RESEARCH ARTICLE Legume Research- An International Journal, Volume 45 Issue 1: 110-115 (January 2022)

Influence of Weather Parameters on the Seasonal Abundance of Legume Pod Borer *Maruca vitrata* (Crambidae: Lepidoptera) on Dolichos Bean (*Lablab purpureus* var. *typicus*)

T.D. Jayabal, J.S. Kennedy

10.18805/LR-4699

ABSTRACT

Background: Legume pod borer, *Maruca vitrata* (Fabricius), infests the Dolichos bean throughout the cropping season. However, there is no information on the seasonal abundance of *M. vitrata* over different seasons on Dolichos bean, which is an essential tool for forecasting and developing integrated pest management strategies.

Methods: The seasonal abundance of *M. vitrata* on Dolichos bean were studied during three consecutive cropping seasons of 2019 *Summer*, *Kharif* and *Rabi*. The larval population in flowers and pods and the number of larval webbings and weather parameters were recorded and subjected to correlation and multiple linear regression analysis.

Result: The overall larval abundance was observed to be higher in flowers than in pods. The highest larval abundance in flowers and pods was 14.60 and 13.40 during the 48th and 50th standard meteorological week (SMW) of *Rabi* 2019 respectively, which corresponds to 8 to 10 weeks after sowing (WAS) in flowers and 10 to 12 WAS in the case of pods. The number of larval webbings was higher, with 18.76 during the 49th SMW of *Rabi* 2019. The maximum temperature had a significant negative correlation with the larval abundance in flowers (r= -0.570), pods (r= -0.523) and the number of active webbings (r= -0.477). At the same time, the regression coefficient shows that rainfall had a significant negative influence on the larval abundance in pods (B= -1.26).

Key words: Dolichos bean, *Maruca vitrata*, Seasonal larval abundance.

INTRODUCTION

Dolichos bean or Lablab (*Lablab purpureus var. typicus*) is an important and the most diverse domesticated vegetable legume grown in many parts of Tamil Nadu and Andhra Pradesh, Karnataka, Madhya Pradesh and Maharashtra. It is also used as livestock feed, green manure, ornamental or medicinal herb (Pengelly and Maass, 2001; Maass, 2016). It is rich in protein, minerals and vitamins and is a significant source of protein for the South Indian diet. Insect pests, especially lepidopterans pod borers, account for the production constraint by causing significant yield losses globally in the Dolichos bean (Rouf and Sardar, 2011). Amid this, the genetically complex *M. vitrata* (Lepidoptera: Crambidae) is considered as one of the severe legume pests having high damage potential and a wider host range (Jackai 1995; Sharma *et al.,* 1999; Margam *et al.*, 2011; Periasamy *et al.,* 2015), with a higher preference to Dolichos bean over the other legumes (Rekha and Mallapur, 2007; Mallikarjuna *et al*., 2012).

Further, it is a pest of regional significance in Tamil Nadu and Karnataka (Anonymous, 2014). The larva causes economic damage to the Dolichos bean by feeding on the flower buds, peduncle, stem, tender and matured pod (Jackai, 1990). Though it is a severe pest, there was a dearth of research related to the dynamics of the key pest, *M. vitrata*. The information on the seasonal abundance and distribution of the insect pest concerning the weather parameters forms the essential tool for forecasting and developing integrated pest management strategies. Hence, the present study was framed to understand the influence of weather parameters on the abundance and population build-up of *M. vitrata* on the Dolichos bean.

Department of Agricultural Entomology, Tamil Nadu Agricultural University, Coimbatore-641 003, Tamil Nadu, India.

Corresponding Author: J.S. Kennedy, Department of Agricultural Entomology, Tamil Nadu Agricultural University, Coimbatore-641 003, Tamil Nadu, India. Email: jskennedy@tnau.ac.in

How to cite this article: Jayabal, T.D. and Kennedy, J.S. (2022). Influence of Weather Parameters on the Seasonal Abundance of Legume Pod Borer *Maruca vitrata* (Crambidae: Lepidoptera) on Dolichos Bean (*Lablab purpureus* var. *typicus*). Legume Research. 45(1): 110-115. DOI: 10.18805/LR-4699.

Submitted: 19-06-2021 **Accepted:** 11-10-2021 **Online:** 19-10-2021

MATERIALS AND METHODS

Seasonal abundance of *M. vitrata on* Dolichos bean was recorded on three consecutive cropping seasons during 2019 (May-December) at Narasipuram village of Coimbatore district (11.0152°N, 76.9326°E). *M. vitrata* larval population and number of active larval webbings were used to find the seasonal abundance. The larval population were recorded from ten samples representing flowers and pods respectively on five locations in the field at weekly intervals starting from 40 (5 to 6 weeks after sowing) to 90 (13 weeks after sowing) days after sowing and per cent larval abundance was estimated**.** The number of active larval webbings from five racemes per plant was made on ten randomly selected plants at weekly intervals starting from 40 to 90 days after sowing. The data on the larval population and the number of active webbings recorded throughout the cropping season were correlated with weather parameters *viz*., maximum temperature (T_{max}), minimum temperature (T_{min}), relative humidity (RH) and rainfall data obtained from the Agro Climate Research Centre, Tamil Nadu Agricultural University, Coimbatore. The multiple linear regression analysis was carried out to assess the degree and level of influence of the various weather parameters on the larval abundance and the number of webbings of *M. vitrata.* The correlation and multiple linear regression analyses were done using SPSS ver.17.0 software to work out the correlation coefficient and regression, with the formula suggested by Regupathy and Dhamu (1990).

$$Y= b_0 \pm b_1(T_{max}) \pm b_2 (T_{min}) \pm b_3 (RH) \pm b_3 (rainfall)$$

RESULTS AND DISCUSSION

Even though there was ample information available in India on the *M. vitrata* seasonal abundance, infestation and impact of weather parameters on major pulses, pigeon pea (Sharma *et al.,* 1999; Sreekanth *et al*., 2015; Sreekanth *et al*., 2019; Taggar *et al*., 2019; Sujayanand *et al*., 2021) and black gram (Swamy and Devaki, 2015; Kapoor, 2019), the data is inadequate concerning Dolichos bean (*Lablab purpureus* var. *typicus*). The results on the seasonal larval abundance of *M. vitrata* in the Dolichos bean have been depicted in Table 1. The results have shown that the larval abundance of *M. vitrata* was noticed from six weeks after sowing (19th, 32nd and 45th - SMW) during the entire study period and it remained to persist in varying populations up to thirteen weeks after sowing (26th, 39th and 52nd - SMW).

During *Summer* 2019, the larval abundance in flowers and pods ranged from 1.80-11.80 and 1.20-8.80 per 50 samples, respectively, whereas the number of active webbings ranged from 1.27 to 9.28. The initial larval abundance in flowers (2.60 larvae per 50 samples), pods (1.40 larvae per 50 samples) and webbings (1.27 active webbings per 10 plants) were minimum. The larval abundance reached its peak in flowers (11.80 larvae per 50 samples), pods (8.80 larvae per 50 samples) and webbings (9.28 active webbings per 10 plants) during 24th SMW, which coincided with the peak bud initiation, flowering and pod formation stage of the crop. The results on the larval abundance in the Dolichos bean are similar to the previous reports by Sampathkumar and Durairaj (2015), who observed that the relative abundance of *M. vitrata* was the maximum at the time of flowering. Subsequently, the larval abundance started declining from the 26th SMW (13 WAS) since the crop was approaching physiological maturity.

The larval population during *Kharif* 2019 was witnessed one week earlier than the *Summer* season during the 31st SMW with 1.40 and 0.00 larvae per 50 samples in flower buds and pods, respectively. There was a fluctuation in the larval incidence from 31st to 37th SMW, whereas the *Summer* season had a gradual spike followed by the population decline at the final stage of the crop. The highest peak of the pest was attained during 35th SMW and 38th SMW with 13.20 and 11.40 larvae per 50 samples in flower buds and pods, respectively. The number of active webbings was higher during the 36th SMW, with 15.74 webbings in five racemes per ten plants.

During the *Rabi* 2019, the larval abundance in flowers and pods ranged from 3.20-14.60 and 3.20-13.40 per 50 samples, respectively, whereas the number of active larval webbings ranged from 4.92 to 18.76. During *Rabi* 2019, the larval abundance in flowers (9.40 larvae per 50 samples), pods (3.20 larvae per 50 samples) and webbings (5.23 active webbings per 10 plants) were found to be higher even in the initial stage of flowering (6 WAS) when compared to other two seasons. The larval abundance reached its peak in flowers (14.60 larvae per 50 samples), pods (13.40 larvae per 50 samples) and webbings (18.76 active webbings per 10 plants) during 48th, 50th and 49th SMW, respectively, which overlapped with the peak bud initiation, flowering and pod formation stage of the crop. The present results are corroborating with the results of Mallikarjuna *et al*. (2012), who reported that the population density of *M. vitrata* in *Lablab purpureus* (L.) Sweet reached its peak from the first week of December (48th SMW). Similarly, in pigeon pea [*Cajanus cajan* (L.)], Sreekanth *et al*. (2015) and Sreekanth *et al*. (2019) reported that the larval population per plant increased from 47th SMW and reached its peak during the end of December (12.6 larvae/plant at 51st SMW). Like the *Summer* season, the larval abundance gradually declined and reached 3.20 larvae in flowers and 4.60 larvae in pods.

Irrespective of the cropping seasons, the larval abundance in pods increased gradually from 12th WAS and 13th WAS compared to flowers. The highest percentage of larval abundance was observed in flowers and pods with 20.85% and 15.90% during *Rabi* season; similarly, the lowest rate of larval abundance was recorded during *Summer* 2019 with 9.75% 7.75% in flowers and pods, respectively. The present results are in line with the findings of Ali *et al.* (2004), who reported that the *M. vitrata* larva preferred flowers of Country bean. Also, our findings are in accordance with the reports of Sharma *et al.* (1999) and Jayasinghe *et al.* (2015) in yard long bean, who reported that the *M. vitrata* larva prefers flower buds rather than pods resulted in higher abundance and infestation in flower buds. During the study period, the fluctuation in *M. vitrata* larval population in Dolichos bean was based on the availability of other host plants like pigeon pea, cowpea, black gram and green gram in the vicinity. However, the larval population tends to remain in varying proportions year-round.

The data relating to the correlation studies between *M. vitrata* larval abundance in flowers and pods, mean number of active webbings and different weather parameters are presented in Table 2. The results revealed that maximum temperature significantly influenced the larval abundance in flowers and pods among the weather parameters. A significant negative relationship was observed between maximum temperature and the larval abundance in flowers (r= -0.570) and pods (r= -0.523). The results of Sreekanth *et al.* (2015) are reliable with our findings, who observed that the minimum and mean temperature had a significant negative correlation (r= -0.759 and -0.815, respectively) with the larval population. Most of the previous reports in other host plants depicted a contrasting result that, *M. vitrata* larval population had a positive correlation with maximum temperature (Kuldeep and Ram (2007) in pigeon pea, Sravani *et al.* (2015) in green gram, Dumala (2015) in cowpea, Swamy and Devaki (2015) in black gram.

Similarly, a significant negative correlation was shown between maximum temperature and number of active webbings (r= -0.477). At the same time, the number of active webbings and larval abundances in flowers and pods showed a non-significant relationship with the minimum temperature, relative humidity and rainfall. These findings are in concurrence with the report of Taggar *et al.* (2019), who documented a similar non-significant correlation between the larval population and rainfall. In contrast, Dumala (2015) reported the significant influence of the rainfall (r= -0.226) on the *M. vitrata* larval population in Green gram.

The correlation analysis showed that an increase in maximum temperature by 1°C decreased *M. vitrata* larval

Table 1: Seasonal abundance of *Maruca vitrata* in Dolichos bean during three consecutive cropping seasons of 2019 (May-December)

SMW*	Max. temp (°C)	Mini. temp (°C)	Relative humidity (%)	Rainfall (mm)	Larval abundance**		Number of active webbings in 5 racemes/ plant***
					Flowers	Pods	
***Summer* 2019 (May and June)**							
19 (6 WAS)	35.96	25.43	85.86	1.79	2.60	1.40	1.27
20 (7 WAS)	35.57	24.57	85.57	2.07	2.40	1.80	3.75
21 (8 WAS)	36.41	25.31	86.71	0.54	1.80	1.20	4.54
22 (9 WAS)	35.07	24.49	82.71	6.86	3.60	2.80	5.32
23 (10 WAS)	34.79	25.00	81.43	0.66	8.20	5.60	7.76
24 (11 WAS)	32.36	24.07	77.29	0.64	11.80	8.80	9.28
25 (12 WAS)	32.81	24.13	79.86	1.56	6.20	6.20	4.63
26 (13 WAS)	33.50	25.43	76.00	0.00	2.40	3.20	2.50
***Kharif* 2019 (Aug and Sep)**							
31 (5 WAS)	32.45	23.85	79.14	2.14	1.40	0.00	0.00
32 (6 WAS)	27.53	22.43	83.71	28.03	4.20	1.80	4.21
33 (7 WAS)	29.67	22.87	87.14	0.29	10.40	4.40	5.68
34 (8 WAS)	30.30	23.01	85.57	1.00	8.60	5.00	8.35
35 (9 WAS)	30.40	23.39	82.29	0.53	13.20	6.00	13.48
36 (10 WAS)	30.14	24.11	77.57	1.43	9.00	5.40	15.74
37 (11 WAS)	31.27	23.09	87.57	4.60	12.00	11.00	12.15
38 (12 WAS)	31.24	23.24	86.57	0.29	5.60	11.40	8.42
39 (13 WAS)	31.27	23.07	86.57	1.50	2.00	6.60	3.89
***Rabi* 2019 (Nov and Dec)**							
45 (6 WAS)	31.21	21.71	87.29	10.31	9.4	3.2	5.23
46 (7 WAS)	29.71	22.69	86.71	5.40	8.20	3.80	8.92
47 (8 WAS)	29.07	22.50	85.29	0.84	12.40	8.00	11.60
48 (9 WAS)	27.96	22.51	88.14	6.23	14.60	9.40	9.50
49 (10 WAS)	27.64	21.39	84.43	0.63	13.80	11.80	18.76
50 (11 WAS)	28.29	20.46	85.29	1.49	12.40	13.40	9.28
51 (12 WAS)	28.00	21.00	86.43	0.17	9.40	9.40	6.63
52 (13 WAS)	27.71	21.65	86.75	0.63	3.20	4.60	4.92

*SMW- Standard Meteorological Week; **Mean of five replications; ***Mean of 10 plants; WAS- Weeks after sowing.

Table 2: Correlation matrix: impact of weather parameters on the population of *Maruca vitrata* in Dolichos bean.

Factors		Correlation coefficient (r)			
		Temperature (°C)		Relative humidity	Rainfall
		Maximum	Minimum	(%)	(mm)
Larval abundance	Flowers	-0.570** (0.002)	-0.436* (0.029)	0.14 NS (0.501)	-0.096NS (0.647)
	Pods	-0.522** (0.007)	-0.482* (0.015)	0.185 (0.375)	-0.270NS (0.192)
Number of *Maruca vitrata* larval webbings in 5 racemes/10 plant		-0.477* (0.016)	-0.315 NS (0.125)	-0.011NS (0.960)	-0.165NS (0.431)

**Correlation is significant at 0.01 level (2-tailed); *Correlation is significant at 0.05 level (2-tailed); NSNon-significant value. Numbers in the paratheses are p values.

population in flowers and pods by 0.88 and 0.69 units (Y= -0.889X + 35.32 and Y= -0.069X + 37.29), respectively. In the same way, the larval population in pigeon pea tends to reduce by 1.25 units when there was an increase in temperature by 1°C (Taggar *et al.*, 2019). Correspondingly, with an increase in minimum temperature by 1°C, there was a reduction in *M. vitrata* larval population in flowers and pods by 1.27 and 1.19 (Y= -1.274X + 37.29 and Y= -1.198X + 33.81), respectively. However, for every 1 mm increase in rainfall, the larval population in flowers and pods and the number of active webbings decrease by 0.07, 0.17 and 0.12 units (Y= -0.072X + 7.78, Y= -0.173X + 6.39 and Y= -0.127X + 7.83), respectively.

The multiple linear regression analysis (Table 3) was carried out with *M. vitrata* larval abundance in flowers, pods and the number of active webbings as dependent variables against the weather parameters. The results revealed that the coefficient of determination (R^2) was significant with the weather parameters *viz.*, maximum temperature, minimum temperature, relative humidity and rainfall contributed directly towards the larval abundance in flowers and pods to the extent of 39.20 and 44.30 per cent, respectively. Moreover, our findings are consistent with the previous reports of Sujayanand *et al.* (2021). They reported that the weather parameters influenced over *M. vitrata* larval population by 41% (R^2= 0.41). The regression coefficient (B) values indicate that the maximum temperature significantly influences the larval abundance in flowers and the number of active webbings (B= -1.26 and -1.25, respectively).

Similarly, rainfall showed a significant influence on the larval abundance in pods (B= -0.26). The results are in contrast with the findings of Sujayanand *et al.* (2021). They conveyed that the correlation coefficient (B= -0.12) observed for relative humidity significantly influenced *M. vitrata* larval population. The fluctuation in the larval abundance in the present study was mainly due to the prevailing weather condition in a particular location and the availability of the most preferred host plant.

The present study revealed that the *M. vitrata* larval abundance in flowers, pods and the number of active

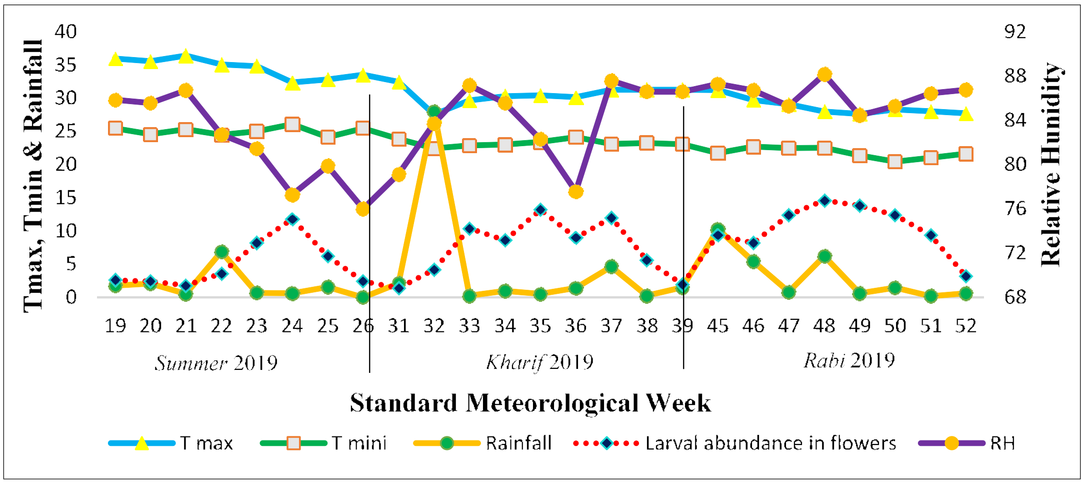

Fig 1: Overall *M. vitrata* larval abundance in flowers during three seasons of 2019.

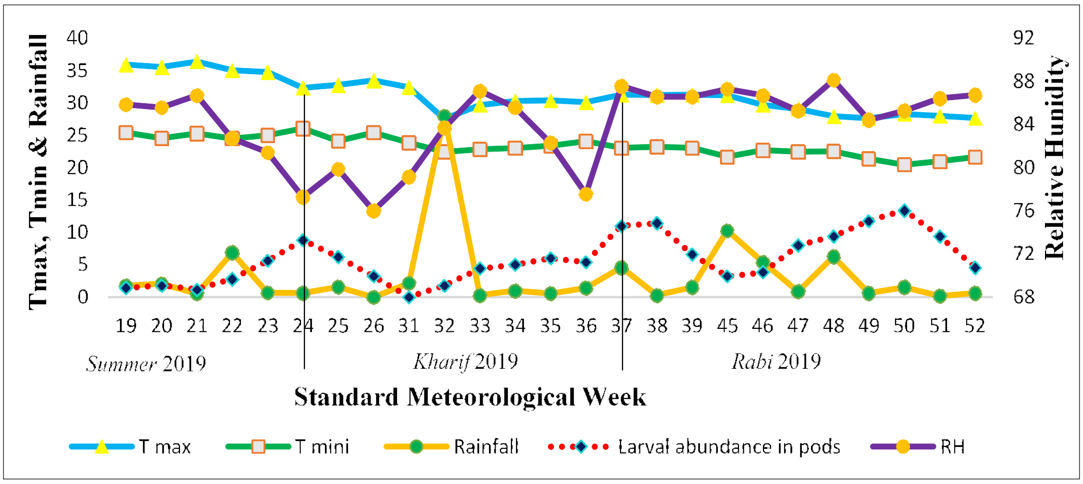

Fig 2: Overall *M. vitrata* larval abundance in pods during three seasons of 2019.

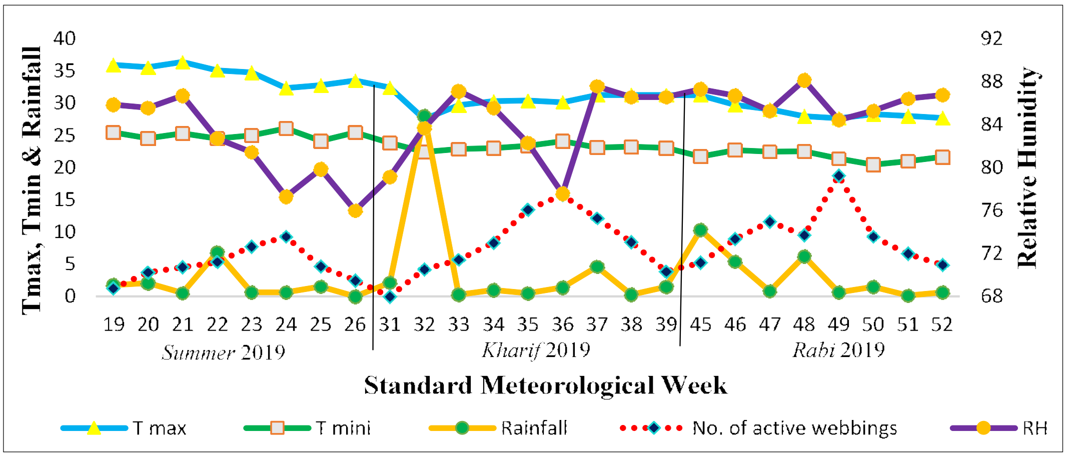

Fig 3: Overall *M. vitrata* larval abundance in pods during three seasons of 2019.

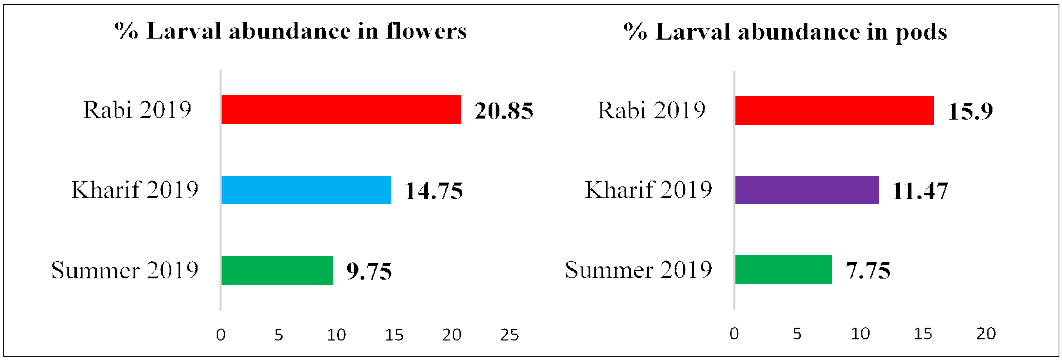

Fig 4: Larval abundance (%) of *M. vitrata* in flowers and pods during three different seasons of 2019.

Table 3: Multiple linear regression model for weather parameters on the population of *Maruca vitrata* in Dolichos bean.

Particulars		Multiple linear regression Equation	R^2 Value (Coefficient of determination)
Larval abundance	Flowers	Y= 21.574-1.262X_1 +0.710X_2 +0.112X_3 -0.189X_4	0.392* (0.034)
	Pods	Y= 30.526-0.706X_1 -0.232X_2 +0.043X_3 -0.260X_4	0.443** (0.016)
Number of *Maruca vitrata* larval webbings in 5 racemes/10 plant		Y= 28.357-1.251X_1 +0.838X_2 -0.008X_3 -0.228X_4	0.333^{NS} (0.075)

**Correlation is significant at 0.01 level (2-tailed); *Correlation is significant at 0.05 level (2-tailed); NS: Non-significant value. Numbers in the paratheses are p values. Y= Incidence of *Maruca vitrata*; X1 = Maximum temperature (°C); X2 = Minimum temperature (°C); X3 =Relative humidity morning (%); X4= Rainfall (mm).

webbings on Dolichos bean was highest during 48^{th} to 50^{th} SMW of 2019. Also, the larval abundance initiated from the peak flower setting and pod formation stage with the varying population during three consecutive cropping seasons of 2019. Concerning crop phenology, the larval population tends to migrate from flowers (8 to 10 WAS) to pods (after 10 WAS) primarily due to the source-sink relationship. These results insist on the importance of timely insecticide application for better management of *M. vitrata* during the early stage of infestation. The correlation and multiple regression analysis reveal the importance of weather parameters on larval abundance. Furthermore, the data on the seasonal larval abundance in Dolichos bean will help develop better integrated ecological engineering and eco-friendly management tactics for this devastating pest.

CONCLUSION

Forecasting and developing integrated pest control strategies require information on the seasonal abundance and distribution of insect pests in relation to weather parameters. As a result, the abundance of *M. vitrata* larvae in flowers, pods and the number of active webbings on Dolichos bean was highest during the 48^{th} to 50^{th} SMW of 2019. The necessity of timely insecticide application for improved management of *M. vitrata* during the early stages of infestation is emphasized by these findings.

ACKNOWLEDGEMENT

The authors are highly thankful to the Head, Department of Agricultural Entomology, Tamil Nadu Agricultural

University, for providing the research facilities required to complete this study.

References

Ali, M., Rahman, M.M. and Alam, M.Z. (2004). Host preference, seasonal and geographical influence on the incidence of legume pod borer (*Maruca vitrata* F.) (Lepidoptera; Pyralidae) in Bangladesh. Journal of Agricultural Science and Technology. 5(1 and 2): 47-55.

Anonymous (2014). AESA based IPM package for Lablab bean. Project Coordinator's Report. National Institute of Plant Health Management, Hyderabad and Directorate of Plant Protection, Quarantine and Storage, Faridabad, India. 1-38.

Dumala, S. (2015). Biology and insecticidal management of spotted pod borer, *Maruca vitrata* (Fabricius) (Crambidae, Lepidoptera) on green gram. M.Sc thesis, Acharya N.G. Ranga Agricultural University, Guntur, India.

Jackai, L.E. (1995). The legume pod borer *Maruca testulalis* and its principal host plant, [*Vigna unguiculata* (L.) Walp]. use of selective insecticide sprays as an aid in the identification of useful levels of resistance. Crop Protection. 14(4): 299-306.

Jackai, L.E.N., Ochieng, R.S. and Raulston, J.R. (1990). Mating and oviposition behaviour in the legume pod borer, *Maruca testulalis*. Entomologia Experimentalis et Applicata. 56(2): 179-186.

Jayasinghe, R.C., Premachandra, W.D. and Neilson, R. (2015). A study on *Maruca vitrata* infestation of Yard-long beans (*Vigna unguiculata* subspecies *sesquipedalis*). Heliyon. 1(1): e00014.

Kapoor, B. and Shankar, U. (2019). Trap catches of *Helicoverpa armigera* Hubner and *Maruca vitrata* Fabricius and their natural enemies on black gram [*Vigna mungo* (L.) Hepper]. Journal of Entomology Zoology Studies. 7: 246-51.

Kuldeep, S. and Ram, U. (2007). Effect of temperature and relative humidity on pod borer in pigeonpea. Journal of Food legumes. 20(1): 121-123.

Maass, B.L. (2016). Origin, domestication and global dispersal of *Lablab purpureus* (L.) Sweet (Fabaceae): Current understanding. Seed. 10: 14.

Margam, V.M., Coates, B.S., Ba, M.N., Sun, W., Binso-Dabire, C.L., Baoua, I., Ishiyaku, M.F., Shukle, J.T., Hellmich, R.L., Covas, F.G. and Ramasamy, S. (2011). Geographic distribution of phylogenetically-distinct legume pod borer, *Maruca vitrata* (Lepidoptera: Pyraloidea: Crambidae). Molecular Biology Reports. 38(2): 893-903.

Mallikarjuna, J., Kumar, C.T.A., Chakravarthy, A.K. and Revadi, S. (2012). Seasonal incidence and abundance of pod borers in Dolichos bean, *Lablab purpureus* L.(Sweet) in Bengaluru, Karnataka, South India. Current Biotica. 6(1): 107-112.

Periasamy, M., Schafleitner, R., Muthukalingan, K. and Ramasamy, S. (2015). Phylogeographical structure in mitochondrial DNA of legume pod borer (*Maruca vitrata*) population in tropical Asia and sub-Saharan Africa. PLoS One. 10(4): p.e0124057.

Pengelly, B.C. and Maass, B.L. (2001). *Lablab purpureus* (L.) Sweet -diversity, potential use and determination of a core collection of this multi-purpose tropical legume. Genetic Resources and Crop Evolution. 48(3): 261-272.

Regupathy, A. and Dhamu, K.P. (1990). Statistics Work Book for Insecticide Toxicology. Suriya Desktop Publishers. 22-24.

Rekha, S. and Mallapur, C.P. (2007). Studies on insect pests of Dolichos bean in northern Karnataka. Karnataka Journal of Agricultural Sciences. 20(2): 407-409.

Rouf, F.M.A. and Sardar, M.A. (2011). Effect of crude seed extract of some indigenous plants for the control of legume pod borer (*Maruca vitrata* F.) on country bean. Bangladesh Journal of Agricultural Research. 36(1): 41-50.

Sampathkumar, S. and Durairaj, C. (2015). Relative abundance of legume pod borer, *Maruca vitrata* Geyer (Lepidoptera: Crambidae) on pigeonpea and its relationship with weather parameters. Madras Agricultural Journal. 102(1-3): 67-70.

Sharma, H.C., Saxena, K.B. and Bhagwat, V.R. (1999). The legume pod borer, *Maruca vitrata*: bionomics and management. ICRISAT information bulletin. International Crops Research Institute for the Semi-Arid Tropics, Patancheru, India (ICRISAT). 55: 8-50.

Sravani, D., Mahalakshmi, M.S., Sandhyarani, C. and Kumari, V.P. (2015). Seasonal incidence of spotted pod borer, *Maruca vitrata* (Fabricius) (Crambidae, Lepidoptera) on greengram under unsprayed conditions. International Journal of Pure and Applied Bioscience. 3: 152-158.

Sreekanth, M., Ratnam, M., Seshamahalakshmi, M., Rao, Y.K. and Narayana, E. (2015). Population build-up and seasonal abundance of spotted pod borer, *Maruca vitrata* (Geyer) on pigeonpea [*Cajanus cajan* (L) Millsp.]. Journal of Applied Biology and Biotechnology. 3(04): 43-45.

Sreekanth, M., Ratnam, M. and Ramana, M.V., (2019). Population dynamics of pod borers on pigeonpea [*Cajanus cajan* (L) Millsp.] in relation to abiotic factors. International Journal of Bio-resource and Stress Management. 10(6): 616-620.

Sujayanand, G.K., Chandra, A., Pandey, S. and Bhatt, S. (2021). Seasonal abundance of spotted pod borer, *Maruca vitrata* fabricius in early pigeonpea [*Cajanus cajan* (L.) Millsp.] and its management through farmscaping in Uttar Pradesh. Legume Research. 44(2): 233-239.

Swamy, S.V.S. and Devaki, K. (2015). Influence of abiotic factors on incidence of spotted pod borer, *Maruca vitrata* (Geyer) on Black gram grown in Rice fallow. Annals of Plant Protection Sciences. 23(1): 12-15.

Taggar, G.K., Singh, R., Cheema, H.K. and Singh, P. (2019). Relative abundance, population dynamics and damage potential of spotted pod borer, *Maruca vitrata* (Fabricius) on early pigeonpea in Punjab. International Journal of Tropical Insect Science. 39(3): 229-234.