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***Cover Page: Emerald cockroach wasp, *Ampulex* sp. (Ampulicidae)**
Photo credit: Dr. Sevgan Subramanian, ICIPE, Nairobi, Kenya

Insect Environment

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Editorial

High Impact Factor Insect Papers- Hyped? Insect Decline-the Culprit is Light!

Of late some Entomological papers, especially in so called "Impact Factor" (IF) Journals look at least to me incomprehensible and seem hyped with augmented software and machine-generated data on chemicals and life systems, and stat packages converting them into "absurd" graphical figures. The papers use costly chemicals and statistical packages, from multinational firms and these are multi-dollar businesses. Are we succumbing to these in the name of high-end papers, in high impact journals just to get promotions and perhaps awards?

Is IF an international business play? As I said in my last editorial 1000's of standard and applied journals have been given ratings <6 by NAAS; the basis is unclear! Nobody knows and it is impossible by any committee to rate mountains of journal every two years. Yet it is done! Here the clear winners are the international publishers with the advantage of IF attributed to their journal from 'citations'. This is not a level playing field. Say, if one publishes a paper on improved agronomy in Ragi millet (*Eleusine coracane*) who are the takers? Maybe the South Indian agricultural scientists and farmers. Who will cite the paper? The need to cite may not arise as the finding will find mention in extension bulletins and many times in regional languages, inaccessible to nosey citation list tickers! But the journal and author which publish such papers do great service to the stakeholder. Such authors unfortunately are outside the radar of awards and promotions. The hyped writers who sway to international publishing have an advantage. Indian journals run by reputed societies and academics are relegated to lower rating and perhaps tactfully diverting promotion-aspiring authors to IF business journals.

Another strategy perhaps is dubbing any journal (registered following the law of the land) attempting sincere publishing a predatory journal! Is this a tiger versus deer game? Even a newspaper can publish a scientific article that too by a non-specialist, and how dare they are dubbed predators- a term that has caught on in scientific circles? Of course. I am for an orderly research investigation, with clear hypothesis and experimentation and sensible and 'natural intelligence’ analysis with inference leading to advancement of knowledge for application for mankind. Even a good observation or record can be of high value. *Insect Environment* is proud to be one such journal that supports newness of relevance without hype or fraud. Against this backdrop I request all our readers to watch a YouTube presentation by Prof P. Balaram (Former Editor, *Current Science*) on "Science publishing, greed, vanity and the decline of scholarship. (https://www.youtube.com/watch?v=ndtYh_rp7yw&t=17s).

From this issue, we have new International Editorial Advisors additionally joining us: Dr. Yubak Dhoj G C, Senior Agricultural Officer (Plant Protection) for FAO, Executive Secretary, Asia Pacific Plant Protection Commission Secretariat, Bangkok; Dr Carlos A H Flechtmann, Department of Plant Protection, FEIS/UNESP, Solteira, Sao Paula Brazil and Dr Ravindra Chandra Joshi, Senior Consultant, Philippine Rice Research Institute, Philippines. We heartily welcome these three highly accomplished entomologists. They will help promote insect journalism and blogging from those parts of the world. We thank Dr. Subramanian Sevgan and Dr. D N Nagaraj for their excellent photographic contributions to *Insect Lens*.

Insect decline: To our readers, I would like to recommend "The Darkness Manifesto” by Johan Eklöf. I quote one of his statements, "With about half of all insects on the planet nocturnal, artificial light is robbing them of food and reproductive partners." Do we recommend light traps? We had a busy last quarter, evident from all our blogs and we will continue to play our role, as the only ‘make in India’ blog-news journal on topical insect scenario in India and the globe. Our extension gallery in this issue shows how our small team outreaches relevantly in insect conservation and management.

I richly appreciate the contribution of Co-Editor-In-Chief Dr. M.A Rashmi who has been upholding the insect journal and blogs very dynamically and efficiently.

Dr Abraham Verghese
Editor-in-Chief

Research articles

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A protocol for mass rearing of red palm weevil, *Rhynchophorus ferrugineus* (Olivier) on pineapple *Ananas comosus* L.

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Abstract

Different instar larvae of the red palm weevil (RPW), *Rhynchophorus ferrugineus* (Olivier) were successfully reared on pineapple (*Ananas comosus* L.). About 40 larvae with an average weight of ca. 2.10 g were produced from a single fruit weighing ca. 1.25 kg. The cost of producing these larvae was only $ 2.5 and was cheaper compared with rearing on sugar cane, date palm bolts, and artificial diet. The developed rearing protocol is simple, efficient, and cost effective. The pros and cons of rearing RPW on pineapple as well as on other substrates are discussed.

Introduction

Research on the red palm weevil (RPW), *Rhynchophorus ferrugineus* (Olivier) has grown drastically in the last 20 years with aim of making a breakthrough in the management of this notorious and serious palm pest. Many laboratories around the world are currently involved in RPW research activities. Often, the main problem that these laboratories face is the availability of high numbers of cheap, good quality insects for laboratory experiments. Many investigators have described protocols for mass rearing of RPW on different substrates for experimental purposes (Kaakeh, 2005; Al-Ayedh, 2008; Ju, et al., 2010; Aldawood and Rasool, 2011; El-Shafie et al., 2013).

In many cases, the laboratory rearing and mass production of RPW is very important to maintain purity, age, physiological stage homogeneity, and sex-based selection to carry out lab, semi-field and field experiments. Mass rearing and production of RPW has the following objectives:

- Refining existing RPW rearing protocols to ensure the continuous availability of high quality RPW larvae and adults (free of insecticide residues) for bioassay tests and experimental purposes throughout the year. For example, studying toxicity of different insecticides to different developmental stages of the weevil including eggs, larvae, pupae and adults as well as the egg-laying preferences and response of females to kairomones of different date palm cultivars.

- Maintaining a self-sustaining reproductive culture of RPW.
- Studying important biological traits of the weevil such as number of larval instars, fecundity, egg hatchability, adult longevity, survival, mating behavior and developmental periods of different stages.
- Quantifying basic flight attributes of the weevil such as flight velocity, flight frequency, flight periodicity and distance flown.
- Testing response of adult males and females for attraction to aggregation pheromones and factors affecting these responses such as weevil sex, age, and mating status.
- Production of RPW larvae for human consumption. In Thailand, people rear RPW in commercial farms and harvest it as food (Hoddle, 2015).

In this study, we carried out laboratory experiments on rearing of RPW on pineapple (*Ananas comosus* L.) and compared it with other methods of mass rearing *viz*. on date palm bolts, sugarcane, and artificial (meridic) diets with respect to the technical protocols and production cost.

Methodology and rearing protocol

Adult weevils were collected from insecticide-free pheromone traps installed in highly infested date palm plantation in Al-Gowaybah district in Al-Ahsa oasis of Saudi Arabia. The weevils were kept in large plastic box and fed on sugar cane. The pineapple fruits (Golden sweet), imported from the Philippines were purchased from the local vegetable and fruit market. The steps for mass production of RPW larvae on pineapple is summarized below (Figure 1, A-C):

1. The pineapple fruits were carefully selected, which were not fully ripened, so that it could stay for at least three weeks without deterioration.
2. A cavity was made in the fruit using kitchen fruit corer tool. The cavity needed to be wide enough to accommodate at least six weevils (4 females and 2 males) and allow free movement, feeding, mating and egg laying.
3. The selected weevils (young and healthy) were introduced inside the cavity.
4. The cap removed during the cavity making was fixed back in its place and covered with a cotton pad
5. The whole pineapple fruit was wrapped with a muslin cloth and kept in a plastic box at room temperature.
6. The wrapped fruit was opened after at least three weeks, and the larvae was collected.

Fig. 1A. Making a cavity of 5 cm diameter using kitchen fruit corer tool

Fig. 1B. Introducing the weevils (4 females and 2 males) inside the cavity

Fig. 1C. Covering the cavity with cotton pad and wrapping the whole fruit with a muslin cloth

Results and discussion

As many as 40 RPW larvae of different ages with an average weight of ca. 2.10 g were produced from a single pineapple fruit. The protocol is very simple and can be followed easily by even unskilled labor (Figure 2). With respect to the cost of mass rearing, it was found to be cheaper than rearing RPW on other substrates including sugar cane, date palm bolts, and artificial diet (Table 1).

Table 1: The cost of producing 40 different instar RPW larvae reared on four different substrates

Substrate	**Cost in US$**
Pineapple fruit (ca. 1.25 kg)	2.50
Sugar cane (4.00 kg)*	3.2
Date palm bolt (ca.12.50 kg)	20.00
Artificial diet (ca. 1.60 kg)	5.30

* The sugar cane has to be changed every 4-5 days resulting a waste and an increase in cost

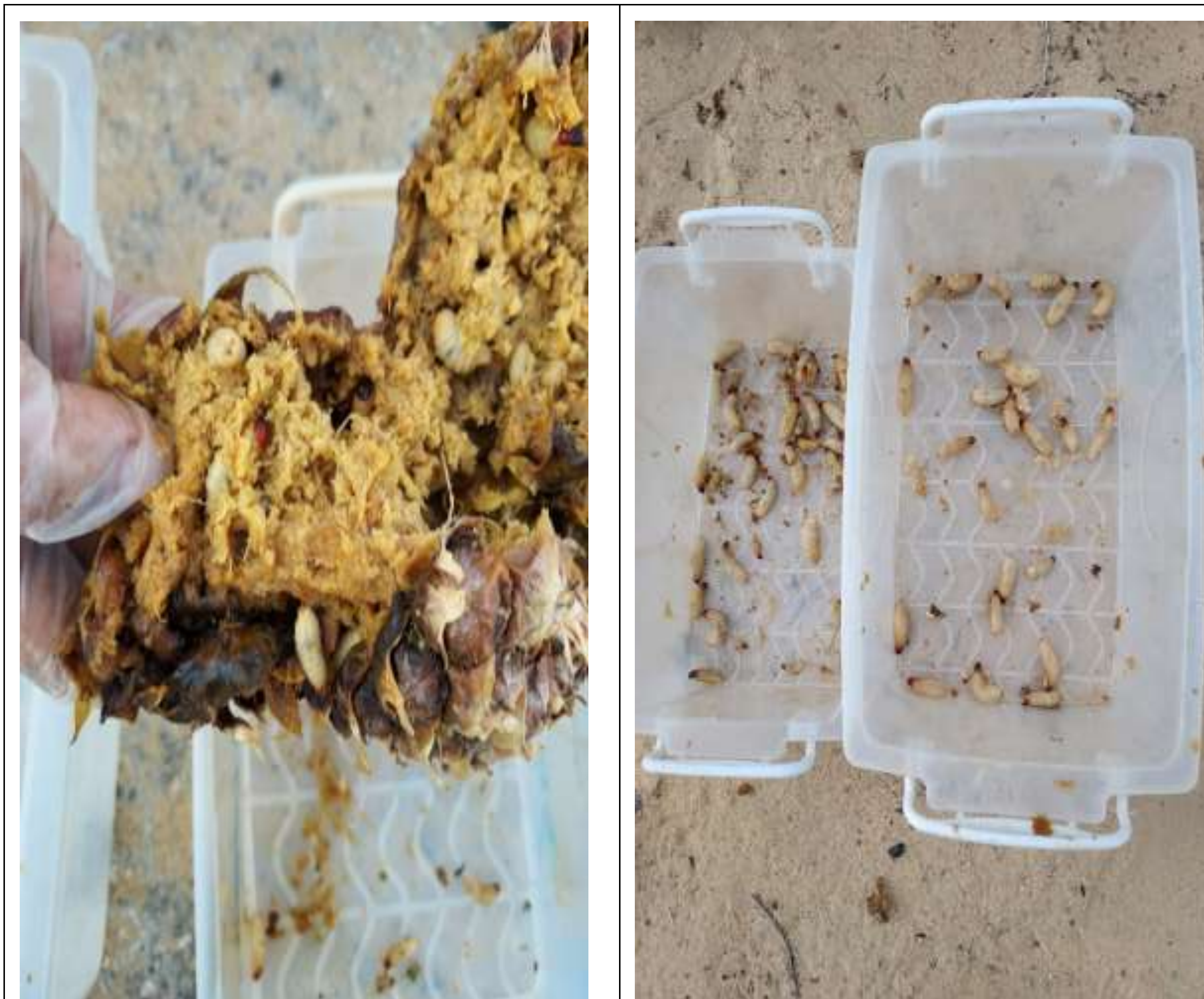

Fig. 2. Different instar larvae of red palm weevil produced exclusively on one fruit of pineapple

The mass rearing of RPW on date palm trunks is laborious and expensive (Al-Ayedh, 2011). Moreover, the offshoots used in the rearing process should be healthy and free from infestation by other coleopteran borers such as the longhorn beetle and the fruit bunch borer. Infested offshoots may cause the infestation of the red palm weevil by phoretic mites. Rearing RPW on artificial diet is more difficult and labor intensive because it requires diet preparation, replacement of the diet on regular basis, and handling of delicate larvae. Most of the artificial diets are susceptible to microbial contamination, which sometimes result in complete colony failure. Therefore, diet preservatives are needed that might have negative impacts on insect health (Aldawood and Rasool, 2011). Agar, which is commonly used in preparation of insect rearing diet, is expensive (Ahmed et al. 1998). Although there is some success in efforts to rear successive generations of economically important insects entirely on an artificial, in many cases they may lose both their fitness and reproductive potential which cause longer development times and lower fecundity (Coudron et al. 2002). In this respect, it has been found that the average size of RPW reared on artificial diet and sugar cane are smaller than of those reared on date palm (El-Shafie et al., 2013). The larvae reared on pineapple and artificial diet have to be transferred to containers with fiber and adhesive solid objects so that they can successfully spin their cocoons, if pupae and adult weevils are needed (El-Shafie et al., 2013). This will add more work and makes the process of rearing labor intensive. More numerical data is needed regarding the cost of RPW rearing on different substrates. Further studies are required to optimize the rearing process in term of technical protocols and production cost.

Conclusions

Mass production of high-quality weevils on either date palm offshoots or artificial diet is possible and may be required for research and bioassay experiments. The main shortcomings of RPW mass rearing on date palm and artificial diet is the relatively high cost of production. Compared to other substrates, pineapple proved to be simple and the cost of production per larva is cheap. Therefore, we recommend this technique of rearing for mass production of RPW larvae.

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References

Ahmed, K., Khalique, F. and Malik, B. A. 1998. Modified artificial diet for mass rearing of chickpea pod borer, *Helicoverpa armigera* (H.). *Pakistan Journal of Biological Sciences* **1**:183-187.

Aldawood, A. S and Rasool, K. G. 2011. Rearing optimization of red palm weevil: *Rhynchophorus ferrugineus* (Coleoptera: Curculionidae) on date palm: *Phoenix dactylifera*. *Florida Entomologist*, **94**(4): 756-760.

Al-Ayedh, H. 2008. Evaluation of date palm cultivars for rearing the red date palm weevil, *Rhynchophorus ferrugineus* (Coleoptera: Curculionidae). *Florida Entomologist*, **91**: 353-358.

Al-Ayedh, H. 2011. Evaluating a semi-synthetic diet for rearing the red palm weevil *Rhynchophorus ferrugineus* (Coleoptera: Curculionidae). *International Journal of Tropical Insect Science*, **31**(1-2): 20-28.

Coudron, T. A., Wittmeyer, J and Kim, Y. 2002. Life history and cost analysis for continuous rearing of *Podisus* *maculiventris* (Heteroptera: Pentatomidae) on a zoophytophagous artificial diet. *Journal of Economic Entomology*, **95**: 1159-1168.

El-Shafie, H. A. F., Faleiro, J. R., Abo-El-Saad, M. M. and Aleid, S. M. 2013. A meridic diet for laboratory rearing of red palm weevil, *Rhynchophorus ferrugineus* (Coleoptera: Curculionidae). *Scientific Research and Essays*, **8**(39): 1924-1932.

Hoddle, M. S. 2015. Red palm weevils-Food or foe? *Palms*, **59**(1): 21-30.

Ju, R. T., Wang, F and Wan, F. H., 2010. Effect of host plant on development and reproduction of *Rhynchophorus ferrugineus* (Olivier) (Coleoptera: Curculionidae). *J. Pest Sci.* DOI 10.1007/s10340-010-0323-4, Springer-Verlag 2010.

Kaakeh, W. 2005. Longevity, fecundity, and fertility of red palm weevil, *Rhynchophorus ferrugineus* Olivier (Coleoptera: Curculionidae) on natural and artificial diets. *Emirates Journal of Agricultural Science*, **17**(1): 23-33.

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Rice: A new host of fall armyworm *Spodoptera frugiperda* (J.E. Smith) and its strains in the Philippines

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Considered now a global invasive pest of corn, the polyphagous fall armyworm (FAW), *Spodoptera frugiperda* J. E. Smith (Lepidoptera: Noctuidae), has spread rapidly across Africa, South and Southeast Asia and the Pacific since 2018 causing devastating impacts on corn-growing countries (Goergen et al., 2016; Hruska, 2019; Abro et al., 2021; FAO 2022). Regular updates of countries affected by FAW, and the global distribution, is available on CABI's FAW portal (www.cabi.org/ ISC/fall army worm) (CABI, 2019). In the Philippines, its first reported damage on corn was recorded in June 2019 in Piat, Cagayan Valley region (Navasero et al., 2019) and then it spread to all regions of the Philippines.

Rice has been reported as one of the key hosts of this pest in other countries e.g., the USA where it is a regular and serious pest mostly in the southeastern states (Pantoja et al., 1986). However, in the Philippines, the first reported FAW attack on rice was documented on May 17, 2021 on the rice seedbeds of Gonzaga, Cagayan. Thus, little is known on its spread and damage to rice and rice-based farming systems in the Philippines. Therefore, we monitored the presence of FAW in and around rice ecosystems, and identified areas where FAW was observed, so as to map the FAW invasion pathway in the Philippines. This information is crucial to come-up with adequate early preparedness and mitigation measures to counter any level of incursions of FAW invasions in rice – a staple crop in the Philippines and Asia.

Key rice production areas in the Philippines were monitored for the presence of FAW and its damage, in collaboration with the Department of Agriculture – Regional Field Offices (DA-RFOs) through the Regional Crop Protection Centers (RCPCs), and Municipal Local Government Unit (MLGUs) in different regions/provinces. Initially, reports of occurrence was requested from the RCPCs and Bureau of Plant Industry (BPI). The sampling procedure for FAW occurrence and damage assessment used the visual observations or assessment method in scouting and collection of FAW in the rice fields, as well as in assessing the FAW damage. Prior to the visual observation inside the rice field, the field edges of the rice field were examined first for possible presence of FAW coming from the adjacent crops or grasses growing around the field. The non-rice vegetation, which could possibly serve as alternate hosts was noted. For observations in the seedbed, the data were taken inside a one m^2 quadrat with three replicates per seedbed. Monitoring was done on a monthly basis during the dry seasons and wet seasons of 2021 and 2022 in rice seedbeds, as well as in transplanted and direct-seeded rice fields.

Tracking the FAW Invasions in Rice

In the Philippines, during the first reported FAW damage on rice in seedbeds at Gonzaga, Cagayan in May 2021 there were three to 26 FAW larvae/ft^2 recorded during the validation and assessment (Fig. 1). FAW infestation was recorded in four provinces (Cagayan, Isabela, Nueva Vizcaya, and Quirino) in 14 municipalities from Region II with infestations in rice seedbeds and some in direct-seeded rice at seedling stage (Fig. 2).

A year after the FAW invasion in the rice seedbeds of Region 2, follow-up monitoring activities were conducted in the municipalities of Gonzaga, Santa Ana and Enrile in the Province of Cagayan. The re-invasion of FAW in the rice seedbeds was documented in the experimental field of Cagayan State University (CSU) in Barangay Flourishing, Gonzaga, Cagayan (18^O15’7.7476” N, 121^O59’54.9823” E) in May 2022, a year after it was first recorded. Close monitoring of FAW population and damage in Cagayan revealed infestations in other barangays: Pateng (San Pedro and Paddek) (18^O14’50.8200” N, 121^O58’29.2440” E); Ipil, Magrafil, Calayan, Tapel, Smart, Cabiraoan, Sitio Tabungao of Gonzaga and Barangay Rapuli of Santa Ana, Cagayan (18^O22’36.3367” N, 122^O8’40.3710” E) (Figs. 2, 3 & 4). Most of the FAW-infested rice seedlings in the seedbeds were sown late compared to the neighboring fields which were established 2-3 weeks earlier. Also, it was observed that rice crops were established earlier in Gonzaga and Santa Ana, Cagayan by about a month or more compared to the other towns and provinces nearby. Rice varieties infested were both inbred (NSIC Rc 222, NSIC Rc 402) and hybrid (Pioneer, SL-8H, Syngenta NK S6003). The FAW population recorded was 19.33 larvae/m^2 (NSIC Rc222) and 3.33 larvae/m^2 (Pioneer hybrid variety) in CSU-Gonzaga campus experimental field; Brgy. Pateng, Gonzaga with 8.67 larvae/m^2 (Syngenta S6003 with 7.12% damage) and none in NSIC Rc 480; and Brgy Rapuli, Santa Ana, Cagayan with 20.8 larvae/m^2 (NSIC Rc 402 with 1.21% damage) and none in Pioneer PHB77 (NSIC Rc492H). During the Focus

Group Discussion (FGD), the farmers mentioned that they applied many kinds of insecticides to control FAW. However, the agricultural technicians from RCPC II provided farmers with Lufenorun (an insecticide from the "Benzoylurea" group which acts as a chitin synthesis inhibitor under IRAC 15) to apply in the seedbed. They also provided *Metarhizium* sp. to apply after transplanting, and sex pheromone traps to install in the FAW infested fields.

In addition, FAW and its damage on rice was also reported in Porais, San Jose City, Nueva Ecija (15° 44' 44.2860" N, 121° 2' 46.1508" E) last June 2022 by the local Government Unit-San Jose City through DA-RCPC III. Interview with the affected farmer said that it was the first time that his direct-seeded rice was infested with the FAW larvae. According to him, the common cropping pattern in the area is onion-rice. However, during the previous season, some neighboring fields were planted with white corn instead of onion.

FAW Strains in the Rice and Rice-Corn Cropping System

The field collected FAW larvae in the different monitoring sites were sent to CABI UK for FAW strain molecular characterization. The molecular analysis was performed by the Molecular Identification team of the Diagnostic and Advisory Service, CABI UK. Out of the 10 samples sent for strain identification, nine were successfully identified while no sequence was obtained in one sample (Table 1). Interestingly, one of the four samples collected from rice in CSU Gonzaga, Cagayan was corn strain while two of the five samples collected from corn in Tarlac and Pangasinan were rice strain. FAW rice strain has been reported from corn plants in Gonzaga, Cagayan (Navasero *et al*., 2019) and was also reported in Pakistan (Yousaf et al., 2022), and Australia (Piggott *et al*., 2021). However, to our knowledge this was the first report that a corn strain was collected attacking rice plant in the Philippines. Moreover, this was also the first report that a rice strain of FAW collected from corn plants is present in the provinces of Tarlac and Pangasinan. It is important to know the presence of both or either of the FAW strain for better management of the pest in relation to its host preference. Both FAW strains were collected in corn and rice plants and with the results of the molecular identification, the point is whether it is a C- or R-strain as both were observed attacking rice, and in almost equal proportions based on the samples used for identification (N=4 and 5 for corn strain and rice strain, respectively (Table 1). The possibility of the presence of FAW hybrids of the two strains in the monitoring areas needs also to be verified.

Fig. 1. Assessment of (A) FAW damage and collection of FAW larvae and pupa in rice seedbeds; and B) Rice seedlings with larva (yellow circle) and pupa (white circle) of FAW as well as the damage in leaves observed in Gonzaga, Cagayan on May 24, 2021.
(Photo credits: Dindo King Donayre).

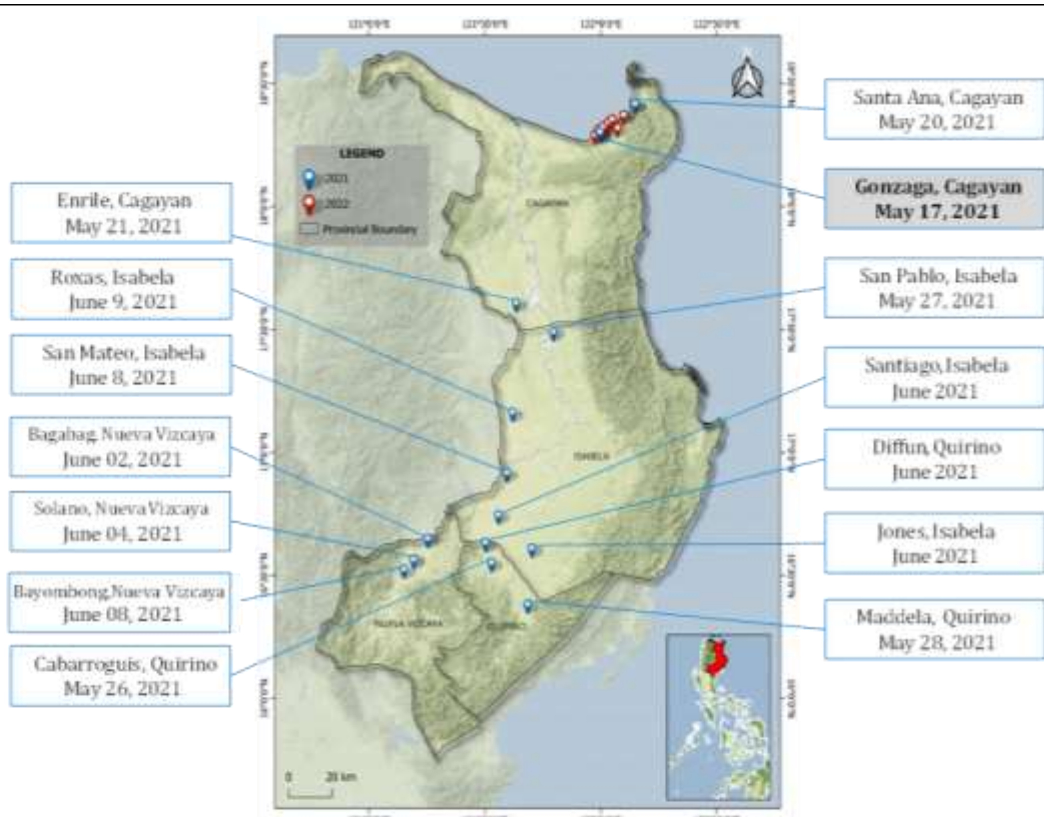

Fig. 2. Map of reported FAW infestation in Region II (Cagayan Valley), Philippines, during wet seasons (WS) of 2021. (Data source: 2021 WS DA-RCPC 2).

Fig. 3. FAW larvae collected and recorded in the rice seedbeds of the different infested barangays of Gonzaga and Santa Ana, Cagayan, 2022 wet season.

(Photo credits: Femia Sandoval).

Fig. 4. Re-invasion of FAW in rice seedbeds was recorded in Cagayan State University experimental field, Flourishing, Gonzaga, Cagayan and in other barangays of Gonzaga and Santa Ana on May 24 –27, 2022. (Data Source: 2022 WS – PhilRice and DA-RCPC 2).

Future Directions

In the Philippines, FAW is expanding its distribution to new rice areas, where it has never been reported earlier. Recurrent FAW invasions are a threat to the Philippine rice food security. Some possible reasons for future FAW invasions that need to be validated could be the (1) proximity of the rice to the corn cropping system; (2) mixed cropping of rice and corn; (3) changes in pesticide use or in the variety of corn planted near rice-growing areas. The impact of climate change drivers that favors FAW reproduction, growth and alters tri-trophic relationships needs special attention. In view of this, the Philippine Rice Research Institute has intensified its collaborative research efforts with CABI, and has also provided funds for the regular field monitoring, and research to elucidate its spread, damage and yield losses in rice, and consequently formulate strategies to manage FAW in rice should it become a challenge to rice production.

Table 1. Molecular identification of the collected fall armyworm (FAW) larvae from the different monitoring sites.

Sample Number	Collected from	Location	Date collected	FAW strain*
1	Rice	Callao, Gonzaga, Cagayan	May 24, 2021	sp. 1 rice strain
2	Rice	CSU campus Flourishing, Gonzaga, Cagayan	May 24, 2022	sp. 2 corn strain
3	Rice	Rapuli, Santa Ana, Cagayan	May 25, 2022	sp. 1 rice strain
4	Corn	Rapuli, Santa Ana, Cagayan	June 15, 2022	sp. 2 corn strain
5	Corn	Rizal, Rosales, Pangasinan	February 4, 2021	sp. 1 rice strain
6	Corn	Panalicsican, Concepcion, Tarlac	February 17, 2021	sp. 1 rice strain
7	Corn	Singat, Pura, Tarlac	March 2, 2021	sp. 2 corn strain
8	Rice	Pateng, Gonzaga, Cagayan	May 25, 2022	sp. 1 rice strain
9	Corn	Escaler, Magalang, Pampanga	February 18, 2021	No sequence obtained
10	Corn	PhilRice CES Maligaya, Science City of Muñoz, Nueva Ecija	June 28, 2022	sp. 2 corn strain

*Summary of sequencing results using The Barcode of Life Data System (BOLD) systems database.

References

Abro Z., Kimathi E., De Groote H., Tefera T., Sevgan. S and Niassy. S. 2021. Socioeconomic and health impacts of fall armyworm in Ethiopia. *PLoS ONE*. **16**(11): e0257736. https://doi.org/10.1371/journal.pone.0257736

CABI, 2019. Datasheet on *Spodoptera frugiperda* (fall armyworm), Ivan Rwomushana, CABI Africa, Canary Bird, 673 Limuru Road, Muthaiga, Nairobi, Kenya. https://www.cabidigitallibrary.org/doi/10.1079/cabicompendium.29810#tosummaryOfInvasiveness

FAO. 2022. Technical guidance on fall armyworm – Coordinated surveillance and an early warning system for the sustainable management of transboundary pests, with special reference to fall armyworm (*Spodoptera frugiperda* [J.E. Smith]) in South and Southeast Asia. Bangkok. https://doi.org/10.4060/cc0227en ; https://www.fao.org/3/cc0227en/cc0227en.pdf

Goergen G, Kumar, P. L, Sankung, S. B., Togola, A. and Tamò. M. 2016. First Report of Outbreaks of the Fall Armyworm *Spodoptera frugiperda* (J E Smith) (Lepidoptera, Noctuidae), a New Alien Invasive Pest in West and Central Africa. *PLoS ONE*, **11**(10): e0165632.doi:10.1371/journal. pone.0165632

Hruska, A. J. 2019. Fall armyworm (*Spodoptera frugiperda*) management by small holders. CAB Reviews 14 No. 043.

Navasero, M. V, Navasero, M. M., Burgonio, G. A. S., Ardez, K. P., Ebuenga, M. D., Beltran M. J. B., Bato, M. B., Gonzales, P. G., Magsino, G. L., Caoili, B. L., Barrion-Dupo, A. L. A and Aquino, M. F. G. M., 2019. Detection of the fall armyworm, *Spodoptera frugiferda* (J.E. Smith) (Lepidoptera: Noctuidae) using larval morphological characters, and observations on its current local distribution in the Philippines. *Philipp Ent*. **33**(2):171-184.

Pantoja A, Smith, C. M. and Robinson, J. F. 1986. Effects of the fall armyworm (Lepidoptera: Noctuidae) on rice yields. *Journal of Economic Entomology*, **79** (5): 1324–1329. https://doi.org/10.1093/jee/79.5.1324.

Piggott, M. P., Tadle, F. P. J., Patel Sgomz, K. C and Thistleton, B. 2021. Corn-strain or rice-strain? Detection of fall armyworm, *Spodoptera frugiperda* (JE Smith) (Lepidoptera: Noctuidae), in northern Australia. *Int J Trop Insect Sci*., **41**: 2607–2615. https://link.springer.com/article/10.1007/s42690-021-00441-7

Yousaf, S., Rehman, A., Masood, M., Ali, K. and Suleman, N. 2022. Occurrence and molecular identification of an invasive rice strain of fall armyworm *Spodoptera frugiferda* (Lepidoptera: Noctuidae) from Sindh, Pakistan, using mitochondrial cytochrome c oxidase I gene sequences. *Journal of Plant Diseases and Protection*, **129**:71-78. https://link.springer.com/article/10.1007/s41348-021-00548-6.

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Record of *Lema pectoralis* Baly, 1865 (Coleoptera: Chrysomelidae) on the beaked micropera orchid *Micropera rostrata* (Roxb.) N. P. Balakr., 1970, Philippine ground orchid *Spathoglottis plicata* Blume, 1825 and *Papilionanthe teres* (Roxb.) Schltr. (Orchidaceae: Epidendroideae)

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Orchids, mostly native to tropical regions of the globe belong to Orchidacea. They are highly prized for their beautiful inflorescences and are commercially exploited to cater to varying customer requirements, especially as cut flowers and indoor plants. With more than 28,000 currently accepted species, distributed in about 763 genera (Christenhusz and Byng, 2016), there is vast scope in further commercial utilization and improvement of members of family Orchidacea. India with its high floral biodiversity and tropical climate contributes both in orchid species richness and suitability in growing them in large areas in protected and open conditions.

Known as the gateway of the North East region, the Indian state of Assam is one of the eight North East Indian states which bear a separate identity phytogeographically and orchids are the major component of the vegetation at different climatic conditions (Gogoi *et al*., 2012). The agroclimatic condition of Assam is most congenial for the luxurious growth and development of alluring varieties of Orchid species in natural habitat mostly as epiphytic or lithophytic (Gogoi *et al.*, 2015)**.** Orchids are associated with the culture of Assamese people from the past. The elegant epiphytic orchid *viz*., Foxtail Orchid (*Rhynchostylis retusa*) was promptly selected as the state flower of Assam, which itself vouches for the importance bestowed upon them.

Though cost effective, open orchid cultivation practices lead to unintended pest and disease incidences. Among these biotic constraints, pests like thrips, scales, aphids, beetles, caterpillars, grass hoppers, wasps, ants, mites, molluscs and nematodes (Bharathimeena, 2016) stood out more for their ability to cause severe damage to economic products, *i.e.* spikes and florets. Hence researchers had given special emphasis to identify new or emerging pest problems in orchid cultivation.

Among Assam's orchid fauna, the epiphytic beaked micropera orchid (*Micropera rostrata*) stood out for its ability to produce numerous clusters of pendulous racemose inflorescences having beautiful small non-resupinate, fleshy, purple and fragrant flowers (Fig.1). They have erect stem carrying oblong-linear, notched leaves arranged alternately in two opposite vertical rows and is seen in Assam, Bangladesh and eastern Himalayas regions. Philippine ground orchid (*Spathoglottis plicata*), is an evergreen, terrestrial plant with crowded pseudobulbs, three or four large, pleated leaves and up to forty resupinate, pink to purple flowers (Fig. 2). It is found from tropical and subtropical Asia to Australia and the western Pacific region. Whereas *Papilionanthe teres* is an epiphytic orchid species with many variations found in many parts of South-East Asia. The plants have needle like leaves with appealing medium to large flowers (Fig. 3).

Heavy infestations of yellow chrysomelid beetles and their grubs were observed on *Micropera rostrata* and *Spathoglottis plicata* initially and later on *Papilionanthe teres* under open conditions in Jorhat district of Assam during the last weeks of April 2023. In the first site, numerous grubs were seen feeding on the *M. rostrata* raceme (Fig. 4-6). Whereas adults decimated the buds and flowers of a ground dwelling orchid *S. plicata* (Fig. 10-12) exclusively and some was feeding on the *M. rostrata*. Later both adults and grubs were seen feeding on the flowers of *P. teres*, on its epiphytic host, jackfruit.

The specimens were preserved and with the help of available literatures were identified as *Lema pectoralis* Baly, commonly known as Yellow Orchid beetle, a serious pest of orchids (Mohammedsaid, 2004). *Lema pectoralis* is reported to have two subspecies with the subspecies, *Lema pectoralis pectoralis* Baly occurring in Peninsular Malaysia and Singapore while *L. pectoralis unicolor* Clark occurring in Nepal, Thailand, Vietnam, Hainan, south China, and Taiwan (Bharathimeena, 2016). During 2021-22, the first author collected yellow chrysomelid beetles and grubs heavily feeding on Aranthera Anne Black Orchid from Kottayam in Kerala, which were later identified as *Lema* sp nr *pectoralis.* They differed from *L. pectoralis* Baly in having yellow antennae and tibiae, whereas the antennae and tibiae are black in both the subspecies of *L. pectoralis.*

Different stages of grubs (newly hatched to prepupal stages) were seen exclusively feeding on the *M. rostrata* inflorescences, causing their browning and necrosis. Newly hatched grubs couldn't be easily distinguished as they had the same colour of the raceme (Fig. 4) on which they were feeding. Later stages of grubs were seen covering its body with faecal matter, which it carries on its back (Fig. 7). Adult beetles showed marked preference to buds and flowers of *S. plicata* over the flowers of *M. rostrata.*

Numerous mating pairs of adult beetles were observed on the inflorescences of *S. plicata*, where the female beetles continued feeding during the process (Fig. 12).

Eggs were mostly laid singly on buds and the newly hatched white larvae had black prognathous head, thoracic shield and legs. The larva feeds immediately upon emergence and had swollen and humped abdomen with wrinkles. As they grow they take on the color of its food and in later stages have honey yellow colour and are covered with its slimy pinkish/brownish excreta, thus resembling bird droppings. Mature grubs, excreted a meringue-like substance at the time of pupation for making a frosty cocoon under the leaves, stems or peduncle (Fig. 8 & 9). As many as 2-3 cocoons per leaf or 8-11 cocoons per plant cluster could be seen on *M.rostrata*. Bright yellow pupae are seen in this whitish frothy glutinous covering that stuck to the hands when touched. The adult beetles emerged by biting a clear circular hole through it. Medium sized (approx. 1 cm body length) yellow coloured adult beetles having black antennae and tibiae, sometimes exhibited gregarious habit and fed on the *S. plicata* flowers (Figure: 10). Being a weak flier, when disturbed they exhibited thanatosis and flew away to a nearby plant and later returning to the flower head on which it was feeding. Hirao *et al*., (2001) reported that total development period for *L. pectoralis* was 24 days.

Adult specimens were deposited in the Banana Research Station, Kerala Agricultural University, Thrissur. This is the first report of *Lema pectoralis* on *Micropera rostrata* and *Papilionanthe teres*.

Fig. 1: ***Micropera rostrata***

Fig. 2: ***Spathoglottis plicata***

Fig. 3: ***Papilionanthe teres***

Fig. 4: Newly hatched grubs


Fig. 5 & 6: *Lema pectoralis* grubs feeding on *M. rostrata* racemes

Fig. 7: Damaged inflorescence


Fig. 8 & 9: *L. pectoralis* grubs making frosty cocoons on *M. rostrata*

Fig. 10: Gregarious adults

Fig. 11: Adult feeding damage

Fig. 12: Mating adults

References

Baly, Joseph S. 1865. Phytophaga Malayana; a revision of the phytophagous beetles, of the Malay Archipelago, with descriptions of the new species collected by Mr. A. R. Wallace. *Transactions of the Entomological Society of London ser*. **3:**v.4: 1-300.

Bharathimeena, T. 2016. First report of *Lema* sp nr *pectoralis*Baly, 1865 (Coleoptera: Chrysomelidae) on the green bay orchid *Eulophia andamanensis* Rchb.f (Orchidaceae: Epidendroideae). *Entomon*, **41**(2): 157-158.

Christenhusz, M. J. M. and Byng, J. W. 2016. The number of known plants species in the world and its annual increase. *Phytotaxa*. **261** (3): 201–217. doi:10.11646/phytotaxa.261.3.1

Gogoi, K.; Raju Das and RajendraYonzone. 2012. Orchid diversity of Assam, India: The Genus Micropera Lindley in: *International Journal of Pharmacy & Life Sciences*. 3 (9). 1987–1990.

Gogoi, K.; Das, R. and Yonzone, R. 2015. Orchids of Assam, North East India-An annotated checklist. *International Journal of Pharmacy & Life Sciences*, **6**(1): 4123 – 4156

Hirao G. A., B. P. gabriel and H. T. Facundo, 2001. Life history and habits of the orchid lema, *Lema pectoralis* Baly (Coleoptera:Chrysomelidae), a major pest of orchids. *The Philippine Agricultural Scientist*, **84**:2: 166-170

Mohamedsaid M. S., 2004. Catalogue of the Malaysian Chrysomelidae (Insecta: Coleoptera). Sofia & Moscow: *Pensoft*. pp. 239.

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Documenting Odonata along the Sri Krishna Lake, Bengaluru, Karnataka

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Anisoptera (dragonflies) (Insecta: Odonata) inhabit a wide range of habitats *viz*., forest, fields, pond, lake, swamps and marshes. Dragonflies are found to be more sensitive to pollution than damselflies (Jacob *et al*., 2017). An approx. 6500 species of dragonflies are found globally, classified in about 600 genera (Vick, 2002). In India a rich diversity of Odonata, around 498 species are found among which 186 species are endemic (Joshi *et al*., 2023). Considering paucity of data on Oonata diversity from the region, a survey was conducted in Sri Krishna Lake, Byatarayana Doddi, Bannerghatta, Anekal Taluk. The water body is found to be polluted by solid waste dumping that could impact the aquatic biota.

Study area: The study was conducted in the environs of Sri Krishna Lake (12.4927N, 77.3253E) (Map1), Byatarayana doddi, Bannerghatta, Anekal Taluk, Bengaluru Urban District. Cropping is practiced in land around the water body and is also surrounded by natural vegetation.

Study Duration: Field visits were conducted during April-May 2023 to photo-document individual count of the species. Identification was done using field guide (Subramanian, 2005).

Materials: Species observed were photographed using DSLR camera, Realme C15, Samsung Galaxy M31s mobile phone and Adcom Macro lens Attachment (12X-24X).

A total of eleven species of Anisoptera belonging to three different families *viz.*, Libellulidae, Aeshnoidae and Gomphidae were observed (Table 1, Figs. 1-10) in which 81.81% observed species belonged to Libellulidae (Fig. 11), two species namely *Brachythemis contaminata* and *Crocothermis servilia* (Fig. 12) were found to be abundant and maximum activities were observed during the midday. Simpson’s Index (D) (0.2), Simpson’s index of diversity (1-D) (0.7), Shannon-H (1.8) and Evenness Index (0.6) indicated good diversity and necessity to continue seasonal observations.

Map 1: The Sri Krishna Lake

Table 1: List of Anisopterans observed during the present study

Fig. No.	Family	Common name	Scientific name	No. of individuals
1.	Libellulidae	Ditch Jewel	*Brachythemis contaminata*	72
2.		Common Picture Wing	*Ryothemis variegata*	6
3.		Trumpet Tail	*Acisoma panorpoides*	9
4.		Ruddy Marsh Skimmer	*Crocothermis servilia*	42
5.		Scarlet Marsh Hawk	*Aethriamantha brevipennis*	22
6.		Little Blue Marsh Hawk	*Brachydiplax sobrina*	7
7.		Green Marsh Hawk	*Orthetrum sabina*	8
8.		Pied Paddy Skimmer	*Neurothermis tullia*	12
9.		Crimson Marsh Glider	*Trithemis aurora*	3
NA	Aeshnoidae	Blue-tailed Green Darner	*Anax guttatus*	5
10.	Gomphidae	Common Clubtail	*Ictinogomphus rapax*	4

***NA,** Blue-tailed Green Darner was observed and identified, not photographed

Fig. 1: *Brachythemis contaminata*

Fig. 2: *Ryothemis variegata*

Fig. 3: *Acisoma panorpoides*

Fig. 4: *Crocothermis servilia*

Fig. 5: *Aethriamantha brevipennis*

Fig. 6: *Brachydiplax sobrina*

Fig. 7: *Orthetrum sabina*

Fig. 8: *Neurothermis tullia*

Fig. 9: *Trithemis aurora*

Fig. 10: *Ictinogomphus rapax*

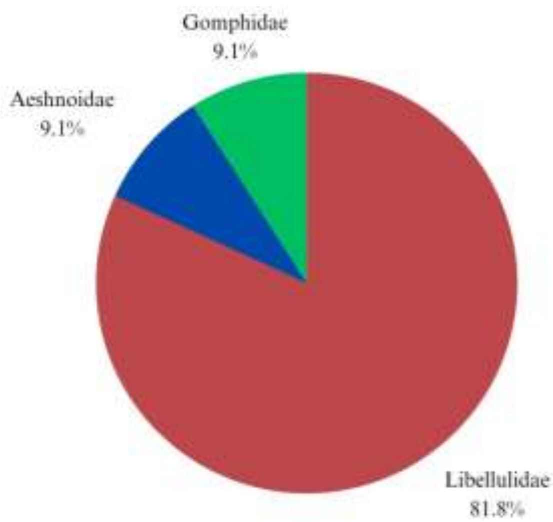

Fig. 11: Distribution of Anisoptera families from the Sri Krishna Lake

This is first time observation of dragonfly diversity undertaken in this area. Further studies on endemism and conservation if there are threatened species needs to be undertaken.

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References

Jacob, S., Thomas, A. P., and Majnu, E. K. 2017. Odonata (Droagonflies and Damselflies) as Bio Indicators of Water Quality. *IJIRSET*. **6** (9):19464-19474.

Joshi, S., P. Dawn, P. Roy, and K. Kunte (eds.) 2023. Odonata of India, v. 1.57. *Indian Foundation for Butterflies*. (https://www.indianodonata.org/)

Subramanian, K.A. 2005. Dragonflies and Damselflies of peninsular India - A field guide. Project Lifescape. Indian Academy of Sciences, Bangalore, India. 118p.

Vick, G. S. 2002. Preliminary biodiversity assessment of odonate fauna of the Takamanda Forest Reserve, Cameroon. IDF- report **4**:1-10.

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First report of red wax scale, *Ceroplastes rubens* Maskell (Coccidae: Hemiptera) a new pest in mango (*Mangifera indica*) from Gujarat, India

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Abstract

A roving survey was carried out on mango (*Mangifera indica*) field during 2021 at B. A. College of Agriculture, Anand Agricultural University, Anand, Gujarat. Infestation of *Ceroplastes rubens* Maskell, a new pest was recorded on mango (*M. indica*). It feeds mainly on leaves, but also on twigs and branches by sap depletion and greyish brown discoloration of leaves. The adults have elliptical, dorsally pentagonal reddish brown body that is coated with pink to reddish brown wax. The present study is the first report of *C. rubens* on mango from Gujarat, India.

Keywords: *Ceroplastes rubens* new pest, *Mangifera indica*, Gujarat

Introduction

The mango (*Mangifera indica* L.) is a fruit that originated in Southeast Asia and has been cultivated in India for at least 4000 years (Candolle, 1884), where it is a highly important cultural and religious symbol. Because of its attractive smell, delightful taste, outstanding flavour, nutritional richness (Vitamin A and C), and health-promoting properties, mango is known as the "King of fruits". Fresh mangoes and mango pulp are the important items of agri-exports. Mangoes are also used to make processed foods such as candies, relishes, pickles, drinks, and a variety of other items. In Gujarat, it is being cultivated in area of 166.36 Mha with an annual production of about 1222.29 MT and productivity of 8.00 MT/ha (Anon., 2020). There are around 400 insect pests known to attack mango (Srivastava, 2000). Among these pests, approximately two dozen insect pests cause severe damage to various parts of the mango tree.

The red wax scale *Ceroplastes rubens* (Hemiptera, Coccidae) is highly polyphagous. The host range covers more than 150 plant species. Besides mango, the red wax scale attacks commercially important crops like citrus, avocado, tea, coffee, banana, guava, coconut, Ixora, sandalwood and brinjal (Williams and Watson, 1990; Vithana *et al.* 2018). *Ceroplastes rubens* was first described by Maskell in 1883 from material collected on *Mangifera indica* and *Ficus* sp. in Australia. *Ceroplastes rubens* is located within the large genus *Ceroplastes*, in the tribe Ceroplastini of the subfamily Ceroplastinae, family Coccidae (Qin and Gullan, 1994).

The infestation of *C. rubens* as insect pest is not reported from Gujarat (India). So, the present study is the first report of *C. rubens* infesting mango from Gujarat.

Materials and Methods

A roving survey was carried out at college campus of B. A. College of Agriculture, Anand Agricultural University, Anand (Latitude-22.5363° N, Longitude-72.9749° E, Altitude-45 m above MSL) in Gujarat, India on mango tree during 2021. Infestation on leaves was observed on mango (*M. indica* L.). Live adults of wax scale insects were collected and preserved in 70% ethyl alcohol. Specimens were sent to the Division of Insect Systematics, ICAR – NBAIR, Bangalore.

Results

In the present study, infestation of *C. rubens* was recorded on mango (*M. indica* L.) field in the month of September and October. *Ceroplastes rubens* occurs on leaves and twigs but is most commonly found along the midrib on both surfaces of the leaves. The number of red wax scale adults was in the range of 3 to 5 per leaf. There were 50-60 nymphs recorded in a leaf, crawling away from the female scale insect (fig. 3). Like all other soft scales, *C. rubens* produces honeydew and as a result sooty mold has been developed high on leaves, which reduces photosynthesis, resulting in less carbon assimilation. The highest incidence was observed on new shoot during the month of October. There was continuous activity of black carpenter ants found surrounding each adult scale insect on all infected mango leaves (fig. 4).

It was observed earlier in India on citrus, but not recorded and no further details are available (Dekle, 2002). To the best of our knowledge no much references were available for this insect on any crop in India so it couldn’t be discussed.

Nature of damage

Red wax scales feed on the leaves, branches and twigs of its hosts. They were more commonly seen on the upper surfaces of leaves, generally in lines along the midribs (fig. 2). As they suck sap from the plants, the surplus has excreted as honeydew, which covers the leaves with sugary substances, allowing black fungus growth to colonise it. Ants obtain honeydew by tending the scales. So, it was observed that it causes damage in two ways: directly through feeding, and indirectly by build-up of sooty mold fungi on the surface of leaves reducing photosynthesis and decreases the quality of fruits.

Conclusion

The present investigation is the first report of red wax scale, *Ceroplastes rubens* M., a new pest on mango (*M. indica*) from

Gujarat, India. Infestation of this scale insect was recorded in mango trees at college campus of B. A. College of Agriculture, Anand Agricultural University, (District: Anand).

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Fig. 1a: Dorsal view of adult

Fig. 1b: Lateral view of adult

Fig. 2: Damage symptoms

Fig. 3: Emergence of nymphs

Fig. 4: Red wax scale and carpenter ant

References

Anonymous 2020. Retrieved from (https://www.tnagrisnet.tn.gov.in)

Candolle, A. de *Origine des Plantes Cultivées* Germer Bailliére and Cie, Paris, 1883, 159-161 (English translation 1884. Origin of Cultivated Plants, London).

Dekle G.W. 2002. Red Wax Scale, *Ceroplastes rubens* Maskell (Insecta: Homoptera: Coccidae). Institute of Food and Agricultural Sciences, University of Florida, USA.

Qin, T. K. and Gullan, P. J. 1994. Taxonomy of the wax scales (Hemiptera: Coccidae: Ceroplastinae) in Australia. *Invertebrate Systematics*, **8**(4), 923-959.

Srivastava, R. P. 2000. Mango insect pests and their management. *Mango cultivation. International Book Distribution Co.* Lucknow. p.187-299.

Vithana, K. V. A. I. K., Sirisena, U. G. A. I. and Hemachandra, K. S. 2018. Pink wax scale (*Ceroplastes rubens*) a growing threat to agriculture in Sri Lanka. *Tropical Agricultural Research*. 30 (2), 13-22.

Williams, D. J. and Watson, G. W. 1990. *The scale insects of the tropical South Pacific region. Part 3: the soft scales (Coccidae) and other families*. CAB International.

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Nest abundance of Asian weaver ant (*Oecophylla smaragdina*) around NPKL 7th Block Lake, Bheemanakuppe, Southern Bengaluru

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Ants are fine architects of the animal world, millions of years before mankind started to build cities, they started to build complicated infrastructures. India has over 828 species and subspecies of ants listed, representing 100 genera grouped in 10 subfamilies (Bharti *et al.*, 2016). The Asian weaver ant (*Oecophylla smaragdina*) (Formicidae: Hymenoptera) is obligate arboreal and eusocial (Fig. 1), widely distributed through the humid tropics and subtropics of Africa, Asia, Australia, and the Western Pacific (Wetterer, 2017). They are known for their remarkable nest-weaving skills with very large colonies and highly polydomous. The queen weaver ant starts laying eggs under the leaves, guarding them until it hatches into worker ants. Worker ants exhibit polyphenism and are classified into 'major' (8-10 mm) and 'minor' (4-5 mm), the major forage, defend, and expand the colony whereas the minor ants stay in the nest caring for the young (Jackson 2016). The workers of these cooperative nest builder start to build a nest by selecting a suitable location, generally flexible trees and shrubs, using their larvae silk as a binding agent to bind the leaves into a nest (Holldobler and Wilson, 1977). They have become an important ant in the tree canopies that can serve as an indicator of habitat quality and health. They are aggressive predators of insects and an excellent pest control agent (Jessa *et al.*, 2019) and their foraging activity was optimum at 25°C with an ambient humidity of 80% as noted by Marcela *et al.* (2019). The present observations were made around NPKL (Nada Prabhu Kempegowda Layout) 7th block lake (12.917910727824513 N, 77.44730356695479 E) in Bheemanakuppe, Southern Bengaluru (Fig. 2).

Fig. 1. Weaver Ant nest in the study site

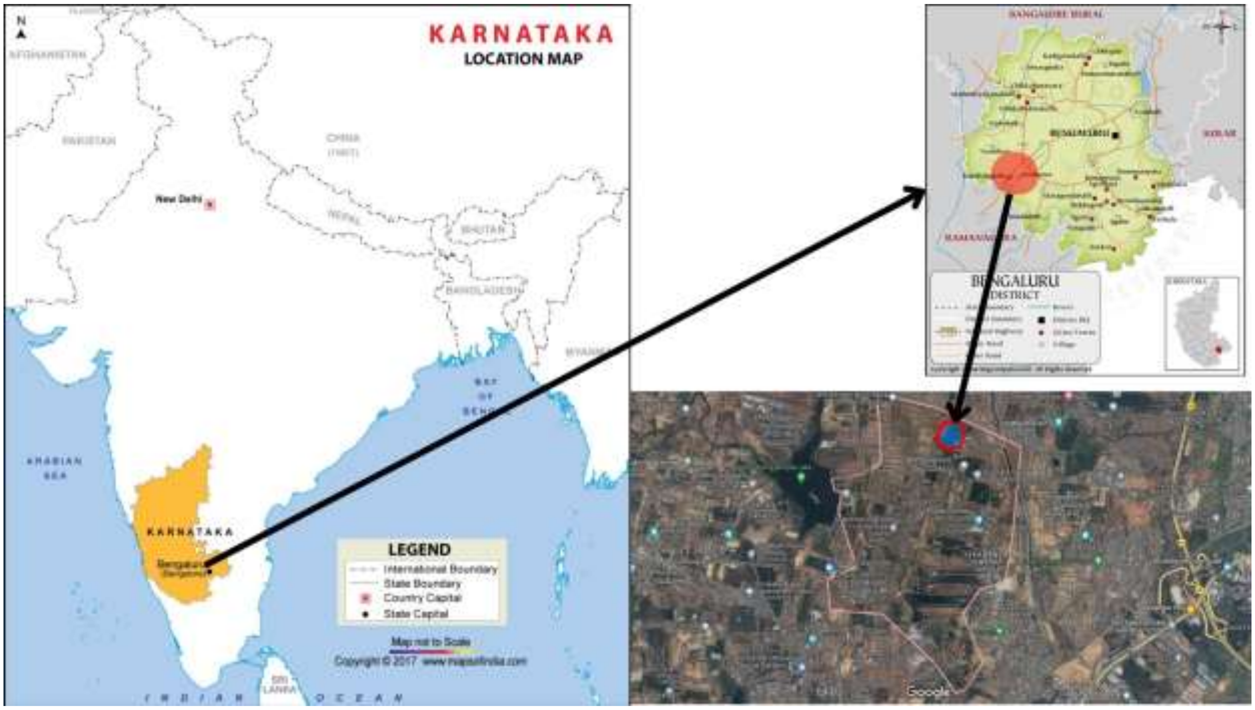
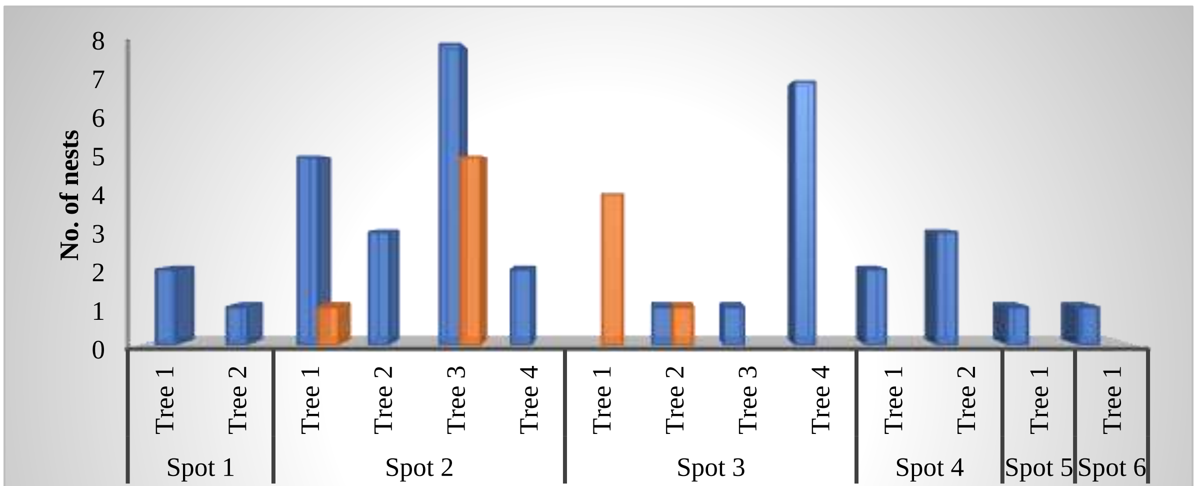


Fig. 2. Study Area (NPKL Lake in Bheemanakuppe Bengaluru)

Fig 3. Satellite view of NPKL 7th Block Lake with nest count sites

All out-search method (to locate and count all the nests in the trees around the lake) was used to observe and count weaver ant nests during May 2023. Trees with nests were found only in the western and southern margins, such trees were clustered into six spots each ranging from 1- 4 trees, flora in between the spots did not harbor any nest (Fig. 3 and 4). Spots 1-5 in the Western margin, Spot 6 in Eastern Margin consist of tree(s) with nests. The distance between Spot 1 and 2 was 81.85m, Spot 2 and 3 was 53.59m, Spot 3 and 4 was 40m, Spot 4 and 5 was 29.7m, and Spot 5 and 6 was 184.64m. The iPhone's "Measure" app was used to record the distance between selected study points. I map was used to find the GPS of the location, and Google Maps was used to get a satellite view of the location.



	Spot 1		Spot 2				Spot 3				Spot 4		Spot 5	Spot 6
	Tree 1	Tree 2	Tree 1	Tree 2	Tree 3	Tree 4	Tree 1	Tree 2	Tree 3	Tree 4	Tree 1	Tree 2	Tree 1	Tree 1
Active Nest	2	1	5	3	8	2		1	1	7	2	3	1	1
Inactive Nest			1		5		4	1						

Fig. 4. Abundance of active and inactive nests in each spot

A total of 51 nests were found during the study, 37 nests (73%) were found to be active with weaver ants and 14 nests (27%) inactive nests with dried nest material and absence of weaver ants. In Spot 1 three active nests were found, in Spot 2 eighteen active nests and nine inactive, in Spot 3 nine active and five inactive nests, in Spot 4 five active nests, in Spots 5 and 6 only one active nest each was observed (Fig. 4). All the weaver ant nests were on *Pongamia pinnata*, around the lake. Prospective studies on host preference needs to be undertaken. *Oecophylla smaragdina* was an efficient bio-control agent against pentatomid bug infesting on Pongamia (Hosetti and Rudresh, 2012). Most of the nests observed were in the western margin (13 trees) of the lake, and one in southern margin of the lake. This could be due to the presence of construction works in progress on the southern margin and a granite industry on the eastern margin of the lake. The northern margin was not accessible. The weaver ants have an impressive sense of place that helps them to secure new territory (Holldobler and Wilson, 1977). Therefore, the dynamics of anthropogenic land use and its impacts on the ecosystem, also the adaptability of biota including the weaver ant needs to be monitored in such rapidly developing peri-urban zones.

References

Bharti H, Guénard B, Bharti M, Economo E.P. 2016. An updated checklist of the ants of India with their specific distributions in Indian states (Hymenoptera, Formicidae). *Zoo Keys* **551**: 1–83. Available at: https://www.researchgate.net/deref/http%3A%2F%2Fdx.doi.org%2F10.3897%2Fzookeys.551.6767

Holldobler, B. K and Wilson, E. O. 1977. Weaver Ants. Scientific American, Inc.146-154 pp

Hosetti, B. B., and Rudresh, B. S. 2012. Studies on *Oecophylla smaragdina* as a bio-control agent against pentatomid bug infesting on Pongamia tree. *J. Environ. Biol*. **33**: 1103–1106.

Jackson, G. 2016. Biocontrol - green weaver ant (386). Fact sheet. Available at: https://app.pestnet.org/submissions/title/Green%20weaver%20ant%20(386)

Jessa H. T., Tobin, D. N. and William, E. S. 2019. Weaver Ants Provide Ecosystem Services to Tropical Tree Crops. *Frontiers in Ecology and Evolution,* 7. Article 120, 1-9.

Marcela P, Abu H A, Kumara T K and Joanna S. 2019. Food preferences and foraging activity of Asian weaver ants, *Oecophylla smaragdina* (Fabricius) (Hymenoptera: Formicidae). *Tropical Life Sciences Research.* **30**(2): 167–179. https://doi.org/10.21315/tlsr2019.30.2.12

Wetterer, J. K. 2017. Geographic distribution of the weaver ant *Oecophylla smaragdina*. *Asian Myrmecology*. **9**: 1–12. http://dx.doi.org/10.20362/am.009004

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Review articles & Short notes

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Insect frass and exuviae for plant growth and health

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Insect derived products as frass and exuviae are significant sources of many macro and micronutrients required by plants for their growth and development. Insect frass serves as an ideal source of nutrients to the plants but also help to develop a circular economy, where byproduct of one process in the ecosystem becomes the input for the successive levels, thus citing a perfect example of zero-waste policy. This way the byproducts of mass insect breeding industries can be managed for sustainable agricultural production.

Introduction

The industrial production of insects for food and feed is rapidly increasing and the associated production of massive quantities of insect-derived products as frass and exuviae are made accessible as the soil organic supplements. As used in its original context, the term "frass" refers to a mixture of excrements derived from farmed insects, the feeding substrate, dead eggs and with a content of dead farmed insects of not more than 5% in volume and not more than 3% in weight. Insect exuviae majors in chitin which is digested by beneficial bacteria to promote plant growth and development and strengthen the plant defense against pathogens. Therefore, adding insect-derived products to soil has beneficial effects on soil microflora, plant growth and resilience and microbial antagonism against plant pathogens and insects (Fonseca *et al.*, 2020).

Mass insect breeding industry

As of April 2019, there are more than 250 industries operating in this sector (Poveda, 2021). Scientifically speaking, there are hundreds of publications that highlight the importance of insects as ideal source of nutrients for plant growth. Mass rearing of insect demands the synchronization of industrial processes with insect life cycle. Frass is the major organic byproduct of this industry which is further processed to be used as an organic fertilizer or livestock feed (Fig. 1). It has been ascertained that yellow mealworms (*Tenebrio molitor*) can ingest 220 g of food that is composed of corn and carrots, assuming an insect biomass production of 4 g and 180 g of frass and residues, respectively (Poveda, 2021). This provides a rough estimation of the amount of frass that this business can generate daily.

Development of circular economy: a zero-waste policy

With the recent authorization of insects as essential components of pig and poultry feed by the European Union, the generation of insect residual streams has scaled up heavily.

The insect derived products have immense potential and provide tremendous opportunity to enhance crop productivity within a circular agriculture (Fig. 2). The enhancement of important functional groups like PGPR and antagonists of pathogens impacts the performance of more complicated ecological networks. Beneficial soil bacteria can influence plant physiology and increase growth of the plant in addition to luring mutualist insects like pollinators and natural enemies.

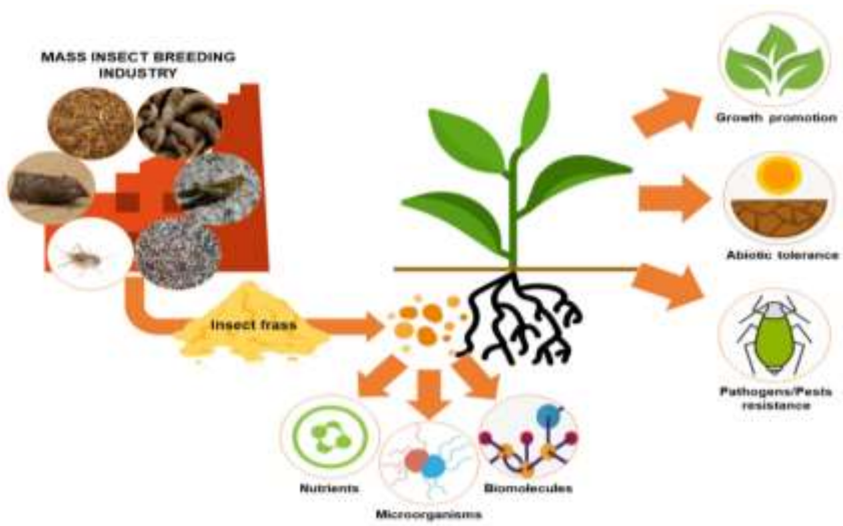

Fig. 1: Generation of frass from insect mass breeding industry (Poveda, 2021)

Fig. 2: Development of circular economy: A zero waste policy

Effects of insect frass on plants

Frass incorporated organic soil amendments stimulate the indigenous beneficial soil microflora that possess ISR (Induced Systemic Resistance) and biocontrol activity. Adding to that, these organisms also facilitate plant –pollinator interactions in the ecosystem resulting in increased fruit set and agricultural productivity. This also facilitates the release of HIPVs (Host Induced Plant Volatiles) from plants triggered by insect feeding. These volatiles and odour cues attract the parasitoids and predators of the insects and lower levels of insect infestations (Fig. 3).

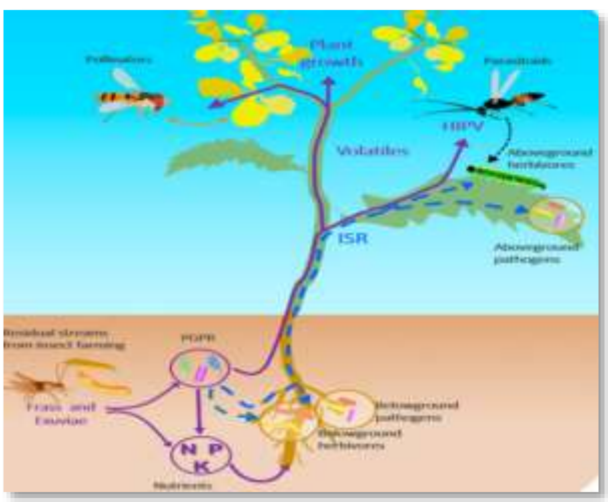

Fig. 3: Frass mediates plant growth by various ways (Fonseca *et al.*, 2022)

Addition of frass and exuviae increases the load of PGPR in the rhizosphere vicinity which forms a symbiotic relation with plants. They benefit from energy-rich host root exudates and in turn synthesize plant growth hormones such as cytokinins, auxins, and gibberellins or provide increased access to nutrients such as phosphorus or iron. Examples of growth-promoting strains are *Azospirillum, Burkholderia, Enterobacter, Flavomonas, Kluyvera, Paenibacillus, Rhizobium, Serratia,* and *Streptomyces*.

Frass as a source of nutrition

Insect frass nourishes soil with macro- and micronutrients and has a tremendous potential to be employed as a fertilizer. Nutrient concentrations of the black soldier fly, *Hermetia illucens* (Linnaeus) frass had significantly higher nitrogen, pottasium and sulphur concentrations. The phosphorus, calcium and magnesium concentration was found higher in the frass obtained from *Gryllus bimaculatus* De Geer, *Bombyx mori* Linnaeus and *Pachnoda sinuate* (Fabricius), respectively. Scientific evidence shows that frass fertilizers from all the insect species had adequate concentrations and contents of macronutrients (nitrogen, phosphorus, and potassium), secondary nutrients (calcium, magnesium, and sulphur) and micro-nutrients (manganese, copper, iron, zinc, boron, and sodium) (Beesigamukama *et al.*, 2022) (Fig. 4).

Role of frass as organic matter

Frass can be treated as a primary source of soil organic matter. It improves the soil organic carbon content, water holding capacity and porosity of the soil. Thus, frass helps in restoring the essential nutrients of soil and making them available for plant growth.

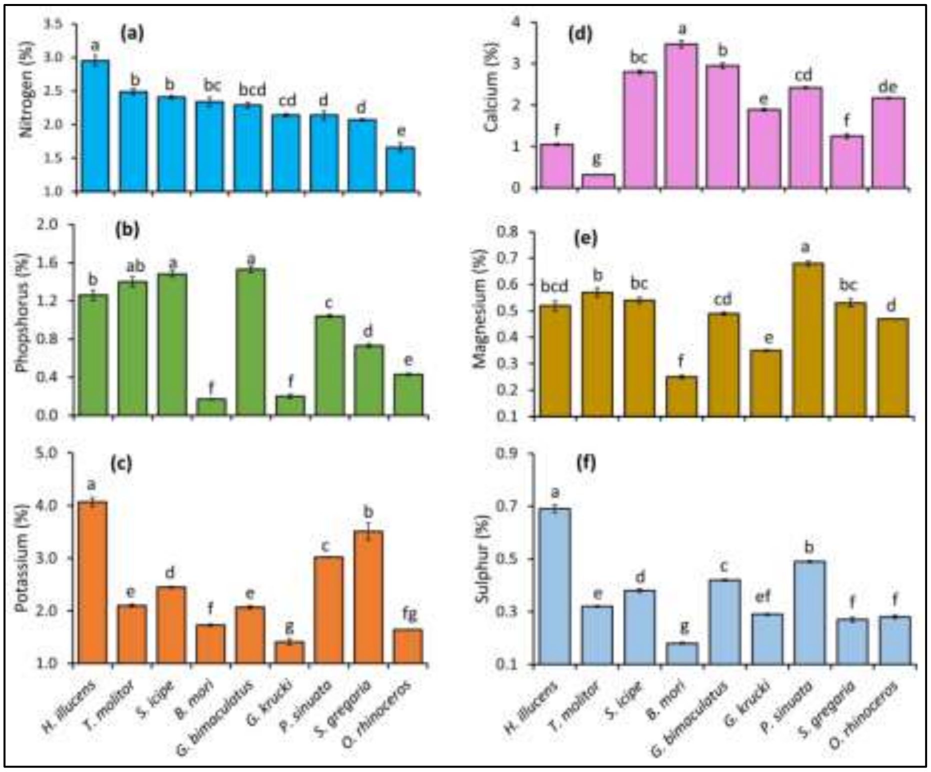

Fig. 4: Relative nutrient content in the frass of various insects (Beesigamukama *et al.*, 2022)

Enhancement of beneficial soil microbes

Plant growth promoting rhizobacteria help in the mineralization of complex organic nutrients and convert them into plant absorbable forms. They are also instrumental in enhancing the resistance of plants to pests and diseases. The operating mechanism is to trigger the ISR pathway of the host plant against pathogens and herbivores or stimulate the attraction of the natural enemies of herbivores. While the utility of beneficial microflora for achieving sustainable agricultural production is great, the outcomes of microbial applications in field-based crop production are often inconsistent. Beneficial microbes are commonly inoculated into soil, the success of which depends on their establishment both in the soil and on plant roots which is constrained by competitive interactions with indigenous microbes. Thus, to stimulate soil bacteria use of soil amendments has been suggested amendment-mediated stimulation of indigenous microorganisms has a clear advantage over the employment of microbial inoculants because the enriched soil-borne microbes are well adapted to local soil conditions.

As prime examples, root-colonizing *Bacillus cereus* and *B. subtilis* both promote plant growth, mediate ISR, and have antagonistic activity against a broad range of plant pathogens and pests. In view of the increased abundance of bacilli associated with applying insect exuviae as soil amendment, the utilization of insect-derived products to promote plant growth and health seems to bear good prospects. Upon adding insect residues to the soil, the beneficial chitinolytic bacteria present in the soil get stimulated. In a comparative study made to access the diversity of chitinolytic bacteria produced from mealworm exuviae and fungus cell walls, it was revealed that the exuviae stimulated a high diversity of chitinolytic bacteria than the latter. The richness and diversity of the bacterial communities were found highest for the mealworm cuticle (Yani, 2015).

Frass mineralization

Frass from mealworm farm is quickly mineralized after its incorporation into the soil. After 7 days of incubation, 37% of total organic carbon (TOC) was mineralized. Further, a slower but continuous C mineralization occurred, reaching 56% of TOC after 91 days. Nitrogen mineralization had a similar pattern: a rapid mineralization just after frass application (37% of total N after 17 days of incubation) was followed by a slower but continuous N mineralization (55% of total N at the end of the incubation period). In terms of mineralization, the mealworm frass used in this study compares well with frass from other insects (Houben *et al.*, 2020) (Fig. 5).

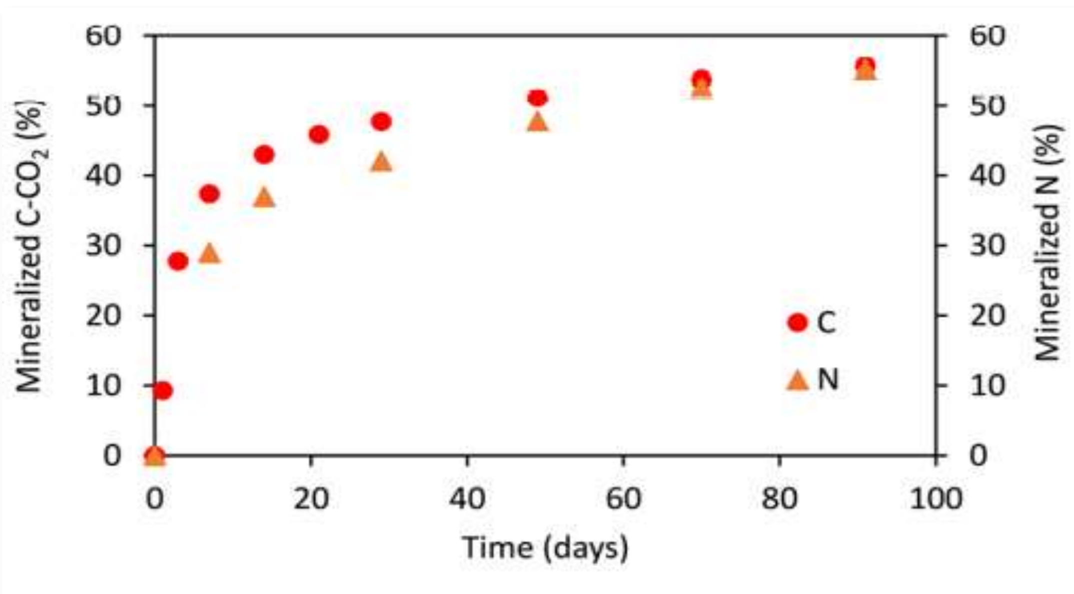

Fig. 5: Carbon and nitrogen mineralization dynamics of frass (Houben *et al.*, 2020)

Development of plant resistance

The sparse research on how insect derivatives affect plant resistance shows that effects differ between plant species, insect species that produced the frass, and plant organ to which the frass was supplied. For example, caterpillar frass suppresses caterpillar-induced defenses in maize plants, while it increases the defense against pathogens and aphids.

Chitin is recognized by plants as a microbe-associated molecular pattern (MAMP), eliciting diverse defense responses in plants including, but not limited to, systemic expression of defense related genes, programmed cell death, and release of reactive oxygen species. Its efficiency in stimulating plant defenses against pathogens after application as a soil amendment or as a foliar spray has been shown in numerous systems. Therefore, the addition of chitin-rich insect residual streams to agricultural soil is expected to benefit plant resistance.

Microbial antagonism against plant pathogen and insects

Several greenhouse and field studies have shown that the application of chitin containing amendment coincided with a reduction in disease incidence caused by root-infecting fungi, such as *Verticillium dahliae* , *Fusarium oxysporum , and Rhizoctonia solani* .The key mechanism for this suppression of pathogens is attributed to increased abundance and activity of chitinolytic bacteria and fungi, particularly members of Actinobacteria, Gamma proteobacteria, Bacilli, and Mortierellomycetes.

The chitinases produced by these microbes, in combination with other cell wall-degrading enzymes and antibiotics, can weaken and disrupt the developing cell wall of fungal pathogens. In a similar way, chitinases can affect the development of root herbivores and have been shown to reduce larval feeding and biomass when ingested. The underlying mechanism is thought to be the degradation of chitin in the insect midgut peritrophic matrix. Chitinolytic activity is only one of many mechanisms underlying microbial antagonism.

National Bureau of Agricultural Insect Resources (NBAIR) has termed the Black Soldier fly larval frass as “Black Gold” after acknowledging the potential benefits that it provides. A study on the total fresh weight of Pakchoi (*Brassica rapa* L.) plants 35 days after planting using various treatments (Control, NPK treatment, compost, 5% BSF frass, 10% BSF frass, 15% BSF frass, compost + liquid organic biofertiliser (LOB)) was assessed.

The result showed that Pakchoi cultivated with compost+LOB, compost, and BSF frass (5%, 10%, 15%) produced the highest biomass compared to control and NPK treatment significantly. The highest total plant weight was achieved in the treatment of Compost+LOB (Augustyani *et al.*, 2021) (Fig. 6).

Fig. 6: Total fresh plant weight of Pakchoi plants in 35 days of planting (Augustyani *et al.*, 2021)

Conclusion

Using insect organic amendments like frass and exuviae, we can restore the soil quality by stimulating the beneficial microbes. Increased nutrient content induces the systemic resistance and provide protection from harmful pathogens. So, there is a scope to use insect waste obtained from insect farming as an alternative to chemical fertilizers in sustainable crop production. Soil is a home to quarter of the world biodiversity- a living soil is farmer's greatest asset.

References

Agustiyani, D., Agandi, R., Nugroho, A. A. and Antonius, S. 2021. The effect of application of compost and frass from Black Soldier Fly Larvae (*Hermetiaillucens* L.) on growth of Pakchoi *(Brassica rapa* L.). *Environmental Earth Sciences*, **762**(1): 12-36.

Beesigamukama, D., Subramanian, S. and Tanga, C. M. 2022. Nutrient quality and maturity status of frass fertilizer from nine edible insects. *Scientific Reports*, **12**(1): 1-13**.**

Fonseca, K.Y., Nurfikari, A., Vande zande, E. M., Wantulla, M., Van Loon, J. J., De Boer, W. and Dicke, M. 2022. Insect frass and exuviae to promote plant growth and health. *Trends Plant Science*, **27** (7): 646-654.

Houben, D., Daoulas, G., Faucon, M. P. and Dulaurent, A. M. 2020. Potential use of mealworm frass as a fertilizer: Impact on crop growth and soil properties. *Scientific Reports*, **10**(1): 46-59.

Poveda, J. 2021. Insect frass in the development of sustainable agriculture. A review. *Agronomy for Sustainable Development*, **41**(1): 5.

Yani, B. 2015. Ecological functioning of bacterial chitinases in soil (Doctoral dissertation, Leiden University).

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Scientists' warning on loss of insect biodiversity and implications for sustainable agriculture

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Abstract

Climate change is a long-term shift in global or regional climate patterns. Climate change is among the biggest environmental challenges, humans face in the 21st century. The most imminent climatic change in recent times is the increase in atmospheric temperatures due to increased levels of greenhouse gases such as carbon dioxide (CO_2), methane (CH_4), ozone (O_3), nitrous oxide (N_2O) and chlorofluorocarbons (CFCs), largely because of industrialization and burning of fossil fuels, etc. The term biodiversity is the short form of 'biological diversity. As per the Convention on Biological Diversity (CBD), biodiversity means the variability among all living organisms from all sources including inter alia terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are a part. Climate change is among the major environmental challenges for humans with catastrophic effects on faunal (especially insect) biodiversity and agricultural production. Insect biodiversity provides an array of indispensable services in agricultural production including pollination, nutrient recycling and natural control of pests. Special efforts are required for conserving and identifying insects and elucidating their role in ecosystem functioning. Intensive research, constant surveillance, early detection and rapid response are essential to face the emerging pest and disease threats to crop production. Insect Conservation, landscape heterogeneity, biological control and IPM are the keys to environmentally benign and climate-resilient crop protection for sustainable agricultural production in the future.

Key Words: Climate change, biodiversity, insects, pollination, IPM

*Plenary Lecture delivered by the senior author (RA, arorarame@gmail.com) at the 26th Punjab Science Congress and National Conference on Environment, Food Security and Health with reference to Climate Change, Feb 9, 2023, Sri Guru Granth Sahib World University, Fatehgarh Sahib, Punjab

The climate is the synthesis of weather conditions in each area, characterized by long-term statistics (mean values, variables, probabilities of extreme values, etc.) for the meteorological elements in that area. Climate change is a long-term shift in global or regional climate patterns. Climate change is among the biggest environmental challenges, humans face in the 21st century. It's generally manifested as variation in the distribution of weather patterns or change in extreme weather events over extended periods. The Inter-Governmental Panel on Climate Change (IPCC) has defined climate change as ‘any change in climate over time whether due to natural variability or as a result of human activity’. The most imminent climatic change in recent times is the increase in atmospheric temperatures due to increased levels of greenhouse gases such as carbon dioxide (CO_2), methane (CH_4), ozone (O_3), nitrous oxide (N_2O) and chlorofluorocarbons (CFCs), largely because of industrialization and burning of fossil fuels, etc. As per recent estimates, the globally averaged combined land and ocean surface temperature data as calculated by a linear trend, show warming of 1.09^{0}C in 2011-20 over 1850-1900 and estimates reveal projected warming of 1.2-4.5^{0}C by the end of the 21st century. The amount of CO_2 has jumped from 280 ppm to more than 400 ppm in the last 150 years and is projected to cross 500 ppm around 2050. It is of immense concern that most of the warming (of 0.1^{0}C/decade) observed over the last fifty years is attributed to human activities (IPPC, 2022).

The term biodiversity is the short form of ‘biological diversity. As per the Convention on Biological Diversity (CBD), biodiversity means the variability among all living organisms from all sources including inter alia terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are a part; this includes diversity within species, between species and of ecosystems. The Entomological Society of America (ESA) defines biodiversity as “the comprehensive variety and variability of life on Earth- the full spectrum of species, populations, interactions, behaviors, and gene pools that compose the living world.”

A perusal of the voluminous literature available on the subject, suggests that climate change and other anthropogenic activities will have serious consequences for ecosystem services, water availability, crop production and diversity and abundance of arthropods including pollinators, trash burners and decomposers, insect pests and natural enemies and the extent of crop losses due to insect pests (Arora and Dhawan, 2011, Arora, 2013, Sanchez-Bayo and Wyckhuys, 2019). A warning issued by the Union of Concerned Scientists and reissued by the Alliance of World Scientists, and signed by over 15,000 scientists claims that humans are “pushing Earth’s ecosystems beyond their capacities to support the web of life” (https://www.scientistswarning.org/the-warning). Climate change is affecting individual organisms, populations, species, communities and ultimately the ecosystems and whole biomes. The loss of agrobiodiversity (flora, fauna especially pollinators), pest and disease outbreaks, and failure of established pest management practices are some of the major consequences of climate change, which will affect both crop production and food security (Arora and

Sharma, 2021, Harvey *et al*., 2022). It has been reported that 3-14% of species are at risk from warming of 1.5^{0}C, 3-18% at 2^{0}C, 3-29% at 3^{0}C and 3- 39% at 4^{0}C (IPCC, 2022).

Insect biodiversity globally and in India

With more than a million identified species, insects comprise nearly two-thirds of the animal biodiversity on planet Earth. But many more remain unidentified and the total number of insect species has been estimated to be around 5.5 million. Insects serve to pollinate a majority of the species of flowering plants. Bees (superfamily Apoidea), flies, beetles and butterflies and moths are some of the major groups of insect pollinators of entomophilic plants. Several groups of insects act as natural enemies of many insect pests and weeds. In addition, they provide many other essential ecosystem services in natural as well as in agroecosystems. Springtails, termites, ants, beetles, mole crickets and cicadas serve to improve soil aeration and add organic matter to the soil (Arora and Dhaliwal, 1999, van Huis, 2014). The precipitous and rather unexpected decline in insect populations has been reported over the last two decades but has caught our attention only recently (Wagner *et al*., 2021). It has left us with no option but to take immediate and drastic action for the conservation of insects and other arthropods. Consequently, the Entomological Society of America (ESA) hosted a symposium on 'Insect decline in the Anthropocene' at their annual meeting in St Louis in November 2019. The eleven papers presented there discussed in depth the causes and cures for this decline and the same were published in a special issue (in 2021) of the *Proceedings National Academy Science* USA 118:2). The symposium emphasized that long-term species-level demographic data were meager from the tropics, which embodies much of the biodiversity (Wagner et al. 2021). The major causes of biodiversity losses in insects include habitat destruction and deforestation, urbanization, climate change, intensive agriculture, pesticide and fertilizer use, wetland/river alteration and other anthropogenic activities (Sanchez-Bayo and Wyckhuys, 2019, Harvey *et al*., 2020).

India's Biological Diversity Act, of 2002 was enacted with the aim of conservation of biological diversity, sustainable use of biological diversity, and fair and equitable sharing of the benefits of biological diversity. The act is being revised and the Biological Diversity Amendment Bill, 2021 is pending before Parliament for approval. However, no special provisions are proposed for the conservation of arthropods which are essential for providing ecosystem services. As per the Zoological Survey of India, Kolkata, the insect biodiversity in India is comprised of 63760 identified species from 658 biological families representing 3 classes and 27 orders. Among various states in the country, Sikkim harbored the maximum number (5941) of insect species followed by West Bengal (5818) and Meghalaya (5118). Not surprisingly, Punjab- the food bowl of the country, has only 1116 identified species of insects (Chandra, 2015). But many more insect species remain unidentified and their role in ecosystem functioning remains unacknowledged.

Implications of biodiversity loss for sustainable agriculture

i. The loss of many species of pollinators, natural enemies of pests, trash burners and decomposers of dead plants, animals and other organic matter.

ii. Fragmented food chains and food webs resulting in losses in biodiversity and/or abundance of many species of amphibians, reptiles, fishes and birds.

iii. The emergence of many new economically important pests of crop plants in different regions of the world.

iv. Failure of existing/ recommended control measures against important pests in many crops/ locations.

Insect conservation

The funding for research on arthropods and the conservation of arthropods and other organisms needs to increase dramatically to enable us to protect nature's ecosystem and ultimately ourselves from impending disaster. Professor E.O. Wilson proposed conserving half the lands and seas on the planet to safeguard the bulk of biodiversity and the project came to be known as the 'Half-Earth Project' (Wilson, 2016). With only about 20 percent of an estimated 5.5 million insect species identified, there is an immediate need to identify insects and other arthropod fauna and to illuminate their ecological role in nature as well as in agroecosystems. There is an urgent need to prepare a long-term research agenda in insect taxonomy including molecular taxonomy. There are just a couple of designated insect repositories including the Zoological Survey of India (ZSI), Kolkata and the National Bureau of Agricultural Insect Resources (NBAIR), Bengaluru in the country. New designated repositories and data centres on insects must be established in universities/ other institutions as per the Biodiversity Act of 2002. The number of threatened and extinct insect species is woefully underestimated because so many species are rare or undescribed. Further, inventories of insect fauna must be prepared at the block, district, state and national levels (Chandra, 2015).

The extinction risk and conservation status of an overwhelming majority of identified species also need to be determined. Biological invasions have become increasingly common, posing a great threat to regional biodiversity and ecosystems. The impacts of invasive species are considered to be the second leading threat to worldwide biodiversity after habitat destruction (Harvey *et al*., 2020). Arthropods constitute more than half of the biodiversity on the planet and research and conservation of these organisms must receive proportionate funding.

The development of forecasting models for predicting the effects of climate change on ecologically significant arthropods should be a priority at the regional, national and international levels. Dynamic global vegetation models have emerged as an important technique to study the impact of various climate change scenarios on vegetation, biogeochemical cycles and biodiversity.

With increasing urbanization, there has been a phenomenal increase in lighting especially UV lights and LED lights, which have adversely affected the survival and behaviour of insects. Light pollution interferes with insects that use natural light as orientation cues for navigation. The adverse effects of soil, water and air pollution, by pesticides, fertilizers, and industrial effluents, on insects are well known. Noise pollution by vehicles and industries interferes with acoustic communication by insects. Hence, a reduction in various types of pollution may help in the establishment and growth of insect populations (Owens *et al.*, 2020).

Deforestation, urbanization and mining have caused extensive destruction of the habitats of insects and other organisms. Further, modern agriculture based on monocultures and homogeneity cannot support biodiversity. An increase in landscape diversity and a lowering of cropping intensity are expected to support a wider variety and abundance of native flora and fauna including insects.

The massive task of biodiversity conservation and mitigation of the adverse effects of climate change, on pollination and other ecosystem services, is only possible with the participation of all sections of society, with emphasis on students, informed citizens and farmers, mobilized through awareness campaigns and educational programmes for community participation.

Climate-resilient plant health management

The wide-ranging and in many cases uncertain effects of climate change on crops, insect pests and natural enemies require intensive research, constant surveillance, early detection and rapid response (Arora, 2013, Arora and Sharma, 2021, Rao *et al.*, 2022). Strict quarantine measures must be adopted to prevent the spread of pests and pathogens to new areas. Invasive species are a huge threat to modern agriculture and must be contained as soon as detected.

The period of activity and rate of multiplication of insects may keep changing with changing environmental conditions. The temperature may also affect the number of days required to reach different crop phenological stages. Therefore, the population dynamics of the pests as well as their natural enemies on the popular cultivars of important crops must be studied periodically at multiple locations in each agro-climatic zone.

Pesticides are known to kill many species of non-target insect/ non-insect populations in the agroecosystem as well as in soil and water. Further, pesticide production, transport, storage, application and breakdown all contribute to climate change. Therefore, pesticide use must be replaced with biological control and other ecological measures (IPM) through policy interventions (subsidies, taxation) to induce innovation and adoption of insect-friendly technologies. Most countries have already enforced pesticide residue limits while importing agricultural commodities.

There is a need to prioritize the import of agricultural produce from healthy, species-rich ecosystems using holistic crop production and protection technologies. This will help to bring investment in eco-friendly technologies.

Pest management is a dynamic process, especially in a changing climate regime. It is therefore essential that all the cultural, mechanical biological and chemical control measures must be periodically (at least after every 5 years) reevaluated and suitably modified to maintain their efficiency.

Conclusions

Climate change is among the major environmental challenges for humans with catastrophic effects on faunal (especially insect) biodiversity and agricultural production. Insect biodiversity provides an array of indispensable services in agricultural production including pollination, nutrient recycling and natural control of pests. Special efforts are required for conserving and identifying insects and elucidating their role in ecosystem functioning (Harvey *et al*., 2020). Intensive research, constant surveillance, early detection and rapid response are essential to face the emerging pest and disease threats to crop production. Insect Conservation, landscape heterogeneity, biological control and IPM are the keys to environmentally benign and climate-resilient crop protection for sustainable agricultural production in the future.

References

Arora, R. 2013, Impact of climate change on insect pest scenario and management. In: *Proceedings of Brainstorming Workshop on Climate Change and Sustainability of Agriculture*. February 6, 2013, DST, PSCST and Punjab Agricultural University, Ludhiana, pp. 32-46.

Arora, R. and Dhaliwal, G. S. 1999, *The Insects- Diversity, Habits and Management*. Kalyani Pubs., New Delhi.

Arora, R. and Dhawan, A. K. 2011, Climate change and insect pest management. In: Dhawan, A.K., Singh, B., Arora, R. and Bhullar, M.B. eds., *Recent Trends in Integrated Pest Management*. Indian Society for the Advancement of Insect Science, Punjab Agricultural University, Ludhiana, pp. 77-88.

Arora, R. and Sharma, S. 2021, *An Introduction to Integrated Pest and Disease Management*. Kalyani Pubs., New Delhi.

Chandra, K. 2015, A century of ZSI research on insect biodiversity. Lead Paper presented at the 4th Congress on Insect Science, April 17, 2015, Indian Society for the Advancement of Insect Science, Punjab Agricultural University, Ludhiana.

Harvey, J. A. and Heinen, R. 2020, International scientists formulate a roadmap for insect conservation and recovery. *Nature Ecology & Evolution.* Available online at http//doi.org/10.1038/s41559-019-1079-8.

Harvey, J. A. and Tougeron, K. 2022. Scientists' warning on climate change and insects. *Ecological Monographs* 2022, DOI: 10.1002/ecm.1553.

IPPC. 2022, *Climate Change 2022: Impact, Adaptation and Vulnerability*. Working Group II Contribution to the IPPC Sixth Assessment Report. Intergovernmental Panel on Climate Change, Cambridge University Press, Cambridge.

Owens, A. C. S. and Cochard, P. 2020. Light pollution is a driver of insect declines. *Biol. Conserv*. **241**: 108259.

Rao, S. M. and Prasad, T. V. 2022, *Adaptation Strategies for Pest Management in Climate Change Scenarios*. ICAR-CRIDA and MANAGE, Hyderabad.

Sanchez-Bayo, F. and Wyckhuys, K.A.G. 2019. Worldwide decline of the entomofauna: A review of its drivers. *Biol. Conserv.* **232**, 8-27.

Van Huis, A. 2014. The global impact of insects. Farewell address upon retiring, Wageningen University, Wageningen.

Wagner, D. L. and Grames, E. M. 2021. Insect declines in the Anthropocene: Deaths by a thousand cuts. *Proceedings National Academy of Sciences*, USA, 118(2), e20233989118.

Wilson, E. O. 2016. *Half-Earth: Our Planet's Fight for Life*. E.O. Wilson Biodiversity Foundation, Liveright Publ. Corp., NY.

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Fire Ants: A nuisance pest in the silk reeling industry

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The fire ant, *Solenopsis geminata* (family Formicidae), is a eusocial insect. A serious problem posed by ants in the sericulture industry is their association with the mealybug infestation, that causes serious issues for the farmers in the harvesting of mulberry leaves (Mahimasanthi *et al,* 2014). The fire ants even cause economic losses to the silkworm as they attack worms during rearing and mounting. Further, it has been reported that this ant can hamper egg laying by gravid female moths in the grainage (silkworm egg-producing centres) industry (Govindan et al, 1998). But the very next stakeholder in the sericulture industry is the reeling industry, which is even affected by ants. Our observational studies were carried out in the reeling units in the 'Silk City of Karnataka' (the Ramanagaram District (12° 42' 54.1260" N and 77° 16' 52.6656" E), revealed that to have profitability in these sectors, the reelers purchase large quantities of the cocoon at a low price and subject it to stifling to avoid the formation of moth-pierced cocoons, in turn to avoid the problem of getting continuous filaments. But even after stifling, the reelers face the problem of getting continuous filaments. But our study reveals that the ants are the offenders; they affect and damage the cocoons in the huge storage lots.

These red ants create a serious problem by reducing cocoon quality, silk quality, and the efficiency of reelers. They damage the stifled and stored cocoons by cutting the silk fibre, making holes of 3.50–3.65 mm, and feeding on dead pupa (Fig. 1). When subjecting these cocoons to cooking, the reelers face a severe problem finding a continuous reeling end. On reeling the ant-infested cocoon (Fig. 2) on eprovate (a single cocoon reeling device), the non-breakable filament length (NBFL) of the silk fibre has reduced from 450–600 mt to 10–20 mt. Further, it also revealed that the ant-pierced cocoon completely sucked the water inside and completely submerges in the cooking basin, which interfered with the reeling process. The majority of the reeling workers in the observation area expressed that ants bit the reelers, cookers, and cocoon transporters while doing reeling activity. It was also observed that on reeling the ant-infested cocoon, the silk thread quality was affected by partially eaten pupa powders and soil particles (Fig. 3) and caused the reeling bath water to turn completely turbid. Therefore, this ant infestation problem must be clearly addressed for reelers to achieve profitability in the silk reeling industries.

Fig. 1. Ant pierced cocoon

Fig. 2. Fire ants' infestation on cocoon

Fig. 3: An ant-infested, cut-open cocoon with a partially fed pupa and earth particles.

References

Mahimasanthi, A., Sakthivel, N., Nalini, R. and Rajavel, S. 2014. Association of ants with pink hibiscus mealybug, *Maconellicoccus hirsutus* (Green) and its influence on predatory fauna in mulberry ecosystem. *Journal of Biopesticides*, *7*: 47.

Govindan, R., Narayanaswamy, T. K. and Devaiah, M. C. 1998. Principles of silkworm pathology. *Seri Scientific Publishers,* pp. 352-364.

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Euphorbia sp. encourages pollinators

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Weeds provide food for insects in exchange for pollination. The stability of mutualistic interactions in pollination networks depends on conservation of insect pollinators and weed communities (Rollin *et al*., 2016). The Euphorbia plant in my garden closely resembles *Euphorbia triangularis* (Family: Euphorbiaceae). It is spiny, succulent, about two meters, branched. It is also found in the Southern African region and Mozambique, where it flowers in June-August (pza.sanbi.org, 2023). The Euphorbia in Bangalore also has flowers in clusters of greenish-yellow, flowering between January and March. The Euphorbia plant attracts butterflies, bees, etc. (pza.sanbi.org, 2023). Euphorbiaceous plants have one of the specialized pseudanthia ("false flowers") forming the inflorescence of plants called a cyathium (plural: cyathia). Three Euphorbia species together attracted over 200 species of insect visitors to their cyathia. Bees that are oligolectic on euphorbia figure prominently among these in both number of species and abundance of individuals (Joan, 1979). I chose to plant these in my garden, as it requires less water, nutrition and even care! But, once it flowers, I realized it attracts several pollinators and being unsprayed, contributes to survival of pollinators. The pollinators on flower visitors frequenting on the flowers were as follows

1. *Ischiodon scutellaris* (Diptera)
2. *Eristalis arbustorum* (Diptera)

Tetragonula iridipennis (Hymenoptera) and *Camponotus parius* (Hymenoptera). The Dipterans are predatory in their larval stages, and this observation shows, that planting Euphorbia (*triangularis*) in garden, will help in augmenting useful insects. Urban gardens with limited water source can consider this plant. In my opinion it is a natural climate resilient plant.

Fig. 1 *Euphorbia triangularis* flowering

Fig. 2 *Tetragonula iridipennis*

Fig. 3 *Eristalinus arvorum*

Fig. 4 *Ischiodon scutellaris*

References

Rollin, O., Benelli, G. and Benvenuti, S. 2016. Weed-insect pollinator networks as bio-indicators of ecological sustainability in agriculture. *A review*. *Agron. Sustain. Dev*. **36**: 8. https://doi.org/10.1007/s13593-015-0342-x

Ehrenfeld and Joan G. 1979. "Pollination of Three Species of Euphorbia Subgenus Chamaesyce, with Special Reference to Bees." *The American Midland Naturalist*, 101(1):87-98. JSTOR, https://doi.org/10.2307/2424904. https://doi.org/10.2307/2424904

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Distorted pods of moringa due to mites (?) in Bangalore, Karnataka

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Moringa is an important health crop on account of its nutritional benefits mainly in the form of moringa leaf tea. The pods are used as vegetables and for seeds. We saw an unusual distortion of the pod mainly as a coil at the distal end. Only a single fruit was found deformed. Experts in horticulture have opined that in the early flower/fruit set stage sucking insects could have caused this probably mites (*Tetranychus urticae*) or the tea mosquito bug, *Helopeltis* sp. Another school of thought was attributed to boron deficiencies or combination of both. Moringa has several pests recorded on it (Joshi et al., 2016). We are reporting as this was an unusual distortion, and insects/mites are also suspected to be causal agents. In this case at flowering there was a heavy infestation of the red mite, *Tetranychus urticae* which could be the causal agent of distortion in the moringa pod.

Distorted pods of moringa

Reference

Joshi, Ravindra and David, Vasantharaj and Kant, Rashmi.,2016. A review of the insect and mite pests of *Moringa oleifera* Lam.. *Acta horticulturae*. **29**. 29-33.

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A preliminary documentation of the insect diversity in and around Asirvanam monastery, Bengaluru

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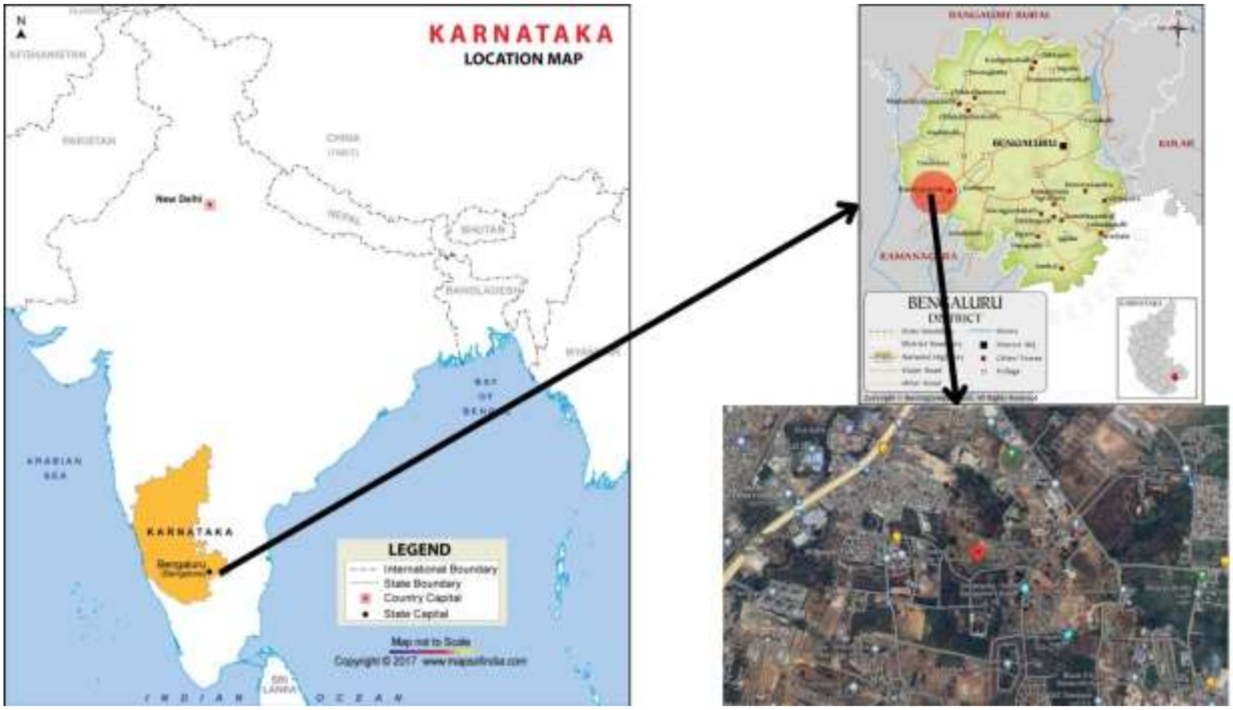
Asirvanam is the first monastery of the Benedictines in India, founded by St. Andrew's Abbey, Belgium It was canonically established in 1952 (Anon. a, 2023). The study was undertaken in Asirvanam Benedictine Monastery (Map 1), (12.88597° N, 77.45917° E), Anchepalya, Bengaluru South Taluk, Bengaluru Urban District in August 2022. Surrounded by a quiet atmosphere the campus encompasses an array of natural and man-made ecosystems *viz*., scrub forest, agricultural fields, and kitchen garden with seemingly vivid biodiversity. Insects create the biological foundation for all terrestrial ecosystems. They cycle nutrients, pollinate plants, disperse seeds, maintain soil structure and fertility, control populations of other organisms, and provide a major food source for other taxa (Geoffrey 2017). However, urbanization involving severe destruction of habitat threatens entomofaunal diversity like any other fauna (Anon. b, 2018). Entomofaunal diversity in urban and peri-urban environments of Bengaluru has been documented (Jaganmohan *et al.,* 2013; Devi *et al.,* 2021). Insects observed during the present study in Asirvanam were photographed using DSLR Camera (EOS 500D). Sweep nets were used to collect active insects. The Odonata were identified by using Jose and Chandran (2020) and butterflies using Kehimkar (2016).

In this study, a total of twenty-three species belonging to five orders *viz*., Lepidoptera, Diptera, Odonata, Hymenoptera, and Orthoptera were observed. Twelve species of Lepidoptera with a predominant percentage composition of (52%) followed by three species of Odonata (13%), three species of Diptera (13%), three species of Hymenoptera (13%), two species of Orthoptera (9%) were noticed in the study area (Table 1, Figs. 1-21). The greenery on the campus provides good shelter and food. Even though it was a rapid and short-term study twenty-three species of insects were recorded. Avian diversity study conducted in the study area reveals forty-three birds in the area including insectivorous birds (Harrington and Jayashankar, 2023). This is the first documentation of entomofauna from the study area undertaken in a short duration. Further studies to understand the spatio-temporal distribution and eco-behavior of the entomofauna needs to be undertaken.



Map 1: Asirvanam in Bengaluru, Karnataka, India (Source: Google maps)

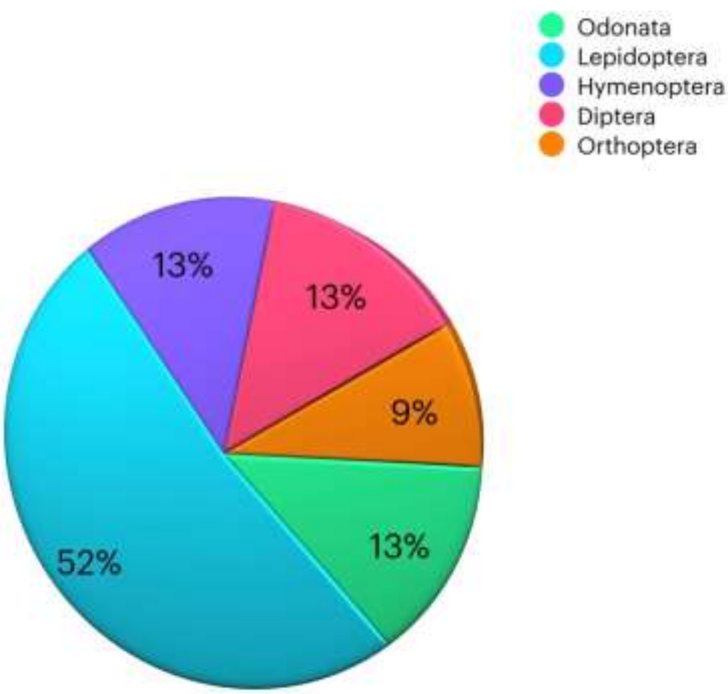


Fig. 1: Percent representation of entomofaunal orders found during the study

Table 1. List of Insects recorded during the study in Asirvanam

SI No.	Common Name	Scientific Name	Order	Fig. No.	IUCN
1	Lime swallowtail	*Papilio demoleus*	Lepidoptera	**2**	NE
2	Danaid Eggfly	*Hypolimnas misippus*		**3**	LC
3	Double-Branded Crow	*Euploea sylvester coreta*		**4**	LC
4	Yellow Pansy	*Junonia hierta*		**5**	NE
5	Angled Castor	*Ariadne ariadne*		**6**	NE
6	Common Mormon	*Papilio polytes*		**7**	LC
7	Blue Tiger	*Tirumala limniace*		**8**	NE
8	Common tiger	*Danaus genutia*		**9**	LC
9	Common pierrot	*Castalius rosimon*		**10**	LC
10	Chocolate Pansy	*Junonia iphita*		**11**	NE
11	Tailed palm fly	*Elymnias caudata*		**12**	NE
12	Tawny coaster	*Acraea terpsicore*		**13**	NE
13	Scarlet Skimmer	*Crocothemis servilia*	Odonata	**14**	LC
14	Pied paddy Skimmer	*Neurothemis tullia*		**15**	LC
15	Black Percher	*Diplacodes lefebvrii*		**16**	LC
16	Mosquito	*Aedes* sp.	Diptera	**INA**	LC
17	Fruit fly	*Drosophila melanogaster*		**INA**	LC
18	House fly	*Musca domestica*		**INA**	LC
19	Weaver ant	*Oecophylla smaragdina*	Hymenoptera	**17**	LC
20	Asian honey bee	*Apis cerana*		**18**	LC
21	The Greatest banded Hornet	*Vespa tropica*		**19**	NE
22	Deccan grasshopper	*Colemania sphenarioides*	Orthoptera	**20**	LC
23	Bombay locust	*Patanga succincta*		**21**	LC

LC – Least Concern, **NE** – Not Evaluated, **INA**-Image Not Available

Lepidoptera:

Fig. 2: *Papilio demoleus*

Fig. 3: *Hypolimnas misippus*

Fig. 4: *Euploea sylvester coreta*

Fig. 5: *Junonia hierta*

Fig. 6: *Ariadne ariadne*

Fig. 7: *Papilio polytes*

Fig. 8: *Tirumala limniace*

Fig. 9: *Danaus genutia*

Fig. 10: *Castalius rosimon*

Fig. 11: *Junonia iphita*

Fig. 12: *Elymnias caudata*

Fig. 13: *Acraea terpsicore*

Odonata:

Fig. 14: ***Crocothemis servilia***

Fig. 15: ***Neurothemis tullia***

Fig. 16: ***Diplacodes lefebvrii***

Hymenoptera:

Fig. 17: ***Oecophylla smaragdina***

Fig. 18: ***Apis cerana***

Fig. 19: ***Vespa tropica***

Orthoptera:

Fig. 20: ***Colemania sphenarioides***

Fig. 21: ***Patanga succincta***

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References

Anonymous a.2023. Available at: https://asirvanambenedictines.org/ (Accessed: 16 May 2023).

Anonymous b. 2018. Available at https://www.newindianexpress.com/cities/bengaluru/2018/jan/05/bengaluru-is-no-city-for-small-things-1745768.html

Devi, T., Thulasipathi, N. and Ganesh. 2021. Diversity of insect orders from two botanical gardens of Bengaluru, Karnataka, India. *Insect Environment* **24** (2): 300 – 305

Geoffrey, S. 2017. The importance of insects', In : *VA Insect Biodiversity* (Eds.) Robert G, F, Peter H. A, pp. 9–43. https://doi.org/10.1002/9781118945568.ch2

Harrington, D and Jayashankar, M. 2023. A pilot study to document avifaunal diversity of Asirvanam monastery a peri-urban ecotone in southern Bengaluru, Karnataka. Proceedings of National seminar on "*Current Environmental Issues and Measures of Mitigation*". 59 - 63 Available at: https://www.researchgate.net/publication/369858619

Jaganmohan, M., Vailshery, L. S. and Nagendra, H. 2013. Patterns of insect abundance and distribution in urban domestic gardens in Bangalore, India. *Diversity*. 5: 767-778 https://doi.org/10.3390/d5040767

Jose, J and Chandran, V. 2020. Introduction to Odonata 2 : Society for Odonate Studies. Internet Archive. https://archive.org/details/introduction-to-odonata-2

Kehimkar, I.2016. Butterflies of India. Bombay Natural History Society, Mumbai. pp xii + 528

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World Bee Day 2023 Celebrations in Kerala- Report

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The Federation of Indigenous Apiculturists (FIA), Thiruvanthapuram, Kerala had over 153 bee farmers gathered in YMCA to celebrate World Bee Day. The inaugural session started at 10.00 am with Shri A. Abdul Kalam, Patron, FIA in chair. Dr. Stephen Devanesan, General Secretary offered welcome address to the dignitaries including the bee farmers.

Dr. Roy Stephen, Dean, Faculty of Agriculture, Kerala Agricultural University inaugurated the World Bee Day celebration distributing stingless bee colonies and releasing the 8th issue of the publication of '*THENEECHAKARSHAKAN*' a quarterly publication of the Federation that was presented by Dr. K.S Premila, former Professor and Head AICRP on Honey Bees and Pollinators, Vellayani Centre of Kerala Agricultural University. In the inaugural address Dr. Roy stated that the calamities of climate change may lead to the decline of pollinators including the honeybees resulting in reduction of agricultural productivity.

Dr. T.P. Rajendran, the former Assistant Director General (Plant Protection), Indian Council of Agricultural Research (ICAR) was the lead speaker. He has brought forward his suggestions highlighting the United Nations theme: "Bee engaged in pollinator- friendly agricultural production" ensuring sustainable and profitable beekeeping. Agricultural productivity in Kerala can be enhanced by cross pollination in commercial crops such as coconut, cardamom, cashew etc. Among the many insects of the Agro-Environment Service conducts, many insects belonging to the genus of bees are notable. Bees are an excellent natural resource for crop pollination.

Beekeeping on an industrial basis has been going on for four decades in our state initiated by Dr. Spencer Hatch former Secretary YMCA Marthandom (1937). Beekeeping in rubber plantations was started from 1975 by providing beehives and technical training to small rubber farmers through cooperatives due to research efforts at the Rubber Research Institute in Kottayam. Today, about eight thousand tons of honey is produced in Kerala (2023). According to an estimate in 2018, 80,000 tons of rubber honey can be produced from 5,45,000 acres of this crop in the state.

Today, about 36000 million tons (2022) of honey is produced in our country. Out of this the states of Uttar Pradesh, Bengal and Bihar produced 75% of the honey. This means that the enhanced production of cross-pollinated crops in farms of these states was done through beehives.

The quality of honey is a matter of great debate in the country. Presently FSSAI-certified honey is assured for marketing. FIA propose to develop hallmark standards for the honey produced and processed in Kerala. This will give huge boost for honey export also.

Mr. K.S. Pradeep, Deputy General Manager Canara Bank distributed the identity card to the beekeepers and suggested that the adoption of scientific technology will be the best option for sustainable and profitable beekeeping in the country in turn will help in agricultural production.

Dr. Arthur Jacob, former Associate Director of Research, Kerala Agricultural University presented the pledge on World Bee day to the beekeepers. Mr. Saji Nair, Managing Director, Metro media, Mr. GS Aravind, Purchase Manager, Marico Ltd, and Mr. P.R. Unnikrishnan delivered special address on this occasion. 150 beekeepers participated in the celebration.

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Popular Blogs

Jasmine inferno: outrage of a small fly

The fly, *Contarinia maculipennis* Felt (Diptera: Cecidomyiidae) is blazing across 700 acres of cultivated jasmine in Tiruchirappalli district of Tamil Nadu. Surveillance based on farmers' calls, by ICAR-KVK, Sirugamani, revealed Posampatti, Podavur, Puliyu, Koppu, Viyalanmedu, Ayilapettai villages have been affected. Damage includes reddening of buds, flower drop and distorted stems. Associated with this is probably the budworm. An acre of jasmine fetches more than 10 lakhs per year income to the farmers. Jasmine is also exported. Hence this requires an urgent extension of judicious management. The fly may spread to other districts and states; hence an alert is needed.

International Phytosanitary Research and Services adds:

Dr. I. Merlin Kamala and Dr J. S. Kennedy (Tamil Nadu Agricultural University) found *Beauveria bassiana* and *Metarhizium anisopliae* (Entomopathogenic Fungi-EPF) to be effective up to 80%. The strategy should be to stop all chemical insecticides (probably the chief cause of the outbreak of the fly) and start weekly sprays of genuine EPFs. IPRS can supply registered efficacious EPFs. As pupation is below the plant on the ground, chemical sprays should be directed only onto the ground to prevent adult emergence. We rue the fact that in spite of two decades of research on phytochemicals no indigenous attractant or repellent is in the market!

Those entomologists who are open to more research on the fly may contact Dr Sheeba through this blog.

Jamun Seed Wasp: An Impediment to Growers, Seed Powder Export and Threat to Biodiversity

Jamun, *Syzygium cumini* is a tree belonging to the Myrtaceae Family, originally from India and widely distributed in Asian countries, known for its medicinal value. There is an increasing demand for these fruits and there is a steep hike in prices every year. A survey conducted by Rashvee- International Phytosanitary Research and Services (R-IPRS) and team in different areas of Karnataka, showed that in *Syzygium cumini* 15 to 30 percent of jamun fruits are affected by the seed borer, *Anselmella kerrichi* a phytophagous Eulophid. Others like fruit borer, *Conogethes punctiferalis*, weevil borers and fruit flies, *Bactrocera* spp may also occur.

There is no documented IPM for *A. kerrichi*, though reported almost six decades ago. Some entomologists have found some attractants but this has not seen the light of day as a product. The IPRS team in an earlier observation found that a combo of lambda-cyhalothrin 9.5% and thiamethoxam 12.6% at 0.5 ml at the pea stage of first-formed fruits is effective. As jamun is continuously harvested, subsequent chemicals should be avoided and instead the safe Rashvee herbal liquid spray at 3ml per litre should be used.

Dr N.C Patel, Progressive Horticulturist of Karnataka has stressed the need for developing an Integrated Pest Management for this pest. Entomologists of horticultural universities/colleges should come out with management strategies. As jamun seed powder is exported *A, kerrichi* damage is a minor quarantine issue. *A. kerrichi* also attacks *S. parameswaranii* (an endangered tree in the Western Ghats) and other wild *Syzygium* of semi-evergreen forests of the Western Ghats, India. If not managed, it may become a threat to biodiversity.

References

Athira Reghunath and Ramasubbu Raju. 2020. *Anselmella kerrichi* – A new pest on the reproductive reduction of an Endangered tree (*Syzygium parameswaranii*) of semi-evergreen Forests of the Western Ghats, India, ***Trees, Forests and People***, Volume 2: 100017, https://doi.org/10.1016/j.tfp.2020.100017.

Aishwarya Hiremath, Pooja and Ramegowda, G. K. Jamun seed and fruit borer complex at University of Horticultural Sciences Campus, GKVK, Bengaluru, ***Insect Environment***, Vol. 24 (1) 2021, 31-33.

INSECT LENS

Eyes of the praying mantis "Pseudopupil"

The black dots in eyes are called as 'pseudo-pupils' and are an optical artifact of compound eyes' structure. Compound eyes of the praying mantis is composed of many individual optical "modules" called ommatidia for gathering and sensing light all bundled together like a bunch. Each one produces a small piece of a larger image mosaic.

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White-barred Emperor, Charaxes brutus (Nymphalidae: Lepidoptera)

The White-barred Charaxes is found in the higher rainfall regions of the forest in Southern Africa.. There are multiple generations per year so this species can be found in flight year-round.

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Coccinellid grubs feeding on scales

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Any lead to identification?

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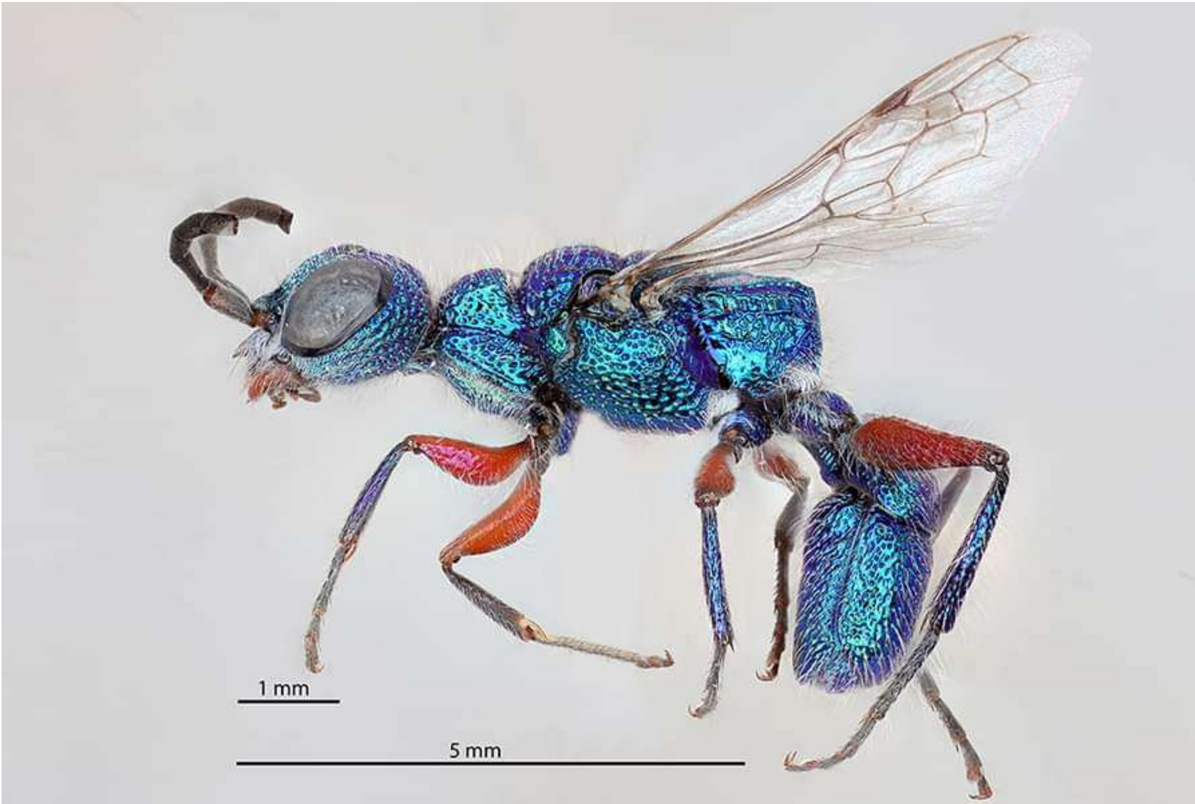

Emerald cockroach wasp, Ampulex (Ampulicidae)

It is known for its unusual reproductive behaviour, which involves stinging a cockroach and using it as a host for its larvae. It thus belongs to the entomophagous parasites.

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Cactus flies or banana stalk flies, Teleostylinus lineolatus (Neriidae: Diptera)

Neriidae is a relatively small family of true flies with long, stilt-like legs. Most species are found in the tropics. Many species are strikingly sexually dimorphic, with males having much longer legs, heads and/or antennae than females. Larvae have the ability to leap during the stage just before pupation when they migrate from the larval feeding substrate to the pupation site.

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Oxybelus sp. (Carbronidae: Hymenoptera)

These are solitary predatory wasps that nest in the ground. As with other Carbronids, they also uniquely predate flies (Diptera) and provision their nest with the flies for their young ones.

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Philanthus sp. (Crabronidae: Hymenoptera)

The Philanthus genus has over 135 known species. They are solitary predatory wasps that nest in the ground. Philanthus are commonly referred to as bee wolves based on their preferential predatory behaviour on bees. The European bee wolf, Philanthus triangulum, is the most widespread Philanthus wasp species, which specializes on predating honeybees. It is a minor pest of bee farming. Other species of Philanthus preferentially predates on other bees such as Bumble bee, other hymneopterans and at times other crabronids. This image depicts the ground nesting behaviour of the female Philanthus. Males are known to have territorial behaviour marking their zones against competing males by applying pheromones to various plant surfaces.

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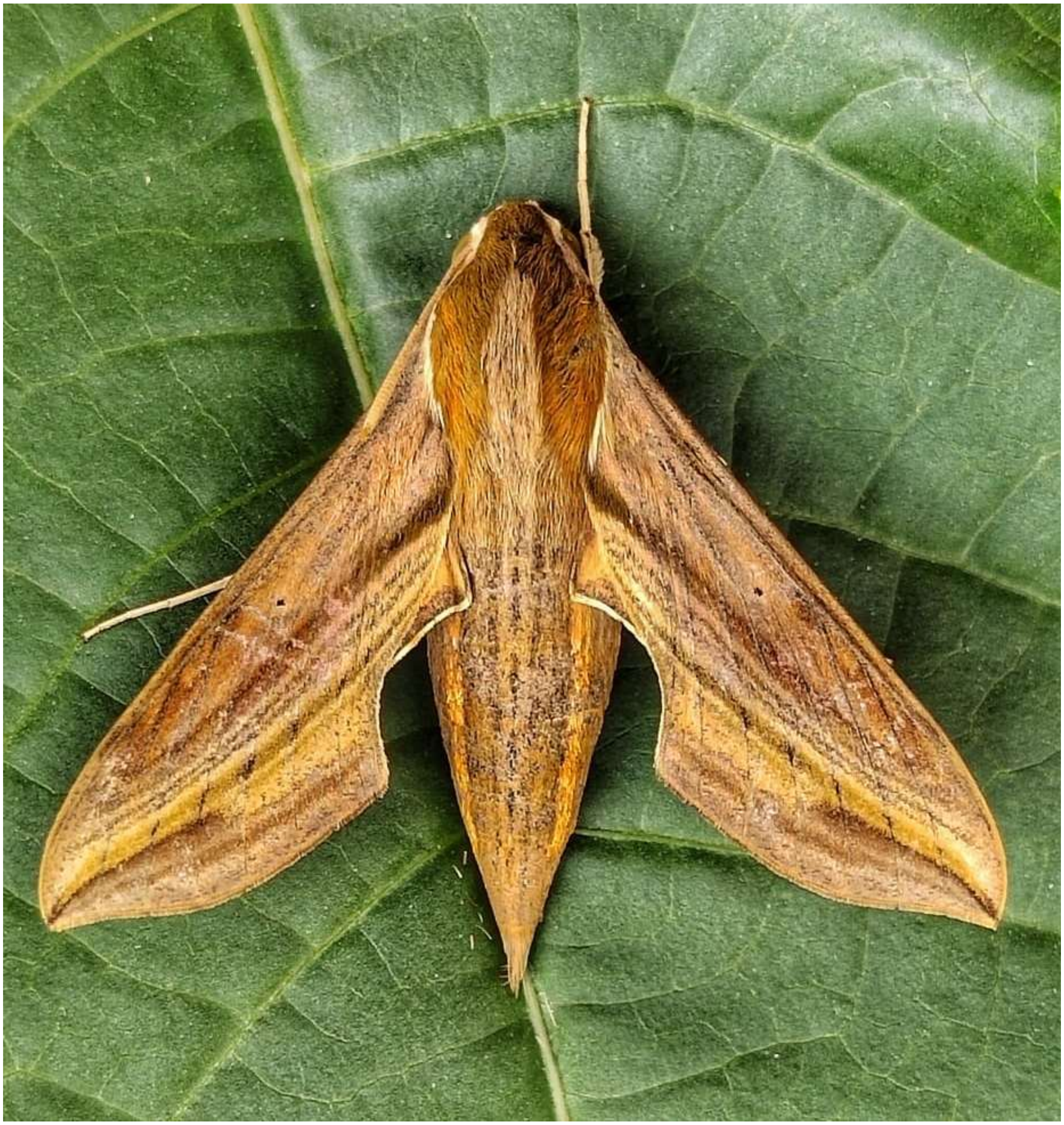

Hawk moth, Sphinx sp. (Sphingidae: Lepidoptera)

Hawk moths have the world's longest tongues than any other moth or butterfly (some up to 14 inches long). Although caterpillars may feed on plants, the adults have an important role as pollinators of many plant species and are the most significant pollinator of papaya.

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Slims, Aciagrion occidentale (Coenagrionidae: Odonata)

They are widely distributed across Central and South India, Sri Lanka, Thailand, Cambodia and Vietnam. Suitable habitat is shrub dominated wetlands although it can also be found in bogs, marshes, swamps, peat lands, small streams and permanent freshwater lakes.

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The Orange Tortricid Moth, Loboschiza koenigiana (Tortricidae: Lepidoptera)

These are occasional feeders of Neem, Melia azedarach, Jasmine and Hibiscus. A beauty in its design.

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Common Giant-Reed Bee, Macrogalea candida (Apidae: Hymenoptera)

Macrogalea bees are a group of native bee species that do not produce honey but are likely pollinators of crops and wild plants. Females have a sting, but they are not aggressive and will only sting if handled. These hairy, medium sized, long-tongued bees are only found in sub-Sahara Africa. Macrogalea bees nest in soft, dead plant stems and live independently (i.e. they are solitary).

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Syrphid, most likely Betasyrphus sp. (Syrphidae: Diptera) foraging on Ocimum

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Email: *ssubramania@icipe.org*

Honey bee, Apis mellifera (Apidae: Hymenoptera) foraging on Thorn Trees, Vachellia.

Thorn trees, Vachellia are key drought tolerant crops in the arid zones in Africa. Honey from bee's foraging on these drought tolerant tree crops are highly valued and demanded in the market. Conservation of Vachellia trees linked with bee farming and honey production can be a great income generation opportunity for communities in the arid zones of Africa and beyond. Let us conserve bees and the ecosystem services that they provide.

Author: *Dr Sevgan Subramanian*

Location: *ICIPE, Kasarani, Nairobi, Kenya (20th May, 2023)*

Email: *ssubramania@icipe.org*

Ceroplastes sp.

Observed on mango leaves at ICIPE, Nairobi, Kenya. Any leads to its ID is greatly appreciated.

Author: *Dr Sevgan Subramanian*
Location: *ICIPE, Kasarani, Nairobi, Kenya*
Email: *ssubramania@icipe.org*

Coridius janus (Dinidoridae)

Author: *Dr D. N. Nagaraj, Project Head (Entomologist) Ento Proteins Pvt. Ltd., Mangalore*

Location: *Bengaluru, Karnataka*

Email: *nasoteya@yahoo.co.in*

Latoia sp. (Limacodidae: Lepidoptera) feeding on Eucalyptus

They are often called slug moths because their caterpillars bear a distinct resemblance to slugs. The larvae are often liberally covered in protective stinging hairs, and are mostly tropical, but occur worldwide, with about 1800 described species and probably many more as yet undescribed species.

Author: *Dr Sevgan Subramanian*

Location: *Karura forest, Nairobi, Kenya*

Email: *ssubramania@icipe.org*

Syrphid fly, mostly Paragus capricorni (Syrphidae: Diptera)
(ID courtesy @Georg Gorgen, International Institute of Tropical Agriculture)

The adults feed on pollen and nectar from flowers as it is usual for syrphines, but larvae of Paragus feed mostly on soft-bodied Hemiptera and some other insects

Author: *Dr Sevgan Subramanian*

Location: *ICIPE, Nairobi, Kenya (May 2023)*

Email: *ssubramania@icipe.org*

Any leads to its ID is greatly appreciated.

Author: *Mr. Rushikesh Rajendra Sankpal*

Location: *Warananagar, Dist- Kolhapur, State- Maharashtra*

Email: *rushisankpal@gmail.com*

EXTENSION

OUTREACH BY RASHVEE-IPRS AND AVIAN TRUST

Pre-harvest Integrated Pest Management for mango fruit fly by Dr. Abraham Verghese at Asia Pacific Plant Protection Commission Workshop on Systems Approach for Fruit Fly Management on Mango held at Vashi, Navi Mumbai from 19 -23 June 2023.

Mango orchard - Regular consultation with quality inputs from experts

Jamun fields visit

World Environment Day celebration by AVIAN trust -Planting of fruit trees

World Environment Day celebration by AVIAN trust -Certificate distribution to the participants

World Environment Day celebration by AVIAN trust- Insect walk

World Environment Day celebration by AVIAN trust- Bird watch

Jamun field visit

Avocado field visit

Mango field visit

Mango field visit- examining fruit fly trap

Teaching insects to school children

School children tasting fresh mangoes in field

Mango fields visit for school children

Mango fields visit for school children

Entomology to public

Field visits with ICAR-NBAIR Scientists as a part of BIRAC project work

Field visits with Plant Protection Officer

Gauva field visit

Outreach to mango traders on fruit fly trap

Distribution of internship certificates to interns at R-IPRS

Dr Abraham Verghese as an IRC expert at ICAR NBAIR