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Influence of morphological factors on the incidence of *Maruca vitrata* (Geyer) on short duration pigeon pea *Cajanus cajan* (L.) Millsp

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Abstract
Six plant parameters, *viz*. Days to 50 per cent flowering, pod wall thickness, pod length, number of grains per pod, days to maturity, trichome density of pod at immature, half mature and fully mature stages were studied in relation to the expression of varietal reaction towards, *Maruca vitrata* in twenty genotypes of short duration pigeonpea. It was observed that pod length (mm) showed positive and significant correlation with *Maruca* webbing (0.4619), larval population (0.4680) and pod damage (0.7710). Highly susceptible genotype Paras possessed maximum pod length 55.86 mm as compared to most tolerant genotype AH10-17 possessed minimum pod length 36.22 mm. The trichomes density showed negative correlation *Maruca* webbing, larval population and pod damage. It was observed that highly susceptible genotype Paras has least number of trichomes at immature stage of pod possessed A type (47.73/ mm^2), B type (1.00/ mm^2), C type (6.21/ mm^2),half mature pod possessed A type (70.83/ mm^2), B type (1.00/ mm^2), C type (1.87 / mm^2) and full mature pod possessed A type (56.27/ mm^2), B type (0.01/ mm^2), C type (0.00 / mm^2) as compared to tolerant genotype AH10-17 with maximum trichomes density at immature stage of pod possessed A type (161.07/ mm^2), B type (8.33/ mm^2), C type (13.69/ mm^2),half mature pod possessed A type (146.30/ mm^2), B type (6.88/ mm^2), C type (6.47 / mm^2) and full mature pod possessed A type (121.07/ mm^2), B type (0.11/ mm^2), C type (0.009/ mm^2).

Keywords: *Maruca*, trichomes, pigeon pea, webbing and pods

Introduction

The spotted pod borer, *Maruca vitrata* (Geyer) derives its pre-eminent importance as a pest of tropical grain legumes from its extremely wide geographical distribution, extensive host range. Its ability to feeding on reproductive parts, the young growing plant tips, stems, flower buds, flowers, pods and seeds. During recent years due to introduction of short duration pigeonpea cultivars, the incidence of *M. Vitrata* has been aggravated as flowering of these varieties occur during periods of high humidity and moderate temperature which is congenial for the development of pest (Sharma *et al.*1999) [11].Various plant morphological features likes days 50 per cent flowering, pod length, pod wall thickness, trichom density, days to maturity may produced physical stimuli and play an important role by providing resistance to the plants against *M. vitrata* (Halder *et al.*, 2006) [1]. From the gene pool of crop species, certain crosses produce genotypes that vary from complete susceptibility to high level of resistance against insects. Therefore the present study was undertaken, Resistant factors in cultivar have become crucial element in the success of many ongoing insect pest management programs.

Material and Methods

The present investigation was carried out at the Pulses Research Farm of Departement. of Genetics & Plant Breeding and laboratory of department of Entomology at Chaudhary Charan Singh Haryana Agricultural University, Hisar using 20 promising genotypes *viz.*, AH 09-36, AH 09-38, AH-09-77, AH 10-17, AH 10-29, AH 12-01, AH 12-03, AH 12-04, AH-12-06, AH 12-06B, AH 12-07, AH 12-09, AH 12-11, AH 12-14, Paras, Manak, Pusa 992, AL 201, PL 229 and UPAS-120. Above genotypes were sown at the distance of 45 X 10 cm^2 using randomized block design replicated thrice. Each block has plot size 3 rows of 4 m length. Larval population and webs was recorded at weekly intervals starting on appearance of insect from 4^{th} week of September, 2014 from randomly selected five plants per plot by using ground cloth sheet sampling method.

Days at which half of the flowers of the randomly selected pigeonpea plants bloomed was noted. Plants were randomly selected from each plot at the time of flowering and bloomed plant were counted. The observation was made till 50 per cent flowering was attained. Wall thickness and pod length of randomly selected 20 pods out of 200 pods taken from 5 plants from each plot of different genotype was used. Hand cut cross section of 20 pods were taken and measured with the help of vernier calliper.

Total number of grains in each pod of randomly selected 20 pods out of 200 pods taken from 5 plants from each plot of different genotype were recorded

To measure trichome density, pods were selected from all the three replications of each 20 pigeonpea genotypes and from each replication pods were selected at three stages i.e. immature, half mature and fully mature and trichome density was measured. The wall of the pod was cut into bits and deep in Di- methyle Sulfoxide (DMS) forovernight. Next day bits were used for making slides andnumbers of trichomes present on the epidermis of the bits were counted under a binocular microscope. Days required for pod maturity was calculated by taking the observations from the date of pod initiation to harvesting of pods in all the three replication of 20 pigeonpea genotypes. The data so obtained was correlated with larval population, web count and per cent pod damage. The result was as below.

Results and Discussion

Different morphological characters *viz.*, days to 50% flowering pod length, number of grains per pods, pod wall thickness, trichome density, and days to maturity, and were recorded on different genotypes and correlated with check varieties Paras and Mank (Table- 1).

Fifty per cent flowering

The data on days to 50 percent flowering revealed that there was significant difference in different genotypes and it ranged from 92 days to 100 days.Minimum days to 50 percent flowering was recorded in AH.12-07 and AH12-06 (92 days) and maximum days to 50 percent flowering was recorded in AH.10-17 and UPAS-120 (100 days) The data revealed that although there was positive correlation with days to 50% flowering but it was not significant with larval population, number of webs and damage pods.

Pod length

Maximum pod length was recorded in Paras (55.86 mm) it was statistically on par with AH 12-07 (53.22 mm), AH 12-11 (55.23 mm) and AH 10-29 (53.47 mm) maximum pod damage was recorded in Paras (68.45%),AH12-11(63.75 %) and AH10-29 (54.73%) having maximum pod damage. Minimum pod length was recorded in AH10-17 (36.22 mm) it was on par with UPAS 120 (39.55 mm) and having minimum pod damage. Jagtap *et al*., 2014 [4] also reported genotype SPS-62 having shorter pod length (3.25 mm) were preferred lesser by *H. armigera* larva than genotype SPS -11 having longer pod length 9.05 mm. The data revealed that there was positive and significant correlation with larval population (r=0.4680*), webbing (r= 0.4619*) and damage pods (r=0.771**).The findings were in accordance with Halder and Srinivasan (2011) [2] reported positive and significant correlation (0.808) between cowpea pods length and *M. vitrata* incidence

Number of grains per pod

The data on number of grains per pod revealed that there was significant difference with each other and ranged from 3.1 to 4.3. Minimum number of grains were recorded in AH 10-17 (3.10) it was statistically on par with Pusa 992 (3.1), PL 229 (3.2), AH 12-03, AH12-14, AH 12-07 and AH 12-04 (3.3). Maximum number of grains were recorded in Paras (4.3) it was on par with AH 12-09 (3.40), AH 12-04 (3.30) and AH 09-77 (3.40). The data revealed that there was no significant correlation with larval population, web number and damaged pods. Krishan (2013) also reported no significant correlation of number of grains per pod with pod damage.

Pod wall thickness,

The data on pod wall thickness revealed that there was significant difference in different genotypes which it ranged from 0.36 mm to 0.57 mm Minimum pod wall thickness was recorded in AH10-17 (0.36 mm), AH12-14 (0.36 mm) and Manak (0.36 mm) and maximum was in Paras (0.57 mm). The data revealed that there was negative correlation (r= -0.0635) with webbing, larval (r = -0.0126) and damaged pods (-0.1970). Pandey *et al*. (2011) [7] who reported five tolerant and six resistant genotypes on the basis of podwall thickness similarily Moudgal *et al*. (2008) [5] at Hisar, Haryana also found negative association between pod wall thickness and pod fly infestation in pigeonpea

Trichome density

The data on trichomes density was recorded thrice at reproductive stage. It was recorded at milky stage i.e. immature, half mature and at maturity of the crop. Three types of trichomes found on pod wall of pigeonpea *viz.*,A type, B type and C type similar finding by Shanower *et al*. (1999) [9] identified three glandular (Type A, B and E) and two non-glandular (Type C and D) trichome types with light and electron microscopy.

A type of trichomes generally uniformly distributed all over the pod wall, B types of trichomes are glandular with bulbous base while C types of trichomes are having more length than other two. On immature stages of pod, A type of trichome differed significantly with each other which ranged from 47.73 /mm^2 to 161.07 /mm^2.Minimum trichome density of A type was recorded in Paras (47.73 /mm^2) which was significantly differed than other genotypes. Maximum trichome density of A type was recorded on AH 10-17 (161.07 /mm^2). There was negative correlation (r= -0.4766) with number of webs, larval population (r = -0.3624) and damage pod (r=-0.8730*). B type of trichome on immature pod ranged from 1.00 /mm^2 to 8.33/mm^2. Minimum trichome density was recorded on Paras (1.00 /mm^2) while maximum recorded on AH 10-17 (8.33/ mm^2). There was negative correlation (r= - 0.1094) with number of web, larval population (r= - 0.1688) and damage pod (r= -0.1840). C type of trichome on immature pod ranged from 13.69 /mm^2 – 6.21/ mm^2. Minimum trichome density of immature pods of type C was recorded in Paras (6.21 mm^2). It was significantly differ than other genotypes. Maximum trichome density of C type was recorded on AH 10-17 (13.69/ mm^2). There was negative correlation (r= -0.5771**) recorded with web, larval population (r = -0.4471*) and damage pod (r= -0.8790**).

On half mature pods, A type of trichomes significantly differered in different genotypes and ranged from 146.3/mm^2 to 70.93/ mm^2. Minimum trichome density of immature pods type A was recorded in Paras (70.93/ mm^2). It was significantly different than other genotypes. Maximum trichome density of A type was recorded on AH 10-17 (146.30 /mm^2). There was negative correlation (r= -0.2627) with number of webs, larval population (r = -0.1185) and damage pods (r= -0.6010*). B types of trichome on immature pod ranged from 1.00 /mm^2 to 6.88/ mm^2. Minimum trichome density (1.00/ mm^2) was reported on Paras, AH 09-77, AH 12-09, AH 12-11 and AL201 while maximum recorded on AH 10-17 (6.88 /mm^2). There was negative correlation (r= -0.0379) with number of webs, larval population (r= - 0.2490) and (r= -0.240). C type of trichomes on immature pod ranged from 6.47 /mm^2 to 1.87 /mm^2. Minimum trichome density of A type was recorded in Paras (1.87 /mm^2). Maximum trichome density of A type was recorded on AH 10-17 (6.47/ mm^2). There was negative correlation (r= -0.1987) with number of webs, larval population (r = -0.1365) and damage pod (r= -0.3490).On mature stages of pod, A type of trichome significantly differ with each other and ranged from 121.07/ mm^2 to 56.27/ mm^2. Minimum trichome density (56.27/ mm^2) of immature pods, A type was recorded in Paras. It was significantly differ than other genotypes. Maximum trichome density of A type was recorded on AH 10-17 (121.07/ mm^2). There was negative correlation (r= -0.3624) with web, (r= -0.2958) with larva and (r= -0.2700)with damage pods. C type of trichome on mature pod ranged from 0.00 /mm^2. to 0.09 /mm^2 Minimum trichome density of C type on mature pod was recorded in Paras (0.00 /mm^2). Maximum trichome density of C type on mature pod was recorded on AH 10-17 and AH 09-36 (0.09/ mm^2). There was negative and significant correlation (r= -0.5862**) with number of webs, larval population (r = -0.3298) and pod damage (r= - 0.7360 **) accordance with Oghiakhe *et al.* (1992 C) [6] and Peter (1995) [8]. Sunitha *et al*. (2008) [12] and Sharma *et al.* (2009) [10] who studied studied the trichome density were found to be associated with resistance to *M. vitrata* in short duration pigeonpea genotypes. Halder and Srinivasan (2011) [2] reported similar results on cowpea against *M. vitrata.* Jackai and Oghiakhe (1989) [3] also demonstrated that the trichomes were responsible for resistance in wild cowpeaTVNu-72 and TVNu-73 to *M. vitrata* when compared to susceptible variety IT 84 E-124.

Days to maturity

The data on days to maturity was recorded on different genotypes of pigeonpea and it ranged from 148 days to 146 days.Minimum days to maturity was recorded in AL201 and PL229 which was (138 days). Maximum day to maturity was recorded in UPAS-120 (146 days). There was no significant correlation with larval population, web number and damaged pods with days to maturity of crop

Morphological characters of the genotypes i.e. 50 per cent flowering, number of grains, pod wall thickness and days to maturity were evaluated. Days to 50 per cent flowering revealed that there was significant difference in different genotypes and it ranged from 92 to 100 days.Minimum days to 50 percent flowering was recorded in AH 12-07 and AH 12-06 (92 days) and maximum days to 50 per cent flowering was recorded in AH 10-17 and UPAS-120 (100 days), although no significant correlation could established with larval population, number of webs and damaged pods.

There was positive and significant correlation with larval population (r=0.4680*), web count (r= 0.4619*) and damaged pods (r=0.771**). Maximum pod length was recorded in Paras (55.86 mm) and it was statistically on par with AH 12-07 (53.22 mm), AH 12-11 (55.23 mm) and AH 10-29 (53.47 mm). Minimum number of grains were recorded in AH 10-17 (3.10) and it was statistically on par with Pusa 992 (3.1), PL 229 (3.2), AH 12-03, AH12-14, AH 12-07 and AH 12-04 (3.3). Maximum number of grains were recorded in Paras (4.3) and it was on par with AH 12-09 (3.40), AH 12-04 (3.30) and AH 9-77 (3.40).

Table 1: Correlation of morphological parameters of pigeonpea genotypes with *M. vitrata*

Genotypes	Days to 50% flowering	Pod length (mm)	Pod wall thickness (mm)	Number of grains /pod	Days to maturity	Trichome density per mm^2								
						Immature			Half mature			Fully mature		
						A	B	C	A	B	C	A	B	C
AH09-36	96	43.26 (6.65)	0.38 (1.18)	3.9 (2.21)	141	137.48 (11.77)	7.67 (2.94)	12.44 (3.65)	125.60 (11.25)	4.33 (2.30)	5.80 (2.60)	101.60 (10.13)	0.03 (1.01)	0.09 (3.09)
AH09-38	98	41.66 (6.53)	0.44 (1.20)	3.6 (2.15)	140	138.44 (11.80)	7.97 (2.99)	12.65 (2.74)	125.87 11.26)	4.68 (2.37)	5.87 (2.62)	88.53 (9.46)	0.02 (1.01)	0.02 (2.27)
AH09-77	98	55.66 (7.53)	0.46 (1.20)	3.4 (2.10)	140	73.21 (8.61)	2.33 (1.82)	4.00 (3.74)	79.73 (8.98)	1.00 (1.41)	3.60 (2.14)	62.13 (7.94)	0.00 (1.00)	0.04 (2.99)
AH10-17	100	36.22 (6.10)	0.36 (1.17)	3.1 (2.02)	144	161.07 (12.73)	8.33 (3.05)	13.69 (3.83)	146.30 (12.13)	6.88 (2.80)	6.47 (2.73)	121.07 (11.04)	0.11 (1.05)	0.09 (2.58)
AH10-29	96	53.47 (7.38)	0.43 (1.19)	4.3 (2.30)	144	89.33 (9.50)	4.67 (2.37)	11.00 (3.27)	80.80 (9.04)	1.33 (1.52)	3.13 (2.02)	67.73 (8.29)	0.00 (1.00)	0.06 (3.62)
AH12-01	93	48.10 (7.01)	0.45 (1.20)	3.9 (2.21)	139	127.47 (11.33)	6.67 (2.76)	9.73 (3.13)	99.73 (10.03)	3.67 (2.15)	4.07 (2.24)	82.67 (9.14)	0.02 (1.00)	0.04 (2.80)
AH12-03	96	51.66 (7.26)	0.45 (1.20)	3.3 (2.07)	140	106.13 (10.35)	6.00 (2.64)	6.53 (3.66)	85.07 (9.27)	2.33 (1.81)	3.27 (2.06)	73.07 (8.60)	0.00 (1.00)	0.03 (2.74)
AH12-04	91	51.11 (7.22)	0.48 (1.21)	3.3 (2.08)	140	114.80 (10.76)	6.33 (2.70)	8.91 (3.14)	91.73 (9.63)	3.00 (1.99)	6.47 (2.73)	77.87 (8.88)	0.01 (1.00)	0.06 (3.83)
AH12-06	92	41.22 (6.50)	0.39 (1.18)	3.6 (2.14)	140	139.88 (11.85)	8.00 (2.99)	12.99 (3.74)	126.13 (11.27)	4.97 (2.43)	6.00 (2.64)	94.93 (9.79)	0.07 (1.03)	0.03 (2.48)
AH12-06B	93	46.22 (6.87)	0.41 (1.19)	3.8 (2.19)	140	132.11 (11.53)	7.00 (2.82)	11.21 (3.49)	101.87 (10.14)	3.67 (2.15)	2.67 (1.90)	84.43 (9.24)	0.02 (1.01)	0.03 (2.97)
AH12-07	92	53.22 (7.36)	0.46 (1.20)	3.3 (2.07)	140	104.27 (10.25)	5.60 (2.56)	6.27 (2.23)	80.80 (9.04)	1.67 (1.63)	3.13 (2.02)	70.93 (8.48)	0.00 (1.00)	0.03 (2.81)
AH12-09	96	41.23 (6.50)	0.44 (1.20)	3.4 (2.10)	140	126.11 (11.27)	6.60 (2.75)	9.27 (3.15)	98.13 (9.95)	1.00 (1.41)	3.93 (2.21)	79.47 (8.97)	0.00 (1.00)	0.06 (3.26)
AH12-11	95	55.23 (7.50)	0.45 (1.20)	3.7 (2.17)	140	86.91 (9.37)	3.33 (2.07)	6.11 (2.66)	80.80 (9.04)	1.00 (1.41)	2.93 (1.97)	65.87 (8.17)	0.00 (1.00)	0.05 (2.91)
AH12-14	99	47.11 (6.94)	0.36 (1.16)	3.3 (2.07)	140	129.60 (11.43)	6.88 (2.80)	10.00 (3.20)	101.07 (10.10)	3.67 (2.15)	4.20 (2.27)	83.47 (9.19)	0.02 (1.00)	0.05 (2.90)
PARAS	97	55.86 (7.54)	0.57 (1.19)	4.3 (2.30)	145	47.73 (6.98)	1.00 (1.41)	6.21 (2.68)	70.93 (8.48)	1.00 (1.41)	1.87 (1.69)	56.27 (7.56)	0.01 (1.00)	0.00 (1.00)

MANK	98	46.22 (6.87)	0.36 (1.16)	3.9 (2.22)	140	132.53 (11.55)	7.67 (2.94)	12.32 (3.65)	101.30 (10.11)	4.32 (2.30)	5.07 (2.46)	86.93 (9.37)	0.02 (1.01)	0.02 (2.24)
PUSA992	93	49.88 (7.13)	0.41 (1.19)	3.1 (2.02)	140	124.68 (11.21)	6.33 (2.70)	8.93 (2.66)	93.07 (9.70)	3.16 (2.03)	3.80 (2.19)	79.20 (8.95)	0.01 (1.00)	0.05 (3.44)
AL201	93	48.56 (7.04)	0.43 (1.18)	3.6 (2.14)	138	72.00 (8.57)	1.00 (1.41)	4.00 (2.23)	73.60 (8.63)	1.00 (1.41)	2.40 (1.83)	58.93 (7.74)	0.00 (1.00)	0.02 (2.24)
PL229	94	51.63 (7.25)	0.39 (1.20)	3.2 (2.05)	138	110.33 (10.55)	6.33 (2.70)	8.80 (2.68)	88.66 (9.47)	2.67 (1.90)	3.40 (2.08)	77.33 (8.85)	0.01 (1.00)	0.08 (3.56)
UPAS-120	100	39.55 (6.37)	0.43 (1.22)	3.6 (2.14)	146	142.10 (11.96)	8.00 (2.99)	13.22 (3.77)	130.80 (11.48)	5.37 (2.51)	6.22 (2.69)	11.6 (10.12)	0.09 (1.04)	0.04 (2.86)
r value(web)	0.1411	0.4619*	-0.0635	0.2660	-0.1985	-0.3624	-0.1094	-0.5771**	-0.2627	0.1007	-0.1987	-0.3624	-0.1094	-0.5862**
r value (larva)	0.1490	0.4680*	-0.0126	-0.1760	-0.2008	-0.4766*	-0.1688	-0.4471*	-0.1185	-0.0379	-0.1365	-0.2958	-0.0758	-0.3298
r value damage pod	-0.2440	0.7710**	-0.1970	0.0110	-0.1670	-0.873**	-0.1840	-0.879**	-0.601*	-0.2400	-0.3490	-0.2700	-0.1870	-0.736**
SEm (±)	0.38	0.09	0.01	0.02		(0.61)	(0.07)	(0.07)	(0.02)	(0.06)	(0.03)	(0.015)	(0.37)	(2.96)
CD	NS	0.27	NS	0.07	NS	(1.77)	(0.22)	(0.20)	(0.06)	(0.18)	(0.09)	(0.04)	(0.00)	(0.15)

Figures in the parentheses are $\sqrt{x+1}$ transformed value,*At 5% level of significance,**At1%level ofsignificance

References

1. Halder J, Srinivasan S, Muralikrishna T. Biochemical basis of resistance against *Maruca vitrata* (Geyer) in mung bean.Journal of Entomological Research, 2006; 30(4):313-316.
2. Halder J, Srinivasan S. Varietal screening and role of morphological factors on distribution and abundance of spotted pod borer, *Maruca vitrata* (Geyer) on cowpea. Annals of Plant Protection Sciences. 2011; 19(1):71-74.
3. Jackai LEN, Oghiakhe S. Pod wall trichomes and resistance oftwo wild cowpea, *Vigna vexillata* accessions to *Maruca testulalis* (Geyer) (Lepidoptera : Pyralidae) and *Clavigralla tomentosicollis* Stal. (Hemiptera: Coreidae). Bulletin of Entomological Research, 1989; 79:595-605.
4. Jagtap BR, Acharya S, Patel JB, Bharat L. Impact of morphological and biochemical constitution of genotypes on incidence of *Helicoverpa* in pigeonpea [*Cajanus Cajan* (L.) Millsp.]**.** Journal of Food Legumes 2014; 27(1):48-51.
5. Moudgal RK, Lakra RK, Dahiya B, Dhillon MK. Physico-chemical traits of *Cajanus cajan* (L.) Millsp. pod wall affecting *Melanagromyza obtusa* (Malloch) damage. Euphytica. 2008; 161(3):429-436.
6. Oghiawle S, Jackai LEN, Makanjuola WA. Pod wall toughness has no effect on cowpea resistance to the legume pod borer *Maruca testualis* (Geyer) (Lepidoptero : Pyralidae). Insect Science and its Application, 1992; 13:345-349.
7. Pandey V, Srivastava CP, Nath T, Raha P Chemical. traits of pigeonpea pod wall affecting pod fly damage. Indian Journal of Agricultural Sciences, 2011; 81(11):1059-1062.
8. Peter JA. Pigeonpea trichomes a promising source for pod borer resistance. IPM and IKM Newsletter for legume crops in Asia. 1995; 2:5-4.
9. Shanower TG, Romeis J, Minja EM. Insect pests of pigeonpea and their management. Annual Review of Entomology. 1999; 44:77-96.
10. Sharma HC, Sujana G, Rao DM. Morphological and chemical components of resistance to pod borer, (*Helicoverpa armigera* Hubner) in wild relatives of pigeonpea, [*Cajanus cajan* (L.) Millsp.].Arthropod- Plant Interactions. 2009; 3(3):151-161.
11. Sharma KK, Yadav HS, Chandra A. Reaction of field bean varieties to pod borercomplex. JNKVV Research Journal. 1999; 33(1-2):78-79.
12. Sunitha V, Rao GVR, Lakshmi KV, Saxena KB, Rao VR, Reddy YVR. Morphological and biochemical factors associated with resistance to *Maruca vitrata* in short duration pigeonpea, [*Cajanus cajan*(L.) Millsp.].International Journal of Tropical Insect Science, 2008; 28(1):45-52.
13. Yadav K. Screening of pigeonpea genotypes against important insect pests and their management Msc Thesis Submittted to Chaudhary Charan Singh Haryana Agricultural University. 2013, 26.