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ASSESSMENT OF INSECT-PEST DYNAMICS AND THEIR MANAGEMENT THROUGH AGROFORESTRY SYSTEMS OF SEMI-ARID TROPICS

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ABSTRACT

Insect-pests are the most important group of organisms causing injury to plants in agroforestry systems. Therefore, the identification, period of infestation, nature of damage and management of insect-pest in agroforestry systems are crucial to sound and sustained production. The present study revealed total twelve insects of five orders under agrisilviculture and agrihorticulture system which are two insects of Coleoptera eg. Six-spotted zigzag ladybird (*Cheilomenes sexmaculata)*, and *Illeis cincta* on *Dalbergia sissoo*, one insect ofHemiptera eg. Mustard aphid (*Lipaphis erysimi*), and one insect of Hymenoptera eg. Honey bee (*Apis indica)* on Mustard under agrisilviculture system. Four insect were observed of Heteroptera eg. Zelus bug (*Zelus luridus)* Leaf-footed bug /Squash Bugs (*Aschistocoris brevicornis*), Stink bug (*Erthesina fullo)*, and Jewel Bug (*Chrysocoris purpureus)* on Guava, two insects of Lepidoptera eg. Common evening brown (*Melanitis leda)*, Dark small-branded swift (*Pelopidas mathias)*, one insect of Hemiptera eg. Mustard aphid (*Lipaphis erysimi*), and one insect of Hymenoptera eg. Honey bee (*Apis indica)* on Mustard under agrihorticulture system. The number of insects varied from block to block due to shade of tree component. The number of insects in open was less because of more sunlight as compare to the block of 75%, 50%, 25% and no pruned tree and the block of D_3, D_2, D_1 and no deheaded tree in agrisilviculture and agrihorticulture system respectively. Minimum mean population of insect-pest was found fewer than 75% pruning intensity and 2.0 m deheading level under agrisilviculture and agri horticulture system respectively and maximum mean population of insect-pest was found under no pruned tree in agrisilviculture system and no deheaded tree in agrihorticulture system.

Keywords **:** Insect-pest, Agroforestry systems, Pruning intensity, Deheading level etc.

Introduction

In Agroforestry systems trees and crops are attacked by insects and pest at all stages of their growth just like other annual and perennial crops. Insects may attack one or more species within a system and across systems in the landscape, so pest management strategies should depend on the nature of the insect and magnitude of its damage (Rao *et al*., 2000).Research involving agricultural and horticultural cropping system, however, suggests that vegetation diversity frequently result in significant reduction of insect-pest problem. Trees also affect pest infestations by acting as barriers to movement of insects, masking the odours emitted by other components of the system and sheltering herbivores and natural enemies.

Materials and Methods

The present investigation was carried out at New Dusty Acre area, Department of Forestry, College of Agriculture, Jawaharlal Nehru Krishi Vishwa Vidyalaya, Jabalpur (M.P.) during Rabi season of November 2018 to March 2019 in well established 20 years old both *Dalbergia sissoo* based agrisilviculture and Guava based agri horticulture system. Study area lies at 23°12’50” North latitude & 79°57’56” East longitude. Study area belongs to Kymore Plateau and Satpura Hills Agro-climatic Zone as per classification of National Agricultural Research Project. Jabalpur lies

between 22°49' to 24°8' North Latitude and 78°21' to 80°58' East Longitude with an average altitude of 411.78 meters above the mean sea level. To know the distribution and association of various insect-pest in Jabalpur (Dusty acre farm under Department of Forestry, JNKVV, Jabalpur, M.P.) both agroforestry systems (shisham, guava, and mustard) were surveyed at weekly interval and the observation were noted for the incidence of major insect-pests and minor pests from each replication where each replication consisting of 16 trees. Ten randomly selected branches in each plant were observed for major and minor pest. To study infestation, ten trees were randomly selected per replication and from which five branches were randomly selected at lower and upper canopy levels. Based on the data collected on the infestation of various insect pests, the susceptibility and level of tolerance was screened.

Result

Study was worked out on insect-pest communities under agrisilviculture (Mustard+ *D. sissoo*) system and agrihorticulture (Mustard+Guava) system at different Pruning Intensities and deheading Level respectively. Result reveals that about 4 species of insects in agrisilviculture system and 8 species in agrihorticulture system. The data on mean number of various insect-pest population was recorded at weekly interval during the crop period from November to February of winter season at Jabalpur, Madhya Pradesh during 2018-19.

Table 1 : Population dynamics of insect-pest communities in agrisilviculture system during 2018-19.

S. No	Common Name	Scientific Name	Order	Family
Dalbergia sissoo				
1.	Six-spottedzigzag ladybird	*Cheilomenes sexmaculata*	Coleoptera	Coccinellidae
2.	Illeis cincta	*Illeis cincta*	Coleoptera	Coccinellidae
Mustard				
1.	Mustard aphid	*Lipaphis erysimi*	Hemiptera	Aphididae
2.	Honey bee	*Apis indica*	Hymenoptera	Apidae

Cheilomenes sexmaculatus is a beneficial insect because of their predaceous nature. it is one of the potential predators of aphids. This insect is considered as the most economical and eco-friendly predator against mustard aphids.

Illeis cincta was identified as a mycophagous insect. It was found on powdery mildew disease of *D. sissoo*. The feeding behaviour of larvae and adults was observed throughout the day but more specific to morning and evening hours of the day and it was hide on lower surface of leaf during after noon.

Mustard aphid (*L. erysimi*) is a major pest of the mustard. It caused direct injury to leaves and stems. It feed by sucking sap from their host-plants. It lives on leaves, young shoots, inflorescences and growing points, causing rolling, chlorosis, dwarfing of whole plants, make honey dew like structure on young leaves and shoots.

Apis indica is a floral visitor beneficial insect. It plays a major role in honey production and crop pollination in flowering plant.

Table 2: Population dynamics of insect pest communities in agrihorticulture system during 2018 – 19.

S. No	Common Name	Scientific Name	Order	Family
Guava				
1.	Zelus bug	**Zelus luridus**	***Heteroptera***	Reduviidae
2.	Leaf-footed bug	**Aschistocoris brevicornis**	***Heteroptera***	***Coreidae***
3.	Stink bug	*Erthesina fullo*	***Heteroptera***	***Pentatomidae***
4.	Jewel bug	*Chrysocoris purpureus*	***Heteroptera***	***Scutelleridae***
Mustard				
1.	Common evening brown	*Melanitis leda*	Lepidoptera	satyridae
2.	Dark small-branded swift	*Pelopidas mathias,*	Lepidoptera	Hesperiidae
3.	Honey bee	*Apis indica*	Hymenoptera	Apidae
4.	Mustard aphid	*Lipaphis erysimi*	Hemiptera	Aphididae

Zelus bugis a predator of other insects that occur on leaves of trees and shrubs. It has forelegs modified to help insect prey. For this, it uses sticky traps. However, they also use sticky substances to ensnare and hold insects. It can often be seen feeding on prey such as small flies, wasps, and sawflies.

Leaf-footed bug inject their sharp, sucking mouthparts into the plant and suck the sap from the leaves and fruits. The leaves will wilt because the damage prevents the flow of nutrients to the leaves.

Stink bug has an impact on timber trees and horticultural crops. It feed upon bark and trunk of the tree and sucks sap. adults feed by inserting their long, tube-like sucking mouthparts into the fruits, leaves and stems of plants from which they suck sap containing sugars and nutrients.

Jewel bug is polyphagous bug with beautiful coloration (metallic and green blue with black spots). It attacked mainly the tender shoots and fruits of plan. It was found sucking the sap from fruits, due to which the colour of fruits changed from green to yellow.

Common evening brown have polyphagous nature. The caterpillars of *M. leda* feed on leaves and young shoots of the host plant, and hide underside of crops. Adult butterflies of *M. leda* are nectar feeders and occasionally pollen feeders. The nectar of flower is the main source of adult for nutrition.

Dark small-branded swift observed as floral visitor insect and act as a pollinator on the flowers of mustard crop. The larvae affect to the margin of leaves and backward rolling of the leaves are symptoms of damage

Discussion

Seasonal Incidence and Population Dynamics of insect-pest under agrisilvicuture system.

Population dynamics and prevalence of Six-spotted zigzag ladybird on mustard aphid (*Lipaphis erysimi)* which started from 3rd week of January to last week of February. The minimum and maximum temperature was 8.4^{0}C, 28.8^{0}C and relative humidity was 75.8% in the morning and 31.4% in the evening. Similar results were also reported by Singh *et al*. (2008). The biology and feeding potential of *Cheilomenes sexmaculala* was studied in the laboratory at 27±2°C and 70±5% relative humidity on mustard aphid. Kulkarni and Patel (2001) from Gujarat, who reported that aphid incidence occurred between the first week of January and the fourth week of February with high incidence during the first week of February. The population of ladybird beetle which appeared during the last week of January (0.67 beetles/plant) reached the peak level (2.90 beetles/plant) during the third week of February.

Illeis cincta which appeared from fourth week of January to last week of February. Maximum population was recorded on the 2nd week of February. Average population of *I. cincta* in all treatments and replications at different pruning intensities. It was identified as a mycophagous insect. It was found on powdery mildew disease of *D. sissoo*. In this context similar work was conducted by Thite *et al*. (2013). *I. cincta* belongs to family – Coccilinidae and shows mycophagous behaviour on powdery mildew disease of *D. sissoo* and *X. strumarium*. It was observed that the micophagous insect was identified and confirmed as *I. cinacta*.

Lipaphis erysimi which started from second week of January. Maximum population was recorded on the first week of February. The minimum and maximum temperature was 26.20C and 9.90C and the relative humidity was 69% in the morning and 36.42% in the evening. Similar results were also carried out by Sarkar *et al*. (2008) revealed that aphid was active during mid of December to February and most abundant during 3rd and 4th week of January when the temperature ranged from 7.9 to 25.5 °C. Takar *et al*. (2005) observed the *L. erysimi* appeared on Mustard in the first week of January (16.3 aphids/plant) and reached its peak (764.2 aphids/plant) in second week of February.

Seasonal Incidence and Population Dynamics of insect-pest under agrihorticuture system.

Chrysocoris purpureus was observed as polyphagous bug with beautiful coloration (green blue with black spots). It attacked mainly the tender shoots, leaves and fruits of guava tree and observes on tender shoots of mustard. It was found as sucking type pest. Similar Incidence were recorded by Doman *et al*. (2018) The blue bug, *C. purpureus* attacked mainly the tender shoots and fruits of Jatropha. It was found sucking the sap from fruits, due to which the colour of fruits changed from green to yellow.

The population dynamics and prevalence of Zelus bug was find out from 3rd week of December to last week of January. *Zelus luridus* is a predator of other insects that occur on leaves of trees and shrubs. It has forelegs modified to help insect prey. For this, it uses sticky traps. However, they also use sticky substances to ensnare and hold insects. Similar observation conducted by Weirauch (2006). The adult of this species, glandular units in the legs are the source for a sticky cover on the fore tibia, which also assists in prey capture. Thus, a functional replacement of extrinsic

sticky substances derived from the mother's secretion on the egg mass of *Z. luridus*.

Leaf-footed bug appeared from 4th week of December to last week of January. This bugs inject their sharp, sucking mouthparts into the plant and suck the sap from the leaves and fruits. Maximum population was recorded on the 2nd week of January during this week the minimum and maximum temperature was 6.0^0C, 23.9^0C and the relative humidity was 84.5% in the morning and 42.8% in the evening. Average mean population of Leaf-footed bug in all treatments and replications at different deheading level was 3.6, 3.2, 2.9, 2.6, and 2.3, in D_0, D_1, D_2, D_3 and Open condition respectively.

The Stink Bug (*Erthesina fullo*) is a pest which was observed on guava tree. it has dark brown and grey colour. It has an impact on timber trees and horticultural crops. It feed upon bark and trunk of the tree and sucks sap. Similar host incidence report was conducted by MPI (2014), there is limited information on the host range of *E. fullo*, but it is known to feed on various plants. Hosts include Citrus (Li *et al*., 1997), *Mangifera indica, Diospyros kaki, Cinnamomum camphora, Hibiscus rosa-sinensis, Eucalyptus, Psidium guajava, Averrhoa carambola, Zea mays, Punica granatum, Ziziphus jujube, Prunus armeniaca, Prunus persica, Prunus pseudocerasus, Prunus salicina, Pyrus bretschneideri, Pyrus calleryana, Salix, Ailanthus altissima* (Rider, 2015).

Population dynamics and prevalence of Common evening brown (*Melanitis leda)* which started from 4th week of December. Average mean population of Common evening brown in all treatments and replications at different deheading level was 3.7, 3.5 3.2, 2.8 and 2.5, in D_0, D_1, D_2, D_3 and open condition respectively. It wings are dark brown with a large sub-apical patch which is black with two white spots. It's have polyphagous nature. The caterpillars of *Melanitis leda* feed on leaves and young shoots of the host plant, and hide underside of crops. Adult butterflies of *Melanitis leda* are nectar feeders and occasionally pollen feeders. The similar finding was reported by Anita Singh and Amarjit Lal Sharma (2014). also reveals that *Myzus persicae, Bemisia tabaci; Pyrilla perpusilla* and *Melanitis leda* are common insect pest on Mustard, Wheat and Chick pea which persist throughout the year. This is due to their polyphagous nature and ability to migrate from one host to other.

Dark small-branded swift observed from 3rd week of December the minimum and maximum temperature was 8.4^0C, 22.3^0C and the relative humidity was 77.4% in the morning and 36.6% in the evening. It observed as floral visitor insect and act as a pollinator on the flowering of the mustard crop. The larvae affect to the margin of leaves and backward rolling of the leaves are symptoms of damage. Average mean population of Dark small-branded swift in all treatments and replications at different deheading level was 2.6, 2.4, 2.2, 1.9 and 1.7, in D_0, D_1, D_2, D_3 and open condition respectively. Similar behaviour was recorded by Yuna Ikeuchi (2015). Report that the diurnal skipper *Pelopidas mathias* can act as a pollinator for the population of *Habenaria radiata* in Nara Prefecture, Japan.

Population dynamics and prevalence of *Apis indica* which started from fourth week of January. *A. indica* is a floral visitor beneficial insect. It plays a major role in honey production and crop pollination in flowering plants. Maximum population was recorded on the 2nd week of February minimum and maximum temperature was 10.7^0C, 26.2^0C and the relative humidity was 77.5% in the morning and 47.71% in the evening where the insect population was 3.7, 4.1, 4.4, 4.5 and 4.6 in open condition, under the D_3, D_2, D_1 and no deheaded tree respectively. Average mean population of *A. indica* in all treatments and replications at different deheading level was 3.5, 3.3, 3.1, 2.8 and 2.5, in D_0, D_1, D_2, D_3 and open condition respectively.

Population dynamics and prevalence of *Lipaphis erysimi* which started from second week of January and it was found upto last week of February. Apis indica is a floral visitor beneficial insect. It plays a major role in honey production and crop pollination in flowering plants. Maximum population was recorded on the 1st week of February the minimum and maximum temperature was 11.6^0C and 23.5^0C and the relative humidity was 85.3% in the morning and 55.7% in the evening. Minimum population of *L. erysimi* was recorded in 4th week of February. It was observed 2.0, 4.4, 4.5, 4.8 and 5.8 in open condition and under D_3, D_2, D_1 and no deheaded tree, respectively. After this week *L. erysimi* was not found. The minimum and maximum temperature was 9.9^0C, 26.2^0C and the relative humidity was 69% in the morning and 36.42% in the evening. Similar incidence period reported by Kulkarni and Patel (2001) from Gujarat conducted experiments during winter 1998-99 and they reported that aphid incidence occurred between the first week of January and the fourth week of February with high incidence during the first week of February.

Conclusion

Based on the results the conclusions are drawn from the present investigation.

The number of insects varied from block to block due to shade of tree component. The number of insects in open was less because of more sunlight as compare to the block of 75%, 50%, 25% and no pruned tree and the block of D_3, D_2, D_1 and no deheaded tree in agrisilviculture and agrihorticulture system respectively and maximum mean population of insect-pest was found under no pruned tree in agrisilviculture system and no deheaded tree in agrihorticulture system.

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