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Studies on seasonal incidence of major insects of pigeonpea in Jalna district, Maharashtra

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Abstract
The purpose of this study was to investigate the seasonal occurrence of several insect pests affecting pigeonpea crops in the Jalna area of Maharashtra, with a focus on the influence of meteorological conditions. The data pertaining to the seasonal occurrence of *Helicoverpa armigera* reveals that the activity of *H. armigera* commenced during the 41st Standard Metrological Week, but the incidence of *Maruca vitrata* was seen on the crop starting from the 44th standard week. The occurrence of *M. obtusa* was seen starting from the 47th Standard Metrological Week (SMW), whereas the presence of *Exelastis atomosa* was noted to commence from the 38th Standard Metrological Week.
The present study focuses on the investigation of the seasonal occurrence of three major pests, namely *Helicoverpa armigera*, *Melanagromyza obtusa*, and *Maruca vitrata*, in pigeon pea crops. Additionally, the study also examines the presence of *Exelastis atomosa* in relation to these pests.

Keywords: *Helicoverpa armigera*, pigeon pea, and roving survey *Melanagromyza obtusa*, *Maruca vitrata*, *Exelastis atomosa*

Introduction
Pigeonpea (*Cajanus cajan* (L) Millsp.) is a prominent grain legume in the semi-arid tropics (SAT), commonly referred to as redgram, arhar, and tur (Nene *et al*., 1990). In the context of India, the pulse crop that holds the second highest level of significance, following chickpea, is observed. Pod borers, a kind of pest that inflicts damage during the reproductive phase, are known for their extremely destructive nature, resulting in significant output losses of around 52.4 percent in the Southern states of India. The crop is susceptible to infestation by many insect pests throughout its growth cycle, starting from the seedling stage and continuing until the harvesting phase. The pod borer complex is composed of several species, including *Helicoverpa armigera*, Grapholita critica, *Maruca vitrata*, Lampides boeticus, *Exelastis atomosa*, and *Melanagromyza obtusa*.
The growth of the pod borer complex is highly influenced by certain seasons and temperatures. Therefore, an experiment was done to investigate the seasonal occurrence of pod borers in the Jalna region of Maharashtra, focusing on the relationship with various meteorological factors.

Materials and Methods
Field studies were undertaken to investigate the seasonal occurrence of significant insect pests in pigeonpea. The experimental procedures for performing these research are provided below.
An investigation was conducted at the Agricultural Research Station in Badnapur to examine the seasonal occurrence of significant insect pests affecting pigeonpea during the kharif season of 2014-15. The cultivar BSMR-853 was developed.
The assessment of crop status and the implementation of appropriate package of procedures.
Following the initiation of intercultural operations, such as hand weeding and hoeing, subsequent to the occurrence of weed infestation, appropriate measures were taken. Adequate measures were implemented to ensure the sustained growth of the crop. The crop was left untreated with insecticides in order to facilitate the natural growth of the insect population.
The study examines the temporal patterns of significant insect pest occurrence within a field setting.
The pigeonpea BSMR-853 genotype was planted in order to examine the occurrence of the primary insect pests of pigeonpea throughout different seasons.
The present study focuses on the observation of insect pests and their natural opponents.
The study involved conducting weekly observations starting from the growth beginning stage and continuing till the harvest period.

The study employed the Plant Inspection Method (PIM) as a sample technique for conducting population assessment. The researchers recorded the quantity of both infested and non-infested blooms and pods, as well as documented the presence of natural enemies. A sample of five plants was chosen at random from a plot. After calculating the data in percentage, the population counts underwent time series analysis (Croxton and Cowden, 1964) [3]. A log was kept documenting the daily measurements of temperature, relative humidity, rainfall, sunlight, and wind speeds. The data that was obtained underwent regression analysis (Panse and Sukhatme, 1985) [12] in order to make conclusions about the correlations between weather conditions and the population growth of significant insect pests in pigeonpea.

The weather parameters include many factors that are used to measure and describe the atmospheric conditions at a given time and location. These parameters typically include temperature, humidity, wind speed and The collection of daily meteorological data, including maximum and lowest temperature, relative humidity, rainfall, and wind velocity, was facilitated by the Agricultural Office in Badnapur.

Results and Discussion

The study examines the seasonal occurrence of significant insect pests affecting pigeonpea crops.

The investigation conducted during the kharif season of 2014-2015 aimed to examine the seasonal occurrence of the primary insect pests of pigeonpea and their associated biological agents, with a focus on their relationship with biotic factors. The acquired results are provided in the following sections.

The present study investigates the seasonal occurrence of *Helicoverpa armigera* (Hubner).

Table 1 displays the data pertaining to the seasonal occurrence of *Helicoverpa armigera*. The aforementioned activity *Helicoverpa armigera*, often known as the cotton bollworm, emerged during the 41st Standard Metrological Week, which corresponds to the second week of October. The infestation rate observed was 0.20 larvae per plant. A rising pattern was observed in the larval population of *Helicoverpa armigera*, with the highest number of larvae recorded at 0.6 larvae per plant during the 46th SMW (second week of November). The population remained stable until the 51st SMW (third week of December), after which it began to decline from the 52nd SMW (last week of December) onwards, eventually reaching zero in the 5th SMW (last week of January).

During the designated research period, the activity of *H. armigera* commenced during the onset of blooming and persisted throughout the crop's growth until harvest. The early studies conducted by Kaneria (1994) [6], Rao *et al*. (2001) [19], and Sahoo and Senapati (2000) [21] have reported the infestation of the crop by the pest *H. armigera* during the blooming to pod filling stage. These findings align with the results obtained from the current inquiry. Moreover, Deshmukh *et al*. (2003) [5] documented the occurrence of *H. armigera* in pigeonpea fields starting in October, with the highest levels of activity seen throughout the months of November and December.

The objective of this study is to investigate the correlation coefficient between the larval population of *Helicoverpa armigera* and meteorological parameters.

The data reported in Table 2 demonstrates a link between larval population and meteorological factors. Specifically, the correlation coefficient indicates that there is a positive and highly significant relationship (r=0.4098) between maximum temperatures and the population build-up. The larval population of *H. armigera* exhibited a significantly significant negative connection with relative humidity before noon (r= -0.6525), relative humidity in the afternoon (r= -0.6186), and wind velocity (r= -0.6166). The observed correlation coefficients between rainfall (r = -0.0477) and minimum temperature (r = -0.06) indicated a negative relationship; nevertheless, these correlations were found to be statistically non-significant.

Previous research conducted by Naresh and Singh (1984) [10] as well as Kumar *et al*. (2003) [8] demonstrated that abiotic variables have a varying impact on the population growth of *H. armigera*. These factors include the timing of sowing, timing of blooming, and the kind of crop (short or long duration). Similarly, the findings of this study regarding the population growth and infestation of *H. armigera* in pigeonpea at Badnapur may differ from those reported by other researchers due to the pest's ability to adapt to the local climate and its specific response to the crop.

The present study investigates the seasonal occurrence of *Maruca vitrata*.

Table 1 displays the data pertaining to the seasonal occurrence of *Maruca vitrata* in pigeonpea. In the Kharif season of 2014-15, the crop had an infestation of *Maruca vitrata*, with an average of 0.30 larvae per plant. This infestation began in the 44th standard week, which corresponds to the last week of October, and persisted until the harvest period on the pigeonpea crop. The highest larval count, namely 0.70 larvae per plant, was recorded between the 47^{th} and 48^{th} standard meteorological week, which corresponds to the third and fourth week of November. Subsequently, a decrease in population was seen, with a reported count of 0.20 larvae per plant during the harvest period. Initially, the larval population of *Maruca vitrata* was observed to be low, namely at 0.30 larvae per plant. However, it subsequently rose and reached its highest point at 0.70 larvae per plant between the third and fourth weeks of November. This population level remained relatively consistent throughout the months of December and January. Moreover, the pest exhibited a declining pattern, and at the time of harvest, the population had decreased to 0.20 larvae per plant.

The occurrence of *Maruca vitrata* on pigeonpea has been similarly seen and reported by Lal *et al*. (1983) [9] and Akhauri *et al*. (1994) [1]. Reddy *et al*. (1998) [20] and Sahoo and Senapati (2000) [21] observed the beginning of pest infestation on pigeonpea and other pulse crops during the blossoming to pod maturity phases.

The population saw a gradual rise, reaching its maximum level during the last week of November and the first two weeks of December. As the crop reached the stage of maturity, a noticeable decline in the number of pests was noticed, namely in the case of *Maruca vitrata*, which was detected throughout the harvest period. In a previous study conducted by Sharma *et al*. (1999) [22], the authors noticed the presence of *Maruca vitrata* during the second week of November, with the highest population levels occurring in the second week of December. Chaitanya *et al.* (2013) [2] observed that the infection of *Maruca vitrata* occurred from the beginning of blooming in the first week of November till crop maturity. The observed variability in the activity of *Maruca vitrata* can be ascribed to factors such as seasonal fluctuations, meteorological conditions, the adaptation of the pest, and its geographical dispersion.

The objective of this study is to determine the correlation coefficient between the larval population of *Maruca vitrata* and meteorological parameters.

The analysis of Table 2 reveals that there exists a discernible relationship between weather parameters and the larval population of *Maruca vitrata* on pigeonpea. Specifically, the data indicates that maximum temperatures exhibit a weak positive correlation (r= 0.353) with the population growth of the pest. On the other hand, the minimum temperature demonstrates a weak negative correlation (r= -0.02) with the larval population of *Maruca vitrata* on pigeonpea, although this correlation is not statistically significant. The morning relative humidity had a substantial negative association, with a correlation coefficient of -0.5185. The results of the study suggest a mild negative correlation (r = -0.06) between the minimum temperature and the larval population of *Maruca vitrata* on pigeonpea. However, this correlation was found to be non-significant. On the other hand, the relative humidity at the time of evening (-0.49) was shown to have a significant negative influence on the larval population of *Maruca vitrata*. The wind velocity (r= -0.4869) demonstrates a substantial link with M. vitrata in a statistically significant way. On the other hand, rainfall (r= -0.0537) displays a negative correlation with the larval population of *Maruca vitrata*, although this correlation is not statistically significant.

In previous studies, Kaneria (1994) [6] and Patel (1997) [13] observed a detrimental impact of meteorological conditions on the larval population of M. vitrata.

The temporal occurrence of *M. obtusa* throughout the year.

The data pertaining to the seasonal occurrence of *M. obtusa* is depicted in Table 1, which indicates that the presence of *M. obtusa* was seen starting from the 47th Standard Meteorological Week (SMW), corresponding to the third week of November, with an average of 0.80 larvae per plant. There was an apparent upward tendency in the larval population of the pod fly, with the highest number of larvae, namely 0.80 larvae per plant, seen during the 50th SMW (second week of December). Subsequently, the population experienced a fall, and at the time of harvest, the recorded larval count was 0.20 larvae per plant.

Kaneria (1994) [6] made a similar observation regarding the activity of *M. obtusa* in pigeonpea. The study found that during the second week of November, the activity level was 6.15%, which then peaked at 45.52% in early January. Similarly, Das and Katiyar (1998) [4] observed *M. obtusa* in the last week of October and recorded the highest population of maggots and pupae during the second week of December and the last week of January.

The correlation coefficient between the larval population of *M. obtusa* and meteorological parameters was examined.

The data presented in Table 2 clearly demonstrates that there exists a weak positive correlation (r= 0.2645) between the larval population of *M. obtusa* and the maximum temperature, as well as a weak negative correlation (r= -0.26) between the larval population of *M. obtusa* and the minimum temperature on pigeonpea in the current study. The larval population of *M. obtusa* exhibited a strong association with both the relative humidity in the morning (r = -0.5648) and evening (r = -0.48), as well as the wind velocity (r = -0.4751). These correlations were found to be very significant. The correlation between rainfall and the variable of interest (r = -0.00971) exhibited a slight negative correlation that was found to be statistically non-significant. In their investigation on the impact of several climatic conditions, Kumar and Nath (2005) [7] demonstrated a detrimental influence of rainfall, minimum wind velocity, and relative humidity on *M. obtusa*. Similarly, the study conducted by Subharani and Singh (2007) [25] examined the correlation coefficient and found that the infestation of *M. obtusa* was not significantly affected by any of the environmental factors, except for relative humidity. The researchers observed a significant negative impact of relative humidity on pest infestation during the duration of the study. The current study bears resemblance to Verma's (1983) [24] research, wherein they observed that temperatures exceeding 25 °C and humidity levels surpassing 90% during pod formation appeared to enhance the pod fly's activity, leading to extensive oviposition by female flies within the pods. While rainfall seemed to have minimal influence on favoring the pest, a moderate amount of rainfall, however, may promote the pest's activity. The current findings are consistent with the studies of Kumar *et al*. (2003) [8].

The occurrence of *Exelastis atomosa* at certain seasons.

Table 1 displays the data pertaining to the seasonal occurrence of *Exelestis atomosa*. The aforementioned activity The population of *Exelestis atomosa* commenced during the 38th Standard Metrological Week (SMW), which corresponds to the third week of September. The initial density of larvae per plant was recorded as 0.20. A rising pattern was observed in the larval population of *Exelestis atomosa*, with the highest recorded number of larvae being 0.7 per plant during the 49th SMW (1st week of January). Subsequently, the population gradually declined and reached a negligible level at the time of harvest, with only 0.20 larvae per plant. The current study has resemblance to the research conducted by Akhauri *et al*. (1994) [1], which focused on the population dynamics and relative abundance of the pod borer complex in early pigeonpea. Akhauri *et al*. (1994) [1] reported that the occurrence of the pod borer complex was highest towards the end of November, with a period of increased incidence spanning from mid-October to the end of November. According to the findings of Pathak and Shrirama (2002) [14], the active phase of *Exelestis atomosa* was seen to occur during the months of September and November.

The objective of this study is to determine the correlation coefficient between the larval population of *Exelestis atomosa* and meteorological parameters.

The data presented in Table 2 clearly demonstrate the correlation coefficients between the larval population of *Exelastis atomosa* and weather parameters. It is observed that the maximum temperature exhibits a highly significant positive correlation (r= 0.6452) with the larval population. On the other hand, the minimum temperature shows a weak positive correlation (r= -0.26) with the larval population of *Exelastis atomosa* on pigeonpea in the study, which is not statistically significant. The relative humidity in the morning and evening, as indicated by correlation coefficients of -0.720 and -0.7129 respectively, exhibited a strong and statistically significant negative relationship with the larval population of *Exelastis atomosa*. Additionally, the wind velocity, with a correlation coefficient of -0.7216, also demonstrated a substantial negative connection with the larval population of *Exelastis atomosa*. The correlation between rainfall and the variable of interest (r = -0.2972) exhibited a slight negative association, which was found to be statistically non-significant. The current study aligns with the earlier findings of Sharma (1998) [23], which suggested that the combination of high humidity and low temperatures observed in November and December might potentially provide favorable conditions for the proliferation of the pest. The study observed a positive correlation between incidence, relative humidity, and rainfall, whereas temperatures had a negative impact.

Table 1: Seasonal incidence of insect pests on pigeonpea

SMW	Date	*No of pest population/plant*			
		H. armigera	*M. vitrata*	*M. obtusa*	*E. atomosa*
33	21/08/2014	0	0	0	0
34	28/08/2014	0	0	0	0
35	04/09/2014	0	0	0	0
36	11/09/2014	0	0	0	0
37	18/09/2014	0	0	0	0
38	25/09/2014	0	0	0	0.2
39	02/10/2014	0	0	0	0.2
40	09/10/2014	0	0	0	0.3
41	16/10/2014	0	0	0	0.4
42	23/10/2014	0	0	0	0.2
43	30/10/2014	0	0	0	0.5
44	30/10/2014	0.3	0.3	0	0.4
45	06/11/2014	0.5	0.5	0	0.4
46	13/11/2014	0.4	0.4	0	0.6
47	20/11/2014	0.7	0.7	0.8	0.3
48	27/11/2014	0.7	0.7	0.5	0.3
49	04/12/2014	0.5	0.5	0.7	0.7
50	11/12/2014	0.6	0.6	0.4	0.6
51	18/12/2014	0.4	0.4	0.6	0.3
52	24/12/2014	0.5	0.5	0.7	0.3
1	01/012015	0.2	0.2	0.5	0.3
2	08/01/2015	0.5	0.5	0.6	0.3
3	15/01/2015	0	0	0.7	0.4
4	22/01/2015	0	0	0	0.1
5	29/01/2015	0	0	0.7	0.5
6	05/02/2015	0.2	0.2	0.3	0.2

Table 2: Correlation of co-efficient between larval population of pod borer complex with weather parameters in pigeonpea

Weather parameters	*H. armigera*	*M. vitrata*	*M. obtusa*	*E. atomosa*
Maximum Temperature	0.4098	0.353	0.2645	0.6452
Minimum Temperature	-0.06	-0.02	-0.26	0.159
Relative Humidity AM	-0.6525	-0.5185	-0.5084	-0.726
Relative Humidity PM	-0.6186	-0.49	-0.48	-0.7179
Rainfall	-0.0477	-0.0537	-0.0971	-0.0616
Wind velocity	-0.6166	-0.4869	-0.4751	-0.7216

Significant at 5% (r = 0.3809)
Significant at 1% (r = 0.4869)

Conclusion

The current study clearly reveals that the combination of high humidity and low temperatures observed in November and December might potentially provide favorable conditions for the proliferation of the pest. The study observed a positive correlation between incidence, relative humidity, and rainfall, whereas temperatures had a negative impact. This clearly implies that selection of proper timing for sowing is very crucial for cultivation of pigenpea with minimum cost of plant protection.

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