



# Population Dynamics of Fruit Fly, *B. dorsalis* (Hendle) on Mango and Correlation with Weather Parameters

M. K. Jena <sup>a\*</sup>, S. R. Patel <sup>a</sup> and Z. K. Patel <sup>a</sup>

<sup>a</sup> Department of Agricultural Entomology, N. M. College of Agriculture, Navsari Agricultural University, Navsari-396 450, Gujarat, India.

## Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

## Article Information

DOI: 10.9734/IJECC/2022/v12i121605

## Open Peer Review History:

This journal follows the Advanced Open Peer Review policy. Identity of the Reviewers, Editor(s) and additional Reviewers, peer review comments, different versions of the manuscript, comments of the editors, etc are available here: <https://www.sdiarticle5.com/review-history/96117>

Original Research Article

Received: 28/10/2022

Accepted: 30/12/2022

Published: 31/12/2022

## ABSTRACT

Investigation on the population dynamics of fruit fly *Bactrocera dorsalis* (Hendle) (Diptera: Tephritidae) was carried out by installing "Nauroji-Stonehouse Fruit Fly Trap" in the mango orchard of organic farm, Navsari Agricultural University, Navsari, Gujarat, India during 2021-22. The population of *B. dorsalis* prevailed throughout the year in mango orchard with its peak activity from 14<sup>th</sup> SMW to 31<sup>st</sup> SMW which coincided with the fruiting and harvesting period of fruits. The population of *B. dorsalis* decreased from August to February. Correlation analysis revealed a significant positive correlation of population of *B. dorsalis* with maximum temperature, minimum temperature, average temperature, evening relative humidity, average relative humidity, rainy days, rainfall and wind velocity but a significant negative correlation with duration of bright sunshine hours. However, there was a nonsignificant correlation of population of *B. dorsalis* with morning relative humidity.

Keywords: *B. dorsalis*; mango; population dynamics; correlation; weather parameters; South Gujarat.

\*Corresponding author: E-mail: jenamanoj401@gmail.com, d003208@sggw.edu.pl;

## 1. INTRODUCTION

“Mango, *Mangifera indica* (L.), belongs to the family Anacardiaceae, is known as “king of fruits” which is widely cultivated in tropical and subtropical regions of the world” [1,2,3]. It originated in the Indo-Burma region. It is the national fruit of India, Pakistan and the Philippines. India ranks first among world’s mango producing countries of the world and ranks third for the export of mango. The area under mango cultivation in India is 2.29 million hectares with production of 20.44 metric tonnes and productivity of 8.90 metric tonnes per hectare [4]. “The mango crop is attacked by about 492 species of insects, 17 species of mites and 26 species of nematodes at the world level” [5]. Of these, 188 species of insects have been reported from India [6]. One of which is the damage caused by fruit fly [7,8], which attack various kinds of fruits found all over the world [9]. They are regarded as the quarantine pests [10-13]. In India, fruit flies cause crop loss up to Rs. 29,460 million per annum in mango, guava, sapota and citrus [13,14]. Among various species of fruit fly, three species viz., *B. dorsalis*, *B. zonata* (Saunders) and *B. correcta* (Bezzi) are considered as economically important pests infecting mango crop [15,16]. “The oriental fruit fly *B. dorsalis* was first reported in Taiwan Island” [17] and “is a serious pest on a wide range of fruit crops in the Indian subcontinent. It is endemic to Southeast Asia, but has also been introduced to various regions of the world and became threats to the wide range of cultivated and wild fruits” [18]. The *B. dorsalis* reported to cause 100.0, 87.0, 78.0 and 61.0 per cent fruit damage in rainy season on guava, mango, peach and pear, respectively [19], whereas Singh [20] reported significant losses in Kinnow due to fruit flies. They are invasive pests of horticultural crops worldwide due to high reproductive rate, shorter generation and doubling time, extreme polyphagy, high mobility and wider adaptability to new environments [21,22,19,10]. Moreover, the damaging stage is the maggot which feeds on the pulp of the fruit and remains unexposed to the chemical pesticides. Therefore, it is very difficult to manage the pest. Hence, development of an integrated management package is a pre-requisite to manage this pest. Looking to the importance of this pest, the present investigation was carried out on population dynamics of *B. dorsalis* and correlation with weather parameters in the mango orchard.

## 2. MATERIALS AND METHODS

The present investigation on population dynamics of *B. dorsalis* on mango was carried out starting from April 2021 to March 2022 at the mango orchard, organic farm, Navsari Agricultural University, Navsari, Gujarat, India. For this study mango orchard of one hectare with *var.* Kesar was selected which was kept free from the insecticidal spray.

In this study ten Methyl eugenol based “Nauroji Stonehouse Fruit Fly Traps” were installed by keeping trap to trap distance of 30 m for monitoring the population of *B. dorsalis* round the year. The data on number of adult males of *B. dorsalis* caught per ten traps were recorded at weekly interval. The influence of weather parameters viz., maximum temperature, minimum temperature, morning and evening relative humidity and rainfall were worked out by statistical correlation and regression analysis as per Bansode and Patel [23].

## 3. RESULTS AND DISCUSSION

Data recorded during 2021-22 are presented in Table 1 and depicted in Figs. 1 and 2. The data revealed that the *B. dorsalis* population was observed throughout the year with its peak activity from 14<sup>th</sup> Standard Meteorological week (SMW) to 31<sup>st</sup> SMW. The maximum number of male *B. dorsalis* (322) were trapped in 28<sup>th</sup> SMW, which exhibited the peak of population of *B. dorsalis* in the area whereas the minimum number of *B. dorsalis* (41) were trapped in 14<sup>th</sup> SMW, which exhibited the least of population of *B. dorsalis* in the area. The population of *B. dorsalis* decreased from August to February. The peak activity of *B. dorsalis* population in mango orchard coincided with fruiting and harvesting period of fruits.

Observation on occurrence of *B. dorsalis* throughout the year and peak activity coincided with fruiting and harvesting period of mango has been made earlier by Dale [24] who revealed that the population remained throughout the year and highest fly population coincided with the maturity and harvesting period of mango in mango orchard at north Gujarat. Dale [24] reported that the maximum activity coincided with the fruiting season in guava orchard at north Gujarat. The population recorded throughout the year in sapota orchard, north Gujarat [24]. The highest fruit fly infestation (36.67%) coincided with ripening cum harvesting period of mango at

Navsari Agricultural University, Navsari, Gujarat [25]. The population prevailed throughout the year and coincided with the maturity and harvesting period of sapota at Navsari Agriculture University, Navsari, Gujarat [26]. The population prevailed throughout the year and coincided with the maturity and harvesting period of sapota at Gandevi, south Gujarat [27]. The maximum catches coincided with fruiting and harvesting stages of the crop at Navsari Agricultural University, Paria, Gujarat [28]. The maximum population coincided with fruiting period of mango at N. M. College of Agriculture, Navsari Agricultural University, Navsari, Gujarat [23]. The fruit fly was active throughout the year in the mango orchard at the mango orchard, College of Agriculture, Navsari Agricultural University, Bharuch, Gujarat [29]. The maximum population coincided with fruiting period of guava at N. M. College of Agriculture, Navsari, Gujarat [30] which are in favour of the present findings.

During present studies, the activity of *B. dorsalis* was higher during April to July in south Gujarat

with peak activity in 28<sup>th</sup> SMW and least in 14<sup>th</sup> SMW. A more or less similar trend was found by Dale [24] who recorded that the population was higher in the month of July and August, while the lowest population was recorded in the month of January and December in mango orchard at north Gujarat. The population peaked in the month of July and August whereas it was the lowest in the month of January and March in sapota orchard, north Gujarat [24]. The highest population was recorded during the month of April to August in sapota orchard at Gandevi, Gujarat [31]. The highest infestation (36.67%) was on 22<sup>nd</sup> SMW in mango orchard at Navsari Agricultural University, Navsari, Gujarat [25]. The maximum activity (172.10 flies per trap) was found during March to August, whereas population was found to be lower during month of December and January (11.10 to 21.30 flies per trap) in sapota orchard at Navsari Agricultural University, Navsari, Gujarat [26]. The maximum activity (172.10 flies per trap) during March to August and population was found to be lower during month of December and January (11.10 to 21.30 flies per trap) in sapota orchard at

**Table 1. Population of *B. dorsalis* in different SMW in mango orchard**

Sr. No.	SMW	Number of <i>B. dorsalis</i> caught/10 traps	Sr. No.	SMW	Number of <i>B. dorsalis</i> caught/ 10 traps
1	14	41	27	40	146
2	15	190	28	41	152
3	16	204	29	42	160
4	17	219	30	43	172
5	18	232	31	44	165
6	19	216	32	45	120
7	20	202	33	46	160
8	21	196	34	47	190
9	22	182	35	48	97
10	23	230	36	49	100
11	24	240	37	50	96
12	25	231	38	51	93
13	26	280	39	52	82
14	27	310	40	1	150
15	28	322	41	2	92
16	29	288	42	3	80
17	30	292	43	4	76
18	31	297	44	5	120
19	32	304	45	6	136
20	33	252	46	7	102
21	34	228	47	8	170
22	35	147	48	9	172
23	36	138	49	10	192
24	37	122	50	11	202
25	38	137	51	12	220
26	39	126	52	13	170

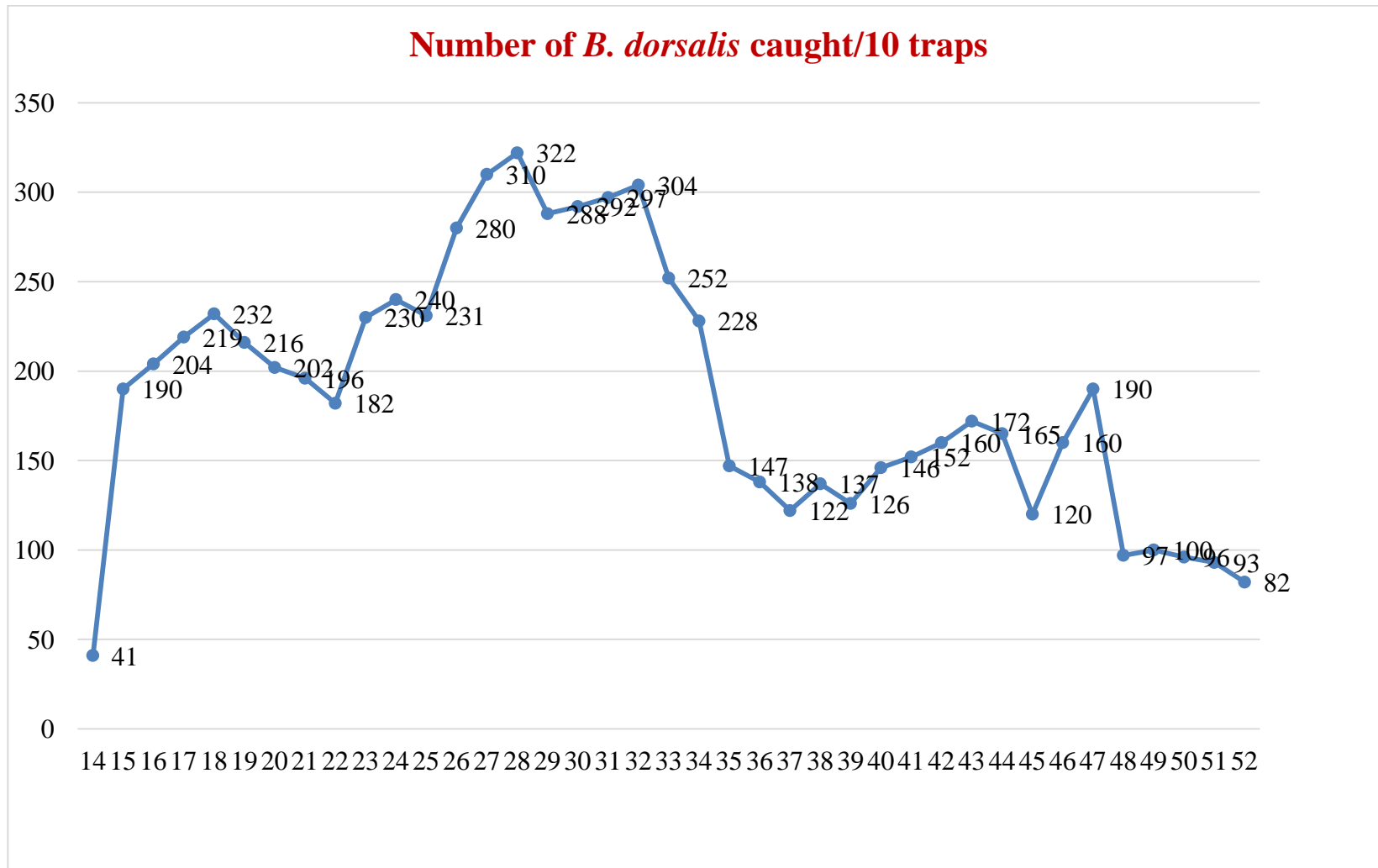
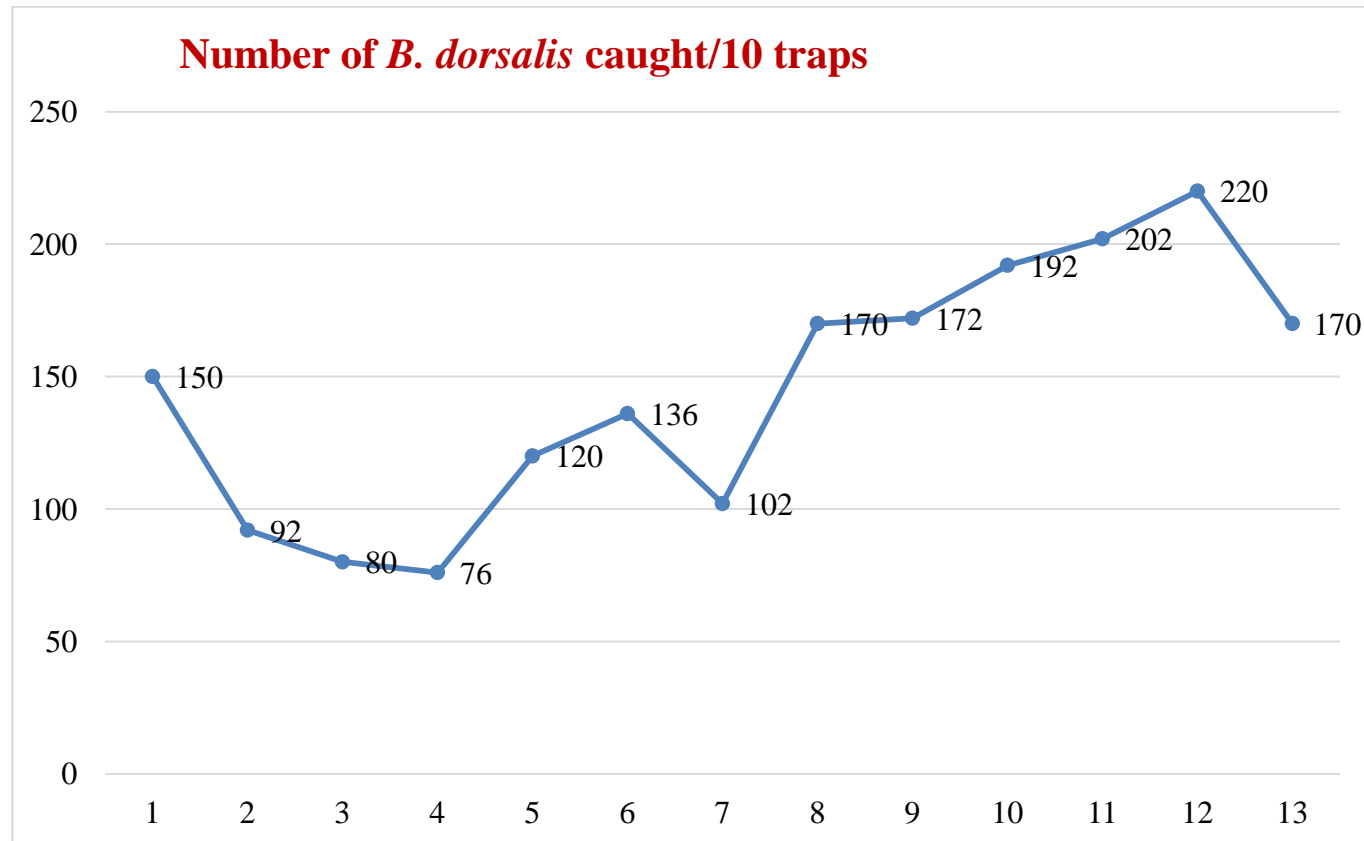


Fig. 1. Population of *B. dorsalis* from 14<sup>th</sup> to 52<sup>nd</sup> SMW in mango orchard



**Fig. 2. Population of *B. dorsalis* from 1<sup>st</sup> to 13<sup>th</sup> SMW in mango orchard**

Gandevi, south Gujarat [27]. The maximum catches during April to July at Navsari Agricultural University, Paria, Gujarat [28]. The maximum population during the month of April to July and the population decreased during December to February at N. M. College of Agriculture, Navsari Agricultural University, Navsari, Gujarat [23]. The maximum catches (128.60 fruit flies/trap) in 28<sup>th</sup> standard meteorological week (SMW) i.e., ninth to 15<sup>th</sup> July, while minimum catches (4.47 fruit flies/trap) in third standard meteorological week (SMW) i.e., 15<sup>th</sup> to 21<sup>st</sup> January at the mango orchard, College of Agriculture, Navsari Agricultural University, Bharuch, Gujarat [29]. These findings are in support of the present findings.

### 3.1 Correlation and Multiple Regression Studies between Population of *B. dorsalis* in Mango Orchard and Weather Parameters

The data on population of *B. dorsalis* recorded during the period April, 2021 to March, 2022 are correlated with different weather parameters and have been presented in table 2. Data indicated a significant positive correlation with maximum temperature, minimum temperature, average temperature, evening relative humidity, average relative humidity, rainy days, rainfall and wind velocity but a significant negative correlation with duration of bright sunshine hours. However, there was a nonsignificant correlation of population of *B. dorsalis* with morning relative humidity.

The present findings are more or less alike with those of Kumar et al. [32] who found that there was a significant positive correlation with temperature (minimum and average), relative humidity (minimum, maximum and average), rainfall and rainy days, but a significant negative correlation with sunshine hours in sapota orchard in Paria, Gujarat. There was a significant positive correlation with temperature (minimum and average), relative humidity (minimum, maximum and average), rainfall and rainy days while a significant negative correlation with sunshine hours in mango orchard at north Gujarat [24]. There was a significant positive correlation with minimum temperature, relative humidity (maximum, minimum and average) and rainy days whereas, negative correlation with maximum temperature, sunshine hours and rainfall in guava orchard at north Gujarat [24].

“There was a significant positive correlation with temperature (minimum and average), relative humidity (maximum, minimum and average), rainfall and rainy days, whereas negative correlation with maximum temperature and sunshine hours in sapota orchard north Gujarat” [24]. “The infestation increased with increase in temperature, relative humidity, wind velocity and evaporation at Navsari Agricultural University, Navsari, Gujarat” [25]. “The population had significantly positive correlation with temperature (maximum, minimum and average) and morning relative humidity whereas, it had positive nonsignificant correlation with average relative humidity and rainfall. Furthermore, a negative correlation with the maximum relative humidity in sapota orchard at Navsari Agricultural University, Navsari, Gujarat” [26]. “There was significantly positive correlation with temperature (maximum, minimum and average) and morning relative humidity whereas, it has positive nonsignificant correlation with average relative humidity and rainfall. Also, a negative correlation with the maximum relative humidity in sapota orchard at Gandevi, south Gujarat” [27]. “There was a positive correlation of population of *B. dorsalis* with temperature (maximum, minimum and average), relative humidity (maximum, minimum and average), rainfall and wind velocity at N. M. College of Agriculture, Navsari Agricultural University, Navsari, Gujarat” [23]. “There was a significant positive correlation between minimum temperature, morning relative humidity, evening relative humidity, wind velocity and rainfall with fruit fly population while, a significant negative correlation with sunshine hours at the mango orchard, College of Agriculture, Navsari Agricultural University, Bharuch, Gujarat” [29]. “There was a positive correlation with temperature (maximum, minimum and average), relative humidity (maximum, minimum and average), rainfall and wind velocity at N. M. College of Agriculture, Navsari Agricultural University, Navsari, Gujarat” [30].

The coefficient values of multiple regression analysis are presented in Table 2. The various parameters utilized for prediction of population of *B. dorsalis* gives 55.55 per cent coefficient of determination due to temperature, relative humidity, rainfall, wind velocity and bright sunshine hours. Therefore, it can be stated that the variation ( $R^2 = 0.555$ ) in population of *B. dorsalis* was due to the above factors [33].

**Table 2. Effect of weather parameters on population of *B. dorsalis* in mango orchard in different SMW**

Weather parameters		Correlation coefficients	Regression Coefficients
(X <sub>1</sub> )	Max. Temp. (°C)	0.27*	-0.918
(X <sub>2</sub> )	Min. Temp. (°C)	0.69**	13.598
(X <sub>3</sub> )	Mean Temp. (°C)	0.64**	--
(X <sub>4</sub> )	M. R.H. (%)	-0.05	-0.486
(X <sub>5</sub> )	E. R.H. (%)	0.41**	-1.318
(X <sub>6</sub> )	Mean R.H. (%)	0.31*	--
(X <sub>7</sub> )	Rainy days (day)	0.38**	--
(X <sub>8</sub> )	Rainfall (mm)	0.29*	-0.017
(X <sub>9</sub> )	Wind velocity (km/h)	0.49**	5.353
(X <sub>10</sub> )	Bright sunshine hours (h)	-0.32*	-4.763
R <sup>2</sup>	Coefficient of determination	--	0.55
CV	Coefficient of variation (%)	--	55.55
R value	Multiple Correlation Coefficient	--	0.74
a value	Intercept	--	65.45

N=52, \*Significant at the level of 5%, \*\*Highly Significant at the level of 5%

Regression equation for the prediction of population of *B. dorsalis* on mango is as below,

$$Y = 65.458 - 0.918 X_1 + 13.598 X_2 - 0.486 X_4 - 1.318 X_5 - 0.017 X_8 + 5.353 X_9 - 4.753 X_{10}$$

Where

Y = Predicted population of *B. dorsalis*

X<sub>1</sub> = Maximum temperature

X<sub>2</sub> = Minimum temperature

X<sub>4</sub> = Morning relative humidity

X<sub>5</sub> = Evening relative humidity

X<sub>8</sub> = Rainfall

X<sub>9</sub> = Wind velocity

X<sub>10</sub> = Bright sunshine hours

So, looking to the relationship of abiotic factors with population of *B. dorsalis*, it may be drawn that population of *B. dorsalis* was positively influenced by temperature (maximum, minimum and average), relative humidity (evening and average), rainfall, rainy days and wind velocity but negatively related to the duration of bright sunshine hours. This implies that the increase in temperature, relative humidity, rainy days, rainfall and wind velocity also increase the fruit fly population and *vice-versa*. Furthermore, the increase in bright sunshine hours reduce the population of *B. dorsalis* and *vice-versa*. However, the population of *B. dorsalis* is not influenced by the morning relative humidity.

#### 4. CONCLUSION

The *B. dorsalis* population prevailed throughout the year but the peak activity occurred during

April to July which coincided with the maturity and harvesting period of the mango fruit. There was a significant positive correlation of population of *B. dorsalis* with maximum temperature, minimum temperature, average temperature, evening relative humidity, average relative humidity, rainy days, rainfall and wind velocity but a significant negative correlation with duration of bright sunshine hours.

#### ACKNOWLEDGEMENT

The authors are highly thankful to the Department of Entomology, N. M. College of Agriculture, Navsari Agricultural University, Navsari, Gujarat for providing necessary facilities throughout the research.

#### COMPETING INTERESTS

Authors have declared that no competing interests exist.

#### REFERENCES

1. Lakshminarayana S. Tropical and subtropical fruits; composition, properties and use. In: mango Nagy S, Shaw PE, editors. Editions. Westport, CT: AVI publishing. 1980;184-257.
2. Majumdar PK, Sharma DK. Mango. In: Bose TK, Mitra SK, editors (editions), Fruits: Tropical and Subtropical. Naya Prakash. 1990;1-62.
3. Scherrer J. The most popular fruit in the world; 2007. [Cited Jan 30, 2015].

- Available:<http://www.banderasnews.com/0712/rr-mangomango.html>
4. Indian horticulture database. Area and production of horticulture crops. First advance estimates. 2019-20;3.
  5. Pena JE, Mohyuddin AI, Wysoki M. A review of the pest management situation in mango agro ecosystem. *Phytopara*. 1998; 26:1-20.
  6. Tandon PL, Verghese A. World list of insect, mite and other pests of mango. Technical Document, No. 5. IIHR Bangalore. 1985;6(3):122-31.
  7. Ekesi S, Chabi-Olaye A, Subramanian S, Borgemeister C. Horticultural pest management and the African economy: successes, challenges and opportunities in a changing global environment. *Acta Hortic*. 2011;911(911):165-83. DOI: 10.17660/ActaHortic.2011.911.17
  8. Badii KB, Billah MK, Afreh Nuamah K, Obeng Ofori D, Nyarko G. Review of the pest status, economic impact and management of fruit infesting flies (Diptera: Tephritidae) in Africa. *Afr J Agric Res*. 2015;10(12):1488-98. DOI: 10.5897/AJAR2014.9278
  9. White IM, Harris EMM. *Fruit flies of Economic Significance: their Identification and Bionomics*. Wallingford, UK: CA B International; 1992.
  10. Jena MK, Patel SR, Bairwa KL, Sahoo S. The melon fruit fly, *Bactrocera Cucurbiteae*: A menace to horticultural crops. Current research in agricultural entomology. New Delhi, India: Bright Sky Publishers. 2022a;2:49-74.
  11. Jena MK, Patel SR, Sahoo S. Fruit fly: A destructive pest of horticultural crops and its management strategies. *Appl Entomol Zool*. 2022b;8:149-76.
  12. Jena MK, Patel SR, Swaroopa K, Sahoo S. Ber fruit fly, *Carpomyia vesuviana* costa and its management strategies. Latest trends in agricultural entomology. New Delhi, India: Integrated Publishers. 2022c;4:27-45.
  13. Mumford JD. Project memorandum on integrated management of fruit flies in India. Department for International Development (DFID). 2001;6.
  14. Mishra J, Singh S, Tripathi A, Chaubi MN. Population dynamics of oriental fruit fly, *Bactrocera dorsalis* (Hendle) in relation to abiotic factors. *Hortic Flora Res Spec*. 2012;1(2):187-9.
  15. Choudhary JS, Kumari A, Das B, Maurya S, Kumar S. Diversity and population dynamic of fruit flies species in methyl eugenol based para pheromone traps in Jharkhand region of India. In: Proceedings of the international conference on anthropogenic impact on environment & conservation strategy (ICAIECS-2012) Nov 02-04, 2012, Ranchi. Department of Zoology, Ranchi University. Ranchi & Departments of Zoology and Botany, St. Xavier's College, Ranchi in association with National Environmentalist Association, India. 2012;57-60.
  16. Verghese A, Nagaraju DK, Madhura HS, Jayanthi PDK, Devi KS. Wind speed as an independent variables to forecast the trap catch of the fruit fly (*Bactrocera dorsalis*). *Indian J Agric Sci*. 2006;76(3):172-5.
  17. Wei D, Dou W, Jiang M, Wang J. Oriental fruit fly *Bactrocera dorsalis* (Hendel). *Biol Invas Manag China*. 2017;267-83.
  18. Drew RAI, Raghu S. The fruit fly fauna (Diptera: Tephritidae: Dacinae) of the rain forest habitat of the Western Ghats, India. *Raffles Bull Zool*. 2002;50(2):327-52.
  19. Sharma DR. Comparison of the trapping efficacy of different types of methyl eugenol based traps against fruit flies, *Bactrocera* spp. infesting Kinnow mandarin in the Indian Punjab. *J Insect Sci*. 2011;24:109-14.
  20. Singh SK, Kumar D, Ramamurthy VV. Biology of *Bactrocera* (*Zeugodacus*) *tau* (Walker) (Diptera: Tephritidae). *Entomol Res*. 2010;40(5):259-63. DOI: 10.1111/j.1748-5967.2010.00296.x
  21. Mohamed S, Ekesi S, Khamis F. Biology and management of fruit flies in Africa, their risk of invasion and potential impact in the near east risk of invasion and potential impact in the near east. Reg symposium on the management of fruit flies in the Near East countries, Hammamet, Tunisia. 2012;1-34.
  22. Prokopy RJ. Stimuli influencing trophic relations in Tephritidae. In: des Insects Millieu Tropheique C, editor. Labeyrie. Coll. Int. Centre National de la Recherche Scientifique. 1977;265:305-36.
  23. Bansode GM, Patel ZP. Effect of weather parameters on population fluctuation of mango fruit flies, *Bactrocera* spp. *Int J Chem Stud*. 2018;6(5):27-30.
  24. Dale NS. Studies on the biology of *Bactrocera zonata* (Saunders) and management of fruit flies in mango



- orchards. M.Sc. (Agri.) [thesis] submitted to Gujarat Agriculture University. Nagar: SK; 2002.
25. Patel KB, Saxena SP, Patel KM. Fluctuation of fruit fly oriented damage in Mango in relation to major abiotic factors. HortFlora Res Spec. 2013;2(3): 197-200.
26. Amol S, Nandre, Shukla A. Population dynamics of fruit fly [*Bactrocera dorsalis* (Hendle)] on sapota. Agric Sci Dig. 2014;34(1):70-2.
27. Nandre AS, Shukla A. Population dynamics of fruit fly, *Bactrocera dorsalis* (Hendle) on sapota. Agric Sci Dig. 2014;34(1):70-2.
28. Bana JK, Hemant Sharma, Sushil Kumar, Pushpendra Singh. Impact of weather parameters on population dynamics of oriental fruit fly, *Bactrocera dorsalis* (Hendle) (Diptera: Tephritidae) under south Gujarat mango ecosystem. J Agrometeorol. 2017;19(1):78-80. DOI: 10.54386/jam.v19i1.762
29. Patel DR, Patel JJ, Muchhadiya DV, Patel RB. Influence of weather parameters on mango fruit fly, *Bactrocera dorsalis* Hendle. J Entomol Zool Stud. 2019;7(4):1157-60.
30. Bansode GM, Patel ZP. Effect of weather parameters on population fluctuation of guava fruit flies, *Bactrocera* spp. Int J Chem Stud. 2020;8(5):1445-8. DOI: 10.22271/chemi.2020.v8.i5t.10504
31. Anonymous. Survey of fruit fly in sapota [annual report]. 3rd Plant Protection Sub Committee Meeting. Gandevi, Gujarat: Fruit Research Station, Navsari Agricultural University. 2007;7-8.
32. Kumar S, Patel C, Bhatt RI. Studies on seasonal cyclicity of *Bactrocera correcta* Bezzi in mango and sapota orchards using methyleugenol TRAP. Gujarat Agric Univ Res J. 1997;22:68-74.
33. Stonehouse J, Mahmood R, Poswal A, Mumford J, Baloch KN, Chaudhary ZM, et al. Farm field assessments of fruit flies (Diptera: Tephritidae) in Pakistan: distribution, damage and control. Crop Prot. 2002;21(8):661-9. DOI: 10.1016/S0261-2194(02)00018-2

© 2022 Jena et al.; This is an Open Access article distributed under the terms of the Creative Commons Attribution License (<http://creativecommons.org/licenses/by/4.0>), which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

Peer-review history:

The peer review history for this paper can be accessed here:  
<https://www.sdiarticle5.com/review-history/96117>