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POPULATION DYNAMICS OF MAJOR INSECT PESTS AND THEIR CORRELATION WITH WEATHER PARAMETERS IN PIGEONPEA (*CAJANUS CAJAN* [L.] MILL SP.)

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ABSTRACT
Results revealed that the incidence of spotted pod borer *(M. testulalis)* and blue butterfly (*L. boeticus)* were commenced in the 39th Standard Meteorological Week (SMW)on pigeonpea crop, while pod borer (*H. armigera)*, plume moth (*E. atomosa*) and tur pod fly (*M. obtusa*) commenced during 32nd, 40th and 41st SMW, respectively**.** The peak larval population of pod borer (7.00/five plant) and blue butterfly (2.25/five plant) were recorded in 42nd SMW, while the plume moth (3.00/five plant) and spotted pod borer (5.00/five plant) attained their peak in 43rd SMW. The tur pod fly (6.00/five plant) population reached to its peak in the 46th SMW. The highest pod damage due to attack of pod borer was 14.32% in 42nd SMW followed by tur pod fly (8.47% in 46 SMW), spotted pod borer (7.38% in 43 SMW), plume moth (6.66% in 43 SMW) and blue butterfly (6.40% in 42 SMW). The larval population of pod borer had positive significant correlation with mean temperature, while negative non significant correlation with relative humidity. In case of blue butterfly, plume moth, pod fly and spotted pod borer, all the abiotic parameters were non-significant at 5 % level.

INTRODUCTION

Pigeonpea (*Cajanus cajan* [L.] Millsp.) is an important pulse crop which is globally cultivated on 4.64 million ha, with an annual production of 3.43 million tonnes and a mean productivity of 780 kg ha-1. India is the primary pigeonpea growing country in the world, accounting for 3.82 million ha area and 2.65 million tonnes of production (Anonymous, 2012-13). The various factors, which limit the production of pigeonpea, the damage inflicted by insect pests is of prime importance. Among the insect pests, pod borer complex *viz*., pod borer (*H. armigera)*, plume moth (*E. atomosa*), spotted pod borer (*M. testulali,)*, tur pod fly (*M. obusta*) and blue butterfly (*L. boeticus)* are major pests of pigeonpea which causes considerable losses in yield (Reddy, 1973). Sharma *et al*. (1991) reported 32-37 insect pests attacking on pigeonpea. Deshmukh *et al*. (2003) reported the losses ranging from 48.75 per cent to 58.75 % in yield due to pod borer complex in pigeonpea. Srilaxmi and Ravindra Paul (2010) observed that *C. cajan* is infested by insect pests belonging to 6 orders and 16 families. Of the 6 orders recorded, pests belonging to Lepidoptera cause maximum damage followed by members of Caleoptera, Diptera, Hemiptera and Homoptera, in that order. *Helicoverpa armigera* was found to be the major pest. Singh *et al*. (2013) found that *M. obusta* had maximum contribution (36.94 %) among all the species of pod borers, followed by *Clavigrella gibbosa* (20.37 %), *L. boeticus* (15.43 %), *E. atamosa* (14.03 %) and *H. armigera* (12.93 %). Sujithra and Chander (2014) reported that the pod borer complex caused 19.11 % pod damage that could be attributed to *M. vitrata* (9.7 %), pod fly (5.3 %), gram pod borer (2.6 %) and leaf webber (2.3 %). In order to develop a sound and perfect pest management technique it is necessary to study the incidence and actual amount of losses caused by the insect pests of pigeonpea. Keeping all these in view, present investigation on seasonal incidence of major insect pests of pigeonpea (*Cajanus cajan* [L.] Millsp.) was carried out.

MATERIALS AND METHODS

The present investigation was carried out at the Instructional Farm, Rajasthan College of Agriculture, Maharana Pratap University of Agriculture and Technology, Udaipur during *kharif*, 2014. The incidence of pod borer's *viz*., *H. armigera, E. atomosa, M. obusta, M. testulalis and L. boeticus* infesting pigeonpea pods was studies in plots each measuring 3.6 m x 3 m (10.8 m^2) replicated four times. The pigeonpea Variety-Manak was sown in the second week of July, 2014. Row to row and plant to plant spacing of 60 cm and 45 cm was maintained, respectively. All recommended management practices were followed for raising the crop except plant protection measures. Five plants were selected randomly from each plot and weekly observations of pest were taken through Plant Inspection Method (PIM) starting from seedling stage to till maturity of the crop (Subharani and Singh, 2004). Insect wise damaged pods were classified based on nature of damage and other symptoms, as mentioned below:

Pod fly

Pods bear small exit holes. The damaged grain carried a mine

below testa and oblong knotch in the grain.

Plume moth

Pods carried the exuviae of the larvae or empty pupal cases and hole made by the larvae for feeding on the grain was of medium size.

Pod borer

Pods carried the holes larger than those made by plume moth larvae, no exuviae of plum moth was present.

Spotted pod borer

The caterpillar enters the bud, flower and pod. The infested flowers and pods are webbing together.

Blue butter fly

The scanting holes were made near the pod axis, larger than those made by plume moth larvae.

In order to study the influence of key abiotic factors on the pest incidence, Simple correlation was worked out between the incidence of pest and meteorological factors for the same period to study the instantaneous effect of meteorological variable by using the formula (Fowler *et al.,* 1998).

$$r_{xy} = \frac{\sum XY - \frac{\sum X \sum Y}{n}}{\sqrt{\left[\sum X^2 - \frac{(\sum X)^2}{n}\right]\left[\sum Y^2 - \frac{(\sum Y)^2}{n}\right]}}$$

Where,

r_{xy} = Simple correlation coefficient

X = Variable *i.e.* abiotic component.
(Average temperature, relative humidity and total rainfall)

Y = Variable *i.e.* mean number of insect per plant.

n = Number of observations.

The correlation coefficient (r) values were subjected to the test of significance using t-test:

The correlation coefficient (r) values were subjected to the test of significance using t test

The calculated t-value obtained was compared with tabulated t-value at 5% level of significance.

$$t = \frac{r}{\sqrt{1-r^2}} \times \sqrt{n-2} \sim t_{n-2} \text{ d.f.}$$

RESULTS AND DISCUSSION

Pod borer, *H. armigera*

The infestation of *H. armigera* commenced during the 32nd standard meteorological week and continues till the 47th SMW (Table 1). The mean population increased from 0.25 larvae/ five plant in the 32nd SMW to 2.25 larvae/five plant in the 36th SMW, thereafter it increase rapidly to the extent of 7 larvae/ five plants in 42nd SMW. The pest population was positive non significant with temperature and significantly inverse correlated with relative humidity. Similar result were also recorded by Shinde *et al.* (2014) who observed two peak periods of *H. armigera* larval population during the entire season from 47th to 50th SMW. The larval population showed a non significant positive correlation with minimum and maximum temperatures while non significant negative correlation with relative humidity. This finding is in close conformity with to findings Borah and Dutta (2004) who also reported positive and significant correlation of *H. armigera* larvae with maximum and minimum temperature. Sandip Patra *et al.* (2016) also reported that the mean pod damage caused by *H. armigera* was 7.50 per cent.

Blue butterfly, *L. boeticus*

Table 1: Incidence of pod borer, *Helicoverpa armigera* in pigeonpea (*C. cajan)* during *kharif,* 2014

SMW	Date of observation	Population of *Helicoverpa armigera*/ 5 plants	Mean pod damage (%)	Mean temperature (ºC)	Relative humidity (%)
31	Aug.-1	-	-	28.10	86.5
32	Aug.-8	0.25	-	25.00	78.5
33	Aug.-15	0.75	-	25.55	81.0
34	Aug.-22	1.25	-	28.70	65.5
35	Aug.-29	2.00	-	27.30	73.0
36	Sep.-5	2.25	-	25.95	72.0
37	Sep.-12	2.75	-	24.40	93.5
38	Sep.-19	3.00	-	26.90	67.5
39	Sep.-26	3.50	7.30	25.10	71.5
40	Oct.-3	4.00	9.00	27.25	62.0
41	Oct.-10	5.25	9.20	26.80	57.5
42	Oct.-17	7.00	14.32	25.85	56.0
43	Oct.-24	6.25	11.60	27.55	47.0
44	Oct.-31	5.50	10.00	26.55	51.5
45	Nov.-7	4.25	12.30	24.40	56.0
46	Nov.-14	3.75	9.60	24.95	65.0
47	Nov.-21	2.25	7.30	21.20	48.0

Correlation coefficient between pest population and mean temperature = 0.1641; Correlation coefficient between pest population and mean relative humidity = -0.6447*
*Significant at 5% level of significance

Table 2: Incidence of blue butterfly, *Lampides boeticus* in pigeonpea (*C. cajan)* during *kharif,* 2014

SMW	Date of observation	Population of *Lampides boeticus* /5 plants	Mean pod damage (%)	Mean temperature (°C)	Relative humidity (%)
39	Sep.-26	0.75	1.20	25.10	71.5
40	Oct.-3	1.50	3.80	27.25	62.0
41	Oct.-10	2.00	5.08	26.80	57.5
42	Oct.-17	2.25	6.40	25.85	56.0
43	Oct.-24	1.25	4.82	27.55	47.0
44	Oct.-31	1.00	3.72	26.55	51.5
45	Nov.-7	0.50	1.24	24.40	56.0

Correlation coefficient between pest population and mean temperature = 0.4889; Correlation coefficient between pest population and mean relative humidity = -0.1556

Table 3: Incidence of plume moth, *Exelastis atmosa* in pigeonpea (*C. cajan)* during *kharif,* 2014

SMW	Date of observation	Population of *Exelastis atmosa* /5 plants	Mean pod damage (%)	Mean temperature (°C)	Relative humidity (%)
40	Oct.-3	0.25	-	27.25	62.0
41	Oct.-10	0.75	2.46	26.80	57.5
42	Oct.-17	1.50	3.82	25.85	56.0
43	Oct.-24	3.00	6.66	27.55	47.0
44	Oct.-31	2.50	5.60	26.55	51.5
45	Nov.-7	2.25	6.24	24.40	56.0
46	Nov.-14	1.50	4.92	24.95	65.0
47	Nov.-21	1.25	6.20	21.20	48.0
48	Nov.-28	0.50	2.48	21.85	46.5
49	Dec.-5	0.25	1.21	19.30	48.0

Correlation coefficient between pest population and mean temperature = 0.46128; Correlation coefficient between pest population and mean relative humidity = -0.13896

Table 4: Incidence of Tur pod fly, *Melanogromyza obusta* in pigeonpea (*C. cajan)* during *kharif,* 2014

SMW	Date of observation	Population of *Melanogromyza obusta* / 5 plants	Mean pod damage (%)	Mean temperature (°C)	Relative humidity (%)
41	Oct.-10	3.00	3.69	26.80	57.5
42	Oct.-17	2.75	5.08	25.85	56.0
43	Oct.-24	3.25	6.10	27.55	47.0
44	Oct.-31	4.00	4.96	26.55	51.5
45	Nov.-7	3.75	4.84	24.40	56.0
46	Nov.-14	6.00	8.47	24.95	65.0
47	Nov.-21	4.25	7.32	21.20	48.0
48	Nov.-28	3.50	6.20	21.85	46.5
49	Dec.-5	3.00	3.63	19.30	48.0

Correlation coefficient between pest population and mean temperature = -0.0097; Correlation coefficient between pest population and mean relative humidity = 0.5281

The incidence of blue butterfly (*L. boeticus)* in the pigeonpea commenced in the 39th SMW (0.75 larvae/five plant) and peak in 42nd SMW *i.e.* 2.25 larvae/five plant (Table 2). The pest population showed positive non significant correlation with temperature and non significant negative correlation with relative humidity. Similar result were also reported by Ameta and Bhardwaj (1995) who observed that the population of *L. boeticus* showed positive correlation with temperature and negative correlation with relative humidity. Sandip Patra *et al.* (2016) also reported that the mean pod damage caused by *L. boeticus* was 6.38 per cent.

Plum moth, *E. atomosa*

The incidence of the plum moth (*E. atomosa)* initiated in the 40th SMW *i.e.* 0.25 larvae/five plant and continued till 49th SMW (Table 3). The pest population attained its peak (3 larvae/ five plants) in the 43rd SMW. The pest population exhibited a non significant positive correlation with temperature and non significant negative correlation with relative humidity. The findings of present investigation is in close conformity with the earlier work carried out by Deshmukh *et al.* (2003) who observed that the larvae of *E. atomosa* were active from the 41st SMW to 49th SMW, with a peak in activity in the 45th SMW (2 larvae/5 plants) when the minimum and maximum temperature, morning and evening relative humidity and rainfall were 32.3 and 16.2°C, 72 and 47 % and 0 mm, respectively.

Tur pod fly, *M. obtuse*

The incidence of the tur pod fly (*Melanagromyza obtuse*) commenced in the 41st SMW and continues till 49th SMW (Table 4). After attaining its peak (6 larvae/five plants) in 46rd SMW the population declined sharply. The increase in population was found non significant inverse correlation with the mean temperature and non significant positive correlation with relative humidity. Similarly, Yadav *et al.* (2011) also

Table 5: Incidence of spotted pod borer, *Maruca testulalis* in pigeonpea (*C. cajan)* during *Kharif,* 2014

SMW	Date of observation	Population of *Maruca testulalis* / 5 plants	Mean pod damage (%)	Mean temperature (°C)	Relative humidity (%)
39	Sep.-26	1.50	2.46	25.10	71.5
40	Oct.-3	2.50	3.80	27.25	62.0
41	Oct.-10	4.00	3.24	26.80	57.5
42	Oct.-17	4.50	3.94	25.85	56.0
43	Oct.-24	5.00	7.38	27.55	47.0
44	Oct.-31	0.75	2.41	26.55	51.5
45	Nov.-7	0.25	1.65	24.40	56.0

Correlation coefficient between pest population and mean temperature = 0.6185; Correlation coefficient between pest population and mean relative humidity = -0.3293

reported that maggots of pod fly were first observed in first week of October (90-100 days old crop) and peaked up to 47th SMW *i.e.* in first week of November. The larval population showed a negative correlation with temperatures and relative humidity. Sandip Patra *et al*. (2016) also reported that the mean pod damage caused by *M. obtuse* was 31.35 per cent. The pod fly, *M. obtusa* Malloch is reported to cause more than 40.00 per cent damage to pigeon pea pods (Anand Kumar Yadav and Sujata Yadav, 2013).

Spotted pod borer, *M. testulalis*

The incidence of the spotted pod borer (*Maruca testulalis*) commenced in the 39th SMW (Table 5). The population attained its peak in the 43rd SMW. The pest population was positive non significant with temperature while non significantly negative correlated with relative humidity. This finding is in close conformity with to findings Sahoo and Behera (2001) who also observed a positive correlation between populations of *M. vitrata, Callosobruchus maculates and Tanaostigmodes cajaninae* and the minimum, maximum and average temperatures. *Grapholita critica* had positive correlation with temperature. Average relative humidity (RH) had a negative effect on pod borer population. Similar results were also reported by Umbarkar *et al*. (Geyer.) (2010) Observed that the population density of spotted pod borer was 0.75 larvae per plant during 5th SMW after sowing (32nd standard SMW) and reached to a peak of 3.81 larvae per plant in 34th standard SMW (7th SMW after sowing).

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