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Effect of weather parameters on population fluctuation of mango fruit flies, *Bactrocera* spp.

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Abstract

Studies on population dynamics of fruit flies (*Bactrocera* spp.), infesting mango were conducted at N.M. College of Agriculture, Navsari by using methyl eugenol trap and per cent infested fruits. The maximum population of *Bactrocera* spp. was observed during the month of April to July which coinciding with fruiting period of mango. The fly population decreased during December 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.

Keywords: *Bactrocera* spp, mango, population dynamics, Gujarat

1. 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. However, the insect pest problems affect both quality and quantity of fruits. Mango trees are prone to the attack of more than 350 species of insect, 8 species of mite and 13 species of nematodes reported from all over the world [1].

Fruit fly, *Bactrocera* spp. is a serious pest of mango 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 spoil 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 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 mango was carried out 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 D.F.I.D (Department for International Development) water bottle traps based on plywood block technology (Plywood block of 5 x 5 x 1.2 cm was soaked in liquid mixture of ethanol: methyl eugenol: dichlorvos (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), and relative humidity [(minimum, maximum and average) per cent %],

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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 Table -1. The data revealed that the fly catches were observed

throughout the year with its peak activity from I week of April to V week of July. The maximum numbers of flies (461) were trapped in II week of June, which exhibited the peak of fly population in the area. The fly population decreased during December to February. The peak activity of fruit fly population in mango orchard coincided with fruiting and harvesting period of fruits.

Table 1: Fruit fly population in different months in mango orchard

Month/ Week	Standard Week	Flies trapped / 3 traps	Month/ Week	Standard Week	Mean Flies trapped / 3 traps
Nov I	45	56	May I	19	372
II	46	45	II	20	470
III	47	83	III	21	381
IV	48	58	IV	22	428
Dec I	49	46	June I	23	398
II	50	62	II	24	461
III	51	25	III	25	386
IV	52	61	IV	26	443
Jan I	1	15	July I	27	453
II	2	46	II	28	346
III	3	31	III	29	253
IV	4	28	IV	30	250
V	5	12	V	31	198
Feb I	6	77	Aug I	32	134
II	7	61	II	33	77
III	8	62	III	34	66
IV	9	92	IV	35	62
March I	10	156	Sept I	36	137
II	11	284	II	37	74
III	12	319	III	38	128
IV	13	345	IV	39	46
April I	14	370	Oct I	40	34
II	15	348	II	41	90
III	16	422	III	42	79
IV	17	441	IV	43	76
V	18	415	V	44	98

Observation on occurrence of flies throughout the year and peak activity coincided with fruiting and harvesting period of mango has been reported by [5] and [6] in south Gujarat.

During present studies, the activity of fruit fly was higher during April to July in south Gujarat. This period was recorded from March to June [7], April to July [5] in south Gujarat, April to May in West Bengal [8] and April in Jharkhand [9]. The fly population was lowest during the winter months [10]. So, the results obtained in the investigation are more or less the same as obtained in the above reports which conforms the present findings.

Correlation, multiple regression studies

The data on fly catches were correlated with different weather parameters and have 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).

Table 2: Effect of weather parameters on fruit fly population in mango

Meteorological factors	Correlation coefficient	Regression coefficient
Max. temp. (°C) (X ₁)	0.305*	806.494
Min. temp. (°C) (X ₂)	0.629*	803.609
Av. temp. (°C) (X ₃)	0.669*	-1577.118
Max. R.H. (%) (X ₄)	0.364*	-1106.092
Min. R.H. (%) (X ₅)	0.018*	-1117.509
Av. R.H. (%) (X ₆)	0.353*	2224.334
Rainy days (day) (X ₇)	0.064	--
Rainfall (mm) (X ₈)	0.259*	0.218
Wind velocity (km/hr) (X ₉)	0.552*	32.222
Sunshine hours (hr) (X ₁₀)	0.077	--
R ²	--	0.666
Variation explained (%)	--	66.66
R value	--	0.816
Constant (A value)	--	-1145.616

N=104 * significant at 5% level (r value \pm 0.193)

The coefficient values of multiple regression analysis are presented in Table 2. The significant parameters utilized for prediction of fruit fly population gives 66.66 per cent coefficient of determination due to temperature, relative humidity, rainfall and wind velocity. Therefore, it can be stated that the variation ($R^2 = 0.666$) in fruit fly population was due to above factors. Suitable regression equation for prediction of fruit fly has been developed as:

$$Y^{\wedge} = -1145.616 + 806.494(x_1) + 803.609(x_2) - 1577.118(x_3) - 1106.092(x_4) - 1117.509(x_5) + 2224.334(x_6) + 0.218(x_8) + 32.222(x_9).$$

Where, Y^{\wedge} = Predicted fruit fly population

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

This interpretation is sustained by the fact that fly population was higher during April to July, which coincides with the fruiting and harvesting period of mango fruit, when the weather parameters viz; temperature, relative humidity, rainfall and wind velocity were in the range of 20.90 to 37.70°C, 37.00 to 97.00 per cent, 0.0 to 1359 mm and 4.80 to 15.07 km/hr, respectively. The positive correlation between minimum temperature, evening relative humidity,

evaporation, wind velocity and negative correlation between maximum temperature and morning relative humidity against mango fruit fly population was reported in south Gujarat [5]. Similarly, from south Gujarat [6] reported significant positive correlation with temperature (maximum, minimum and average), relative humidity (maximum, minimum and average), evaporation and wind velocity. The positive impact of temperature (minimum and average), relative humidity (maximum, minimum and average) and rainfall on mango fruit fly population was observed in north Gujarat [11]. Further, positive correlation between wind speed and fruit fly population in mango orchard was observed in Karnataka [12]. So, looking to the earlier findings, all the workers have demonstrated almost similar relationship between fruit fly infestation and weather factors.

Population dynamics based on per cent infested fruits

Observations on per cent infested fruit were made at weekly interval (Table 3). It can be seen from the mean data, that the infestation of fruit fly was observed from I week of April to V week of July and it ranged between 10.77 to 34.66 per cent. Maximum fruit infestation (25.60 to 34.66 per cent) was observed from I week of May to I week of July, which coincided with harvesting period of mango fruit. The highest per cent (34.66 per cent) fruit infestation was observed in II week of June.

The result revealed that the maximum fruit fly infestation coincided with harvesting period i.e., May to July in mango. Similar observations were also made by [5] and [6] in south Gujarat and [13] and his co-workers in Uttar Pradesh.

Table 3: Periodical infestation of fruit flies in mango

Month/ Week	Mean Per cent fruit infestation	Month/ Week	Mean Per cent fruit infestation
APRIL I	11.44	JUNE I	34.23
II	17.90	II	34.66
III	17.43	III	27.50
IV	11.86	IV	29.17
V	24.38	JULY I	28.29
MAY I	25.60	II	14.82
II	29.22	III	12.15
III	31.88	IV	10.77
IV	32.29	V	13.83

Conclusion

Studies on population dynamics of fruit fly indicated that, the fruit fly population prevailed throughout the year in mango orchard. However, its maximum activity was found during April to July 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 mango 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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