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EVALUATION OF INDIAN BEAN GENOTYPES AGAINST POD BORER [*HELICOVERPA ARMIGERA* (HUBNER)] ON THE BASIS OF PLANT MORPHOLOGICAL CHARACTERS

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ABSTRACT

Screening of Indian bean (*Dolichos lablab* L., Syn. *Lablab purpureus* L.) genotypes was carried out against pod borer *Helicoverpa armigera* (Hubner) on the basis of to plant morphological characters at Navsari Agricultural University, Navsari during 2012-2013. Of the one hundred and fourteen Indian bean entries screened, no entry was found free from pod borer damage; however, lowest pod damage (0.96 %) was observed in NIB 46 indicating tolerant or resistant reaction, while it remained highest in Gujarat papdi 1 (40.46 %) indicating highly susceptible reaction. Genotypes possessing spreading type growth habit were more susceptible to *H. armigera* than erect type entries. Straight podded entries indicated resistance or tolerance than those possessing curved pods. Genotypes which had higher leaf width, leaf area, pod width, pod area and number of seeds per pod displayed significant negative relationship with pod damage indicating resistance against pod borer oriented pod damage. Likewise, genotypes with purple coloured leaf vein, stem, flower and pod showed resistance or tolerance than those possessing light green colour.

Key words: Indian bean, pod borer and genotypes

INTRODUCTION

Indian bean (*Dolichos lablab* L., Syn. *Lablab purpureus* L., *Lablab niger Medik)* is a group of important pulse cum vegetable crops having great potentiality for protein and yield. In south Gujarat, Indian bean is an important pulse vegetable crop grown particularly in Navsari, Surat and Valsad districts. In India, it covers an area of 23.86 million hectares (Anonymous, 2009); while in Gujarat, it occupies an area of 8901 million hectares with production of 7218 million tonnes. The major constraints affecting yield in Indian bean are insect-pests, which act either as a vector of many diseases or cause direct injury to different parts from seedling to maturity stage. Thirty species of insect pests have been recorded on Indian bean (Srivastava and Butani, 1998). Aphid, jassid, whitefly, pod borer, spotted pod borer and pod bug (*Clavigralla*) are serious pests which attack buds, flowers and pods; of which, pod borer *Helicoverpa armigera (Hubner)* is one of the major constraints in stepping up the production (Vyas and Kumar, 2005).

There have been major changes in the status of several pests under the influence of changing cultural practices and environment. It has now become feasible to develop cultivars with multiple and durable pest resistance and other innovative non-chemical approaches of effective pest management. There are many morphological characters such as plant height, leaf thickness, leaf area, trichome density, internode length, internode number, petiole length and stem diameter responsible for host plant resistance to insect pests (Talekar *et al*., 1988). There is hardly any information available on the role of these morphological plant characters against pod borer *H. armigera infestation*. Hence, the present study was undertaken with the objective of screening of various Indian bean genotypes against pod borer on the basis of morphological characters.

MATERIALS AND METHODS

Field experiments were conducted at the Regional Horticultural Research Station, Navsari Agricultural University, Navsari during *Rabi* 2012-2013 to screen one

hundred and fourteen Indian bean genotypes (Table 2) against pod borer damage in relation to morphological characters of the plant. Pod borer, *H. armigera* oriented damage was assessed by counting total number of pods and bored pods from top, middle and bottom part in each tagged plant. The experimental trial was laid out in randomized block design using two replications. Significance of pod borer damage amongst all the entries was computed by ANOVA. The plant morphological parameters of each selected genotype like growth habit (branching or erect), leaf characters (length, breadth, area and colour), trichome and leaf waxy coating (presence or absence), stem or shoot characters (height and colour), flower colour, pod characters (colour, shape, length, width and area), number of seeds per pod and pod yield in total picking or harvest were compared with pod borer oriented damage on the basis of correlation coefficients. Non measurable parameters were compared on the basis of numerical ratings.

RESULTS AND DISCUSSION

I Screening of Indian bean genotypes against major insect pests on the basis of pod borer damage

The results presented in Table-2 indicate that none of the genotypes were free from pod borer attack; however, lowest pod damage was recorded in NIB-46 (0.96 %) followed by NIB-28, 103, 86 and 25 which were at par with it indicating 3.40, 3.70, 4.00, 4.07 per cent pod damage, respectively. Highest pod damage was recorded in Gujarat papdi-1 (40.46 %) followed by NIB-15 (34.02%), NIB-12 (33.22%), and NIB-93 (32.99 %), NIB-8(30.71%) and NIB-90 (30.44%) which were at par with it. *Earlier, Govindan and Thontadarya* (1980) screened seven varieties of field bean for their relative susceptibility to pod boring lepidopterus pests (H. armigera and M. testulalis) wherein lowest pod damage was recorded in CO8 (24%) and CO7 (36%). Similarly, lowest seed damage was recorded in CO8 (18.1%) followed by Hebbal Avane (28.5%) and CO7 (30.7%). *Srivasubramanian et al.* (1989) observed L. purpureus variety CO2 moderately resistant to pod borer. *Reddy* (2005) indicated that none of the genotypes were free from pod borer attack; however, lowest pod damage was recorded in NW-101 (13.83%) which was at par with NW-104, 102, 103, 110 and 105 indicating 14.18, 14.99, 15.63, 16.60 and 18.63 per cent pod damage, respectively. Highest pod damage was recorded in NW-117 (33.91%) followed by NW-118 (32.72%), NW-115 (31.30%), NW-119 (30.41%) and NW-116 (29.57%) which were at par with it. *Bhuvaneshwari* (2008) screened sixty eight genotypes of field bean under natural conditions against pod borer wherein DA-15, 36, 39, 44, 63 and 65 showed resistant reaction indicating pod damage in the range of 0 - 9.42 per cent. Three genotypes (DA-22, DA-40 and DA-53) were grouped as moderately resistant (pod damage ranged from 9.43 to 18.67 %). Twenty two genotypes with 18.68 to 27.92 per cent pod damage showed moderate susceptible reaction. Maximum number of susceptible genotypes (29) indicated 27.93 to 37.17 per cent pod damage. High susceptibility to pod borer damage was observed in eight genotypes with more than 37.17 per cent pod damage. Shewale et al. (2010) observed none of the genotypes screened to be free from incidence of pod borers. NW Sweet white recorded lower number of larva (1.00/plant), which was at par with NV 74, 206, 2005, NW 145, 30 and 29/1.

In the present investigation, although Indian bean genotypes screened against pod borer, *H. armigera* were different from the above reports, yet their variability revealed that none of the entry remained free from pod borer damage. The degree of variability or relative susceptibility indicated lowest pod damage in NIB 46 (0.96 %) indicating tolerant or resistant reaction; while, it remained highest (40.46 %) in Gujarat papdi -1 indicating highly susceptible reaction. The bean genotypes or entries used in the present investigation may differ from those used in the earlier reports; yet degree of variability or trend of variability among the entries is in line and confirms the present investigation.

Table 1. Numerical ratings of Non statistical parameters

Parameter			Numerical rating		
1. Growth habit	Erect 1	Semi-erect 2	Spreading 3		
2. Leaf colour	Light green 1	Green 2	Dark green 3	Purple 4	
3. Leaf vein colour	Green 1	Purple 2			
3. Trichome	Absent(A) 1	Present(P) 2			
4. Wax coating	Absent 1	Present 2			
5. Stem colour	Light green 1	Green 2	Purple 3	Dark green 4	
6. Flower colour	White 1	Cream 2	Pink 3	Purple 4	
7. Pod colour	Light green 1	Green 2	Dark green 3	Green + purple suter 4	Purple 5
8. Pod shape	Straight 1	Slightly curved 2	Moderately curved 3	Curved 4	

Table 2. Pod borer (*H. armigera*) oriented pod damage on Indian bean genotypes in relation to plant growth habit

Sr. No.	Name of the genotype	Pod borer damaged pod (%)	Rank	Susceptibility	Growth habit
1	NIB-1	19.5 (10.8)*	**4**	S	Semi erect
2	NIB-2	27.6 (21.1)	**5**	HS	Semi erect
3	NIB-3	29.3 (23.5)	**5**	HS	Erect
4	NIB-4	21.3 (12.7)	**4**	S	Semi erect
5	NIB-5A	17.6 (8.8)	**3**	MS	Erect
6	NIB-5B	15.9 (7.10)	**3**	MS	Erect
7	NIB-6	21.1 (12.5)	**4**	S	Semi erect
8	NIB-7	13.3 (4.8)	**3**	MS	Semi erect
9	NIB-8	33.9 (30.7)	**6**	HS	Semi erect
10	NIB-9	19.2 (10.6)	**4**	S	Semi erect
11	NIB-10	17.1 (8.3)	**3**	MS	Semi erect
12	NIB-11	15.3 (6.5)	**3**	MS	Semi erect
13	NIB-12	35.34 (33.99)	**6**	HS	Spreading
14	NIB-13	20.2 (11.6)	**4**	S	Erect
15	NIB-14	20.2 (11.5)	**4**	S	Semi erect
16	NIB-15	35.40 (34.02)	**6**	HS	Spreading
17	NIB-16	23.5 (15.6)	**4**	S	Semi erect
18	NIB-17A	18.6 (9.8)	**3**	MS	Semi erect
19	NIB-17B	21.1 (12.7)	**4**	S	Semi erect
20	NIB-18	16.5 (7.7)	**3**	MS	Erect
21	NIB-19	15.5 (6.7)	**3**	MS	Semi erect
22	NIB-20	14.9 (6.2)	**3**	MS	Semi erect
23	NIB-21A	17.5 (8.8)	**3**	MS	Spreading
24	NIB-21B	19.9 (11.2)	**4**	S	Erect
25	NIB-22	16.6 (8.1)	**3**	MS	Spreading
26	NIB-23	26.5 (19.5)	**5**	HS	Semi erect
27	NIB-24	19.8 (11.1)	**4**	S	Spreading
28	NIB-25	12.3 (4.1)	**2**	MR	Erect
29	NIB-26	19.6 (10.9)	**4**	S	Semi erect
30	NIB-27	17.6 (8.7)	**3**	MS	Semi erect
31	NIB-28	11.3 (3.4)	**2**	MR	Erect
32	NIB-29	18.5 (9.9)	**3**	MS	Semi erect
33	NIB-30	23.4 (15.4)	**4**	S	Semi erect
34	NIB-31	21.1 (12.5)	**4**	S	Semi erect
35	NIB-32	24.5 (16.8)	**4**	S	Semi erect
36	NIB-33	22.4 (14.0)	**4**	S	Semi erect
37	NIB-34	27.3 (20.8)	**5**	HS	Spreading
38	NIB-35	27.3 (20.5)	**5**	HS	Semi erect
39	NIB-36	28.3 (22.1)	**5**	HS	Semi erect
40	NIB-37	26.0 (18.7)	**5**	HS	Semi erect
41	NIB-38	23.8 (16.0)	**4**	S	Semi erect
42	NIB-39	22.4 (14.2)	**4**	S	Semi erect
43	NIB-40	23.9 (16.4)	**4**	S	Semi erect
44	NIB-41	21.4 (13.3)	**4**	S	Spreading
45	NIB-42A	27.1 (20.3)	**5**	HS	Semi erect
46	NIB-42B	26.1 (19.0)	**5**	HS	Semi erect
47	NIB-42C	25.4 (17.9)	**5**	HS	Semi erect
48	NIB-43	26.3 (19.3)	**5**	HS	Erect
49	NIB-44	20.5(11.8)	**4**	S	Spreading

Contd.,...

Table 2. Continued

Sr. No.	Name of the genotype	Pod borer damaged pod (%)	Rank	Susceptibility	Growth habit
50	NIB-45	14.6 (6.1)	**3**	MS	Erect
51	NIB-46	6.94 (0.96)	**1**	R	Erect
52	NIB-47	20.3 (11.7)	**4**	S	Semi erect
53	NIB-48	21.5 (13.2)	**4**	S	Semi erect
54	NIB-49	24.8 (17.3)	**4**	S	Erect
55	NIB-50	24.8 (17.1)	**4**	S	Semi erect
56	NIB-51	16.1 (7.2)	**3**	MS	Erect
57	NIB-52	19.5 (11.1)	**4**	S	Semi erect
58	NIB-53	30.4 (25.1)	**5**	HS	Semi erect
59	NIB-54	15.5 (6.8)	**3**	MS	Semi erect
60	NIB-55	16.8 (7.9)	**3**	MS	Semi erect
61	NIB-56	19.6(10.7)	**4**	S	Semi erect
62	NIB-57	16.7 (7.8)	**3**	MS	Semi erect
63	NIB-58	27.1 (20.7)	**5**	HS	Semi erect
64	NIB-59	17.5 (8.7)	**3**	MS	Semi erect
65	NIB-60	18.4 (9.5)	**3**	MS	Semi erect
66	NIB-61	19.1 (10.4)	**3**	MS	Semi erect
67	NIB-62	22.1 (13.7)	**4**	S	Semi erect
68	NIB-63	18.5 (9.6)	**3**	MS	Spreading
69	NIB-64	23.2 (15.2)	**4**	S	Erect
70	NIB-65	32.3 (28.1)	**6**	HS	Semi erect
71	NIB-66	23.4 (15.4)	**4**	S	Semi erect
72	NIB-67	30.1 (24.8)	**5**	HS	Spreading
73	NIB-68	25.3 (17.8)	**4**	S	Semi erect
74	NIB-69	18.9 (10.2)	**3**	MS	Semi erect
75	NIB-70	24.6 (16.9)	**4**	S	Spreading
76	NIB-71	19.3 (10.5)	**3**	MS	Erect
77	NIB-72	20.1 (11.4)	**4**	S	Semi erect
78	NIB-73	17.2 (8.3)	**3**	MS	Semi erect
79	NIB-74	15.9 (7.0)	**3**	MS	Spreading
80	NIB-75	19.7 (10.9)	**4**	S	Semi erect
81	NIB-76	23.3 (15.2)	**4**	S	Semi erect
82	NIB-77	18.7 (9.9)	**3**	MS	Spreading
83	NIB-78	20.5 (11.8)	**4**	S	Spreading
84	NIB-79	27.9 (21.4)	**5**	HS	Semi erect
85	NIB-80	33.6 (30.2)	**6**	HS	Erect
86	NIB-81	20.6 (11.9)	**4**	S	Semi erect
87	NIB-82	27.2 (20.4)	**5**	HS	Semi erect
88	NIB-83	19.2 (10.3)	**3**	MS	Erect
89	NIB-84	31.1 (26.1)	**5**	HS	Semi erect
90	NIB-85	21.2 (12.7)	**4**	S	Semi erect
91	NIB-86	12.3 (4.0)	**2**	MR	Erect
92	NIB-87	21.8 (13.4)	**4**	S	Semi erect
93	NIB-88	16.4(7.5)	**3**	MS	Semi erect
94	NIB-89	17.8 (8.9)	**3**	MS	Semi erect
95	NIB-90	33.7 (30.4)	**6**	HS	Spreading
96	NIB-91	23.9 (16.1)	**4**	S	Semi erect
97	NIB-92A	15.7 (6.9)	**3**	MS	Semi erect
98	NIB-92B	18.0 (9.1)	**3**	MS	Semi erect
99	NIB-93	35.5 (33.2)	**6**	HS	Semi erect

Contd.,...

Table 2. Continued

Sr. No.	Name of the genotype	Pod borer damaged pod (%)	Rank	Susceptibility	Growth habit
100	NIB-94	24.0 (16.0)	**4**	S	Semi erect
101	NIB-95A	19.9 (11.1)	**4**	S	Semi erect
102	NIB-95B	27.7 (21.2)	**5**	HS	Semi erect
103	NIB-96	17.3 (8.4)	**3**	MS	Semi erect
104	NIB-97	20.1 (11.4)	**4**	S	Semi erect
105	NIB-98	21.9 (13.6)	**4**	S	Semi erect
106	NIB-99	20.8 (12.3)	**4**	S	Erect
107	NIB-100	21.9 (13.6)	**4**	S	Semi erect
108	NIB-101	27.1 (20.5)	**5**	HS	Semi erect
109	NIB-102	15.8 (7.0)	**3**	MS	Erect
110	NIB-103	11.8 (3.7)	**2**	MR	Semi erect
111	NIB-104	20.0 (11.2)	**4**	S	Semi erect
112	NIB-105	15.6 (6.7)	**3**	MS	Semi erect
113	NIB-106	23.7(15.7)	**4**	S	Semi erect
114	Gujarat papdi-1	39.78 (40.46)	**7**	HS	Spreading
S. Em $\pm$		2.19			
CD at 5 %		6.13			
CV (%)		14.24			
Pod borer *H. armigera* ('r')					0.2878**

II Relationship of pod borer damage with plant morphological characters

(i) Growth habit. Resistant genotypes like NIB 46, 28, 103, 86 and 25 possessed erect and semi erect growth habits recording lower pod borer damage (0.96, 3.40, 3.70, 4.00, 4.1 %, respectively); while, highly susceptible Gujarat papdi-1 and NIB-15 and 12 genotypes possessed spreading type of growth habit which in turn indicated significantly higher pod borer damage (40.46, 34.02 and 33.22 %, respectively). Correlation between pod borer damage and growth habit was highly significant and positive (r = 0.2878). So, it is evident that erect genotypes showed characteristics of reducing pod damage in Indian bean genotypes (Table 2). Oghiakhe et al. (1991) reported that cowpea cultivar with less dense foliage and long peduncles holding the reproductive structures above the canopy ultimately increased cowpea resistance against legume pod borer, M. testulalis. Fakir et al. (1992) reported that pigeonpea cultivar ICPL-11289 having more branches and leaves with bushier and more compact canopy structure was more infested by pod borer (28.38%) than local cultivar having less number of branches and leaves. Oghiakhe et al. (1993) while studying the effect of plant growth habit (erect v/s spreading and flowering pattern) on resistance of cowpea to legume pod borer, Maruca testulalis Geyer, noted that seed and pod damage assessment values were lower in erect cultivars than in spreading cultivars.

In the present investigation, NIB 46, 28, 103, 86 and 25 possessed erect and semi erect growth habits which in turn had lower pod damage (0.96, 3.40, 3.70, 4.00, 4.1 %, respectively) compared to Gujarat papdi-1 and NIB-15 and 12 which had spreading type growth habit indicating higher pod damage (40.46, 34.02 and 33.22 %, respectively). The present findings are almost similar to the earlier reports which have proved lowest susceptibility of erect type genotypes over the spreading types.

(ii) Leaf width. Significantly higher leaf widths (10.28, 9.46, 9.24, 9.19, 9.16 and 9.13 cm) were noticed in NIB-17A, 5B, 29, 11, 18 and 4, respectively wherein lower pod borer damage (9.8, 7.10, 9.9, 6.5, 7.7 and 12.7 %, respectively) was observed; while, it was comparatively higher in NIB-42A (6.29 cm) which indicated as high as 20.3 per cent pod damage. The correlation between pod borer damage and leaf width was significant but negative (r = -0.2302) implying that higher leaf width minimizes the pod borer infestation (Table 3).

(iii) Leaf area. Leaf area ranged from 44.68 to 100.22 cm^2 wherein significantly higher leaf areas (100.22, 89.89, 88.04, 87.35, 84.74, 83.37cm^2) were observed in NIB-17A, 5B, 40, 11, 18, 72, respectively. These entries recorded 9.8, 7.10, 16.4, 6.5, 7.7, 11.4 per cent pod damage, respectively. Genotypes like NIB-76, 42A and 70 and Gujarat papdi-1 recorded significantly lower leaf areas (45.86, 44.68, 48.53, 49.84 cm^2) and had significantly higher pod borer damage (15.2, 20.3, 16.9, 40.46 %, respectively). Correlation between pod borer damage and leaf area was significant and negative (r = -0.2030). So, it may be concluded that incidence of pod borer *H. armigera* decreased with increased leaf area and vice-versa (Table 3).

Table 3. Pod borer (*H. armigera*) oriented pod damage on Indian bean genotypes in relation to leaf characters and stem colour

S.No.	Name of the genotype	Per cent pod borer damage	Leaf width (cm)	Leaf area (cm^2)	Leaf vein colour	Trichome absent/ present	Stem colour
1	NIB-1	19.5 (10.8)	8.08	70.73	Green	P	Light green
2	NIB-2	27.6 (21.1)	7.05	56.40	Green	A	Light green
3	NIB-3	29.3 (23.5)	8.17	67.38	Green	A	Green
4	NIB-4	21.3 (12.7)	9.13	83.11	Purple	A	Dark purple
5	NIB-5A	17.6 (8.8)	7.30	58.78	Purple	A	Dark purple
6	NIB-5B	15.9 (7.10)	9.47	89.93	Green	A	Green
7	NIB-6	21.1 (12.5)	8.27	68.89	Green	P	Purple
8	NIB-7	13.3 (4.8)	7.42	56.24	Green	P	Purple
9	NIB-8	33.9 (30.7)	7.70	64.17	Green	A	Green
10	NIB-9	19.2 (10.6)	7.00	56.58	Green	A	Green
11	NIB-10	17.1 (8.3)	7.67	65.17	Green	A	Green
12	NIB-11	15.3 (6.5)	9.40	87.40	purple	A	purple
13	NIB-12	35.34 (32.99)	7.25	55.58	Green	A	Green
14	NIB-13	20.2 (11.6)	7.28	57.05	Green	A	Green
15	NIB-14	20.2 (11.5)	8.80	77.40	Green	A	Green
16	NIB-15	35.40(34.02)	7.00	52.50	Green	A	Green
17	NIB-16	23.5 (15.6)	7.47	57.87	Green	A	Green
18	NIB-17A	18.6 (9.8)	10.28	100.26	Green	A	Green
19	NIB-17B	21.1 (12.7)	7.58	58.90	Green	A	Green
20	NIB-18	16.5 (7.7)	9.17	84.79	Green	A	Green
21	NIB-19	15.5 (6.7)	8.75	71.46	Green	P	Green
22	NIB-20	14.9 (6.2)	8.97	69.49	Green	P	Green
23	NIB-21A	17.5 (8.8)	7.87	62.67	Green	P	Green
24	NIB-21B	19.9 (11.2)	8.17	68.06	Green	A	Green
25	NIB-22	16.6 (8.1)	8.50	76.50	Green	P	Green
26	NIB-23	26.5 (19.5)	8.30	71.24	Green	A	Purple
27	NIB-24	19.8 (11.1)	8.53	71.11	Green	A	Green
28	NIB-25	12.3 (4.1)	8.62	77.55	Green	P	Purple
29	NIB-26	19.6 (10.9)	7.95	63.60	Green	P	Green
30	NIB-27	17.6 (8.7)	8.42	70.84	Green	A	Green
31	NIB-28	11.3 (3.4)	7.83	65.93	Green	A	Green
32	NIB-29	18.5 (9.9)	9.25	79.55	Green	P	Green
33	NIB-30	23.4 (15.4)	8.27	70.96	Green	P	Green
34	NIB-31	21.1 (12.5)	8.67	69.33	Green	P	Green
35	NIB-32	24.5 (16.8)	8.28	67.65	Green	A	Green
36	NIB-33	22.4 (14.0)	7.53	60.27	Green	p	Green
37	NIB-34	27.3 (20.8)	8.78	77.59	Green	A	Green
38	NIB-35	27.3 (20.5)	8.87	79.80	Green	A	Green
39	NIB-36	28.3 (22.1)	9.00	86.55	Green	A	Green
40	NIB-37	26.0 (18.7)	8.48	71.40	Green	p	Purple
41	NIB-38	23.8 (16.0)	7.75	58.77	Green	A	Purple
42	NIB-39	22.4 (14.2)	9.17	80.67	Green	P	Green
43	NIB-40	23.9 (16.4)	9.20	88.32	Purple	A	Purple
44	NIB-41	21.4 (13.3)	7.55	55.37	Green	A	Green
45	NIB-42A	27.1 (20.3)	6.38	44.68	Green	A	Green
46	NIB-42B	26.1 (19.0)	7.00	49.35	Green	A	Green
47	NIB-42C	25.4 (17.9)	8.07	71.26	Green	A	Green
48	NIB-43	26.3 (19.3)	7.78	55.78	Green	A	Green
49	NIB-44	20.5(11.8)	7.25	57.40	Green	A	Green
50	NIB-45	14.6 (6.1)	8.05	66.41	Green	A	Purple

Contd.,...

Table 3. Continued

S.No.	Name of the genotype	Per cent pod borer damage	Leaf width (cm)	Leaf area (cm^2)	Leaf vein colour	Trichome absent/ present	Stem colour
51	NIB-46	6.94 (0.96)	7.50	60.84	Purple	A	Dark purple
52	NIB-47	20.3 (11.7)	7.48	56.75	Green	P	Green
53	NIB-48	21.5 (13.2)	7.62	66.65	Green	p	Green
54	NIB-49	24.8 (17.3)	7.05	54.17	Green	P	Purple
55	NIB-50	24.8 (17.1)	7.83	64.63	Green	P	Purple
56	NIB-51	16.1 (7.2)	8.20	71.48	Green	A	Green
57	NIB-52	19.5 (11.1)	8.08	72.35	Green	P	Green
58	NIB-53	30.4 (25.1)	7.67	63.38	Green	A	Green
59	NIB-54	15.5 (6.8)	7.20	57.00	Green	A	purple
60	NIB-55	16.8 (7.9)	7.80	63.70	Green	P	Purple
61	NIB-56	19.6(10.7)	7.83	57.18	Green	P	Purple
62	NIB-57	16.7 (7.8)	8.03	64.13	Green	P	Green
63	NIB-58	27.1 (20.7)	7.23	55.70	Green	P	Green
64	NIB-59	17.5 (8.7)	7.00	50.75	Green	P	Green
65	NIB-60	18.4 (9.5)	7.08	51.12	Green	A	Green
66	NIB-61	19.1 (10.4)	7.78	59.67	Green	A	Purple
67	NIB-62	22.1 (13.7)	7.60	60.42	Green	A	Green
68	NIB-63	18.5 (9.6)	7.87	61.88	Green	A	Green
69	NIB-64	23.2 (15.2)	7.82	67.35	Green	A	Green
70	NIB-65	32.3 (28.1)	7.58	58.64	Green	A	Purple
71	NIB-66	23.4 (15.4)	7.53	57.76	Green	A	Green
72	NIB-67	30.1 (24.8)	7.25	55.46	Green	A	Purple
73	NIB-68	25.3 (17.8)	6.78	52.91	Green	A	Green
74	NIB-69	18.9 (10.2)	7.28	57.05	Green	P	Purple
75	NIB-70	24.6 (16.9)	6.92	48.53	Green	A	Purple
76	NIB-71	19.3 (10.5)	7.85	62.02	Green	A	Green
77	NIB-72	20.1 (11.4)	8.80	83.75	Green	P	Green
78	NIB-73	17.2 (8.3)	8.13	62.90	Green	A	Green
79	NIB-74	15.9 (7.0)	7.83	64.76	Green	A	Green
80	NIB-75	19.7 (10.9)	7.80	65.39	Green	A	Green
81	NIB-76	23.3 (15.2)	6.58	45.86	Green	P	Green
82	NIB-77	18.7 (9.9)	7.50	53.75	Green	P	Green
83	NIB-78	20.5 (11.8)	7.50	58.75	Green	A	Green
84	NIB-79	27.9 (21.4)	7.63	57.00	Green	P	Green
85	NIB-80	33.6 (30.2)	7.47	60.73	Green	A	Green
86	NIB-81	20.6 (11.9)	9.02	81.90	Green	A	Green
87	NIB-82	27.2 (20.4)	8.50	77.35	Green	A	Green
88	NIB-83	19.2 (10.3)	7.42	57.85	Green	A	Green
89	NIB-84	31.1 (26.1)	8.05	67.08	Green	A	Green
90	NIB-85	21.2 (12.7)	7.57	61.54	Green	A	Green
91	NIB-86	12.3 (4.0)	7.95	71.55	Purple	A	Purple
92	NIB-87	21.8 (13.4)	8.23	64.63	Purple	A	Purple
93	NIB-88	16.4(7.5)	6.92	50.84	Green	A	Green
94	NIB-89	17.8(8.9)	8.48	69.99	Green	P	Green
95	NIB-90	33.7 (30.4)	8.05	67.08	Green	A	Green
96	NIB-91	23.9 (16.1)	7.48	59.62	Green	A	Green
97	NIB-92A	15.7 (6.9)	8.33	69.44	Green	A	Green
98	NIB-92B	18.0 (9.1)	7.58	63.57	Green	A	Green
99	NIB-93	35.5 (33.2)	7.28	55.60	Green	A	Green
100	NIB-94	24.0 (16.0)	7.28	62.52	Green	A	Green
101	NIB-95A	19.9 (11.1)	8.30	64.33	Green	A	Green

Contd.,...

Table 3. Continued

S.No.	Name of the genotype	Per cent pod borer damage	Leaf width (cm)	Leaf area (cm^2)	Leaf vein colour	Trichome absent/ present	Stem colour
102	NIB-95B	27.7 (21.2)	7.58	62.56	Green	A	Green
103	NIB-96	17.3 (8.4)	8.13	59.51	Green	A	Green
104	NIB-97	20.1 (11.4)	7.33	55.49	Green	A	purple
105	NIB-98	21.9 (13.6)	7.42	58.72	Green	A	Green
106	NIB-99	20.8 (12.3)	7.43	54.88	Green	A	Green
107	NIB-100	21.9 (13.6)	7.68	56.60	Green	A	Green
108	NIB-101	27.1 (20.5)	7.17	52.32	Green	A	Green
109	NIB-102	15.8 (7.0)	8.03	67.61	purple	A	purple
110	NIB-103	11.8 (3.7)	7.45	57.99	Green	A	Green
111	NIB-104	20.0 (11.2)	7.50	56.88	Green	A	Green
112	NIB-105	15.6 (6.7)	7.25	55.83	Green	A	Green
113	NIB-106	23.7(15.7)	7.67	56.86	Green	A	Green
114	Gujarat papdi-1	39.78 (40.46)	7.06	49.84	Green	A	Green
S. Em $\pm$		2.19	0.09	0.31		2.19	
CD at 5 %		6.13	0.26	0.88		6.13	
CV (%)14.24		4.60	5.56		14.24		
Pod borer *H. armigera* ('r')			-0.2303**	-0.2030*	-0.2212*	-0.1904*	-0.2194*

* Significant at 5 % level ** Significant at 1 % level
A: Absent P: Present

Table 4. Pod borer (*H. armigera*) oriented pod damage on Indian bean genotypes in relation to flower colour and pod characters

S.No.	Name of the Genotype	Per cent pod borer damage	Flower colour	Pod colour	Pod shape
1	NIB-1	19.5 (10.8)	Purple	Cream	Straight
2	NIB-2	27.6 (21.1)	Cream	Light green	Slightly curved
3	NIB-3	29.3 (23.5)	White	Dark green	Moderately curved
4	NIB-4	21.3 (12.7)	Pink	Green+ Purple	Slightly curved
5	NIB-5A	17.6 (8.8)	Purple	Green+ Purple.s	Slightly curved
6	NIB-5B	15.9 (7.10)	White	Green	Slightly curved
7	NIB-6	21.1 (12.5)	Purple	Light green	Moderately curved
8	NIB-7	13.3 (4.8)	Purple	Dark green	Slightly curved
9	NIB-8	33.9 (30.7)	White	Dark green	Moderately curved
10	NIB-9	19.2 (10.6)	White	Light green	Moderately curved
11	NIB-10	17.1 (8.3)	White	Light green	Slightly curved
12	NIB-11	15.3 (6.5)	Purple	Dark green	Slightly curved
13	NIB-12	35.34 (32.99)	White	Light green	moderately curved
14	NIB-13	20.2 (11.6)	White	Dark green	Slightly curved
15	NIB-14	20.2 (11.5)	White	Green	Slightly curved
16	NIB-15	35.40(34.02)	White	Light green	Moderately curved
17	NIB-16	23.5 (15.6)	White	Light green	Slightly curved
18	NIB-17A	18.6 (9.8)	White	Light green	Straight
19	NIB-17B	21.1 (12.7)	White	Green	Slightly curved
20	NIB-18	16.5 (7.7)	White	Light green	Straight
21	NIB-19	15.5 (6.7)	White	Light green	Slightly curved
22	NIB-20	14.9 (6.2)	White	Light green	Slightly curved
23	NIB-21A	17.5 (8.8)	White	Light green	Slightly curved
24	NIB-21B	19.9 (11.2)	White	Light green	Slightly curved
25	NIB-22	16.6 (8.1)	White	Dark green	Slightly curved
26	NIB-23	26.5 (19.5)	Purple	Dark green	Modrtely Curved

Contd.,...

Table 4. Continued

S.No.	Name of the Genotype	Per cent pod borer damage	Flower colour	Pod colour	Pod shape
27	NIB-24	19.8 (11.1)	White	Dark green	Slightly curved
28	NIB-25	12.3 (4.1)	Purple	L.Green+ Purple.s	Moderately curved
29	NIB-26	19.6 (10.9)	White	L.Green+ Purple.s	Slightly curved
30	NIB-27	17.6 (8.7)	White	Dark green	Slightly curved
31	NIB-28	11.3 (3.4)	White	Dark green	Slightly curved
32	NIB-29	18.5 (9.9)	White	Light green	Slightly curved
33	NIB-30	23.4 (15.4)	White	Dark green	Slightly curved
34	NIB-31	21.1 (12.5)	White	Dark green	Moderately curved
35	NIB-32	24.5 (16.8)	White	Dark green	Moderately curved
36	NIB-33	22.4 (14.0)	Purple	Green	Moderately curved
37	NIB-34	27.3 (20.8)	White	Dark green	Slightly curved
38	NIB-35	27.3 (20.5)	White	Green	Slightly curved
39	NIB-36	28.3 (22.1)	White	Light green	Moderately curved
40	NIB-37	26.0 (18.7)	Purple	Green+ Purple. s	Slightly curved
41	NIB-38	23.8 (16.0)	Purple	Green+ Purple. s	Slightly curved
42	NIB-39	22.4 (14.2)	Cream	Dark green	Straight
43	NIB-40	23.9 (16.4)	Purple	G+ purple	Slightly curved
44	NIB-41	21.4 (13.3)	White	Green	moderately curved
45	NIB-42A	27.1 (20.3)	White	Light green	Moderately curved
46	NIB-42B	26.1 (19.0)	White	Dark green	Slightly curved
47	NIB-42C	25.4 (17.9)	White	Green	Slightly curved
48	NIB-43	26.3 (19.3)	White	Dark green	Straight
49	NIB-44	20.5(11.8)	White	Light green	Moderately curved
50	NIB-45	14.6 (6.1)	Purple	Light green	Slightly curved
51	NIB-46	6.94 (0.96)	Pink	Dark purple	Straight
52	NIB-47	20.3 (11.7)	White	Green	Slightly curved
53	NIB-48	21.5 (13.2)	White	Green	Moderately curved
54	NIB-49	24.8 (17.3)	White	Green	Moderately curved
55	NIB-50	24.8 (17.1)	White	Green	Moderately curved
56	NIB-51	16.1 (7.2)	Pink	Dark green	Moderately curved
57	NIB-52	19.5 (11.1)	White	Green	Slightly curved
58	NIB-53	30.4 (25.1)	Cream	Light green	moderately curved
59	NIB-54	15.5 (6.8)	Purple	Dark green	Straight long
60	NIB-55	16.8 (7.9)	Pink	Dark green	Moderately curved
61	NIB-56	19.6(10.7)	Pink	Light Green+ Purple. s	Slightly curved
62	NIB-57	16.7 (7.8)	White	Dark green	Moderately curved
63	NIB-58	27.1 (20.7)	White	Green	Moderately curved
64	NIB-59	17.5 (8.7)	Cream	Dark green	Moderately curved
65	NIB-60	18.4 (9.5)	White	Light green	Moderately curved
66	NIB-61	19.1 (10.4)	Purple	Dark green	Moderately curved
67	NIB-62	22.1 (13.7)	Cream	Light green	Moderately curved
68	NIB-63	18.5 (9.6)	Cream	Dark green	Slightly curved
69	NIB-64	23.2 (15.2)	Cream	Dark green	Moderately curved
70	NIB-65	32.3 (28.1)	Pink	Dark green	Slightly curved
71	NIB-66	23.4 (15.4)	White	Light green	Slightly curved
72	NIB-67	30.1 (24.8)	Pink	Green+ Purple. s	Slightly curved
73	NIB-68	25.3 (17.8)	White	Light green	Slightly curved
74	NIB-69	18.9 (10.2)	Purple	Dark green	Moderately curved
75	NIB-70	24.6 (16.9)	Pink	L. Green+ Purple.s	Slightly curved
76	NIB-71	19.3 (10.5)	White	Light green	Moderately curved
77	NIB-72	20.1 (11.4)	White	Green	Slightly curved
78	NIB-73	17.2 (8.3)	Purple	Green	Moderately curved

Contd.,...

Table 4. Continued

S.No.	Name of the Genotype	Per cent pod borer damage	Flower colour	Pod colour	Pod shape
79	NIB-74	15.9 (7.0)	White	Light green	Moderately curved
80	NIB-75	19.7 (10.9)	White	Light green	Moderately curved
81	NIB-76	23.3 (15.2)	White	Light green	Moderately curved
82	NIB-77	18.7 (9.9)	Purple	Green	Moderately curved
83	NIB-78	20.5 (11.8)	White	Dark green	Slightly curved
84	NIB-79	27.9 (21.4)	White	Light green	Slightly curved
85	NIB-80	33.6 (30.2)	White	Light green	Moderately curved
86	NIB-81	20.6 (11.9)	White	Dark green	Slightly curved
87	NIB-82	27.2 (20.4)	White	Light green	Moderately curved
88	NIB-83	19.2 (10.3)	White	Green	Moderately curved
89	NIB-84	31.1 (26.1)	White	Light green	Curved
90	NIB-85	21.2 (12.7)	White	Light green	Straight
91	NIB-86	12.3 (4.0)	Pink	Green+ Purple. s	Slightly curved
92	NIB-87	21.8 (13.4)	Purple	Green	Slightly curved
93	NIB-88	16.4(7.5)	White	Green	Slightly curved
94	NIB-89	17.8 (8.9)	White	Green	Moderately curved
95	NIB-90	33.7 (30.4)	Pink	Dark green	Moderately curved
96	NIB-91	23.9 (16.1)	White	Light green	Slightly curved
97	NIB-92A	15.7 (6.9)	White	Dark green	Moderately curved
98	NIB-92B	18.0 (9.1)	White	Green	Slightly curved
99	NIB-93	35.5 (33.2)	White	Light green	Slightly curved
100	NIB-94	24.0 (16.0)	White	Light green	Moderately curved
101	NIB-95A	19.9 (11.1)	White	Green	Slightly curved
102	NIB-95B	27.7 (21.2)	White	Light green	Slightly curved
103	NIB-96	17.3 (8.4)	White	Green	Slightly curved
104	NIB-97	20.1 (11.4)	pink	Dark green	Moderately curved
105	NIB-98	21.9 (13.6)	White	Light green	Moderately curved
106	NIB-99	20.8 (12.3)	White	Dark green	Broad slightly curved
107	NIB-100	21.9 (13.6)	White	Green	Slightly curved
108	NIB-101	27.1 (20.5)	White	Light green	Moderately curved
109	NIB-102	15.8 (7.0)	Purple	Purplish Dark Green	Slightly curved
110	NIB-103	11.8 (3.7)	White	Dark green	Moderately curved
111	NIB-104	20.0 (11.2)	White	Dark green	Slightly curved
112	NIB-105	15.6 (6.7)	White	Green	Moderately curved
113	NIB-106	23.7(15.7)	White	Green	Slightly curved
114	Gujarat papdi-1	39.78 (40.46)	white	Light green	moderately curved
S. Em $\pm$		2.19			
CD at 5 %		6.13			
CV (%)		14.24			
Pod borer *H. armigera* ('r')			-0.1926*	-0.2460**	0.3046**

* Significant at 5 % level ** Significant at 1 % level

(iv) Leaf vein colour. The results mentioned in Table 3 reveal that resistant genotype NIB-46 possessed purple coloured leaf veins which in turn indicated 0.96 per cent pod borer damage; while, highly susceptible Gujarat papdi-1 possessed light green coloured leaf vein which in turn indicated 40.46 per cent pod borer damage. Correlation between pod borer damage and leaf vein colour was highly significant and negative (r = - 0.2212). So, it may be concluded that genotypes possessing purple colored leaf vein were resistant to pod borer *H. armigera* damage.

(v) Leaf trichome. Genotypes *viz;* NIB-1, 6, 7, 19, 20, 21A, 22, 25, 26, 48 and 56 possessed trichomes on leaf surface wherein comparatively lower pod borer damage was recorded (10.8, 12.5, 4.8, 6.7, 6.2, 8.8, 8.1, 4.1, 10.9, 13.2 and 10.7 per cent, respectively) while, highly susceptible genotypes/varieties like Gujarat papdi-1, NIB-12 and 15 were devoid of leaf trichomes. Correlation between pod borer damage and trichome was significant and negative (r = - 0.19049). This shows lower pod damage in entries where trichome was present on their leaves. So, trichomes on leaf surface have

Table 5. Pod borer (*H. armigera*) oriented pod damage on Indian bean genotypes in relation to pod characters and yield

S.No.	Name of the genotype	Per cent pod damage	Pod width (cm)	Pod area (cm^2)	No. of seeds/pod	Pod yield (gm)
1	NIB-1	19.5 (10.8)	3.10	29.40	5.00	287.50
2	NIB-2	27.6 (21.1)	1.27	6.20	3.40	207.50
3	NIB-3	29.3 (23.5)	1.22	6.37	3.80	37.50
4	NIB-4	21.3 (12.7)	1.85	12.84	4.00	250.00
5	NIB-5A	17.6 (8.8)	2.05	15.01	4.20	225.00
6	NIB-5B	15.9 (7.10)	2.47	19.16	4.00	262.50
7	NIB-6	21.1 (12.5)	1.68	12.18	4.00	437.50
8	NIB-7	13.3 (4.8)	1.08	5.48	4.00	193.75
9	NIB-8	33.9 (30.7)	1.45	6.27	4.20	175.00
10	NIB-9	19.2 (10.6)	1.08	4.54	3.00	243.75
11	NIB-10	17.1 (8.3)	1.03	10.90	5.00	293.75
12	NIB-11	15.3 (6.5)	1.70	9.92	4.00	187.50
13	NIB-12	35.34 (32.99)	1.40	7.74	4.40	107.50
14	NIB-13	20.2 (11.6)	1.96	13.03	4.60	131.25
15	NIB-14	20.2 (11.5)	1.30	5.68	4.00	212.50
16	NIB-15	35.40(34.02)	1.05	8.05	3.80	337.50
17	NIB-16	23.5 (15.6)	1.86	17.67	4.00	200.00
18	NIB-17A	18.6 (9.8)	2.47	24.09	4.40	675.00
19	NIB-17B	21.1 (12.7)	1.94	19.36	4.20	70.00
20	NIB-18	16.5 (7.7)	2.44	12.77	4.20	775.00
21	NIB-19	15.5 (6.7)	1.30	7.87	3.60	275.00
22	NIB-20	14.9 (6.2)	1.92	10.23	4.20	162.50
23	NIB-21A	17.5 (8.8)	1.94	15.51	4.00	182.50
24	NIB-21B	19.9 (11.2)	1.58	8.06	4.40	370.00
25	NIB-22	16.6 (8.1)	1.34	7.15	3.60	311.25
26	NIB-23	26.5 (19.5)	1.36	7.22	4.00	370.00
27	NIB-24	19.8 (11.1)	1.90	10.26	3.80	77.50
28	NIB-25	12.3 (4.1)	1.86	10.63	3.60	87.50
29	NIB-26	19.6 (10.9)	1.77	9.74	4.20	85.00
30	NIB-27	17.6 (8.7)	0.98	5.60	4.40	217.50
31	NIB-28	11.3 (3.4)	0.98	6.61	4.20	307.50
32	NIB-29	18.5 (9.9)	1.99	10.71	4.00	62.50
33	NIB-30	23.4 (15.4)	0.98	5.30	4.00	291.25
34	NIB-31	21.1 (12.5)	1.64	9.35	3.40	162.50
35	NIB-32	24.5 (16.8)	1.82	9.19	3.60	155.00
36	NIB-33	22.4 (14.0)	0.98	7.47	4.00	128.75
37	NIB-34	27.3 (20.8)	1.94	18.34	3.80	207.50
38	NIB-35	27.3 (20.5)	1.65	8.13	5.00	267.50
39	NIB-36	28.3 (22.1)	0.98	5.52	3.60	177.50
40	NIB-37	26.0 (18.7)	1.60	10.87	3.80	243.75
41	NIB-38	23.8 (16.0)	2.26	15.02	4.00	156.25
42	NIB-39	22.4 (14.2)	1.93	19.57	3.60	97.50
43	NIB-40	23.9 (16.4)	2.03	11.70	4.20	256.25
44	NIB-41	21.4 (13.3)	1.90	8.17	4.00	387.50
45	NIB-42A	27.1 (20.3)	1.12	5.20	4.00	156.25
46	NIB-42B	26.1 (19.0)	1.75	12.39	4.00	137.50
47	NIB-42C	25.4 (17.9)	1.80	14.84	4.80	120.00
48	NIB-43	26.3 (19.3)	2.10	9.35	3.80	310.00
49	NIB-44	20.5(11.8)	0.98	6.86	4.00	50.00
50	NIB-45	14.6 (6.1)	1.89	19.34	5.00	12.50
51	NIB-46	6.94 (0.96)	1.57	17.25	5.40	240.00

Contd.,...

Table 5. Continued

S.No.	Name of the genotype	Per cent pod damage	Pod width (cm)	Pod area (cm^2)	No. of seeds/pod	Pod yield (gm)
52	NIB-47	20.3 (11.7)	1.82	8.28	4.00	43.75
53	NIB-48	21.5 (13.2)	0.98	5.70	4.00	156.25
54	NIB-49	24.8 (17.3)	1.40	7.69	4.60	215.00
55	NIB-50	24.8 (17.1)	1.13	11.09	4.00	218.75
56	NIB-51	16.1 (7.2)	2.21	12.84	4.40	38.75
57	NIB-52	19.5 (11.1)	2.19	12.16	4.00	17.50
58	NIB-53	30.4 (25.1)	0.91	7.15	4.00	65.00
59	NIB-54	15.5 (6.8)	0.93	4.37	5.00	57.50
60	NIB-55	16.8 (7.9)	1.55	8.12	3.60	57.50
61	NIB-56	19.6(10.7)	1.58	8.56	3.80	0.00
62	NIB-57	16.7 (7.8)	1.62	7.29	3.80	43.75
63	NIB-58	27.1 (20.7)	1.35	5.64	3.40	107.50
64	NIB-59	17.5 (8.7)	1.03	4.26	3.40	67.50
65	NIB-60	18.4 (9.5)	0.97	5.03	3.80	142.50
66	NIB-61	19.1 (10.4)	1.77	9.95	3.80	250.00
67	NIB-62	22.1 (13.7)	1.60	8.41	4.40	106.25
68	NIB-63	18.5 (9.6)	2.07	11.28	3.60	110.00
69	NIB-64	23.2 (15.2)	1.33	6.90	3.60	25.00
70	NIB-65	32.3 (28.1)	1.70	8.26	4.00	93.75
71	NIB-66	23.4 (15.4)	1.43	8.58	3.60	125.00
72	NIB-67	30.1 (24.8)	1.83	9.31	3.80	87.50
73	NIB-68	25.3 (17.8)	1.18	7.66	3.80	112.50
74	NIB-69	18.9 (10.2)	1.97	10.74	3.40	206.25
75	NIB-70	24.6 (16.9)	1.50	14.96	4.60	90.00
76	NIB-71	19.3 (10.5)	1.58	8.45	4.00	87.50
77	NIB-72	20.1 (11.4)	1.40	9.00	5.80	462.50
78	NIB-73	17.2 (8.3)	2.00	8.86	4.60	107.50
79	NIB-74	15.9 (7.0)	1.60	6.94	4.40	170.00
80	NIB-75	19.7 (10.9)	1.17	5.51	4.00	146.25
81	NIB-76	23.3 (15.2)	1.03	5.38	3.60	37.50
82	NIB-77	18.7 (9.9)	1.53	7.78	3.60	118.75
83	NIB-78	20.5 (11.8)	1.58	7.37	4.00	75.00
84	NIB-79	27.9 (21.4)	1.85	8.67	4.00	90.00
85	NIB-80	33.6 (30.2)	1.50	9.41	4.40	68.75
86	NIB-81	20.6 (11.9)	1.97	8.17	4.80	125.00
87	NIB-82	27.2 (20.4)	0.90	3.59	4.00	31.25
88	NIB-83	19.2 (10.3)	1.00	6.54	4.20	183.75
89	NIB-84	31.1 (26.1)	1.97	12.37	4.40	55.00
90	NIB-85	21.2 (12.7)	1.90	13.77	4.40	32.00
91	NIB-86	12.3 (4.0)	2.00	22.07	4.80	313.75
92	NIB-87	21.8 (13.4)	1.63	8.72	3.80	32.50
93	NIB-88	16.4(7.5)	1.30	6.89	4.00	43.75
94	NIB-89	17.8 (8.9)	2.00	10.08	3.80	57.50
95	NIB-90	33.7 (30.4)	2.08	21.19	4.00	45.00
96	NIB-91	23.9 (16.1)	1.10	5.83	4.40	73.75
97	NIB-92A	15.7 (6.9)	1.77	11.48	3.80	163.75
98	NIB-92B	18.0 (9.1)	1.50	10.32	5.00	71.25
99	NIB-93	35.5 (33.2)	2.00	14.03	3.80	312.50
100	NIB-94	24.0 (16.0)	1.23	6.39	4.20	126.25
101	NIB-95A	19.9 (11.1)	2.00	13.35	4.00	420.00
102	NIB-95B	27.7 (21.2)	1.10	4.90	5.00	105.00
103	NIB-96	17.3 (8.4)	1.82	11.46	4.80	462.50

Contd.,...

Table 5. Continued

S.No.	Name of the genotype	Per cent pod damage	Pod width (cm)	Pod area (cm^2)	No. of seeds/pod	Pod yield (gm)
104	NIB-97	20.1 (11.4)	1.58	10.60	4.00	300.00
105	NIB-98	21.9 (13.6)	1.15	5.25	4.20	170.00
106	NIB-99	20.8 (12.3)	2.08	17.82	4.00	52.50
107	NIB-100	21.9 (13.6)	2.23	11.74	4.00	215.00
108	NIB-101	27.1 (20.5)	1.00	3.91	4.00	211.25
109	NIB-102	15.8 (7.0)	2.52	16.82	4.00	331.25
110	NIB-103	11.8 (3.7)	2.00	10.67	4.00	106.25
111	NIB-104	20.0 (11.2)	1.55	9.97	4.60	81.25
112	NIB-105	15.6 (6.7)	1.60	9.25	4.20	12.50
113	NIB-106	23.7(15.7)	2.02	10.64	5.00	47.00
114	Gujarat papdi-1	39.78 (40.46)	0.95	3.66	3.80	126.25
S. Em ± 2.19		0.10	0.22	0.09	0.78	
CD at 5 %		6.13	0.27	0.62	0.25	2.20
CV (%) 14.24		9.39	9.86	5.88	9. 37	
Pod borer *H. armigera* ('r')		-0.1965*	-0.1762*	-0.1902*	-0.0782	

* Significant at 5 % level ** Significant at 1 % level

played a significant role in conferring resistance to bean entries towards pod borer (Table 3).

(vi) Stem colour. Genotypes like NIB-46, 86 and 25 possessed purple stem colour indicating significantly lower pod damage (0.96, 4.00, and 4.07 %, respectively). While, highly susceptible Gujarat papdi-1 possessed green coloured stem indicating highest pod damage (40.46 %). Significant negative correlation (r = - 0.2194) was exhibited between pod borer damage and stem colour. So, it may be concluded that genotypes possessing purple colour stem had lower pod damage and were found to be resistant than those having green stem (Table 3).

(vii) Flower colour. Genotypes like NIB-46, 86 and 25 possessed purple coloured flowers which in turn recorded significantly lower pod damage (0.96, 4.00, and 4.07 %, respectively) while, susceptible Gujarat papdi-1, NIB-15 and 12 possessed white coloured flowers which in turn recorded significantly higher pod damage (40.46, 34.02, and 33.22 %, respectively). Correlation between pod borer damage and flower colour was significant and negative (r = - 0.1926). So, it may be concluded that entries possessing purple colour flower were resistant to pod borer damage than those possessing white coloured flowers. Thus, it is evident that flower colour induced resistance in entries towards pod borer damage (Table 4). Sison et al. (1993) observed that cultivar with purple flower (ICPL-87101, ICPL-86012, ICPL-86005) were least preferred for oviposition by H. armigera than yellow (ICPL-86015, ICPL-86015) and orange flowered (ICPL-88023) genotypes. In the present findings, entries like NIB-46, 86 and 25 possessing purple coloured flowers recorded significantly lower pod damage while, Gujarat papdi-1, NIB-15 and 12 possessing white coloured flowers had significantly higher pod damage. These results are almost the same as recorded in the above report and are said to be in close agreement with the above report.

(viii) Pod colour. Genotype NIB-46 possessed purple colour pods which in turn recorded significantly lower pod damage (0.96%), though it was at par with NIB-28, and 103 possessing dark green pods and NIB-86 and 25 possessing green with purple suter pods. These genotypes recorded 3.40, 3.70, 4.00, 4.07 per cent pod damage, respectively. However, Gujarat papadi-1 and genotypes NIB-15, 12 and 93 possessing light green colour pods in turn recorded significantly higher pod damage (40.46, 34.02, 33.22 and 32.99 %, respectively). The results in terms of correlation between pod borer damage and pod colour was highly significant and negative (r = - 0.2460). It could be concluded that genotypes which had purple colour pods induced resistance and those possessing light green pods were susceptible to pod borer (Table 4).

(ix) Pod shape. The genotype NIB-46 possessed straight pods in turn recorded significantly lower pod damage (0.96%) while, Gujarat papdi-1 and genotypes NIB-15 and 12 possessing curve shaped pods indicated significantly higher pod damage (40.46, 34.02, 33.22 and 32.99 %, respectively). Correlation between pod borer damage and pod shape was highly significant and positive (r = 0.3046). So, it may be concluded that pod damage increased with increasing pod curvature and curve pod entries were most susceptible to pod borer than straight podded entries (Table 4).

Oghiakhe et al. (1992) studied effect of pod angle on resistance of cowpea to legume pod borer *M. testulalis*

Geyer in two cowpea cultivars: IT82D-716 (susceptible to borer damage) and TVu 946 (resistant to borer damage). Pod angles i.e. normal, a decreased and an increased angle were used in the study. Negative and highly significant ($P < 0.01$) relationships were found between pod angle and per cent pod damage. Pods with wide angles (greater than or equal to 89 degrees) were damaged on one and rarely on both pods, whereas pod shape or pod angle and curved pod or pods with narrow angle were more susceptible than straight pods or pods with wide angle. In the present investigation, Gujarat papdi-1, NIB-15 and 12 possessed curved pods indicated significantly higher pod damage than straight podded entries.

(x) Pod width. Pod width ranged from 0.90 to 3.10 cm indicating significantly higher pod width (3.10, 2.52, 2.47, 2.47, 2.44, 2.26, 2.23, 2.21, 2.19 cm) in NIB-1, 102, 5B, 17A, 18, 38, 100, 51 and 52 in turn recorded significantly lower pod damage (10.8, 7.00, 7.10, 9.8, 7.7, 16.0, 13.6, 7.2 and 11.1 %, respectively). While, significantly lower pod widths (0.90, 0.91, 0.93, 0.95, 0.97, 0.98, 0.98, 0.98, 0.98, 0.98, 0.98, 0.98, 0.98 cm) were observed in NIB-82, 53, 54, Gujarat papdi-1, NIB-60, 48, 44, NIB-28, 27, 30, and 33 indicating significantly higher pod damage in NIB-82(20.4%), NIB-53(25.1%) and Gujarat papdi-1(39.78%). Correlation between pod borer damage and pod width was significant and negative ($r = - 0.1965$). So, this implies that entries having lowest pod width were most susceptible to *H. armigera* than those possessing higher pod widths (Table 5).

(xi) Pod area. Pod area ranged from 29.40 to 3.66 cm^2. Significantly higher pod areas were recorded in NIB-1 (29.40 cm^2) and 17A (24.09 cm^2) with pod damage of 10.8 and 9.8 per cent, respectively. Genotypes which had significantly lower pod areas were NIB-82 (3.59 cm^2) and Gujarat papdi-1 (3.66 cm^2) which in turn recorded higher pod borer damage (20.4 and 39.78 %, respectively). Correlation between pod borer damage and pod area was significant and negative ($r = - 0.1762$). It could be deduced that entries having lower pod area or small or medium sized pods were more susceptible to *H. armigera* than those possessing large pods (Table 5).

(xii) Number of seed per pod. Number of seeds per pod ranged from 3.3 to 5.8 indicating comparatively higher seeds (5.75, 5.35, 5.00, 4.95, 4.95, 4.95, 4.88, 4.88, 4.88, 4.80, 4.75, 4.75, 4.60, 4.68 seeds per pod) in NIB-72, 46, 10, 35, 54, 45, 92B, 95B, 106, 86, 42C, 81, 13 and 96 which in turn recorded comparatively lower pod damage (11.40, 0.10, 8.30, 6.80, 6.10 % respectively); while, significantly higher pod damage was observed in Gujarat papadi-1 (40.46 %), 15 (34.02 %) and 12 (33.22 %) which in turn recorded 3.8, 3.8 and 4.4 seeds per pod, respectively. Correlation between pod borer damage and number of seeds per pod was significant and negative ($r = - 0.1902$). Hence, it may be concluded that genotypes possessing higher number of seeds were less favoured by incidence of pod borer, H. armigera as they play a significant but indirect role in inducing resistance in Indian bean genotypes (Table 5). Similar results were observed by Verularkar and Singh (1998) who reported that wild relatives of pigeon pea, Cajanus scarabacoides with higher number of seeds per pod (5.5) had high level of resistance to pod borer H. armigera than Pant A3 and UPAS-120. In the present investigation, genotypes having high number of seeds were less favoured by pod borer thus inducing resistance or tolerance.

(xiii) Pod yield. Pod yield ranged from 775 to 12.6 gm per plant. In resistant entries like NIB-46, 28, 103 and 86, pod yields were 240, 307.5, 106.2 and 313.7 gms per plant, respectively which in turn recorded pod damage of 0.96, 3.40, 3.70 and 4.0 per cent, respectively while, in susceptible entries like Gujarat papdi-1, NIB-15 and 12, pod yields of 126.25, 337.5 and 107.5 gms per plant were observed indicating pod damage of 40.46, 34.02, 32.99 per cent, respectively. Correlation between pod borer damage and pod yield was however non-significant but negative ($r = - 0.0782$) (Table 5). Haldar et al. (2011) studied eight plant parameters, viz., pod wall thickness, number of pods per cluster, angle between pods, trichomes on leaves and stems, trichome length, pod length and pod width in relation to varietal reaction against Maruca vitrata in eleven varieties of cowpea and observed highly susceptible cv. GC-9708 having lowest number of pods per cluster (2.8). In the present investigation, relationship between pod yield and pod damage was non-significant but negative implying that resistant genotypes had lower pod damage which is almost the same as reported above report.

Thus, it can be summarized that role of morphological characters in inducing resistance or susceptibility in Indian bean genotypes towards pod borer damage caused by *H. armigera* has been manifold. Growth habit ($r = 0.2878$) and pod shape ($r = 0.3046$) indicated significant and positive relationship. This implies that with unit increase in these characters, entries like Gujarat papdi 1, NIB 15 and 12 displayed spreading type characters and were more prone to the pod borer oriented damage while resistant genotypes like NIB-46, 28, 103, 86 and 25 possessed erect and semi erect growth habit in turn recorded lower pod damage. Similarly, NIB-46 which possessed straight pod recorded lowest pod damage (0.96%) thus made the entry resistant towards the pod borer. On the other hand, leaf width, leaf area, leaf vein colour, leaf trichome, stem colour, flower colour, pod colour, pod width, pod area and number of seeds per pod displayed significant and negative relationship with the pod damage caused by pod borer. This implies that with unit increase in values of these

characters there was corresponding decrease in pod borer damage thus made the entries resistant towards the pest and vice-versa where corresponding decrease in values of these characters made the entry susceptible to the pest. In contrast, characters like plant height, leaf length, leaf colour, waxy coating, pod length and pod yield failed to induce significant resistance or susceptibility in the selected entries against the pest under discussion.

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