International Journal of Environment and Climate Change

Volume 13, Issue 11, Page 3243-3249, 2023; Article no.IJECC.109312
ISSN: 2581-8627
(Past name: British Journal of Environment & Climate Change, Past ISSN: 2231–4784)

Seasonal Occurrence of Melon Fruit Flies (*Zeugodacus cucurbitae* Coq.) and Its Natural Enemies on Bitter Gourd

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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/v13i113496

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/109312

Original Research Article

Received: 06/09/2023
Accepted: 14/11/2023
Published: 16/11/2023

ABSTRACT

Aim: To study the seasonal occurrence of cucurbit melon fly and correlation study with weather parameters to know the impact of abiotic environmental factors on the activity of melon fruit fly concerning infesting the fruits of bitter gourd in crop ecosystem.
Place and Duration of Study: College of Agriculture, VNMKV Parbhani, Maharashtra. Studies during two seasons *Rainy* and *Summer* 2021 and 2022 respectively.
Methodology: The experimental plot was kept unsprayed throughout the crop season. The observation was recorded as soon as the incidence was noticed from five randomly selected plants at weekly intervals. The observations of fruit flies were recorded from the day of fruit formation to

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the last picking of the fruit. The damaged and healthy fruits were recorded at eachpicking to knowing the percentage fruit infestation by fruit flies.
Results: Fruit fly was the major pest of bitter gourd in fruit damage. The fruit damage record range was 15.65 to 59.33 per cent in the *rainy* season whereas, 28.99 to 61.14 per cent in the *summer* season. The per cent fruit infestation shows a significant and positive correlation with no. of maggots per fruit (r = 0.857 and 0.905) during both seasons respectively. Weather parameters like morning relative humidity (MRH) and rainfall the during rainy season show significant and positive correlation (r = 0.87 and r = 0.71 respectively) whereas, during the summer season significant and positive correlation (r = 0.77) with MRH and significant and negatively correlated with (r = - 0.66) minimum temperature. The record of larval pupal parasitoid *Psyttalia fletcheri* (Silvestri) and it was discovered that 16% of the population was parasitized during the experimental period
Conclusion: The infestation may vary from season to season, region to region and concerning variety also. Here the infestation range was higher during the summer season, which may be because of the coincidence with the fruit season of mango in that area.

Keywords: Melon fruit fly; bitter gourd; weather parameters; rainy; summer; correlation.

1. INTRODUCTION

Melon fly is a serious pest of vegetable crops, especially cucurbits such as melon, pumpkin, squash, zucchini and cucumber. It damages over 81 plant species, but plants belonging to the family Cucurbitaceae are preferred most [1]. As one of the most serious, even though enough research has been done so far in India, there is still very little information accessible for melon fly. Moreover, due to regional variations in meteorological circumstances, the seasonal incidence of any pest may vary from place to place.

Fruit flies use a wide spectrum of hosts, from severe monophagy to extreme polyphagy. Some tephritid species, particularly those of the subfamilies Dacinae and Trypetinae, have frugivorous larvae that feed on the fruit pulp of both cultivated and wild plants, giving rise to their common name of "fruit flies." Larvae of the remaining species feed on stems, shoots and flowers [2]. It infests more than 125 species of plants, including cucurbits, tomatoes, and many other vegetables, which have been recorded as hosts of the melon fly. Preferred hosts include: cantaloupe, cowpea, cucumber, gourd, pumpkin, squash, string bean, tomato and watermelon. Occasional hosts include eggplant, fig, mango, orange, papaya and peach. Wild hosts include balsam apple; Chinese cucumber, *Momordica spp*.; colocynth; two genera of cucurbits-*Sicyos sp*.; *Cucumis trigonus*; *Diplocyclos palmatus*; and passion-flower, *Passiflora spp*. However, White and Elson-Harris [3] claim that a lot of these reports might have been based on haphazard observations of adults trapped in traps placed on non-host trees or resting on plants.

As this pest is polyphagous it may cause significant economic losses, which can range from 30% to 100% depending on the crop and season [4]. Nowadays *Z. cucurbitae* has become a threat to intensive agriculture. Therefore, the purpose of the current proposal was to consider the seasonal occurrence of *Z. cucurbitae* and to investigate the impact of meteorological parameters on the population dynamics of the bitter gourd crop pests to forecast the most effective management strategies concerning both space and time for this pest.

2. MATERIALS AND METHODS

The experiment was conducted during the *Rainy* 2020-21 and *Summer* 2021-22 at the Experimental Farm of the Department of Agricultural Entomology, Vasantrao Naik Marathwada Krishi Vidyapeeth, Parbhani Maharashtra. To study the population dynamics of fruit flies the experimental plot was kept unsprayed throughout the crop season. The observation was recorded as soon as the incidence was noticed from five randomly selected plants at weekly intervals.

The observations of fruit flies were recorded from the day of fruit formation to the last picking of the fruit. The damaged and healthy fruits were recorded at each picking for record fruit infestation by fruit flies by following the formula. The mean per cent fruit infestation was taken and the standard deviation has been worked out.

$$\text{Percent Fruit infestation} = \left(\frac{\text{Number of infested fruits}}{\text{Total number of Fruits}}\right) \times 100$$

The fruit infestation was subjected to correlation and multiple regression with weather

parameters like maximum temperature, minimum temperature, morning relative humidity, evening relative humidity, rainfall, wind velocity, number of rainy days, and sunshine hours. The weather data was collected from the observatory of the Department of Agricultural Meteorology, Vasantrao Naik Marathwada Krishi Vidyapeeth, Parbhani.

3. RESULTS AND DISCUSSION

3.1 Fruit Fly Infestation during *Rainy* 2021

The per cent fruit infestations during *Rainy* shows that (Table.1) the per cent fruit infestation varies from 15.65 to 59.33 per cent with a mean of 41.23 per cent of fruit infestation a on number basis whereas, on a weight basis the per cent fruit infestation during this season vary 12.41 to 65.00 per cent with mean 12.41 to 65.00 per cent fruit infestation. The number of maggots per fruit varied from 4.49 to 21.00 maggots per fruit with a mean 11.96 number of maggots per fruit.

3.1.1 The correlation study between fruit infestation and maggot count with weather parameters

The correlation studies with weather parameters (Table 2) shows that a significant and positive correlation existed between per cent fruit infestation (on a number basis) and morning relative humidity. While, non-significant and positive correlation with maximum temperature, minimum temperature, evening relative humidity, rainfall and Rainy days r = 0.21, r = 0.61, r = 0.51, r = 0.62 and r = 0.59 respectively, non-significant and negative correlated with evaporation, bright sunshine hours and wind speed r = -0.49, r = -0.09 and r = -0.59, respectively.

The correlation between weather parameters and per cent fruit infestation on a weight basis shows a significant and positive correlation with morning relative humidity and rainfall r = 0.84 and r = 0.71 respectively. The non-significant and positive correlation has existed with maximum temperature (r = 0.21), minimum temperature (r = 0.55), evening relative humidity (r = 0.46) and Rainy days (r = 0.63), non-significant negative correlation with evaporation (r = -0.48), bright sunshine hours (r = -0.02) and wind speed (r = -0.644), respectively (Table 2).

The correlation with number of maggots per fruit with weather parameter shows (Table 2) that significant and positive correlation with minimum temperature (r = 0.73), morning relative humidity (r = 0.92), evening relative humidity (r = 0.76), rainfall (r = 0.89) and Rainy days (r = 0.89) whereas, significant and negative correlation with evaporation (r = -0.78). The maggot population was non-significant and negatively correlated with maximum temperature (r = -0.086) bright sunshine hours (r = -0.44) and wind speed (r = -0.302).

3.1.2 The association between per cent fruit infestation and maggots count per fruit during season *Rainy* 2021

The association between several maggots per fruit and per cent fruit infestation on bitter gourd during *Rainy* season 2021 in Table.4. It shows that percent fruit infestation both on a number basis and weight basis showed a significant and positive correlation with many maggots per fruit r = 0.838 and r = 0.857 respectively.

3.2 Fruit Fly Infestation during *Summer* 2022

The per cent fruit infestation of bitter gourd during the *Summer* season recorded data presented in (Table.1) it shows that the per cent fruit infestation varies from 28.99 to 47.57 per cent with mean per cent fruit infestation 47.57 per cent on number basis and weight basis varied from 61.93 to 25.84 per cent with mean per cent fruit infestation of 48.66 per cent. While number of maggots per fruit varies from 27.40 to 6.53 maggots per fruit with the mean number of maggots being 18.59 per fruit during the *Summer* season.

3.2.1 Correlation study with weather parameters

The correlation association between fruit infestation and their maggots with weather parameters during *Summer* season represented in Table 3 and it shows that percent fruit infestation on number basis was non-significant and positively correlated with morning relative humidity (r = 0.52), evening relative humidity (r = 0.25), rainfall (r = 0.12), *Rainy* days (r = 0.13) bright sunshine hours (r = 0.17), wind speed (r = 0.09) whereas, non-significant and negatively correlated with maximum temperature (r = -0.44), minimum temperature (r = -0.37) and with evaporation (r = -0.45).

The per cent fruit infestation recorded on a weight basis showed a significant and positive

correlation with morning relative humidity (r = 0.77) whereas, significant and negative correlated with minimum temperature (r = -0.66). Non-significant and positively correlated with evening relative humidity (r = 0.58), rainfall (r = 0.34), *Rainy* days (r = 0.34) evaporation (r = 0.62), wind speed (r = 0.11) while non- significant and negatively correlated with maximum temperature (r = -0.65) shown in Table 3.

The correlation study (Fig. 1) of several maggots per fruit during the *Summer* season with weather parameters shows that significant and positive correlation with the morning relative humidity (r = 0.88) and evening relative humidity (r = 0.83) whereas, significant but negatively correlated with maximum temperature and minimum temperature r = -0.73 and r = -0.77 respectively. Non-significant and positively correlated with rainfall (r = 0.34), Rainy days (r = 0.34), evaporation (r = 0.62) and wind velocity (r = 0.19) whereas, non-significant and negative correlation with bright sunshine hours(r = -0.14) Table 3.

3.2.2 The association between per cent fruit infestation and maggots count per fruit

The correlation association between several maggots per fruit and per cent fruit infestation during the *Summer* season in (Table 4) shows that the percent fruit infestation both on a number basis and weight basis shows a significant and positive correlation with several maggots per fruit r = 0.682 and r = 0.905 respectively.

More or less similar results were recorded by the following authors at different topographic regions. Laskar et al. [5] noticed during warm Rainy months flies were more active as compared to dry and winter months in the foothills of the Himalayas. Similarly, Nair et al. [6] concluded in their work that maximum temperature and minimum temperature have a significant influence on the Z.tau population of cucurbits in Tripura ecosystem. Beer et al. [7] concluded that the trapped *B. cucurbitae* had a positive correlation with minimum temperature, maximum temperature and relative humidity during the *Kharif* season**.** Similarly, Bhowmik et al. [8] recorded the highest fruit infestation i.e. 51.66 and 58.88 per cent on pointed gourd while on bitter gourd the highest infestation was 40.14 and 54.71 per cent during the 2012 and 2013 respective years.

Amin et al., [9] conducted study during summer and winter on sweet gourd. They recorded the highest fruit fly larval population/infested fruits during summer as compared to winter. Flies abundance was significantly and positively correlated with mean temperature and rainfall but significantly and negatively correlated with light intensity. Relative humidity was insignificantly but positively correlated with fly abundance. The combined effect of the weather parameters on fruit fly abundance was 75.4% and was significant predictor of fruit fly abundance. Subhradeep et al., [10] recorded *Zeugodacus cucurbitae* is the most abundant species in the snake gourd ecosystem and dominated the community of fruit flies throughout the study. The rate of infestation varied from 6.93 % to 44.09 %. Choudhary et al., [11] documented that the Adult population of melon fruit flies showed positive and significant correlation with maximum temperature and significant and negative correlation with morning relative humidity on cucumber.

3.2.3 Record of natural enemies

A total of 50 pupae were maintained under observation, and their color gradually changed from light cream to dark brownish. Eight of the pupae turned out to be parasitoid. In the last week of October, it was discovered that 16% of

Fig. 1. a) Fruit fly (Male and Female) b) Parasitoid

Table 1. Percent fruit infestation of bitter gourd during both seasons *Rainy* 2021 and *Summer* 2022

Rainy Season 2021				*Summer* Season 2022			
SMW	Per cent fruit infestation		No. of Maggots/fruit	SMW	Per cent fruit infestation		No. of Maggots/Fruit
	Number basis	Weight basis			Number basis	Weight basis	
38	48.61*	46.15	16.67	21	28.99	25.84	6.53
39	54.41	54.66	21.00	22	36.81	26.45	8.33
40	56.12	65.00	21.74	23	61.14	53.68	14.73
41	59.33	52.16	13.04	24	38.66	40.77	17.67
42	42.53	45.99	10.26	25	55.12	55.93	20.47
43	37.67	41.24	8.12	26	49.00	54.68	19.40
44	33.16	34.33	5.30	27	51.04	61.86	25.67
45	23.55	22.34	7.00	28	53.53	56.76	27.40
46	15.65	12.41	4.49	29	53.86	61.93	27.07
Max.	59.33	65.00	21.74	Max.	61.14	61.93	27.40
Min.	15.65	12.41	4.49	Min.	28.99	25.84	6.53
Mean	41.23	41.59	11.96	Mean	47.57	48.66	18.59
STDV	14.24	15.44	6.17	STDV	9.84	13.36	7.23

Table 2. Correlation between percent fruit infestation by fruit flies and their maggots/fruit with weather parameters during the *Rainy* season 2021

Percent fruit infestation	Temperature(*C)		Relative Humidity (%)		R.F (mm)	*Rainy* days	Evaporation (%)	BSS (Hours)	WS (Km/hr)
	Max.	Min.	MRH	ERH					
Number Basis	0.21	0.61	0.87**	0.51	0.62	0.59	-0.49	-0.09	-0.59
Weight basis	0.21	0.55	0.84**	0.46	0.71*	0.63	-0.48	-0.02	-0.644
No. of maggots/fruit	-0.086	0.73*	0.92**	0.76*	0.89**	0.89**	-0.78*	-0.44	-0.302

** Significance at 5 %, ** Significance at 1 %*

Table 3. Correlation between percent fruit infestation by fruit flies and their maggots/fruit with weather parameters during the *Summer* season 2022

Percent fruit infestation	Temperature(*C)		Relative Humidity (%)		Rain fall (mm)	*Rainy* days	Evaporation (%)	BSS (hrs/day)	Wind Speed (Km/hr)
	Max.	Min.	Morning	Evening					
No. Basis	-0.44	-0.37	0.52	0.25	0.12	0.13	-0.45	0.17	0.09
Weight basis	-0.65	-0.66*	0.77*	0.58	0.34	0.34	0.62	-0.05	0.11
No. of maggots/fruit	-0.73*	-0.77*	0.88**	0.83**	0.34	0.34	0.62	-0.14	0.19

** Significance at 5 %, ** Significance at 1 %*

Table 4. Association between per cent fruit infestation and maggots of melon fruit fly in bitter gourd crop during both *Rainy* 2021 and *Summer* season 2022

Rainy Season 2021				*Summer* Season 2022			
SMW	% Fruit Infestation		Maggots/ Fruits	SMW	% Fruit Infestation		Maggots/ Fruits
	No. basis	Wt. basis			No. basis	Wt. basis	
38	48.61	46.15	16.67	21	28.99	25.84	6.53
39	54.41	54.66	21.00	22	36.81	26.45	8.33
40	56.12	65.00	21.74	23	61.14	53.68	14.73
41	59.33	52.16	13.04	24	38.66	40.77	17.67
42	42.53	45.99	10.26	25	55.12	55.93	20.47
43	37.67	41.24	8.12	26	49.00	54.68	19.40
44	33.16	34.33	5.30	27	51.04	61.86	25.67
45	23.55	22.34	7.00	28	53.53	56.76	27.40
46	15.65	12.41	4.49	29	53.86	61.93	27.07
Maggots	0.838*	0.857*		Maggots	0.682*	0.905**	

the population was parasitized. This process was conducted twice to ensure the associated parasitoid. The emerged parasitoids was confirmed as *Psyttalia fletcheri* (Silvestri) Fig. 1 b It was a larval pupal parasitoid, it lay egg on the larvae of melon fly and emerged as an adult from pupae.

4. CONCLUSION

Fruit fly was the major pest of bitter gourd in fruit damage. The fruit damage record range was 15.65 to 59.33 per cent in the *rainy* season whereas, 28.99 to 61.14 per cent in *summer* season. Per cent fruit infestation was positively correlated with relative humidity and rainfall of weather factors.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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Available:https://doi.org/10.9734/ijecc/2023/v13i113223

Peer-review history:
The peer review history for this paper can be accessed here:
https://www.sdiarticle5.com/review-history/109312