EFFECT OF MORPHOLOGICAL CHARACTERS ON SUSCEPTIBILITY AGAINST BLUE BUTTERFLY, *Lampides boeticus* LINNAEUS IN PIGEONPEA

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ABSTRACT

An experiment was conducted during Kharif 2007-08 and 2008-09 at Anand Agricultural University, Anand, to screen the cultivars / genotypes of pigeonpea [Cajanus cajan (L.) Millspaugh] for their susceptibility against lepidopteron pod borers. The study on varietal susceptibility indicated that the varieties; ICPL 87119, GAUT 2001-10, GAUT 97-33, AAUT 2005-7, GAUT 2002-16 and AAUT 2005-8 were found to be tolerant, whereas GT 101 and Banas varieties showed less susceptible reactions, but AVPP 1 and GT 100 varieties exhibited moderately to highly susceptible reactions against blue butterfly (Lampides boeticus Linnaeus) based on larval population. The determinate genotypes/cultivars with green pods were found more susceptible to H. armigera, E. atomosa and L. boeticus with higher larval population as well as pod and seed damage than indeterminate genotypes/cultivars with brown striped pods. The pigeonpea genotypes/cultivars with short and narrow pod, short and narrow seed, less seed weight with thick pod wall exhibited less susceptible reaction against H. armigera, E. atomosa and L. boeticus with low larval population. Pod and seed damage due to lepidopteron pod borers showed highly significant positive correlation with seed weight.

KEY WORDS: Blue butterfly, Lampides boeticus, pigeonpea, susceptibility, tolerance

INTRODUCTION

Pigeonpea, *Cajanus cajan* (L.) Millspaugh is one of the major pulse crops of the tropics and subtropics. It is the second most important pulse crop of India, after chickpea (Nene *et al*., 1990). Indians, in general, prefer vegetarian food and one of the main sources of getting protein is the pulses. It is an agricultural crop of rainfed-drylands, which can be grown on mountain slopes to reduce soil erosion. The area grown under this crop was 35.80 lakh hectares with an annual production of 27.40 lakh tonnes leading to a productivity of 765 kg / ha (Anonymous, 2006). In Gujarat, pigeonpea is grown under 2.66 lakh hectares with an annual production of 2.63 lakh tonnes leading to a productivity of 987 kg / ha (Anonymous, 2009). Insect pests, and pod borer complex in particular, are considered the primary biotic constraints to pigeonpea production in Middle Gujarat. Pigeonpea is tasty, not

only to people, but also to insect pests. A large number of insect pests (more than 300 species) attack pigeonpea (Prasad and Singh, 2004). Insects that attack the reproductive structures of plant cause the maximum yield losses (Rangaiah and Sehgal, 1984). The most economical pests those attack at flowering and podding stage of the crop are pigeonpea pod borer, *Helicoverpa armigera* (Hubner); blue butterfly, *Lampides boeticus* Linnaeus and plume moth, *Exelastis atomosa* (Walsingham) (Reed *et al*., 1989). Among which, *L. boeticus* may also cause damage, especially to the poorest farmers who cannot meet the expense of chemical control. The first line of defence against insect pest is cultivation of tolerant crop variety. To know the mechanism of resistance against blue butterfly is also essential for the development of high yielding tolerant variety of pigeonpea. Use of tolerant cultivars virtually does not involve any skill or expensive investment in pest management. It can be considered as a primary component in pest management besides cultural, biological and chemical control measures. Therefore, it is necessary to evaluate the effect of morphological factors for their susceptibility against pod borer complex in the different genotypes / cultivars of pigeonpea. The information provides a base in the sound breeding programme for development of resistance cultivar of pigeonpea.

MATERIALS AND METHODS

With a view to screen the cultivars / genotypes of pigeonpea, *C. cajan* for their susceptibility to *L. boeticus* in middle Gujarat conditions, an experiment was conducted during *Kharif* 2007-08 and 2008-09 at B. A. College of Agriculture, Anand Agricultural University, Anand. To investigate the susceptibility of pigeonpea genotypes against *L. boeticus*, 16 cultivars were grown in two rows of 5.0 meters length with 90 cm x 20 cm spacing. All the recommended agronomical practices were followed for raising the crop. The entire experimental plot was kept free from any pest management tactics.The experiment was conducted in randomized block design (RBD) with three replications in each genotypes / cultivars of pigeonpea.

Population of larvae of blue butterfly

The observations of pod borers infesting pigeonpea were initiated when buds were observed on the plant and continued till harvesting of the crop. The larvae of blue butterfly (*L. boeticus*) were recorded at weekly interval from five randomly selected tagged plants. The data, thus, obtained were subjected to $\sqrt{X+0.5}$ transformations prior to statistical analysis.

Morphological characters

The morphological characters *viz*., plant type, pod size, seed size, number of seeds per pod, seed weight, pod colours and thickness of pod wall of various pigeonpea cultivars were recorded for pest preference under field conditions.

The apical portion of the plant was critically examined, and based on their flowering pattern plants were grouped into two groups like; indeterminate type and determinate type. The length and breadth of 25 pods from each cultivar were measured with the help of standard scale after the seed was sun dried; with the help of verniear callipers. The number of seeds per pod was determined from randomly picked 25 pods from five plants of each cultivar at harvest. For this, number of locules unfilled as well as filled up with the seed were counted and recorded as number of seeds per pod. The weight of 100 seeds of each

cultivars of pigeonpea was recorded after the seed was sun dried, from the random sample taken from the whole plot. The average of the samples for each cultivar was calculated and recorded. The main colour of the pods was recorded when the pods were in seed filling stage from all plants in the plot. Based on colour, pods are classified as green and green with brown streak. The colour pattern on the seed coat was also recorded after the seeds of the whole plot have been sun dried. Based on colour of seed coat, seeds are classified as white seed and red seed.

In order to measure the thickness of pod wall, 25 freshly plucked pigeonpea pods of 25 days age were randomly collected from each cultivar. The four-locule pods were chosen for cross section. The cross section has been made from the sutures of second locule from the petiole side with the help of sharp stainless steel scalpel. It was examined under light compound microscope. The thickness of pod wall was measured with the help of ocular and stage micrometers and then it was converted to thickness in mm by calculating least count (LC). The formula for calculating LC is given below.

$$\text{Least count (LC)} = \frac{\text{Value of stage micrometer}}{\text{Value on ocular micrometer}}$$

Actual measurement = Value of ocular micrometer x LC of thickness

Data on morphological parameters like; pod size, seed size, pod wall thickness and number of seeds per pod were correlated with pod borer complex infesting various pigeonpea cultivars using standard statistical procedure as suggested by Steel and Torrie (1980).

Category of susceptibility

The pigeonpea cultivars were grouped into four categories of resistance by comparing the mean incidence of each cultivar with mean incidence and standard deviation Patel *et al*. (2002).

Category of Resistance	Scale for Resistance
Tolerant	**Xi** < $\bar{X}$
Less Susceptible (LS)	**Xi** > $\bar{X}$ < **(**$\bar{X}$ **+ 1 SD)**
Moderately Susceptible (MS)	**Xi** > **(**$\bar{X}$ **+ 1 SD)** < **(**$\bar{X}$ **+ 2SD)**
High Susceptible (HS)	**Xi** > **(**$\bar{X}$ **+ 2SD)**

RESULTS AND DISCUSSION

Sixteen different genotypes / cultivars of pigeonpea were screened for their susceptibility against blue butterfly (*L. boeticus*) in middle Gujarat conditions during 2007-08 and 2008-09. The data, thus, obtained on larval population, pod and seed damage were statistically analyzed and summarized as under.

Larval population of L. boeticus

The results presented in Table 1 revealed lower (1.33 larvae per 5 plants) larval population of *L. boeticus* in genotype AAUT 2005-7, which was at par with GAUT 2001-10, AAUT 2005-8, GAUT 97-33, ICPL 87119, GAUT 93-17, GAUT 97-45 and GAUT 2002-16 in which larval population ranged from 2.00 to 3.33

larvae per 5 plants. Higher (7.00 larvae per 5 plants) larval population was found in variety ICPL 87, which was at par with GT 100, GT 1, AVPP 1, Banas, GT 101 and BDN 2, in which larval population ranged from 4.33 to 6.67 larvae per 5 plants during 2007-08. During 2008-09, the lower (1.67 larvae per 5 plants) larval population was recorded in genotype AAUT 2005-7, which was at par with AAUT 2005-8, GAUT 2001-10, GAUT 97-33, ICPL-87119 and GAUT 97-45 in which larval population ranged from 2.33 to 3.33 larvae per 5 plants. Higher (7.00 larvae per 5 plants) larval population was found in variety GT 100, which was at par with ICPL 87, AVPP 1, GT 101, GT 1, Banas and BDN 2, in which larval population ranged from 5.00 to 6.67 larvae / 5 plants.

Two years pooled data are presented in Table 1 revealed lower (1.50 larvae per 5 plants) larval population in genotypes AAUT 2005-7, which was remain at par with GAUT 2001-10 and AAUT 2005-8 in which larval population was observed 2.17 and 2.33 larvae per 5 plants, respectively. Higher (6.83 larvae per 5 plants) larval population was found in variety GT 100 and ICPL 87, which was remain at par with AVPP 1 and GT 1, in which larval population ranged from 5.33 to 5.83 larvae per 5 plants. The order of susceptibility of different genotypes / cultivars of pigeonpea was found to be GT 100 ≥ ICPL 87 ≥ AVPP 1 ≥ GT 1 ≥ GT 101 ≥ Banas ≥ BDN 2 ≥ GP 22 ≥ GAUT 2002-16 ≥ GAUT 93-17 ≥ GAUT 97-45 ≥ ICPL 87119 ≥ GAUT 97-33 ≥ AAUT 2005-8 ≥ GAUT 2001-10 ≥ AAUT 2005-7.

Susceptibility categorization

Based on larval population of *L. boeticus* various genotypes / cultivars of pigeonpea were categorize and presented in Table 2. The varieties AAUT 2005-7, GAUT 2001-10, AAUT 2005-8, GAUT 97-33, ICPL 87119, GAUT 93-17, GAUT 97-45, GAUT 2002-16 and GP 22 recorded less than 4.08 larvae per 5 plants were found tolerant against *L. boeticus*, while varieties BDN 2, Banas, GT 101 and GT 1 recorded less than 5.70, but more than 4.08 larvae per 5 plants were found less susceptible varieties. The varieties AVPP 1, ICPL 87 and GT 100 recorded less than 7.31 and more than 5.70 larvae per 5 plants were found moderately susceptible to *L. boeticus* (Table 2).

Morphological characters

Plant type: The results presented in Table 3 revealed that lowest (3.50 ± 1.23 larvae per 5 plants) larval population of *L. boeticus* was observed in indeterminate type of pigeonpea, whereas determinate type of pigeonpea genotypes recorded highest 5.83 ± 1.41 larvae per 5 plants. Kushwaha and Malik (1987) and Reddy *et al*. (2001) reported determinate genotypes of pigeonpea susceptible to lepidopteron pod borers.

Pod wall colour: The results presented in Table 3 revealed that lowest (3.87 ± 1.61 larvae per 5 plants) larval population of *L. boeticus* was observed in pigeonpea with brown striped green pods, whereas pigeonpea genotypes with green pods recorded highest 5.58 ± 0.35 larvae per 5 plants.

Seed colour: The results presented in Table 3 revealed that lowest (3.95 ± 1.53 larvae per 5 plants) larval population of *L. boeticus* was observed in pigeonpea genotypes with white seed, whereas pigeonpea genotypes with red seeds recorded highest 5.00 ± 2.59 larvae per 5 plants.

Pod length: The results presented in Table 4 revealed negligible differences of larval population of *L. boeticus* between long (4.14 ± 1.94 larvae per 5

plants) and short (4.04 ± 1.44 larvae per 5 plants) pods. The correlation study indicated non-significant (r = 0.119) effect of pod length on larval population of *L. boeticus* (Table 5). This might be due to charisma of blue butterfly towards pigeonpea flower equally towards the all variety. In contrast to this, Nawle and Jadhav (1983) and Nanda *et al*. (1996) recorded positive correlation of pod borers with length of pigeonpea pod. Chandrayudu *et al*. (2006) also reported more proneness of pod borers to big pod. Halder *et al*. (2006) found positive correlation between pod length and pod damage by spotted pod borer in cowpea, mungbean and urdbean. Kamakshi and Srinivasan (2008) reported significant positive correlation between pod length and pod borer complex in field bean. Thus, there is a need of further study.

Pod breadth: The results presented in Table 4 revealed lowest (3.50 ± 1.49 larvae per 5 plants) larval population of *L. boeticus* was observed in pigeonpea genotypes with narrow pods, whereas, pigeonpea genotypes with broad pods recorded highest 5.36 ± 1.10 larvae per 5 plants. The correlation study indicated non-significant positive (r = 0.176) effect of pod breadth on larval population of *L. boeticus* (Table 5). Nawle and Jadhav (1983) as well as Nanda *et al*. (1996) recorded positive correlation of pod borers with breadth of pigeonpea pod.

Seed length: The results presented in Table 4 revealed that lowest (3.79 ± 1.55 larvae per 5 plants) larval population of *L. boeticus* was observed in pigeonpea genotypes with short seeds, whereas pigeonpea genotypes with long seeds recorded highest 5.33 ± 1.50 larvae per 5 plants. The correlation study indicated non-significant positive (r = 0.214) effect of seed length on larval population of *L. boeticus* (Table 5).

Seed breadth: The results presented in Table 4 revealed that lowest (3.50 ± 1.59 larvae per 5 plants) larval population of *L. boeticus* was observed in pigeonpea genotypes with narrow seeds, whereas pigeonpea genotypes with broad seeds recorded highest 5.05 ± 1.21 larvae per 5 plants. The correlation study indicated non-significant (r = 0.077) effect of seed breadth on larval population of *L. boeticus* (Table 5). The present findings are more or less similar to the findings of Dodia (1992) and Anonymous (2007).

Number of seeds per pod: The results presented in Table 4 revealed that lowest (3.85 ± 1.68 larvae per 5 plants) larval population of *L. boeticus* was observed in pigeonpea genotypes with more number of seeds per pod, whereas pigeonpea genotypes with less number of seeds per pod recorded highest 4.60 ± 1.48 larvae per 5 plants. The correlation study indicated non-significant negative (r = -0.124) association between larval population of *L. boeticus* and number of seeds per pod (Table 5).

Seed weight: The results presented in Table 4 revealed that lowest (3.76 ± 1.50 larvae per 5 plants) larval population of *L. boeticus* was observed in pigeonpea genotypes when weighed less than 11.00 g / 100 seeds, whereas pigeonpea genotypes with more than 11.00 g / 100 seeds weight recorded highest (5.50 ± 1.53 larvae per 5 plants). The correlation study indicated non-significant positive (r = 0.246) effect of seed weight on larval population of *L. boeticus* (Table 5).

Dodia (1992) also reported positive correlation with infestation of *H. armigera* to seed weight.

Pod wall thickness: The results presented in Table 4 revealed that

lowest (3.57 ± 1.55 larvae per 5 plants) larval population of *L. boeticus* was observed in pigeonpea genotypes with thick pod wall, whereas pigeonpea genotypes with thin pod wall recorded highest 4.74 ± 1.56 larvae per 5 plants. The correlation study indicated non-significant negative (r = -0.386) association between larval population of *L. boeticus* and pod wall thickness (Table 5). Kamakshi and Srinivasan (2008) and Moudgal *et al*. (2008) also reported significant negative correlation between pod wall thickness and pod damage by spotted pod borer in green gram and pod fly infestation in pigeonpea, respectively.

CONCLUSION

Pigeonpea varieties; ICPL 87119, GAUT 2001-10, GAUT 97-33, AAUT 2005-7, GAUT 2002-16 and AAUT 2005-8 were exhibited tolerant reactions against blue butterfly (*Lampides boeticus* Linnaeus) based on larval population. The lowest larval population of *L. boeticus* was observed in indeterminate type of pigeonpea, whereas the highest larval population of *L. boeticus* was in pigeonpea genotypes with green pods and red seed colour. However, pod as well as seed length and breadth, seed weight, number of seeds per pod and pod wall thickness showed non-significant effect on larval population of *L. boeticus*.

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Table 1: Reaction of various genotypes / cultivars of pigeonpea against blue butterfly (*L. boeticus*)

Cultivars / Genotypes	***L. boeticus* (Larvae Per 5 Plants)**		
	2007-08	**2008-09**	**Pooled**
AAUT 2005-7	1.33 (1.34)	1.67 (1.46)	1.50 (1.40)
AAUT 2005-8	2.33 (1.64)	2.33 (1.64)	2.33 (1.64)
AVPP 1	5.67 (2.47)	6.00 (2.54)	5.83 (2.51)
Banas	4.67 (2.25)	5.00 (2.34)	4.83 (2.30)
BDN 2	4.33 (2.20)	5.00 (2.34)	4.67 (2.27)
ICPL 87119	3.00 (1.84)	3.33 (1.93)	3.17 (1.88)
GAUT 93-17	3.00 (1.86)	3.67 (2.02)	3.33 (1.94)
GAUT 97-33	2.33 (1.68)	3.00 (1.93)	2.67 (1.81)
GAUT 97-45	3.33 (1.93)	3.33 (1.93)	3.33 (1.93)
GAUT 2001-10	2.00 (1.56)	2.33 (1.65)	2.17 (1.61)
GAUT 2002-16	3.33 (1.93)	4.00 (2.11)	3.67 (2.02)
GP 22	3.67 (2.02)	4.00 (2.11)	3.83 (2.06)
GT 1	5.67 (2.47)	5.00 (2.34)	5.33 (2.40)
GT 100	6.67 (2.67)	7.00 (2.74)	6.83 (2.70)
GT 101	4.67 (2.22)	5.33 (2.40)	5.00 (2.31)
ICPL 87	7.00 (2.72)	6.67 (2.67)	6.83 (2.69)
S.Em.± T	0.21	0.18	0.12
Y			0.05
T x Y			0.19
C. D. at 5 % T	0.61	0.52	0.35
Y			NS
T x Y			NS
C. V. %	17.74	14.53	16.15

Note: Figures in parentheses are $\sqrt{x + 0.5}$ transformed values

Table 2: Categorization of pigeonpea genotypes for their susceptibility to blue butterfly (*L. boeticus*) (based on larval population)

Category of Susceptibility	**Scale**	**Varieties**
$\overline{X}$ **=4.08 S.D.=1.61**		
Tolerant	Xi < 4.08	AAUT 2005-7 (1.50), GAUT 2001-10 (2.17), AAUT 2005-8 (2.33), GAUT 97-33 (2.67), ICPL 87119 (3.17), GAUT 93-17 (3.33), GAUT 97-45 (3.33), GAUT 2002-16 (3.67), GP 22 (3.83)
Less Susceptible (LS)	Xi > 4.08 < 5.70	BDN 2 (4.67), Banas (4.83), GT 101 (5.00), GT 1 (5.33)
Moderately Susceptible (MS)	Xi > 5.70 < 7.31	AVPP 1 (5.83), ICPL 87 (6.83), GT 100 (6.83)
High Susceptible (HS)	Xi > 7.31	---

Table 3: Influence of some visual morphological characters on larval population of *L. boeticus* in various genotypes / cultivars of pigeonpea

Plant Characters		**Larvae Per 5 Plants**
Maturity group	Early (5)	5.86 ± 0.96
	Medium (11)	3.27 ± 1.11
Plant type	Determinate (4)	5.83 ± 1.41
	Indeterminate (12)	3.50 ± 1.23
Pod wall colour	Green (2)	5.58 ± 0.35
	Green with brown striped (14)	3.87 ± 1.61
Seed colour	Red (2)	5.00 ± 2.59
	White (14)	3.95 ± 1.53

Note: Figures in parentheses are numbers of genotypes / cultivars studied

Table 4: Larval population of *L. boeticus* infesting various genotypes/cultivars of pigeonpea in relation to different morphological characters

Plant Characters	Range	Category	Larvae Per 5 Plants
Pod length (cm)	> 5.00 (7)	long	4.14 ± 1.94
	< 5.00 (9)	short	4.04 ± 1.44
Pod breadth (cm)	> 0.90 (5)	broad	5.36 ± 1.10
	< 0.90 (11)	narrow	3.50 ± 1.49
Seed length (mm)	> 5.00 (3)	long	5.33 ± 1.50
	< 5.00 (13)	short	3.79 ± 1.55
Seed breadth (mm)	> 4.70 (6)	broad	5.05 ± 1.21
	< 4.70 (10)	narrow	3.50 ± 1.59
Seeds per pod (Nos.)	> 4.00 (11)	more	3.85 ± 1.68
	< 4.00 (5)	less	4.60 ± 1.48
Seed weight(g/100 seeds)	> 11.00 (3)	more	5.50 ± 1.53
	< 11.00 (13)	less	3.76 ± 1.50
Pod wall thickness (mm)	> 0.70 (9)	thick	3.57 ± 1.55
	< 0.70 (7)	thin	4.74 ± 1.56

Note: Figures in parentheses are numbers of genotypes / cultivars studied

Table 5: Correlation coefficient of pod borers with different plant characters

Plant Characters	Larval Population of *L. boeticus*
Pod length (cm)	0.119
Pod breadth (cm)	0.176
Seed length (mm)	0.214
Seed breadth (mm)	0.077
Number of seeds per pod	-0.124
Seed weight (g / 100 seed)	0.246
Pod wall thickness (mm)	-0.386

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