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## Morphological basis of resistance against *Maruca vitrata* (G) in Indian bean, *Lablab purpureus* var. *typicus* (L)

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### Abstract

The spotted pod borer, *Maruca vitrata* (Geyer) is one of the major limitations to increasing the production and productivity of Indian bean in the tropics. The concealed feeding habit of spotted pod borer in flowers and pods make it difficult to control. Hence, host plant resistance is an important tool for the management of these pests. Therefore, nine determinate Indian bean varieties were screened for resistance to spotted pod borer under field conditions and characterized for morphological traits in the flowers and pods. The correlation studies revealed that, pod wall thickness (0.852<sup>\*\*</sup>), pod length (0.756<sup>\*\*</sup>), pod weight (0.709<sup>\*</sup>), number of seeds per pod (0.795<sup>\*</sup>), seed length (0.850<sup>\*\*</sup>), seed width (0.798<sup>\*\*</sup>) had significant positive correlation with spotted pod borer damage. Therefore these traits can be used as phenotypic markers to identify Indian bean varieties with resistance to spotted pod borer *M. vitrata*.

**Keywords:** Spotted pod borer, Indian bean, Morphological traits, resistance

### Introduction

Indian bean (*Lablab purpureus* var. *typicus* (L.) Sweet) also called as Indian butter bean, lablab bean, Dolichos bean, waby bean (English) is mainly grown for fresh whole pod and dry seeds as pulse grain. Its demand is excellent in local markets. Commercial cultivation of this vegetable increases day by day but, the average production is low at farmer's level. Govindhan (1974) [4] recorded as many as 55 species of insects and a species of mite feeding on Indian bean from seedling stage to harvest. The poor yield is mainly attributed to the attack of a wide range of insect pests among them spotted pod borer, *Maruca vitrata* (Geyer) (Crambidae, Lepidoptera) is a serious polyphagous pest attacking various legumes viz., cowpea, green gram, black gram, red gram, yam bean, field bean etc., (Atachi and Djihou, 1994) [1]. It causes serious yield losses to edible legumes due to its extensive host range, high damage potential and cosmopolitan distribution. Larva of *M. vitrata* feeds on flowers, stems, peduncles and pods of legumes resulting in lower yield. Varying yield loss has been reported viz. 20-60 per cent in cowpea (Singh and Alen, 1980) [12], 9-84 per cent in pigeon pea (Ganapathy, 1996) [4], 9.14-34.95 per cent in dolichos bean (Rekha and Mallapur, 2007) [11]. Screening of available cultivars helps to know the resistant variety available for cultivation by farmers which gives higher yield even after pest infestation. Growing of resistant varieties is an ideal component of integrated pest management without any additional cost. Therefore screening of available cultivars helps to know the resistant variety available for cultivation by farmers which gives higher yield even after pest infestation. Knowledge on specific factors that contribute to insect resistance can be extremely useful to entomologists and plant breeders. Development of varieties with multiple mechanisms of resistance should slow down the development of insect biotypes. Knowledge on mechanisms of insect resistance could facilitate the development of more stable and long lasting type of resistance. Therefore; the present study was undertaken on the role of the morphological characters of the plants on the flower and pod damage by *M. vitrata*.

### Materials and Methods

Studies on infestation of spotted pod borer on flowers and pods, were undertaken on nine determinate Indian bean varieties viz., Arka Amogh, Arka Jay, Arka Sambhram, Arka Soumya, Arka Vijay, NIB 1, Konkan Bhushan, Tirupathi Local and West Godavari Local at Department of Entomology, College of Horticulture, Venkataramannagudem, West Godavari

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Dist., Andhra Pradesh, during during *Kharij*, 2017-18. Indian bean seeds were sowed in a plot of size 30 x 20 m with a spacing of 60 cm between rows and 30 cm between plants. Recommended package of practices were adopted for raising the crop excluding the plant protection measures. Randomly selected five plants in each replication were tagged and were used for data collection. Data on various flower characters of different Indian bean varieties viz. flower colour, number of flower shoots per plant, number of flowers per plant, length of the flower shoot, number of flowers per shoot, average distance between two nodes, number of flowers per node, days required to 50% flowering, number of infested flowers per plant and pod characters viz., pod colour, pod wall thickness, pod length, pod width, number of pods per plant, seed colour, number of seeds per pod, seed length, seed width, seed weight and days to pod maturity were studied for their role in expression of varietal reaction to spotted pod borer and procedure adopted for recording observations.

### Methodology

At flowering stage the number of infested flowers from five randomly selected and tagged plants from a plot were counted as against total number of flowers per flower shoot and per cent flower infestation was worked out. The observations on flower infestation were taken at weekly interval up to the fruiting stage. At the time of harvesting, the pods of each plant were harvested separately and numbers of healthy and infested pods per pant were counted. The observations were taken at each picking untill final harvesting. Data on per cent flower infestation, pod infestation and percent increase of yield over control was recorded and the data was subjected to

statistical analysis.

### Results and Discussion

#### Morphological parameters of the flowers of Indian bean varieties in relation to flower infestation

Plants defend themselves against herbivores using their biophysical and structural features. In many cases, it is obvious that the biophysical characters of the host plant play an important role in conferring resistance to pod borer. Major biophysical characters of Indian bean flowers and pods in relation to spotted pod borer infestation is given in Table 1 and 2.

Data (Table 1) revealed that the mean per cent flower infestation in different Indian bean varieties ranged from 17.75 to 52.60 per cent. Flower infestation was high in the variety Arka Soumya (52.60%). Low flower infestation was observed in NIB-1 (17.75%).

The flower colour noted was white in all varieties viz., Arka Amogh, Arka Sambaram, Arka Soumya, Arka Vijay, Konkan Bhushan, Tirupathi Local, and West Godavari Local. In variety Arka Jay, purple colour flowers was noticed (Plate 1). Flower colour did not have any significant effect on larval population and there was no significant correlation found for flower infestation

with number of flower shoots per plant, number of flowers per plant, length of the flower shoot average distance between two flower nodes, number of days required for flower initiation, number of infested flowers per plant but number of larvae per plant correlated with flower infestation it is may be based on the biochemical contents of the flowers.

**Table 1:** Flower characters of Indian bean varieties and infestation of spotted pod borer, *M. vitrata*

S. No.	Name of the varieties	Flower colour	Number of flower shoots per plant	Number of flowers per plant	Length of the flower shoot (cm)	Number of flowers per shoot	Average distance between two flower nodes (cm)	Number of flowers per node	Days required for flower initiation (DAS)	Number of infested flowers per plant	Flower infestation percentage
1	Arka Amogh	White	10.33 (3.36)	181.00 (13.48)	31.97 (5.74)	20.00 (4.58)	1.67	3.00 (2.00)	40.25	78.93 (9.50)	50.21
2	Arka Jay	Violet	13.00 (3.74)	266.67 (16.34)	33.83 (5.90)	28.00 (5.38)	2.20	3.09 (2.00)	42.33	106.50 (11.12)	42.28
3	Arka Sambhram	White	11.00 (3.46)	182.00 (13.52)	29.93 (5.56)	20.67 (4.65)	1.33	4.00 (2.23)	41.33	85.56 (9.80)	47.25
4	Arka Soumya	White	12.00 (3.60)	220.00 (14.86)	32.80 (5.81)	21.67 (4.76)	2.00	3.33 (2.07)	42.67	117.75 (10.80)	52.60
5	Arka Vijay	White	9.00 (3.16)	183.00 (13.56)	30.90 (5.65)	22.67 (4.86)	2.33	3.00 (1.99)	39.00	85.31 (9.77)	51.94
6	NIB-1	White	16.00 (4.12)	250.00 (15.81)	30.50 (5.61)	14.33 (3.91)	2.33	1.67 (1.62)	37.00	99.43 (11.01)	17.75
7	Konkan Bhushan	White	13.00 (3.74)	290.00 (17.05)	54.37 (7.44)	23.33 (4.93)	3.00	3.67 (2.15)	53.00	99.68 (10.99)	41.45
8	Tirupathi Local	White	8.00 (2.99)	133.33 (11.58)	34.77 (5.98)	17.33 (4.28)	3.33	3.32 (2.06)	40.00	56.25 (6.61)	32.41
9	West Godavari Local	White	11.00 (3.46)	311.66 (17.68)	60.57 (7.84)	30.00 (5.47)	3.67	4.00 (2.23)	41.33	168.00 (11.56)	42.64
SE(m) ±			0.06	0.30	0.03	0.07	0.11	0.07	1.62	0.29	2.72
C.D. at 5%			0.19	0.90	0.11	0.22	0.33	0.22	4.90	0.89	8.23

-Data based on average of 15 observations -Figures in parentheses are Square root transformed values -DAS: Days after sowing

#### Morphological parameters of the pods of Indian bean varieties

Of the nine Indian bean varieties planted, the pod colour varied from light green to dark green. In varieties Arka Amogh, Arka Jay, Arka Sambhram, Konkan Bhushan, the colour of the pod was green. Light green colour pods were

noticed in NIB-1 and West Godavari Local. In varieties, like Arka Soumya and Arka Vijay pods were dark green in colour. Pod wall thickness of different Indian bean varieties ranged from 1.02 to 1.89 mm. High pod wall thickness was recorded in varieties West Godavari Local (1.89 mm). Low pod wall thickness was measured in NIB-1 1.02 mm, which were

statistically on par with each other. The pod wall thickness was found to be highly significant (0.852) and positively associated with the pod damage. The results are in accordance with the findings of Chandrayadu *et al.* (2006) [2] who reported that pod wall thickness was positively correlated with pest damage.

Pod length in different varieties ranged from 3.89 to 9.56 cm. Long pods was observed in the variety Arka Soumya (9.56 cm). Pods were short in NIB- 1 (3.98 cm). The pod length was found to be highly significant (0.756) and positively associated with the pod damage. Nanda *et al.* (1996) [9], Halder *et al.* (2006) [6], Kamakshi and Srinivasan (2008) [8], Halder *et al.* (2011) [7] also reported significant positive correlation between pod length and pod borer infestation.

Pod width in different Indian bean varieties ranged from 0.51 to 2.02 cm. Lowest pod width measured in Arka Soumya (0.51 cm). In varieties like NIB-1, Arka Vijay, Arka Amogh, Arka Jay, Konkan Bhushan, West Godavari Local and Arka Sambhram the pod width measured were 0.60, 0.77, 0.83, 1.00, 1.03, 1.07 and 1.53 cm which were statistically similar with each other. Variety Tirupathi Local measured highest pod width (2.02 cm). The pod width was found to be positive (0.294) non significant with the pod damage due to spotted pod borer infestation. Kamakshi and Srinivasan (2008) [8] at reported that relationship between pod width and pod borer was non-significant.

Pod weight in different Indian bean varieties ranged from 2.27 to 8.67 g. Lowest pod weight was measured in NIB-1 (2.27g). Highest pod weight was recorded in Tirupathi Local (8.67 g) which was superior to other varieties. The pod weight was found to be highly significant (0.709) positively associated with the pod damage.

There was considerable variation among the varieties under study for number of pods per plant ranging from 16.67 to 30.33 per plant. Highest number of pods per plant observed in Konkan Bhushan (30.33). Less number of pods per plant recorded in West Godavari Local in which pods per plant were 16.67 per plant. The pod per plant was found to be negative (-0.448) and non-significant.

Significant variation was noticed with respect to days to pod maturity which ranged from 46.67 to 64.67 DAS. Early fruiting was observed in the variety NIB-1 (46.67 DAS). Arka Sambhram and Konkan Bhushan achieved pod maturity in 61.33 and 64.67 DAS. Correlation studies showed the days to pod maturity was found to be positive (0.464) and non-significant.

Pod infestation in different Indian bean varieties ranged from 20.00 to 50.00%. Pod infestation was high in the variety West Godavari Local (50.00%). Variety NIB-1 (20.00) recorded the

lowest pod infestation per cent age among the varieties. The number of larvae per plant was found to be highly significant (0.795) positively associated with the pod damage.

The colour of seeds of Indian bean varieties screened had no clear cut impact on the infestation of pod borer. Seed colour was recorded green in Arka Amogh, Arka Jay, Arka Sambhram, Arka Soumya, Konkan Bhushan, Tirupathi Local, and West Godavari Local. Creamy white colour seeds were observed in Arka Vijay. Light green colour seeds were observed in NIB-1.

Considerable variation was observed among the varieties regarding number of seeds per pod which ranged from 3.00 to 5.78. Highest number of seeds per pod was recorded in Arka Soumya (5.78/ pod). Number of seeds per pod recorded was low in NIB-1, Arka Vijay, Arka Amogh and Konkan Bhushan viz., 3.00, 3.33, 3.67 and 3.67 respectively, which were statistically on par with each other. The seeds per pod were found to be significant (0.795) and positively associated with the pod damage.

Seed length in different Indian bean varieties ranged from 0.88 to 1.50 cm. Seed length was highest in Arka Soumya (1.50 cm). Lowest seed length was observed in Tirupathi Local, Arka Amogh Arka Vijay and NIB-1 which recorded, 1.10, 1.01, 0.97 and 0.88 cm, respectively and were on par with each other. The seed length was found to be significant (0.850) and positively associated with the pod damage due to *M. vitrata* in Indian bean varieties. Dodia (1992) [3] also reported positive correlation with infestation pod borers in pigeon pea to seed size.

Seed width in different Indian bean varieties ranged from 0.41 to 0.76 cm. Seed width was high in West Godavari Local, Tirupathi Local and Arka Jay which registered 0.76, 0.73 and 0.69 cm, respectively and were statistically on par with each other. Low seed width was recorded in Arka Soumya (0.47 cm), Arka Amogh(0.43cm) and NIB-1 (0.41cm). The seed width was found to be significant (0.798) and positively associated with the pod damage. The results of the study are in accordance with the findings of Dodia (1992) [3] in pigeon pea varieties with more seed size less pod damage.

Seed weight in different Indian bean varieties ranged from 0.32 to 0.81 g. Highest seed weight was observed in West Godavari Local (0.81g). Low seed weight was observed in the varieties like Arka Amogh, Arka Vijay, Arka Soumya and NIB-1 viz. 0.43, 0.42, 0.38 and 0.32 g, respectively and were statistically on par with each other. The seed weight was found to be highly significant (0.828) and positively associated with the pod damage. Dodia (1992) [3] also reported positive correlation with infestation pod borers in pigeon pea to seed weight.

**Table 2:** Correlation and regression studies on morphological parameters of flowers and pods in relation to per cent flower damage by spotted pod borer, *M. vitrata* in Indian bean

S. No.	Variable	Correlation coefficient(r)	Regression equation (Y=a+bX)	R <sup>2</sup> value
<b>A. Morphological characters of flowers</b>				
1	Number of flower shoots per plant (X) vs. Per cent flower damage (Y)	0.524 <sup>NS</sup>	Y = 69.910 - 2.421X	0.2745
2	Number of flowers per plant (X) vs. Per cent flower damage (Y)	-0.152 <sup>NS</sup>	Y = 48.457 - 0.028X	0.0232
3	Length of the flower shoot (X) vs. Per cent flower damage (Y)	-0.001 <sup>NS</sup>	Y = 42.157 - 0.001X	0.0000
4	Number of flowers per shoot (X) vs. Per cent flower damage (Y)	0.499 <sup>NS</sup>	Y = 17.259 + 1.130X	0.2486
5	Average distance between two flower nodes (X) vs. Per cent flower damage (Y)	-0.332 <sup>NS</sup>	Y = 53.798 - 4.783X	0.1104
6	Number of flowers per node (X) vs. Per cent flower damage (Y)	0.606 <sup>NS</sup>	Y = 11.684 + 9.443X	0.3673
7	Days required to flower initiation(X) vs. Per cent flower damage(Y)	0.206 <sup>NS</sup>	Y = 21.984 + 0.480X	0.0424
8	Number of infested flowers per plant (X) vs. Per cent flower damage (Y)	0.654 <sup>NS</sup>	Y = 20.964 - 0.227X	0.4279
9	Number of larvae per plant (X) vs. Per cent flower damage (Y)	0.710*	Y = -0.303 + 8.129X	0.5035
<b>B. Morphological characters of pods</b>				

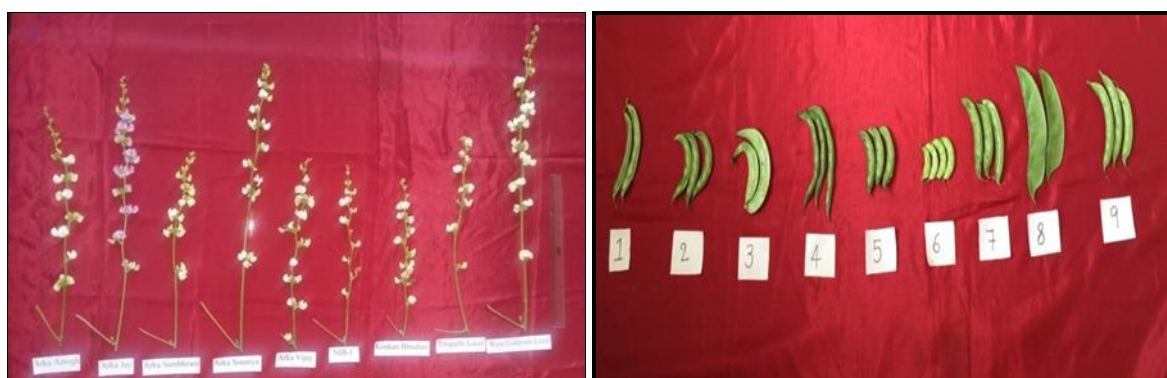
1	Pod wall thickness (X) vs. Per cent pod damage (Y)	0.852**	Y= -9.357+ 34.107X	0.7255
2	Pod length (X) vs. Per cent pod damage (Y)	0.756*	Y= 1.550 + 4.663X	0.5721
3	Pod width (X) vs. Per cent pod damage (Y)	0.294 <sup>NS</sup>	Y= 28.322 + 6.367X	0.0865
4	Pod weight (X) vs. Per cent pod damage (Y)	0.709*	Y= 16.640 + 3.449X	0.5033
5	Number of pods per plant (X) vs. Per cent pod damage (Y)	-0.448 <sup>NS</sup>	Y= 54.250 -0.851X	0.2004
6	Days to pod maturity(X) vs. Per cent pod damage (Y)	0.464 <sup>NS</sup>	Y= -17.334 + 0.904	0.2154
7	Number of seeds per pod (X) vs. Per cent pod damage (Y)	0.795*	Y= -1.053 + 8.426X	0.6313
8	Seed length (X) vs. Per cent pod damage (Y)	0.850**	Y= -13.917 +41.397X	0.7217
9	Seed width (X) vs. Per cent pod damage (Y)	0.798**	Y= -0.535 + 61.883X	0.6371
10	Seed weight (X) vs. Per cent pod damage (Y)	0.828**	Y= 4.722 + 58.582X	0.6855
11	Number of larvae per plant (X) vs. Per cent pod damage (Y)	0.795*	Y= -1.053 + 8.426X	0.6313

\* Significant at  $p < 0.05$ ; \*\* Significant at  $p < 0.01$  Y= dependent variable, X= independent vari

**Table 3:** Pod characters of Indian bean varieties and infestation of spotted pod borer, *M. vitrata*

S. No.	Name of the variety	Pod colour	Pod characters								Seed characters				
			Pod wall thickness (mm)	Pod length (cm)	Pod width (cm)	Pod weight (g)	Number of pods per plant	Time required for pod maturity (DAS)	Infested pods Per plant	Pod infestation (%)	Seed colour	Number of seeds per pod	Seed length (cm)	Seed width (cm)	Seed weight (g)
1	Arka Amogh	Green	1.18	6.23	0.83	3.77	27.67 (5.35)	58.00	7.00 (2.83)	25.30	Green	3.67 (2.16)	1.01	0.43	0.43
2	Arka Jay	Green	1.49	6.96	1.00	6.13	26.00 (5.19)	59.33	11.67 (3.56)	44.90	Green	5.44 (2.54)	1.23	0.73	0.58
3	Arka Sambhram	Green	1.28	8.53	1.53	6.10	16.83 (4.21)	61.33	7.33 (2.89)	43.60	Green	4.67 (2.38)	1.37	0.63	0.57
4	Arka Soumya	Dark green	1.26	9.56	0.51	4.73	20.33 (4.17)	60.27	7.67 (2.94)	37.70	Green	5.78 (2.60)	1.50	0.47	0.38
5	Arka Vijay	Dark green	1.11	5.96	0.77	3.47	20.33 (4.62)	56.00	5.00 (2.43)	24.60	White	3.33 (2.08)	0.97	0.51	0.42
6	NIB-1	Light green	1.02	3.89	0.60	2.27	28.33 (5.42)	46.67	5.67 (2.57)	20.00	Light green	3.00 (2.00)	0.88	0.41	0.32
7	Konkan Bhushan	Green	1.23	7.54	1.03	4.63	30.33 (5.59)	64.67	11.00 (3.46)	36.30	Green	3.67 (2.16)	1.17	0.53	0.60
8	Tirupathi Local	Dark green	1.23	7.45	2.02	8.67	17.67 (4.31)	57.00	5.67 (2.58)	32.10	Green	4.00 (2.24)	1.10	0.69	0.52
9	West Godavari Local	Light green	1.89	8.28	1.07	8.00	16.67 (4.19)	54.67	8.67 (3.11)	51.00	Green	4.89 (2.43)	1.39	0.76	0.81
SE(m) ±			0.08	0.24	0.07	0.19	0.13	1.13	0.14	0.47		0.06	0.08	0.02	0.04
C.D. at 5%			0.25	0.74	0.20	0.58	0.37	3.41	0.41	1.14		0.18	0.25	0.07	0.11

- Data based on average of 15 observations - Figures in parentheses are Square root transformed values



**Plate 1:** Flowers shoots of different Indian bean varieties **Plate 2:** Pods of different Indian bean varieties

Arka Amogh	Arka Jay	Arka Sambhram
Arka Soumya	Arka Vijay	NIB-1
Konkan Bhushan	Tirupathi Local	West Godavari Local

## Conclusion

The present investigation clearly suggested that Indian bean varieties with characters like pod wall thickness, length of the pods, pod weight, number of seeds per pod, seed length, seed width and seed weight positively correlate with damage.

Therefore, these morphological traits can be used as markers to identify the resistance sources of Indian bean varieties with different mechanism of resistance against pod borer. This finding can be used very effectively in pod borer resistant breeding programme.



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