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SPECIES DIVERSITY AND ECONOMIC TRAP OF FRUIT FLY (*BACTROCERA* SPP.) (TEPHRITIDAE: DIPTERA) POPULATION WITH ABIOTIC FACTORS

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ABSTRACT

The flies of family Tephritidae are sometimes called the 'true fruit flies'. Field experiments were conducted to study on species diversity and economic trap of fruit fly (*Bactrocera* spp.) (Tephritidae: Diptera) population with abiotic factors in Bundelkhand region Jhansi (U.P.). The population range of *Bactrocera affinis*, *B. cucurbitae*, *B. dorsalis* and *B. zonata* was recorded. *Bactrocera cucurbitae* was predominant species in cue lure and *B. zonata* in methyl eugenol baited traps. Bottle fruit fly trap baited with cue lure and methyl eugenol was superior to Mc Phail and Param fruit fly traps. Bottle fruit fly trap were trapped 5948 fruit flies with cue lure and 2798 fruit flies in methyl eugenol which were 23.58 and 11.09 per cent of total trapped flies, respectively. Bottle fruit fly trap baited with cue lure was most economic compression to other traps and trapped 10.5 fruit flies after one rupee investment and in methyl eugenol it was trapped 8.4 fruit flies after one rupee investment. Cue lure para-pheromon was most effective and trapped a total of 17422 (69.05%) fruit flies. Cost of lure was superior in cue lure which trapped 6.2 flies after one rupee investment. *Bactrocera affinis*, *B. dorsalis* and *B. zonata* population trapped in methyl eugenol bait traps was significant with minimum temperature but it was non-significant with maximum temperature, relative humidity, and rainfall and wind velocity.

Key words : Fruit fly, Methyl eugenol, Diversity, Abiotic factors.

Introduction

The flies of family Tephritidae are sometimes called the 'true fruit flies'. Fruit flies are quarantine pest and their control is difficult. They have great impact on agriculture and the economy of many countries as they attack a number of plant species and cause enormous damage to fruits, vegetables and flower heads. Out of nearly 4,400 species of fruit flies distributed throughout

the world (Norrbom, 2004), 250 species are of economic importance and are distributed widely in temperate and sub-tropical regions of the world (Christenson and Foote, 1960), but the greatest diversity of species occur in the tropical regions (Norrbom *et al.*, 1998). The fruit fly species which are serious pests of agriculture throughout the world belongs to genera *viz.*, the major economically important species of fruit flies are *Bactrocera*

cucurbitae, *B. dorsalis*, *B. zonata* and *B. correcta*. Among these *B. dorsalis*, *B. zonata* and *B. correcta* infest mango and guava (Verghese and Devi, 1998) and *B. cucurbitae* infests cucurbitaceous vegetables (Atwal and Dhaliwal, 2002). Biotic factors *viz.*, parasites, predators, host plant resistance and abiotic factors *viz.*, temperature, rainfall, humidity and sunshine hours play an important role in regulation of the pest population. Parapheromones *viz.*, methyl eugenol and cue-lure are good male attractants and play an important role both in monitoring and management of fruit flies. Shukla and Mishra (2005) recommended hanging of traps baited with wooden blocks soaked in ethanol, methyl eugenol and malathion (6:4:1) @ 10 traps/ha in mango orchards during fruiting period *i.e.* from April to August for the management of *B. dorsalis* and *B. zonata*.

Materials and Methods

The studies conducted at Department of Entomology, Institute of Agricultural Sciences, Bundelkhand University Jhansi, U.P., India. Species diversity and economic trap of fruit fly (*Bactrocera* spp.) (Tephritidae: Diptera) population with abiotic factors were studied.

Preparation of Bottle fruit fly Trap

Bottle fruit fly Traps used in present study were prepared in the Laboratory of Department of Entomology, Institute of Agricultural Sciences, Bundelkhand University Jhansi, U.P., India. Sufficient number of transparent, white mineral water bottles of one litre capacity measuring 276 mm long, 76.4 mm wide at base and 27.4 mm at neck were purchased from market. A total of four entry holes of 22.5 mm² size were made at equal distance just below

the curve of the shoulders with the help of a blade. In order to hang soaked ply wood block/ cotton wick into the Bottle fruit fly Traps and for taking out trapped flies at the time of observations, each bottle was also cut from 60 mm above the bottom in such a way that the cut part may be replaced. A hole was also made in the lid of each bottle for the hanging the dispenser into the trap and also to hang the trap from the branch of fruit/bottle palm trees or bamboo poles fixed for the purpose.

10 to 12 holes were made into an old 1 liter plastic bottle or 3 holes on each side for allow flies enter. Put a wire from the cover to suspend the bait. Secure the pheromone dispenser aligns with the entrance holes inside the trap. Rectangular opening make in to the lower part of the container for removing the flies. Fill half the trap with soapy water. Put bait in the pheromone dispenser or suspend the pheromone capsule from the lid using string or wire. Hang on branch of a tree. Place traps for different pests at least 3 meters apart. If traps are used for monitoring the pests, 2-3 traps are enough for 1 ha field.

Results and Discussion

Result of investigations on “Species diversity and economic trap of fruit fly (*Bactrocera* spp.) (Tephritidae: Diptera) population with abiotic factors” carried out at the Organic Research Farm Kargunwa ji, Jhansi and in the Laboratory of the Department of Entomology, Institute of Agricultural Sciences, Bundelkhand University, Jhansi, Uttar Pradesh during the years 2019-20 and have been presented below

Effective and economic trap for fruit flies trapping

As per the data given in Table 1, the adult fruit flies population started soon after the installed bottle fruit fly traps baited with cue lure (CL) in the field and it was trapped 116.7±2.1 adults/traps/week in its first observation. The maximum population was recorded from 11th SW with 249.0±2.0 adults/traps/week. The maximum population was recorded just after the first observation at 46th SW but thereafter the population was observed to decrease manner in bottle fruit fly traps and it was lowest at 3rd SW.

The fruit fly population was recorded from McPhail fruit fly trap baited with cue lure (CL) start with 119.3±1.2 adults/traps/week but the lowest population was noticed in 2nd SW, while the highest population (205.0±3.6 adults/traps/week) was also noted in the last week of the trail. The population rang of trapped fruit fly, *Bactrocera cucurbitae* in Param fruit fly traps was 35.0±1.7 to 227.7±3.1 adults/traps/week. The population of fruit flies was recorded from Bottle fruit fly trap and baited with methyl eugenol with start from 45th SW to continue 11th



Fig. 1 : Bottle fruit fly Trap.

Table 1 : Effectiveness of the traps baited with para-pheromone against fruit flies, *Bactrocera* spp.

SW	Population (Mean±SD) of trapped fruit flies					
	CL			ME		
	BFFT [§]	MDFFT [*]	PFFT [#]	BFFT	MDFFT	PFFT
45	116.7±2.1	119.3±1.2	110.0±2.0	38.0±3.0	34.7±2.5	21.3±1.5
46	145.0±2.0	135.0±2.6	126.7±2.1	40.3±1.5	37.0±2.0	21.3±1.5
47	133.7±3.5	123.0±2.0	130.7±2.5	43.0±3.0	43.7±2.3	33.7±1.5
48	94.7±3.5	96.7±1.2	96.0±2.0	52.7±1.5	49.3±2.5	40.3±2.1
49	89.3±1.5	87.7±3.5	88.0±2.6	56.7±2.1	52.7±1.2	52.0±3.6
50	61.3±2.1	62.7±1.5	59.3±2.1	60.7±1.5	60.3±1.5	61.7±2.5
51	55.0±2.0	53.7±1.5	51.7±1.2	44.0±3.0	42.7±2.1	52.7±1.5
52	50.7±2.1	50.0±2.0	50.3±1.5	36.7±2.1	33.7±2.1	46.0±2.0
1	43.3±2.5	43.0±2.6	40.3±1.5	34.3±1.5	32.3±2.5	38.3±3.1
2	39.0±1.0	38.7±2.1	36.7±1.5	23.0±2.0	24.3±1.5	35.0±2.0
3	34.7±2.5	36.7±1.5	35.0±1.7	19.3±0.6	22.0±1.0	28.0±2.6
4	56.0±2.6	48.0±3.6	53.3±2.5	26.3±2.5	24.3±1.5	22.0±2.0
5	76.0±3.0	76.3±1.5	78.3±2.1	31.7±2.1	33.0±2.0	20.3±2.5
6	94.7±3.1	99.0±2.0	94.7±2.1	45.7±2.1	42.0±1.7	25.0±2.6
7	106.3±3.1	109.3±2.5	106.3±2.5	49.7±1.5	51.7±1.5	33.0±2.6
8	144.3±2.5	138.0±2.0	144.3±2.1	68.7±1.5	70.3±2.5	42.7±2.5
9	190.0±3.0	173.3±3.1	193.0±2.6	77.0±2.0	79.3±1.5	50.7±1.5
10	203.0±2.0	200.3±2.5	206.7±2.5	86.7±2.1	88.0±2.0	61.0±2.0
11	249.0±2.0	205.0±3.6	227.7±3.1	98.3±2.5	95.3±3.1	68.0±1.7

[§]Bottle Fruit Fly Trap, ^{*}McPhail Fruit Fly Trap, [#]Param Fruit Fly Trap.

SW during study period. The population was increased after first observation to continue 51st SW but after that it started decreased in the traps by 3rd SW and then it was seen in increasing order till last week. Mc Phail fruit fly traps were show similarity in fruit fly trapping but there was population rang was recorded between 22.0±1.0 to 95.3±3.1 adults/traps/week. The Param fruit fly traps were trapped maximum population of fruit fly at 11th SW with 68.0±1.7 adults/traps/week.

The maximum flies were trapped in Bottle fruit fly trap baited with cue lure followed by Param fruit fly trap, McPhail fruit fly trap but when these traps baited with methyl eugenol then maximum population was trapped in Bottle fruit fly traps followed by Mc Phail fruit fly traps and Param fruit fly trap. Pal *et al.* (2012-b) reported that the Rakshak Fruit Fly Trap was superior to bottle fruit fly trap. Performance of traps have been evaluated earlier also (Patel and Patel, 1998; Jhala *et al.*, 2008; Shukla *et al.*, 2008 and Chua, 2009), but none of these workers have evaluated the performance of Rakshak fruit fly Trap hence present results could not be compared.

The economic performance of the fruit fly traps was based on the numbers of trapped fruit flies after per rupee investment. The Bottle fruit fly trap baited with cue lure

was most effective and economically because it has trapped a total of 5948 adult fruit flies (FFs) and it was 23.58 per cent of totaled trapped flies in both the lures (Table 2). The cost benefit was highest with trapped 10.5 fruit flies after per rupee investment followed by Mc Phail Fruit fly traps (5.4 FFs/rupee) and Param fruit fly traps (5.0 FFs/rupee) with cue lure. Pal *et al.* (2012-b) earlier reported that the Bottle Fruit Fly Traps dispensed through cotton wick and replenished at 3 months interval proved most economical (205.38FFs/rupee).

Rakshak fruit fly Trap baited with ME, maximum 38.25 & 31.09 FFs per rupee investment were trapped during June, 2011 and 2012, respectively. The Bottle fruit fly trap baited with methyl eugenol was most effective and economically followed by Mc Phail Fruit fly traps and Param fruit fly traps. In this trap was capturing 2798 FFs (11.09%) of total trapped flies. The lowest cost of benefit (2.4 FFs/rupee) was noticed in case of Param fruit fly trap. Cue lure was most effective as well as economic followed by methyl eugenol. The numbers of flies caught by this lure was 17422, which was 69.05% of the total trapped flies and its economy was recorded at 6.2 FFs/rupee followed by methyl eugenol (3.7 FFs/rupee).

Table 2 : Economic performance of fruit fly traps.

	CL			ME		
	BFFT	MDFFT	PFFT	BFFT	MDFFT	PFFT
Cost/trap (Rs.)	56.5	106.0	116.5	33.5	79.5	95.60
Total cost of traps (Rs.)	565.0	1060.0	1165.0	335.0	795.0	956.0
Trapped fruit flies	5948	5687	5787	2798	2750	2259
Trap performance in per cent	23.58	22.50	22.94	11.09	10.9	8.95
Cost of benefit (FFs/rupee)	10.5	5.4	5.0	8.4	3.5	2.4
Lure performance	17422			7807		
Lure performance in per cent	69.05			30.95		
Cost of lure with traps	2790			2086		
Cost of benefit (FFs/rupee)	6.2			3.7		

Table 3 : Correlation coefficient between population of fruit flies and abiotic factors.

Abiotic factor	<i>B. affinis</i>	<i>B. cucurbitae</i>	<i>B. dorsalis</i>	<i>B. zonata</i>
Maximum temperature (°C)	0.3364 ^s	0.7233*	0.3511 ^s	0.3390 ^s
Minimum temperature (°C)	0.4429*	0.7400*	0.4545*	0.4449*
Relative humidity (%)	0.2032 ^s	0.4220*	0.2144 ^s	0.2049 ^s
Rain fall (mm)	0.2071 ^s	0.3054 ^s	0.2142 ^s	0.2080 ^s
Wind velocity (km/hr)	0.4004 ^s	0.2443 ^s	0.3963 ^s	0.3992 ^s

(Table value at 5% - 0.4155) *Significant, ^sNon-significant values.

Correlation between population of fruit flies and abiotic factors

The population of *Bactrocera affinis* was correlated with maximum & minimum temperature (°C), relative humidity (RH%), rain fall (mm) and wind velocity (km/hr). Its population was significant correlation with only minimum temperature but it was non significant with maximum temperature, relative humidity (RH%), rain fall (mm) and wind velocity (km/hr). Pal *et al.* (2015) were recorded that the *B. affinis* population was positive correlation with all abiotic factors.

The correlation was recorded as significant between population of *Bactrocera cucurbitae* and maximum & minimum temperature (°C) and relative humidity (RH%) but it was non-significant with (%), rain fall (mm) and wind velocity (km/hr). Pal *et al.* (2012-c) earlier reported that highly significantly negative correlation with minimum and maximum temperature, relative humidity and rainfall but positive correlation with sunshine. Paw *et al.* (1991) and Varma (1992-b) found significant positive correlation with minimum temperature (°C), rainfall (mm) and humidity (%).

Bactrocera dorsalis population was found to be non-significant correlation with minimum temperature, RH, rain fall and wind velocity where as it was significant with only maximum temperature. Gupta *et al.* (1990)

reported that the positive and significant correlation between population of *B. dorsalis* and rainfall (mm) in 1986, but negative and non-significant during 1987. Verghese and Devi (1998) recorded significant positive correlation with minimum temperature and wind speed. Bhatia (2000) recorded significant positive correlation between population caught in traps and minimum maximum temperature (°C). Babu and Viraktamath (2003) noted non-significant correlation with relative humidity and rainfall.

Non-significant correlation was recorded of the population of *B. zonata* with minimum temperature, RH, rain fall and wind velocity where as it was significant with only maximum temperature.

Gupta *et al.* (1990) found positive significant correlation with rainfall in 1986 and negative non-significant during 1987. Agarwal and Kumar (1999) found positive correlation with minimum and maximum temperatures and rainfall and negative correlation with RH (%).

Species diversity in fruit flies

A total of four species of fruit fly *viz.*, *B. affinis*, *B. cucurbitae*, *B. dorsalis* and *B. zonata* were recorded during study period. Three species of fruit fly *viz.*, *Bactrocera affinis*, *B. dorsalis* and *B. zonata* were trapped in methyl eugenol baited traps and one species *viz.*, *Bactrocera cucurbitae* was trapped in cue lure baited traps (Table 3). Pal *et al.* (2012b) were reported that a total of five species of fruit fly, *Bactrocera affinis*, *B. correcta*, *B. diversa*, *B. dorsalis* and *B. zonata* in methyl eugenol baited traps and four, *B. caudate*, *B. cucurbitae*, *B. nigrofemoralis* and *B. yercaudiae* in cue lure baited traps.

The results of “Study on Population Dynamic of Fruit fly, *Bactrocera* spp. (Tephritidae: Diptera) and Species Diversity” have been summarized below:

Effective and economic trap for fruit flies trapping

On an average, 147.26 fruit flies were trapped in Bottle fruit fly traps baited with cue lure on the basis of flies trapped but found population range 34.7±2.5-249.0±2.0 FFs/trap/week, whereas in case of methyl eugenol it was 19.3±0.6-98.3±2.5 FFs/trap/week. McPhail

fruit fly trap baited with cue lure, an average of the total population captured by it was 299.31 fruit flies per week while it was 144.73 in methyl eugenol. The population range of trapped fruit fly in Param fruit fly trap baited with cue lure was 35.0 ± 1.7 - 227.7 ± 3.1 FFs/trap/week while it was 20.3 ± 2.5 - 68.0 ± 1.7 FFs/trap/week in case of methyl eugenol.

The economics performance of the Bottle fruit fly trap when it was baited with cue lure was captured at the rate of 10.5 fruit flies per puree investment, which is double the profit of the other traps of this lure, while in the same order, McPhail fruit fly Trap came in second and Param fruit fly trap came in third position. Even when bottle fruit fly trap was baited with methyl eugenol, its performance was more than double that of other traps. If the performance of the lure is observed that the cue lure trapped 38.1 per cent more flies than the methyl eugenol whereas on the basis of economics, it caught 6.2 flies after per rupee investment.

Correlation between population of fruit flies and abiotic factors

Environmental factors have a direct impact on the population of fruit flies. The correlation was Non-significant between population of *Bactrocera affinis* with maximum temperature, relative humidity, rainfall and wind velocity while it was significant with minimum temperature. The population of *Bactrocera cucurbitae* was correlate significant with minimum and maximum temperature and RH%, while it was non-significant with rainfall and wind velocity. *Bactrocera dorsalis* and *B. zonata* population was correlate and follow as *B. affinis*.

Species diversity in fruit flies

A total of four species of fruit fly were trapped in para-pheromon traps. Three species viz., *Bactrocera affinis*, *B. dorsalis* and *B. zonata* were trapped in methyl eugenol baited traps while only one species, *Bactrocera cucurbitae* was trapped in cue lure baited traps.

Conclusion

- *Bactrocera cucurbitae* was predominant species of fruit fly during study.
- *Bactrocera zonata* was predominant species comparison to *B. affinis* and *B. dorsalis* of fruit fly which were trapped in traps baited with methyl eugenol.
- Bottle fruit fly trap baited with cue lure was trapped 5948 fruit flies but when it was baited with methyl eugenol it caught 2798 flies.
- Mc Phail fruit fly traps baited with cue lure was

trapped 5687 (22.5%) fruit flies while in methyl eugenol it was trapped 2750 (10.9%) flies.

- Param fruit fly trap baited with cue lure was trapped 5787 (22.94%) fruit flies, while in methyl eugenol, it was trapped 2259 (8.95%) flies.
- Bottle fruit fly trap baited with cue lure was most economic compression to other traps and trapped 10.5 fruit flies after one rupee investment.
- Bottle fruit fly trap baited with methyl eugenol was most economic compression to other traps and trapped 8.4 fruit flies after one rupee investment.
- Cue lure para-pheromon was most effective with good performance and trapped a total of 17422 fruit flies. It was 69.05% of total trapped files.
- Cost of lure was supper in cue lure which trapped 6.2 flies after one rupee investment.

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