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Seasonal Incidence of Fruit Fly (*Zeugodacus tau*) in Cucurbit Ecosystem in Tripura

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A B S T R A C T

Fruit fly (*Zeugodacus tau*) is one of the most destructive pests which cause extensive damage to cucurbitaceous crops in Tripura as well as many other states of India. The present study of two years duration was carried out to investigate the seasonal incidence of adult males of *Z. tau* in relation to abiotic factors. The study was carried out in cucurbit ecosystem in Tripura from July, 2015 to June, 2017. Para- pheromone lure (cue-lure) baited traps were used for catching male fruit flies. The population of male fruit flies showed almost similar fluctuation during the study period with two peaks in end of March to April and September-October. The numbers of fruit flies captured in cue lure baited traps correlated positively with temperature, relative humidity and rainfall. Maximum temperature and minimum temperature have significant influence on *Z. tau* population.

Introduction

Zeugodacus tau (Walker) (Diptera: Tephritidae), a quarantine pest of international concern, has become widespread and economically important in South and Southeast Asia (Li et al, 2020). This insect species attacks more than 50 economically important crop species, especially cucurbitaceous plants and other fleshy fruits (Allwood *et al.,* 1999; Kapoor, 2005/ 6 and Singh *et al.,* 2010). According to Drew and Romig (2013) this fruit fly species has been reported to infest fruits of nine plant families, primarily species of Cucurbitaceae.

In Tripura it coexists with *Z. cucurbitae* in Cucurbit ecosystem and causes enormous losses to all kind of commonly grown cucurbitaceous crops (Nair et al, 2017). Like *B cucurbitae*, males are attracted to the para pheromone cue-lure [4 (P-acetoxyphenyl-2-butanone)]. Monitoring of pest population is necessary for formulating effective management strategies against any pest. Though enough works on seasonal incidence of *Z. cucurbitae* have been done so far throughout India but available information regarding this aspect for *Z. tau* is comparatively very less. Moreover, seasonal incidence of any pest may vary from place to

place due to variation in climatic conditions. Occurrence of *Z. tau* at high population densities is associated with high levels of damage and could lead to high economic losses (Boopathi, 2017), so the present work was envisaged to find out the seasonal incidence of *B. tau* in Cucurbit ecosystem in Tripura and also to know the effect of weather parameters on population dynamics of this pest species so that appropriate time of action can be determined for effective management of this pest.

Materials and Methods

The present study was carried out in 'Experimental Farm' of College of Agriculture, Lembucherra, Tripura from July, 2015 to June, 2017. Different cucurbitaceous crops such as cucumber (*Cucumis sativus*), bitter gourd (*Momordica charantia*), spiny gourd (*Momordica dioica*), sponge gourd (*Luffa cylindrica*), ridge gourd (*Luffa acutangula*), bottle gourd (*Lagenaria siceraria*), snake gourd (*Trichosanthes cucumerina*), pointed gourd (*Trichosanthes dioica*), ash gourd (*Benincasa hispida*), pumpkin (*Cucurbita moschata*) and water melon (*Citrullus lanatus*) as per their growing seasons were grown in the 'Experimental Farm' following recommended package of practices except for the plant protection measures to create a cucurbit ecosystem throughout the study period for attracting fruit flies.

Traps baited with para- pheromone lures (cue-lure) [4 (P-acetoxyphenyl-2-butanone)] were installed at ten sites for catching male fruit flies. The traps used for monitoring fruit flies were prepared with one litre plastic mineral water bottles by following the methods modified after Raghuvanshi *et al.*, (2012). The traps were hung about 1.5 meters above the ground and a distance of at least 300 m^2 between the traps was maintained. Trapped flies from each trap were brought to the laboratory separately at every seven days intervals for taking observations and mean trap catches were calculated for every week throughout the experiment. Data was recorded at weekly intervals starting from 27th standard week of 2015 to 26th standard week of 2017.

The influence of weather factors on trap catches of fruit flies were studied by using the meteorological data collected from ICAR, Lembucherra, Tripura. Correlation and Regression study was made between weekly trap catches of fruit flies and mean weather parameters namely maximum temperature, minimum temperature, relative humidity and rainfall for every standard week.

Results and Discussion

Seasonal incidence

Almost similar pattern of population fluctuation of adult fruit flies were recorded throughout the present study period (Table 1 and Fig. 1). The adult flies remained abundant throughout the study periods in the cucurbit ecosystem except during the winter months. Though the population of adult males was low (≤ 20 flies/trap/week) during the cooler months i.e. during November to January but it had never become zero. 5-18 adult male flies per trap were caught from 45th SW of 2015 to 5th SW of 2016 and 9- 20 adult male flies per trap were caught from 45th SW of 2016 to 5th SW of 2017. Lowest trap catches were recorded on 52nd SW of 2015 (5 flies/trap/week) and 51st SW of 2016 (9 flies/trap/week). Moderate to high trap caches (more than 20 flies/trap/week) were recorded through out the remaining period of the present study i.e. from February to October months. Two peaks in the fly population were recorded during the present study. One population peak was during last week of

March to April and the other one was during September - October. 49-64 flies were captured per trap per week from 35th to 42nd SW of 2015 (maximum on 40th SW) and 44-68 flies were captured per trap from 36th to 43rd SW of 2016 (maximum on 42nd SW). 63-83 flies/trap/week were trapped from 13th to 17th SW of 2016 with the highest trap catches on 14th SW and 56-72 flies/trap/week were trapped from 14th to 17th SW of 2017 with the highest trap catches on 14th SW. The seasonal incidence of *Z. tau* has been depicted graphically in Fig. 1.

Table.1 Seasonal incidences of fruit fly (*Zeugodacus tau*)

standard week	Per Week catches of Z tau	standard week	Per Week catches of Z tau	standard week	Per Week catches of Z tau	standard week	Per Week catches of Z tau
Year 2015		Year 2016				Year 2017	
27	40	1	11	27	38	1	12
28	44	2	8	28	34	2	10
29	36	3	12	29	29	3	12
30	35	4	10	30	32	4	10
31	32	5	18	31	29	5	20
32	33	6	22	32	35	6	27
33	41	7	30	33	43	7	26
34	47	8	39	34	44	8	20
35	63	9	37	35	48	9	27
36	58	10	46	36	62	10	49
37	53	11	42	37	62	11	56
38	49	12	48	38	61	12	48
39	57	13	73	39	44	13	40
40	64	14	83	40	64	14	72
41	55	15	72	41	65	15	63
42	52	16	75	42	68	16	69
43	44	17	63	43	50	17	56
44	22	18	35	44	25	18	42
45	16	19	30	45	17	19	35
46	15	20	34	46	15	20	45
47	17	21	42	47	17	21	34
48	12	22	36	48	13	22	32
49	13	23	43	49	10	23	34
50	9	24	30	50	14	24	38
51	12	25	30	51	9	25	33
52	5	26	36	52	11	26	30

Table.2 Correlation co-efficient between weather parameters and incidence of *Zeugodacus tau*

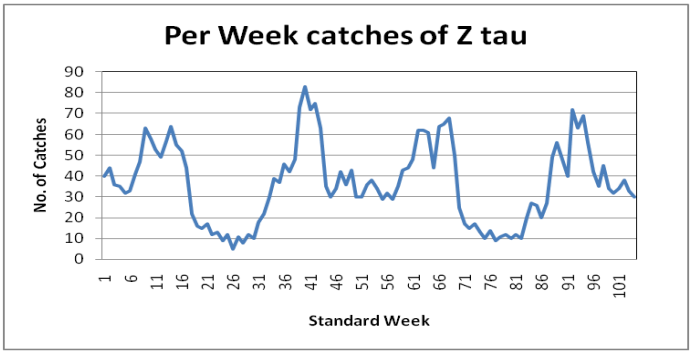
Weather Parameters	Correlation value with Mean weekly trap catches
Maximum Temperature	0.685**
Minimum Temperature	0.637**
Rainfall	0.233*
Relative Humidity	0.195*

(* = significant at 5%, **= significant at both 1% and 5%, NS = Non-significant)

Table.3 Multiple regression between weather parameters and incidence of *Z. tau*

Weather Parameters	Regression model	Standard Error	P-value
Maximum Temperature (x_1)	Y=-31.63+2.75 x_1+1.39 x_2-0.001 x_3-0.619 x_4	1.012	0.008
Minimum Temperature (x_2)		0.654	0.036
Rainfall (x_3)		0.024	0.966
Relative Humidity (x_4)	R^2=0.498	0.291	0.036

Fig.1 Seasonal incidence of fruit fly (*Per Week catches of Z tau)*



Effect of abiotic factors on fruit fly adult abundance

Studies to find out the relationship between trap catches of *Z. tau* and weather parameters such as maximum and minimum temperature, rainfall and relative humidity during the present work has revealed that there is significant positive correlation with maximum (r= 0.685) and minimum (r= 0.637) temperature at both 1% and 5% level of significance and also with rainfall (r= 0. 233) and relative humidity (r= 0. 195) at 5% level of significance (Table 2).

The multiple linear regression analysis between *Z. tau* and the weather parameters revealed that maximum temperature and minimum temperature have significant influence and rainfall and relative humidity have non-significant influence on seasonal incidence (dependent variable) of *Z. tau* population. All the weather factors together influenced the fruit fly trap catches to the extent of 49.8 percent. The multiple linear regression model fitted was Y=-31.63+2.75 x_1+1.39 x_2-0.001 x_3-0.619 x_4. Where, x_1 = Maximum temperature, x_2 = Minimum temperature, x_3 = Rainfall, x_4 = relative humidity (Table 3).

The present finding is in conformity with Hasyim *et al.,* (2008) who observed that fruit fly population correlated positively with all three abiotic factors (rainfall per day, number of rainy days, and average day temperature) studied. However, in contrary to the present findings Hossain *et al.,* (2019) reported that incidence of *Z. tau* was inversely related to rainfall and temperature, with abundance peaks during the dry and cooler winter months. Information regarding seasonal incidence of *Z. tau* from India is meagre. Gupta and Verma (1992) studied the population fluctuations of *B. cucurbitae* and *B. tau* infesting cucurbitaceous crops and observed that fruit fly incidence was closely associated with weather factors and pest status changes rapidly owing to dynamic nature of the environment.

In the present study also close association of *Z. tau* incidence with weather factors has been recorded. Sawai *et al.,* (2019) through their one year's study reported that *Z. tau* had significant positive correlation with maximum relative humidity which is in conformity with the present study. However, many workers have studied the seasonal incidence of another important and more commonly known fruit fly pest of Cucurbits i.e. melon fly (*Z cucurbitae*) (Raghuvanshi *et al.,* 2012; Sunil *et al.,* 2016; Abhilash *et al.,* 2017; Sawai *et al.,* 2019). Sawai *et al.,* (2019) noticed population of adult flies of *Z. cucurbitae* throughout the period in cue lure traps, however, the peak activity was recorded from third week of September to the last week of October with a distinct peak in the last week of September. Sawai *et al.,* (2019) studied the correlation of *Z. cucurbitae* population with weather parameters and found significantly positive correlation of the fly catch in the cue lure baited trap with average temperature and negative correlation with bright sunshine hours. Sunil *et al.,* (2016) recorded peak of Fruit fly infestation on bitter gourd during last week of September (52 %) and in last week of February (33 %). Incidence of fruit fly in kharif recorded significant positive correlation with rainfall (r = 0.71) and positively correlated with maximum temperature (r = 0.35) and maximum RH (r = 0.59) while during rabi, there was significant positive correlation with maximum temperature (r = 0.76). Abhilash *et al.,* (2017) found significant positive correlation of melon fruit fly incidence with maximum and minimum temperature but significant negative correlation with afternoon relative humidity and rainfall. According to Wazir *et al.,* (2019) the population of *Bactrocera cucurbitae* was highly significant and positively correlated with mean relative morning humidity, relative evening humidity and rainfall but highly negatively correlated with maximum temperature.

In conclusion the evident from the present findings that the population of *Z. tau* is positively correlated with the environmental factors of which maximum temperature and minimum temperature have significant influence on *Z. tau.* In the climatic condition of Tripura this species of fruit fly is prevalent all through out the year with two peaks, one during last week of March- April and another one during September-October. So, this information generated from the present study may be utilized in planning and formulating management strategies for effective suppression of this important pest of cucurbitaceous crops in Tripura.

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