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Major Insect Pests and their Natural Enemy Biodiversity in Ecological Engineering Groundnut (*Arachis hypogaea* L.) Crop

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ABSTRACT: The present study was carried out at Organic, Ecological Engineering Research Farm, NIPHM, Rajendranagar, Hyderabad during the *Kharif* and *rabi* seasons of two consecutive years 2020-2021 and 2021-2022 to observe the biodiversity of major insect pests and their natural enemies in the groundnut ecosystem. In the experimental field a total of 10 species of insect pests belonging to different orders and varied families were recorded. The order Lepidoptera showed the highest number of 6 species. This was further followed by Hemiptera (2 species), Thysanoptera (1 species) and Coleptera (1 species). 22 species of predator in 9 different orders and 5 species of parasitoids belonging to Hymenopteran order were found. The study revealed that the natural enemy population in organically maintained ecological engineering field helps in managing insect pests naturally and encourages farmers to choose ecological engineering as key component for sustainable agriculture.

Keywords: Biodiversity, groundnut, insect pests, predator, parasitoid, ecological engineering, organic.

INTRODUCTION

Groundnut (*Arachis hypogaea* L.) is an important leguminous crop in India. It is also known as peanut, earthnut, and goobers (Dwivedi *et al.*, 2003). It is cultivated mostly in the semi-arid tropical and sub-tropical regions (Sharma *et al.*, 2003) and valued for its high oil content and edible seeds. Globally, groundnut covers 315 lakh hectares with the production of 536 lakh tonnes with the productivity of 1701 kg per hectare (Anonymous, 2020). India ranks first in groundnut area under cultivation with annual all season coverage of 55.71 lakh hectares and is the second largest producer with 102 lakh tonnes with productivity of 1831 kg per hectare in 2020-21 (agricoop.nic.in). Groundnut is cultivated in one or more (*kharif, rabi* and *summer*) seasons, but nearly 90% of acreage and production comes from *kharif* crop (June-October).

Though India ranks first in area under groundnut cultivation, the productivity is quite low compared to that of USA, China, Argentina and Indonesia (Anonymous, 2005). There are many reasons for low productivity of groundnut that include attack of pests and diseases. Among biotic constraints insect pests are the most destructive factor with groundnut production as well as oil content and quality (Biswas, 2011). The crop is attacked by about 100 species of insect pests (Nandgopal, 1992). The total yield loss due to insect pests of groundnut was worked out to 40.2% (Baskaran *et al.*, 2013). Among the various insect pest attacking this crop, major insect pest of groundnut are the groundnut aphid (*Aphis craccivora* Koch), leaf miner (*Stomopteryx nertara* meyrick), stem borer (*Sphenoptera perotett* camron), white grub (*Holotrichia consainguinia* Blanchard), bihar hairy caterpillar (*Spilosoma oblique* walker), tobbaco caterpillar (*Spodoptera litura* Fab.), red hairy caterpillar *(Amsacta albistriga* Butler), jassid (*Empoasca kerri* Pruthi), thrips (*Scritothrips dorsalis*) and termite (*Odontotermes obesus* Rambur) (Atwal and Dhaliwal 2008). Neverthless, until late 1980, aphid was not known to be a major groundnut pest (Ghewande and Nandgopal 1992). The aphid does direct damage to the crop and also induces sap suction to the viral diseases caused by rosette (Alegbejo *et al.*, 1999; Subrahmanyam *et al.*, 2001). The existence of pests and natural enemies in groundnut ecosystem can be used as a reference for the development of an efficient ecological and biological control strategy that are economically and environmentally sound and also helps in deciding the judicious use of insecticides

MATERIALS AND METHODS

The present study was conducted during two seasons (*Kharif* and *rabi*) of two consecutive years (2020-21 & 2021-22) in the ecological engineering research farm of National Institute of Plant Health Management, Rajendranagar, Hyderabad. For this purpose groundnut variety Girnar 4 (ICGV 15083) was raised in an area of 1125 m^2 with spacing 30 × 10 cm.

To enrich the nutrient content of soil and to boost the crop growth, the organic fertilizers like Vermicompost, Vermiwash, Mycorrhizae, Phosphate solubilizing bacteria, Potashmobilizing bacteria and Zinc solubilizing bacteria were used. Biopesticides (*Trichoderma harzianum* and *Pseudomonas fluorescens)* were used to control soil borne diseases. The organic field at NIPHM, was maintained with poly culture and good insectary plants belonging to Compositae, Leguminaceae, Umbelliferae, Brassicaceae etc. families created favourable environment forpollinators and natural enemies. Around the groundnut field, corn as border crop, attractant plants like Sunflower, Marigold, Cosmos and many shrubs were planted to attract natural enemies and pollinators. Repellent plants like Ocimum/Basil and Mint were grown to repel insects. Nectar rich plants with small flowers *i.e.* mustard, sunflower, cowpea, sesame, sun hemp etc., were planted to provide shelter and food to the bees and adults of parasitoids. Marigold was maintained as trap crop for pod borer eggs and to repel beetles and nematodes. Castor was planted in the field to trap tobacco caterpillar.

Tobacco caterpillar (*Spodoptera litura)* and pod borer (*Helicoverpa armigera)* like polyphagous pests were monitored using pheromone traps. The experimental plot was kept unsprayed with chemical fertilizers and pesticides during the period of study and all agronomical practices were followed to render suitable crop growth. The pest and natural enemy population was recorded in this unprotected plot of groundnut from crop sowing to maturity at weekly intervals from 10 randomly selected plants from middle rows excluding border rows to record the appearance of various insect pests and natural enemies.

Records were taken by visual observation on the standing crop during morning and evening hours at weekly intervals. Some insects were collected by hand nets, hand picking and were preserved in the insect box and vial having 75% alcohol (Immature and soft bodied insects) for identification. The collected insects were also reared in the laboratory at an ambient temperature (24-34^{o}C) in cages and preserved in the insect boxes. For recording observations, the methodology as given in NCIPM manual for groundnut surveillance was followed (NCIPM, 2011).

RESULTS AND DISCUSSION

As resulted from survey of the groundnut crop throughout its two growing seasons *kharif* and *rabi*, during two consecutive years 2020-2021 and 2021-2022 an inventory of the arthropod fauna was prepared (Table 1). The study revealed the occurrence of several insect pests and their natural enemies (predator and parasitoid (Table 2 & 3).

A total of 10 species of insect pests belonging to four orders namely Hemiptera, Thysanoptera, Lepidoptera and Coleoptera were recorded. In the experimental fields of present study, among the various insect pests recorded, the order Lepidoptera represented the highest number of five species. Among all the Lepidopteran pests leaf miner, tobacco caterpillar, fall armyworm and red hairy caterpillar were found as the predominant group of insect pests in the trial field.Order Lepidoptera consisted of 6 species of insect pests belonging to 3 different families, followed by Hemiptera with 2 species in 2 different families, Thysanoptera with 1 species and Coleoptera with 1 species.

During the study 22 species of predators belonging to 9 different orders, 7 species of Coleoptera, 6 Species of Hemiptera, 3 species of Diptera, 1 species of Neuroptera, Dictyoptera, Odonata, Dermaptera, Arachnida and Hymenoptera were recorded and 5 species of parsitoids belonging to Hymenoptera order were found.

The present records are in accordance with the findings of Vasista *et al.* (2020) recorded nine species of coccinellids in groundnut crop ecosystem. Anonymous, (2020) recorded more than 100 species of insect pests mainly belonging to Lepidoptera and coleopteran orders in groundnut ecosystem. Ajazand Akhtar (2017) reported that coccinellids are important in biological control of soft bodied insects and are of high priority in organic and integrated pest management system. Swaminathan *et al.* (2016) reported the major predatory insect groups which includes coccinellids (*Coccinella septumpunctata*, *Cheilomenes sexmaculata* and *Brumoides suturalis*), lygaeid bug, rove beetles and syrphid flies against maize aphids. Sunil and Sarfraz (2019) observed insect pests aphid and leafhopper as major sucking insect pests infesting on groundnut crop. Sharma *et al.* (2019) observed a biodiversity of 34 species of harmful insects and 14 species of predatory and parasitic insects in soybean crop. Biswas (2014) found that thirty six species of insect pests were recorded to infest the different growth stages of groundnut crop. Among the recorded pest species, the hairy caterpillar, *Spilarctia obliqua* (Walker); common cutworm, *Spodoptera litura* (F.); jassid, *Empoasca terminalis* (Distant); leaf miner, *Stomopteryx nerteria* (M.) and leaf roller, *Anersia ephippias* (Meyr.) were considered as the major pests, while the rest were of minor importance. Snehel *et al.* (2016) found twenty six species of insect pests infest pigeonpea crop and fifteen natural enemies were associated with the insect pest complex. Harish *et al.* (2020) observed the occurrence of natural enemies mainly ladybird beetle which predate on soft-bodied insects like leafhopper and aphids in groundnut ecosystem. The variation in insect pests and their natural enemies numbers could be due to varietal differences and different agroclimatic conditions.

Table 1: Major insect pests diversity in groundnut ecosystem at NIPHM during *kharif* and *rabi*, 2020-2021 and 2021-2022.

Sr. No.	Insect Pests		Family	Order	Pest Status
	Common Name	Scientific Name			
1.	Aphids	*Aphis craccivora* (Koch.)	Aphididae	Hemiptera	Major
2.	Jassid	*Empoasca kerri* (Pruthi)	Cicadellidae	Hemiptera	Major
3.	Thrips	*Scirtothrips dorsalis*(Hood) and *Thrips tabaci* (Lindeman)	Thripidae	Thysanoptera	Major
4.	Leaf miner	*Aproarema modicella* (Deventer)	Gelechiidae	Lepidoptera	Major
5.	Tobacco caterpillar	*Spodoptera litura* (Fabricius)	Noctuidae	Lepidoptera	Major
6.	Fall armyworm	*Spodoptera frugiperda* (JE Smith)	Noctuidae	Lepidoptera	Major
7.	Bihar hairy caterpillar	*Spodoptera oblique* (Walk)	Erebidae	Lepidoptera	Major
8.	Gram pod borer	*Helicoverpa armigera* (Hubner)	Noctuidae	Lepidoptera	Major
9.	Red hairy caterpillar	*Amsecta albistriga* (Walker)&*A. moorei(*Buttler)	Erebidae	Lepidoptera	Major
10.	White grub	*Lachnosterna (Holotrichia) serrata* (Fab.) & *Lachnosterna (Holotrichia) consanguinea* (Blanchard)	Scarabaeidae	Coleoptera	Major

Table 2: Natural enemies (predators and parasitoids) diversity in groundnut ecosystem at NIPHM during *kharif* and *rabi*, 2020-2021 and 2021-2022.

Sr. No.	Natural enemies		Family	Order	Prey
	Common Name	Scientific Name			
Predators					
1.	Lady bird beetle	*Coccinella transversalis, Cheilomenes sexmaculata, Anegleis cardoni, Minochilussex maculata,* and *Harmonia octomaculata*	Coccinellidae	Coleoptera	Soft-bodied insects (leafhopper and aphids)
2.	Green lacewing	*Chrysoperla carnea* and *Chrysoperla zastrowi*	Chrysopidae	Neuroptera	Soft-bodied insects (aphids)
3.	Reduviid bug	*Rhynocoris marginatus* and *Rhynocoris fuscipes*	Reduviidae	Hemiptera	Soft-bodied insects and Lepidopteran larvae
4.	Ground beetles	*Scarinus subterranious*	Carabidae	Coleoptera	Soft-bodied insects and Lepidopteran larvae
5.	Pentatomid bug	*Eocanthecona furcellata*	Pentatomidae	Hemiptera	Lepidopteran larvae
6.	Rove beetles	*Oligota* spp.	Staphylinidae	Coleoptera	Soft-bodied insects
7.	Big eyed bugs	*Geocoris* spp.	Geocoridae	Hemiptera	Soft-bodied insects and Lepidopteran larvae
8.	Mirid bug	*Dicyphus hesperus*	Miridae	Hemiptera	Soft-bodied insects and Lepidopteran larvae
9.	Anthocorid bugs/pirate bugs	*Blaptostethus pallesence*	Anthocoridae	Hemiptera	Soft-bodied insects
10.	Predatory cecidomyiid fly	*Aphidoletis aphidimyza*	Cecidomyiidae	Diptera	Soft-bodied insects and Lepidopteran larvae
11.	Predatory gall midge	*Feltiella minuta*	Cecidomyiidae	Diptera	Soft-bodied insects and Lepidopteran larvae
12.	Dragonfly	Dragonfly	Anisoptera	Odonata	Lepidopteran larvae and adults
13.	Predatory wasp	*Vespa cincta*	Vespidae	Hymenoptera	Lepidopteran larvae
14.	Robber fly	Robber fly	Asilidae	Diptera	Soft-bodied insects
15.	Earwigs	*Forficula auricularia*	Forficulidae	Dermaptera	Soft-bodied insects (aphids)
16.	Spiders	*Argiope catenulata*	Araneae	Arachnida	Soft-bodied insects (aphids) and Lepidopteran larvae
17.	Praying mantis	*Mantis religiosa*	Mantidae	Mantodea	Soft-bodied insects (aphids) and Lepidopteran larvae
Parasitoids					
18.	Egg parasitoid wasp	*Trichogramma chilonis*	Trichogrammatidae	Hymenoptera	Pod borer, tobacco caterpillar and white grub
19.	Egg parasitoid wasp	*Telenomus* spp.	Platygastridae	Hymenoptera	Red hairy caterpillar, Pod borer and tobacco caterpillar
20.	Egg-larval parasitoid wasp	*Chelonus blackburni*	Braconidae	Hymenoptera	Leaf miner
21.	Larval parasitoid wasp	*Bracon* spp.	Braconidae	Hymenoptera	Leaf miner and white grub
22.	Larval Parasitoid wasp	*Goniozus* spp.	Bethylidae	Hymenoptera	Leaf miner

CONCLUSION

The results of the present study revealed the occurrence of several species of insect pests and their natural enemy population in the groundnut. As groundnut crop ecosystem is ecologically diversified the natural enemy population is more than insect pests and thereby reduce the pest population naturally. Ecologically diversified agro-ecosystem supports conservation of natural enemies which is not only helps in managing insect pests but also helps in rescuing the environment from ill effects of hazardous pesticides which otherwise are used to manage the insect pests.

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Conflict of Interest. None.

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