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Studies on seasonal incidence of pod borer complex in field bean

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Abstract
The present study was carried out in three different dates of sowing (D_1, D_2, D_3) during *Rabi*, 2020-21 to know the seasonal incidence of pod borer complex in field bean. The spotted pod borer (*Maruca vitrata*), tobacco caterpillar (*Spodoptera litura*), blue butterfly (*Lampoides boieticus)* and pea pod borer (*Etiella zinkeinella*) were found to infest the crop with varying intensities. The peak population of *M. vitrata* (3.40 larvae/plant) was recorded in 01 SW of D_2, *S. litura* (1.60 larvae/plant) in 02 SW of D_3, *L. boieticus* (1.90 larvae/plant) in 02 SW of D_2 and *E. zinkeinella* (1.20 larvae/plant) in 01 SW of D_1. In the D_3 sown crop, the evening relative humidity showed significant positive correlation with population of tobacco caterpillar (r = 0.706) and significant negative correlation with pea pod borer (r = -0.634), respectively whereas sunshine hours had shown significant negative correlation with tobacco caterpillar (r = -0.622) and significant positive correlation with *L. boiticus* (r = 0.706) and *E. zinkeinella* (r = 0.651). There was significant negative correlation between population of tobacco caterpillar and maximum temperature (r = -0.652) as well as pea pod borer and minimum temperature (r = -0.643).

Keywords: seasonal incidence, spotted pod borer, pea pod borer, blue butterfly

Introduction
Pulses constitute important human diet after cereals and have high protein content. Among the pulses, one of the most important vegetable crops is field bean and it provides high protein content to the human beings. Field bean, *Lablab purpureus* (L.) Sweet., also known as Dolichos bean, belonging to tribe Phaseoleae and family Fabaceae, is a bushy, semi-erect herb showing no tendency to climb. The dolichos bean field crop is mostly restricted to the peninsular region of India, where it is grown in Andhra Pradesh, Karnataka, Tamil Nadu and Maharashtra. It is grown in Australia also, as a crop for fodder and in East Africa for similar purposes. In India, beans are cultivated in an area of 215 thousand hectares with a total production of 20,80,000 tonnes whereas in Andhra Pradesh, beans are grown in an area of 12.02 thousand hectares with 139,320 tonnes of total production and 16.90 M.t ha^{-1} of total productivity [National Horticulture Board, Ministry of Agri. &FW (DAC&FW), Govt. of India; 2019-20- II Adv. Est.] [16].

Insect pests, particularly the pod borer complex, play a crutial role in the yield losses that occur in pulses. Govindan (1974) [7] identified up to 55 insect pest species and one mite species that infest field beans. The larvae of pod borers are the most destructive, causing crop losses of up to 80-100 per cent (Katagihallimath and Siddappaji, 1962) [9]. These, sometimes, incur a deficit of nearly 54 per cent in field beans in India and hence leading to low productivity in India (Naik *et al.*, 2009) [15]. Pod borers of dolichos bean include *Helicoverpa armigera* (Hubner), *Adisura atkinsoni* (Moore), *Maruca vitrata* (Geyer), *Etiella zinckenella* (Treitschke), *Sphenarches caffer* (Zeller), *Exelastis atomosa* (Walshinghan), *Callosobruchus chinensis* (Linnaeus) and *Lampides boeticus* (Linnaeus) (Chakravarthy, 1977 [3]; Mallikarjunappa, 1989 [13]). Among the pod borer complex, the pod damage due to *H. armigera*, *M. vitrata* and *L. boeticus* were to the tune of 20.43, 16.66 and 10.20 percent, respectively (Jeer, 2011) [8].

The details on the correlation between various weather parameters and the occurrence of different pod borer complexes in field bean will be extremely useful in developing better Integrated pest management methods, as weather parameters determine the pest's population buildup and severity. Furthermore, seasonal incidence of pod borer complex in field bean and its relationship to weather parameters in Chittoor district of Andhra Pradesh is scanty. Hence, to know the seasonal incidence of pod borer complex in field bean, the present study is carried out.

Material and Methods

To study the seasonal incidence of pod borer complex in the field bean, crop was grown at three different dates with fortnightly intervals *i.e*., Early (D_1): 15th October 2020, Normal (D_2): 30th October 2020, Late (D_3): 15th November 2020 in plot size of 10 m × 10 m with row to row spacing of 45 cm and 15 cm plant to plant spacing. The study was carried out during *Rabi*,2020-21 at the wet land farm, S.V. Agricultural College, Tirupati, ANGRAU. All the recommended routine agronomic practices except plant protection measures were followed for raising the crop. The larval population of pod borer complex along with the larval damage on the crop were recorded at weekly intervals commencing from bud initiation to harvesting of the crop in three different dates of sowing. From each plot, ten plants were selected randomly and data was recorded on population of pod borer complex present on plants starting from bud initiation up to harvesting stage of crop at weekly intervals. Observations were recorded in the morning hours on number of larvae of pod borer complex in the experimental plots. The observations on pod damage were recorded by counting total number of pods from ten randomly selected plants and number of pods damaged by the pod borers. Pods which are shrunken, deformed and shrivelled were considered as damaged pods. Later, the per cent damage was worked out using following formula

$$\text{Per cent pod damage} = \frac{\text{Number of damaged pods/10 plants}}{\text{Total no. of pods/10 plants}} \times 100$$

The data obtained in the studies during *Rabi*, 2020-21 were subjected to correlation and multiple regression analysis with various weather parameters *viz.*, maximum temperature, minimum temperature, morning relative humidity, evening relative humidity, rainfall and sunshine hours.

Results and Discussion

The incidence of pod borer complex *viz*., spotted pod borer (*M. vitrata*), tobacco caterpillar (*Spodoptera litura* (Linnaeus)), blue butterfly (*L. boieticus)* and pea pod borer (*E. zinkeinella*) started from seven to fourteen days after bud intiation with peak infestation during 50-80 days after sowing in all the three dates of sowing.

The results from the present investigation revealed that, in all the three dates of sown crop (D_1, D_2, D_3), the incidence of *M. vitrata* started from 30-35 days after sowing (48-51 standard weeks (SW)) and continued till the harvest of the crop (04-08 SW). However, the peak infestation was observed at peak flowering stage of field bean *i.e.*, 51, 01, 03 SW (50-70 days after sowing) with 3.20, 3.40 and 2.50 larvae/plant, respectively in D_1, D_2, and D_3 sown crops. Tobacco caterpillar incidence started from 47-51 SW and continued upto 04-08 SW with the peak infestation at 51, 53, 02 SW (1.20, 1.50, 1.60 larvae/plant, respectively) in D_1, D_2, and D_3 sown crops. The incidence of blue butterfly, *L. boeticus*, started from 50 SW and lasted upto 04-07 SW with the peak infestation at 53 SW (1.80 larvae/plant), 02 SW (1.90 larvae/plant) a nd 05 SW (1.50 larvae/plant) in D_1, D_2, and D_3 sown crops, respectively. The incidence of pea pod borer, *E. zinckenella*, started from 52 SW and lasted upto 04-07 SW with the peak infestation at 01 SW (1.20 larvae/plant), 02 SW (1.00 larva/ plant) and 05 SW (0.80 larva/plant) in D_1, D_2, and D_3 sown crops, respectively.

In early sown crop (D_1), the incidence of *M. vitrata* started from 48 standard week (SW) whereas incidence of *S. litura*, *L. boeticus* and *E. zinkeneilla* started from 47, 50, 51 SW, respectively and continued up to 04 SW for *M. vitrata*, *L. boeticus* and *E. zinkeneilla* while 02 SW for *S. litura*

A. B. C. D.

Plate 1: Pod damage due to pod borer complex larvae in field bean; a. Spotted pod bore;r b. Tobacco caterpillar; c. Blue butterfly; d. Pea pod borer

In normal sown crop (D_2), incidence of *M. vitrata*, *S. litura* started from 49 SW while the incidence of *L. boeticus* and *E. zinkeneilla* started from 52, 53 SW, respectively and continued till 06 SW for all the three pests *viz*., *M. vitrata*, *L. boeticus* and *E. zinkeneilla* whereas 04 SW for *S. litura*. In late sown crop (D_3), incidence of *M. vitrata, S. litura* started from 51 SW whereas the incidence of *L. boeticus* and *E. zinkeneilla* started from 02, 04 SW, respectively and continued till 07 SW for *M. vitrata*, 06 SW for *S. litura* whereas 08 SW for *L. boeticus* and *E. zinkeneilla*, respectively. The present results revealed that higher incidence of pod borer complex *viz*., *M. vitrata, S. litura*, *L. boeticus* and *E. zinkeneilla* was recorded on normal sown field bean crop when compared with early and late sown crop. Correlation studies revealed that all the pod borers showed non-significant correlation with the weather parameters in early (D_1) and normal (D_2) sown crops. The incidence of tobacco caterpillar exhibited significant negative correlation with maximum temperature (r = -0.652) and sunshine hours (r = -0.622) whereas significant positive correlation with evening relative humidity (r = 0.706) in the late sown crop (D_3).

Table 1: Seasonal incidence of pod borer complex in field bean crop during *Rabi*, 2020-21

Standard week (SW)	Mean no. of larvae/plant												Per cent Pod Damage		
	D_1				D_2				D_3						
	Spotted Pod Borer	Tobacco Caterpillar	Blue Butterfly	Pea Pod Borer	Spotted Pod Borer	Tobacco Caterpillar	Blue Butterfly	Pea Pod Borer	Spotted Pod Borer	Tobacco Caterpillar	Blue Butterfly	Pea Pod Borer	D_1	D_2	D_3
47 SW	0.00	0.20	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
48 SW	1.20	0.40	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
49 SW	2.21	0.60	0.00	0.00	0.20	0.40	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
50 SW	2.98	1.00	0.40	0.00	0.50	0.30	0.00	0.00	0.00	0.00	0.00	0.00	10.24	0.00	0.00
51 SW	3.20	1.20	1.06	0.15	1.20	0.70	0.00	0.00	0.20	0.20	0.00	0.00	34.59	0.00	0.00
52 SW	3.14	0.90	1.42	0.39	1.98	1.10	0.20	0.00	0.30	0.60	0.00	0.00	37.93	11.21	0.00
53 SW	2.30	0.30	1.80	0.42	2.70	1.50	1.50	0.10	0.90	1.20	0.00	0.00	50.00	25.81	0.00
01 SW	1.30	0.20	1.67	1.20	3.40	1.40	1.64	0.60	1.40	1.00	0.00	0.00	45.46	41.77	11.11
02 SW	1.67	0.10	1.32	0.55	2.40	0.80	1.90	1.00	1.90	1.60	0.40	0.00	39.21	59.68	23.38
03 SW	1.12	0.00	0.65	0.43	1.80	0.90	1.20	0.40	2.50	0.80	0.79	0.00	68.89	68.78	25.00
04 SW	0.42	0.00	0.20	0.30	2.00	0.30	0.90	0.80	1.56	0.40	1.40	0.20	40.57	73.14	16.66
05 SW	0.00	0.00	0.00	0.00	0.60	0.00	0.60	0.40	0.70	0.20	1.50	0.80	0.00	69.51	39.83
06 SW	0.00	0.00	0.00	0.00	0.20	0.00	0.10	0.30	0.00	0.10	1.20	0.80	0.00	71.24	57.24
07 SW	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.1	0.00	0.87	0.60	0.00	0.00	61.25
08 SW	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.10	0.20	0.00	0.00	56.41

D_1- Early Sown crop
D_2- Normal Sown crop
D_3- Late Sown crop

Table 2: Correlation co-efficient between weather variables and pod borer complex in field bean during *Rabi*, 2020-21

	Correlation coefficients (r)											
	Spotted pod borer			Tobacco Caterpillar			Blue butterfly			Pea pod borer		
	D_1	D_2	D_3	D_1	D_2	D_3	D_1	D_2	D_3	D_1	D_2	D_3
Maximum temperature	-0.548 NS	-0.235 NS	-0.210 NS	-0.478 NS	-0.547 NS	-0.652*	-0.294 NS	0.024 NS	0.420 NS	-0.040 NS	0.453 NS	0.437 NS
Minimum temperature	-0.279 NS	0.329 NS	0.311 NS	-0.090 NS	0.457 NS	0.412 NS	-0.232 NS	0.273 NS	-0.639*	0.047 NS	-0.036 NS	-0.643*
Morning Relative humidity	-0.400 NS	-0.209 NS	0.308 NS	-0.144 NS	-0.235 NS	0.222 NS	-0.488 NS	-0.039 NS	0.261 NS	-0.220 NS	0.068 NS	0.166 NS
Evening Relative humidity	-0.096 NS	0.137 NS	0.368 NS	0.293 NS	0.347 NS	0.706*	-0.189 NS	0.022 NS	-0.590 NS	-0.140 NS	-0.250 NS	-0.634*
Rainfall	-0.238 NS	-0.167 NS	0.168 NS	0.097 NS	-0.024 NS	0.239 NS	-0.498 NS	-0.220 NS	-0.347 NS	-0.263 NS	-0.274 NS	-0.245 NS
Sunshine hours	-0.238 NS	-0.210 NS	-0.213 NS	-0.269 NS	-0.460 NS	-0.622*	-0.024 NS	-0.118 NS	0.706*	0.046 NS	0.243 NS	0.651*

*****Significant at 0.05 level (two-tailed)
NS- Non significant
D_1- Early Sown crop
D_2- Normal Sown crop
D_3- Late Sown crop

Table 3: Multiple regression between larval population and weather parameters in field bean crop during *Rabi*, 2020-21

	Insect Larvae	Multiple Regression Equation	Coefficient of Determination (R^2)
Early Sown Crop (D_1)	Spotted Pod Borer	$Y = 16.14 + 0.11X_1 – 0.92X_2 – 0.09X_3 + 0.15X_4 – 0.06X_5 – 0.20X_6$	0.75
	Tobacco Caterpillar	$Y = 7.27 + 0.30X_1 – 0.53X_2 – 0.09X_3 + 0.05X_4 + 0.11X_5 – 0.22X_6$	0.75
	Blue Butterfly	$Y = -6.52 - 0.79X_1 + 0.77X_2 + 0.07X_3 + 0.10X_4 - 0.48X_5 + 0.81X_6$	0.88
	Pea Pod Borer	$Y = -6.62 - 0.43X_1 + 0.65X_2 + 0.03X_3 + 0.04X_4 - 0.24X_5 + 0.51X_6$	0.88
Normal Sown Crop (D_2)	Spotted Pod Borer	$Y = -8.25 – 1.26X_1 + 1.30X_2 + 0.19X_3 + 0.01X_4 - 0.56X_5 + 1.03X_6$	0.85
	Tobacco Caterpillar	$Y = 7.77 - 0.53X_1 + 0.46X_2 – 0.01X_3 - 0.01X_4 - 0.14X_5 + 0.27X_6$	0.86
	Blue Butterfly	$Y = -20.77 - 0.79X_1 + 0.89X_2 + 0.29X_3 + 0.00X_4 - 0.49X_5 + 0.68X_6$	0.87
	Pea Pod Borer	$Y = -16.09 - 0.16X_1 + 0.29X_2 + 0.16X_3 + 0.02X_4 - 0.22X_5 + 0.30X_6$	0.80
Late Sown Crop (D_3)	Spotted Pod Borer	$Y = -36.72 – 0.30X_1 + 0.83X_2 + 0.18X_3 + 0.17X_4 - 0.57X_5 + 1.19X_6$	0.78
	Tobacco Caterpillar	$Y = -6.49 – 0.49X_1 + 0.49X_2 + 0.11X_3 + 0.11X_4 - 0.28X_5 + 0.37X_6$	0.81
	Blue Butterfly	$Y = -14.06 + 0.08X_1 - 0.10X_2 + 0.12X_3 + 0.04X_4 - 0.08X_5 + 0.27X_6$	0.77
	Pea Pod	$Y = 2.27 + 0.10X_1 - 0.25X_2 + 0.03X_3 - 0.03X_4 + 0.12X_5 - 0.18X_6$	0.80

	Borer		

X_1 = Maximum Temperature
X_2 = Minimum Temperature
X_3= Morning Relative Humidity
X_4 = Evening Relative Humidity
X_5 = Rainfall
X_6 = Sunshine hours

Table 4: Correlation co-efficient and multiple regreesion between weather variables and per cent pod damage in field bean during *Rabi*, 2020-21.

	Per cent Pod damage		
	D_1	**D_2**	**D_3**
Maximum temperature	0.402 NS	0.798**	0.806**
Minimum temperature	-0.513 NS	-0.483 NS	-0.333 NS
Morning Relative humidity	-0.588 NS	-0.216 NS	0.226 NS
Evening Relative humidity	-0.701**	-0.716*	-0.742**
Rainfall	-0.742**	-0.526 NS	-0.178 NS
Sunshine hours	0.483	0.687*	0.676*
Multiple Regression Equation	$Y = -383.27 – 11.12X_1 + 24.51X_2 + 0.83X_3 + 1.81X_4 – 11.94X_5 + 22.09X_6$	$Y = -786.02 – 10.38X_1 + 20.73X_2 + 9.29X_3 – 2.27X_4 – 8.94X_5 + 16.20X_6$	$Y = -209.30 + 11.34X_1 – 8.86X_2 + 2.18X_3 - 1.48X_4 + 5.81X_5 – 7.73X_6$
Coefficient of Determination (R^2)	0.87	0.89	0.86

*Significant at 0.05 level(two-tailed) **Significance at 0.01 level(two-tailed) NS- Non significant
X_1 = Maximum Temperature
X_2 = Minimum Temperature
X_3 = Morning Relative Humidity
X_4 = Evening Relative Humidity
X_5 = Rainfall
X_6 = Sunshine Hours
D_1- Early Sown crop
D_2- Normal Sown crop
D_3- Late Sown crop

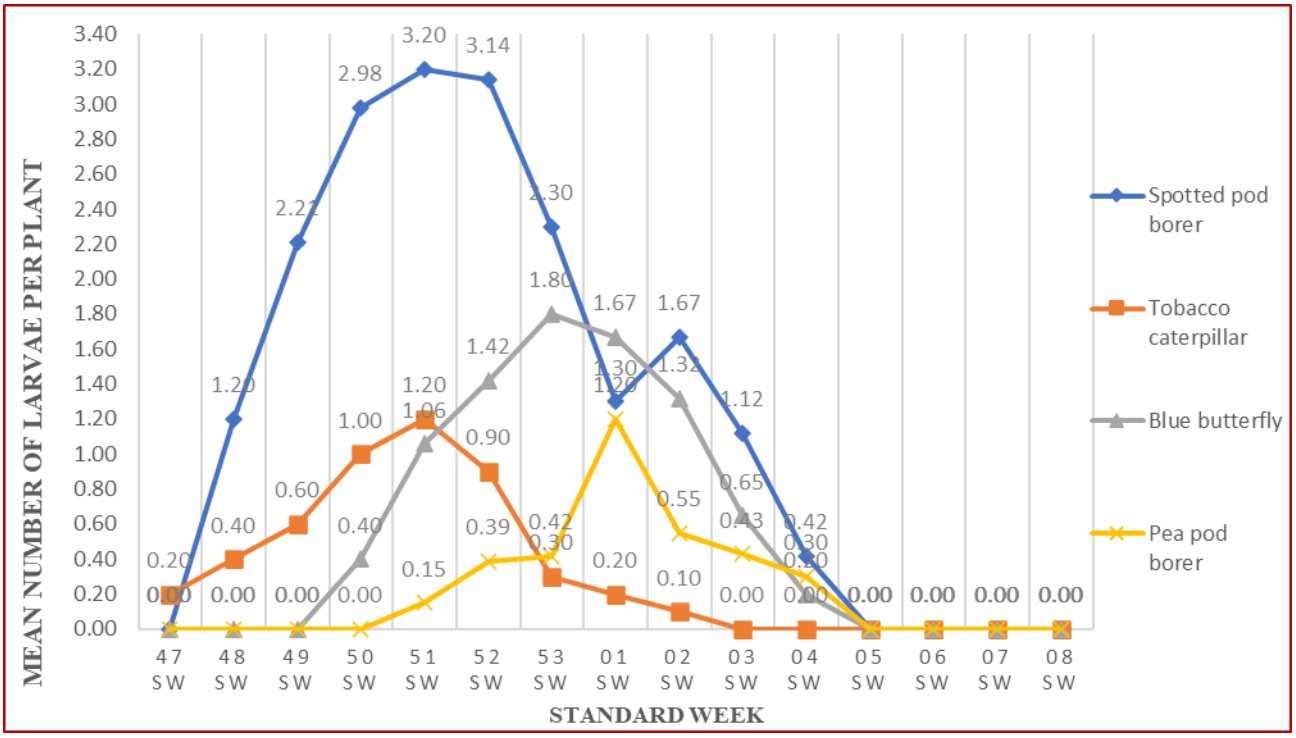

Fig 1: Seasonal incidence of pod borer complex in field bean early sown crop (D_1) during *Rabi*, 2020 -21

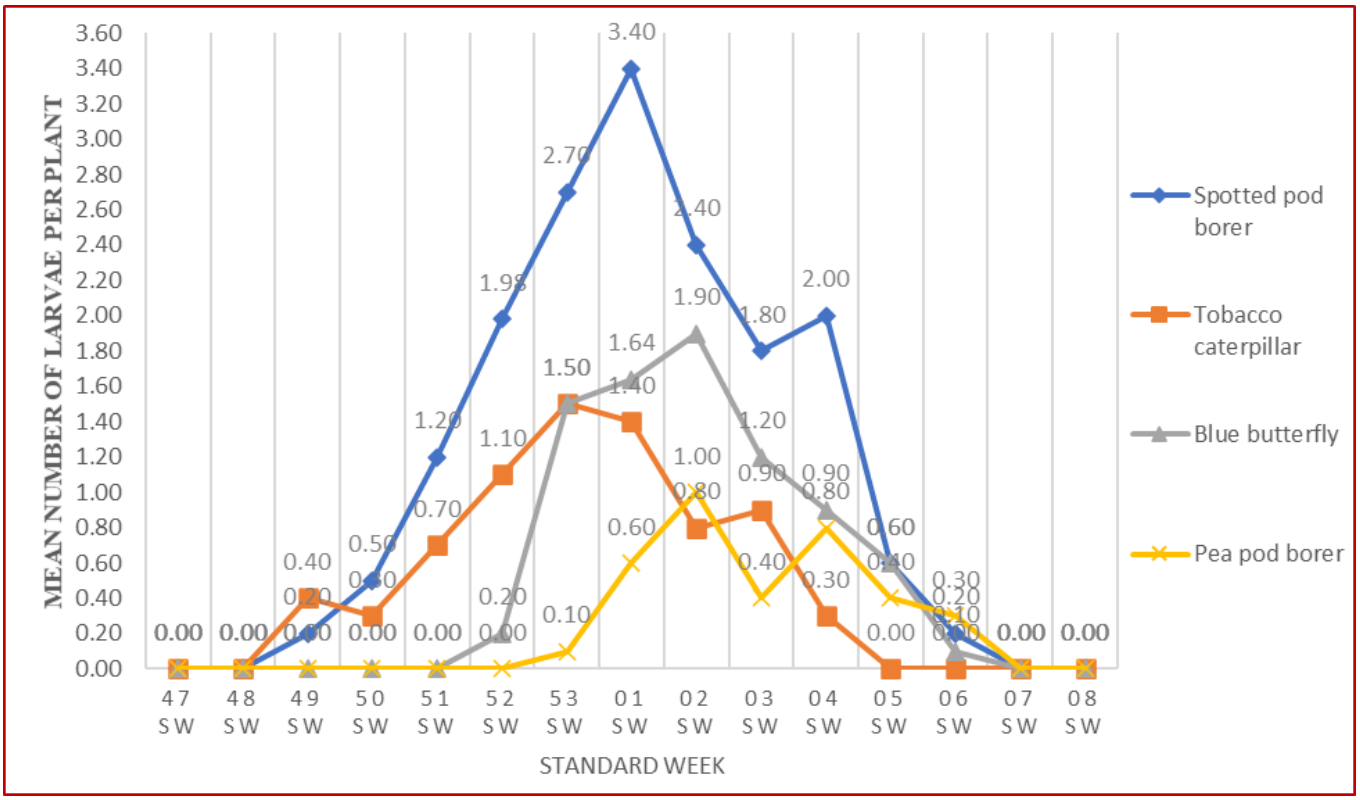

Fig 2: Seasonal incidence of pod borer complex in field bean normal sown crop (D_2) during *Rabi*, 2020 -21

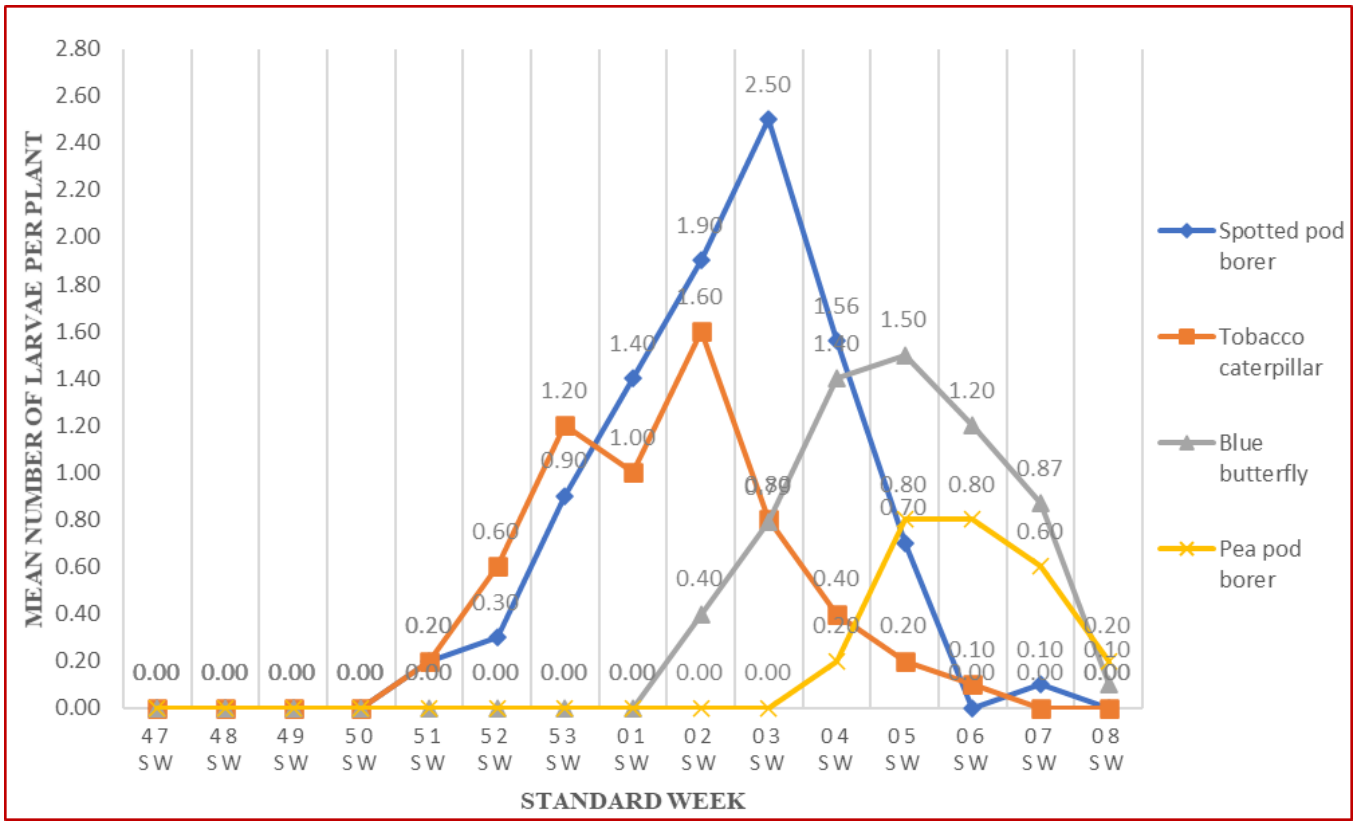

Fig 3: Seasonal incidence of pod borer complex in field bean late sown crop (D_3) during *Rabi*, 2020 -21

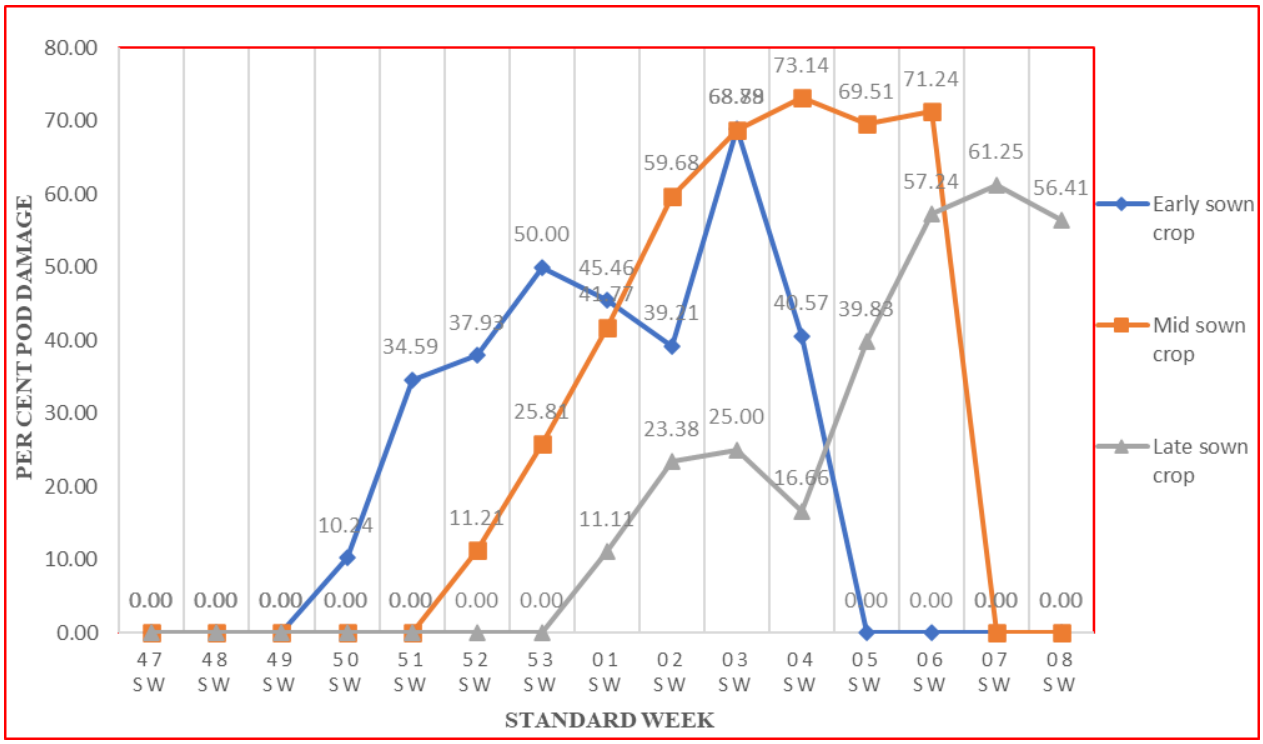

Fig 4: Effect of seasonal incidence of pod borer complex on per cent pod damage in field bean during *Rabi*, 2020

The blue butterfly larvae showed significant negative correlation with minimum temperature (r = -0.639) and significant positive correlation with sunshine hours (r = 0.706). Pea pod borer larvae exhibited significant negative correlation with minimum temperature (r = -0.643) and evening relative humidity (r = -0.634) whereas significant positive correlation with sunshine hours (r = 0.651) in late sown crop (D_3).

The results from regression analysis revealed that all the weather parameters have influenced the larval population of pod borer complex *viz.*, *M. vitrata*, *S. litura*, *L. boeticus*, *E. zinkeneilla* to an extent of 75.31, 74.72, 88.11 and 87.68 per cent, respectively in early sown crop (D_1) whereas it was of 85.07, 86.12, 87.31 and 80.00 per cent, respectively in normal sown crop (D_2) while 78.10, 81.20, 77.11 and 79.60 per cent, respectively in late sown crop (D_3).

The per cent pod damage due to pod borer complex ranged between 10.24 and 73.14 per cent in all the three sown crops with highest per cent damage recorded at 03 SW (68.89%) in D_1 sown crop, 04 SW (73.14%) in D_2 sown crop and 07 SW (61.25%) in D_3 sown crop. The per cent pod damage has shown significant positive correlation in normal and late sown crop with maximum temperature (r = 0.798, 0.806) and sunshine hours (r = 0.687, 0.676), whereas there was significant negative correlation with evening relative humidity in all the three dates of sowing (r = -0.701, -0.716, -0.742). The correlation between per cent pod damage and rainfall was significantly negative in early sown crop (r = -0.742). The weather parameters have shown influence on per cent pod damage caused by pod borer complex to an extent of 86.78, 88.95 and 85.51 per cent in D_1, D_2 and D_3 sown crops, respectively.

These presents results were in agreement with Umbarkar *et al.* (2010) [23] who reported that the population of *Maruca* pod borer started appearing from 5th week after sowing and peak pest density was observed during 7th week after sowing in green gram at Junagadh. Similarly, Shivaraju *et al.* (2008) [20], Chittibabu *et al.* (2009) [4] and Sonune *et al.* (2010) [21] reported that the peak larval activity coincided with peak flowering stage in black gram. The results were also in confirmity with Thejaswi *et al.* (2008) [22] who opined that the incidence of *Maruca* is from second fortnight of September to first fortnight of February with peak incidence from second fortnight of November to December first fortnight in field bean at Karnataka. The results are in contrary with the results obtained by Yadav *et al.* (2015) [25] who reported that the peak infestation of the larval population of *S. litura* was observed at 40 SW in blackgram. Similarly, Mohapatra *et al.* (2018) [14] reported that the peak larval population of *S. litura* was observed at 39 SW in blackgram. This change in the incidence may be due to change in the season, crop and weather conditions.

These findings were also in close agreement with the investigation done by Mallikarjuna (2009) [11] who reported that the peak incidence (15 larvae/quadrate) of *L. boeticus* was observed during 21st December (third week) with a mean incidence range of 0 to 15 larvae per quadrate. Aoki (1927) [2] and Rekha (2005) [18] recorded the incidence of *L. boeticus* in large number on beans during December. Similar observations were also

made by Singh and Dhooria (1971) [19], Pandey *et al.* (1978) [17] and Govindan and Thontadarya (1982) [6] on pea and field bean.

However, Abdallah *et al.* (1994) [1] reported that *E. zinckenella* is a pest of various leguminous crops in the cropping season. The pest showed peak activity in February to March. Mallikarjuna *et al.* (2012) [12] also reported that pea pod borer, *E. zinckenella* peaked during the 1st week of December. This change in the incidence may be due to change in the season and weather conditions.

The present results from correlation studies revealed that spotted pod borer exhibited nonsignificant correlation with all the weather parameters. All other pod borers exhibited nonsignificant relationship with maximum temperature. Similar to the above results, Mallikarjunappa (1989) [13] reported that there was no influence of weather parameters on

the incidence of pod borers on field bean and recorded non-significant correlation with all the pod borers.

In contrast to the above results, Yadav *et al.* (2015) [25] reported that temperature (minimum and maximum), relative humidity (morning and evening) and sunshine showed a non-significant positive correlation with the population of *S. litura* on black gram. Kumar *et al.* (2007) [10] also reported a non-significant correlation between maximum temperature, minimum temperature, relative humidity, and rainfall and tobacco caterpillar on black gram. Mohapatra *et al.* (2018) [14] reported that the population of *S. litura* showed significant negative correlation with relative humidity on black gram. In contrast to the above correlation results, Mallikarjuna (2012) [12] reported that, with minimum RH, *E. zinckenella* (r=0.54) has showed significant positive correlation and correlation was significantly positive between maximum RH and incidence of *L. boeticus* (r=0.61). Vaibhav *et al.* (2018) [24] proved that the correlation of the larval population of *E. zinckenella* was found negative with maximum (r= -0.007) and positive with minimum (r= 0.378) temperature during *Rabi*, 2014-15. It was positively correlated (r= 0.313) with relative humidity and also positive (r=0.393) with rainfall. Dhaka *et al.* (2011) [5] reported that the population of *E. zinckenella* on vegetable pea was negatively correlated with minimum and maximum temperature and positively correlated with minimum and maximum relative humidity and with rainfall.

Conclusion

Normal sown crop (D_2) has recorded higher incidence of pod borer complex *viz*., *M. vitrata, S. litura, L. boeticus* and *E. zinkeneilla* when compared with early (D_1) and late sown crop (D_3). The correlation coefficients worked out revealed that all the weather parameters expect morning relative humidity and rainfall had a significant correlation with pod borer complex population in the late sown crop (D_3). All the meteorological parameters, *viz.,* maximum temperature, minimum temperature, relative humidity, rainfall and sunshine hours had no significant impact on population of the pod borers in early (D_1) and normal (D_2) sown crops.

References

1. Abdallah SA, Barakat AA, Sammour EA, Badawy HMA, Soliman MM. Field evaluation of certain insecticides against cowpea pod borer *Etiella zinckenella*. Bulletin of Entomological Society of Egypt Economic Series. 1994;21:191-197.
2. Aoki V. On *Polyommatus boeticus* L. infesting *Vicia faba* (in Japanese). Kontyuii 1927;1:53-55.
3. Chakravarthy AK. Pod borer resistance in *Lablab niger* (L.) cultivars with special reference to the pod borer, *Adisura atkinsoni* Moore (Lepidoptera: Noctuidae). M.Sc (Agri.) Thesis, University of Agricultural Sciences, Bengaluru 1977, 122.
4. Chittibabu G, Madhumathi T, Arjuna Rao P, Srinivasa Rao V. Seasonal Incidence of Spotted Pod Borer [*Maruca vitrata* (Geyer); Pyralidae; Lepidoptera] on Blackgram. The Andhra Agricultural Journal. 2009;56:31-33.
5. Dhaka SS, Singh G, Ali N, Mittal V, Singh DV. Efficacy of novel insecticides against pod borer, *Etiella zinckenella* (Treitschke) in vegetable pea. *Crop Research* (Hisar). 2011;42(2):331-335.
6. Govindan R, Thontadarya TS. Studies on insect pests of field bean in Karnataka. Mysore Journal of Agricultural Sciences 1982;16:295-300.
7. Govindan R. Insects of the field bean, *Lablab purpureus* var. *lignosus medikus* with special reference to the biology and ecology of the pod borer, *Adisura atkinsoni* Moore (Leipdoptera: Noctuidae). M. Sc. (Agri.) thesis, University of Agricultural Sciences, Bangalore 1974, 1-34.
8. Jeer. Seasonal incidence of pod borer complex of field bean, *Lablab purpureus* L. (Sweet) 2011. http://www.lablablab.org/html/insects-management.html.
9. Katagihallimath SS, Siddappaji C. Observations on the incidence of lepidopteran pod borers of Dolichos lablab and the results of preliminary insecticidal trails to control them. 2nd All India Congress of Zoology 1962, 59.
10. Kumar R, Ali S, Chandra U. Seasonal incidence of insect-pests on Vigna mungo and its correlation with abiotic factors. Annals of Plant Protection Sciences. 2007;15(2):366-369.
11. Mallikarjuna J, Kumar CTA, Rashmi MA. Field evaluation of indigenous materials and newer insecticide molecules against pod borers of dolichos bean. Karnataka Journal of Agricultural Sciences. 2009;22:617.
12. Mallikarjuna J, Kumar ACT, Chakravarthy AK, Revadi Santosh. Seasonal incidence and abundance of pod borers in Dolichos bean, *Lablab purpureus* L. (Sweet) in Bengaluru. Current Biotica 2012; 6(1):107-112.
13. Mallikarjunappa. Field bean pod borer complex with reference to germplasm screening, life table, action threshold, crop loss and chemical control of *Adisura atkinsoni*. M. Sc. (Agri.) thesis, University of Agricultural Sciences, Bangalore 1989, 6-15.
14. Mohapatra MM, Singh DC, Gupta PK, Chandra U, Patro B, Mohapatra SD. Seasonal Incidence of Major Insect-Pests on Blackgram, *Vigna mungo* (Linn.) and Its Correlation with Weather Parameters. International Journal of Current Microbiology and Applied Sciences. 2018;7(6):3886-3890.
15. Naik MI, Tejaswi L, Sridhara S, Manjunath M, Pradeep S. Yield loss and economic injury level for pod borers of field bean (*Lablab purpureus* L.). Environment and Ecology. 2009;27(3):1044-1047.
16. National Horticulture Board statistics, 2019-20
17. Pandey ND, Misra SC, Pandey UK. Some observations on the biology of *Polyomnatus boeticus* L. (Lepidoptera: Lycaenidae) a pest of *Cajanas cajan* (L.) Mill. Indian Journal of Entomology 1978;40:81-82.
18. Rekha S. Status and management of pod borer complex in dolichos bean *Lablab purpureus* (L.) M.Sc. (Agri.) Thesis, University of Agriculture Science, Dharwad 2005.
19. Singh H, Dhooria M. Bionomics of the pea pod borer, *Etiella zinckenella* (Tr.) Indian Journal of Entomology 1971;33:123-130.
20. Shivaraju C, Ashok Kumar CT, Sudhir Kumar S, Thimmiah M. Seasonal incidence of pod borer complex on Blackgram, [*Vigna mungo* (L.)] Journal of Entomological Research 2008;35:39-42.
21. Sonune VR, Bharodia RK, Jethva DM, Dabhade PL. Seasonal incidence of spotted pod borer, *Maruca testulalis* (Geyer) on blackgram. *Legume Research.* 2010;33:61-63.
22. Thejaswi L, Mohan I, Naik Y, Manjunatha M. Studies on population dynamics of pest complex of field bean

(*Lablab purpureus* L.) and natural enemies of pod borers. Karnataka Journal Agricultural Sciences 2008;21:399-340.
23. Umbarkar PS, Parsana GJ, Jethva DM. Seasonal incidence of gram pod borer, *Helicoverpa armigera* (Hubner) on green gram. Legume Research. 2010;33: 148-149.
24. Vaibhav V, Singh G, Deshwal R, Maurya NK, Vishvendra. Seasonal incidence of major pod borers *Etiella zinckenella* (Treitschke) and *Helicoverpa armigera* (Hubner) of vegetable pea in relation with abiotic factors. Journal of Entomology and Zoology Studies 2018;6(3):1642-1644.
25. Yadav SK, Agnihotri M, Bisht RS. Seasonal incidence of insect-pests of blackgram, Vigna mungo (Linn.) and its correlation with abiotic factors. Agriculture Science Digest 2015b;35(2):146-148.