International Journal of Environment and Climate Change

Volume 13, Issue 8, Page 396-404, 2023; Article no.IJECC.99939
ISSN: 2581-8627
(Past name: British Journal of Environment & Climate Change, Past ISSN: 2231–4784)

Monitoring of Melon Fruit Fly, *Zeugodacus cucurbitae* Coquillett Population using Para-pheromone Traps in Bitter Gourd (*Momordica charantia* L.)

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

Article Information

DOI: 10.9734/IJECC/2023/v13i81966

Open Peer Review History:
This journal follows the Advanced Open Peer Review policy. Identity of the Reviewers, Editor(s) and additional Reviewers, peer review comments, different versions of the manuscript, comments of the editors, etc are available here: https://www.sdiarticle5.com/review-history/99939

Original Research Article

Received: 15/03/2023
Accepted: 17/05/2023
Published: 26/05/2023

ABSTRACT

Investigations were carried out on monitoring of melon fruit fly, *Zeugodacus cucurbitae* Coquillett on bitter gourd (*Momordica charantia* L.) using para-pheromone traps during *Kharif*, 2018-19 at CCS HAU, Hisar. The incidence of *Z. cucurbitae* started gradually and increased from 31st to 42nd Standard Meteorological Week (SMW) corresponding to the 1st week of September to 3rd week of October. Higher number of fruit flies (on average 9.5 to 40.5 flies/trap) were recorded in the month of September to first fortnight of October with a peak of 40.5 flies/trap during 37th SMW. Correlation analysis with various weather parameters indicated that maximum temperature (r = 0.611*), morning relative humidity (0.590*) and rainfall (0.747**) had significant positive correlation with trap

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catch population of melon fruit fly. The present findings also revealed that the influence of all-weather parameters was high and significant on trap catches population of the adult male melon fruit fly (R^2=0.76).

Keywords: Monitoring; Zeugodacus cucurbitae; trap catches; standard meteorological week; correlation.

1. INTRODUCTION

India is a one of the leading producers of fruits and vegetables, which serve as an important source of nutrition for its enormous population. Bitter gourd, *Momordica charantia* L. belonging to family Cucurbitaceae is widely cultivated vegetable crop across Asian countries. Fruits of this vegetable have the richest nutritive value among cucurbits [1] as they are good source of carbohydrates, proteins, vitamins and minerals. Several health benefits have been reported, with reference to treatment of cancer [2] and anti-diabetic properties [3]. Insect pests and diseases are the two major limiting factors [4] in increasing the yield potential in cucurbits and cole crops. Numerous insect-pests are known to attack bitter gourd during different crop growth stages, among which, melon fruit flies (*Zeugodacus cucurbitae* Coquillett and *Z. tau*) have been recorded as a serious pest infesting the most economic part of bitter gourd crop [5]. The most serious of them is melon fruit fly, *Z. cucurbitae*, which causes severe damage to cucurbits and is a cosmopolitan pest which prefers tropics and subtropics [6]. It causes losses up to the extent of 30-100 per cent in cucurbits [7]. In several other case studies, it is reported to cause fruit infestation of 31.27 and 28.55 per cent on bitter gourd and water melon, respectively [8]. It is very difficult to manage this particular pest which belong to the family Tephritidae, because except adults the remaining life stages are concealed or hidden, thus the usual target for its management is the adult stage only. Therefore, monitoring pest population in relation to weather parameters will help in determining appropriate time of action and suitable method of management. This information is very much necessary for formulating Integrated Pest Management strategy to manage melon fruit flies. Keeping this in mind, the present investigation was carried out on monitoring adult males of *Z. cucurbitae* in relation to weather parameters.

2. MATERIALS AND METHODS

In the present investigation, the population of male adults of *Z. cucurbitae* was monitored using para-pheromone (cue lure) traps during the *Kharif* season of 2018-19 at Vegetable Research Farm, CCSHAU, Hisar. The current study utilized comparatively cheaper bottle traps. Three windows of one inch each were made with the help of a knife at three inches from top of an used 1 litre water bottle. A small hole was carved on the center of the cap or lid. A wire of ten-inch length was taken to make a knot at the center of the lid so as to make a loop. The wire inside the bottle was tied to cue lure bait in hanging position. The bottles were partially filled with soap water. Cue lure was purchased from M/s Sisco Research Laboratories Pvt. Ltd., Mumbai.

Installation of two cue lure traps was done immediately after sowing. The traps were refilled every week with soap water and every two weeks with cue lure. The adult males of *Z. cucurbitae* were separated based on typical wing pattern and were gathered, sorted, and recorded on a weekly basis. The collected data were subjected to correlation and regression analysis with the abiotic factors *viz*., minimum and maximum temperature, morning and evening relative humidity (RH), wind speed, sunshine hours and rainfall (Tables 1 and 2).

2.1 Statistical Analysis

The data on weather parameters *viz*., maximum and minimum temperature, morning and evening RH, sunshine hours, wind speed, evaporation and rainfall were collected from Meteorological Observatory, College of Agriculture, CCSHAU, Hisar, Haryana (Table 3). The correlation between trap catches of *Z. cucurbitae* and various weather parameters was calculated by the Pearson's correlation coefficient using SPSS 22.0 software.

3. RESULTS AND DISCUSSION

The monitoring of adult males *Z. cucurbitae* on bitter gourd was carried out from August 2018 (31st SMW) to October 2018 (42nd SMW). Higher number of fruit flies (average 9.5 to 40.5 flies/trap) were recorded during the month of September to first fortnight of October. The

maximum numbers of fruit flies (40.5 flies/trap) were recorded during 37th SMW (Fig. 1). The number of fruit flies decreased drastically in further weeks, as the crop season was coming to an end. Along with monitoring, investigation was also carried out to find out the relationship between trap catch population of *Z. cucurbitae* and weather parameters such as maximum and minimum temperature, morning and evening RH, rainfall, evaporation, bright sunshine hours and average wind speed. Maximum temperature (*r* = 0.611*), morning RH (0.590*) and rainfall (0.747**) had significant positive correlation with trap catch population of melon fruit fly. Evening RH (*r* = 0.247) and bright sunshine hours (*r* = 0.304) shown positive correlation whereas, minimum temperature (*r* = -0.236) and average wind speed (-0.043) had negative and non-significant correlation with the trap catch population of melon fruit fly (Table 1, Figs. 2A and 2B). The multiple regression analysis between trap catches of melon fruit fly adults and weather parameters presented in Table 2 revealed that all weather parameters collectively accounted for 76 per cent variability in trap catches of melon fly adults. The present findings revealed that all the weather parameters exhibited high and significant effect on the trap catches of the adult male melon fly (R^2=0.76).

Seasonal variation in weather factors plays an important role in the reproduction, growth, development, and distribution of insects and influences their population dynamics and infestation rates [9]. The present findings are almost consistent with the findings of Pawar et al. [10] who recorded maximum number of trap catch population of *Z. cucurbitae* in bitter gourd during the first fortnight of October. The study conducted by Khan et al. [11] showed that rainfall had the greatest effect on population dynamics of the fruit flies. The cue lure baits which were replaced every 15 days attracted males of *Z. cucurbitae* only. The present results are in consistent with the observations of Vignesh and Viraktamath [12] and Boontop et al. [13] who reported that cue lure traps attracted only male *Z. cucurbitae.*

The trap catch population of fruit fly significantly and positively correlated with the maximum temperature, rainfall and morning RH and positive correlation existed with evening RH and bright sunshine hours whereas negative correlation existed with minimum temperature, evaporation and average wind speed (km/h). Weather factors, particularly temperature and rainfall, are the main meteorological parameters influencing the distribution of fruit flies [14]. They tend to hide and aggregate under the dried

Table 1. Correlation between various weather parameters in relation to *Z. cucurbitae* trap catch population during *Kharif*, 2018

Weather parameters	Fruit fly population
Maximum temperature (ºC)	0.611*
Minimum temperature (ºC)	-0.236
Relative humidity - Morning (%)	0.590*
Relative humidity - Evening (%)	0.247
Rainfall (mm)	0.747**
Evaporation (mm)	-0.359
Bright sunshine hours	0.304
Average wind speed (Km/h)	-0.043

**Correlation is significant at P ≤ 0.05; **Correlation is significant at P ≤ 0.01*

Table 2. Multiple regression analysis between weather parameters and trap catch population of *Z. cucurbitae* during *Kharif*, 2018

	Regression equation	R^2
Trap catches of melon fruit fly	Y = -360.63+3.12 T_{max}+1.94 T_{min}+2.74 RHm – 0.32 RHe – 5.6 SSH + 0.91 RF – 7.47 WS + 13.94 EV	0.76

T_{max}: Maximum temperature (ºC), T_{min}: Minimum temperature (ºC), RHm: Relative humidity - Morning (%), RHe : Relative humidity - Evening (%), SSH : Bright sunshine hours, RF : Rainfall (mm), WS : Average wind speed (Km/h) and EV : Evaporation (mm)

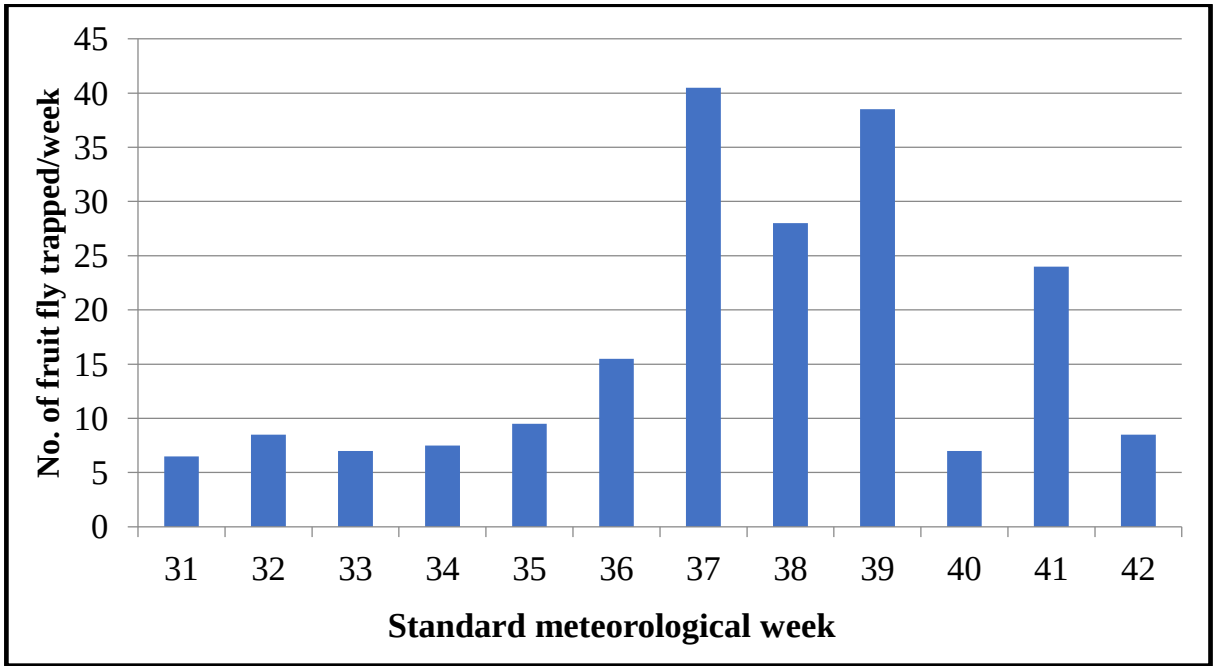

Fig. 1. Trap catches of melon fruit fly at vegetable research farm, CCSHAU, Hisar during *Kharif*, 2018

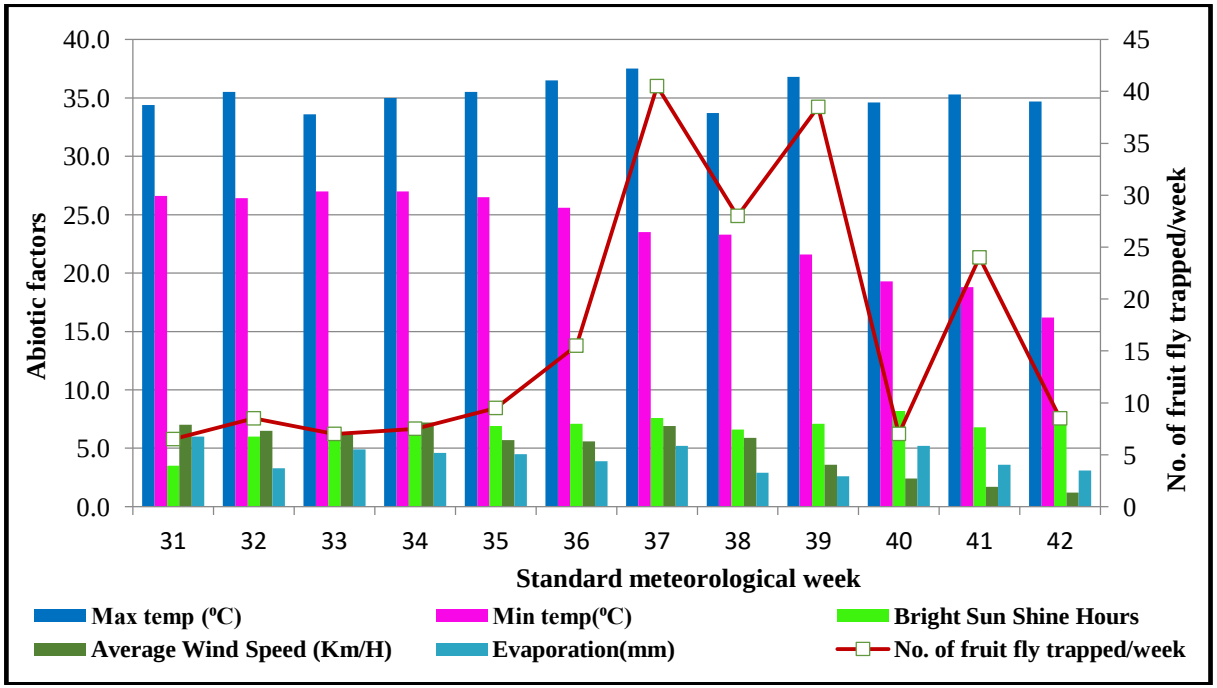

Fig. 2(A). Influence of various weather factors on the trap catches population of *Z. cucurbitae* during *Kharif*, 2018

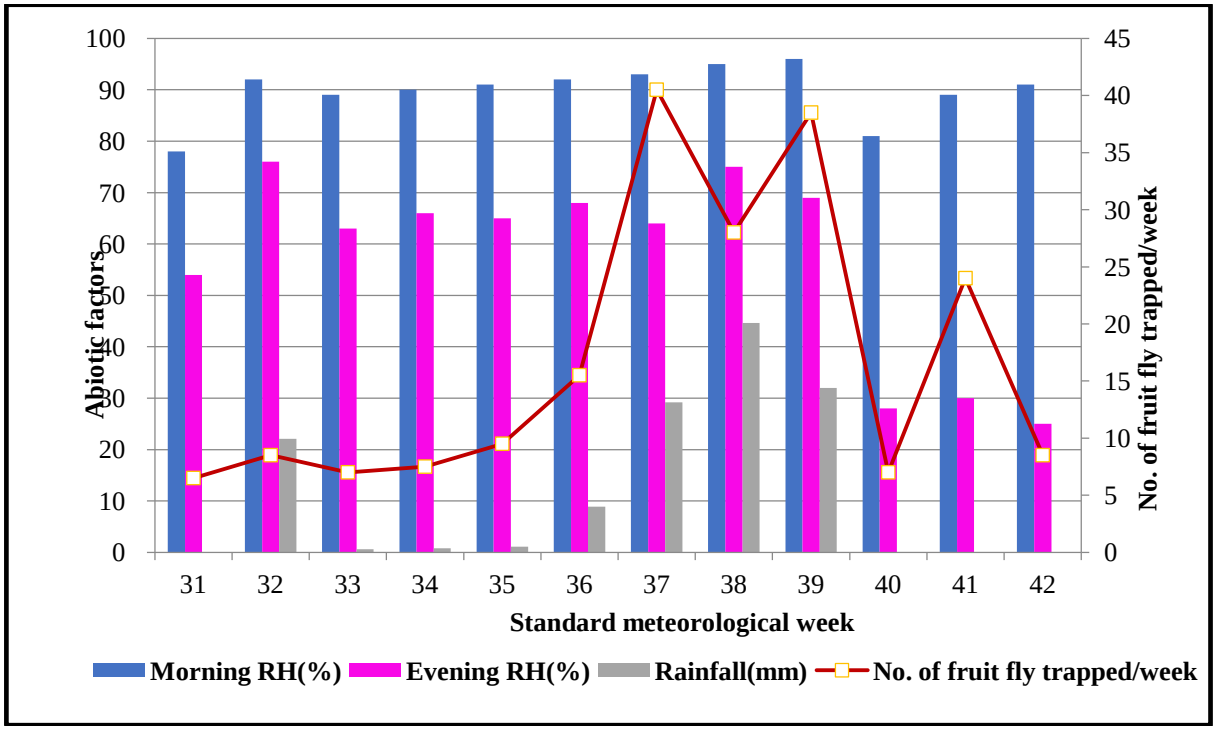

Fig. 2(B). Influence of rainfall and relative humidity on the trap catches population of *Z. cucurbitae* during *Kharif*, 2018

Table 3. Average weather data at Hisar during the experiment season 2018

Sl. No.	Standard Meteorological Week	Max. Tem. (^{o}C)	Min. Tem. (^{o}C)	Morn. RH (%)	Even. RH (%)	Rainfall (mm)	Evaporation (mm)	Avg. wind speed (km/h)	Bright Sun Shine Hours
1	31	34.4	26.6	78	54	0	6	7	4
2	32	35.5	26.4	92	76	22.1	3.3	6.5	6
3	33	33.6	27	89	63	0.6	4.9	6.2	6.3
4	34	35	27	90	66	0.8	4.6	7.2	6.5
5	35	35.5	26.5	91	65	1.1	4.5	5.7	6.9
6	36	36.5	25.6	92	68	8.9	3.9	5.6	7.1
7	37	37.5	23.5	93	64	29.2	5.2	6.9	7.6
8	38	33.7	23.3	95	75	44.6	2.9	5.9	6.6
9	39	36.8	21.6	96	69	32	2.6	3.6	7.1
10	40	34.6	19.3	81	28	0	2.9	2.4	8.2
11	41	35.3	18.8	89	30	0	3.1	1.7	6.8
12	42	34.7	16.2	91	25	0	2.7	1.2	7.6

leaves of bushes and trees during the cold season. High temperatures and long periods of sunshine have strong influence on their reproduction and abundance [15]. Present findings are supported by Das et al. [16] who reported that trap catches of *Z. cucurbitae* showed a highly significant positive correlation with maximum temperature and morning RH in pumpkin. Hossain et al. [17] recorded higher number of *Z. cucurbitae* during early rainy seasons of 2017 and 2018, which declined during the tail end of rainy season. Sunil et al. [18] observed peak infestation of *Z. cucurbitae* on bitter gourd during last week of September (52%) and recorded significant positive correlation of fruit fly incidence with rainfall (r = 0.71) and positive correlation with maximum temperature (r = 0.35) and maximum RH (r = 0.59). The present study also indicated that the influence of weather parameters was high and significant on trap catches of melon fruit fly (R^2=0.76). The present findings are in conformity with those of Vignesh and Viraktamath [12] who recorded multiple regression value of R^2=0.762 when regression analysis was carried out between incidence of *Z. cucurbitae* with respect to various weather parameters in bitter gourd. Similarly, in the investigations conducted by Nair and Pal [19], the weather factors together influenced the fruit fly population to the extent of 79 per cent. However, Khan et al. [20] recorded multiple linear regression value of R^2=0.40 in bitter gourd, which indicated the role of weather parameters *i.e.*, 40% with respect to melon fly trap catches. This indicated that variations or fluctuations in weather conditions at different regions tend to play varied role in maintaining the populations of *Z. cucurbitae.*

4. CONCLUSION

The incidence of *Z. cucurbitae* was monitored throughout the experimental period. Maximum trap catches (40.5 flies/trap) was observed during the 3rd week of September (37th SMW). The maximum temperature, morning RH and rainfall had significant positive correlation with trap catch population of melon fruit fly. Influence of all the weather parameters had high impact on trap catch population of the adult male melon fruit fly. Therefore, the information so generated, may be useful to predict and forecast the *Z. cucurbitae* population during the *Kharif* season. Region specific crop simulation dynamics models can be prepared so that farmers can adopt the control measures well in advance to save the fruit yield. It is usually desirable to collect data from many geographic regions in order to produce precise predictions in significantly fluctuating temperatures even for a certain place.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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Peer-review history:
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