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In long duration pigeonpea [*Cajanus cajan* (L.) Mill SP] under agroclimatic conditions of Eastern U.P., *Helicoverpa armigera* (Hübner) was monitored through pheromone traps

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Abstract
Agricultural Research Farm, Institute of Agricultural Sciences, Banaras Hindu University, Varanasi, monitored *Helicoverpa armigera* (Hübner) male moths using pheromone traps in long-term pigeon pea throughout 2019-20. Pheromone traps have been used to track spatial land differences in the abundance of male moths. [*Helicoverpa armigera* (Hubner)] in pigeon pea cultivation in large plots experimental area at Agriculture Research Farm, Institute of Agricultural Sciences at Banaras Hindu University U.P. 2019-20. The pheromone traps were mounted on 1 January 2020 @ 1 ha-on. Operated in module during the investigation trap and the data obtained from the pheromone trap catches were recorded once a week. The septa pheromone was impregnated with 2 mg pheromone and after every 18 days was substituted with one new. The pheromone trap for trapping the maximum number of male moths was set up at a height of 0.5 m above the crop canopy. At weekly intervals the moth caught in those traps was removed and killed. Once the pheromone trap captures reached 4 moth trap-1 the egg and larval counts were begun. In general monitoring of [*H. armigera* (Hubner)] on pigeon pea genotype field moth catches minimum to maximum population within the following week minimum number of moth catches in 2nd and 15th SMW (0.50 percent) excluding 1st SMW and maximum number of moth catches in 10th SMW (6.25 percent) followed by other week respectively 7th, 8th, 9th, 11th SMW maximum number of moth catches in the field respectively. Correlation analysis with meteorological parameters revealed that the emergence of H. armigera was significantly associated with maximum temperature, minimum temperature, wind speed, and sunshine, whereas evaporation was significantly associated with month activities.

Keywords: Monitoring, pigeon pea, SMW, trap

Introduction
The pigeon pea is a perennial legume from the Fabaceae family, which is primarily grown as a crop for food. The legume is also grown as a vegetable. The fourth-largest food legume in the world has Pigeon pea. Because of its domestication in India, it became a common grain food in Asia, Africa and Latin America, at least 3,500 years ago. It is the second largest pulse crop in India after chickpea (Das *et al*., 2015) [17]. It is grown in nearly 4.8 million hectares worldwide covering 22 countries in Asia, Africa and the Caribbean in tropical and subtropical areas around the world. In the pigeon pea production, India has a virtual monopoly of around 11.8 percent of the pulse area and 17 percent of the country's total pulses (Anonymous, 2016) [3]. India accounts for 90% of global production of 3.17 million tons, with an area of 3.88 million ha (E-Pulses data book IIPR, 2016). Despite the high production potential in India, biotic stresses pose problems in reducing pigeon pea productivity. Pigeon pea productivity in the country is low for a variety of reasons, the most important of which is insect pest damage (Rawat, Keval, & Chakravarty, 2017) [13]. Although more than 250 insect pests were affected by crops by Srivastava and Joshi (2011) [16], the harm caused by *Helicoverpa armigera* (Hübner), *Melanagromyza obtusa* (Malloch), *Maruca vitrata* (Geyer) and *Clavigralla gibbosa* (Spinola) led to a significant drop in the grain yield. Gram pod borer is a cosmopolitan and highly polyphage insect which attacks many agricultural crops throughout the world, which is the main biotic constraint on the growth of pigeon pea production. The insects are of great importance for crops of agricultural importance. Due to the larval preferences for nitrogen-rich parts of plant, such as reproductive structure and growing tips, the key pest status of *H. Armigerais*. *H. armigera* causes heavy lost up to 60% and an annual loss of 400 million US

dollars is estimated to be in pigeon pea (Anonymous, 2007) [2]. The population of *H. armigera* in different crops also had an effect on recent climatic changes (Srivastava, 2009) [14]. Pheromone traps are an important component of the IPM program for monitoring its population (Ahmed and Khalique, 2002) [1]. As one of the tools in integrated pest management, pheromone technology has enormous potential. Pheromones aid in the monitoring and indirect control of insect pest populations, either through male annibilation through mass trapping or mating disruption (Kumar & Durairaj, 2012) [10]. This study was therefore performed to monitor and evaluate the *H. amigera* incidence in pigeon pea in the eastern U.P. of India.

Materials and Methods

Pheromone traps have been used in the Agricultural Institute, Banaras Hindu University, Varanasi and Entomological Research Field Randomized Block Design of the Eastern U.P. in 2019-20 to monitor the temporal and spatial changes in the abundance of male moth *of H. armigera* in pigeon pea crop. At 20 ha on the 5th of November 2019-20, the pheromone traps were installed. Two traps were operated in each module during the investigation and the data from the pheromone trap captures were recorded once a week. Pheromone septa had 2 mg of pheromone impregnated and had been replaced by a new one every 18 days. At 0.5 m above the plant canopy, the pheromone traps were set to catch the maximum number of male moths. The moth that was caught in these traps was taken away and killed weekly. The commonly grown pigeon pea 18 was taken for the study and grown in plots of about 30 m per 30 m per person (900 m^2). The experiments in the Randomized Block Design were statistically carried out, sowing was performed on ridges on July 23rd 2019. The seed was seeded at a range of 75 cm from row to row, and 30 cm from plant to plant. Agricultural practices have been recommended to increase the crop. Harvesting took place respectively on 9 and 6 April 2020. The correlation coefficient has been developed to establish the relation among *H. armigera* male moth catches, egg and *H. armigera* larvals with abiotic factors i.e. maximum temperature, minimum temperature, relative humidity, wind speed, sunshine hours, and evaporation, in line with the statistical package (Gomez and Gomez, 1984) [7].

Fig 1: Monitoring of *H. armigera* in pigeonpea field

Results and Discussion

The data on pheromone trap catches and larval population of *H. armigera* along with various weather parameters has been under the following headings. The percentage population moth shown in the field of pigeon pea shown in number varies in the first week showed no population. Population started to appear at 2nd week and lest damage shown in 2nd and 15th week (0.50) and highest population shown in 10th week (6.25%) population followed by 3rd week (1.25) and 14th week shown moth (1.50) 4th and 5th week appears moth population (2.50%), 6th week (3.00%), 13th week shown (3.25), 7th week (4.25%), 12th week (4.75%), 8th and 9th week (5.00)and 11th week (5.50) as followed respectively Highest moth population catches in 10th standard week as respectively table No. 1 and Figure No. 2.

Table 1: Monitoring of (*H. armigera)* on pigeon pea at Varanasi during *Kharif* 2019-20.

SMW	Month & Date	Rainfall (mm)	Temperature (°C)		R.H. %		Wind Speed km/hr	Sunshine (hours)	Evaporation (mm)	Male moth catches per trap
			Max.	Min.	Morn.	Even.				
1	01/01/2020	0.8	20.5	11.1	95	65		1.5	1.2	0.00
2	07/01/2020	2.9	18.5	9.6	93	73		3.8	1.2	0.50
3	14/01/2020	0.0	21.7	10.8	84	55		4.4	1.5	1.25
4	21/01/2020	0.0	21.5	9.1	85	51		6.9	2.0	2.50
5	28/01/2020	0.0	21.8	10.1	84	49		6.6	2.2	2.50
6	04/02/2020	0.0	22.4	8.7	92	44		6.8	2.0	3.00
7	11/02/2020	0.0	24.9	11.4	81	41		7.5	2.7	4.25
8	18/02/2020	8.6	24.7	15.3	88	68		3.7	1.9	5.00
9	25/02/2020	2.2	26.0	14.9	94	61		4.5	2.3	5.00
10	04/03/2020	0.0	26.4	15.4	85	58	4.2	5.6	3.1	6.25
11	11/03/2020	45.8	26.9	16.7	93	69	3.4	6.6	2.5	5.50
12	18/03/2020	0.0	30.9	16.9	83	40	2.4	8.3	2.5	4.75
13	25/03/2020	0.0	33.5	18.1	73	99	5.0	9.6	3.8	3.25
14	01/04/2020	0.0	35.3	17.6	63	21	3.6	9.4	5.5	1.50
15	08/04/2020	0.0	38.1	21.3	60	25	2.6	8.7	5.4	0.5
	Mean									3.05

Table 2: Monitoring of (*H. armigera)* on pigeon pea at Varanasi during *Kharif* 2019-20.

Insect pest (*H. armigera*)	Rainfall(mm)	Temperature (°C)		Relative Humidity (%)		Wind speed (km/hr)	Sunshine hours	Evaporation (mm)
		Min.	Max.	Morn.	Even.			
Male moth	0.371633	0.224172	0.078142	0.269093	0.191663	0.219527	0.128075	-0.04396

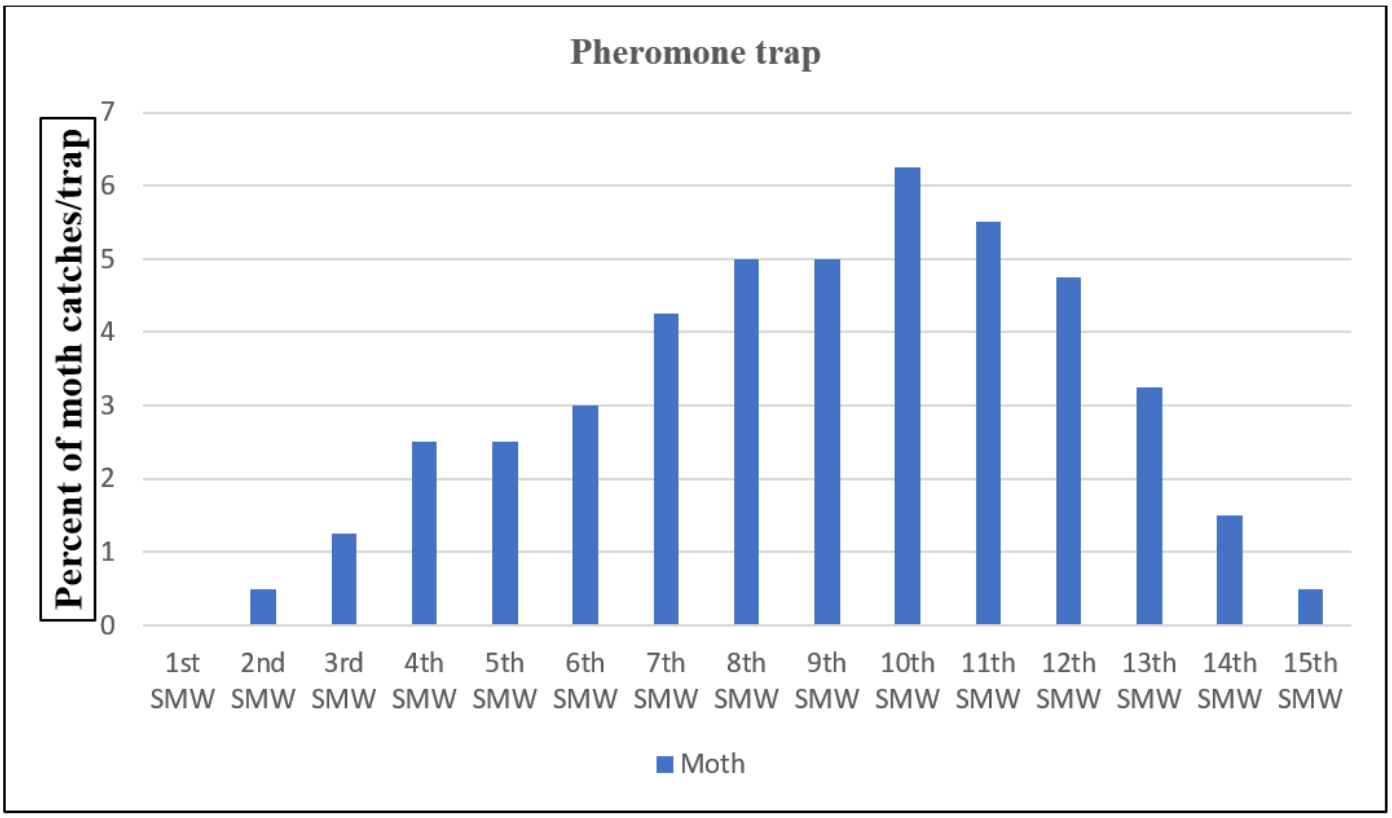

Fig 2: Monitoring of gram pod borer (*H. armigera)* on pigeon pea at Varanasi during *Kharif* 2019-20

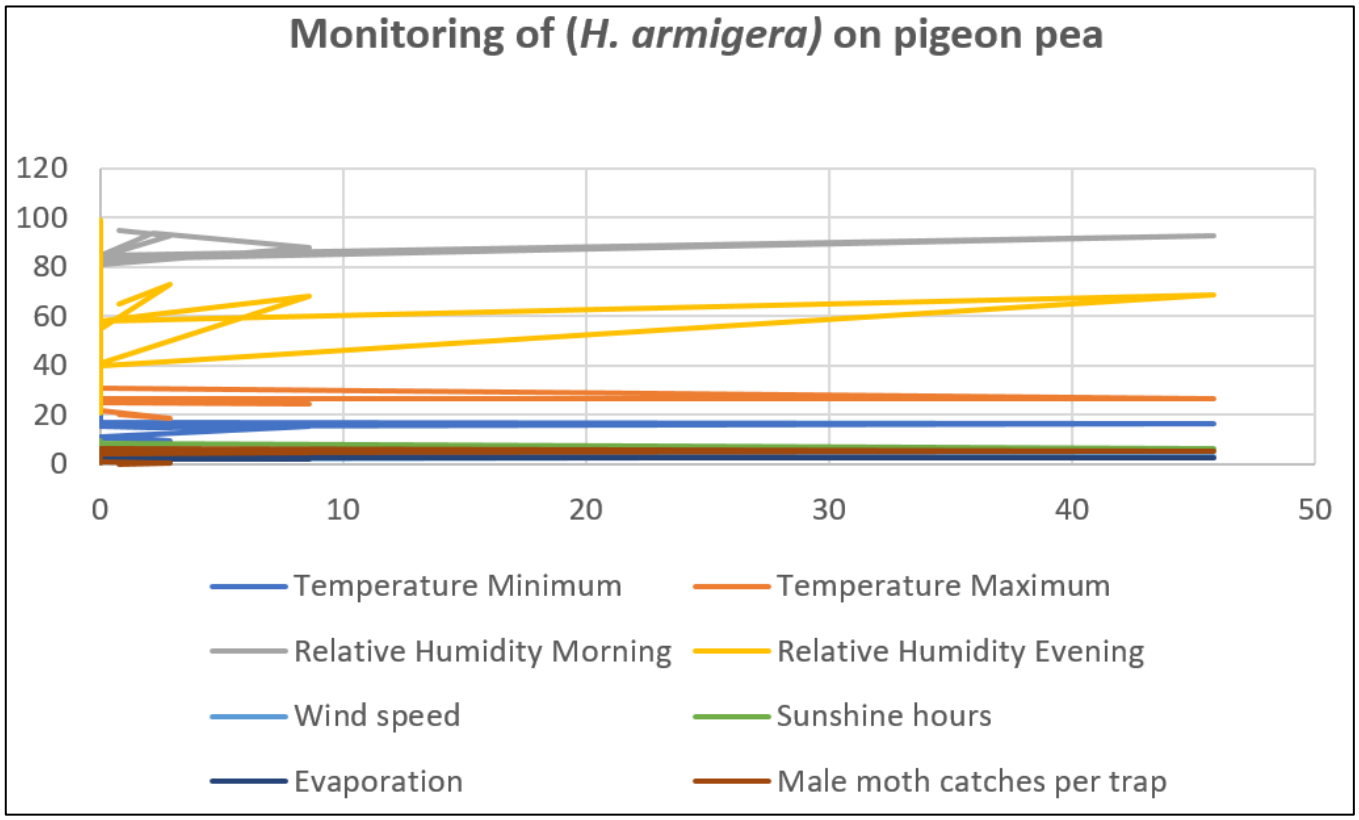

Fig 3: Graphical representing of monitoring of *H. armigera* on pigeon Pea

Summary and Conclusion

In general monitoring of [*H. armigera* (Hubner)] on pigeon pea genotype field moth catches minimum to maximum population within the following week minimum number of moth catches in 2nd and 15th SMW (0.50 percent) excluding 1st SMW and maximum number of moth catches in 10th SMW (6.25 percent) followed by other week respectively 7th, 8th, 9th, 11th SMW maximum number of moth catches in the field respectively. Forecasting pest occurrence and peak activity periods is essential for developing a financially viable, environmentally sound, and easily adaptable pest management program (Srivastava, 2010) [15].

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Conflict of Interest

The authors declare that there is no conflict of interests regarding the publication of this paper.

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