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Population Dynamics of Three Species of Genus *Bactrocera* (Diptera: Tephritidae: Dacinae) in BARI, Chakwal (Punjab)

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Abstract.- The population dynamics of three important pest species, peach fruit fly *Bactrocera zonata,* melon fruit fly *Bactrocera cucurbitae* and Oriental fruit fly, *Bactrocera dorsalis* (Diptera: Tephritidae) was conducted all the year round monitoring through male lure-traps during 1998-1999 in Barani Agricultural Research Institute, Chakwal, Northern Punjab. The fruit flies showed a low population level from November to February, and increased level from March to August. The population peak appeared in July and August and maximum declined was observed in October depending on the host fruit maturity, temperature and rainfall. Availability of host fruits was another essential factor affecting population fluctuation. Peach, guava, different species of sweet orange, pear, mango and melon were the main host plant. Peach, guava and mango were the preferred hosts, therefore, their fruiting period and productivity exerted essential effects on the fly population fluctuation.

Key words: Population dynamics, *Bactrocera zonata, Bactrocera cucurbitae, Bactrocera dorsalis,* fruit flies.

INTRODUCTION

Fruit flies (Diptera: Tephritidae) incur most of the damage to fruits and vegetables in the Indian sub-continent. The members of the subfamily Dacinae infest almost all kinds of fleshy fruits, including solanaceous and cucurbitaceous plants. Many species are specialized, and host specific, in their feeding habits while others are generalists and attack a wide range of fruits and vegetables (Kapoor *et al.,* 1980). Three most notorious and destructive species of fruit flies in the old world tropics are peach fruit fly *Bactrocera (Bactrocera) zonata* (Saunders), melon fruit fly *Bactrocera (Zeugodacus) cucurbitae* Coquillett and Oriental fruit fly, *Bactrocera (Bactrocera) dorsalis* Hendel. These species are widespread in the Oriental region. *Bactrocera zonata* originated in South and South-East Asia where it attacks many (more than 50) host plants, including guava, mango, peach, apricot, fig and citrus (White and Elson-Harris, 1992). *Bactrocera cucurbitae* has been recorded from more than 125 fruits of host species. This species is native to tropical Asia and widespread as far west as Pakistan. Melon fly causes considerable damage to all cucurbit crops everywhere it occurs. Reports from Pakistan reveal that *B. cucurbitae* normally causes 20-75% damage to melon production (Kafi, 1986).

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Bactrocera dorsalis is a very destructive insect pest of many fruits and infests over 100 host plants including many types of commercial fruits, such as citrus, mango and peach as well as a wide range tropical and subtropical fruits and vegetables (Hui and Liu, 2005). It was first recorded in 1912 from Taiwan and now it is established in the Asia Pacific region. It is also introduced in USA. About 80% of guava fruits in markets were infested by this species. In present work the population dynamics of three pest species was studied as temporal distribution is essential before a low input IPM strategy could be designed.

MATERIALS AND METHODS

Male lure traps made from plastic bottles that measured 20 cm in length and 8 cm in diameter. These traps had two holes on each side to allow the flies to enter inside. Male lures were suspended inside each trap, near the centre. The lures consisted

of a small cotton wick soaked with 2 ml of methyl eugenol (ME) or cue lure (CL) and few drops of insecticides (Chlorpyrifos). These lures, mixed with insecticides were replaced fortnightly throughout the year. Male flies were attracted to lures, and quickly killed by the insecticide on the cotton wick.

These traps were hung two meters high with fruit trees, in the experimental orchards of Barani Agricultural Research Institute, Chakwal (31°55' 96"N, 72°43' 37"E, 1725 feet altitude) in 1998-1999. The experimental orchards comprised of different varieties of peach, plum, apricot, almond, sweet lime, sweet orange, orange, dates, grape fruit, olive, guava, fig, mango, lemon and different vegetables like different types of gourds, melon and watermelon.

The captured male flies were collected and counted on daily basis and then added to monthly basis. Flies were identified using identification key developed by Mahmood and Hasan (2005). Flies were destroyed after identification and counting. The specimens of rare species were preserved and deposited in Pakistan Museum of Natural History, Islamabad. Meteorological data used in this study were provided by Soil and Water Conservation Research Institute, Chakwal.

The trapping capture data presented as an average without special statistical analysis. A Correlation analysis was performed on the data of captured flies (Dependent variable) of three important species and monthly mean temperature (Independent variable). For this purpose correlation coefficient "r" (also called Pearson's product moment correlation after Karl Pearson) was calculated by the formula

$$r = \frac{\sum XY - \frac{\sum X \sum Y}{N}}{\sqrt{\left(\sum X^2 - \frac{(\sum X)^2}{N}\right)\left(\sum Y^2 - \frac{(\sum Y)^2}{N}\right)}}$$

To test the significance of "r" a modified t-test was conducted at a specified level of significance (alpha a = 0.05) with N-2 degree of freedom. In case if the "r" was less than or equal to the critical value of "r" (tabulated), then null hypothesis is accepted. In contrary null hypothesis is rejected. These analyses were worked out using software Analyze-it for Microsoft Excel.

RESULTS AND DISCUSSION

The captured flies mostly contained three species peach fruit fly *Bactrocera zonata*, melon fruit fly *Bactrocera cucurbitae* and Oriental fruit fly, *Bactrocera dorsalis. Bactrocera (Zeugodacus) zahadi* Mahmood and *Bactrocera (Bactrocera) nigrofemoralis* White & Tsruta have also been recorded occasionally. *Bactrocera (Zeugodacus) signata* (Hering) and *Bactrocera (Zeugodacus) duplicata* (Bezzi) were also recorded for the first time from Pakistan. These were already known from India (Mahmood, 2006). Decrease in populations of all three species was recorded in second year, which could be the result of continuous trapping. However, it could not be compared with the level of infestation by these species during these years. This decrease in population may be due to the reason that flies avoided to go in traps.

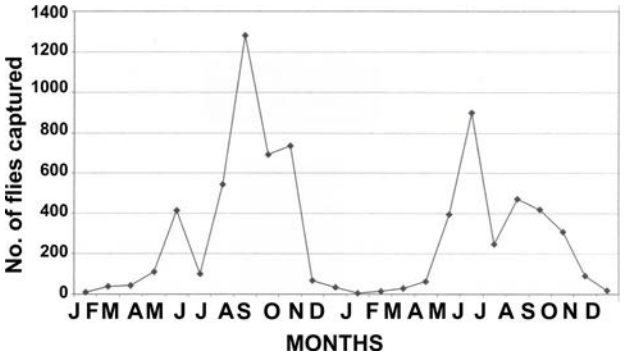

Fig. 1. Population dynamics of *Bactrocera zonata*.

Population of peach fruit flies, Bactrocera zonata

Figure 1 shows population of *B. zonata*, which was minimum (9 flies) with mean temperature 10.95°C in January, 1998. Ripened fruits of almost all citrus varieties were available but its population could not increase in January and February due to unfavorable (low) temperature. There was a gradual increase in number of flies caught in March (48), April (110) and in May (416) as peach fruit matured in April and May. The peach fruit was heavily (90%) infested by fruit fly. The

mean temperature also gradually increased from 15.93°C (March) to 27.26°C (May). Then there was a slight fall in its population in June (100 flies) as its regular host was not available, high temperature (30.8°C) and low humidity. In July the population of this species again increased to 546 with the mean temperature 30.18°C. Monsoon season usually starts in early July and humidity increases significantly. Maximum flies were recorded in August 1998 (1282 flies) with mean temperature 29.11°C and humidity is also high in this month. Mango and guava fruits ripened during July and August. These fruit were heavily attacked by different species of fruit flies. High infestation of guava has resulted in abandoning the production of this popular fruit in Southern Pakistan thus declining its export by about 50% (Kafi, 1986). Number of flies captured gradually decreased from September (694) to thirty three in December due to unavailability of host and decrease in temperature (27.25°C and 12.36°C, respectively). During 1999, lowest population (5 flies) with lowest mean temperature (9.87°C) was in January. Then there was a gradual increase in the population of this species and mean temperature till June, when its population was maximum (896 flies) with mean temperature (30.59°C), and then gradually decreased to twenty one flies with 12.6°C in December 1999.

The value of "$r_{(cal)}$" (0.68) (Table I) was greater than the value of "$r_{(tab)}$" (0.515 when α = 0.01) at 22 degree of freedom, indicates that there was positive correlation between the temperature and population of *B. zonata* (Fig. 2).

Table I.- Values of correlation coefficient.

Species	DF	Value of r	Value of t	2-tailed p
B. zonata	22	0.68	4.33^{***}	0.0003
B. cucurbitae	22	0.48	2.57^{**}	0.0176
B. dorsalis	22	0.34	1.70^{ns}	0.1

Population of melon fruit fly, Bactrocera cucurbitae

Figure 3 shows population of *B. cucurbitae*, which was minimum (one specimen) with mean temperature 10.95°C in January 1998. There was a gradual increase in number of flies caught (261) with rise in temperature (27.26°C) up to May. The number of collected flies decreased to 53 in June, due to unavailability of host, high day temperature and low humidity. Maximum flies (481) were recorded in August, when mean temperature was 29.11°C and humidity was also high due to onset of monsoon season. Melon, mango and guava fruits ripened during July and August. These fruits were heavily attacked by different species of fruit flies. Damage of 20% to 75% to melon production has been reported by this species. (Kafi, 1986). After August the number of flies gradually decreased to six in December due to unavailability of host and decrease in temperature (12.36°C).

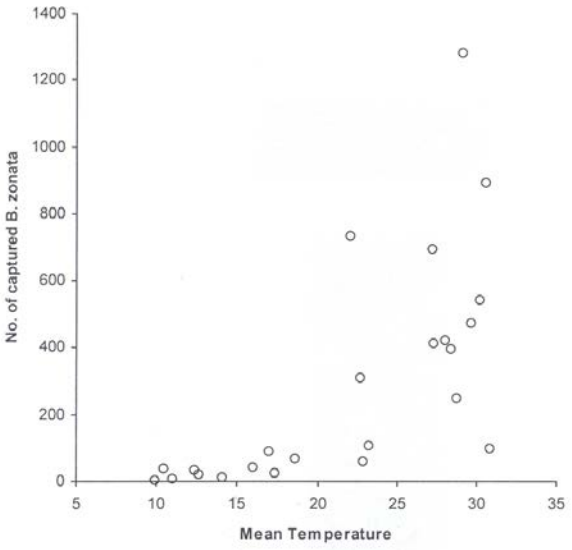

Fig. 2. Scatergram depicting Pearson's correlation between mean temperature and number of captured flies of *B. zonata* during the study period.

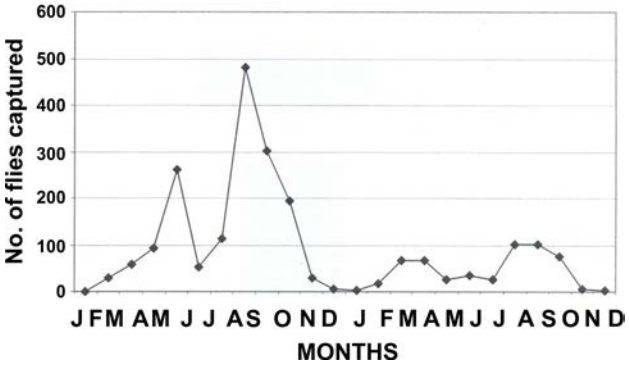

Fig. 3. Population dynamics of *Bactrocera cucurbitae*.

During 1999, lowest population (4 flies) was in January, with mean temperature 9.87°C. Then there was a gradual increase in the population till August and September, when the population of flies was 102 and 101, with mean temperature 29.68°C and 28.03°C, respectively. Then there was a gradual decrease in population till December 1999 (4 flies) with mean temperature 12.06°C.

The value of "$r_{(cal)}$" (0.48) (Table I) was greater than value of "$r_{(tab)}$" (0.404 when $\alpha = 0.05$) at 22 degree freedom, indicated that there was positive correlation between average mean temperature and population of *B. cucurbitae* (Fig. 4).

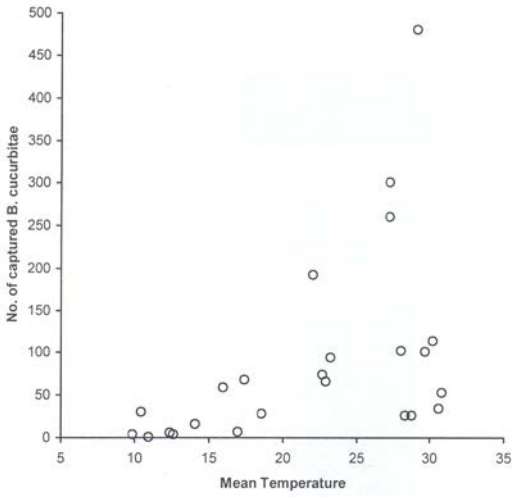

Fig. 4. Scatergram depicting Pearson's correlation between mean temperature and number of captured flies of *B. cucurbitae* during the study period.

Population of the oriental fruit fly, B. dorsalis

Figure 5 shows population of *B. dorsalis*, which was minimum (0) in January 1998 with mean temperature 10.95°C. There was a gradual increase in number of flies caught, maximum flies (141) were recorded in August with mean temperature 29.11°C and humidity was also high. Mango and guava fruits ripened during July and August, and this species is a major pest of these fruits. After August the number of flies gradually decreased and no specimen was recorded in December due to unavailability of host and low temperature (12.36°C). During 1999, lowest population (0 flies) was in January when mean temperature was 9.87°C. Then there was a gradual increase in the population till August when the number of flies trapped was 15. There was a gradual decrease in population captured till December 1999 when the specimens of this species were not recorded.

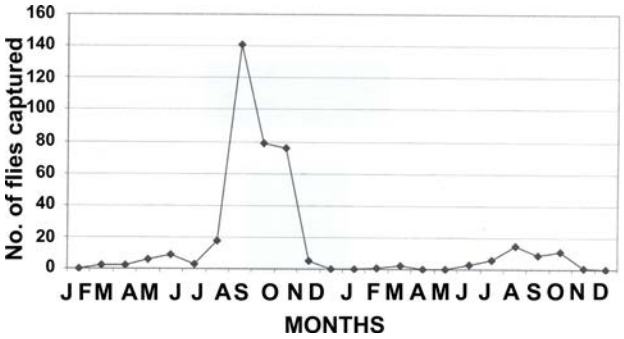

Fig. 5. Population dynamics of *Bactrocera dorsalis.*

There was no positive correlation between the temperature and population of *B. dorsalis* (Table I).

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REFERENCE

KAFI, A., 1986. *Progress and problems in controlling fruit flies infestation*. Paper presented at F AO expert consultation on progress and problems in controlling fruit fly infestation, RAP A, Bankock, 16-19 December 1986.

KAPOOR, V. C., HARDY, D.E., AGARWAL, M.L. AND GREWAL, J.S., 1980. *Fruit fly (Diptera: Tephritidae) systematics of the Indian subcontinent.* Export Indian Publisher Jullundur. India.

HUI, Y. AND LIU, J., 2005. Population dynamics of the oriental fruit fly, *Bactrocera dorsalis* (Diptera: Tephritidae) in the Kunming area, southwestern China. *Insect Sci.*, **12**:387-392.

MAHMOOD, K., 2006. New record of two of fruit flies (Dacinae, Tephritidae, Diptera) species from Pakistan. *Pakistan J. Zool.*, **38**: 82-83.

MAHMOOD, K. AND HASAN, S. A., 2005. Revision of Subfamily Dacinae (fruit flies) (Tephritidae: Diptera) of South East Asia. *Pakistan J. Zool. Suppl.*, **7**: 1-65.

WHITE, I.M. AND ELSON-HARRIS, M.M., 1992. *Fruit flies*

of economic significance: their identification and bionomics. C.A.B. International, U.K, pp. 601.

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