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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 Carpomya vesuvianawere 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 Trybliographa 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 ºC. 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 (Saunder), Carpomia vasuviana (Costa) and Bactrocera cucurbitae(Coquillett), from the time of fruit setting upto harvesting. All above mentioned fruit fly species inflictcolossal 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. visuvana 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 prevalenceareas.

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 flyand 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 hacter 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 eugnol 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 flyand 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 wererecorded 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 dorsalisfrom 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 eugnol 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 daci and Dichasmimorpha 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. dosalis 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. vesuviana was not attracted to methyl eugnol. 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 Dichasmimorpha 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 orchard of NIA, Experimental Farm, Habib Farm Hyderabad, Nawaz Abad Mirpurkhas, and Dheli Farm confirmed that T. daci was dominant species parasitizing the a number of species. Our studies are in line with the results of Papadopouls and Katsoyanos (2003), who recorded maximum parasitization by Ceratitus captita. 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 thatthe C. vesuvianaoccur only between January to March with one peak in population abundance inFebruary. 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 todevelop 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 zonataBactrocera dorsalis and Carpomya vesuvianaattacks on jujube fruit. Bactrocera zonataoccurs in large numbers upto 90% population among three recorded species. However, C.vesuvianawas the 2nd t most important species infesting the ber fruits. Moreover, two parasitoids namely Trybliographa daci and Dichasmimorpha longicaudatawere recorded which limit the population of fruit infesting flies. Nevertheless, T. daciwas found the dominant parasitoid species on three of the recorded species.

References

AlujaM. J. Guillen, P. Liedo, M. Cabrera, E. Rlos, g. Larosa, H. Celedonio, D. Mota 1990. Fruit infesting tephritids [diptera : tephritidae] and associated parasitoids in chiapas, mexico. Entomophaga 35 , 39-48.

Arora P.k, J, nirmal, S. K. Kaur, P. S. Thind and aulakh 2001. Effect of different varieties of ber on fruit fly attack.Horticultural journal. 14: 117-120.

BakhshiJ. C. And P. Singh, 1974. The ber - A good choice for semi-arid and marginal soils. Indian horticulture, 19: 27-30.

Bashir Ahmad, Ruk Hasnain Anjum, Amir Ahmad, Malik M. Yousaf , Mumtaz Hussain and Wali Muhammad (2005) compari son of different methods to control frui t fly (carpomyia vesuviana) on ber (zizyphu s mauritiana) pak. Ento mol. Vol. 27 , no .2 ,

Brown, M. W., and W. V. Welker. 1992. Development of the phytophagous arthropod community on apple as affected by orchard management. Environment entomology.21: 485- 492.

Chen P and H Ye. 2007. Population dynamics of bactrocera dorsalis (diptera: tephritidae) and analysis of factors influencing populations in baoshanba, yunnan, china. Entomological science 10: 141–147.

Chaudary V. And Rakesh 1999.Studies on the incidence of ber fruit fly carpomya vesuviana (costa) sw haryana.Croo. Res. Hisar. 18: 115-118.

Cugala, D. , Santos, L. Albano, G. (2010) second ruforum biennial meeting 20 - 24 september 2010, entebbe, uganda assessment of the fruit fly, batrocera invadens, pest status and the establishment of the parasitoid, fopius arisanus in mozambique

Government of Pakistan 2010 Fruit, vegetables and Condiments Statistics of Pakistan 2009-10. Government of Pakistan Ministry of Food and Agriculture (economic wing) Islamabad. Pp. 2-6.

Gupta, A K. Verma, and O. P Bhalla, 1990. Population of fruit flies (b. Zonata, b. Dorsalis) infesting fruit crop in north – western himalayan region. Indian journal of agricultural science. 60: 471-474.

Hannah J. Burrack and Frank G. Zalom (2008) olive fruit fly (Diptera: tephritidae) ovipositional preference and larval performance in several commercially important olive varieties in California J. Econ. Entomol. 101: 750-758.

Hui YJ. H. liu (2005) population dynamics of the oriental fruit fly, bactrocera dorsalis (Diptera: tephritidae) in the Kunming area, Southwestern China. Doi 10.1111/j.1744-7917.2005.00048.x

Israely, N. B, O. K Yuval , and D. Nestel 1997. Influence of trap location on trapping efficiency of mediterranean fruit fly. Alon. Hanotea 51: 164-168.

Jiron, L. F; J. Hedstrom (1988). Occurrence of fruit flies of the genera anastrepha and ceratitus (diptera: tephertidae) and their host plants availability in costa rica. Florida entomologist, 71: 62-73.
Lance R. D and D. B Gates 1994. Sensitivity of detection trapping system for mediterranean fruit fly (diptera: tephertidae) in southern california. Journal of economic entomology. 87: 1377-1383.
Landolt P. J, R. R Heath and D. Rosen 1996. Development of pheromone based trapping system for monitoring and controlling tephertid fruit flies in florida. Pest management in the sub-tropics.58: 197- 207.
Liss, W. J., L. J. Gut, P. H. Westigard, and C. E. Warren. 1986. Perspectives on arthropod community structure, organi-zation, and development in agricultural crops. Annual review of entomology 31: 455- 478.
Macarthur, R. H., and E. O. Wilson. 1963. An equilibrium theory of insular zoogeography. Evolution 17: 373-387.
Mahmood K. and Mishkatullah(2007).Population dynamics of three species of genus Bactrocera (Diptera: tephritidae: dacinae) in Bari, Chakwal (Punjab) Pakistan J. Zool., 39: 123 - 126 ,
Mary L. Cornelius, Jian J Duan, and Russell H. Messing (2000) volatile host fruit odors as attractants for the oriental fruit fly (diptera: tephritidae) j. Econ. Entomol. 93(1): 93-100
Muhammad Sarwar 2006. Incidence of insect pests on ber (zizyphus jujube) tree. Pakistan journal of zoology. 38: 261-263.
Martínez.FM. T, C. Navarro,, J. M. Campos, C. Marzal, J. M. Fibla and L. Bargues and f. G marí 2010. Seasonal and annual trends in field populations of mediterranean fruit fly, ceratitis capitata,in mediterranean citrus groves: comparison of two geographic areas in eastern spain. Spanish journal of agricultural research. 8: 757-765.
Niklaus-ruiz Borge M. and T. Basedow (1997) A survey on the occurrence and flight periods of fruit fly species (diptera: tephritidae) in a fruit growing area in southwest nicaragua, 1994/95 bulletin of entomological research 87: 405–412
Papadopoulos,n. T, B. I. Katsoyannos, J. R. Carey, and N. A. Kouloussis 2001. Seasonal and annual occurrence of the mediterranean fruit fly (diptera: tephritidae) in northern greece annals entomology society of america 94: 41-50.
Papadopouls, N. T and B. I. Katsoyanos (2003). Field parasitism of ceratitus captita larvae by aganaspis daci in chios, greece. Biocontrol 48: 191-195.
Ramasamy, M. P. 1989. A survey of three main tephertids and their hostss in mauritius and some studies on their control with attractive traps. Insect science and its application. 10: 383-391.
Rieux, R., S. Simon, and H. Defrance. 1999. Role of hedg-erows and ground cover management on arthropod populations in pear orchards. Agric. Ecosystem environment.73:119 -128.
Roger I. Vargas, Luc leblanc, Rudolph Putoa, and Avietam (2007) Impact of introduction of Bactrocera dorsalis (diptera: tephritidae) and classical biological control releases of Fopius arisanus (hymenoptera: braconidae) on economically important fruit flies in french polynesia j. Econ. Entomol. 100(3): 670-679
Siddiqui, Q. H; N. Ahmad; S. M. M. S. Rashdi; S. Niazi (2003). Effect of the day time and trap height on the catches of peach/ guava fruit flies, bactrocera zonata (Saunder) through Male Annihilation Technique. Asian Journal of Plant Sciences, 2: 228-232
Singh and D. R. Sharma (2012) abundance and management of fruit flies on peach through male annihilation technique (mat) using methyl eugenol basedmineral water bottle traps sandeep journal of insect science 25: 135-143.
Singh, K. K., Chadha, K. L. And Gupta, M. R. 1973. Ber cultivation in unjab. Punjab Agricultural University, Ludhiana.
Teresa M. Vera, Rafael Rodriguez, Diego F. Segura, Jorge l. Cladera, and Robert W. Sutherst (2002) potential geographical distribution of the mediterranean fruit fly, ceratitis capitata (diptera: tephritidae), with emphasis on argentina and australia environ. Entomol. 31(6): 1009-1022
Vayssiéres J. F, Sam Korie ,David Ayegnon (2009) correlation of fruit fly (Diptera tephritidae) infestation of major mango cultivars in borgou (benin) with abiotic and biotic factors and assessment of damage Crop Protection 28: 477–488
Watt, G. 1893. A dictionary of the economic products of india. Cosmos publications, delhi, india. Proceedings of the indian ocean commission, regional fruit fly symposium. Flic en flac, mauritus pp. 15-21.
Wei Shi, Carole Kerdelhue, and Hui Ye (2005) Population Genetics of the Oriental Fruit Fly, Bactrocera dorsalis (Diptera: tephritidae), in Yunnan (China) Based on Mitochondrial dnaSequences Environ. Entomol. 34: 977-983

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

Date	No of fruits	Fruit weight (Kg)	No of Pupae	*B. zonata*	*B. dorsalis*	*C. visuviana*	*T. daci*	*D. longicadata*
13 Dec 2012	18	0.234	75	65	--	--	--	--
20 Dec 2012	26	0.257	11	9	---	--	--	--
27 Dec 2012	31	0.396	3	2	--	---	--	--
3 Jan 2013	97	3.05	341	281	6	02	21	5
10 Jan 2013	57	0.530	37	29	3	--	--	--
17 Jan 2013	112	0.604	11	8	2		--	2
24 Jan 2013	75	1.195	17	11	2	2	--	--
31 Jan 2013	304	3.530	270	171	14	23	12	2
7 Feb 2013	209	2.234	121	45	11	34	13	6
14 Feb 2013	142	1.321	163	78	16	21	14	--
21 Feb 2013	113	0.810	23	8	3	6	4	--
28 Feb 2013	231	0.47	24	8	4	--	9	--
Total	1415	14.631	1096	715	61	88	73	15
Percentage (%)				90	5.56	8.02	6.66	1.36

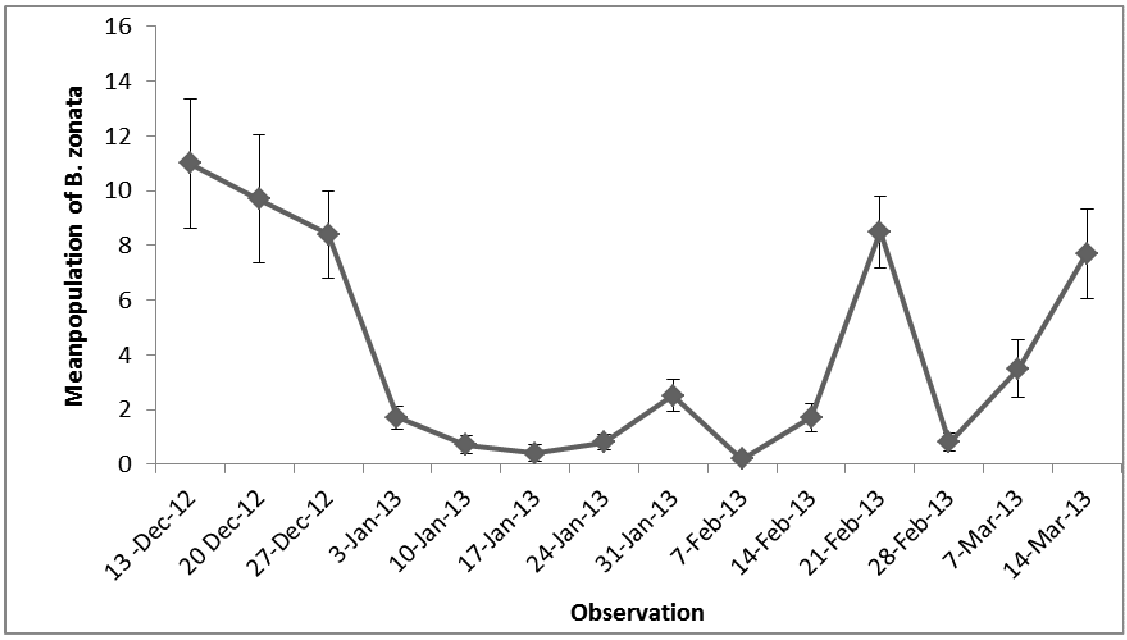

Figure 1. Average number of Peach fruit fly *B. zonata* catches /trap/day in the Jujube Orchards of NIA, Experimental Farm during 2012-13

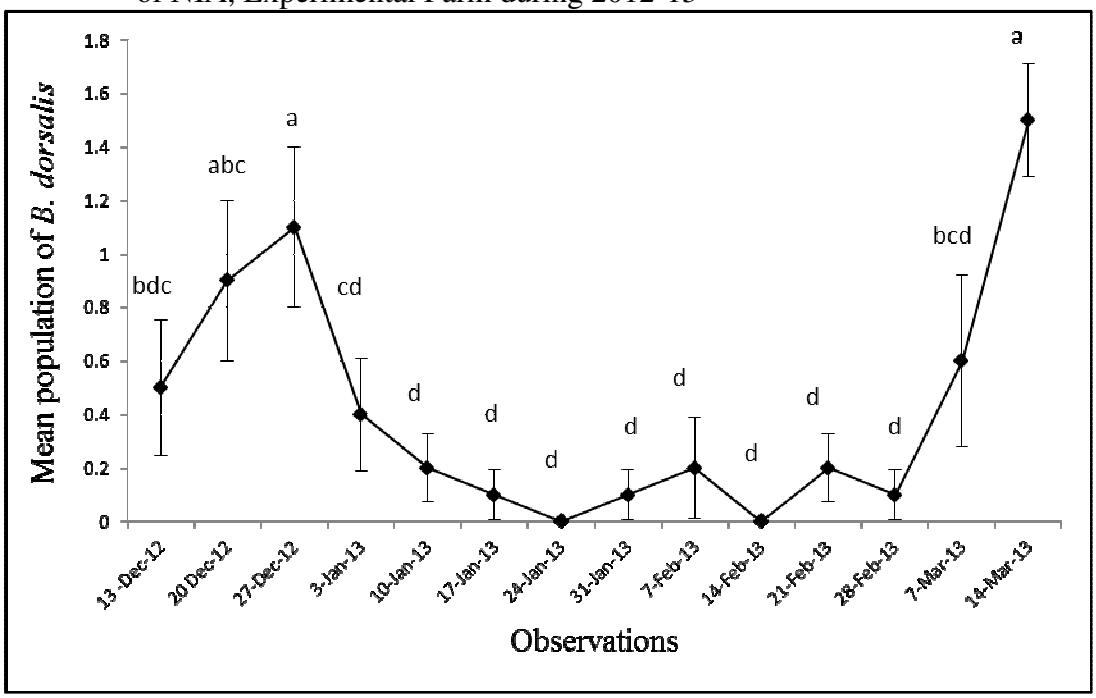

Figure 2. Average number of oriental fruit fly *B. dorsalis* catches /trap/day in the Ber Orchards of NIA, Experimental farm during 2012-13

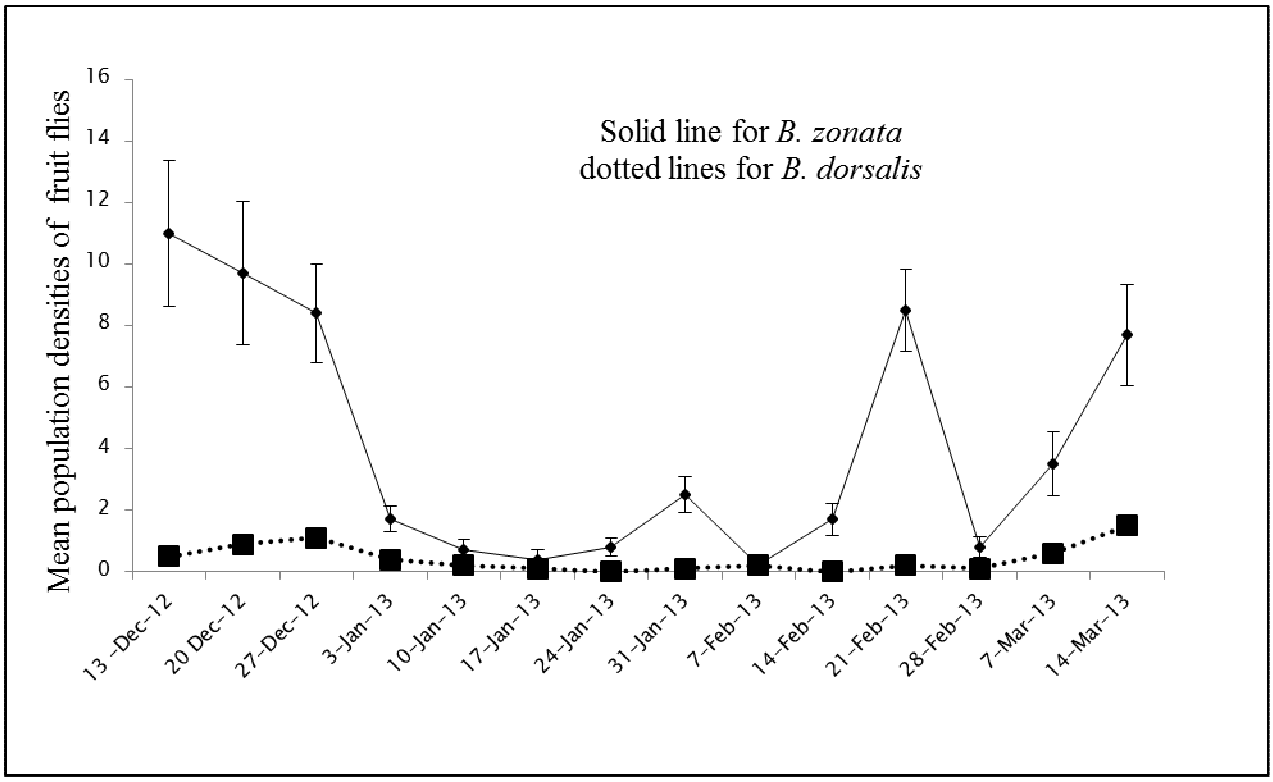

Figure 3. Average number of fruit flies catches /trap/day in the Ber Orchards of NIA, Experimental farm during 2012-13