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The study of insect pest association and their seasonal incidence on wheat under *Acacia nilotica* based agroforestry system

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Abstract
The present investigation was caried out to evaluate the effect of different agroforestry systems on productivity of wheat with respect to insect pest at Forestry Research farm, Department of Forestry, Jawaharlal Nehru Krishi Vishwa Vidyalaya, Jabalpur, Madhya Pradesh. This research work continuously worked during the Rabi season 2020-21 and 2021-22. The present study revealed total six insects on wheat under *Acacia nilotica* based agroforestry system (Table no. 1) out of which two insects belonging to Lepidoptera *viz.* Pink stem borer (*Sesamia inferens*) and Wheat armyworm (*Mythimna separata* Walk.) and one Hemiptera Wheat Aphid (*Aphis gossypii*) caused more damage at different crop growth stage were observed. Similarly two predators of Coleoptera *viz.* 7-Spotted Beetle (*Coccinella septempunctata*), Brumers (*Brumus suturalis*) and one parasite of Hymenoptera *viz.* Braconid wasp (*Lysiphlebus testaceipes*) were observed. The maximum incidence of Pink stem borer was recorded during second week of march 10th Standard meteorological week SMW (2.81 per meter row length/plot) when the crop at reproductive stage. Whereas, the Wheat armyworm highest population was recorded at third week of February 7th SMW (2.88 per meter row length/plot). The maximum intensity of Wheat Aphid recorded on the third week of march (9.29 per plant) 11th SMW. The predators *Coccinella septempunctata*, *Brumus suturalis* and perasitoid Beaconed wasp was noticed during the crop period with maximum population of 3.00, 2.69 and 2.63 per meter row length at 8th, 7th and 12th SMW, respectively.

Keywords: *Brumus suturalis*, wheat, *Acacia nilotica*, agroforestry system, predators etc.

Introduction
Wheat (*Triticum aestivum* L.) is one of the major cereal crops of the world. It is grown extensively under agro-forestry system in central and northern India. In India, wheat which triggered green revolution and contributing nearly 35 percent to the national food basket. It is the second most important cereal in India after rice and is grown on an area of 31.781 million hectares with total annual production of 96.64 million tons (Anonymous, 2016. a) [2]. Wheat is the most important staple food for about two billion people (36% of the world population) and it is responsible up to 70 percent of daily calorie intake of the population living in rural regions (Cakmak, 2008) [4]. On the global scale, the crop is grown over an area of 240 million hectare (m ha), with production of 713 million tonnes (mt) (Anon., 2015a) [1]. India is the second largest producer of wheat in the world next to China and the crop has provided the fastest pace of growth to Indian agriculture. Various insect pests cause considerable damage to wheat (*Triticum aestivum* L.) plants throughout their life. Pests of wheat are either Polyphagous or oligophagous. In India, wheat is ravaged by a number of insect pests *viz*., Termites, shoot fly, *Atherigona naqvii* (Steyskal), Brown wheat mite, *Petrobia latens* (Muller); Armyworm, *Mythimna separata* Walker and Aphid, *Sitobion avenae* (Fabricius) (Deol, 1982) [5]. It has been estimated that global yield losses due to insect pests in the pre-green revolution era were about 5.1%, however, the losses increased to 9.3% in the post-green revolution in 1990s (Dhaliwal *et al*., 2010) [7]. Insect pests are dynamic and highly adaptable. Changes in environmental temperature can modify their physiology, behaviour, and distribution.

Methods and Materials
The present investigation was carried out at Forestry Research farm, Department of Forestry, Jawaharlal Nehru Krishi Vishwa Vidyalaya, Jabalpur, Madhya Pradesh. during Rabi season of 2020-21 and 2021-22 in well established 23 years old plantation of *Acacia nilotica*. 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. The population of the insect pest was observed and quantified on wheat under *Acacia nilotica* plantation where plot size kept 5 m × 4 m and replicated four times with a field border of 1m and crop are showed in row which maintained row to row spacing of 20 cm and plant to plant spacing of 10 cm. The observation was recorded at weekly interval started from soon after appearance of pest till the maturity of crop. To find out the population of wheat aphid, randomly five plants were selected from each untreated plot. The quantification of other pest *viz*. *Sesamia inferens Mythimna separata* Walk., *Aphis gossypii. Coccinella septempunctata, Brumus suturalis* and *Lysiphlebus testaceipes* were surveyed at weekly interval from one square meter area of each plot. The daily metrological data pertaining to temperature, relative humidity and rain fall during experimental period was obtained from Meteorological observatory, College of Agricultural Engineering, JNKVV, Jabalpur MP. The data on abiotic factors *viz*., temperature (°c), relative humidity (%) and rainfall (mm) were correlated to mean infestation caused by pest.

Results and Discussion

During the course of investigation six insect pest of wheat were revealed under *Acacia nilotica* based agroforestry system (Table no. 1) out of which two insects belonging to Lepidoptera *viz*. Pink stem borer (*Sesamia inferens*), Wheat armyworm (*Mythimna separata* Walk.) and one Hemiptera Wheat Aphid (Aphis gossypii). Similarly two predators of Coleoptera *viz*. 7-Spotted Beetle (*Coccinella septempunctata*), Brumers (*Brumus suturalis*) and one parasite of Hymenoptera *viz*. Braconid wasp (*Lysiphlebus testaceipes*) were observed. The insect wise details, their nature of damage, seasonal incidence and their infestation is presented as follows:

Incidence of Pink stem borer *(Sesamia inferens)*.

It is Polyphagous insect which are belonging to Order Lepidoptera and family Noctuidae. It mainly outbreaks in rice and wheat. laid between leaf sheath and the stem. Its larvae appeared behind the leaf sheath in groups. It make tunnel like structure inside shoot and internode and feed on the epidermal layer of the leaf sheath. It was observed during fourth week of February (8TH SMW) and Minimum population was recorded on the last week of march (12TH SMW). Corroborative findings have also been reported by Deole (2016) [6] observed on highest larval population of *S. inferens* during last week of February on maize and peak activity of adult moths was found during second week of March in Chandigarh. Garg (1988) [8] observed that pink stem borer hibernated in rice stubbles from end of October to March and emerged from mid – April and laid eggs on spring rice, wheat and barley in UP. Singh B and JS Kular (2015) [13] was also observed mild incidence of the pest during the second fortnight of February and March.

Table 1: Seasonal activity of insect pest infesting to wheat under *Acacia nilotica* based agroforestry system during the Rabi season 2020-21 and 2021-22.

S. No.	Species	Standard meteorological weeks (SMW)									
		5	6	7	8	9	10	11	12	13	14
Lepidoptera											
1.	*Sesamia inferens*				+	+	+	+	+		
2.	*Mythimna separata*	+	+	+	+	+					
Hemiptera											
3.	*Sitobion avenae*				+	+	+	+	+		
Coleoptera											
4.	*Coccinella septempunctata*	+	+	+	+	+					
5.	*Brumus suturalis*	+	+	+	+	+					
Hymenoptera											
6.	*Lysiphlebus testaceipes*						+	+	+	+	+

Incidence wheat armyworm (*Mythimna separata)*

Wheat armyworm is a crucial polyphagous insect which decreased productivity and quality of grains. Which are belonging to Order Lepidoptera and Family Noctuidae. The primary symptom is defoliation of the plant. Larvae feed on younger plants and leaves. The armyworm active during cloudy days, dawn and dusk period of sun light. It was observed during first week of February on wheat crop (5TH SMW). Minimum population of Wheat armyworm was recorded on the first week of March (9TH SMW). The similar incidence also observed by Poonam Jasrotia *et al.* (2019) [11] they reported as a minor pest of wheat in U.P., Bihar, Rajasthan and Punjab. Besides wheat it also attacks rice, sorghum, maize, sugarcane etc.

Incidence wheat aphid (*Sitobion avenae)*

Aphids are soft-bodied and very small flying pests of wheat crop. Which are belonging to Order Hemiptera and Family Aphididae. It's have piercing-sucking mouthparts. It was observed during fourth week of February (8TH SMW) on wheat crop under *Acacia nilotica* based agroforestry systems. Minimum population of Wheat aphid was recorded on the fourth week of March (12TH SMW). Corroborative findings have also been reported by Tanveer Ahmed *et al.* (2015) [15] Aphids became visible on 24th February (55 DAS) and enlarged regularly till 22nd March (81 DAS). After 22nd March their number dwindled till first week of April (93 DAS). Azhar Abbas Khan1 *et al.* (2011) [3] Aphids cause yield losses either directly (35-40%) by sucking the sap of the plants or indirectly (20-80%) by transmitting viral and fungal diseases.

Incidence 7-spotted beetle (*Coccinella septempunctata)*

7-Spotted Ladybird beetles are one of the most attractive colorful beetle. It attained yellow or red with small black spots on their wing covers. Which are belonging to Order Coleoptera and Family Coccinellidae. Lady beetle is Aphidophagous nature with both adults and larvae are predator of aphids. It also known as a bio-agent for their special role in biological ecosystem. It was observed during

first week of February (5TH SMW). Minimum population of 7-Spotted Beetle was recorded on the first week of march (9TH SMW). Corroborative findings have also been reported by Azhar Abbas Khan1 *et al.* (2011) [3]. The highest and lowest populations of coccinellid predators were recorded on five species of wheat against wheat aphid. The highest population of coccinellid predators was recorded during the 3rd week of February. Mohammad Thamseer *et al.* (2022) [10]. Seven spotted ladybird beetle analysed based on the variation in the elytral patterns and revealed five morphs of predator. These were predating on sucking pests (aphid) of cotton and wheat.

Incidence Brumers (*Brumus suturalis)*

It is three-striped Aphidophagous lady-beetle. Which are belonging to Order Coleoptera and Family Coccinellidae. It play the major role as a bio-agent against many insect pest such aphid, mites and thrips etc. It was observed during first week of February (5TH SMW). Minimum population of *Brumus suturalis* was recorded on the first week of march (9TH SMW). These results agree with earlier findings of Shah Nawaz Khuhro *et al.* (2012) [14]. Determined the feeding potential of lady bird beetle, and *Brumus suturalis*(Fab.) on small and soft body insects eg. cotton Mealy bug, aphid, thrips and mites of crop. Shahzad Ali *et al.* (2016) [12] Reported The data regarding Black aphids, Green aphids, Thrips and Predators such as *Brumus suturalis*, Green lace wings, 7-spotted beetles and 11-spotted beetles population on five varieties of wheat.

Incidence Braconid wasp (*Lysiphlebus testaceipes)*

Braconid wasp is a popular biological control agent. Which are belonging to Order Hymenoptera and Family Braconidae. This small Parasitoids play an important role in the natural control of aphids in cereal crop. Parasitoids lay their eggs inside and outside of the body of aphid (host). It was observed during second week of March (10TH SMW). Minimum population of Braconid wasp was recorded on the second week of April (14TH SMW). Similar result was reported by Loulou Albittar *et al.* (2016) [9]. He revealed three Parasitoid species, *Aphidius colemani*, *Lysiphlebus testaceipes* and *Lysiphlebus fabarum* (Hymenoptera: Braconidae: Aphidiinae) have the potential to be used as biological control agents against *Aphis fabae* and *Myzus persicae* species of aphids.

Conclusion

The infestation of insect pest and their seasonal incidence may be depends on climatic conditions and soil type which may shifted with the change of abiotic factors *viz.* Temperature humidity and rainfall. Therefore, assessment of insect pest of field crops with major forestry species should be done at a defined interval so that epidemic of any new insect pests may be avoided.

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