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Effect of Weather Parameters on Population Fluctuation of Sapota Fruit Flies (*Bactrocera* spp.)

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Abstract

Studies on population dynamics of fruit flies (*Bactrocera* spp.), infesting sapota were conducted at N.M. College of Agriculture, Navsari (Gujarat) by using methyl eugenol trap and per cent infested fruits. The study revealed that, fruit fly population prevailed throughout the year. The maximum population of *Bactrocera* spp. was observed during the last week of March to last week of August month which coinciding with fruiting period of sapota. The fly population decreased during September to February. The trap catch study carried out for two years was correlated with abiotic factors and it was found that, it showed positive correlation with temperature (maximum, minimum and average), relative humidity (maximum, minimum and average), rainfall and wind velocity.

Key word : *Sapota, population dynamics, correlation, multiple regression South Gujarat.*

Introduction

The demand for fruits has increased in many developed and developing countries especially in the form of canned or fresh fruits. The per capita consumption of fruits has increased from 40 to 85 gm., leading to the demand for increasing the yield as well as quality of fruits. Sapota (*Achras sapota* Linn.) belong to family Sapotaceae and commonly known as '*Chiku*'. India is considered to be largest producer of sapota in the world. However, the insect pest problems affect both quality and quantity of fruits. Sapota trees are prone to the attack of more than 25 species of insect pest (1).

Fruit fly, *Bactrocera* spp. is a serious pest of mango as well as sapotao and causing qualitative losses in south Gujarat (2) It has been reported that in India fruit flies causes loss up to Rs.29,460 million per annum in mango, guava, sapota and citrus (3); whereas, from south Gujarat its damage has been reported as 16 to 40 and 4 to 52 per cent in mango and sapota, respectively (4). The incidence of fruit fly not only reduces the yield, quality but also cause economic losses. Besides, it also spoils the prestige of fruit growers in national and international market.

The population build of any insect is very intimately associated with weather parameters prevailing during preceding and corresponding periods. The pest status does not remain static throughout the year but changes accordingly based on abiotic factors like temperature, humidity, rainfall and light etc. Information on seasonal population fluctuation and peak activity of fruit fly in relation to weather factors are essential, so as to evolve schedule for its effective and timely control. Looking to the apparent importance of the pest, not much information is available pertaining to population dynamics of fruit flies on sapota in south Gujarat. Keeping this in view, the present investigation was carried out.

Materials and Methods

A study on population dynamics of fruit fly on sapota was carried out during at N.M. College of Agriculture, Navsari during 2004-2006, which was based on data of flies trapped in methyl eugenol trap (DFID Trap) as well as per cent infested fruits. For the purpose fruits were collected randomly, at weekly intervals from the selected orchards during the peak fruiting period. The randomly collected fruits were dissected to check the incidence of fruit fly and per cent infestation was worked out by counting number of infested fruits, out of total number of observed fruits.

Similarly, three DFID (Department for International Development) water bottle traps based on plywood block technology (Plywood block of 5x5x1.2 cm was soaked in liquid mixture of ethanol: methyl eugenol : dichlorovos (6:4:1) v/v/v for 48 hours) were installed in each orchard. The data on trapped flies were collected at weekly interval. The data on trapped flies were correlated with weather parameters viz., temperature (minimum, maximum and average ^{o}C), relative humidity [(minimum, maximum and average) per cent %], rainfall (mm) rainy days, wind velocity (Km/hrs) and sunshine hours.

Results and Discussion

Population dynamics based on fly catches : The data collected during the experimentation are presented in

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Table-1 : Fruit fly population in different months in sapota orchard.

Month/Week	Standard week	Flies trapped (Mean of 2yr./ 3 traps)	Month/Week	Standard week	Flies trapped (Mean of 2yr./ 3 traps)
November I	45	34	May I	19	221
II	46	60	II	20	241
III	47	88	III	21	262
IV	48	46	IV	22	222
December I	49	34	June I	23	371
II	50	39	II	24	307
III	51	77	III	25	425
IV	52	32	IV	26	466
January I	1	79	July I	27	417
II	2	75	II	28	329
III	3	68	III	29	284
IV	4	60	IV	30	310
V	5	36	V	31	332
February I	6	68	August I	32	250
II	7	61	II	33	137
III	8	42	III	34	125
IV	9	71	IV	35	87
March	10	56	September I	36	101
II	11	48	II	37	94
III	12	74	III	38	77
IV	13	115	IV	39	83
April I	14	196	October I	40	58
II	15	378	II	41	34
III	16	303	III	42	68
IV	17	302	IV	43	58
V	18	308	V	44	48

Table-1. The data revealed that, the fly catches were observed throughout the year with its peak activity from IV week of March to IV week of August.

The highest 466 flies were trapped in IV week of June, exhibited the peak of fly population in the area. The fly population found decreasing during the September to February. The peak activity of fruit fly population in sapota orchard also found coinciding with fruiting and harvesting period of fruits. Observation on occurrence of fruit flies throughout the year and peak activity coinciding with fruiting and harvesting period in sapota were also made (5,6,7) from Gujarat.

During present studies, the activity of fruit fly found higher during March to August in south Gujarat. Earlier, this period recorded during May to September (5), April to August (6) and April to September (7) in south Gujarat. Moreover, (8) from north Gujarat it was reported that, the fruit fly population was the lowest during January and March in sapotao orchard.

Correlation, multiple regression studies : The data on fly catches were correlated with different weather parameters and has been presented in Table-2. Data indicated a significant positive correlation with maximum temperature (x_1), minimum temperature (x_2), average temperature (x_3), maximum relative humidity(x_4), minimum relative humidity (x_5), average relative humidity (x_6), rainfall (x_8), and wind velocity (x_9), however, it showed significant negative correlation with sunshine hours (x_{10}).

The coefficient values of multiple regression analysis are presented in table-2. Moreover, significant parameter utilized for prediction of fruit fly population gives 61.15 per cent co-efficient of determination due to temperature, relative humidity, rainy days, rainfall, wind velocity and sunshine hours. Therefore, it can be stated that the variation (R^2 = 0.611) in fruit fly population was due to above factors. Suitable regression equation for prediction of fruit fly is developed as :

Table-2 : Effect of weather parameters on fruit fly population in sapota.

Meteorological factors		Correlation coefficient	Regression coefficient
Max. temp.	(X_1)	-0.049	-
Min. temp.	(X_2)	0.651*	7.524
Av. temp.	(X_3)	0.533*	-0.428
Max. R.H.	(X_4)	0.473*	70.409
Min. R.H.	(X_5)	0.581*	68.399
Av. R.H.	(X_6)	0.588*	-135.340
Rainy days	(X_7)	0.269*	-23.965
Rainfall	(X_8)	0.328*	0.160
Wind velocity	(X_9)	0.688*	21.375
Sunshine hours	(X_{10})	-0.276*	5.591
R^2		-	0.611
Variation explained (%)		-	61.15
R value		-	0.782
Constant (A value)		-	-426.054

N = 104 *Significant at 5% level (r value ± 0.193)

$$\hat{Y} = -426.054 + 7.524\,(x_2) - 0.428\,(x_3) + 70.409\,(x_4) + 68.399\,(x_5) - 135.340\,(x_6) - 23.965\,(x_7) + 0.160\,(x_8) + 21.375\,(x_9) + 5.591\,(x_{10})$$

So looking to the relationship of abiotic factors on overall population, it may be concluded that fly population was directly influenced by temperature (minimum and average), relative humidity (maximum, minimum and average), rainfall, rain days and wind velocity, whereas it was negatively influenced by sunshine hours . This implies that the increase in temperature (minimum and average), relative humidity (maximum, minimum and average), rainfall, rainy days and wind velocity also increases the fruit fly population and vice-versa. Whereas, decrease in sunshine hours increases population and vice-versa.

This interpretation is sustained by the fact that fruit fly population was higher during March to August, which coinciding with fruiting and harvesting period of sapota fruit, when the weather parameter *viz*., temperature (minimum and average), relative humidity (maximum, minimum and average), rain days, rainfall, wind velocity and sunshine hours were in the range of 18.70 to 32.45°C, 29.43 to 97.00 per cent, 0 to 7 days, 0.0 to 1359 mm, 4.29 to 15.07 and 0.53 to 10.73, respectively. The positive impact of temperature (minimum and average), relative humidity (maximum, minimum and average), rainfall, rainy days and negative impact of sunshine hours on population build up of fruit fly has been reported (7) in south Gujarat and (8) in north Gujarat.

Population dynamics based on per cent infested fruits : The observations on per cent infested fruit were made at weekly interval during the investigation (Table-3). It can be seen from the mean data, that the infestation of fruit fly was observed from I week of February to IV week of September and it was ranged between 5.00 to 35.24 per cent.

Table-3 : Periodical infestation of fruit flies in sapota.

Per cent fruit infestation (Mean of 2 year)			
Month/Week	Infestation (%)	Month/Week	Infestation (%)
February I	5.00	June I	32.39
II	6.50	II	32.00
III	6.55	III	35.24
IV	6.95	IV	33.13
March I	11.21	July I	28.99
II	11.67	II	29.00
III	12.67	III	28.64
IV	13.54	IV	23.02
April I	15.07	V	26.79
II	16.00	August I	22.6
III	18.38	II	21.77
IV	19.51	III	18.75
V	21.64	IV	11.21
May I	23.91	September I	8.57
II	24.40	II	12.08
III	26.77	III	15.97
IV	30.5	IV	6.35

The maximum fruit infestation (16.00 to 35.24 per cent) was observed from II week of April to III week of August, which coinciding with harvesting period of sapota fruit. The highest per cent (35.24) fruit infestation was observed in III week of June.

The result revealed that the maximum fruit fly infestation was coinciding with harvesting period i.e., April to August in sapota. Similar observations were also made (9) in south Gujarat and (8) in north Gujarat.

Conclusions

Studies on population dynamics of fruit fly indicated that, the fruit fly population prevailed throughout the year in sapota orchard. However, its maximum activity was found during last week of March to last week of August months. The population dynamics of fruit fly, based on per infestation also indicated that, the maximum fruit fly infestation was found coincided with harvesting period of sapota fruit. Further, it was observed that, fruit fly population was directly influenced by temperature (maximum, minimum and average), relative humidity (maximum, minimum and average), rainfall and wind velocity.

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