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Relative Abundance of Legume Pod Borer, *Maruca vitrata* Geyer (Lepidoptera: Crambidae) on Pigeonpea and its Relationship with Weather Parameters

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Legume pod borer, *Maruca vitrata* Geyer is one of the serious pests occurring during flowering and pod formation stage of pigeonpea. Relative abundance of *M. vitrata* studied in pigeonpea variety, CORG 7 during Kharif and Rabi seasons of 2011 and 2012 at Department of Pulses, TNAU, Coimbatore revealed that in 2011, the first peak incidence was during 34th SMW (IV week of August) and 36th (I week of September) SMW as 4.44 and 3.68 webbings/ plant respectively followed by the second peak during 50 (II week of December) and 52nd (IV week of December) SMWs as 9.38 and 5.72 webbings per plant respectively. In 2012, on 50 and 52nd SMWs (II and IV weeks of December) the peak incidence of 6.21 and 5.10 webbings per plant were recorded respectively. The larval incidence showed a significant negative correlation with maximum temperature (r=0.455*), sunshine hours (r=0.382*) and evaporation (r=402*) and positive correlation with minimum relative humidity (RH) (r=0.399*) and rainfall (r=0.463*). Regression analysis showed all abiotic factors together determine the variation in *Maruca* damage by 61.4 per cent (R_2 = 0.614).

Key words: Legume pod borer, *Maruca vitrata*, Pigeonpea, Relative abundance, Weather parameters

The pulses being rich source of proteins with high nutritional value occupy a special role in diet of human beings. Among pulses, pigeonpea, *Cajanus cajan* (L.) Millsp. occupies an important place next to chickpea and is widely grown in semi-arid tropical regions of the world. The pigeonpea production in recent years is not able to meet the requirements of growing population due to various biotic and abiotic factors and necessitating the losses and constraints to be curbed. Pod borers have been identified as the major constraints in increasing the productivity of pigeonpea (Sahoo and Senapati, 2002). The legume pod borer, *Maruca vitrata* Geyer (Lepidoptera: Crambidae: Pyraustinae) is one of the serious pests during flowering and pod formation stages causing huge losses (Pappu *et al*., 2010). Normally, larvae feed on anthers, filaments, styles, stigma and ovaries of flowers (Singh and Allen, 1980). The larvae damage leaves by rolling, webbing along with the inflorescence and continue feeding inside. At flowering and pod formation stages, larvae fed on buds, flowers and pods by webbing them (Sharma, 1998). In India, *Maruca* damage has been found to range from 9 to 51 per cent in pigeonpea (Bhagwat *et al*., 1998). Ganapathy (1996) estimated an avoidable loss of nearly 50.0 per cent and flower drop ranging from 9.4 to 12.7 per cent in short, medium and long duration pigeon pea cultivars in Tamil Nadu. Timely prediction and occurrence of insect pest help in their management at the initial stage of its incidence or life stage. Hence, the present study was conducted to understand seasonal occurrence of *M. vitrata* in pigeonpea at Coimbatore.

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Materials and Methods

The relative abundance of *M. vitrata* was studied in pigeonpea variety, CO RG 7 sown in 40 m_2 plots at monthly intervals during Kharif and Rabi seasons of 2011 and 2012 at Department of Pulses, Tamil Nadu Agricultural University (TNAU), Coimbatore in order to ensure the ensure continuous availability of reproductive stages of the crop in the field for *Maruca* incidence. The crop was raised under unprotected condition. The number of fresh webbings made by *Maruca* larvae on 50 randomly selected plants at fortnight interval was recorded for 14 fortnights of both years.

The weather data on maximum temperature (°c), minimum temperature (°c), maximum relative humidity (%), minimum relative humidity (%), rainfall (mm), sunshine hours, wind velocity (km/hr) and pan evaporation (mm) were obtained from Agro Climate Research Centre (ACRC), Coimbatore for the entire study period and their previous fortnight average was worked out. The damage caused by M. vitrata at every fortnight was correlated with the weather parameters using the number of webbings as dependent variable (Y) and each of weather parameters as independent variable (X). Multiple regression analysis also performed with weather parameters. The correlation and regression analyses were performed using SPSS 16.0 software package.

Results and Discussion

The results on relative abundance of *M. vitrata* were presented in Table 1 as number of webbings made by larva per plant revealed that the maximum pest population was observed at the time of flowering. Since, there was variation in the incidence of *M. vitrata* in a year, the results were interpreted as both Kharif and Rabi seasons in 2011 and 2012.

In 2011, the incidence of *M. vitrata* started from IV week of June (26th SMW- Standard Meteorological Week) and recorded 1.88 webbings per plant and

Table 1. Relative abundance of *M. vitrata* on pigeonpea during 2011 and 2012

SMW	Number of *Maruca* webbings/ plant	Max. T (oC)	Min. T (oC)	Max. RH (%)	Min. RH (%)	Wind speed (kmph)	SSH	RF (mm)	Evap. (mm)
26 (2011)	1.88 ± 2.85	30.7	22.4	83.5	53.2	9.2	5.5	1.9	4.8
28	0.14 ± 0.53	31.9	23.2	86.5	49.5	8.4	5.3	0.1	5.2
30	1.12 ± 2.09	30.9	23.4	79.6	60.9	11.6	5.8	2.1	5.6
32	0.16 ± 0.55	30.6	23.0	81.3	55.7	10.1	3.6	0.2	4.8
34	4.44 ± 3.05	31.8	22.7	91.9	54.3	6.7	4.2	0.3	4.9
36	3.68 ± 3.85	30.5	22.8	86.1	62.6	9.7	5.9	1.0	5.0
38	1.46 ± 2.49	30.5	22.8	86.1	62.6	9.7	5.9	1.0	5.0
40	2.38 ± 2.53	32.4	22.0	88.4	52.7	5.9	8.1	0.0	5.6
42	0.91 ± 2.03	32.7	22.6	89.8	53.7	4.4	7.8	7.7	4.8
44	0.00 ± 0.00	32.7	22.6	89.8	53.7	4.4	7.8	7.7	4.8
46	0.41 ± 1.23	29.3	22.4	92.6	71.1	4.5	3.9	15.7	3.2
48	1.50 ± 3.03	28.5	21.3	87.1	64.0	6.2	3.9	6.8	3.2
50	9.38 ± 8.28	29.3	21.1	90.8	56.3	4.5	6.8	0.0	3.0
52	5.72 ± 7.33	29.1	17.1	88.2	45.1	5.0	7.0	0.1	3.6
26 (2012)	0.64 ± 1.05	30.5	22.7	80.9	55.8	10.5	5.4	1.9	5.0
28	0.78 ± 1.78	31.9	23.2	86.5	49.5	8.4	5.3	0.1	5.2
30	0.84 ± 1.49	31.9	23.0	80.9	51.9	11.5	5.6	0.4	6.0
32	0.42 ± 1.51	31.9	23.0	80.9	51.9	11.5	5.6	0.4	6.0
34	0.00 ± 0.00	31.1	23.5	76.1	50.9	13.8	4.5	0.5	6.5
36	1.46 ± 1.41	31.9	22.7	87.6	55.3	6.7	6.1	1.0	5.2
38	0.52 ±0.97	30.8	23.1	79.9	54.1	11.6	4.0	0.4	5.9
40	0.18 ± 0.39	33.1	22.1	85.2	48.3	6.3	8.4	1.0	6.2
42	0.28 ± 0.76	25.4	22.1	84.4	50.1	5.9	7.0	7.6	5.6
44	2.10 ± 2.97	28.5	22.3	91.2	66.3	5.4	4.4	2.4	3.1
46	0.58 ± 1.05	23.0	21.1	89.1	54.4	4.6	6.7	0.8	3.6
48	0.64 ± 1.54	21.8	19.8	89.7	44.4	3.7	7.2	0.6	4.3
50	6.21 ± 4.00	31.1	20.0	87.3	41.6	5.3	8.3	0.2	4.6
52	5.10 ± 8.02	30.0	20.0	82.4	41.3	7.2	5.3	0.0	5.1

*Mean and standard deviation of 50 plants; SMW- Standard Meteorological Week

Max. T – Maximum Temperature, Min. T- Minimum Temperature, Max. RH – Maximum Relative Humidity, Min. RH - Minimum Relative Humidity, SSH - Sunshine hrs, RF – Rainfall, Evap. - Evaporation

reached its peak during 34th SMW (IV week of August) as 4.44 webbings per plant and 36th (I week of September) SMW as 3.68 webbings/ plant and started declining (Table 1). The second peak was registered during 50 (II week of December) and 52nd webbings per plant, respectively.

In 2012, from 26th (I week of June) to 48th (V week of November) SMW the incidence was low, ranging from 0.0 to 2.10 webbings per plant during 34th (IV week of August) and 44th (I week of November) SMWs respectively. On 50 and 52nd SMWs (II and IV weeks of December) the incidence attained its peak and was 6.21 and 5.10 webbings per plant respectively.

Similar results were obtained by scientists across the world. At Hisar, Srivastava *et al.* (1992) recorded the peak moth activity during 40th and 42nd

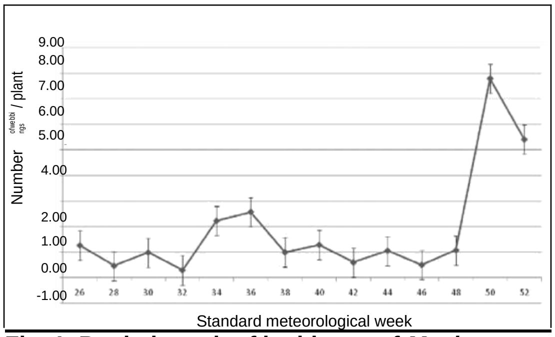

Fig. 1. Pooled result of incidence of *M. vitrata* on pigeonpea (2011 and 2012)

SMWs coinciding with the flowering of medium and long duration types sown in the first fortnight of June. At ICRISAT, Hyderabad, Srivastava *et al*. (1992) recorded more *Maruca* moth catches in light traps from early November to mid December with the peak

Table 2. Correlation relationship weather parameters and relative abundance of *M. vitrata* on pigeonpea (July 2011 to Jan. 2013)

Intercept	Mean number of webbings/ plant
Y_1 - Mean number of webbings/ plant	1
X_1 - Mean maximum temperature (oC)	-0.455*
X_2 - Mean minimum temperature (oC)	-0.110NS
X_3 - Mean maximum RH (%)	0.273NS
X_4 - Mean minimum RH (%)	0.399*
X_5 - Mean wind speed (kmph)	-0.093NS
X_6 - Mean sun shine hrs	-0.382*
X_7 - Mean rainfall (mm)	0.463*
X_8 - Mean evaporation (mm)	-0.402*

*Significant at 5%; **Significant at 1%; NS – Non significant

during the 46th and 47th standard weeks in November followed by a second peak in September during the 37th and 38th standard weeks. In Sri Lanka, Saxena *et al.* (1992) recorded high larval population in mid-October, gradually decreased towards middle of November on pigeonpea.

The results of pooled data over two years (2011 and 2012) showed that the peak incidence of 7.80 *Maruca* webbings/ 10 plants during 50th SMW (II week of December) and the minimum incidence (0.29 webbings/ plant) was recorded during 32nd SMW (August) (Fig. 1). The present results are close to the earlier findings of other scientists across India. Akhauri *et al.* (1994) observed *Maruca* incidence between mid October and end of November with the peak at the end of November. Bajpai *et al.* (1995) also reported the incidence to commence from early September with the peak during mid October and then declining at Pant Nagar. The incidence increased with the initiation of flowering, and the highest population at full podding stage (Imosanen and Singh, 2005). In ICRISAT, Hyderabad Srinivasa-Rao *et al.,* (2006) recorded the incidence of *M. vitrata* from seven weeks after sowing (33rd SMW) and till the harvest with varied level of incidence on different pigeonpea varieties. In Karnataka, Gopali *et al.,* (2010) recorded peak menace of *Maruca* recorded during the periods with high humidity and moderate temperature in September to October which coincided with the maximum flowering in redgram.

Table 3. Multiple regression coefficient of weather factors on mean number of webbings/ plant by *M. vitrata* in pigeonpea (July 2011 to Feb 2013) (n= 28)

Variable	Beta wt.	Regression coefficients	Standard error	't' value	't' probability
a (Intercept term)	-	1.795**	20.998	0.085	0.933
X_1 (Mean maximum temperature)	0.383	0.325	0.154	2.108	0.049
X_2 (Mean minimum temperature)	-0.474	-0.773**	0.483	-1.599	0.126
X_3 (Mean maximum Relative Humidity)	0.252	0.136	0.254	0.534	0.600
X_4 (Mean minimum Relative Humidity)	-0.052	-0.017	0.110	-0.154	0.880
X_5 (Mean wind speed)	0.369	0.299	0.525	0.568	0.576
X_6 (Mean sunshine hours)	0.143	0.231	0.393	0.588	0.563
X_7 (Mean rain fall)	-0.319	-0.203	0.149	-1.363	0.189
X_8 (Mean evaporation)	-0.576	-1.357**	0.930	-1.459	0.161

R^2 value = 0.614, F value = 3.77

Influence of weather parameters on M. vitrata

The analytical data on correlation coefficient between population of *M. vitrata* and weather parameters are presented in Table 2. Larval incidence (number of webbings/ plant) showed a significant negative correlation with maximum temperature (r=-0.455*), sunshine hours (r=-0.382*) and evaporation (r=-0.402*) and positive correlation with minimum relative humidity (RH) (r=0.399*) and rainfall (r=0.463*). The present findings are in consonance with the observations of Kumar and Nath (2005) who reported that population build up of *M. vitrata* was positively correlated with rainfall, wind velocity, average temperatures and average relative humidity, while negatively correlated with evaporation and sunshine hour. In redgram, Ganapathy (1996) and Sharma and Franzamann (2000) also recorded a positive correlation between incidence, RH and rain fall while negative relation with temperatures. Babu (2002) also observed that minimum temperature and sunshine hours exerted significant negative influence of the larval population of *M. vitrata* in groundnut. But, Ramdas (1983) reported a positive correlation of weekly plant infestation of *M. vitrata* with mean minimum temperature (r=0.442), mean maximum temperature (r=0.338) and total rain fall (r=0.548) on cowpea in Bangalore. In blackgram, Sounne *et al.* (2010b) obtained a significant negative correlation in larval population (r = 0.554) and per cent pod damage (r = 0.556) with minimum temperature.

The results on regression analysis resulted in the following equation and showed that all abiotic factors together determined the variation in *Maruca* damage by 61.4 per cent (R^2 = 0.614).

$$\text{Number of webbings/ plant} = 1.795^{**} + 0.325X_1 - 0.773^{**}X_2 + 0.136X_3 - 0.017X_4 + 0.299X_5 + 0.231X_6 - 0.203X_7 - 1.357^{**}X_8$$

Out of eight variables analysed, mean minimum temperature and evaporation were found to exert significant influence on *Maruca* damage (Table 3). When the other variables were at their mean level, one degree rise in minimum temperature and one milli meter (mm) increase in evaporation rate are expected to reduce the number of *Maruca* webbings by 0.773 and 1.357 respectively. In pigeonpea, (Jackai *et al.,* 1992) reported the successful development of *M. vitrata* from 22 to 28°C and temperatures above 34°C were lethal to *Maruca* larvae. Sharma (1998) opined that the high humidity and low temperatures during the months of November to December might be conducive for the pest build up.

The present study clearly showed that relative abundance of *M. vitrata* was maximum at the time of flowering of all periods of observation and peak incidences were mostly at December of both 2011 and 2012 in pigeonpea.

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