Research Article

Influence of Meteorological Parameters on Pod Borer Incidence in Pigeonpea (*Cajanus cajan* (L) Millsp.)

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Abstract

The field experiment conducted to study the impact of weather parameters on the population buildup of gram pod borer, *Helicoverpa armigera*, spotted pod borer, *Maruca vitrata* and tobacco caterpillar, *Spodoptera litura* on pigeonpea (*Cajanus cajan* (L) Millsp.) at Regional Agricultural Research Station, Lam farm, Guntur during 2017-18 yielded a good amount of information. The peak population of *H. armigera* and *S. litura* was observed during 46th (Nov. 12-18) and 45th SMW (Nov. 5-11) with 3.6 and 123.6 moths/trap/week, respectively. The larval population of *H. armigera*, *M. vitrata* and *S. litura* started appearing in 31st, 44th and 31st SMW, respectively. However, peak population was observed during 46th, 49th and 32th SMW with 5.2, 3.2 and 1.6 larvae/plant, respectively. The correlation studies conducted between weather parameters and pest incidence showed that moderately significant correlation was obtained between adults of *H. armigera* and RH I, RH II and sunshine hours with correlation coefficient (r) being0.476, 0.408 and -0.439. Further, moderately significant correlation was obtained between larval population of *H. armigera* and RH I with correlation coefficient (r) being 0.311. Significant correlation was observed between the larval population of *M. vitrata* and rainfall with correlation coefficient (r) being 0.509, whereas the relationship was moderate with RH I, RH II and wind speed with correlation coefficient (r) being 0.392, 0.438 and -0.404, respectively.

Keywords: *Helicoverpa. armigera*, *Maruca vitrata*, Pigeonpea, Seasonal incidence, *Spodoptera litura*, Weather parameters

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Introduction

Pigeonpea (*Cajanus cajan* (L) Millsp.)) is a tropical grain legume mainly grown in India and ranks second in area and production and contributes about 90% in the world's pulse production. In India, the crop is cultivated in an area of 4.78million ha with 4.25 million tonnes and 889 kg ha^{-1} of productivity. In Andhra Pradesh, it is cultivated in an area of 2.76 lakh ha with 1.39 lakh tonnes of production and 504 kg ha^{-1} of productivity [1]. Though the area under redgram is increasing, the yields have remained stagnant (500-700 kg per ha) for the past 3-4 decades due to the insect pest damage particularly, gram pod borer, *Helicoverpa armigera* and spotted pod borer, *Maruca vitrata* [2] and [3]. Both the pests prefer to feed on flowers and fruiting bodies, thereby causing heavy yield loss. The yield loss due to *H. armigera* and *M. vitrata* was up to more than 60 and 84%, respectively [4]. The annual monitory loss due to *H. armigera* and *M. vitrata* was estimated globally as US $ 400 million [5] and US $ 30 million [6], respectively. The typical concealed feeding habit of spotted pod borer, protects the larvae from natural enemies, human interventions and other adverse factors including insecticides [7]. Though, larval and adult population of *Spodoptera litura* was observed, it will not cause any economic loss to farmers as it feeds mainly on leaves and the plant has the capacity to compensate the vegetative loss. Management of pod borers relies heavily on insecticides, often to the exclusion of other methods of management. However, indiscriminate use of insecticides has resulted in the development of resistance and resurgence. In order to optimize the application of insecticides, studies on monitoring and influence of various weather parameters on the population build up and seasonal incidence of the pest are very much required for planning an effective pest management strategy that will help farmers benefit financially without the risk of long term problems including resurgence. Hence, an attempt was made to monitor the pod borer population along with studies on influence of weather parameters on the population buildup.

Materials and Methods

An experiment was carried out at Regional Agricultural Research Station, Lam farm, Guntur, Andhra Pradesh during 2017-18 with pigeonpea cv. LRG 52 (Amaravathi) sown in 1.5x 0.2 m spacing by following all the package of practices recommended for the crop in this region and season and was kept completely under unprotected conditions.

In order to monitor the adult population of *Helicoverpa* and *Spodoptera*, pheromone traps @ 10 ha $^{-1}$ were erected 60 cm above the crop canopy. The male moth catches were recorded once in each standard meteorological week (SMW) starting from sowing to pod maturity stage of the crop and expressed as number of months/trap/week. The lures were changed at 30 days interval. Simultaneously, observations on *H. armigera*, *S. litura* and *M. vitrata* larvae were recorded at weekly intervals from 10 randomly selected plants from three locations in the plot. The trend of population build-up of the borers was determined by working out the mean number of larvae/plant. Simultaneously, weather parameters like maximum, minimum and mean temperatures, morning and evening relative humidity, sunshine hours and rainfall collected from meteorological observatory, RARS, Lam were used for correlation studies to know the influence of weather parameters on the population of *M. vitrata*. Further, other insect pests like thrips, blister beetles, bud weevils, pod weevils, pod sucking bugs, blue butterflies, plume moths, pod wasps, mites and bruchid population per plant was also recorded during the crop season.

Results and Discussion

The larval population of *H. armigera* started appearing from 31st SMW (30 - 5, Aug) and fluctuated population was noticed thereafter and reached its peak level on 46th SMW (5.2 larvae per plant) and thereafter decreased and nil population was recorded in 52nd SMW. The adult moth catch of *H. armigera* was started appearing from 29th SMW to 7th SMW with peak moth catch during 46th SMW (3.6 moths / trap / week) (**Table 1** and **Figure 1**). The incidence of *M. vitrata* commenced from 44th SMW (0.6 larvae per plant) and remained active up 2nd SMW (Jan. 8-14). The pest reached its peak level (3.2 larvae per plant) at 49th SMW (Dec. 3-9), which coincides with the peak flowering stage of the crop (Table 1 and **Figure 2**). The larval population of *S. litura* was noticed in the 31st SMW. Similarly, the peak population of *S. litura* (123.6 moths / trap / week) was observed in 45th SMW. However, its intensity and economic loss to the plant was negligible (Table 1 and **Figure 3**).

Table 1 Monitoring of Pod borers in pigeonpea during *Kharif*, 2017

SMW	Date	Moths/ trap / week (no.)		Larvae / plant (no.)		
		H. armigera	*S. litura*	*H. armigera*	*M. vitrata*	*S. litura*
29	16-22 July, 2017	0.4	19.0	0	0	0
30	23-29	0	5.2	0	0	0
31	30-5 Aug	0	1.4	0.4	0	1.2
32	6-12	0.4	1.4	0	0	1.6
33	13-19	2.4	19.0	0.6	0	0
34	20-26	0.4	19.8	2.2	0	0.2
35	27-2 Sep	1.4	28.6	3.0	0	1.2
36	3-9	0.4	13.0	0.8	0	1.2
37	10-16	0	6.8	2.0	0	1.2
38	17-23	0	2.6	1.0	0	1.2
39	24-30	0	0.6	0.4	0	0.8
40	1-7 Oct.	3.0	32.0	0	0	0
41	8-14	2.0	41.2	0	0	0
42	15-21	2.6	15.0	1.0	0	1.2
43	22-28	0.6	5.4	2.2	0	1.2
44	29-4 Nov	0.2	2.6	2.6	0.6	1.0
45	5-11	3.4	123.6	3.8	0.8	0.4
46	12-18	3.6	67.2	5.2	1.2	0
47	19-25	2.2	10.2	4.2	1.6	0.6
48	26-2 Dec	0.2	1.4	1.8	2.0	0.4
49	3-9	1.8	78.0	1.6	3.2	0
50	10-16	0.4	66.2	1.0	1.4	0
51	17-23	0.4	10.4	0.6	1.0	0
52	24-31	0.2	3.4	0.4	0.6	0
1	1-7 Jan, 2018	0.6	19.4	0	0.6	0
2	8-14	0	15.8	0	0.2	0
3	15-21	0.2	11.8	0	0	0
4	22-28	0.6	8.2	0	0	0
5	29-4 Feb.	0.4	5.4	0	0	0
6	5-11	0	6.0	0	0	0
7	12-18	0.2	2.0	0	0	0

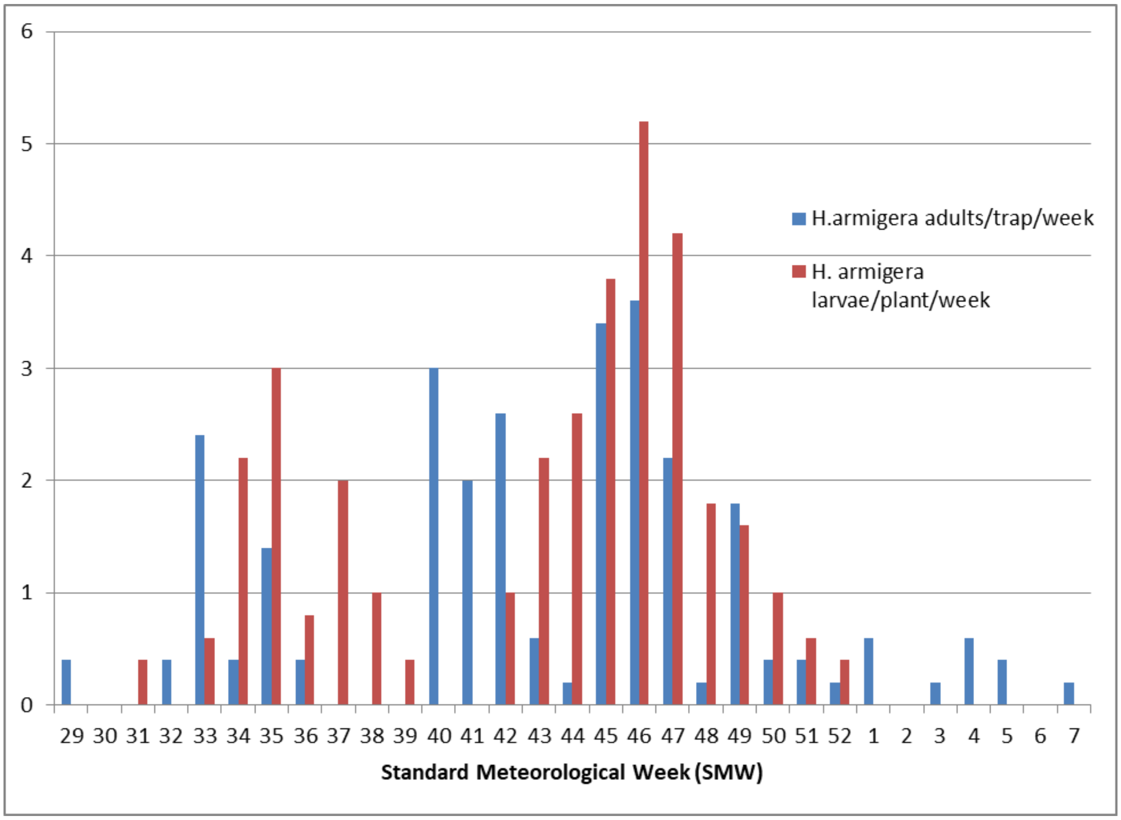

Figure 1 Incidence of *Helicoverpa armigera* on Pigeonpea during 2017-18

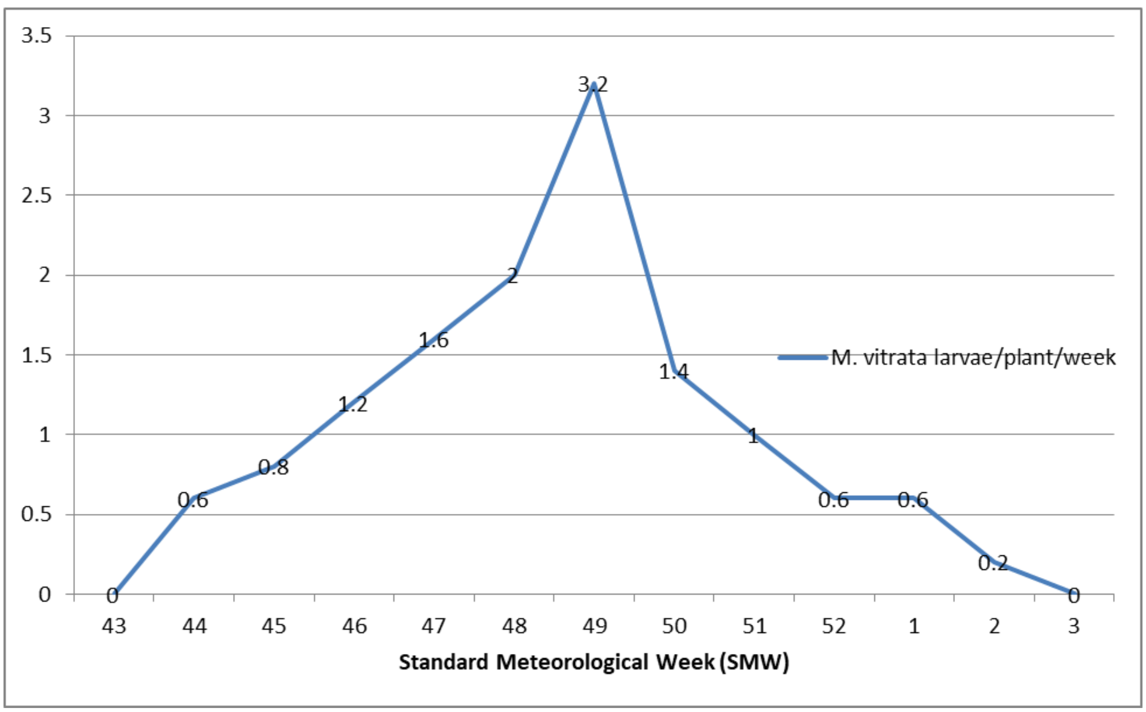

Figure 2 Incidence of *Maruca vitrata* on Pigeonpea during 2017-18

The results were in conformity with the findings of [8], who observed peak male moth catches of *H. armigera* from 43 to 45th SMW in pigeonpea at Sriganganagar (Rajasthan). Similarly, with regard to *M. vitrata*, the present finding were in accordance with the findings of [9], who reported that *M. vitrata* larval population gradually increased from third week of November (47th SMW) and reached peak level at the 3rd week of December (51st SMW) and remained active up to last week of January. The results obtained were also in concurrence with the reports of [10], who found that incidence of *M. vitrata* on pigeonpea was bimodal where early infestation starts from September reaching its first peak during middle October and second peak during December. The incidence of *M. vitrata* increased with the initiation of flowering, having the highest population at full podding stage of pigeonpea [11].

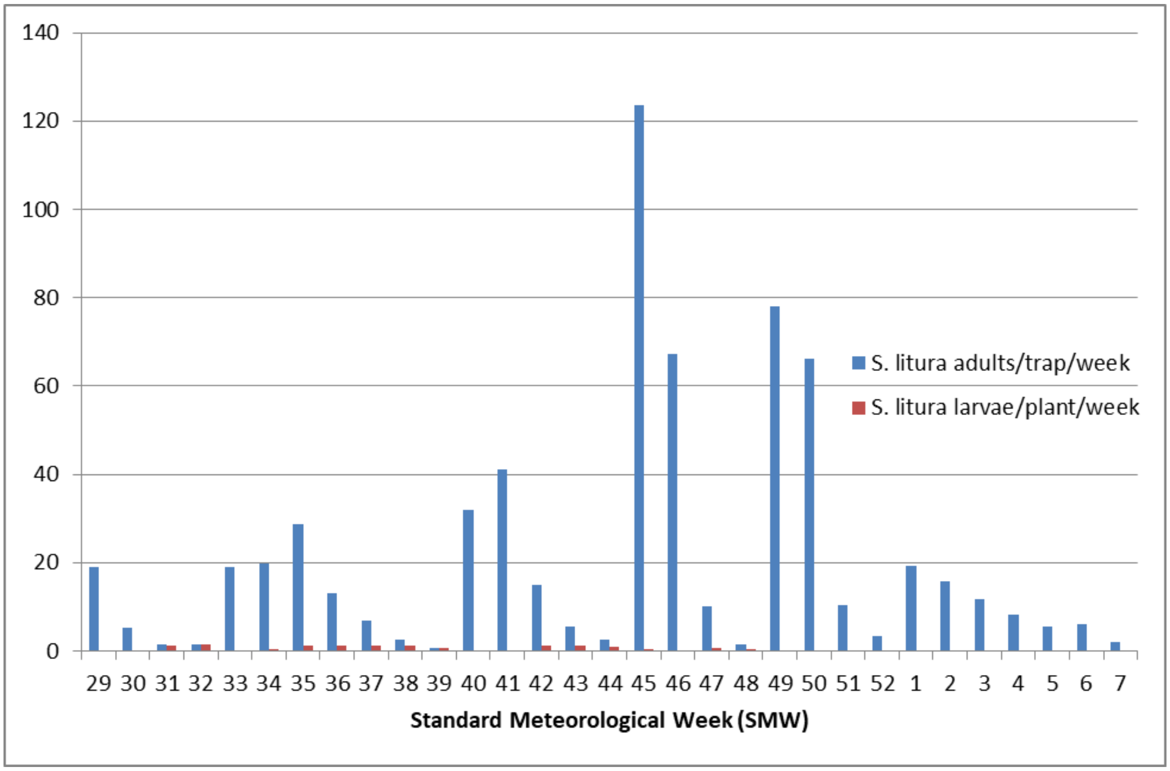

Figure 3 Incidence of *Spodoptera litura* on Pigeonpea during 2017-18

Correlation and regression studies conducted between weather parameters and pest incidence showed that moderately significant correlation was obtained between adults of *H. armigera* and RH I, RH II and sunshine hours with correlation coefficient (r) being 0.476, 0.408 and -0.439. Moderately significant correlation was obtained between adults of *S. litura* and RH-I and evaporation with correlation coefficient (r) being 0.332 and 0.314, respectively. Further, moderately significant correlation was obtained between larval population of *H. armigera* and RH I with correlation coefficient (r) being 0.311. Similarly, moderately significant correlation was obtained between larval population of *S. litura* with RH I and RH II with correlation coefficient (r) being -0.349 and -0.359, respectively. Significant correlation was observed between the larval population of *M. vitrata* and rainfall with correlation coefficient (r) being 0.509, whereas the relationship was moderate with RH I, RH II and wind speed with correlation coefficient (r) being 0.392, 0.438 and -0.404, respectively (**Table 2**).

Table 2 Correlation coefficient between weather parameters and pest incidence during *Kharif*, 2017

Weather parameters	**Correlation coefficient (r)**				
	Moths of *H. armigera*	**Moths of *S. litura***	**Larvae of *H. armigera***	**Larvae of *M. vitrata***	**Larvae of *S. litura***
Max T (ºC)	-0.130	0.002	0.069	0.146	0.254
Min T (ºC)	0.266	0.193	0.233	0.169	0.103
Mean Temp. (ºC)	0.123	0.127	0.181	0.192	0.218
RH-I (%)	**0.476**	**0.332**	**0.311**	0.392	**-0.349**
RH-II (%)	0.408	0.088	0.102	**0.438**	**-0.359**
RF (mm)	0.190	-0.084	0.204	**0.509**	0.188
Rainy days	0.244	-0.123	0.083	0.291	-0.078
Sunshine (hrs)	**-0.439**	0.087	0.096	-0.130	0.145
Wind speed (km/hr)	-0.001	-0.099	-0.249	**-0.404**	0.263
Evaporation (mm)	0.062	**0.314**	0.045	-0.276	-0.127

The present findings were in conformity with findings of [12] who reported that maximum, minimum and mean temperatures and relative humidity recorded at morning, evening and mean were found to be highly correlated with that of larval population of *M. testulalis*. However, [3], [13] and [14] reported that highly significant correlation was obtained between *M. vitrata* and minimum temperature and wind speed. Positive correlation (r=0.86) between rainfall and incidence of *M. vitrata* has been reported by [10]. The larval population of *M. vitrata* was significantly influenced by average temperature and relative humidity at Hissar [15]. Population buildup of *M. vitrata* varied remarkably in different parts of the country probably due to differences in agro climatic conditions and crop types [2]. Morning and evening relative humidities showed significant positive correlation and minimum temperature showed significant negative correlation on the larval population of *M. vitrata* in rice fallow blackgram [16].

The data pertaining to other insect pests showed that thrips, blister beetles, bud weevils were more during active flowering stage of the crop i.e., 48th and 49th SMW. whereas pod weevils and pod sucking bugs were more during pod formation stage i.e., 50th SMW. Plume moths and pod wasps were more during pod development stage of the crop (51 and 52 SMW). Mite and bruchid population gradually increases as the crop advances to maturity (**Table 3**).

Table 3 Incidence of other insect pests on pigeonpea during *Kharif*, 2017

SMW	Date	No. of thrips/ flower	No. of blister beetles/ plant	No. of Bud weevils/ plant	No. of pod weevils/ plant	No. of pod sucking bugs/ plant	No. of blue butterflies/ plant	No. of plume moths/ plant	No. of pod wasps/ plant	No. of mites/ 3 leaflets	No. of bru chids /plant
43	22-28	0	0	0	0	0	0	0	0	0	0
44	29-4 Nov.	1.4	0	0	0	0	0	0	0	0	0
45	5-11	2.6	0.2	0.2	0.4	0.6	0.4	0.2	0	0.2	0
46	12-18	3.0	0.6	1.6	1.0	1.4	1.0	0.6	0.4	0	0
47	19-25	3.2	2.2	2.4	1.4	2.2	1.4	0.8	1.0	0	0
48	26-2 Dec.	4.2	2.4	3.4	2.4	3.2	2.0	1.8	1.4	0.4	0
49	3-9	4.0	2.6	4.6	3.2	4.2	1.6	2.6	2.8	0	0
50	10-16	3.0	1.4	3.0	4.4	4.8	1.4	3.8	3.8	0.2	0
51	17-23	2.6	0.8	2.0	3.0	4.0	1.0	4.8	4.8	0	0
52	24-31	2.0	0.4	1.4	1.6	2.6	0.6	3.6	5.4	0	1.0
1	1-7 Jan. 2018	1.4	0.2	1.0	1.0	1.8	0.4	1.8	3.8	0.2	2.4
2	8-14	1.2	0	0.6	0.6	1.2	0.2	1.0	2.6	0.8	3.8
3	15-21	0.6	0	0.2	0.4	0.6	0	0.6	1.4	1.2	4.8
4	22-28	2.6	0	0	0.2	0.2	0	0.2	0.6	1.8	5.8
5	29-4 Feb.	4.0	0	0	0	0	0	0	0.2	2.0	7.0
6	5-11	4.6	0	0	0	0	0	0	0	2.2	8.2

Conclusions

From the present findings it can be inferred that there was only single peak without any multiple peaks or overlapping broods of *H. armigera* and *M. vitrata*. Since, larval population of *H. armigera* and *M. vitrata* was more during 46th and 49th SMW, respectively which corresponds to first fortnight of November to 1st fortnight of December, which in turn coincides with peak flowering stage of the crop, farmers can be alerted to initiate pest management practices in time.

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