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Occurrence and Seasonal Abundance of Fruit Fly, *Bactrocera zonata* Saunders (Diptera: Tephritidae) in Relation to Meteorological Factors

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ABSTRACT

Fruit flies belonging to the genus, *Bactrocera* are among the major pests of fruits worldwide. Among the many species of fruit flies, *Bacterocera zonata* is a serious pest of fruits causing severe losses to the fruit production and quality, in Pakistan. In the present experiment the population of *B. zonata* was monitored using methyl eugenol traps during the year, 2015. Occurrence and population dynamics of the fruit fly were compared with meteorological factors, such as temperature, relative humidity and sunshine. The highest mean population of fruit fly remained at 499 in the month of August. It started to decline afterwards and remained at 348 in the month of September. The lowest population was recorded at 26, 3, 2 and 1 for November, December, January and February, respectively. The optimum monthly average temperature and relative humidity ranged from 26 to 35 °C and 60%, respectively. The population of the fruit fly was positively correlated with the temperature and slightly negative correlation was seen for relative humidity.

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Authors' Contribution
RAK conceived and designed the study, performed analysis and wrote the article. MN performed experimental work and helped in data collection.

Key words
***Bactrocera zonata*, Methyl eugenol, Population dynamics, Meteorological factors.**

INTRODUCTION

True fruit flies (Diptera: Tephritidae) comprising of approximately 4,500 species distributed globally are considered serious pests of soft fruits (White and Elson-Harris, 1992; Tan and Nishida, 1998). Out of these about 40 species of the genus, *Bactrocera* are considered to be important pests.

Among the fruit fly, the peach fruit fly, *Bactrocera zonata* (Saunders) (Diptera: Tephritidae) is the most abundant and serious pest of fruit orchards in the world. It attacks fruit like guava, peach, mango, citrus, apricot, fig and apple etc. Besides fruits, it may infest some vegetables like tomato, pepper and eggplants as secondary hosts (Kapoor and Agarwal, 1982; Liquido *et al*., 1990; White and Elson-Harris, 1992; El-Minshawy *et al*., 1999; Hashem *et al*., 2004; Ghanim, 2009; El-Gendy, 2012).

According to an estimate losses in fruits without management have been recorded at upto 24% to cucurbits in Pakistan (Stonehouse *et al*., 1998). Two species of fruit flies established in different regions of Pakistan include, peach fruit fly, *Bactrocera zonata* and cucurbit fruit fly *Bactrocera cucurbitae* (Coquillett). Incidence and abundance of *B. zonata* has been recorded in coastal and sub-coastal areas of Baluchistan and Sindh, as well as semi-desert areas and northern plains of Punjab. Its presence has also been recorded as a rare pest from the foothills of Islamabad, Peshawar valley (Marwat *et al*., 1992).

The aim of the present study was to monitor fruit fly, *B. zonata* population throughout the year and to determine the influence of meteorological factors such as temperature, relative humidity and sunshine on the population dynamics of the peach fruit fly, *B. zonata*.

MATERIALS AND METHODS

Study area

The experiment was conducted at the Nuclear Institute for Agriculture and Biology (NIAB), Faisalabad from January to December, 2015. The area in question mainly consists of mango, guava and citrus.

Design of the fruit fly trap and installation

The fruit fly trap was constructed from transparent plastic bottles of approximately 1 liter capacity. Two holes were cut, one in the lid and the other exactly the opposite to facilitate the entry of fruit flies. The holes were fitted with a PVC pipe of about 1/2 inch diameter with a length of 3 inches (Fig. 1). The lure was suspended exactly in the center. Ten traps were suspended with the branches of the

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fruit trees randomly about 2 meters above the soil surface. All the traps were randomly distributed among mango, guava and citrus plants.

Fig. 1. Design of the Methyl eugenol fruit fly trap, used to capture male *B. zonata* suspended by metal wire with guava tree in NIAB.

Attractant used in the study

Commercial formulation of methyl eugenol, a sex pheromone used specifically for capturing of *B. zonata* was used. Using a syringe 1 ml of methyl eugenol was applied to cotton and then suspended in the middle of the bottle. The cotton swab was replaced every month with fresh ones.

Data analysis

Data of the ten traps were pooled for a single week and expressed as the number of fruit fly captured/month. Analysis of Variance (ANOVA) was performed using statix 8.1 and means were compared by Least Square Design (LSD). The differences among means were considered significant at $P \leq 0.05$ level. All the plots were drawn using software MS-EXCEL 2007.

RESULTS AND DISCUSSION

The fruit fly population showed a trend of fluctuation throughout the year. The highest mean numbers of fruit fly catch, 499 was recorded in August and the lowest fruit fly catch, 2/trap/month was recorded in February. The highly active months of fruit fly were from May to September, whereas the highly inactive months were December to March. Moderate population was recorded in the month of November and April (Table I). The optimum minimum and maximum temperatures correspond to the peak level of the weekly fruit fly catch were recorded at 25-40 °C, whereas temperature above 40 °C and below 20 °C were critical for fruit fly as very low or no fruit fly was recorded (Fig. 2A). The most favorable relative humidity range for the fruit fly was recorded between 40-60 % (Fig. 2B). Rain fall had no impact on the fruit fly population (Fig. 2C). The peak in the fruit fly population also coincided with the ripening of fruits.

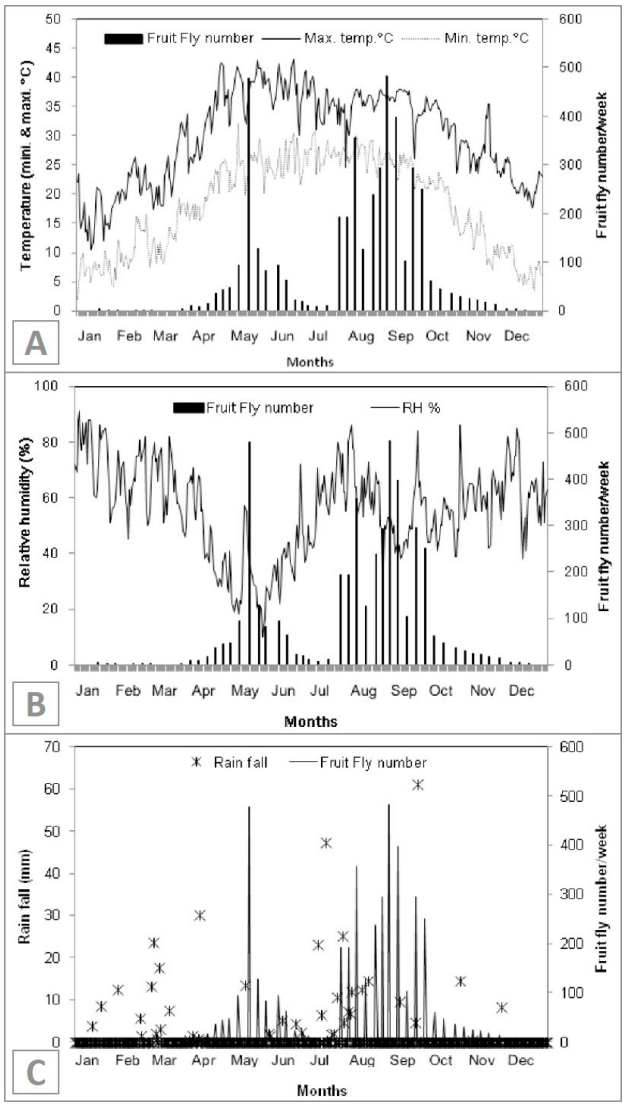

Fig. 2. Weekly population fluctuation of fruit fly in relation to minimum and maximum temperature (°C) (A), relative humidity (%) (B) and rain fall (mm) (C) in 2015.

This kind of trend has also been shown in the mango orchards during the fruiting season (Mwatawala *et al.*, 2006). In fact the presence of fruit trees and the fruiting duration can have significant effects on the peach fruit fly (Ye, 2001). The maximum population of peach fruit fly, *Bactrocera zonata*, was reported during the third week of June (357.0 flies/trap) in India. The peak population,

170.66 males/week, of the oriental fruit fly, *Bactrocera* spp. was also recorded in July in India (Agarwal and Kumar, 1999; Makhmoor and Singh, 1998). Abdel Galil *et al*. (2010) recorded a population peak of fruit flies in September that coincided with the ripening season of citrus, guava and mango. The present findings are more or less in line with the reports of the previous investigators.

Table I.- Fluctuation in the fruit fly population in relation to metrological data.

Months	Mean population[a]	Average temperature °C		Relative humidity (%)	Sun-shine (h)
		Max	Min		
January	2.00^{H}	16.48	6.89	75.32	4.99
February	1.67^{H}	21.95	11.13	66.03	5.57
March	4.33^{H}	24.50	13.64	64.03	6.99
April	51.00^{F}	33.21	20.71	43.86	9.10
May	129.33^{C}	36.69	24.87	27.54	10.61
June	70.67^{DE}	38.12	25.57	38.96	9.5
July	79.33^{D}	34.90	27	61.00	5.12
August	499.33^{A}	35.90	26.70	60.00	6.97
September	348.67^{B}	35.38	24.35	52.00	8.18
October	57.33^{EF}	32.13	19.09	52.87	8.29
November	26.33^{G}	27.10	12.06	61.50	6.58
December	3.67^{H}	21.75	7.21	62.60	7

[a] Means within the same column followed by the different letters are significantly different at P≤0.05 level according to ANOVA LSD test.

The fruit fly population started to decline after August, reaching to significantly lower number in October (Table I). Win *et al*. (2014) also reported the lower population in the month of October and November. In another study, Mahmood and Mishkatullah (2007) recorded lower population of fruit fly from November to February, whereas an increase was recorded from March to August. They also recorded peak population of trapped fly adults in July and August, whereas the maximum decline was recorded in October, depending upon the availability of mature fruits and temperature.

The population again started to build up from April to July and attaining peak level in August. In an earlier investigation, the author claimed that the maximum population of *Bactrocera* species was recorded in August (Mahmood and Mishkatullah, 2007). In line with the previous investigation *Dacus dorsalis* appeared in the field in April and reached the maximum population in August (Gillani *et al*., 2002). These high fruit fly catches coincided with the guava fruiting season. The population dynamics of the fruit fly population are strongly influenced by the abiotic factors such as temperature and rainfall (Amice and Sales, 1997). The significant effect of the weather factors on population of the fruit fly and among them, rainfall have been reported as the most important factor. (Khan *et al*., 2003).

The lowest numbers of catches were recorded from December to March showing no significant differences in population. This may be due to the low availability of fruit and low temperature. The population of fruit fly started to build up at the end of March. The main factor affecting population build-up of fruit flies in the tropics is fruit abundance and availability (Papadopoulos, 1999). The availability of hosts and abundance of cultivated fruits such as, mangos and guavas are important factors which contribute to the population fluctuations of *Bactrocera species* (Drew and Hooper, 1983).

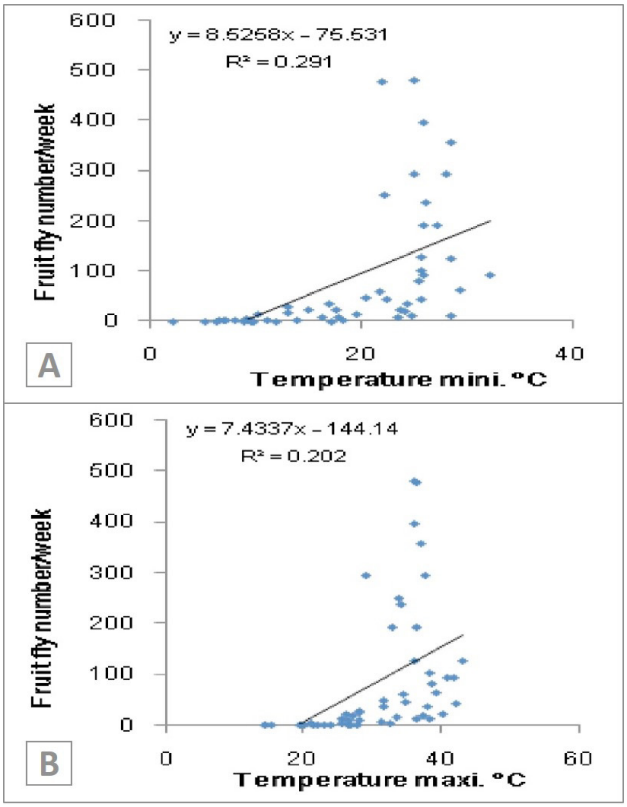

Fig. 3. Relationship between fruit fly number and minimum temperature (°C) (A) and maximum temperature (°C) (B) in 2015.

The weak positive correlation between fruit fly population and temperature was observed (Fig. 3A, B). No correlation was seen for sunshine hours, and relative humidity to the number of insects trapped (Fig. 4A, B). Amice and Sales (1997) observed influence of abiotic factors, such as temperature on the population dynamics

of fruit flies. Win *et al*. (2014) reported a positive correlation (r=0.33) of minimum temperature with insect count. Similarly, positive correlation of the fruit fly with temperature was reported by Kannan and Venugopala (2006). Sarada *et al*. (2001) reported a population of *Bactrocera sp.* showed positive correlation with minimum temperature and weak positive correlation with maximum temperature. Our results are in agreement with these previous researchers.

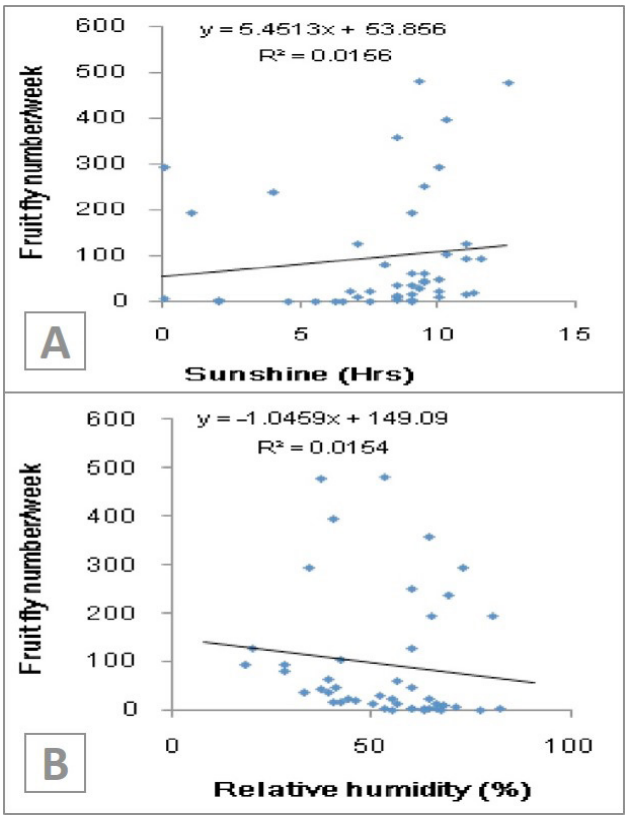

Fig. 4. Relationship between fruit fly number and sun shine (h) (A) and relative humidity (%) (B) in 2015.

CONCLUSION

Based on the results of our current studies, although the population of fruit fly is strongly influenced by the minimum and maximum temperatures, availability of the ripened fruits, especially mango and guava is a major limiting factor for the population build-up of *B. zonata.*

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Statement of conflict of interest

We declare that we have no conflict of interest

REFERENCES

Abdel-Galil, F.A., Amro, M.A., Abdel-Moniem A.S.H. and El-Fandary O.O., 2010. Population fluctuations and interspecific competition between Tephritid flies attacking fruit crops in the New Valley oases, Egypt. *Arch. Phytopathol. Pl. Protect.,* **43**: 647-659. https://doi.org/10.1080/03235400802021272

Agarwal, M.L. and Kumar, P., 1999. Effect of weather parameters on population dynamics of peach fruit fly, *Bactrocera zonata* (Saunders). *Entomology,* **24**: 81-84.

Amice, R. and Sales, F., 1997. Seasonal abundance of fruit flies in New Caledonia. In: *Management of fruit flies in the Pacific* (eds. A.J. Allwood and R.A.I. Drew), *ACIAR Proc.,* **76**: 134–139.

Drew, R.A.I. and Hooper, G.H.S., 1983. Population studies of fruit flies (Diptera: Tephritidae) in South East Queensland. *Oecologia (Berl.),* **26**: 153-159. https://doi.org/10.1007/BF00379685

El-Gendy, I.R., 2012. Evaluating attractency of some protein derivatives for the Mediterranean fruit fly, *Ceratitis capitata* (Wiedmann) and the peach fruit fly, *Bactrocera zonata* (Saunders). *Int. J. agric. Res.*, **7**: 185-194.

El-Minshawy, A.M., El-Eryan, M.A. and Awad, A.I., 1999. Biological and morphological studies on the guava fruit fly, *Bactrocera zonata* Saunders) (Diptera: Tephritidae) found recently in Egypt. *8th Nat. Conf. Pests & Dis. of Veg. & Fruits in Ismailia*, Egypt, pp. 71-82.

Ghanim, N.M., 2009. *Studies on the peach fruit fly,* Bactrocera zonata *(Saunders) (Tephritidae, Diptera)*. Ph. D. thesis, Faculty of Agriculture, Mansoura University, Mansoura, Egypt.

Gillani, W.A., Bashir, T. and Ilyas, M., 2002. Studies on population dynamics of fruit flies (Diptera: Tephritidae) in guava and nectrin orchards in Islamabad. *Pak. J. biol. Sci.,* **5**: 452-454. https://doi.org/10.3923/pjbs.2002.452.454

Hashem, A.G., El-Wakad, M.F. and Soliman, N.A., 2004. *The fruit flies*. Egyptian Agriculture Ministry, The Agricultural Guidance Division, Egypt, pp. 1-35.

Kapoor, V.C. and Agarwal, M.L., 1982. *Fruit flies and their increasing host plants in India*. Proc. CEC/ IOBC Intern. Symp. Athens/Greece, pp. 252–257.

Khan, M.A., Ashfaq, M. and Khaliq, A., 2003. Role of abiotic factors in population and infestation

fluctuation of fruit flies in guava or chards of Sheikhupura District. *Pak. Entomol.,* **25**: 89–93.

Kannan, M. and Venugopala R.N., 2006. Ecologicoal studies on mango fruit fly, *Bactrocera dorsalis* Hendel. *Annls. Pl. Protect. Sci.,* **14**: 340–342.

Liquido, N.J., Cunningham, R.T. and Nakagawa, S., 1990. Host plants of Mediterranean fruit fly (Diptera: Tephritidae) on the Island of Hawaii (1949-1985 Survey). *J. econ. Ent*., **83**: 1863–1878. https://doi.org/10.1093/jee/83.5.1863

Mahmood, K. and Mishkatullah, 2007. Population dynamics of three species of *Bactrocera* (Diptera:Tephritidae: Dacinae) in BARI, Chakwal (Punjab). *Pakistan J. Zool.,* **39**: 123-126.

Makhmoor, H.D. and Singh, S.T., 1998. Effect of concentration of methyl eugenol for the control of guava fruit fly, *Dacus dorsalis* Hedel in guava Orchard. *Annls. Pl. Protect. Sci.,* **6**: 165-169.

Marwat, N.K., Hussain, N. and Khan, A., 1992. Suppression of population and infestation of *Dacus* spp. by male annihilation in guava orchard. *Pakistan J. Zool.,* **24**: 82-84.

Mwatawala, M.W., De Meyer, M., Makundi, R.H. and Maerere, A.P., 2006. Biodiversity of fruit flies (Diptera: Tephritidae) in orchards in different agro-ecological zones of the Morogoro region, Tanzania. *Fruits,* **61**: 321-332. https://doi.org/10.1051/fruits:2006031

Papadopoulos, N.T., 1999. *Study on the biology and ecology of the Mediterranean fruit fly* Ceratitis capitata *(Diptera: Tephritidae) in northern Greece*. PhD dissertation, Aristotle University of Thessaloniki, Thessaloniki, Greece.

Sarada, G., Maheswari, T.U. and Purushotham, K., 2001. Seasonal incidence and population fluctuation of fruit flies in mango and guava. *Indian J. Ent.*, **63**: 272-276.

Stonehouse, J.M., Mumford, J.D. and Mustafa, G., 1998. Economic losses to tephritid fruit flies (Diptera: Tephritidae) in Pakistan. *Crop Protect.* **17**: 159-164. https://doi.org/10.1016/S0261-2194(97)00091-4

Tan, K.H. and Nishida, R., 1998. Ecological significance of a male attractant in the defence and mating strategies of the fruit fly pest, *Bactrocera papayae. Ent. Exp. appl.*, **89**: 155-158.

White, I.M. and Elson-Harris, M.M., 1992. *Fruit flies of economic significance: their identification and bionomics.* CAB International, Wallingford. U.K., pp. 601.

Win, N.Z., Mi, K.M., Oo, T.T., Win, K.K., Park, J. and Park. J.K., 2014. Occurrence of fruit flies (Diptera: Tephritidae) in fruit orchards from Myanmar. *Korean J. appl. Ent.,* **53**: 323-329.

Ye, H., 2001 Distribution of the oriental fruit fly (Diptera: Tephritidae) in Yunnan province. *Ent. Sin.*, **8**: 175-182.