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FLUCTUATION OF FRUIT FLY ORIENTED DAMAGE IN MANGO IN RELATION TO MAJOR ABIOTIC FACTORS

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ABSTRACT: A field experiment was carried out at Navsari Agricultural University, Navsari during 2009-11. Population of fruit fly was observed during 13 (26 March –1 April) - 30 (23-29 July) Standard Week (SW) in 2009-10, 2010-11 and pooled, respectively. Highest fruit fly infestation (36.67 %) was observed on 22nd SW coinciding with ripening cum harvesting period of mango which increased with increase in temperature, relative humidity, wind velocity and evaporation.

Keywords: *Fruit fly, abiotic factor, population dynamics, mango.*

Mango is one of the most important fruit crops grown in India. Besides mango hopper, it is severely damaged by fruit flies. Most common species attacking the mango crop is *Bactrocera dorsalis* (Verghese and Devi, 12). The incidence of fruit fly not only reduces the yield and quality but also cause considerable economic loss. In India, it has been reported to cause crop loss up to Rs. 29,460 million per annum in mango, guava, sapota and citrus (Mumford, 8; Mishra *et al.,* 7); whereas in south Gujarat, damages to the tune of 16 to 40 and 4 to 2 per cent have been reported in mango and sapota, respectively (Patel and Patel, 9). Kannan and Rao (4) reported peak incidence of fruit fly, *B. dorsalis* on mango during last week of May whereas, correlation between incidence of fruit fly population, temperature (maximum and minimum) was significant and positive while it was negative with rainfall and relative humidity. Ranjitha and Viraktamath (10) reported that relationship of fruit fly population was positive with minimum temperature and relative humidity.

MATERIALS AND METHODS

A field experiment was carried out at Navsari Agricultural University, Navsari during 2009-11. Twelve experimental trees were randomly selected and were kept free from insecticide application. For recording observations, number of damaged and total dropped fruits was counted on each experimental tree at fortnightly interval during April to July. Simultaneously, number of damaged fruits out of ten plucked fruits was also counted. Thus, based on average of both the damages, per cent fruit infestation was assessed. Important meteorological data *viz*., temperature (maximum and minimum), relative humidity (morning and evening), rainfall, rainfall days, sun shine and wind velocity were recorded at weekly interval during October 2009- June 2011. The weekly weather data recorded at agro-meteorological observatory of NAU, Navsari proceeding the week of observation were correlated with the incidence of mango fruit fly to study their relation with pest incidence.

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RESULTS AND DISCUSSION

Population dynamics of mango fruit fly

Fruit fly oriented damage was assessed on the basis of fruit infestation (%). It is evident from the results (Table 1) that infestation of fruit fly varied from 6.62-34.92, 4.24-38.42 and 5.43-36.67 per cent during 13th (26 March –1 April) to 30th (23-29 July) SW in 2009-10, 2010-11 and pooled results, respectively. The highest (34.92, 38.42 and 36.67 %) fruit infestation was observed on 22nd SW (28 May-3 June) during both the years and pooled results, respectively which coincided with ripening cum harvest period of the crop.

Looking to the above results, it is evident that higher fruit fly infestation (>30 %) coincided with

Table 1: Seasonal abundance of mango fruit fly during 2009-11.

Std. week	Std. period	Crop State	Fruit infestation (%)		
			2009-10	2010-11	Pooled
48	26 Nov- 2 Dec 2009	Bud/bud burst	0.00	0.00	0.00
49	3-9 Dec	Bud/bud burst	0.00	0.00	0.00
50	10-16 Dec	Bud/bud burst	0.00	0.00	0.00
51	17-23 Dec	Bud/bud burst	0.00	0.00	0.00
52	24-31 Dec	Bud/bud burst	0.00	0.00	0.00
1	1-7 Jan 2010	In Flowering	0.00	0.00	0.00
2	8-14 Jan	In Flowering	0.00	0.00	0.00
3	15-21 Jan	In Flowering	0.00	0.00	0.00
4	22-28 Jan	In Flowering	0.00	0.00	0.00
5	29 Jan- 4 Feb	Peak Flowering	0.00	0.00	0.00
6	5-11 Feb	Peak Flowering	0.00	0.00	0.00
7	12-18 Feb	Pea/Marble	0.00	0.00	0.00
8	19-25 Feb	Pea/Marble	0.00	0.00	0.00
9	26 Feb-4 March	Pea/Marble	0.00	0.00	0.00
10	5-11 March	Pea/Marble	0.00	0.00	0.00
11	12-18 March	Stone Size	0.00	0.00	0.00
12	19-25 March	Stone Size	0.00	0.00	0.00
13	26 March-1 Apr	Stone Size	10.58	12.72	11.65
14	2-8 Apr	Stone Size	16.22	18.00	17.11
15	9-15 Apr	Stone Size	14.72	15.34	15.03
16	16-22 Apr	Stone Size	11.24	19.24	15.24
17	23-29 Apr	Stone Size	24.12	16.68	20.40
18	30 Apr-6 May	Stone Size	25.28	16.00	20.64
19	7-13 May	Fruiting	28.56	28.32	28.44
20	14-20 May	Fruiting	32.38	30.16	31.27
21	21-27 May	In Ripening	32.98	33.34	33.16
22	28 May-3 June	Rip/Harvest	34.92	38.42	36.67
23	4-10 June	Harvest	34.22	36.38	35.30
24	11-17 June	Harvest	26.38	29.20	27.79
25	18-24 June	Vegetative	22.26	19.22	20.74
26	25 June-1 July	Vegetative	18.56	13.56	16.06
27	2-8 July	Vegetative	14.46	10.12	12.29
28	9-15 July	Vegetative	10.34	8.92	9.63
29	16-22 July	Vegetative	7.78	6.82	7.30
30	23-29 July	Vegetative	6.62	4.24	5.43
31	30 July-5 Aug	Vegetative	0.00	0.00	0.00
32	6-12 Aug	Vegetative	0.00	0.00	0.00
33	13-19 Aug	Vegetative	0.00	0.00	0.00
34	20-26 Aug	Vegetative	0.00	0.00	0.00
35	27 Aug-2 Sep	Emerge New Flush	0.00	0.00	0.00
36	3-9 Sep	Emerge New Flush	0.00	0.00	0.00
37	10-16 Sep	Emerge New Flush	0.00	0.00	0.00
38	17-23 Sep	Emerge New Flush	0.00	0.00	0.00
39	24-30 Sep	Emerge New Flush	0.00	0.00	0.00
40	1-7 Oct	Emerge New Flush	0.00	0.00	0.00
41	8-14 Oct	Emerge New Flush	0.00	0.00	0.00
41	15-21 Oct	Emerge New Flush	0.00	0.00	0.00
43	22-28 Oct	Emerge New Flush	0.00	0.00	0.00
44	29 Oct- 4 Nov	New twigs	0.00	0.00	0.00
45	5-11 Nov	New twigs	0.00	0.00	0.00
46	12-18 Nov	New twigs	0.00	0.00	0.00
47	19-25 Nov	New twigs	0.00	0.00	0.00

Table 2: Correlation and regression coefficients of mango hopper population with meteorological factors.

Weather parameters	Correlation coefficient ('r')			Regression coefficient		
	2009-10	2010-11	Pooled	2009-10	2010-11	Pooled
Maximum temperature (X_1)	0.5324**	0.4255**	0.4731**	0.4075	0.1067	0.2100
Minimum temperature (X_2)	-0.1140	-0.1147	-0.1057	-	-	-
Average temperature (X_3)	0.1643	0.0866	0.1250	-	-	-
Morning Relative humidity (X_4)	-0.0154	-0.1522	-0.0778	-	-	-
Evening Relative humidity (X_5)	-0.3036*	-0.2401	-0.2628*	0.0092	-	-0.0469
Average Relative humidity (X_6)	-0.2287	-0.2233	-0.2163*	-	-	0.1111
Wind Velocity (X_7)	-0.2004	-0.2832*	-0.2262*	-	-0.3898	-0.1643
Sunshine Hours (X_8)	0.5209**	0.3714**	0.4322**	0.4471	-0.1612	0.2478
Rainfall (X_9)	-0.2806*	-0.1858	-0.1781	0.0059	-	-
Evaporation (X_{10})	0.3785**	0.3756**	0.3723**	-0.3682	1.0412	0.1386
R^2	-	-	-	0.3216	0.3873	0.3126
Variation explained (%)	-	-	-	32.16	38.73	31.26
R	-	-	-	0.6230	0.6598	0.5938
Constant (A value)	-	-	-	-12.2407	-2.2229	-10.4438

*Significant at 5 % level, **Significant at 1 % level

fruit ripening cum harvest period i.e. May to July which proves selective preference of the pest to the appropriate crop stage. When fruits were physiologically mature, the female fly seemed to oviposit on the fruit surface. Thereafter, the emerging maggots made their entry inside the fruit pulp and deteriorated and ultimately made it unfit for human consumption. Prior to the fruit ripening stage, the pest might have avoided oviposition on immature fruits particularly at the stone sized fruit stage while the fruit surface was too hard for oviposition.

The population of *D. correctus* in south Gujarat remained considerably high during March - July coinciding with the fruiting season of mango (Anon., 1). Similarly, Jhala *et al*. (3) reported that population of *D. correctus* started increasing from March and reached peak in April; thereafter a second peak was observed in June. They further reported that maximum activity of fruit fly coincided with fruiting and harvesting period of mango. Kumar *et al.* (5) reported that *B. correctus* adults were trapped throughout the year but their population remained high during March - June (fruiting and harvesting period), exhibiting peak in May, thereafter it declined gradually. The peak activity of *Bactrocera* spp. was recorded during May to June in Tirupati, Andhra Pradesh (Sarada *et al.,* 11). However, Dwivedi *et al*. (2) indicated that fruit fly was first observed in April with 3 per cent infestation thereafter, it gradually increased in May (8.2%) and June (9.8%) and slightly declined in July (8.3%). Kannan and Rao (4) and Mahmood and Mishkatullah (6) reported peak population of fruit fly last week of May. In the present investigation, peak infestation of 36.67 per cent of mango fruits was observed during 22nd SW (28 May - 3 June). So, the results obtained in the current investigation are more or less the same as obtained in the above reports which conforms the present findings.

Effect of abiotic factors on population build-up of mango fruit fly

During 2009-10, the fruit fly infestation (Y) showed significant positive correlation with maximum temperature (maximum, minimum and average) (X_1 to X_3) ('r' = 0.4769, 0.5814 and 0.7004), relative humidity (X_5 and X_6) ('r' = 0.2802 and 0.2856), wind velocity (X_7) ('r' = 0.6890) and evaporation (X_{10}) ('r' = 0.6724). Similarly, in the subsequent year, fruit infestation (Y) indicated

significant positive correlation with temperature (maximum, minimum and average) (X_1 to X_3) ('r' = 0.3758, 0.5407 and 0.6132), wind velocity (X_7) ('r' = 0.6718) and evaporation (X_{10}) ('r' = 0.7234). None of the factor indicated significant negative relationship with the fruit fly oriented fruit damage (Table 2).

In pooled results, fruit fly infestation (Y) indicated highly significant positive correlation with maximum temperature (X_1) ('r' = 0.4240), minimum temperature (X_2) ('r' = 0.5525), average temperature (X_3) ('r' = 0.6482) and evaporation (X_{10}) ('r' = 0.6926), evening relative humidity (X_5) ('r' = 0.2647), average relative humidity (X_6) ('r' = 0.2447) and wind velocity (X_7) ('r' = 0.6695) None of the factor indicated significant negative relationship with the fruit fly oriented fruit damage (Table-2). These findings are in consonance with the reports of Mishra *et al.* (7).

The multiple correlation coefficients (R) were significant in 2009-10 (R = 0.9043), 2010-11 (R = 0.8776) as well as in pooled results (R = 0.8756). The regression equations developed for build-up of fruit fly infestation were :

2009-10:

$$\hat{Y} = - 36.5602 - 59.7268 (X_1) -59.6835 (X_2) + 120.5675 (X_3) + 0.2238 (X_5) - 0.2818 (X_6) + 1.2585 (X_7) + 3.0626 (X_{10})$$

2010-11:

$$\hat{Y} = 4.0929 + 18.4730 (X_1) + 20.6162 (X_2) - 39.5787 (X_3) + 0.2959 (X_7) + 6.4071 (X_{10})$$

Pooled:

$$\hat{Y} = -9.9651- 41.3926 (X_1) - 40.3043 (X_2) + 81.7669 (X_3) + 0.1412 (X_5) - 0.1509 (X_6) + 0.7939 (X^7) + 4.7506 (X_{10})$$

Where,

$\hat{Y}$ = Fruit infestation, X_1 = Maximum temperature, X_2 = Minimum temperature, X_3 = Average temperature, X_5 = Evening relative humidity, X_6 = Average relative humidity, X_7 = Wind velocity, X_{10} = Evaporation

The total impact of major abiotic factors on fluctuation of fruit fly infestation was 78.88, 74.51 and 74.96 per cent in 2009-10, 2010-11 and pooled results, respectively.

This interpretation is sustained by the fact that fruit fly oriented fruit infestation or damage was higher from April to July during 2009-10 and 2010-11, which coincided with fruiting and harvesting periods of mango fruit, when temperature (19.01 to 39.03^{o}C) and relative humidity (39.57 to 95.71%) were also gradually increasing were. The period also witnessed high wind velocity causing extensive fruit dropping where the fallen fruits were conducive to fruit fly infestation. Increasing relative humidity caused high evaporation. The positive correlation between temperature and fruit fly population was reported by Kumar *et al* (7) in south Gujarat and Mihsra *et al.* (7) in Lucknow. Further, Verghese and Devi (12) in Karnataka found positive correlation between wind speed and fruit fly population in mango orchard. Kannan and Rao (4) showed significant positive relationship with maximum and minimum temperature and negatively correlated with rainfall and relative humidity. Ranjitha and Viraktamath (10) reported that relationship of fruit fly population was positive with minimum temperature and relative humidity. In the present investigation, the damage caused by fruit fly remained higher during 17th-25th SW (23 April to 24 June) when temperature and wind velocity were also high and relative humidity reached to its high level due to pre-monsoon showers or early commencement of rains. So, looking to the earlier findings, all the workers have demonstrated almost similar relationship between fruit fly infestation and

weather factors. Thus, the present findings are said to be in close agreement with the earlier investigations.

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