Population Dynamics of Fruit Flies on Different Varieties of Jujube

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Abstract

Studies on the “Population dynamics of fruit fly and their parasitoids on different varieties of Jujube” were conducted in the experimental area of Nuclear Institute of Agriculture (NIA), Tandojam during 2012-13. Ten methyl eugnol baited traps were deployed for 24 hours in the Ber orchard weekly and afterward these were brought back to laboratory for identification and recording fruit flies. For identification and recording Fruit fly and parasitoids species, infested fruits were collected and kept in lab for investigating fruit flies and their parasitoids species. Emerged flies and parasitoid were recorded and identified. Results revealed that three species of fruit fly namely Bactrocera zonata, Bactrocera dorsalis and Carpomyia vesuviana were recorded from the time of fruit setting upto harvesting of the jujube fruit. From the collected fruit it was found that 90% infestation is inflicted solely by the B. zonata followed by C. vesuviana (8.02%) and B. dorsalis (5.56%) throughout the season. Furthermore, two species of the parasitoids such as Trybiographa daci and Dichasmimorpha longicaudata, were recorded from infested fruits. Whereas, T. daci (6.6%) and D. longicaudata, (1.36%) were recorded throughout experimental period. Similarly, two species of the fruit flies B. zonata, and B. dorsalis were captured through methyl eugnol baited traps. Maximum B. zonata were captured during experimental period. However, very low population densities of B. dorsalis were recorded. No fly B. dorsalis captures were recorded when temperature dropped < 05 °C. These results could be helpful for the management of fruit flies in different varieties of Jujube.

Keywords: Jujube, Parasitoids, Population dynamics

Introduction

Jujube is an important and delicious fruit of tropical and subtropical regions of the world. It belongs to the genus Zizyphus of family Rhamnaceae (Watt, 1983). Both dried as well as fresh ber fruits are liked by all ages of the people. They are rich source of protein, phosphorus, calcium, iron, carotene vitamin C and carbohydrates (Singh et al., 1973; Bakhshi and Singh, 1974). In Pakistan, jujube is only grown in Sindh and Punjab provinces in orchards as well as single tree in crop fields. Sindh is the leading producer of this fruit in terms of yield as well as in area. Total production of Ber during 2009-10 was 27950 tonnes with the cultivated area of 5425 hectares (ASP, 2009-10). Unfortunately, quality and production of the Ber fruit is deteriorated by a variety of insect as well as non-insect pests. Among these pests, fruit flies have been documented noxious pests of ber fruit. Severity of damage is caused by three fruit fly species namely, Bactrocera zonata (Saunders), Carpomia vasuviana (Costa) and Bactrocera cucurbitae (Coquillett), from the time of fruit setting upto harvesting. All above mentioned fruit fly species inflict colossal losses which ultimately confine the fruit production. Augmentation of fruit flies population in any orchard could be due to the strength of the orchard, nearness to a potential species and orchard age together (MacArthur and Wilson 1963). Moreover, management practices of an orchard also have key effect on the population densities of the beneficial and harmful insects (Liss et al. 1986, Brown and Welker 1992, Rieux et al. 1999). Since fruit flies are noxious pests of ber fruits in nook and corner of ber growing zones of the world. In the Sindh province, B. zonata, B. dorsalis, and C. visuviana are regarded as a pest of Ber fruit depending on the its varieties. To partially address this issue, this work presents a detailed, field work of B. zonata, B. dorsalis, and C. visuvana, on four locally common Ber varieties in field conditions. All these varieties are subject to commercially significant fly infestation in the field unless protected. Fruit fly population surveys are a prerequisite for effective decision-making in area-wide control programmes aimed at pest suppression, as well as those attempting to establish fruit fly free or low prevalence areas.

However, little work on population dynamics of fruit flies and their parasitoids species in terms of identification on different varieties of ber have been carried out so far. The output of the present survey will be exploited for managing the population densities of fruit flies integrated pest management program for fruit flies in Ber orchard. Hopefully, these findings could be helpful in managing the population densities of fruit flies and their integrated pest management (IPM) programmes in different orchards.
Materials and Methods
Study Site
Studies on the Population dynamics of fruit fly and their parasitoids on different varieties of Jujube was conducted in the experimental area of Nuclear Institute of Agriculture (NIA), Tandojam during 2012-13. The four varieties of jujube namely Gola, Lemon Gola, Black Gola and White Gola were cultivated in the NIA, Experimental Farm. The orchard was approximately one hectare in area and the Eastern and Southern sides of the orchard were covered with mango trees. However, Northern and Western side wheat crop was grown. In the orchard, no pest control measures, including pesticidetreatment, were performed during entire period of studies.

Study Methods. In each orchard, ten Tandojam traps baited with methyl eugenol were deployed at 6 feet height above the ground and separated from each other by 12 meters. The traps were installed for 24 hours weekly and afterward these were brought back to laboratory for identification and recording fruit flies and their parasitoids species. The lure was replaced at every installment throughout course of studies. The population counts of the insect pests were made on weekly basis. Four jujube varieties viz, Gola, Lemon Gola, Black Gola and White Gola were monitored to assess the population dynamics of fruit fly and their parasitoids in both orchards. Infested fruits of four above mentioned varieties were collected and kept in lab for investigating fruit flies and their parasitoids species. Infested fruits were kept in lab for pupal collection. Pupae were collected from infested fruit and kept in Petri dishes for examining of percentage of fruit flies their parasitoid species. Emerged flies were recorded and identified. The un-emerged pupae were again kept for parasitoid emergence. Emerged parasitoids were recorded and identified from each variety. The experiment was continued upto the harvesting of Ber fruits in the orchards. The metrological record was maintained during entire course of study. The data collected was subjected to statistical analysis.

Data and statistical analysis
Data on the areas and yields of Bactrocera zonata and Bactrocera dorsalis from ber trees used in this study were obtained from the Experimental Farm of Nuclear Institute of Agriculture (NIA), Tandojam. Correlation analysis was carried out for the monthly capture rates. Means and ANOVA were used by using SAS software.

Results
A field experiment on "" was carried out in the Jujube orchard at Nuclear Institute of Agriculture (NIA), Experimental Farm Tandojam during 2012-13. The population densities of the captured flies through methyl eugenol baited traps and collection of infested fruits is shown in table 1, Fig 1, 2 and 3.

Results showed that three fly species namely Bactrocera zonata, Bactrocera dorsalis and Carpomyia visuviana were captured through trap catches. Whereas, two larval parasitoids, Trybliographa dacii and Dichasmimorphapha longicaudata, were recorded from infested fruits. A total of 1096 pupae in 12 samples were retrieved from guava during 2012-13. From the total obtained pupae 715, 61, 88, 73, and 15 adults of B. zonata, B. dorsalis and C. visuviana, Tdaci and D. longicaudat, respectively from the infested fruit. However, maximum pupal recovery percentage (31.33) was observed on 3rd January 2013. Out of which 9.78% were parasitoids (Table. 1). It was observed the total parasitoid emerged from the collected pupae were protandrous (males emerge earlier than females). However, maximum fly captures of B. zonata and B. dorsalis were recorded during first sampling dates on 13 December 2011 which were (11.4± 2.12 and 0.5 ± 0.11) respectively, as shown in Fig. 1. The fly population gradually decreased in the second and third observations. However, lowest population densities (0.66± 0.11) were observed.

Furthermore, the B. zonata was pre-dominant species throughout the experimental period. Significantly higher densities of B. zonata (F4.93,df = 1326 P < 0.0001) were observed. These results indicate that temperature, humidity, rainfall and sunlight are significantly correlated with population fluctuations of B. dorsalis in the Hyderabad area on 16th January. Increasing trend of the flies (5.9 ± 2.13) was observed in the last monitoring date. In contrast to this, very low population scale of B. dorsalis was recorded throughout the study period. Nevertheless, no catches of B. dorsalis were recorded during 2nd January to 13th February 2013. It started to increase from 20 February which was (0.375±0.17). The catch data showed that fruit fly infestations took place seasonally between mid-February up to harvesting of the fruit. It was further observed that C. visuviana was not attracted to methyl eugenol. It was only found through infested fruit collection.

Discussion
Our study reported parasitism of Bactrocera species (Bactrocera zonata and Bactrocera dorsalis) and
Carpomya vesuviana by Trybliographa daci and Dichasimimorpha longicaudata under field conditions in the Nuclear Institute of Agriculture (NIA), Experimental Farm. Our studies established that T. daci is established in the Tandojam vicinity. Previous studies carried by Khuhro et al (2013 Manuscript in press) in mango or chard of NIA, Experimental Farm, Habib Farm Hyderabad, Nawaz Abad Mirpurkhas, and Dhei Farm confirmed that T. daci was dominant species parasitizing the a number of species. Our studies are in line with the results of Papadopoulos and Katsoyanos (2003), who recorded maximum parasitization by Ceratitus capitata. Furthermore, very low percentage of Diachasmimorpha longicaudata was retrieved from infested fruit. Perhaps D. longicaudata originated from Australia and was introduced in Hawaii between 1912 and 1913. It successfully established against C. capitata (Silvestri, 1914; Pemberton and Willard, 1918) and since then has been consistently reported as one of the important biological control agents of C. capitata in different parts of the world (Wharton, 2005; Wong et al., 1991; Wong and Ramadan, 1987). Nowadays D. Longicaudat has also been reported on a number of fruit fly species (Wharton, 2005).

Furthermore, data collected in the present study demonstrate that the C. vesuviana occur only between January to March with one peak in population abundance in February. The seasonal infestation pattern of C. vesuviana was completely consistent as the jujube fruit start to ripe. However, B. zonata was predominant throughout experimental period. Temperature has been found to be a crucial factor influencing the occurrence of this species. This species has adapted the environmental conditions of the Sindh. The temperature of this species permits to develop and reproduce B. zonata. However, third species which we found was B. dorsalis. It was observed that in severe cold season population densities of B. dorsalis was negligible. Perhaps B. dorsalis may not have adopted the low temperature as it was in case with B. zonata.

CONCLUSIONS

It was found that three species namely Bactrocera zonata Bactrocera dorsalis and Carpomya vesuviana attacks on jujube fruit. Bactrocera zonata occurs in large numbers up to 90% population among three recorded species. However, C. vesuviana was the 2nd most important species infesting the ber fruits. Moreover, two parasitoids namely Trybliographa daci and Dichasimimorpha longicaudata were recorded which limit the population of fruit infesting flies. Nevertheless, T. daci was found the dominant parasitoid species on three of the recorded species.

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Table 1. Biodiversity of fruit fly and their parasitoids in Jujube orchard of NIA, Experimental farm during 2012-13

<table>
<thead>
<tr>
<th>Date</th>
<th>No of fruits</th>
<th>Fruit weight (Kg)</th>
<th>No of Pupae</th>
<th>B. zonata</th>
<th>B. dorsalis</th>
<th>C. visuviana</th>
<th>T. daci</th>
<th>D. longicadata</th>
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<td>Percentage (%)</td>
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<td>5.56</td>
<td>8.02</td>
<td>6.66</td>
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Figure 1. Average number of Peach fruit fly *B. zonata* catches /trap/day in the Jujube Orchards of NIA, Experimental Farm during 2012-13.

Figure 2. Average number of oriental fruit fly *B. dorsalis* catches /trap/day in the Ber Orchards of NIA, Experimental farm during 2012-13.
Figure 3. Average number of fruit flies catches /trap/day in the Ber Orchards of NIA, Experimental farm during 2012-13