International Journal of Advanced Biochemistry Research

ISSN Print: 2617-4693
ISSN Online: 2617-4707
IJABR 2024; SP-8(7): 86-91
www.biochemjournal.com
Received: 11-04-2024
Accepted: 15-05-2024

D Akhilandeshwari
M.Sc. Scholar, Department of Entomology, College of Agriculture, PJTSAU, Rajendranagar, Hyderabad, Telangana, India

I Aruna Sri
Scientist, AINP on Vertebrate Pest Management, Rajendranagar, Hyderabad, Telangana, India

VV Rao
Principal Scientist & Head, AINP on Vertebrate Pest Management, Rajendranagar, Hyderabad, Telangana, India

M Madhavi
Scientist, Seed Research & Technology Centre, PJTSAU, Rajendranagar, Hyderabad Telangana, India

MA Prajwal Gowda
M.Sc. Scholar, Department of Entomology, College of Agriculture, PJTSAU, Rajendranagar, Hyderabad, Telangana, India

Corresponding Author:
D Akhilandeshwari
M.Sc. Scholar, Department of Entomology, College of Agriculture, PJTSAU, Rajendranagar, Hyderabad, Telangana, India

A comparative evaluation of different traps for insect collections in cotton at PJTSAU, Rajendranagar, Hyderabad

D Akhilandeshwari, I Aruna Sri, VV Rao, M Madhavi and MA Prajwal Gowda

DOI: https://doi.org/10.33545/26174693.2024.v8.i7Sb.1453

Abstract
The insect diversity and the types of insect species infesting major crops in Rajendranagar is lacking. Since the majority of insect species are sturdy, proper sampling necessitates the use of appropriate strategies to capture specific insects. To address this, a comparative study was conducted from September 2021 to February 2022 at the college farm, Agricultural Research Institute (ARI), and student farm of Professor Jayashankar Telangana State Agricultural University (PJTSAU), Rajendranagar, Hyderabad, to investigate insect species diversity on cotton using Sweep net, Light trap and Sticky trap methods. Results showed that, in all three locations, Light trap captured higher numbers of insects with counts of 4225, 4149, 3630 predominantly from the order Hemiptera, at college farm, ARI and student farm respectively. Sweep net recorded 2114, 2407 and 2386 insects and Sticky traps collected 2433, 2228 and 1487 insects in college farm, ARI and student farm respectively which are also dominated by order Hemiptera. Shannon index recorded highest for light trap (H = 1.745, 1.803 and 1.785) in college farm, ARI and student farm respectively. From the study it was concluded that, light trap shown to be the most effective and complementary to insect orders but it is affected by influence of weather conditions. To effectively collect insects, it is recommended to employ different trapping methods in crop ecosystem.

Keywords: Insects, light traps, sweep net, diversity, cotton

Introduction
Insects, according to Belamkar and Jadesh (2014) [1], represent the most taxonomically diverse group of creatures globally. With 1,020,007 species, comprising 66% of all known animal species (Zhang, 2011) [21], insects serve as the most abundant category in the animal kingdom. Within India, there exists a rich insect fauna, encompassing 658 families distributed among 27 orders and three classes within Hexapoda. Notably, eight major orders dominate this diversity, namely Lepidoptera, Coleoptera, Orthoptera, Diptera, Hemiptera, Odonata, Hymenoptera, and Thysanoptera, collectively constituting 94% of the insect population. Conversely, the remaining 21 orders contribute only a minor fraction (6%) to the total insect count. Among these major orders, Coleoptera boasts remarkable diversity, with 114 families, followed closely by Hemiptera (92 families), Diptera (87 families), Lepidoptera (84 families), and Hymenoptera (65 families) (Chandra, 2011) [3]. Cotton (Gossypium sp.), often referred to as "white gold," holds significant importance as one of India's primary fibre crops.

The introduction of *Bt* cotton in 2002 marked a milestone in cultivation practices, particularly in combating the bollworm complex. However, its impact on the sucking pest complex remains uncertain. Contrarily, the reduced usage of insecticides in *Bt* cotton has led to a surge in sucking pests (Krishna and Qaim, 2012) [7], rendering it more susceptible to such threats compared to desi cotton (Nath *et al*., 2000) [11].

Throughout various stages of cotton production, the arthropod community encompasses insect pests, natural enemies and non-target insects. Among these, insect pests emerge as pivotal limiting factors, contributing to significant crop losses estimated at 20% to 25% (Butani and Jotwani, 1984) [2]. In India, the cotton crop is known to be attacked by approximately 162 insect and mite species, resulting in substantial yield losses.

For instance, in *Gossypium hirsutum*, bollworms, sucking pests, or both collectively cause losses ranging from 8.45 to 17.35 quintals/ha (Satpute *et al*., 1988) [17].

Sucking pests such as Aphids (*Aphis gossypii* Glover), leafhoppers (*Amrasca biguttula biguttula* Ishida), Whitefly (*Bemisia tabaci* Genn.), Thrips (*Thrips tabaci* Lind.) and Mealybug (*Phenococcus solenopsis* Tinsley) pose significant threats to *Bt* cotton, inflicting severe damage on the crop.

The comprehensive documentation of insects is fundamental for analyzing biodiversity and population dynamics, demanding the utilization of suitable sampling strategies designed to accommodate the resilience of these species (Russo *et al*., 2011) [15]. Three common collection methods followed are Light trap, Sweep net and Sticy traps. Most nocturnal insect species, including 95% of Lepidoptera, are sampled with light traps as traditional methods are ineffective. Light traps also capture bugs, beetles, and flies. However, data from light traps often do not reflect the true abundance of organisms as the traps are influenced by environmental factors (Ramirez-Hernandez *et al*., 2018) [14]. Despite this, light traps remain widely used.

Sweep netting captures insects in flight or at rest in vegetation (Spafford and Lortie 2013) [19]. Yellow sticky traps are commonly used to monitor the pest population especially, species such as whiteflies, leafminers, and aphids (Gu *et al*., 2008) [5]. All the methods provide valuable insights into insect populations and habitats. Since prevalence of insect diversity and different types of insect species infesting the major crops in Rajendranagar is lacking an attempt was made to arrive the occurrence of diversified insects existing in the cotton ecosystem in that particular area.

Materials and Methods

Methodology

Experiment was conducted at multiple locations including College farm, Student farm at College of Agriculture, Agriculture Research Institute (ARI), Rajendranagar, Hyderabad. These research fields are characterized by diverse vegetation, encompassing agricultural crops, shrubs, herbs, trees, and orchards.

The geographical coordinates of the three farm areas are as follows

a) **College farm:** Latitude 17°19'19.64" N, Longitude 78°24'29.89" E, with an elevation of 542.6 meters above mean sea level (MSL).
b) **Student farm:** Latitude 17°19'14" N, Longitude 78°28'33" E, with an elevation of 542.3 meters above MSL.
c) **ARI:** Latitude 17.184° N, Longitude 78.240° E, situated at an elevation of 494 meters above MSL. These locations are all situated in Rajendranagar, Hyderabad.

Methods of collection

Light trap

Nocturnal insects were captured using light traps, with one trap per hectare, operated from 6 PM to 10 PM. The traps, randomly distributed, had containers filled with soapy water. The following morning, each trap was checked, and the captured insects were collected and taken to the lab for identification.

Sweep net

Sweep nets, equipped with a hoop diameter of 30 cm and a handle length of 80 cm, were utilized to collect insects once a week during daytime hours (from 9 AM to 1 PM). At each sampling point, a series of five sweeps were conducted while traversing in a diagonal pattern at 50 m intervals. Subsequently, the collected insects were transported to the laboratory for preservation. Further identification was carried out by placing the specimens into a killing jar containing cotton swabs soaked in ethyl acetate.

Yellow Sticky trap

Yellow sticky traps (10 per acre), smeared with castor oil, were installed in cotton fields. The traps were inspected the day after installation, and the captured insects were counted using a magnifying lens after being brought to the laboratory.

Identification and Data analysis

Insects collected by light were sorted into different orders under a Labomed CZM6 Binocular Zoom stereo microscope within the same week. They were preserved in glass containers with 70% alcohol, labelled with the date of collection, type of trap, and insect order. Hard-bodied insects were dry pinned and stored in insect boxes, while insects collected using sweep nets were dry pinned and similarly labelled. Standard preservation methods by Triplehorn and Johnson (2005) [22] were followed. Specimens were identified to the family level using their key, and assistance for difficult identifications was provided by the Zoological Survey of India, NBAIR, Biodiversity Portal of India, local taxonomists, and experts from other State Agricultural Universities (SAUs). Photographs of minute insects were taken with a Labomed CZM6 Binocular Zoom stereo microscope with a camera in AINP on VPM. Diversity of insects were analyzed using PAST software version 3.25.

Data Analysis

The Shannon-Wiener Diversity Index of insects collected at the ARI, College Farm, and Student Farm using various methods such as sweep nets, light traps, and sticky traps was compared and analysed using the PAST (Paleontological Statistics Tool) software version 3.25.

Shannon -Wiener Diversity Index:

It was used to measure community diversity which taken the account the number of individuals as well as number of taxa in to consideration. The formula used to calculate Shannon - Wiener Diversity index was:

$$H = -\Sigma P_i \text{ In } P_i$$

Where, $P_i = S / N$
S = number of species
N = total number of individuals
In = logarithm to base e

Results and Discussion

Light trap

Among 4225 insect specimens collected by light trap in college farm, highest insect insect order collected was followed by Hemiptera (1510), Coleoptera (1297), Diptera

(478), Lepidoptera (417), Hymenoptera (393), Orthoptera (176), Neuroptera (8), Mantodea (4) > Odonata (2).Whereas, in ARI, altogether 4149 individuals were documented with following sequence of orders: Hemiptera (1498) > Coleoptera (1302) > Diptera (437) > Lepidoptera (417) > Hymenoptera (401) > Orthoptera (87) > Neuroptera (7). Altogether 3630 individuals were recorded in student farm, the descending order of orders is as follows; Hemiptera (1301) > Coleoptera (1190) > Lepidoptera (445) > Hymenoptera (375) > Diptera (257) > Orthoptera (55). Percent composition order Hemiptera was highest with 35.24, 34.69% and 35.91% in college farm, ARI and student farm respectively (Fig 1a, 1b, 1c).

Order Hemipetra is mostly dominated in light trap due to more catchings of Leaf hoppers and stink bugs during study period. In fact, nocturnal insects are collected exclusively through light trap. According to Pachkin *et al*. (2019) [12] and Marchioro *et al*. (2020), the light traps were more attractive for the representatives of Homoptera, Coleoptera which are in line with present findings.

Sweep Net

In the College farm, a total of 2114 individuals were captured *via* sweep net, with the following order sequence based on abundance: Hemiptera (868), Coleoptera (601), Lepidoptera (352), Diptera (127), Hymenoptera (97), Orthoptera (38), Odonata (17), Mantodea (10), and Neuroptera (4). Hemiptera and Coleoptera were the major orders, constituting 41.06% and 28.43%, respectively. In minor orders, Mantodea and Neuroptera had composition rates of 0.47% and 0.19% (Fig 2a). At ARI, 2407 insect specimens were collected, with the order sequence in sweep net being Hemiptera (1071), Coleoptera (633), Lepidoptera (386), Diptera (168), Hymenoptera (106), Orthoptera (28), Odonata (10), and Mantodea (5). Hemiptera dominated with a composition of 44.5% (Fig 2b). In the Student farm, 2386 individuals were recorded, with Hemiptera (987) and Coleoptera (572) being the major orders, comprising 41.37% and 23.97% respectively (Fig 2c).

The abundance of Hemiptera was notably high in sweep net due to the increased incidence of Stink bugs, Dusky cotton bug and Red cotton bugs in the cotton fields during the collection period. This was followed by the Coleoptera order, which was primarily represented by a large number of coccinellid beetles. Musser *et al*. (2007) [10] reported that sweep nets are an efficient approach for trapping Miridae family bugs while Diabata *et al*. (2020) [4] demonstrated that sweep net catches largely comprise of insects from the Hemiptera order. However, according to Shweta and Rajmohana (2016) [18], sweep net are better collection methods for insects compared to other collection methods.

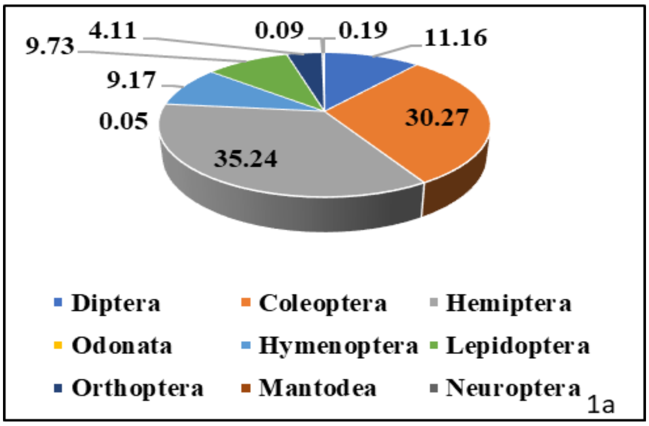
Yellow Sticky trap

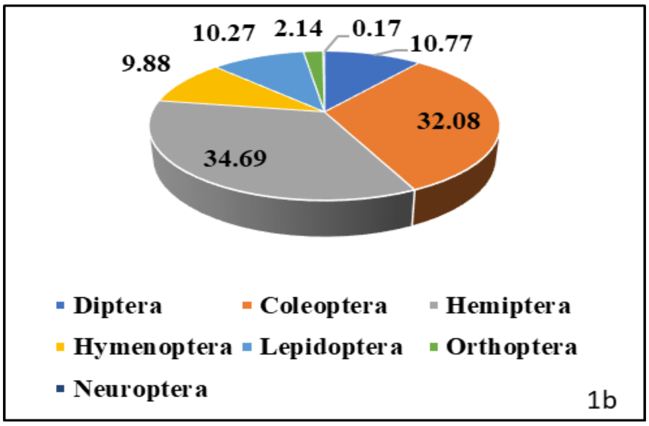
Of the 2,433 individuals recorded from five orders at college farm, Hemiptera (1878) recorded with maximum number with 1,878 individuals which constituted 77.19% (Fig 3a). Of the total, which was followed by Diptera (210), Hymenoptera (115), Lepidoptera (146) and Coleoptera (84). Altogether 2228 insect specimens were found under five orders in ARI. Sequence of order composition Hemiptera (1736) > Diptera (175) > Lepidoptera (135) > Hymenoptera (93) > Coleoptera (89). Hemiptera and Coleoptera were the major and minor orders with per cent composition of 77.92% and 3.99% respectively (Fig 3b). Similarly, in student farm, the total of 1487 individuals were under five orders *viz.*, Hemiptera (1126), Diptera (148), Lepidoptera (144), Coleoptera (110), Hymenoptera (107). Hemiptera was major order with maximum per cent (68.87%) composition and Hemiptera was minor order with 6.54% per cent composition (Fig 3c).

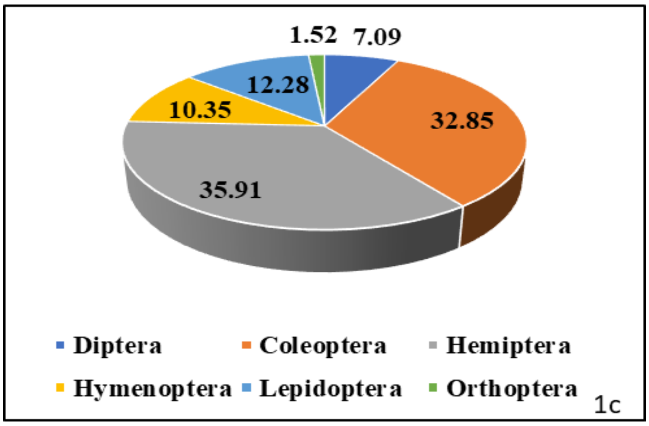
Yellow sticky traps exclusively attracts phototropic insects, such as leafhoppers. As the infestation of leafhopper during study period was high along with whiteflies, Hemiptera recorded maximum in yellow sticky traps.

Highest Shannon Weiner index value was reported for light trap (H = 1.74, 1.803, 1.785) followed by sticky trap (1.43, 1.529, 1.43) and whereas, sweep net (H = 1.314, 1.258, 1.309) in college farm, ARI and student farm respectively.

Sticky traps and light traps are affected by the influence of weather factors in open fields. Rainwater and temperature can affect the stickiness of the traps, while fog can reduce the illumination distance of light traps (Pellegrino *et al*. 2013) [13]. Therefore according to Sanderson *et al*. 2015, sticky traps and light traps are likely to be more effective for pest control in greenhouses than in open fields**.**

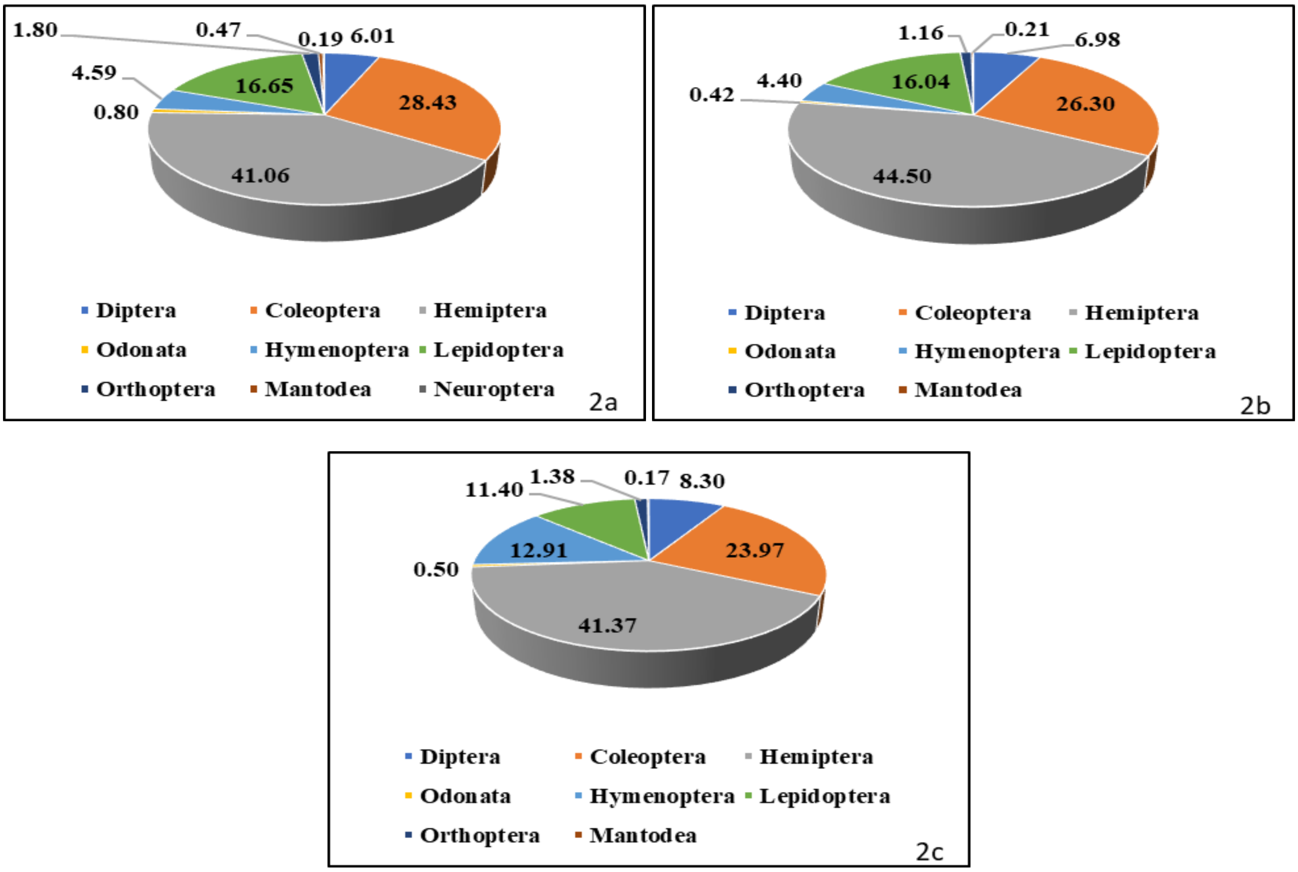






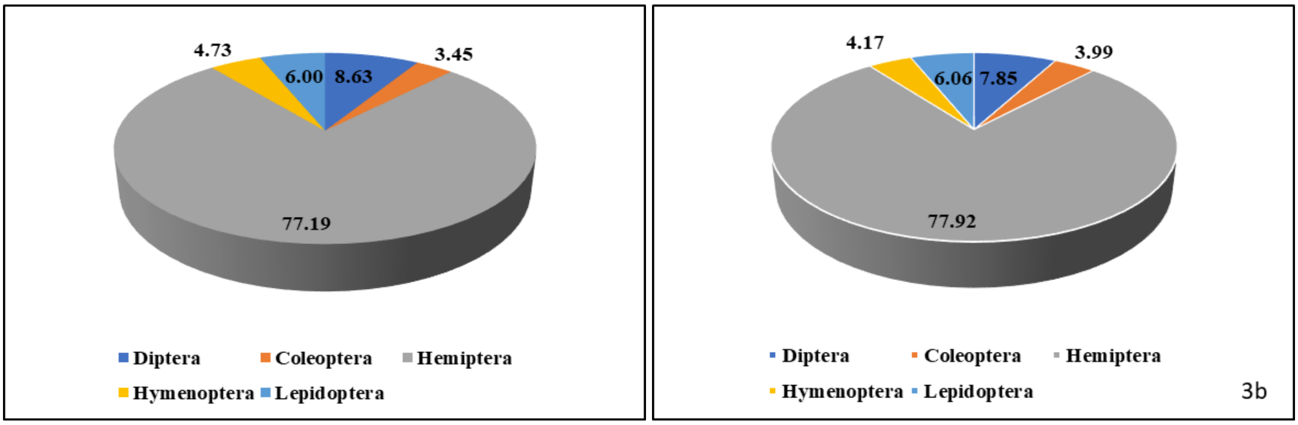
1a. College farm; 1b. ARI; 1c. Student farm

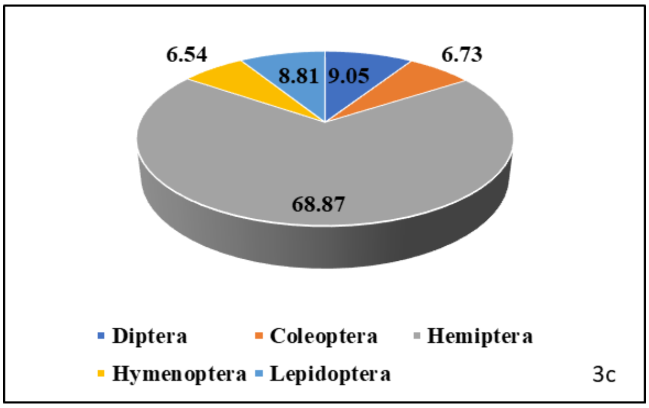
Fig 1: Composition of insect orders in Light trap



1a. College farm; 1b. ARI; 1c. Student farm

Fig 2: Composition of insect orders in Sweep net





3a. College farm; 3b. ARI; 3c. Student farm

Fig 3: Composition of insect orders in Yellow sticky trap

Conclusion

Light trap was found to be highly effective in collecting insects compared to other traps. Light traps emerged as potential tool in monitoring insects and includes diverse array of insect species. Our observations indicate that environmental factors can reduce the attractiveness and visibility of light. Therefore, using a combination of trapping methods is essential to obtain a comprehensive and representative sample of insect diversity in a given area especially in pest management for controlling pest population.

Acknowledgement

I deeply appreciate the invaluable support provided by the officials and workers at AINPVPM, PJTSAU in Hyderabad.

References

1. Belamkar NV, Jadesh M. A preliminary study on abundance and diversity of insect fauna in Gulbarga District, Karnataka, India. Int J Sci Res. 2014;3(12):1670-1675.
2. Butani DK, Jotwani MG. Insects in vegetables. Periodical Expert Book Agency. Development-42, vivek-Bihar, Delhi-110032 (India); c1984. p. 356.
3. Chandra K. Insect fauna of states and Union Territories in India. Arthropods and their Conservation in India (Insects & Spiders). ENVIS. 2011;14(1):189-218.
4. Diabata D, Tano Y. Efficiencies of three insect collection methods in Lamto, Cte d'Ivoire. Int Journ Biol Cons. 2020;12(3):153-158.
5. Gu XS, Bu WJ, Xu WH, Bai YC, Liu BM, Liu TX. Population suppression of Bemisia tabaci (Hemiptera: Aleyrodidae) using yellow sticky traps and *Eretmocerus nr. rajasthanicus* (Hymenoptera: Aphelinidae) on tomato plants in greenhouses. Insect Science. 2008;15:263-270.
6. Hohbein RR, Conway CJ. Pitfall traps: A review of methods for estimating arthropod abundance. Wildlife Society Bulletin. 2018;42(4):597-606.
7. Krishna VV, Qaim M. Bt cotton and sustainability of pesticide reductions in India. Agricultural Systems. 2012;107:47-55.
8. Marchioro M, Battisti A, Faccoli M. Light traps in shipping containers: A new tool for early insect alien detection. Journal of Economic Entomology. 2020;113(2):1-7.
9. Melnychuk NA, Olfert O, Youngs B, Gillott C. Abundance and diversity of Carabidae (Coleoptera) in different farming systems. Agriculture, Ecosystems & Environment. 2003;95(1):69-72.
10. Musser F, Stewart S, Bagwell R, Lorenz G, Catchot A, Burris E, *et al*. Comparison of direct and indirect sampling methods for tarnished plant bug (Hemiptera: Miridae) in flowering cotton. Journal of Economic Entomology. 2007;100(6):1916-1923.
11. Nath P, Chaudhary OP, Sharma PD, Kaushik HD. The studies on the incidence of important insect pests of cotton with special reference to *Gossypium arboreum* (Desi) cotton. Indian Journal of Entomology. 2000;62:391-395.
12. Pachkin AA, Popov IB, Kremneva OY, Zelensky RA. The use of light traps for trapping insects in sunflower agrocenosis. Achievements of Science and Technology of the Agro-Industrial Complex. 2019;33(12):73-76.
13. Pellegrino AC, Nardi C, Bezner-Kerr W, Guglielmo CG, Bento JMS, Mcneil JN. Weather forecasting by insects, modified sexual behaviour in response to atmospheric pressure changes. PLoS ONE. 2013;8(1):45-47.
14. Ramirez-Hernandez A, Escobar F, Montes de Oca E, Arellano L. Assessing three sampling methods to survey and monitor ground beetles (Coleoptera: Carabidae) in riparian cloud forests. Environmental Entomology. 2018;47(6):65-72.
15. Russo L, Stehouwer R, Heberling JM, Shea K. The composite insect trap: An innovative combination trap for biologically diverse sampling. PLoS ONE. 2011;6
16. Sanderson RA, Goffe LA, Leifert C. Time-series models to quantify short-term effects of meteorological conditions on bumblebee forager activity in agricultural landscapes. Agricultural and Forest Entomology. 2015;17(7):270-276.
17. Satpute US, Sarnaik DN, Bhalerao PD. Assessment of avoidable field losses in cotton yield due to sucking pests and bollworms. Indian Journal of Plant Protection. 1988;16:37-39.
18. Shweta M, Rajmohana K. A comparison of efficiencies of sweep net, yellow pan trap and malaise trap in sampling platygastridae (Hymenoptera: Insecta). Journal of Experimental Zoology. 2016;19(1):393-396.
19. Spafford RD, Lortie CJ. Sweeping beauty: Is grassland arthropod community composition effectively estimated by sweep netting? Ecology and Evolution. 2013;3(10):3347-3358.

20. Tobin PC, Robinet C. Advances in understanding and predicting the spread of invading insect populations. Current Opinion in Insect Science. 2022;10(1):985-997.
21. Zhang ZQ. Animal biodiversity: An introduction to higher-level classification and taxonomic richness. Zootaxa. 2011;3148:7-12.
22. Triplehorn CA, Johnson NF. Borror and DeLong's introduction to the study of insects. Thomson Brooks/Cole, Belmont, California; c2005.