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DIVERSITY AND POPULATION DYNAMIC OF FRUIT FLIES SPECIES IN METHYL EUGENOL BASED PARAPHEROMONE TRAPS IN JHARKHAND REGION OF INDIA

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ABSTRACT

Fruit flies (Diptera: Tephritidae) are one of the most diverse group of insects, comprising over 4000 species in 481 genera. This study involved four mango growing districts of Jharkhand situated between 22°48' to 23°45' N L and 84°21' to 85°30' E L. Methyl eugenol based parapheromone traps were used for detection and monitoring of fruit flies pests during fruiting period (from March to July) of mango in year 2012. Three fruit flies species, *Bactrocera zonata* (Saunders), *Bactrocera dorsalis* (Hendel) and *Bactrocera diversa* (Coquillett) were recorded during the monitoring period. According to data of observation on this investigation, *B. Zonata* was recognised as the predominant species infesting mango fruits in the state, comprising 95.04, 93.12, 94.65 and 96.76 percent of population in mango growing areas of Ranchi, Gumla, Lohardaga and Khunti, respectively. Besides this, low population of *B. dorsalis* (2.13 to 4.01 percent) and *B. diversa* (0.60 to 1.50 percent) from different areas were also recorded. Maximum population index (FTD) were 536, 443, 715 and 460 recorded from Ranchi, Gumla, Lohardaga and Khunti district, respectively in the month of April, 2012 coincided with most susceptible stages of infestation viz. stone to fully grown fruit of mango.

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INTRODUCTION

Jharkhand is known for immense natural forest ecosystems integrated fruiting orchard systems. It houses rich plant diversity and a large number of native species of fruit trees, including various species of Anacardiaceae, Myrtaceae, and Sapotaceae. Mango (*Mangifera indica* L.), a member of the family Anacardiaceae, is one of the world's most important tropical fruit. Mango is the most common fruit in Jharkhand region and could be easily cultivated in the eastern part of the country. Its production, however, has been threatened by insect and disease problem and it is considered potential host plants for the species of frugivorous Tephritoidea. Maximum infestation of fruit flies on mango fruits is occurring from stone to fruit maturity stage (Manrakhan and Price, 1999; Mishra *et al.*, 2012).

Fruit flies (Diptera: Tephritidae) are one of the most diverse group of insects, comprising over 4000 species in 481 genera. Tephritid flies of the genus *Bactrocera* are of particular concern throughout Asia and Australia (Kim *et al.*, 1999). There are about 500 described species of *Bactrocera* that are grouped into 28 subgenera (Drew and Hancock 2000). Enormous damage to mango has been caused by these species through its larvae, which feed on fruits. Due to broad host range, wide climate tolerance and high dispersal capacity (Peterson and Denno, 1998), distribution range of these insect has covered the Asia-Pacific region in the last century, ranging from India to Hawaii and encompassing all of South-East Asia. Negative impacts on biodiversity in invaded regions by *B. dorsalis* have also been observed (Duyck *et al.*, 2004). Kapoor *et al.* (1980) included 176 species in the review on Indian Tephritidae out of which 34 belonged to the genus *Bactrocera*. Two important pest species, *Bactrocera tryoni* (Froggatt) and *Ceratitis capitata* Wiedemann have not been reported from India. Bhalla and Pawar (1977) reported *B. zonata* (*Dacus zonatus*) and *B. dorsalis* (*D. dorsalis*) as pests of stone fruits, guava and mango. They are the cause of quarantine constraints imposed by many countries to restrict their entry, and they significantly influence commerce inside and outside of the countries producing fruits and vegetables around the world. Changes in environmental conditions and cropping pattern in Jharkhand have resulted to changes in the species composition and population dynamic of fruit flies. Monitoring of fruit flies diversity and population dynamics in Jharkhand region are a very important and fundamental activities related to the implementation of integrated pest management and pest free zone for export to mango fruits. Methyl eugenol traps has strong olfactory action to attract many fruit fly species from a distance of 1000m and it can be used to monitor to these pest (Vargas *et al.*, 2000).

This paper describes the diversity of tephritid species on methyl eugenol based parapheromone trapping in the Jharkhand region of India, coincidence of population of fruit flies with most susceptible stage of fruits for lying eggs.

MATERIALS AND METHODS

This study was carried out on methyl eugenol based trapping survey in the twenty mango orchards at the districts Ranchi, Gumla, Khunti and Lohardagha of Jharkhand

state of India during mango fruiting period of year 2012 (Table 1). Numbers of traps for fruit fly monitoring were deployed according to method of surveillance for fruit flies described in Manual for Mango Pest Surveillance (NICRA Team of Mango Pest Surveillance, 2011). Fruit fly traps were fabricated from plastic containers (3.5cm radius, 10cm high with holes of 4.3cm in diameter) with a wooden block (5x5cm^2 with 1.2cm thickness) containing methyl eugenol, ethanol and Dimethyl 2, 2-dichlorovinyl phosphate (DDVP) in the ratio of 4:6:1 (v/v). The trapping bottles were placed on the tree branches, 1.60m above the ground, approximately 800m apart from one another to maximize the trapping and minimise to interface with each other. Trap bottles were emptied of their fly catches once a week and their positions also changed within orchards to have of being placed in all the positions in the orchards. The collected fruit flies were stored in vials with 70% ethanol, transported to the Entomological laboratory of ICAR, RCER, Research Centre, Ranchi for counting and identification. Identification was done using microscope (type 020-519.503 LB 30T, Leica, Germany) and taxonomic keys and species descriptions by Drew and Raghu (2002) and Prabhakar *et al.* (2012).

Data analysis

The number of fruit flies captured was expressed in the standard relative fly density index (IAEA, 2003), which allows comparison across different localities, over different exposure periods, and irrespective of the number of traps used. Number of flies captured was log transformed [log (X+1)], subjected to ANOVA, using SAS® 9.2 (SAS, 2010) and means separated by Student-Newman-Keuls (SNK) test at $p=0.05$.

RESULTS AND DISCUSSION

A total of 1883, 1563, 1216 and 1629 male adults from Ranchi, Gumla, Lohardaga and Khunti respectively, were trapped and collected of three *Bactrocera* species from month of March to July in year, 2012. Three species of *Bactrocera* fruit flies were identified, namely *B. zonata* (Peach fruit fly), *B. dorsalis* (Oriental fruit fly) and *B. diversa* (Three-striped fruit fly/Guava fruit fly). All the recorded species are known to be pests of mango fruits (Bhalla and Pawar, 1977). This record was important in light of quarantine because this area did not have any new invasive fruit flies species on methyl eugenol based traps (Kapoor *et al.*, 1980). Out of total fruit flies captured, *B. Zonata* was recognised as the predominant species infesting mango fruits in the region, comprising 95.04, 93.12, 94.65 and 96.76 percent of population in mango growing areas of Ranchi, Gumla, Lohardaga and Khunti, respectively. Besides this, low population of *B. dorsalis* (2.13 to 4.01 percent) and *B. diversa* (0.60 to 1.50 percent) from different areas were also recorded (Table 2).

To compare the relative densities of fruit flies, trap were expressed as number of flies collected (F) divided by the number of traps (T) and further divided by the exposure period of traps (in days) (IAEA, 2003). In all the twenty orchards, *B. zonata* had the highest number as compare to others fruit flies in Methyl eugenol based traps. The maximum fruit flies population was observed during month of April which synchronised with full grown stage of mango fruits (NHM, 2011). The number of trapping catches of fruit flies may be affected due to adjacent fields of other fruit crops which also infested by observed fruit flies (Vargas *et al.*, 2000). Total number of flies and mean trap catches per day from different orchards of four districts were not differed statistically from each other ($F=0.014$; $p=0.05$). Climatic conditions in the whole study area presented little variation with average maximum and minimum temperatures of 35.09°C and 20.8°C,

Table 1: Study locations of diversity and population dynamics of fruit flies

Study site	Location (s)	Latitude DM	Longitude DM	Elevation m (asml)	Number of mango plants	Age of mango orchards
Ranchi	Churu	230 452 N	850 302 E	620	1250	15-20
	Plandu	230 172 N	850 242 E	649	857	15-25
	Ramakrishna mission ashram	230 26'N	850 32'E	590	100	10
Lohardaga	Birendra Prasad mango orchard	230 25'N	840 40'E	542	125	25
Gumla	Mr. Kerketta mango farm	220 52'N	840 51'E	560	500	5-8
	Farmers mango orchard, Marda	220 48'N	840 21'E	571	700	7-9
Khunti	Farmers mango orchard, Giarappa	230 09'N	850 16'E	631	100	10-12

Table 2: Total captured of fruit flies during the season of mango in year 2012 on methyl eugenol based traps in selected district of Jharkhand region of India

Months	Ranchi			Gumla			Lohardaga			Khunti		
	B. zo.	*B. do.*	*B. di.*	Total	*B. zo.*	*B. do.*	*B. di.*	Total	*B. zo.*	*B. do.*	*B. di.*	Total	*B. zo.*	*B. do.*	*B. di.*	Total
March	271(2.43)**	11(1.08)	3(0.60)	285^a(2.46)	204(2.31)	9(1.0)	3(0.60)	216^a(2.34)	122(2.09)	6(0.85)	1(0.30)	129^a(2.11)	210(2.32)	9(1.00)	3(0.60)	222^a(2.35)
April	509(2.71)	21(1.34)	6(0.85)	536^b(2.73)	421(2.63)	18(1.28)	4(0.70)	443(2.65)	679(2.83)	29(1.48)	7(0.90)	715^b(2.85)	436(2.64)	19(1.30)	5(0.78)	460^b(2.66)
May	415(2.62)	17(1.26)	4(0.70)	436^b(2.64)	326(2.51)	14(1.18)	3(0.60)	343^b(2.54)	109(2.04)	5(0.78)	0(0.00)	114^a(2.06)	395(2.60)	17(1.26)	6(0.85)	418^b(2.62)
June	341(2.53)	14(1.78)	4(0.70)	359^{ab}(2.56)	285(2.46)	12(1.11)	3(0.60)	300^a(2.48)	101(2.00)	4(0.70)	1(0.30)	106^a(2.03)	257(2.41)	11(1.08)	8(0.95)	276^a(2.44)
July	253(2.40)	11(1.08)	3(0.60)	267^a(2.43)	248(2.40)	11(1.08)	2(0.48)	261^a(2.42)	143(2.16)	6(0.85)	3(0.60)	152^{ab}(2.18)	234(2.37)	10(1.04)	9(1.00)	253^b(2.40)
Total	1789(3.25)	74(1.86)	20(1.32)	1883(3.28)	1484(3.17)	64(1.81)	15(1.20)	1563(3.19)	1154(3.06)	50(1.71)	12(1.11)	1216(3.06)	1532(3.19)	66(1.83)	31(1.51)	1629(3.21)

B. zo = *B. zonata*; *B. do* = *B. dorsalis*; *B. di* = *B. diversa* **Values are population index (fruit fly trap per day (FTD)) = F/TXD (F = Total number of flies; T = Number of serviced traps; D = Average number of days traps); **Values in parenthesis are log-transformed [log (X + 1)]

respectively. Relative humidity presented an average of 83.08%. The raining season is quite weak but uniform in whole the region with a total precipitation 58.21mm.

Although in this study only twenty traps were used in only one season of mango fruiting for survey and a small area of region was sampled, the diversity of fruit flies found (S = 3) can be considered similar to that in other survey carried out in same type of region. The diversity of fruit trees in a natural forest increases the likelihood of occurrence of monophagous species of fruit flies (sensu Aluja and Mangan, 2008) and therefore, increases the probability of a greater diversity of Tephritoidea in the ecosystem. This pattern is also common in other groups of arthropods (ANDOW, 1991).

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