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Species diversity of fruit flies (*Bactrocera* spp.) in Guava orchards of Sahapur District of Uttar Pradesh

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Abstract

There is a reduction in this production rate of guava cultivation since last few years as the fruit cultivation has been adversely affected by different varieties of fruit flies (*Bactrocera* spp.) infesting different orchards in different areas of Uttar Pradesh. These insect pests severely damage the guava fruits, rendering them unfit for consumption and off-market. In this research, we have carried rigorous investigations in the various orchards of Saharanpur district of Uttar Pradesh state of India, for a course of five months (October-February) over a time duration of three years (2021-2023) to identify the complexity of species of fruit flies that are causing harm to significant guava types including Allahabad Safeda, Chittidar, Arka Mridula and Harijha. The capturing process was conducted using self-made traps of plastic material coated with parapheromone, methyl eugenol, as fruit fly attractant placed in various guava orchards. In this research a total of 247, 251.8 and 272.6 mean number of fruit fly species were captured during 2021, 2022 and 2023 respectively. The findings showed that out of eight total fruit fly species captured during the season four, namely *Bactrocera dorsalis*, *B. zonata*, *B. Correcta* and *B. tau* belonging to the genus *Bactrocera*, were significantly overrepresented in all these varieties of guava with mean numbers (Per month) 99.8, 73.8, 42.4 and 22.4 respectively for the year 2021 and 102.4, 71.2, 48.8 and 15.8 for the year 2022 and 125.8, 83.8, 40.6 and 14 for the year 2023. Allahabad Safeda was recorded with the highest mean number of fruit flies captured numbering approximately 129.82 per month followed by Arka Mridula, Chittidar and Harijha numbering 76.18, 23.70 and 17.13 per month respectively. Subsequently, for the next two years 2022-2023 Allahabad Safeda variety was again recorded with highest number of fruit flies captured numbering 130.61 and 121.94 followed by the rest of three with mean numbers 73.26, 29.24, 18.69 (2022) and 75.91, 34.81, 39.94 (2023) respectively.

Keywords: Uttar Pradesh, diversity, *Bactrocera*, guava, parapheromone, methyl eugenol

Introduction

The guava (*Psidium guajava*), also referred to as the "Apple of the tropics" or "Poor man's apple", is one of the most significant fruit crops in the Myrtaceae family. It originated in Central America, and the Portuguese brought it to India in the seventeenth century ^[1]. With 45% of the global crop, India is one among the leading growers of guava worldwide. On a yearly basis, India produces approximately 24,968,000 metric tons of guava. With an estimated market share of 22.93% and an annual yield of 928.44 tons, Uttar Pradesh is the India's leading guava grower, followed by Madhya Pradesh and Bihar with 16% and 10% of the market share, respectively. Where farming has been gaining popularity recently, harvesting in India has increased by 64%, and guava production in India to 55% over the past four decades ^[2]. Guava is grown in tropical and subtropical regions and tolerates high temperatures, which makes India a favorable place to harvest guavas. India offers a vast array of guava varieties. However, the most popular guava cultivars in India among fruit pulp manufacturers are White Guava and Pink Guava. In India, certain guava varieties are named after their birthplace or shape. The Sardar and Safeda kinds from Allahabad are the most popular in India due to its exceptional quality, ability to yield, and global recognition. The guava varieties that are most common in India are the Bengal Safeda, Allahabad Safeda, Pant Prabhat, Sardar (Lucknow 49), Lalit, Dhareedar, Chittidar, Harijan, and Arka Mridula. Additionally, hybrid types such as Arka Amulya, Kohir Safeda, and Safed jam were produced.

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With more than 4000 species spread among 481 genera, fruit fly genera (Diptera: Tephritidae) are among the most varied groups of pest insects of great concern [3]. In Asia and Australia, tephritid flies of the genus *Bactrocera* with 28 subgenera comprising approximately 500 known species of *Bactrocera* [4]. These insect pests have wreaked enormous havoc on mangoes and guava with their fruit-eating larvae. Owing to their extensive host range, considerable tolerance to climatic changes, and strong dispersal capacity [5], these insects have spread throughout the Asia-Pacific area over the past century, from Hawaii to India and covering all South-East Asia. Mango and guava have been established to be hosts of two significant pest species: *B. zonata* and *B. dorsalis* [6]. There has been enormous damage done to the guava fruit by these species in India in the past decade which resulted in the decrease in productivity rate. However, certain control methods have been implemented by the Govt. and semi Govt. organizations to reduce the population of these insect pests. Techniques for managing these bothersome insects have been devised to remove fruit fly infestations in guava orchards. Owners of large-scale guava and mango plantations employed sanitation and control methods like hydrolyzate + spinosad and methyl eugenol + malathion to eradicate the pest infestations growing in the guava and mango orchards.

In this article we have studied the diversity of fruit flies of genus *Bactrocera* infesting various orchards of Saharanpur district of Uttar Pradesh India. The research was carried during the peak season of guava cultivation in Uttar Pradesh i.e. Oct-Feb. The data provided in this article is aimed to bring into the notice different species of genus *Bactrocera* and their population during the peak months so that necessary controlling measures should be taken by the guava fruit growers to minimize the harm caused by these insect pests.

Materials and Methods

This research was carried in the five orchards located few kilometers away from Glocal University Saharanpur Uttar Pradesh for a period of 5 months from Oct-Feb during 2021-2023. Fruit fly trapping was accomplished by using parapheromone traps coated with methyl eugenol as a fruit fly attractant with 4 guava varieties. To track fruit fly activity in guava orchards self-made traps (20 in number) were installed at different locations. These were prepared from yellow colour plastic material and casted into jar-style traps measuring around 10 inches in height and 5 inches in diameter. These traps include several holes in the sidewalls, each measuring approximately 1.5 inches diameter, that serve as fruit fly entrance points. The top and bottom were closed in

such a way that they could be easily opened later. Bottom of the trap was provided with perforations to drain the rain water out of the traps. Inside the trap a wooden stick measuring around 2 inches and small thickness coated with fruit fly attractant methyl eugenol was suspended from the top with a nylon fibre. These traps were installed on several guava trees hanging at a height of 1.5 metres from ground. A typical view of the trap and fruit flies trapped can be seen from Figure 2.1.



Fig 1: (a) Typical view of a fruit fly trap made from plastic material hanging on a guava tree. (b) Fruit flies trapped in different traps for a period of 7 weeks.

These traps were weeks investigated counting the number of fruit flies trapped then cleaned and reinstalled back. Data was taken from all the traps and calculations regarding the number and different types of fruit fly species was then calculated and is tabulated in results and discussions section. The fruit flies that were trapped in different self-made fly traps were gathered carefully and carried in air tight containers to laboratory for taxonomic identification. Of all the species that got trapped our primary focus was on genus *Bactrocera* eliminating others genera or species. The morphological characteristics of each specimen were investigated under a high-resolution microscope and with the help of scientific taxonomic keys [7] following eight species of genus *Bactrocera* were recognized and labelled accordingly (as can be seen in Figure 2.2) viz.

1. *B. dorsalis*
2. *B. zonata*
3. *B. Correcta*
4. *B. tau*
5. *B. cucubita*
6. *B. tuberculata*
7. *B. scutellaris*
8. *B. diversa*



Fig 2: Shows taxonomic identification of different species of genus *Bactrocera*

Results and Discussions

We have collected fruit flies from all the 20 traps installed in various guava orchards of Saharanpur district of Uttar Pradesh prevailing a few kilometres from Glocal University Saharanpur U.P, India. We primarily focused on the genus *Bactrocera* eradicating all species from any other genera. The duration of capturing process was continued for a period of five months from October to February for three consecutive years 2021, 2022 and 2023. The data obtained from observing and identifying all the fruit fly species is tabulated in Table 3.1. From the table it can be clearly seen that a total of 247 species per month were collected for the year 2021 and the species *B. dorsalis* is found to be dominant with a mean population of 99.8 per month. This finding agrees with the results found by Vignesh *et al.* [8]. They captured fruit flies in the guava orchards of Tamil Nadu state India and throughout the collective period species *B. dorsalis* was found to be dominant. The next dominant species was recorded as *B. zonata* with a mean population of 78.8 per month followed by other species as given in the Table 3.1. The species *B. Correcta* and *B. tau* were recorded with a mean population of 42.4 and 22.4 per month respectively. These findings can be compared with the results found by Kadam 2012 [9]. During his research he also found the species *B. dorsalis*, *B. zonata* and *B. Correcta* most abundant. Verghese, Abraham *et al.* [10] found *B. dorsalis* and *B. Correcta* affecting guava fruit in Bangalore. Madhura *et al.* [11] also recorded the species *B. dorsalis*, *B. zonata* and *B. Correcta* most prevalent affecting guava fruits in Bangalore. Haseeb *et al.* [12], reported species *B. zonata* as most abundant fruit fly species in Aligarh. Kawashita *et al.* [13] also recorded *B. dorsalis*, *B. Correcta* and *B. zonata* as most abundant fruit fly species damaging guava fruits. Dale *et al.* [14] have also reported *B. dorsalis* and *B. zonata* as most harmful species to guava in Gujarat. Kapoor *et al.* [15], recorded species *B. Correcta*, *B. dorsalis* and *B. zonata* as most abundant guava affecting fruit fly insect pests in India. Jalaludin *et al.* [16], also have recorded species *B. zonata* as dominant species. Kumar *et al.* [17] have reported

that *B. dorsalis*, *B. Correcta*, *B. Diversa* *B. Zonata* are mostly abundant species found in mango fruit in Saharanpur and Meerut districts of Uttar Pradesh. The rest of the species were found to be in smaller numbers as recorded in the table. Comparing the relative numbers for different months we can see there is a large number of fruit flies during the month of December. However, the other proportions during other months of collection period are not that much scattered. From Figure 3.1, we can see that the species *B. dorsalis* comprises of around 40%, 41% and 46% of the total species captured during 2021, 2022 and 2023 respectively. Whileas, species *B. zonata* comprises of about 30%, 28% and 31% respectively and the species *B. Correcta* comprises of 17%, 19% and 15% respectively of the total species trapped during 2021-2023. Comparing our findings with the results of Khan *et al.* [18] they have got species *B. zonata* as most abundant species comprising around 50% of the collective population. Mondal *et al.* [19], recorded species *B. Correcta* on guava with 90% population. Ukey *et al.* [20], recorded species *B. dorsalis* comprising 49.95%, *B. zonata* with 31.36% and species *B. Correcta* with 19.95% in Maharashtra.

We have calculated single factor Analysis of Variations (ANOVA) technique for Table 3.1 to check whether the variations in mean per month for every single species in the entire collection in all the three years are significant or not. We also hypothesized that whether these variations are due to different biotic and abiotic factors like relative abundance of different species within different genera, average monthly temperature, average monthly rainfall, and humidity etc. or these variations occur only by chance or some random effects. The results of single factor ANOVA technique for all the three years have been plotted in Table 3.2. From the ANOVA table we got a 'p' value which is very much smaller than 0.05 for all the three years can clearly indicates that the variations in the mean number per month for every year are indeed significant and these variations occur due to various biotic and abiotic factors and not by chance.

Table 1: Shows the number of different species of genus *Bactrocera* collected from 20 traps over a five-month course

Species/Year/Month	2021					2022					2023				
	Oct	Nov	Dec	Jan	Feb	Oct	Nov	Dec	Jan	Feb	Oct	Nov	Dec	Jan	Feb
<i>B. dorsalis</i>	98	112	112	97	80	78	112	110	105	107	126	126	131	112	134
<i>B. zonata</i>	75	76	79	72	67	83	77	58	58	80	85	86	80	85	83
<i>B. Correcta</i>	57	51	35	37	32	43	42	57	53	49	39	46	44	39	35
<i>B. tau</i>	19	26	23	25	19	14	15	25	15	10	10	18	18	14	10
<i>B. cucubita</i>	7	1	4	1	4	1	5	16	6	3	11	1	8	1	0
<i>B. tuberculata</i>	1	2	8	2	0	3	4	2	4	3	0	1	2	3	3
<i>B. scutellaris</i>	0	1	3	0	1	0	12	1	0	1	2	0	9	0	0
<i>B. diversa</i>	6	0	1	0	1	1	0	6	0	0	0	0	0	1	0
Mean (Per Month)	247					251.8					272.6				

Table 2: Shows the one-way analysis of variations of means per month of each species in the entire collection for 2021, 2022 and 2023 respectively

Single Factor ANOVA							
2021	SUMMARY						
	<i>Groups</i>	<i>Count</i>	<i>Sum</i>	<i>Average</i>	<i>Variance</i>		
	<i>B. dorsalis</i>	5	499	99.8	175.2		
	<i>B. zonata</i>	5	369	73.8	20.7		
	<i>B. correcta</i>	5	212	42.4	119.8		
	<i>B. tau</i>	5	112	22.4	10.8		
	<i>B. cucubitae</i>	5	17	3.4	6.3		
	<i>B. tuberculata</i>	5	13	2.6	9.8		
	<i>B. scutellaris</i>	5	5	1	1.5		
	<i>B. diversa</i>	5	8	1.6	6.3		
	ANOVA						
	<i>Source of Variation</i>	<i>SS</i>	<i>df</i>	<i>MS</i>	<i>F</i>	<i>P-value</i>	<i>F crit</i>
Between Groups	50508.78	7	7215.539	164.7383	2.9829E-23	2.312741	
Within Groups	1401.6	32	43.8				
Total	51910.38	39					
2022	SUMMARY						
	<i>Groups</i>	<i>Count</i>	<i>Sum</i>	<i>Average</i>	<i>Variance</i>		
	<i>B. dorsalis</i>	5	512	102.4	193.3		
	<i>B. zonata</i>	5	356	71.2	149.7		
	<i>B. correcta</i>	5	244	48.8	41.2		
	<i>B. tau</i>	5	79	15.8	30.7		
	<i>B. cucubitae</i>	5	31	6.2	33.7		
	<i>B. tuberculata</i>	5	16	3.2	0.7		
	<i>B. scutellaris</i>	5	14	2.8	26.7		
	<i>B. diversa</i>	5	7	1.4	6.8		
	ANOVA						
	<i>Source of Variation</i>	<i>SS</i>	<i>df</i>	<i>MS</i>	<i>F</i>	<i>P-value</i>	<i>F crit</i>
Between Groups	51596.78	7	7370.968	122.137	3.01373E-21	2.312741	
Within Groups	1931.2	32	60.35				
Total	53527.98	39					
2023	SUMMARY						
	<i>Groups</i>	<i>Count</i>	<i>Sum</i>	<i>Average</i>	<i>Variance</i>		
	<i>B. dorsalis</i>	5	629	125.8	71.2		
	<i>B. zonata</i>	5	419	83.8	5.7		
	<i>B. correcta</i>	5	203	40.6	19.3		
	<i>B. tau</i>	5	70	14	16		
	<i>B. cucubitae</i>	5	21	4.2	24.7		
	<i>B. tuberculata</i>	5	9	1.8	1.7		
	<i>B. scutellaris</i>	5	11	2.2	15.2		
	<i>B. diversa</i>	5	1	0.2	0.2		
	ANOVA						
	<i>Source of Variation</i>	<i>SS</i>	<i>df</i>	<i>MS</i>	<i>F</i>	<i>P-value</i>	<i>F crit</i>
Between Groups	77146.78	7	11020.97	572.5178	9.4077E-32	2.312741	
Within Groups	616	32	19.25				
Total	77762.78	39					

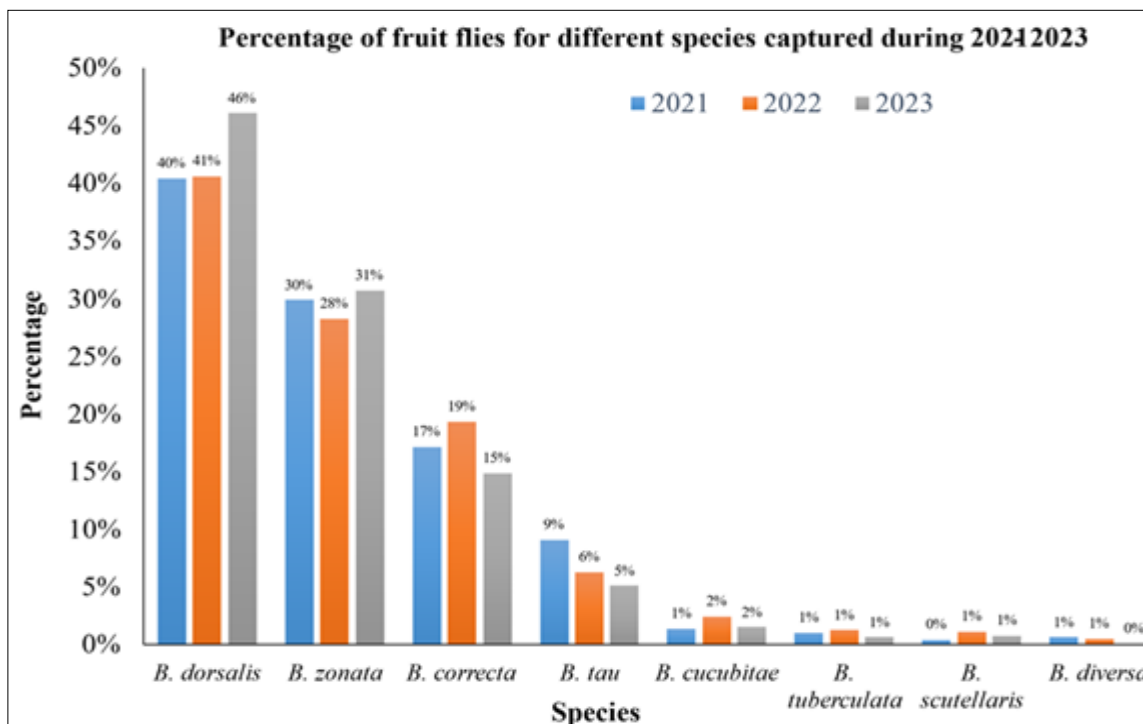


Fig 3: Shows the percentage of species captured per month for three years period

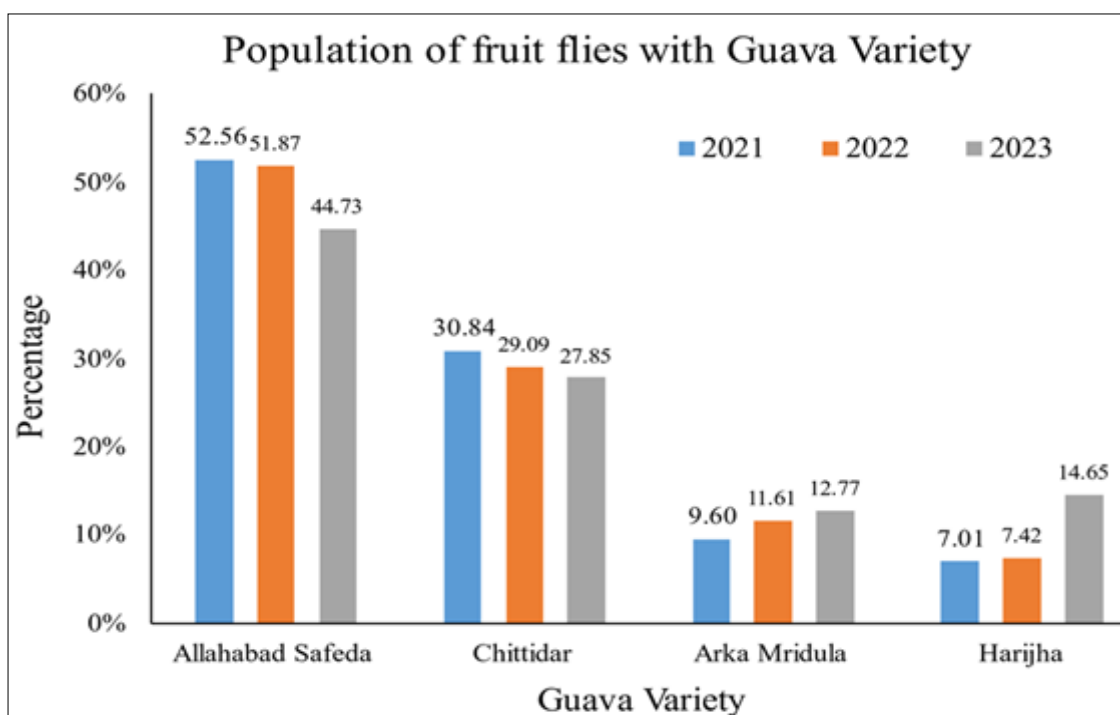


Fig 4: Shows the percentage of total fruit flies captured with different varieties of guava

Table 3: Shows mean number of *Bactrocera* spp. per month captured during Oct-Feb for different guava varieties.

Species/Variety	2021				2022				2023			
	Allahabad Safeda	Arka Mridula	Chittidar	Harijha	Allahabad Safeda	Arka Mridula	Chittidar	Harijha	Allahabad Safeda	Arka Mridula	Chittidar	Harijha
<i>B. dorsalis</i>	56.89	28.94	8.98	4.99	37.89	34.82	18.43	11.26	71.71	25.16	18.87	10.06
<i>B. zonata</i>	53.14	11.07	4.43	5.17	66.22	2.85	0.71	1.42	25.14	33.52	5.03	20.11
<i>B. Correcta</i>	11.87	23.74	5.94	0.85	20.98	21.96	3.42	2.44	14.21	12.18	9.34	4.87
<i>B. tau</i>	5.60	11.20	2.24	3.36	4.90	9.16	1.11	0.63	8.12	4.90	0.14	0.84
<i>B. cucubitae</i>	0.41	0.61	1.26	1.12	0.00	3.53	2.36	0.31	0.92	0.00	0.00	3.28
<i>B. tuberculata</i>	0.23	0.21	0.34	1.82	0.03	0.54	0.00	2.62	1.73	0.00	0.00	0.07
<i>B. scutellaris</i>	0.13	0.40	0.47	0.00	0.59	0.00	2.21	0.00	0.00	0.07	1.43	0.70
<i>B. diversa</i>	1.55	0.00	0.05	0.00	0.00	0.39	1.01	0.00	0.11	0.09	0.00	0.00
Mean (Per Month)	129.82	76.18	23.70	17.13	130.61	73.26	29.24	18.69	121.94	75.91	34.81	39.94

The diversity of *Bactrocera* spp. with different varieties of guava has been tabulated in Table 3.3. From the table it can be clearly seen that the variety Allahabad Safeda was recorded with the highest number of fruit flies during the five month collection period. Of the total collection around 129.82, 130.61 and 121.94 mean number per month was collected from this variety for 2021, 2022 and 2023 respectively. The second highest mean numbers were recorded for the variety Arka Mridula comprising of mean numbers per month 76.18, 73.26 and 75.91 for 2021, 2022 and 2023 respectively. Chittidar and Harijha were recorded with comparatively lesser mean numbers per month equaling around 23.70, 29.24, 34.81 and 17.13, 18.69, 39.94 respectively for the years 2021, 2022 and 2023. For the consecutive three years Allahabad Safeda was dominant variety for which we got huge number of species. From Figure 3.2, we can clearly see that Allahabad Safeda variety of guava is mostly infested in all the three consecutive years.

Conclusions

According to our research observations and findings, *Bactrocera* spp., is a major issue in the guava fruit production in Uttar Pradesh especially in Saharanpur district. Among the eight different species of genus *Bactrocera* recognized affecting guava fruits, only four species namely *B. dorsalis*, *B. zonata*, *B. Correcta* and *B. tau* were found most abundant in Allahabad Safeda, Chittidar, Arka Mridula and Harijha varieties during the guava fruity season of 2021, 2022 and 2013 in guava orchards of Saharanpur district of Uttar Pradesh India. The quantity of insect pests captured in different guava varieties, on the other hand, varied significantly with Allahabad Safeda being mostly damaged. For the consecutive years we observed that their infestation is growing per year. The understanding of the species complex, range, and population abundance of *Bactrocera* spp. may aid in the development curative and control methods to meet their growing population.

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References

- Baloda S, Sharma JR, Kumar M, Singh S, Malik A. Studies on performance of rejuvenated plants and fresh plants of guava C.V. Hisar Safeda, Int. J Pure App. Biosci. 2018;6(1):939-941. DOI: <http://dx.doi.org/10.18782/2320-7051.6066>.
- FAO. World Food and Agriculture - Statistical Yearbook 2021. Rome; c2021. <https://doi.org/10.4060/cb4477en>.
- Kim TH, Kim JS, Mun JH. Distribution and bionomics of *Bactrocera depressa* (Shriaki) in Chonbuck province. Korean J Soil Zool. 1999;4:26-32.
- Drew RA, Hancock DL. Phylogeny of the tribe Dacini (Dacinae) based on morphological, distributional, and biological data. In: Fruit Flies (Tephritidae). Crc Press; c1999. p. 509-522.
- Peterson MA, Denno RF. The influence of dispersal and diet breadth on patterns of genetic isolation by distance in phytophagous insects. The American Naturalist. 1998;152(3):428-446.
- Bhalla OP, Pawar AD. A survey study of insect and non-insect pests of economic importance in Himachal Pradesh. A survey study of insect and non-insect pests of economic importance in Himachal Pradesh; c1977.
- Murguía-Romero M, et al. Taxonomic identification keys on the web: Tools for better knowledge of biodiversity. Revista mexicana de biodiversidad, 2021, 92.
- Vignesh S, Chandrasekaran M, Ambethgarand V, Jeeva S. Species diversity and population dynamics of fruit flies in guava orchards. Journal of Entomology and Zoological Studies. 2020;8(3):615-619.
- Kadam UK. Studies on species diversity, population dynamics and management of fruit flies in guava (*Psidium guajava* L.) Dissertation. Ph.D. Thesis, Mahatma Phule Krishi Vidyapeeth, Rahuri-413 722, dist. Ahmednagar, Maharashtra, India, 2012, 1-160.
- Verghese A, et al. Fruit flies of economic significance in India, with special reference to *Bactrocera dorsalis* (Hendel). Proceedings of 6th International Fruit fly Symposium. 2002.
- Madhura HS, Viraktamath CA. Efficacy of different traps in attracting fruit flies (Diptera: Tephritidae). Pest Management in Horticultural Ecosystems. 2003;9(2):153-154.
- Haseeb M, et al. Biology and Morphometries of *Bactrocera zonata* on Guava. Annals of Plant Protection Sciences. 2010;18(2):508-510.
- Kawashita T, Rajapakse GBJP, Tsuruta K. Population surveys of *Bactrocera* fruit flies by lure trap in Sri Lanka. Research Bulletin of the Plant Protection Service (Japan). 2004.
- Dale NS, Patel RK. Population dynamics of fruit flies (*Bactrocera* spp.) on guava and its correlation with weather parameters. Current Biotica. 2010;4(2):245-248.
- Kapoor VC. Fruit fly pests and their present status in India. In: Proc. 6th Int. Fruit Fly Symp; c2002.
- Jalaluddin SM, et al. Discovery of the guava fruit fly *Bactrocera Correcta* (Bezzi). Entomon. 1999;24(2):195-196.
- Kumar P, et al. Fruit fly damage and crop losses. Field exercise guide on fruit flies integrated pest management, Asian Fruit fly IPM Project, Bangkok, Thailand; c2011.
- Khan MA, et al. Management of fruit flies (Diptera: Tephritidae) of the most perishable fruits. Entomological Research. 2005;35(2):79-84.
- Mondal CK, et al. Bio-friendly management of Guava fruit fly (*Bactrocera Correcta* Bezzi) through wrapping technique. Journal of Applied and Natural Science. 2015;7(1):358-363.
- Ukey NS, et al. Species composition of fruit flies, *Bactrocera* spp. (Diptera: Tephritidae) infesting guava in Maharashtra. Pest Management in Horticultural Ecosystems. 2013;19(2):242-244.