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RESEARCH ARTICLE
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# EFFECTIVENESS OF METHYLE EUGENOLE AND CUE LURE TRAPS TO ATTRACTED GENUS *BACTROCERA* (FRUIT FLIES) SPECIES IN PEACH AND PERSIMMON ORCHARDS IN DISTRICT SWAT OF KPK, PAKISTAN

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## ABSTRACT

ME- methyle eugenole and CL-cue lure are male fruit flies attracting pheromone. Genus *Bactrocera* has belongs to the order diptera and family tepritidae. *Bactorcera* species damage large quantity of peaches and persimmons in district swat. Total six species of genus *Bactrocera* reported in district swat, which had attracted to sex pheromone traps, *Bactrocera zonata, B. invadanse, B. dorsalis complex* attracted to Methyle eugenole while *B. cucurbitae B. tau, B. scutellaris* were attracted to Cue lure. Methyle eugenole showed more effectiveness than cue lure. Total 22672 numbers of species have collected in sex pheromone traps, 20001 were found in methyle eugenol and 2671 founded in CL- cue lure pheromones traps, in the duration of three months July, August and September. In the ME-methyl eugenol, the total number and percentage of *B. zonata* 8497 (42.48%), *B. invadens* 9643 (48.21%), *B. cucurbitae* 66 (0.32), *B. dorsalis complex* 1692 (8.45%), *B. tau* 46 (0.22%)*and B. scutellaris* 57 (0.28%). In ME-methyl eugenol traps, *B. invadense* (48.21%) and *B. zonata* (42.482%), had higher percentage while *B. tau* (0.22%) lower percentage. Total 2671 numbers of *Bactrocera* species founded in CL-cue lure traps duration of the 14-week of study, the numbers and percentage of *B. zonata* were 95 (3.556%), *B. invadense* 139 (5.204%), *B. cucurbitae* 1063 (39.797%), *Bactrocera dorsalis complex* 40 (1.497%), *Bactrocera tau* 457 (17.109%) and *B. scutellaris* 877 (32.834%). In CL-cue lure traps, *B. cucurbitae* percentage had maximum (39.797) while *Bactrocera dorsalis complex* percentage had minimum (1.497%). In the beginning of July *Bactrocera zonata* species numbers were most and the end of September *B. invadense* species number increased. Infestation ratio of species had more in persimmon than peach orchards during the course of three month, July, August and September. The temperature and humidity were also great effects on the numbers of *Bactrocera* species, in these numbers of *Bactrocera zonata* had more in Peach due

to high temperature in seven weeks of July and August, while the numbers of *Bactrocera invadense* were more in persimmon orchards due to low temperature in seven weeks of August and September.

## INTRODUCTION

Order Diptera is a largest order of class insecta, total 5000 species had been reported worldwide. Among them 1,400 species of fruit flies completed their life cycle in vegetables, crops and fruits. (Virgilio *et al.*, 2012). The *Bactrocera* genus contains total 651 species, in which 50 are considered to be the most serious pests for various fruits and vegetables. These pests decrease the productivity and quality of a variety of hosts around the world that consume a variety of food sources. Asia, Australia, and the southern hemisphere are the home of these species. On 270 hosts plants *Bactrocera* dorsalis (the Oriental fruit fly) was discovered. (White and Elson-Harris, 1992). Most fruit flies are medium-sized, have colored wings, and can damage variety of fruits, vegetables, and plants. (Prabhakar *et al.*, 2012; Zubair *et al.*, 2019). *Bacterocera* species actively reproduce when temperatures drop to 32.2°C and humidity levels range between 60 and 70%. According to Ji et al. (2013), the life cycle of fruit flies lasts 21 to 179 days. Characteristics of these are different from each other in the *Bacterocera* genus. (Susanto *et al.*, 2022). The morphological traits of each species are distinctive. There are short, flat wings for flight. Yellow spots termed vittae can be seen on the dorsal side of the thorax. Near the dorsal side of the thorax's termination is a small area known as the scutellum. The scutum is a term used to describe the dorsal side of the thorax. The head's ventral pad is called the setea. The third and last part of the fruit fly is its abdomen, on which color pattern is present, T-pattern on its dorsal side. (Schutze *et al.*, 2015). *Bacterocera* species lay and deposit eggs on hosts in accordance with their preferences for particular sites, locations, colors, odors, climates, and sizes of vegetables and fruit. In the course of their one to three month lives, female lay 1200 to 1500 eggs in the field, and 3000 eggs under ideal circumstances. It takes varying times and temperatures for development from the egg stage to adult state. (Grout *et al.*, 2011); It takes a lengthy time at a high temperature (Grout et al., 2011). According to Ji et al. (2013), sperm did not travel within the first 30 minutes of mating. *Bactrocera* species use two volatile signals, such as the scents of host fruit and protein food, to locate the sites of oviposition and protein feeding. These two volatile signals may be used as attractants.(Cornelius *et al.*, 2000). Fruit flies of the genus *Bactrocera* are found all over the world, but they are more common in Australia, some parts of Asia, and the South Pacific. By attacking a varieties of fruits and vegetables, they can cause both direct and indirect economic damage. (Clarke *et al.*, 2005). Fruit flies species pose a concern to fruits and vegetables because they cause both qualitative and quantitative losses. Control programmers are working very hard to reduce the damage that fruit flies are causing. Various fruit fly species infect a range of hosts. In addition to attacking plant hosts, the genus *Bactrocera* also preys on a range of fruit hosts, including primary hosts like mango, guava, persimmon, and peach as well as minor hosts like cirus, fig, etc.(Delrio and Cocco, 2010).

According to Mariadoss et al. (2021), the majority of fruit flies destroy fruit, which is why they are viewed as the main pest in the horticulture sector. Fruit flies pests with phytophagous diet significantly reduce the amount of fruits, vegetables, and flowers that are grown. Fruit flies, which belong to the Tephritidae family and have 5000 species and 500 genera, are recognized as the most destructive pest in the world due to their history of yield loss. After attacking the host, parasitic fruit flies transform into larvae and ultimately maggots. Fruit becomes mushy and unfit for ingestion as a result of fruit fly larvae feeding on the fruit's pulp. They attacked a variety of crops, including fruit and vegetable crops. The bulk of fruit flies were also explained by Mariadoss et al. in 2021.

The family Ebenaceae consists of 768 trees and shrubs including persimmon. A small pantropical family of order Ericales known as the Ebenaceae is well-known for its fruits and wood. They are mainly found in tropical and subtropical areas of the world. There are more than 5,000 species spread across 2 subfamilies and 4 genera, including the monogeneric subfamily Lissocarpoideae, which present in the South American. The subfamily Ebenoideae contains 3 genera with a total of 8 species, including the widely dispersed genera Euclea L. (18 spp.), Royena L. (17 spp.), and Diospyros L.

(500 spp. ), all of which are indigenous to Africa (Duangjai et al., 2006). The Japanese Phal is another name for the persimmon (*Diospyrose* Kaki). Before being introduced to Japan, persimmon was first grown in China. Around 750 A.D, it was brought from China into Japan. The persimmon is also known as Amlok in Pakistan because to the fact that it has been growing there for a long time in the Amlok Dara Valley in Barikot, Swat district, and lies between 600 and 800 meters above sea level. Swat is the Pakistani district where persimmon growing has the most potential. In Pakistan, India, China, Japan, Pakistan, the United States, and other countries, it is widely farmed (Wealth of India, 1973).

## MATERIALS AND METHODS

### Study area

A study was conducted in the peach and persimmon orchards of the district Swat. Swat is a popular tourist area in the Malakand division Khyber Pukhtunkhwa province, Pakistan. It is 5337 square kilometers in size, has a population of 2,308,624 as of the 2017 census and according 2023 census population of swat is 2,687,384. It is located at an elevation of 980 meters (3,220 feet) and is situated between 35.2227°"N latitude and 72.4258°"E longitude. Saidu Sharif, which is in the Mingora, is its administrative capital. It is situated 247 kilometers from Islamabad, with a travel duration of approximately 3 hours via the Swat Motorway ("Swat Demographics", 2022). Swat is known as the Switzerland of the East. There are many different types of gardens in Swat, including peaches, persimmons, plums, cherries, oranges, and apricots. The upper areas of the Swat are colder and get snowfall in the winter.

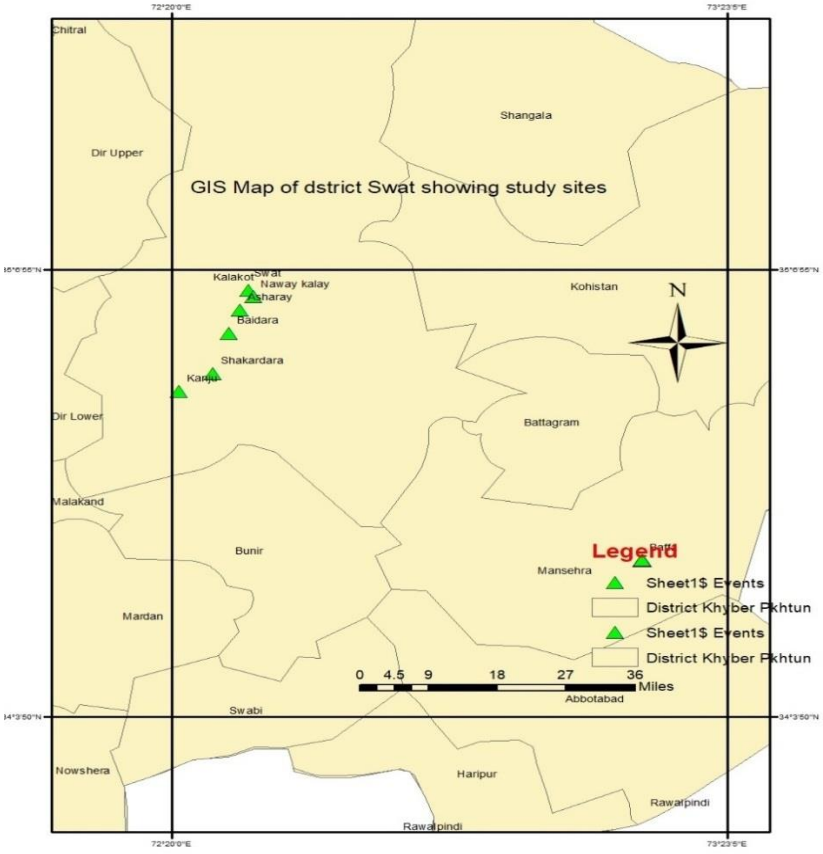


**Figure.1 Map of District Swat**

### Study duration

The study was carried out in Swat, summer of 2022, from July to September, in peach and persimmon orchards.

**Pheromones cylindrical traps:**

Cylindrical pheromone traps used in the research work for the collection of fruit flies. These traps were pierced on both sides, the diameter is 16 centimeters, and the length is 13.5 centimeters show in the figure 2. Cotton swabs were strung inside cylindrical traps using steel wire as support. The three chemicals utilized in the cylinder-shaped traps chemicals are ME-metyl eugenol, CL-lure and Linnate Insecticides are linnate while ME-metyl eugenole and CL-lure are pheromones. Every chemical used to create pheromone traps was produced in a specific concentration. These traps divided into two treatment groups, referred to as treatment1 (T1) and treatment2 (T2). Replication (R1), replication (R2), and replication (R3) had the three categories in each treatment group. Each trap was placed in a tree at a distance of 60 feet from the others, all while being connected to the tree by wire (Fig.3). Data collected on weekly basis and then replaced the traps with pheromones and insecticide. Methyl eugenol (ME) and cue lure (CL) traps were both used to attracted the male fruit flies. Lannate pesticides are used to killed the male fruit flies.


**Figure.2 Two set (methyl eugenol and cue lure) of six cylindrical pheromones trap**

**Figure.3 Hanging of cylindrical traps at the trees with the help of wire**

**Preparation of pheromones cylindrical traps**

- Six pheromone traps were used with two treatments: three traps were used with ME-methyl eugenol and three traps were used with CL-cue lure. On a peach and persimmon tree, six cylindrical traps with two treatments and three copies of each trap were hung. Three cylindrical pheromone traps were built using the components listed below.
- Three ml of lannate and five ml of ME-Methyl Eugenol were injected in the cotton swabs the traps.

Lannate and Cue lure were both injected into cotton swabs inside the traps in quantities of three and five milliliters, respectively (Figs. 4 and 5).

**Figure.4 Suspension of cotton swab inside the cylindrical traps with the help of steel wire.**

**Figure. 5 Chemicals are injected in cylindrical pheromones traps with the help of syringes**


**Figure.6 Three types of chemicals are used in the cylindrical traps**

**Installation of pheromones cylindrical traps**

The traps were positioned in several peach and persimmon orchards. A total of six cylindrical traps were set up, each measuring five to six feet above the ground and 60 feet apart from each other.

**Figure.7 Cylindrical pheromones traps hanging of each group of treatment**

**Data collection of specimens**

Data collection took place over the summer of 2022, from July to September. Data was collected weekly basis from peach and persimmon orchards using pheromone traps, for up to 14 weeks. Each species of fruit flies was removed from each cylinder trap that had entered, and then collected and counted one by one. After that, all of the species were pined and taken to the lab for identification.
The *Bactrocera* specimens were kept dry until identification. Identification by morphology was done using a stereo microscope. Each species was identified by morphological identification at the Entomology lab of the Agricultural Research Institute (ARI), Mingora Swat. Specific identification of the fruit flies was prepared by examining their body parts and taking pictures with the aid of the currently available literature, the taxonomic keys of Drew and Romig., (2013), and by comparing with previously recognized species in the Agriculture Research Institute Mingora Swat. (Fig 8). Pictures of mature specimens were taken using an Axiocam camera, a digital camera that is connected to a stereoscope.

Every specimen was pinned before being placed in a container with naphthalene pellets.
During the investigation, the following bodily components were examined.

- Wings of species
- Scutum of species
- Setae of species
- Medial postsulral yellow of species
- Scutellum of species
- T-Pattren of species

**Figure.8 Stereoscopic (ZEISS) microscope used for identification of Bactrocera species**

## RESULTS

The total six species of genus *Bactrocera* identified *B.zonata, B. invadanse, B.dorsalis complex, B.tau, B.cucurbitae, B.scutellaris* in Swat but their total 22672 numbers collected by using ME-methyl eugenol and CL-cue lure pheromones attracting traps. In 22672 species, 20001 species collected in ME-methyl eugenol pheromones traps(Treatment 1) and 2671 were collected in CL-cue lure pheromones traps(Treatment 2). Orchards wise their 6615 numbers were collected in peaches orchards and 16057 species were collected in Persimmons orchards.

### Traps of methyl eugenol treatment group

Information about the Methyl Eugenol Trap Treatment Group, including the total number of species, individuals, percentage of abundance, etc.,. In the first treatment (T1), group of ME-methyl eugenol, the percentage of abundance of the genus *Bactrocera* spp. Shown in Figures 9, 10, and 11. Treatment 1 group divided into three replication groups (R1), (R2), and (R3). In all 3 categories, *Bactrocera invadense* and *Bactrocera zonata* were more abundant as a percentage of the total species. As shown in Figures 9, 10, and 11. *Bactrocera cucurbitae* , *Bactrocera scutellaris* and *Bactrocera tau* which are only found in extremely small numbers.

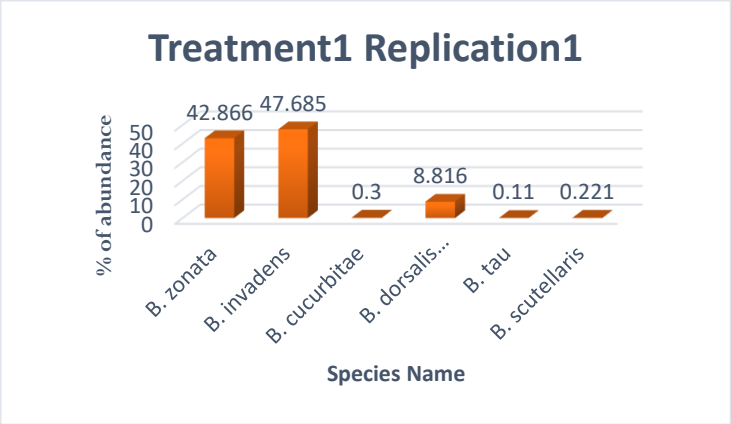


**Figure.9 Percentage of abundance of *Bactrocera* spp. in treatment group T1R1.**

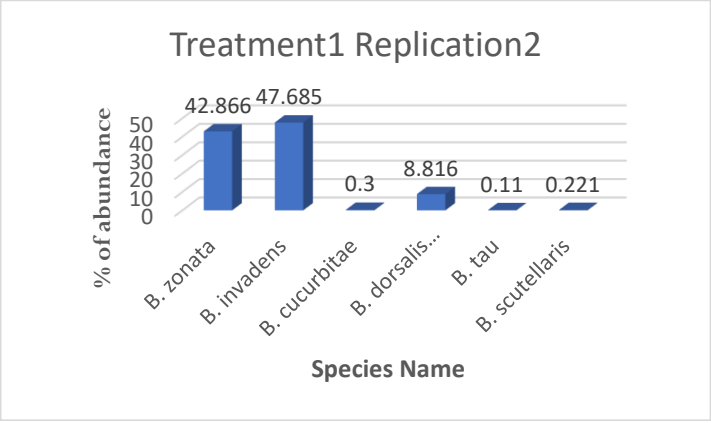


**Figure.10 Percentage of abundance of *Bactrocera* spp. in treatment group T1R2.**

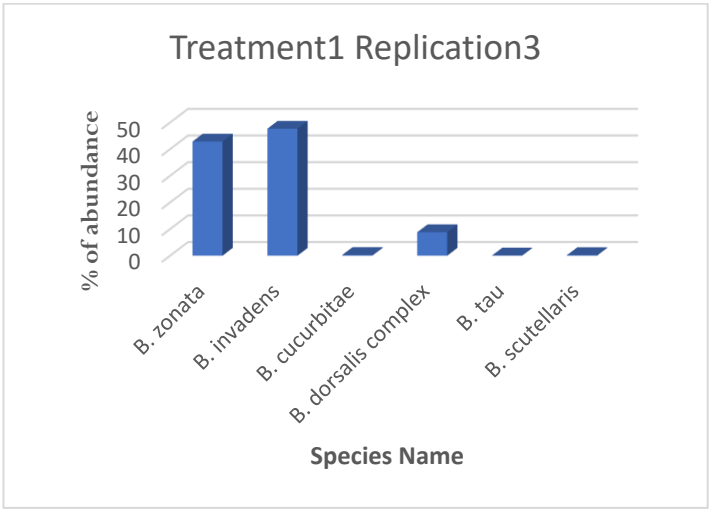


**Figure.10 Percentage of abundance of Bactrocera spp. in treatment group T1R3**.

**Traps of cue lure treatment group**

The Cue lure traps, also known as the treatment#2 group. Graphical representations of the relative abundance of *Bactrocera* spp. in the Cl-cue lure treatment (T2) group were shown in Figures 12, 13 and 14. Treatment 2 group graphs based on the three replication groups replication1(R1), replication(R2), and replication(R3) were plotted to assess the percentage of abundances abundance of each species. In the treatment#2 group, *Bactrocera cucurbitae* was more abundant than other species, but *Bactrocera scutellaris* and *Bactrocera* tau were also more in numbers in CL-lure traps These species were targeted for cue lure development, as seen in Figures . The percentage of abundance of *Bactrocera zonata*, *B. invadens*, and *B. dorsalis* lesser than other species.

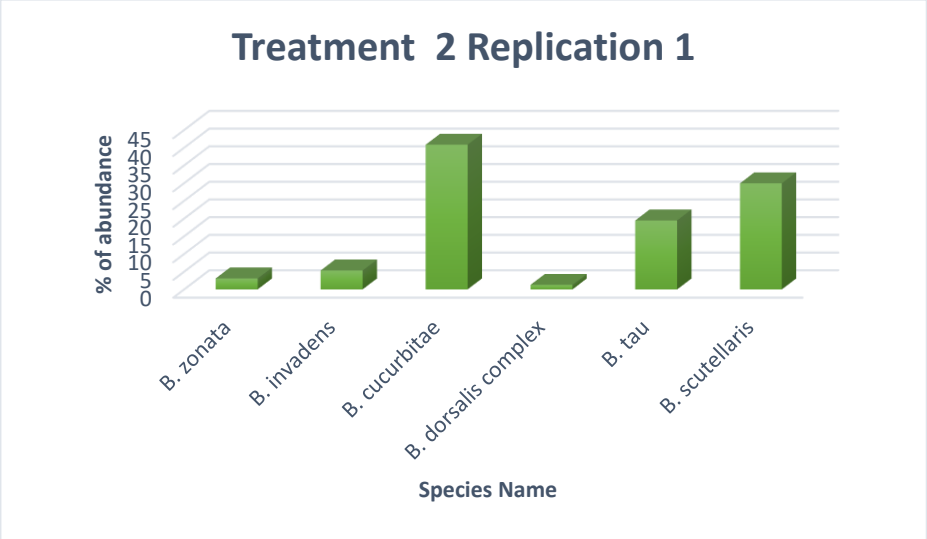


**Figure.12 Percentage of abundance of *Bactrocera* spp. in treatment group T2R1**

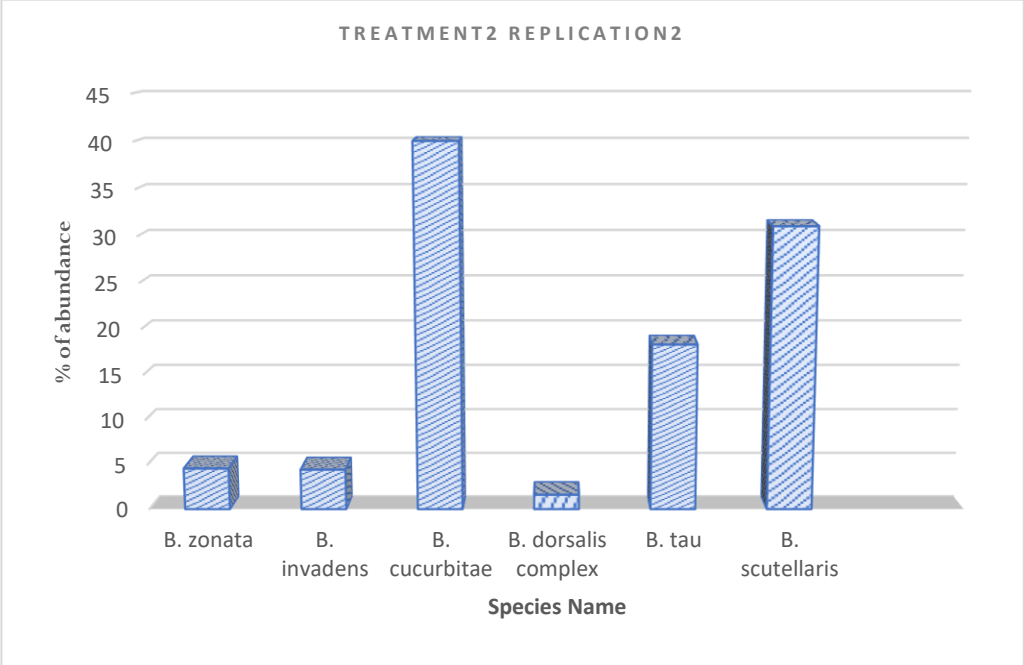


**Figure.13 Percentage of abundance of *Bactrocera* spp. in treatment group T2R2.**

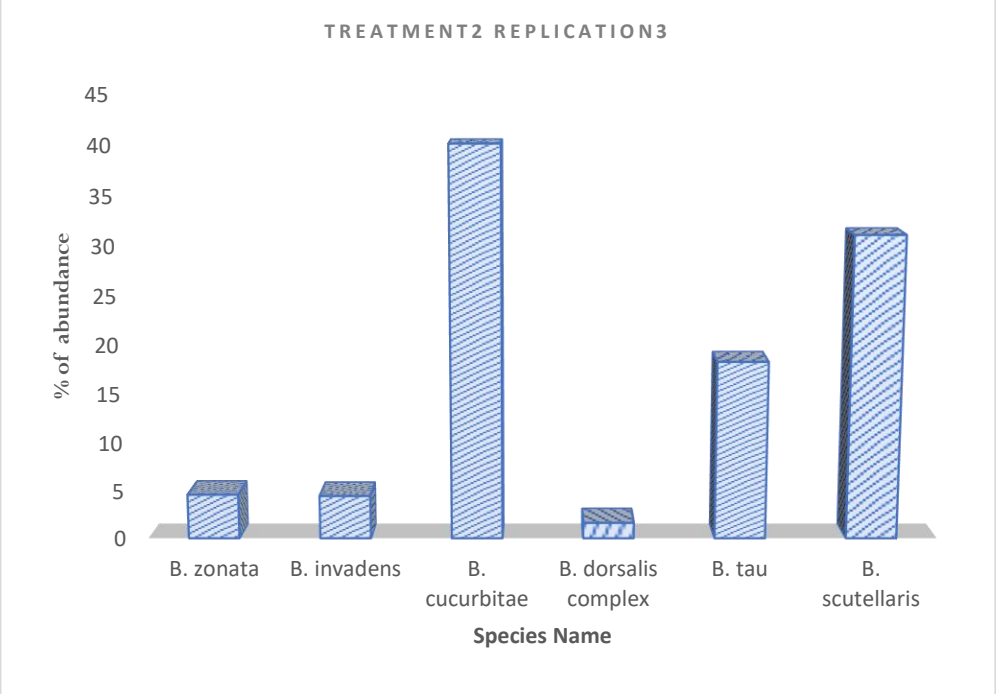


**Figure.14 Percentage of abundance of *Bactrocera* spp. in treatment group T2R3.**

**Infestation Ratio of genus *Bactrocera* in Peach and Persimmon orchards**

Temperature and humidity are the two key factors that affect the species of the genus *Bactrocera*. The result of this work show that *Bactrocera invadense* infestation ratio is higher in persimmon orchards than in peach orchards, while *Bactrocera zonata* infestation ratio was higher in peach orchards than persimmon orchards. The 14-weeks field work was divided into seven weeks of work in persimmon orchards and seven weeks of work in peach orchards.The prevalence of *Bactrocera invadense* in persimmons because of the drop in temperature and rise in humidity, and the high prevalence of *Bactrocera zonata* in peach orchards because of the rapid rise in temperature and rise in humidity. Figure 15 Show the different numbers of species found in the ME-methyl eugenol

treatment group traps in peach and persimmon orchards. The numbers of *Bactrocera* species found in peach and persimmon orchards in CL-cue lure treatment group traps is shown in Figure 16. Figure 17 show the percentage of abundance of *Bactrocera* species in peach orchards, while figure 18 show the percentage of abundance of *Bactrocera* species in persimmon orchards. Figure 19 show percentage of abundance of *Bactrocera* spp. in both peaches and persimmons orchards.

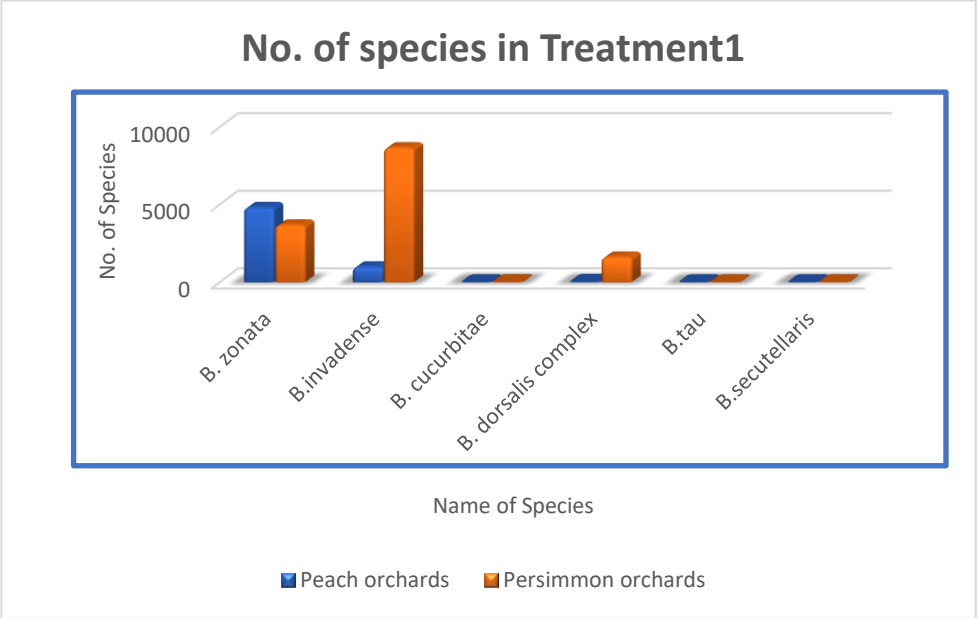


**Figure. 15 No. of species in Treatment1 of the Peach and Persimmon orchards**

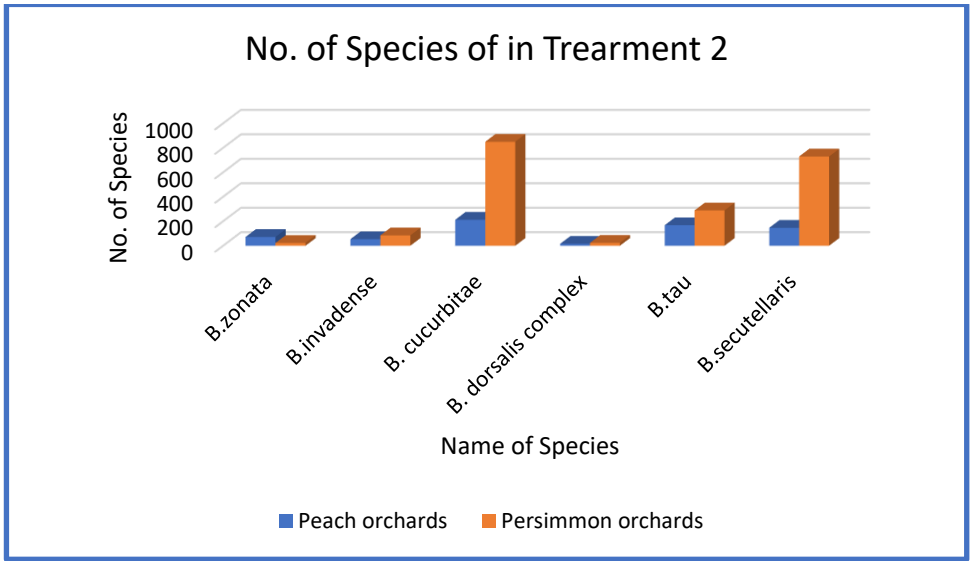


**Figure. 16 No. of species in Treatment 2 of the Peach and Persimmon orchards**

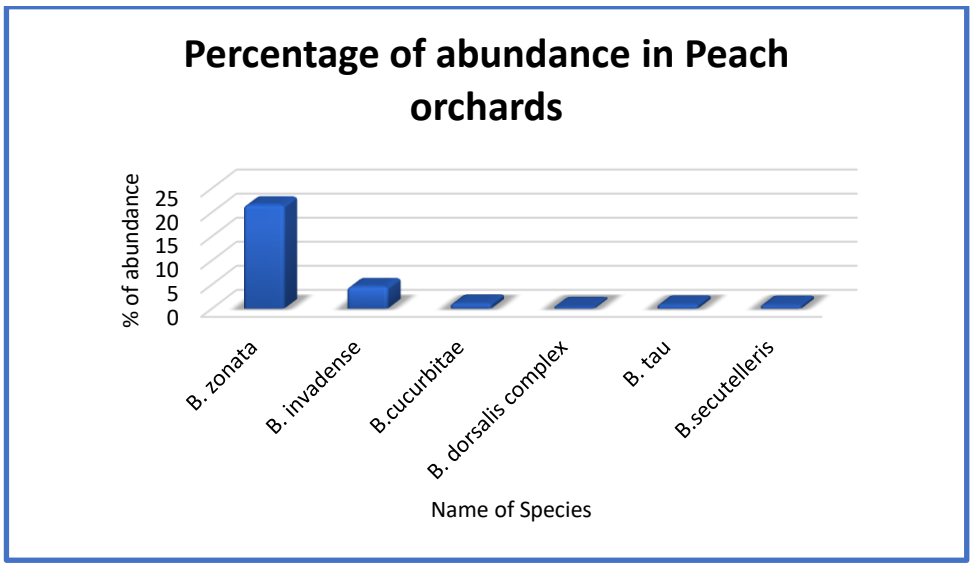


**Figure. 17 Percentage of abundance of *Bactrocera* spp. in Peach orchards**

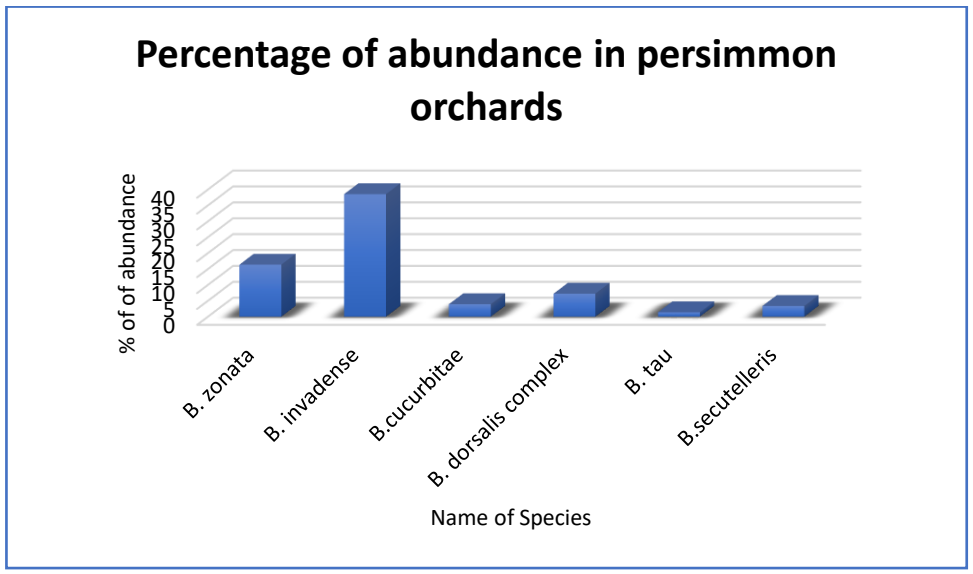


**Figure 18: Percentage of abundance of *Bactrocera* spp. in Persimmon orchards**

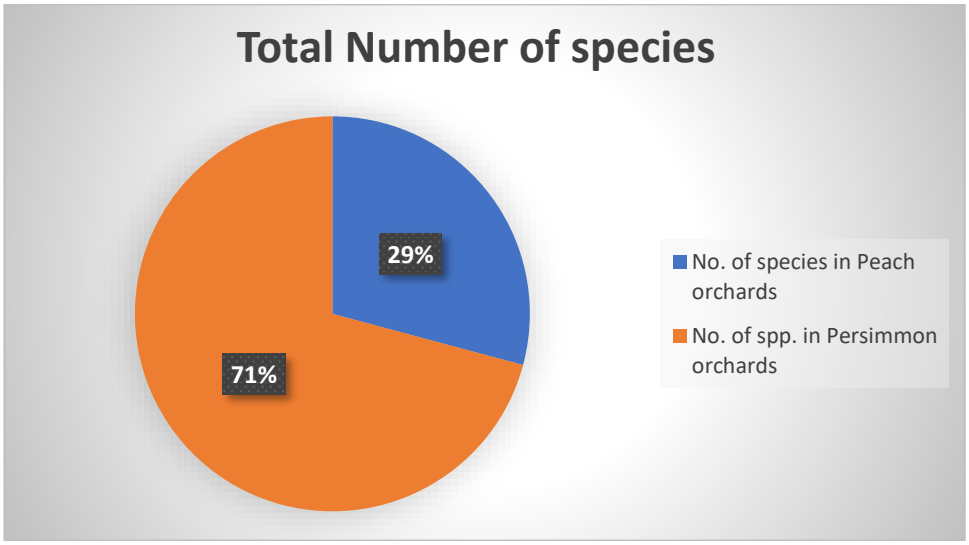


**Figure. 19: Total numbers of *Bactrocera* species in Peach and Persimmon orchards**

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