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Studies on the effect of different dates of sowing on the incidence of redgram spotted pod borer, *Maruca vitrata* (Geyer) in Pudukkottai district of Tamil Nadu

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Abstract
Redgram spotted pod borer, *Maruca vitrata* is an important biotic constraint in realizing higher yields in this rain-fed crop. As this borer hides in flower webs and continues to damage, it remains unnoticed in the field and it escapes the insecticidal contact. An experiment was conducted at National Pulses Research Centre, TNAU, Vamban, Pudukottai district, Tamil Nadu from 2016 to 2019 to study the incidence pattern of *M. vitrata* at different dates of sowings and the effect of weather factors on it's abundance. *M. vitrata* incidence was less in the August second fortnight sown redgram. Redgram crop when sown during the third week of September suffered more with this borer incidence. When compared to this, October first fortnight sown crop suffered less. Delayed sowings recorded more insect incidence. Redgram crop sown in the second fortnight of September was more susceptible to this borer. Incidence of *Maruca* was significantly positively correlated with the maximum relative humidity and significantly negatively correlated with the minimum relative humidity.

Keywords: Redgram, *Maruca vitrata* incidence, date of sowing, weather factors, correlation

Introduction
Redgram is the fifth prominent pulse crop in the world and it is the second most economically important pulse crop after chickpea in India [6]. Redgram is grown mostly in tropical and sub-tropical countries for grains, fodder and feed for livestock. In India, major redgram growing states are Maharashtra, Karnataka, Andhra Pradesh, Tamil Nadu, Bihar, Uttar Pradesh, *etc*., contributing 88.20 per cent of total pigeonpea production basket [1]. In the Indian vegetarian food, redgram is an important ingredient. On an average, pigeonpea has 20 to 25 per cent protein on dry seed basis, which is almost 2.5 to 3.0 times of the value normally found in the cereals [10]. This crop is drought tolerant and is capable of fixing nitrogen biologically. On an average in India, one third of the produced redgram is annually lost because of the insect pest infestation and the estimated loss is approximately Rs.15,000 million [9]. Among the insect pests that attack redgram, spotted pod borer, *Maruca vitrata* Geyer (Crambidae: Lepidoptera) is a devastating pest which cause severe economic losses to the farmers. It attacks from flowering stage and continues to damage the pods up to maturity stage. *M. vitrata* larvae feed by remaining inside the flowers, webbed mass of flowers and pods. This concealed feeding complicates the management of this pest as pesticides and natural enemies have difficulty in penetrating the shelter to reach the larvae. So, it is imperative to search the alternative strategies to manage this insect effectively other than the chemical insecticides. In this direction an attempt was made to investigate the infestation of this borer at different dates of sowings and to know about the meteorological parameters that govern the population build up of this insect to design the successful management tactics.

Materials and Methods
This study was undertaken at National Pulses Research Centre, TNAU, Vamban, Pudukottai district, Tamil Nadu during 2016 to 2019 to study the population dynamics or fluctuations of spotted pod borer, *Maruca vitrata* under field conditions at different dates of sowings to determine the optimum date of sowing (with comparatively less spotted pod borer incidence) for Pudukottai district. In this study, field trials were laid out with the redgram variety, VBN 3 sown in bulk consecutively for three seasons

(*Kharif* 2016-17, *Kharif* 2017-18 and *Kharif* 2018-19). In each season, staggered sowings of redgram were taken up at four different dates of sowings. Generally in Pudukottai district, redgram sowings will be started during the second fortnight of August and will be continued up to the ending of October month depending on the rainfall. Hence, in the present study, first sowing was done during the second fortnight of August and the rest of the three sowings were done at fifteen days interval. Regular observations were recorded on the incidence of *M. vitrata* at weekly intervals starting from flowering to harvest in all the dates of sowing. Incidence of *M. vitrata* was correlated with the weather parameters.

Results and Discussion

A. *Kharif* 2016 to 17

Table 1: Incidence of *M. vitrata* and weather parameters at different dates of sowings in redgram (*Kharif* 2016-17)

Date of Observation	Standard Week	No. of *Maruca* webs/10 plants	Max. Temp.	Min. Temp.	Max. RH	Min. RH	Rainfall
Second fortnight of August (Date of Sowing: 24.08.2016)							
04.01.17	1	1.0	29.43	21.79	87.14	76.71	2.54
11.01.17	2	5.0	28.43	21.64	83.57	75.14	0.00
18.01.17	3	11.0	28.93	21.71	85.36	75.93	0.00
25.01.17	4	8.0	28.93	21.71	85.36	75.93	1.27
01.02.17	5	15.0	28.93	21.71	85.36	75.93	1.27
08.02.17	6	6.0	28.93	21.71	85.36	75.93	0.00
15.02.17	7	5.0	28.93	21.71	85.36	75.93	1.27
First fortnight of September (Date of Sowing: 10.09.2016)							
28.11.16	48	0.0	32.71	23.43	83.43	83.43	0.00
05.12.16	49	2.0	32.24	23.64	82.71	77.29	6.97
12.12.16	50	3.0	33.21	24.79	82.57	79.57	0.00
19.12.16	51	4.0	32.5	24.57	84.857	81.57	0.00
26.12.16	52	26.0	29.79	23.07	87.57	86.29	3.31
02.01.17	1	9.0	29.36	21.86	86.29	80.86	2.54
09.01.17	2	12.0	28.36	21.50	83.71	71.00	0.00
23.01.17	3	4.0	27.93	23.14	83.14	85.43	4.66
Second fortnight of September (Date of Sowing: 24.09.2016)							
13.12.16	50	54.0	32.64	24.43	83.67	83.67	0.00
20.12.16	51	166.0	29.36	22.6	87.33	87.33	23.20
27.12.16	52	167.0	29.42	21.86	87.28	87.28	17.80
03.01.17	1	87.0	28.28	21.64	84.14	84.14	0.00
10.01.17	2	62.0	27.71	22.14	83.00	83.00	0.00
17.01.17	3	17.0	28.07	23.21	84.00	84.00	33.20
24.01.17	4	6.0	29.64	21.85	84.42	84.42	17.60
31.01.17	5	2.0	32.07	22.00	87.71	87.71	0.00
First fortnight of October (Date of Sowing: 06.10.2016)							
09.12.16	49	12.0	33.36	24.79	79.43	77.86	2.99
16.12.16	50	34.0	32.43	24.21	86.29	81.71	0.00
23.12.16	51	12.0	31.64	24.36	86.29	82.71	3.31
30.12.16	52	4.0	29.00	21.86	85.71	86.14	2.54
06.01.17	1	4.0	29.00	21.79	84.86	70.14	0.00
13.01.17	2	5.0	28.14	21.71	84.57	81.14	0.00
20.01.17	3	2.0	28.21	22.21	83.29	81.71	0.00
27.01.17	4	2.0	28.71	22.93	85.43	86.57	4.66

In the August second fortnight sown redgram crop, peak number of webs i.e., 15 webs/10 plants were observed during the early pod development stage. Before that 11 webs/10 plants was the maximum observed during the full flowering stage. At pod development and maturity stages, 2 to 6 webs/10 plants were noted. In the September first fortnight sown redgram crop, number of *M. vitrata* webs were very low during early and full flowering stages and ranged between 0.0 and 4.0/10 plants. Maximum number of 26 webs/10 plants was observed during the early pod development stage. During the pod development stage, 4 to 12 webs/10 plants were observed. During the harvesting stage, 4 webs/10 plants were observed. In the September second fortnight sown redgram crop, infestation of *Maruca* started with 54 webs/10 plants. Immediately during early and full flowering stages more number of webs was observed (166 to 167/10 plants) (Table 1).

During the pod development stage, 62-87 webs were recorded per 10 plants. Afterwards, their number has decreased gradually and reached 2/10 plants at harvesting stage. In the October first fortnight sown redgram crop, *M. vitrata*population and webs appeared with 12 webs/10 plants and reached it's peak (34/10 plants) (Table 1) during early flowering stage. Later on, the incidence has gradually decreased. During the pod development stage, number of webs ranged from 4 to 5/10 plants. During the pod maturation stage, their number has decreased to 2 webs/10 plants. During *Kharif* 2011 and *Kharif* 2012 in the pigeonpea cultivar Pusa 992, pest activity commenced from 36th standard meteorological week (SMW) and continued up to 46th SMW. The 38th and 39th SMW were more congenial for pest attack [10].

Table 2: Correlation of incidence of *M. vitrata* and weather parameters at different dates of sowings in redgram (*Kharif* 2016-17)

Particulars	Peak no. of *Maruca* webs/10 plants	Mean no. of *Maruca* webs/10 plants	Correlation coefficient values				
			Max. Temp.	Min. Temp.	Max. RH	Min. RH	Rainfall
August second fortnight sowing	15.0	6.6	-0.2525	-0.2882	-0.2510	-0.2491	-0.3100
September first fortnight sowing	26.0	7.5	-0.4851	-0.4107	0.8063*	0.1512	0.0664
September second fortnight sowing	167.0	70.1	-0.2207	-0.1309	0.4211	0.4211	0.1728
October first fortnight sowing	34.0	10.4	0.3346	0.2491	0.1689	-0.0063	-0.2206

Peak and average numbers of *Maruca* webs were more in the September second fortnight sown crop followed by August second fortnight sown crop, September first fortnight sown crop and October first fortnight sown crop (Table 2). During *Kharif* season of 2013 and 2014, infestation of *Maruca vitrata* on redgram started with the onset of bud initiation and reached its peak at flowering stage. Maximum incidence of *M. vitrata* (21.17 webs plant-1) was recorded in 2nd week of July sown crop [5]. Spotted pod borer incidence was negatively correlated with the maximum and minimum temperatures. *Maruca* incidence was positively correlated with the maximum relative humidity and this relation was highly significant in September first fortnight sown crop (Table 2). *Maruca* incidence was negatively & non significantly correlated with the minimum relative humidity and rainfall in August second fortnight and October first fortnight sown crops. *Maruca* incidence was positively & non significantly correlated with the minimum relative humidity and rainfall in September first and second fortnight sown crops.

Kharif 2017 to 18

Table 3: Incidence of *M. vitrata* and weather parameters at different dates of sowings in redgram (*Kharif* 2017-18)

Second fortnight of August (Date of Sowing: 20.08.2017)							
Date of Observation	**Standard Week**	**No. of *Maruca* webs/10 plants**	**Max. Temp.**	**Min. Temp.**	**Max. RH**	**Min. RH**	**Rainfall**
15.12.17	50	5	32.9	21.9	88.6	83.0	0.0
22.12.17	51	17	29.2	21.4	91.4	89.9	0.0
29.12.17	52	2	29.9	21.7	92.9	89.1	0.0
05.01.18	1	3	30.1	21.0	92.6	77.9	0.0
12.01.18	2	11	32.4	22.2	87.0	82.3	0.0
19.01.18	3	6	30.6	20.7	92.0	72.6	0.0
25.01.18	4	15	30.6	20.1	92.0	74.0	0.0
01.02.18	5	5	30.9	21.1	88.4	77.6	0.0
First fortnight of September (Date of Sowing: 05.09.2017)							
13.12.17	50	11	32.5	22.1	87.1	81.7	0.0
20.12.17	51	30	30.6	21.4	91.4	88.9	0.0
27.12.17	52	44	29.6	21.6	92.3	88.6	0.0
3.1.18	1	7	29.7	21.3	92.7	82.3	0.0
10.1.18	2	1	30.4	20.4	93.6	73.6	0.0
24.1.18	4	6	30.5	20.1	92.0	74.9	0.0
31.1.18	5	2	30.5	20.8	89.4	79.1	0.0
Second fortnight of September (Date of Sowing: 20.09.2017)							
29.12.17	52	2	29.9	21.7	92.9	89.1	0.0
5.1.18	1	48	30.1	21.0	92.6	77.9	0.0
12.1.18	2	57	32.4	22.2	87.0	82.3	0.0
19.1.18	3	36	30.6	20.7	92.0	72.6	0.0
25.1.18	4	20	30.6	20.1	92.0	74.0	0.0
1.2.18	5	2	30.9	21.1	88.4	77.6	0.0
8.2.18	6	16	32.1	22.0	88.9	69.1	0.0
First fortnight of October (Date of Sowing: 05.10.2017)							
22.12.17	51	2.0	29.2	21.4	91.4	89.9	0.0
29.12.17	52	2.0	29.9	21.7	92.9	89.1	0.0
5.1.18	1	26.0	30.1	21.0	92.6	77.9	0.0
12.1.18	2	16.0	32.4	22.2	87.0	82.3	0.0
19.1.18	3	22.0	30.6	20.7	92.0	72.6	0.0
25.1.18	4	15.0	30.6	20.1	92.0	74.0	0.0
1.2.18	5	13.0	30.9	21.1	88.4	77.6	0.0
8.2.18	6	11.0	32.1	22	88.9	69.1	0.0

In the August second fortnight sown redgram crop comparatively, low *Maruca* population pressure was noted. Peak number of webs observed was 17/10 plants at full flowering stage. Thereafter, 2 to 11 webs/10 plants (Table 3) were observed during pod development and maturation stages. At the time of harvest, 15 webs/10 plants were recorded. In the September first fortnight sown redgram crop, population of *Maruca* started with 11 webs/10 plants at early flowering stage and reached the peak of 44/10 plants at full flowering stage. Thereafter it's population was reduced to 1 to 7 webs/10 plants during pod development and maturation stages. At the time of harvest, 12 webs were recorded per 10 plants. In the September second fortnight sown redgram crop, during the early flowering stage, only 2 webs/10 plants were observed. In the immediate next week, it's number was raised to 48/10 plants. In the next week, at full flowering stage, the

peak of 57 webs/10 plants was recorded. At the time of harvest, 16 webs were recorded per 10 plants.

In the October first fortnight sown redgram crop, at early flowering stage for two weeks, only 2 webs/10 plants were observed. During the full flowering stage, peak number of webs i.e., 26/10 plants was recorded. At pod development stage, 22 webs/10 plants were observed. At the time of harvest, 11 webs were recorded per 10 plants. Incidence of spotted pod borer, *Maruca vitrata* on pigeonpea started with the onset of flowering in first week of November and remained in the field till crop maturity. The peak activity of this borer in Tirupati region was observed during first fortnight of December in all the three cultivars (LRG 41, TRG 22 and TRG 38) [2].

Table 4: Correlation of incidence of *M. vitrata* and weather parameters at different dates of sowings in redgram (*Kharif* 2017-18)

Particulars	Peak no. of *Maruca* webs/10 plants	Mean no. of *Maruca* webs/10 plants	Correlation coefficient values				
			Max. Temp.	Min. Temp.	Max. RH	Min. RH	Rainfall
August second fortnight sowing	17.0	8.4	-0.1686	-0.2119	-0.0877	0.0901	--
September first fortnight sowing	44.0	14.1	-0.2644	0.5263*	0.1006	0.4679	--
September second fortnight sowing	57.0	25.9	0.3185	0.1090	-0.1532	-0.0776	--
October first fortnight sowing	26.0	13.4	0.3128	-0.3716	-0.0027	-0.6321*	--

Peak and average numbers of *Maruca* webs were more in the September second fortnight sown crop followed by September first fortnight sown crop, October first fortnight sown crop and August second fortnight sown crop (Table 4). *Maruca* incidence was negatively correlated with the maximum temperature in August second fortnight and September first fortnight sown crops. In contrast, it was negatively correlated with the maximum temperature at September second fortnight and October first fortnight sown crops. However, none are significant. Significant positive correlation was recorded between *Maruca* incidence and minimum temperature in September first fortnight sown crop. *Maruca* incidence exhibited non significant negative correlation with the maximum relative humidity and significantly positively correlated with the minimum relative humidity in August second fortnight and September first fortnight sown crops. Significant negative correlation between *Maruca* incidence and minimum relative humidity was observed in October first fortnight sown crop.

Kharif 2018 to 19

Table 5: Incidence of *M. vitrata* and weather parameters at different dates of sowings in redgram (*Kharif* 2018-19)

Date of Observation	Standard Week	No. of *Maruca* webs/10 plants	Max. Temp.	Min. Temp.	Max. RH	Min. RH	Rainfall
Second fortnight of August (Date of Sowing: 22.08.2018)							
19.11.18	46	6.0	31.21	21.50	93.71	82.29	0.51
26.11.18	47	12.0	28.64	20.79	94.00	82.86	0.47
03.12.18	48	32.0	27.71	20.07	92.29	81.43	1.43
10.12.18	49	65.0	28.29	19.57	92.00	74.71	7.00
17.12.18	50	24.0	28.36	20.00	93.43	71.43	0.00
24.12.18	51	58.0	28.43	20.57	92.00	72.43	0.00
31.12.18	52	52.0	28.21	18.14	92.86	73.71	1.06
07.01.19	1	48.0	28.36	17.93	90.57	71.00	0.00
14.01.19	2	20.0	28.29	17.64	90.86	72.43	0.00
21.01.19	3	5.0	28.36	17.57	91.14	76.86	0.00
First fortnight of September (Date of Sowing: 06.09.2018)							
07.12.18	49	37.0	28.21	19.50	92.00	79.57	7.57
14.12.18	50	80.0	27.86	20.14	92.57	69.57	0.00
21.12.18	51	138.0	28.57	20.07	92.86	71.43	0.00
28.12.18	52	75.0	28.43	19.43	92.57	73.57	1.06
04.01.19	1	40.0	28.14	17.86	90.86	72.14	0.00
11.01.19	2	82.0	28.57	17.79	91.14	71.57	0.00
18.01.19	3	29.0	28.14	17.64	91.43	75.86	0.00
25.01.19	4	78.0	27.64	18.07	89.71	74.43	0.00
01.02.19	5	61.0	29.57	18.00	80.86	76.57	0.00
08.02.19	6	68.0	32.07	19.79	71.00	69.00	0.00
15.02.19	7	19.0	33.21	19.64	72.29	71.29	0.00
22.02.19	8	3.0	33.86	19.86	61.86	58.86	0.00
Second fortnight of September (Date of Sowing: 21.09.2018)							
20.12.18	51	6.0	28.57	20.00	93.14	71.43	0.00
27.12.18	52	28.0	28.43	19.79	92.29	73.57	1.06
03.01.19	1	44.0	28.07	24.00	91.14	72.86	0.00
10.01.19	2	64.0	28.57	17.79	90.86	72.29	0.00
17.01.19	3	152.0	28.07	17.57	91.43	74.43	0.00
24.01.19	4	80.0	27.79	17.93	91.43	75.43	0.00
31.01.19	5	63.0	29.21	18.14	81.14	75.71	0.00
07.02.19	6	79.0	31.79	19.50	72.14	69.71	0.00
14.02.19	7	26.0	33.00	19.71	71.14	71.14	0.00
21.02.19	8	35.0	33.79	19.71	64.14	60.86	0.00

First fortnight of October (Date of Sowing: 08.10.2018)							
28.12.18	52	12.0	28.43	19.43	92.57	73.57	1.06
04.01.19	1	38.0	28.14	17.86	90.86	72.14	0.00
11.01.19	2	70.0	82.0	28.57	17.79	91.14	71.57
18.01.19	3	40.0	28.14	17.64	91.43	75.86	0.00
25.01.19	4	67.0	27.64	18.07	89.71	74.43	0.00
01.02.19	5	62.0	29.57	18.00	80.86	76.57	0.00
08.02.19	6	69.0	32.07	19.79	71.00	69.00	0.00
15.02.19	7	18.0	19.0	33.21	19.64	72.29	71.29
22.02.19	8	2.0	3.0	33.86	19.86	61.86	58.86

In the August second fortnight sown redgram crop comparatively, low population pressure was noted in the redgram crop. Early sowing of the pigeonpea crop during the first week of June avoids pod borer damage [6]. Peak number of webs observed was 65.0/10 plants at full flowering stage. Thereafter, 20.0 to 58.0 webs/10 plants (Table 5) were observed during pod development and maturation stages. At the time of harvest, 5.0 webs/10 plants were recorded. In the September first fortnight sown redgram crop, at early flowering stage, 37.0 webs/10 plants were observed. In the immediate next week, it's number was raised to 80.0/10 plants. In the next week, at full flowering stage, the peak of 138.0 webs/10 plants was recorded. At the time of harvest, 3.0 webs were recorded per 10 plants. In the September second fortnight sown redgram crop, population of *Maruca* started with 6.0 webs/10 plants at early flowering stage. Gradually, number of webs increased (28-64 webs/10 plants) and reached the peak of 152.0/10 plants at full flowering stage. Thereafter, it's population was reduced gradually to 26.0 to 35.0 webs/10 plants during pod development and maturation stages.

In the October first fortnight sown redgram crop, during the early flowering stage for two weeks, 12.0 to 38.0 webs/10 plants were observed. During the full flowering stage, peak number of webs i.e., 70.0/10 plants was recorded. At pod development stage also, the number of webs observed was more or less equal to the peak population observed (62.0 to 69.0/10 plants). At the time of harvest, 2.0 webs were recorded per 10 plants. Infestation of legume pod borer, *M. vitrata* started with the onset of flower bud and flowers on crop (in 2nd fort night of September) and thereafter incidence was increased and attained peak during II fortnight of October to first fortnight of November (14.33 to 22.00 larvae per 10 plants). 2nd peak incidence of 15.00 to 19.33 larvae per 10 plants was noticed during II fortnight of December. Again the pest incidence drastically decreased after II fortnight of December [11].

Table 6: Correlation of incidence of *M. vitrata* and weather parameters at different dates of sowings in redgram (*Kharif* 2018-19)

Particulars	Peak no. of *Maruca* webs/10 plants	Mean no. of *Maruca* webs/10 plants	Correlation coefficient values				
			Max. Temp.	Min. Temp.	Max. RH	Min. RH	Rainfall
August second fortnight sowing	65.0	32.2	-0.4356	-0.1017	-0.2712	-0.5437*	0.5291*
September first fortnight sowing	138.0	59.2	-0.5184*	0.1317	0.5479*	0.2089	-0.1742
September second fortnight sowing	152.0	57.7	-0.2899	-0.4950	0.1697	0.3352	-0.2541
October first fortnight sowing	70.0	42.0	0.3205	-0.4789	0.2422	0.4663	-0.2993

Peak number of *Maruca* webs was more in the September second fortnight sown crop followed by September first fortnight sown crop, October first fortnight sown crop and August second fortnight sown crop (Table 6). Maximum activity of legume pod borer, *M. vitrata* was between second and last week of November, when the mean population fluctuate around 12.67 to 15.17 larvae/plant [1]. Average number of *Maruca* webs was more in the September first fortnight sown crop followed by September second fortnight sown crop, October first fortnight sown crop and August second fortnight sown crop.

Maruca incidence was negatively correlated with the maximum temperature and this relation was significant in September first fortnight sown crop. *Maruca* incidence was negatively correlated with the minimum temperature. *Maruca* incidence was positively correlated with the maximum relative humidity and this relation was significant in September first fortnight sown crop. Significant negative correlation between *Maruca* incidence and minimum relative humidity was observed in August second fortnight sown crop. Mean morning relative humidity had significantly positive correlation on the *Maruca vitrata* larval population in crop I (date of sowing – 12.06.2010). Webworm larval population was significantly and positively correlated with the bright sunshine hours and some of weather parameters like mean minimum temperature mean evening relative humidity, and total rainfall showed significantly negative correlation with larval population in crop II (date of sowing – 17.07.2010) [2]. *Maruca* incidence was significantly and positively correlated with the rainfall in August second fortnight sown crop. Incidence of *M. vitrata* and rainfall was positive [8].

Table 7: Incidence of *M. vitrata* at different dates of sowings in redgram

S. No.	Season and Year	Incidence of *Maruca* in ascending order
1	*Kharif*, 2016-17	August second fortnight sown crop < September first fortnight sown crop < October first fortnight sown crop < September second fortnight sown crop
2	*Kharif*, 2017-18	August second fortnight sown crop < October first fortnight sown crop < September first fortnight sown crop < September second fortnight sown crop
3	*Kharif*, 2018-19	August second fortnight sown crop < October first fortnight sown crop < September first fortnight sown crop < September second fortnight sown crop

When the overall results were probed, spotted pod borer, *Maruca vitrata* incidence was less when the redgram crop was sown in the third week of August month. Actually this is the time in which the Pudukottai district farmers start to sow the redgram. However, sowing in this time is not strictly adhered because of the untimely and irregular monsoons. As redgram is mostly cultivated as rain-fed crop, farmers wait for the rains for sowing and hence, sowings will be delayed. Redgram crop which was sown in the third week of September suffered more with the borer incidence. When compared to this, redgram crop sown during the end of the first week of October suffered less. Incidence of *M. vitrata* was high in late sown conditions in Gulbarga [3].

So in Pudukottai district, when the redgram crop was sown during the August third week, incidence of *Maruca vitrata*, the most devastating borer among the borer complex was less. Delayed sowings increase the insect incidence and inturn the yield to the farmers. The early sown (15th July) pigeonpea variety, ICPL-87 recorded lowest pod damage by *H. armigera* (3.13 %), *E. atomosa* (6.56 %), and *M. obtusa* (10.06 %) as against the late sown crop (30th August) (7.63, 29.88 and 20.15 %, respectively) at Sardarkrushinagar in Gujarat [4]. Similarly, pod damage due to pod borer complex in redgram was significantly lower (2.60 %) when crop was sown on 10th July and was highest (48.31 %) on crop sown during 25th September [5]. The early-sown (first week of May) short-duration pigeonpea variety, Manak had less than 6.50 per cent pod damage by *H. armigera* whereas, pod damage to pigeonpea sown in mid-May (15-25th) and mid-June (15-25th) was 26.50 and 39.00 per cent, respectively. Grain yield decreased with a delay in sowing from 1.60 t/ha with early sowing to 1.00 t/ha with late sowing during mid-June at Sonipat in Haryana [2]. As the redgram crop sown in the third week of September was attacked by this borer more, sowings during this period may be avoided. In case of delayed monsoons, crop may be sown in the first week of September or second week of October. In crop I (date of sowing – 12.06.2010), incidence of *M. vitrata* commenced after 3rd week of September with 0.11 larvae per plant and attained a peak of 3.56 larvae per plant during the last week of October. In crop II (date of sowing – 17.07.2010), *M. vitrata* infestation started in 1st week of November and showed an upward trend from mid December to mid January 2011 with 3.49 larvae per plant [2].

Conclusion

In Pudukottai district, spotted pod borer, *Maruca vitrata* incidence was less when the redgram crop was sown in the third week of August month. Redgram crop which was sown in the third week of September suffered more with the borer incidence. When compared to this, redgram crop sown during the end of the first week of October suffered less. Incidence of Maruca was significantly positively correlated with the maximum relative humidity and significantly negatively correlated with the minimum relative humidity. High humidity and low temperatures during the months of November to December were conducive for the buildup of *M. vitrata* population [7]. Populations of *M. vitrata* exhibited positive correlation with minimum and maximum temperatures and relative humidity, whereas, population of pod borers was adversely affected by the intensity of rain fall [9].

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