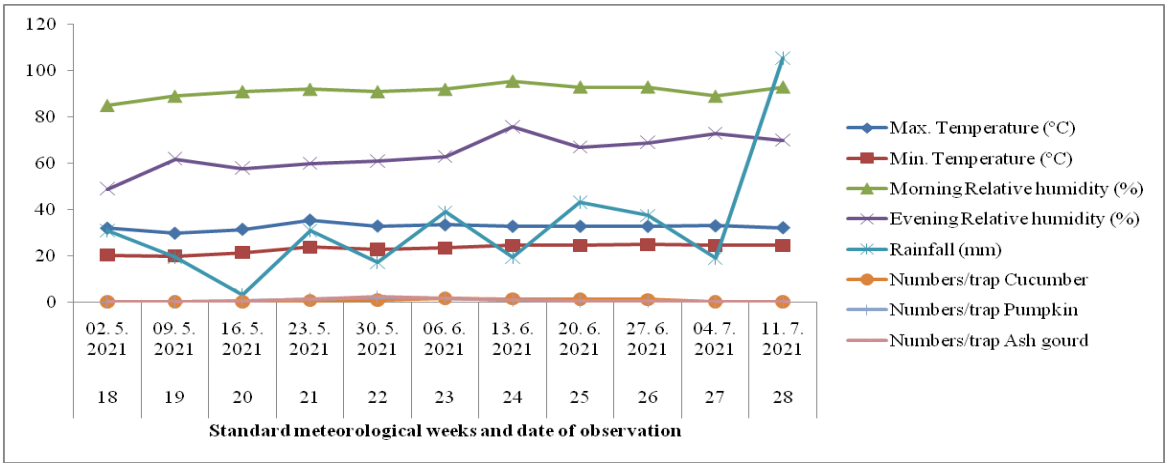

Fig. 2. Seasonal abundance of *Z. cucurbitae* recorded during May-July 2021 on different cucurbit crops.

Table 3: Correlation coefficient (r) of *Z. cucurbitae* with abiotic factors during May-July of 2020 and 2021 on different cucurbits.

Crops	Year	Pearson's correlation coefficient (r)				
		Temperature (ºC)		Relative humidity (%)		Rainfall (mm)
		Maximum	Minimum	Morning	Evening	
Cucumber	2020	-0.425	-0.316	0.281	0.073	1.580
	2021	0.444	0.505	0.631*	0.333	-0.062
Pumpkin	2020	0.430	0.315	0.241	0.068	0.223
	2021	0.522	0.146	0.319	-0.103	-0.217
Ash gourd	2020	-0.433	-0.334	0.260	0.014	0.172
	2021	0.511	0.120	0.255	-0.128	-0.256

* = Significant at 5% level of significance

CONCLUSIONS

Z. cucurbitae had a high initial population that began on cucumber in the first week of May, moved on to pumpkin and ash gourd, and then gradually increased until it peaked in the last week of May on certain cucurbit agro-ecosystems. While rainfall had a negative impact on the population of melon fruit flies, morning relative humidity had a favourable impact. Therefore, it can be established that increased insect activity is caused by high relative humidity and the presence of more delicate fruits in the fields. Therefore, when the fruits are at their most sensitive, *Z. cucurbitae* can attack cucurbitaceous plants. Therefore, growers must maintain vigilance, and appropriate management plans for this fly species must be developed.

FUTURE SCOPE

One of the most damaging insect pests of cucurbit crops is the melon fruit fly. Information on insect incidences at various phonological stages of the crop is crucial for pest management. To construct a crop-pest ecological model to anticipate the incidence of pests well in advance and to alert farmers to begin necessary pest control measures, the information obtained on incidence and correlation with weather parameters during the current study is a useful tool.

Conflict of Interest. None.

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