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Impact of weather parameters on population dynamics of oriental fruit fly, *Bactrocera dorsalis* (Hendel) (Diptera: Tephritidae) under south Gujarat mango ecosystem

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ABSTRACT

The field experiment was conducted during 2013-16 at Navsari Agricultural University, Paria, Gujarat to study the role of weather parameters on population dynamics of oriental fruit fly, *Bactrocera dorsalis* on mango, *Mangifera indica* L. Fruit flies were recorded throughout the investigation period, wherein maximum catches were observed during April - July which coincided with fruiting and harvesting stages of the crop. Weather parameters *viz.,* minimum temperature, evening relative humidity, rainfall and wind velocity were found to be important predictors of fruit fly catches, while maximum temperature and morning relative humidity failed to establish significant correlation with the catches. The optimized model developed using rainfall and wind velocity predicted fruit fly catches based on R^2 value to the tune of 78 per cent. This forewarning model may help mango farmers to take advance decision for minimizing the quantitative and qualitative crop losses caused by fruit flies of the region.

Key words: Fruit fly, correlation, population dynamics, prediction, regression, weather parameters.

Mango, *Mangifera indica* L. (Anacardiaceae) is one of the appetizing fruit crops of tropical as well as subtropical regions of India and is known as "king of fruits" due to its delicious taste, attractive color, savoring flavour and high nutritive value (Lakashminarayana, 1980). More than 300 insect-pest species have been recorded to attack mango in different parts of the world (Pena *et al.,* 1998). Of these, 188 species have been reported in India (Tandon and Verghese, 1985). Among all mango pests, fruit flies are recorded as major pest of mango and three species *viz*; *Bactrocera dorsalis* (Hendel), *B. zonata* (Saunders) and *B. correcta* (Bezzi) are considered as major species (Choudhary *et al.,* 2012 and Verghese *et al.,* 2006). *B. dorsalis* is reported as predominating species and its population is found to be recorded throughout the year in mango ecosystem of south Gujarat (Patel *et al.,* 2013). During ripening stage of mango fruits, female fruit fly lays eggs in the fruit skin with the help of ovipositor and after hatching, the maggots start feeding inside the fruit pulp and causes internal discoloration, off flavors, pulp rotting and fruit drop on the ground and pupates in the soil (Sarwar *et al.,* 2014). Patel *et al.* (2013) observed that fruit flies cause up to 40 per cent yield loss in heavy rainfall zone of south Gujarat.

The aim of present study was to relate the population dynamics of fruit fly with weather parameters under southern agro-climatic Gujarat conditions. Some similar work has been carried out by several workers in different climatic conditions of India (Verghese *et al.,* 2006; Mishra *et al.,* 2012; Singh *et al.,* 2013; Choudhary *et al.,* 2012) but limited work has been done in south Gujarat where mango production centers (especially of Alphonso and late maturing varieties) are mainly located in costal environment. An analysis of ecological issue within southern Gujarat will provide essential information for understanding the population dynamics of fruit fly in the region and will also provide scientific data for formulating management strategies.

MATERIALS AND METHODS

The present studies were carried out in the mango orchard (cv. Alphonso) of All India Coordinated Research Project on fruits, Agriculture Experimental Station, Navsari Agricultural University, Paria ($20^{o}26'$N, $72^{o}58'$E, 10 m at altitude) on 10-12 years old mango trees (planted on 10 x 10 m distance). Fruit fly population was monitored on the basis of total male fruit flies collected during standard week starting from 14th SMW (2-8 April, 2013) to 13th SMW (26-1 April, 2016) with the help of methyl eugenol impregnated Nauroji-Stonehouse parapheromone trap (plywood blocks 5x5x1 cm^3 impregnated in mixture of ethyl alcohol: methyl

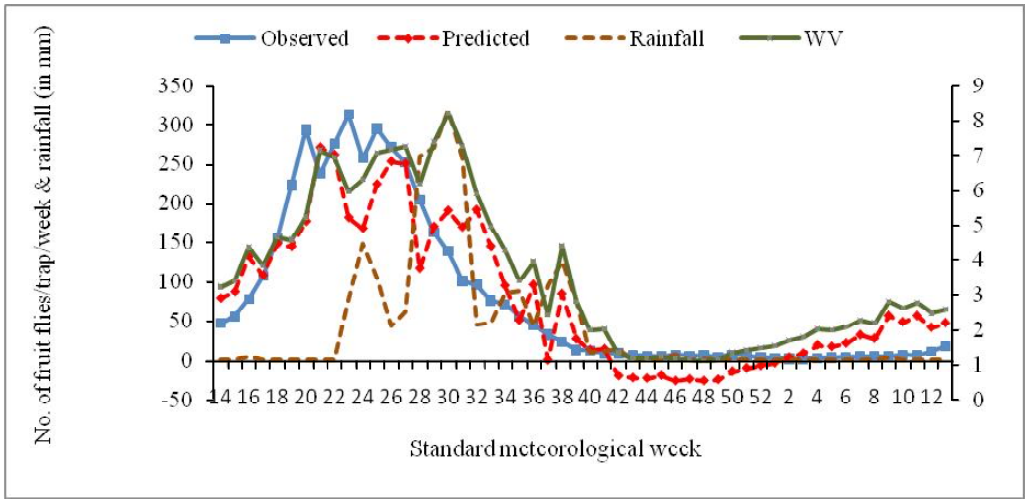

Fig.1: Standard week wise observed versus predicted fruit fly population (using optimized model)

eugenol: DDVP @ 6:4:1 v/v/v for 24 hrs) @ 1 trap per 10 plants and total ten traps were placed in one hectare mango (cv. Alphonso) plot. Traps were placed at 2-3 meters above the ground level. The Alphonso mango block was kept free from any pesticide application during the study period. Identification of fruit fly species was done using Stereomicroscope (SZ61 Magnification, 2.0x-270x) and key and species description was done as suggested by Prabhakar *et al*. (2012). The weather parameters *viz.,* maximum and minimum temperature, morning and evening relative humidity, rainfall and wind velocity were recorded from meteorological observatory of the research station. Statistical analysis of the data was carried out using IBM SPSS software.

RESULTS AND DISCUSSION

Population dynamics of fruit fly

The results of the study (Fig. 1) indicated that mean male population of fruit flies varied from 1.7 to 312.7 per trap indicating maximum population during 23rd SMW (312.7 males /trap) when the prevailing maximum and minimum temperature, morning and evening relative humidity, rainfall and wind velocity were 35.3, 25.9^{0}C, 63.6-78.4%, 76.8 mm and 5.9 kmh^{-1} followed by 25th (294.13 males /trap), and 20th SMW (292.73 males /trap), respectively which coincided with ripening cum harvesting stage of the mango fruits. Thereafter, population started declining gradually (August to March). The present findings are in agreement with Patel *et al.* (2013) who reported highest fruit fly population during 22nd SMW (28-3 June) followed by 23rd and 21st SMWs which coincided with ripening cum harvesting stage of mango fruits.

Table 1: Correlation coefficient between fruit flies complex and weather parameters under south Gujarat conditions

Abiotic parameters	Correlation coefficient Male fruit fly catches
Max. temp. (X_1)	0.050 ^{NS}
Min. temp. (X_2)	0.710**
Morning RH (X_3)	0.046^{NS}
Evening RH (X_4)	0.525**
Rainfall (X_5)	0.363**
Wind velocity (X_6)	0.850**

*Significant at 0.05 level, **Significant at 0.01 level

Effect of weather parameters on population dynamics of the fruit fly

The results revealed that total fruit fly collection exhibited significant positively correlation with minimum temperature ('r'= 0.710), evening relative humidity ('r'= 0.525), rainfall ('r'= 0.363) and wind velocity ('r'= 0.850). Whereas, maximum temperature ('r'= 0.050) and morning relative humidity ('r'= 0.046) indicated non-significant correlation with fruit fly catches (Table 1). So, it is concluded that with increase in minimum temperature, evening relative humidity, rainfall and wind velocity, there was corresponding increase in fruit fly catches. During this period, overall average maximum temperature ranged between 29.4 and 38.8 ºC and the minimum temperature ranged between 8.8 and 26.2 ºC. Morning relative humidity ranged between 69-95 per cent and evening relative humidity ranged between 31-87 per cent. Wind velocity varied between 1.1 to 7.3 kmh^{-1} and average rainfall was 2191 mm. The results of the present investigation are in agreement with findings of Verghese *et al.* (2006) who reported that wind speed and

minimum temperature showed significant and positive correlation with B. dorsalis. Sahoo *et al*. (2016) reported that abiotic factors *viz.,* day temperature, night temperature, heat sum significantly positive correlation with mango fruit fly population and direct effect on the growth and development.

Statistical model developed using step wise regression analysis having rainfall (X_5) and wind speed (X_6) parameters could explain variability in the fruit fly catches up to 78 per cent.

$Y=-79.64 + (-0.41) X_5 + (49.16) X_6 \qquad R^2=0.78$

This models was considered as optimized model. A graphical representation of observed and predicated fruit flies catches (based on optimized model) is depicted in Fig. 1. Weather based predication model for guava fruit fly was developed by Sharma *et al*. (2015) who reported the regressing peaks of fruit fly trap catches on mean values of different weather parameters of April-March weeks (R^2= 0.80). This prediction model is highly useful for estimating fruit fly population one week in advance and saves valuable time and possible crop loss.

CONCLUSIONS

The present study clearly indicated that wind velocity, minimum temperature, evening relative humidity and rainfall significantly showed positive correlation with male fruit fly population or the catches. Based on optimized model, wind velocity with combination of rainfall played a significant role in inducing significant variation in male fruit fly population in methyl eugenol traps during fruiting to harvesting stage of mango under south Gujarat conditions.

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