Journal of Entomology and Zoology Studies

Available online at www.entomoljournal.com

E-ISSN: 2320-7078
P-ISSN: 2349-6800
JEZS 2017; 5(6): 829-836

Received: 21-09-2017
Accepted: 22-10-2017

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Screening of some promising pigeonpea genotypes against *Maruca vitrata* (Geyer)

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Abstract
The present experiment was conducted to screen thirty one genotypes of pigeonpea with three check cultivars *viz.,* PUSA 992, PA 291 & UPAS 120 for their resistance/tolerance to *Maruca vitrata* under natural infestation in pesticide free open field during (2015-2016) to isolate sources of resistance to *Maruca vitrata* and results revealed that when overall mean of the larval population of *Maruca vitrata* was considered together the minimum larval population (1.65 larvae/5 shoots) was observed on genotype UPAS120 x H82-1 (P3) and maximum 2.78 larvae/5 shoots on genotype H82-1 x PUSA 992 (P5). However, among all the genotypes of pigeonpea the minimum webbing (3.64%) on genotype AL 201 x PUSA 992 (P3) and the highest number of webbing (7.67%) was observed on genotype H82-1 x UPAS 120 (P4).

Keywords: *Maruca vitrata,* Pigeonpea, genotypes, resistance, webbing percent

1. Introduction

Pigeon pea (*Cajanus cajan* (L.) Millspaugh) is one of the major grain legume crops in the tropical and subtropical regions of the world. It is the second most important pulse crop of India, after chickpea [1]. It is an important source of high quality dietary protein and is mostly consumed in the form of split pulse; green seeds are used as a vegetable. On the other hand, crushed dry seeds are used as animal feed, green and dry leaves as fodder, stems as fuel wood and to make huts and baskets in tribal areas. It is an agricultural crop of rainfed drylands, which can be grown on mountain slopes to reduce soil erosion. Beside this it's importance to semi-arid cropping systems due to its efficient nitrogen-fixing ability, tolerance to drought and contribution to soil organic matter. Pigeonpea is grown on relatively marginal soils and has the potential to provide upto three crops per year [2]. Among the several factors responsible for low yields of pigeonpea, insect pests are major limiting factors. Pigeonpea is attacked by a large number of insects at all growth stages i.e., seedling to harvest stage, about 250 species of insects belonging to 61 families of 8 orders infesting this crop are known [3]. On estimate, losses due to these insect pests may vary from 27% to 100% and on an average annually 2.5 to 3.0 million tonnes of pulses are lost [4].With a monetary value of nearly Rs. 6,000 crore due to ravages of insect pest complex [5]. Due to introduction of short duration pigeonpea cultivars, the incidence of *M. vitrata* has been aggravated because flowering of these varieties occur during periods of high humidity and moderate temperature which is congenial for the development of pest [6]. *M. vitrara* larvae feed on flowers, buds and pods by webbing them. This typical feeding habit protects the larvae from natural enemies and other adverse factors including insecticides. Larvae move from one flower to another and each may consume 4-6 flowers before larval development is completed. Third instar larvae are capable of boring in to the pods, and occasionally in to peduncles and stems [7, 8] Observed the infestation of *Maruca vitrata* on pigeonpea varying between 9 and 51% at Banglore, Karnataka. [9] Reported 70 -80% yield loss in pigeonpea, whereas it was 17-53% in cowpea [10] and 100% in urd bean [11]. Farmers are frustrated to manage these insect pests with commonly available insecticides. But dependence on only chemicals lead to the problems like development of resistance, outbreak of secondary pests, pesticide residues, hazards to human and animal life, destruction of natural enemies and as well as environmental pollution. In this context, it becomes very imperative to follow alternate approach which is ecologically viable and socially acceptable. Hence, adoption of Integrated Pest Management technology is the need of the hour which utilizes all the suitable technology in compatible manner including Host Plant Resistance. The first line of defense against insect pest is cultivation of resistant crop variety.

Use of tolerant cultivars virtually does not involve any skill or costly investment in pest management. It can be considered as a principal component in pest management besides cultural, biological and chemical control measures. So, keeping Thus, keeping these views in mind, the present study was conducted to identify sources of resistant/tolerance as to evolve less susceptible cultivar to spotted pod borer, *Maruca vitrata* in pigeonpea genotypes.

2. Materials and methods

Studies on screening of some promising genotypes of pigeonpea against *Maruca vitrata* (Geyer) and other pod borer complex was conducted under field at NEB-CRC, GBPUA&T, Pantnagar, Uttarakhand during 2015-2016 crop season. For varietal screening studies thirty one pigeonpea genotypes are selected with three check cultivars and screened under field conditions. pigeonpea genotypes were raised on 24th July 2015 in plot size of 5m x 0.6m x 2, rows of 3 m length with spacing of 60 cm x 10 cm keeping three replications in randomized block design. The plots were keptwithout insecticidal umbrella to allow pod borer complex to multiply throughout the cropping season and tested for their resistance or tolerance to pod borer complex. The observations on the incidence of *Maruca vitrata* larval population and percent webbing by *Maruca vitrata* was observed weekly. The larvae of the pod borers and webs of spotted pod borer (*M. vitrata*) were recorded at weekly intervals from the 5 tagged plants from treatment per replication were initiatedwhen the pest appeared in the field till crop maturity. The data thus obtained were analyzed statistically.

Table 1: List of pigeonpea genotypes screened during 2015-16 against *Maruca vitrata.*

Treatments	Pigeonpea genotypes	Treatments	Pigeonpea genotypes
1	H82-1 x PUSA-992 (P1)	18	AL 201 x UPAS 120 (P1)
2	H82-1 x PUSA-992 (P2)	19	AL 201 x UPAS 120 (P2)
3	H82-1 x PUSA-992 (P3)	20	AL 201 x UPAS 120 (P3)
4	H82-1 x PUSA-992 (P4)	21	AL 201 x UPAS 120 (P4)
5	H82-1 x PUSA-992 (P5)	22	UPAS 120 x PUSA 971 (P1)
6	H82-1 x PUSA-992 (P6)	23	UPAS 120 x PUSA 971 (P2)
7	H82-1 x PUSA-992 (P7)	24	UPAS 120 x PUSA 971 (P3)
8	H82-1 x UPAS120 (P1)	25	UPAS 120 x PUSA 971 (P4)
9	H82-1 x UPAS120 (P2)	26	PA 291 (Check)
10	H82-1 x UPAS120 (P3)	27	UPAS 120 x PUSA 885 (P1)
11	H82-1 x UPAS120 (P4)	28	UPAS 120 x PUSA 885 (P2)
12	UPAS120 x H82-1 (P1)	29	UPAS 120 x AL1483
13	UPAS120 x H82-1 (P2)	30	PUSA 992 (Check)
14	UPAS120 x H82-1 (P3)	31	UPAS 120 x *Cajans acutifolius* (P1)
15	AL 201 x PUSA 992 (P1)	32	UPAS 120 x *Cajans acutifolius* (P2)
16	AL 201 x PUSA 992 (P2)	33	PUSA 992 x UPAS 120
17	AL 201 x PUSA 992 (P3)	34	UPAS 120 (Check)

2.1 Pod damage assessment of pigeonpea genotypes against pod borer complex

Crop samples were taken at maturity from thirty one pigeonpea genotypes. Sample pods were examined for the damage of major pod borers *viz,. Maruca vitrata, Helicoverpa armigera* and *M. obtusa.* The pods were opened and all the grains were examined for maggot damage in case of pod fly, *Melanagromyza obtusa.* Following criteria were adopted to differentiate damage of the pod borers, according to [12] Pods attacked by *M. vitrata* having relatively small holes with scrapped margins, plugging of entrance hole with larval excreta. Besides, above the total number of pods and number of damaged pods by various pod borers were recorded separately for each sample and converted into percent pod damage as indicated below:

$$\text{Percent pod damage} = \frac{\text{No.of damaged pods}}{\text{Total no.of pods}} \times 100$$

2.2 Insect pest susceptibility rating of different genotypes

The susceptibility of different genotypes to insect pests was calculated on the basis of percent pod damage at the time of the crop maturity. The following formula was used as suggested by [13].

$$\text{Insect pest succeptiblity} = \frac{\text{Percent PD in check cultivar} - \text{percent PD in test cultivar}}{\text{percent PD in check cultivar}} \times 100$$

Where, PD = Pod damage

Based on this formula, the performance of each cultivar 1-9 scale as follow:

Table 2: Scale of pest susceptibility rating.

Pest susceptibility	Grade	Category
100%	1	Highly resistant
75 to 90%	2	Resistant
50 to 75%	3	Least susceptible
25 to 50%	4	Least susceptible
10 to 25%	5	Least susceptible
-10 to 10%	6	Moderately susceptible
-10 to -25%	7	Moderately susceptible
-25 to -50%	8	Highly susceptible
<-50%	9	Highly susceptible

2.3 Observation on grain yield

The weight of grains of sample and plot was taken for each genotypes and the total yield per plot included the yield of sample grains and it was then computed on kg/ha basis.

2.4 Statistical analysis

All the data recorded were subjected to statistical analysis as per the Randomized Block Design procedure. Insect population data were transformed by square root ($X+\sqrt{0.5}$) transformation and webbing percent data were transformed by arc sin (q = sin-1x) transformation method

3. Results and Discussion

3.1 Screening of pigeonpea genotypes against larval population of *M. vitrata*

The data recorded on larval population of *Maruca vitrata* at various intervals have been presented in the Table 3 and figure 1**.** The data was recorded from the time of onset of the insect population to the time of crop maturity. At 85 DAG (Days after germination) the larval population of *Maruca vitrata* varied non-significantly from minimum (0.93 larvae/5 shoots) on genotypes UPAS120 x H82-1 (P2), UPAS 120 x H82-1 (P3), AL 201 x PUSA 992 (P3), UPAS120 x PUSA971 (P2), UPAS 120 x AL1483 and PUSA992 x UPAS120 to maximum (2.80 larvae/5 shoots) on genotype UPAS 120 x PUSA 885 (P2) as against the checks PA 291 (1.93 larvae/5 shoots), PUSA 992 (0.00 larvae/5 shoots) and UPAS 120 (0.00 larvae/5 shoots). Population of *Maruca vitrata* larvae were not recorded on check varities PUSA992 and UPAS120 during that period because these two genotypes had not commenced in its flowering stage.

There is gradual increase in larval population of *Maruca vitrata* with the growth of the crop. At 95 DAG, the larval population of *Maruca vitrata* varied significantly from minimum (1.86 larvae/5 shoots) on genotypes H82-1 x PUSA 992 (P2), H82-1 x PUSA 992 (P6), UPAS120 x H82-1 (P1), UPAS120 x H82-1 (P3), AL 201 x PUSA 992 (P1), AL 201 x UPAS 120 (P1), UPAS120 x PUSA971 (P1) and UPAS 120 x PUSA 885 (P1) to maximum (3.33 larvae/5 shoots) on genotype H82-1 x PUSA-992 (P5) as against the checks PA 291 (2.33 larvae/5 shoots), PUSA 992 (0.00 larvae/5 shoots) and UPAS 120 (0.00 larvae/5 shoots). Population of *Maruca vitrata* larvae were not recorded on check varieties PUSA992 and UPAS120 during that period because these two genotypes had not commenced in its flowering stage.

At 105 DAG, the larval population of *Maruca vitrata* varied non-significantly from minimum (2.26 larvae/5 shoots) on genotype AL 201 x UPAS 120 (P1) to maximum (3.53larvae/5 shoots) on genotype H82-1 x PUSA 992 (P5) as against the check cultivar PA 291 (2.46 larvae/5 shoots), PUSA 992 (3.40 larvae/5 shoots) and UPAS 120 (2.33 larvae/5 shoots).

At 115 DAG, the larval population of *Maruca vitrata* varied non-significantly from minimum (2.80 larvae/5 shoots) on genotype UPAS 120 x H82-1 (P3), AL 201 x PUSA 992 (P3), UPAS120 x PUSA971 (P2) and UPAS 120 x AL1483 to maximum (4.53 larvae/5 shoots) on genotypes H82-1 x PUSA 992 (P5) and H82-1 x UPAS120 (P4) as against the checks PA 291 (3.57 larvae/5 shoots), PUSA 992 (3.40 larvae/5 shoots) and UPAS 120 (3.33 larvae/5 shoots).

At 125 DAG, the larval count of *Maruca vitrata* varied non-significantly from minimum (1.66 larvae/5 shoots) on genotypes UPAS 120 x H82-1 (P3), AL 201 x PUSA 992 (P3) and UPAS 120 x AL1483 to maximum (2.86 larvae/5 shoots) on genotype H82-1 x UPAS120 (P4) as against the checks PA 291 (2.46 larvae/5 shoots), PUSA 992 (2.33 larvae/5 shoots) and UPAS 120 (2.46 larvae/5 shoots).

At 135 DAG, the larval population of *Maruca vitrata* varied non-significantly from minimum (0.20 larvae/5 shoots) on genotypes UPAS120 x H82-1 (P2), UPAS 120 x H82-1 (P3), AL 201 x PUSA 992 (P3), AL 201 x UPAS 120 (P4), UPAS120 x PUSA971 (P1), UPAS120 x PUSA971 (P3), UPAS120 x PUSA971 (P4) and UPAS 120 x AL1483 to maximum (0.53 larvae/5 shoots) on genotypes H82-1 x PUSA 992 (P1), H82-1 x PUSA 992 (P4), H82-1 x UPAS120 (P2) and UPAS 120 x PUSA 885 (P2) as against the checks PA 291 (0.20 larvae/5 shoots), PUSA 992 (0.40 larvae/5 shoots) and UPAS 120 (0.40 larvae/5 shoots).

When overall mean of the larval population of *Maruca vitrata* was considered together the minimum larval population (1.65 larvae/5 shoots) was observed on genotype UPAS120 x H82-1 (P3) and maximum 2.78 larvae/5 shoots on genotype H82-1 x PUSA 992 (P5) as compared to 2.15 larvae, 1.49 larvae and 1.42 larvae/5 shoots on PA 291, PUSA 992 and UPAS 120, respectively.

The present findings are in close agreement with the findings of [14] who reported that incidence of *M. vitrata* in three cultivars viz., LRG 41, TRG 22 and TRG 38 started from onset of flowering till maturity. While, [15] reported that *M. vitrata* showed high rate of infestation, which was observed up to 155 DAS (days after sowing) all varieties were infested and having peak period 125 DAS and concluded that highest infestation was observed on full podding stage [16]. reported that peak incidence of *M. vitrata* started from 40th SW to 47th SW.

3.2 *Maruca vitrata* percent webbing

The data recorded on percent webbing of *Maruca vitrata* at various intervals have been presented in the Table 3 and Figure 2. At 85 DAG (Days after germination) the webbing percent of *Maruca vitrata* varied significantly from minimum (1.60 percent) on genotypes UPAS120 x H82-1 (P3) and UPAS 120 x AL1483 to maximum (6.13 percent) on genotypes H82-1 x PUSA 992 (P1), H82-1 x PUSA 992 (P4), H82-1 x PUSA 992 (P5), H82-1 x UPAS120 (P4), UPAS 120 x PUSA 885 (P2), and UPAS120 x C*ajanus acutifolius*(P2) as against 0.00 percent on check PUSA992 and UPAS120 and 3.33 percent on PA 291. Percent webbing of *Maruca vitrata* larvae were not recorded on check varities PUSA992 and UPAS120 during that period because these two genotypes had not commenced in its flowering stage.

There was gradual increase in webbing percent by *Maruca vitrata* with the growth of the crop. At 95 DAG, the percent webbing by *Maruca vitrata* varied significantly from minimum (4.20 percent) on genotypes AL 201 x PUSA 992 (P3), UPAS120 x PUSA971 (P2) and UPAS 120 x AL1483 to maximum (9.33 percent) on genotypes H82-1 x PUSA 992 (P1), H82-1 x PUSA 992 (P5), H82-1 x UPAS120 (P4) and UPAS120 x C*ajanus acutifolius*(P2) as against 0.00 percent on checks PUSA992 and UPAS 120 and 5.46 percent on PA 291. Percent webbing of *Maruca vitrata* were not recorded on check varieties PUSA992 and UPAS120 during that period because these two genotypes had not commenced in its flowering stage.

At 105 DAG, the percent webbing by *Maruca vitrata* varied non-significantly from minimum (4.53 percent) on genotype Al 201 x PUSA 992 (P3) to maximum (9.66 percent) on genotype H82-1 x UPAS120 (P2) as against the checks PA 291 (7.66 percent), PUSA 992 (8.53 percent) and UPAS 120 (7.20 percent).

At 115 DAG, the percent webbing by *Maruca vitrata* varied non-significantly from minimum (6.40 percent) on genotype AL 201 x PUSA 992 (P3) to maximum (11.46 percent) on genotypes H82-1 x PUSA 992 (P1), H82-1 x PUSA 992 (P4), H82-1 x PUSA 992 (P5) and H82-1 x UPAS120 (P4) as against checks PA 291 (7.60 larvae/ 5 shoots), PUSA 992 (9.00 larvae/ 5 shoots) and UPAS 120 (8.53 percent).

At 125 DAG, the percent webbing by *Maruca vitrata* varied non-significantly from minimum (3.20 percent) on genotype AL 201 x PUSA 992 (P3) to maximum (7.20 percent) on genotype AL 201 x UPAS 120 (P3) as against the checks PA 291 (4.53 percent), PUSA 992 (7.20 percent) and UPAS 120 (6.13 percent).

At 135 DAG, the percent webbing by *Maruca vitrata* varied non-significantly from minimum (1.06 percent) on genotypes UPAS120 x H82-1 (P3), UPAS120 x PUSA971 (P2) and UPAS 120 x AL1483 to maximum (6.13 percent) on genotype AL 201 x UPAS 120 (P3) as against the checks PA 291 (1.80 percent), PUSA 992 (6.13 percent) and UPAS 120 (4.26 percent).

When overall mean of the percent webbing by *Maruca vitrata* was considered together, the minimum webbing (3.64 percent) on genotype AL 201 x PUSA 992 (P3) followed by 4.98 percent on UPAS120 x H82-1 (P1), 5.37 percent on AL 201 x UPAS 120 (P2), 6.91 percent on H82-1 x UPAS120 (P2) and the highest number of webbing (7.67 percent) was observed on genotype H82-1 x UPAS 120 (P4) while 5.29, 5.24 and 4.35 percent webbing observed on checks PA 291, PUSA 992 and UPAS 120, respectively.

The present findings arein close agreement with the findings of [17] they screened 110 genotypes and found the Mean numbers of webs per plant by *M. vitarta* were ranged from 1.0 (NS-04-112) to 4.6 (LGG-521).

3.3 Percent pod damage due to *Maruca vitrata* and pest susceptibility rating of genotypes during 2015-16

Percent pod damage due to *Maruca vitrata* showed significant difference among the genotypes in Table 4 and Figure 3 maximum % of pod damage (25.45%) was observed in UPAS 120 X PUSA 885 (P2) followed by (18.32%) H82-1 X PUSA-992 (P1), (15.65%) H82-1 X PUSA 992 (P5), (14.91%) UPAS 120 X PUSA 971 (P4), (13.44%) AL 201 X UPAS 120 (P3), UPAS 120 X PUSA 971 (12.42%), (11.92%) H82-1 X UPAS 120 (P2), (10.82%) AL 201 X UPAS 120 (P2), (9.70%) UPAS 120 X *Cajanus acutifolius* (P2), (8.89%) H82-1 X UPAS 120 (P3), (7.93%) H82-1 X PUSA 992 (P2), (6.69%) PUSA 992 X UPAS 120 and minimum percent pod damage was recorded on (5.74%) UPAS 120 X AL 1483 and percent pod damage of check cultivars are PA 291 (8.22%), PUSA 992 (12.07%) and UPAS 120 (10.4%), respectively.

These findings are in close agreement with [18] who reported 4.71% to 25.56% pod dmage due to *M. vitrata* in pigeon pea cultivar PUSA 992 [19]. reported 5.80% to 68% pod damage due to *Maruca vitrata* in six short duration pigeonpea genotypes.

Out of thirty one genotypes, seven genotypes H82-1 X PUSA 992 (P1), H82-1 X PUSA 992 (P4), H82-1 X PUSA 992 (P5), H82-1 X UPAS 120 (P4), AL 201 X UPAS 120 (P3), UPAS 120 X PUSA 971 (P4), and UPAS 120 X PUSA 885 (P2) were found highly susceptible to *Maruca vitrata* damage as they showed a damage rating of 8 [H82-1 X PUSA 992 (P4), H82-1 X PUSA 992 (P5), H82-1 X UPAS 120 (P4), AL 201 X UPAS 120 (P3), UPAS 120 X PUSA 971 (P4)] and 9 [H82-1 X PUSA 992 (P1) and UPAS 120 X PUSA 885 (P2)] over the check PUSA 992 was also highly susceptible with damage rating of 8 on pest susceptibility rating scale 1-9. Whereas, seven genotypes H82-1 X PUSA 992 (P3), H82-1 X PUSA 992 (P7), H82-1 X UPAS 120 (P2),AL 201 X UPAS 120 (P2), UPAS 120 X PUSA 971 (P1), UPAS 120 X PUSA 971 (P3) and UPAS 120 X *Cajanus acutifolius* (P2) were found moderately susceptible and had damage rating of 6 [H82-1 X PUSA 992 (P3), H82-1 X PUSA 992 (P7), AL 201 X UPAS 120 (P2), UPAS 120 X PUSA 971 (P1), UPAS 120 X *Cajanus acutifolius* (P2)] and 7 [H82-1 X UPAS 120 (P2) and UPAS 120 X PUSA 971 (P3)] over the check UPAS 120 and had damage rating of 6. While seventeen genotypes H82-1 X PUSA 992 (P2), H82-1 X PUSA 992 (P6), H82-1 X UPAS 120 (P1), H82-1 X PUSA 120 (P3), UPAS 120 X H82-1 (P1), UPAS 120 X H82-1 (P2), UPAS 120 X H82-1 (P3), AL 201 X PUSA 992 (P1), AL 201 X PUSA 992 (P2), AL 201 X PUSA 992 (P3), AL 201 X UPAS 120 (P1), AL 201 X UPAS 120 (P4), UPAS 120 X PUSA 971 (P2), UPAS 120 X PUSA 885 (P1), UPAS 120 X AL1483, T31 UPAS 120 X *Cajanus acutifolius* (P1), T33 PUSA 992 X UPAS 120 were found to be least susceptible to *Maruca vitrata* with damage rating of 4 [H82-1 X PUSA 992 (P6), UPAS 120 X H82-1 (P1), UPAS 120 X H82-1 (P2), UPAS 120 X H82-1 (P3), AL 201 X PUSA 992 (P1), AL 201 X PUSA 992 (P3), AL 201 X UPAS 120 (P1), UPAS 120 X PUSA 971 (P2), UPAS 120 X PUSA 885 (P1), UPAS 120 X AL 1483, and PUSA 992 X UPAS 120] and 5 [H82-1 X PUSA 992 (P2), H82-1 X UPAS 120 (P1), H82-1 X PUSA 120 (P3), AL 201 X PUSA 992 (P2), AL 201 X UPAS 120 (P4) and UPAS 120 X *Cajanus acutifolius* (P1)] With damage rating of 5 over the check PA291.

Present findings are in close association with [19] who studied six short duration pigeonpea genotypes against *Maruca vitrata* and found ICPL 98001 and ICPL 98002 Intermediate, ICPL 98008 and ICPL 98003 highly resistant, ICPL 98012 moderately resistance and ICPL 88034 susceptible.

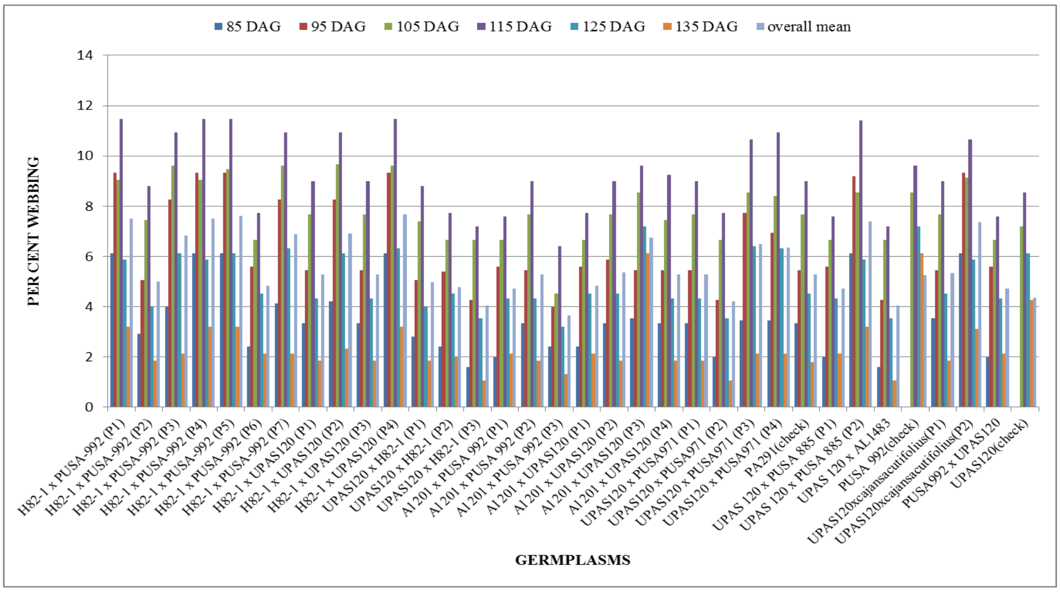

Fig 1: Field screening of thirty one pigeonpea genotypes along with three check cultivars (PA 291, PUSA 992 and UPAS 120) against percent webbing by *Maruca vitrata* larvae during 2015-16

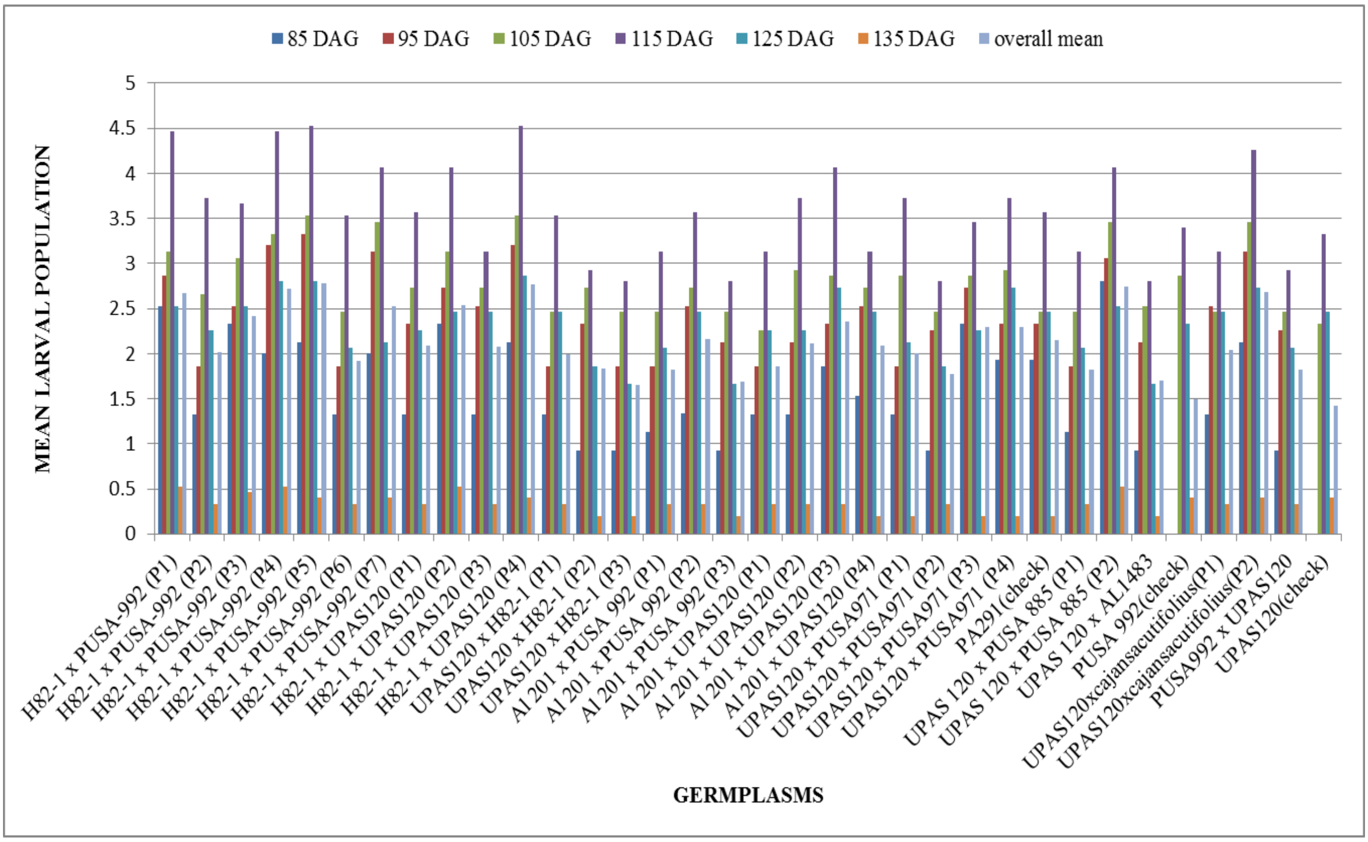

Fig 2: Field screening of thirty one pigeonpea genotypes along with three check cultivars (PA 291, PUSA 992 and UPAS 120) against *Maruca vitrata* larvae during 2015-16

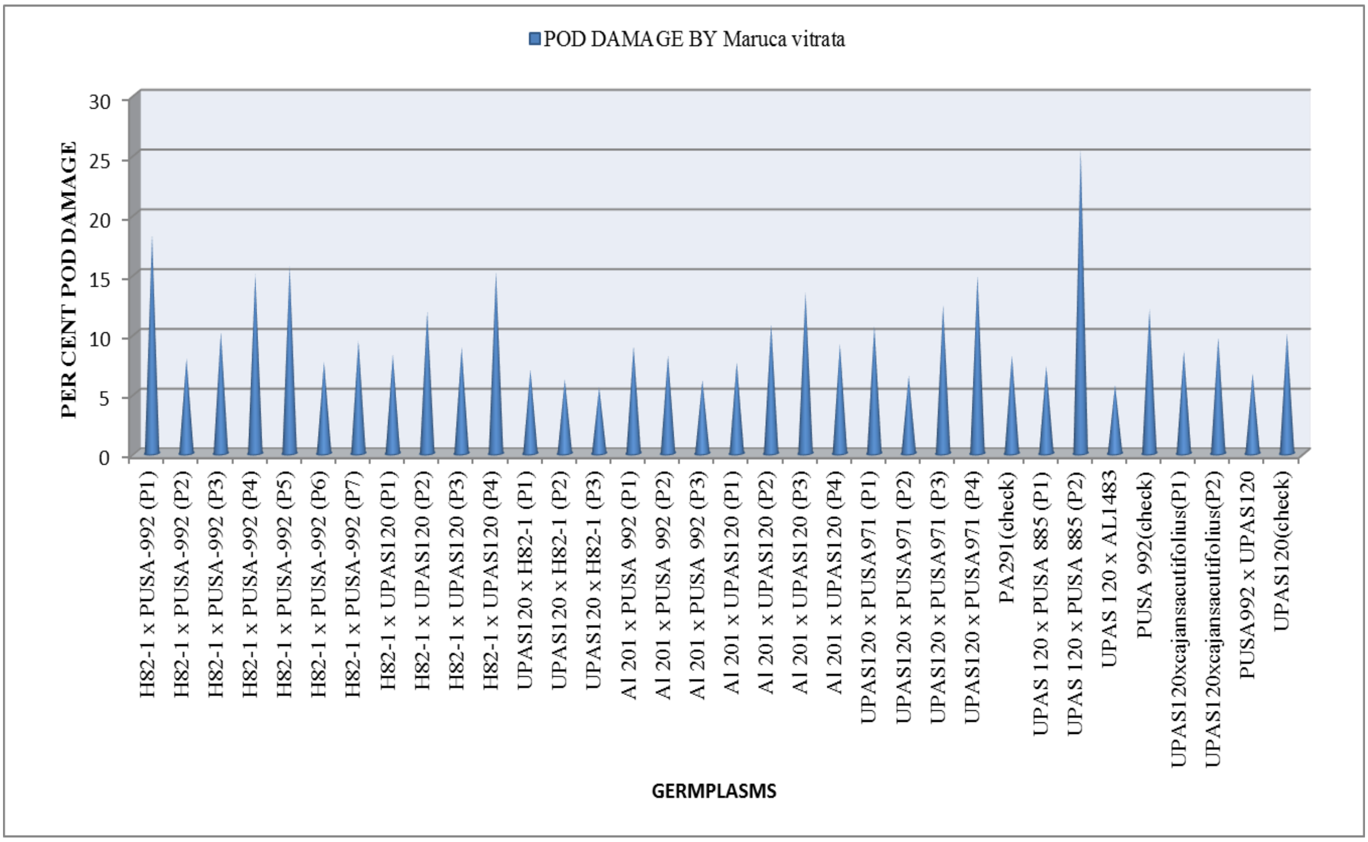

Fig 3: Percent pod damage by *Maruca vitrata.*

Table 2: Screening of different pigeonpea genotypes against larval population of *Maruca vitrata* during 2015-16

Treatments	Genotypes	No. of *Maruca vitrata* larvae /5 shoots^						
		85 DAG	95 DAG	105 DAG	115 DAG	125 DAG	135 DAG	Over all mean
1	H82-1 x PUSA 992 (P1)	2.53 (1.73) ^	2.86 (1.83)	3.13 (1.89)	4.46 (2.19)	2.53 (1.68)	0.53 (1.00)	2.67 (1.77)
2	H82-1 x PUSA 992 (P2)	1.33 (1.32)	1.86 (1.53)	2.66 (1.73)	3.73 (2.01)	2.26 (1.56)	0.33 (0.90)	2.02 (1.56)
3	H82-1 x PUSA 992 (P3)	2.33 (1.59)	2.53 (1.73)	3.06 (1.86)	3.66 (1.99)	2.53 (1.68)	0.46 (0.97)	2.42 (170)
4	H82-1 x PUSA 992 (P4)	2.00 (1.58)	3.20 (1.93)	3.33 (1.92)	4.46 (2.19)	2.80 (1.78)	0.53 (1.00)	2.72 (1.79)
5	H82-1 x PUSA 992 (P5)	2.13 (1.62)	3.33 (1.94)	3.53 (2.00)	4.53 (2.21)	2.80 (1.78)	0.40 (0.94)	2.78 (1.80)
6	H82-1 x PUSA 992 (P6)	1.33 (1.32)	1.86 (1.53)	2.46 (1.65)	3.53 (1.96)	2.06 (1.71)	0.33 (0.90)	1.92 (1.58)
7	H82-1 x PUSA 992 (P7)	2.00 (1.41)	3.13 (1.90)	3.46 (1.95)	4.06 (2.07)	2.13 (1.62)	0.40 (0.94)	2.53 (1.71)
8	H82-1 x UPAS 120 (P1)	1.33 (1.24)	2.33 (1.67)	2.73 (1.76)	3.57 (1.97)	2.26 (1.56)	0.33 (0.90)	2.09 (1.60)
9	H82-1 x UPAS 120 (P2)	2.33 (1.59)	2.73 (1.78)	3.13 (1.62)	4.06 (2.07)	2.46 (1.65)	0.53 (1.00)	2.54 (1.68)
10	H82-1 x UPAS 120 (P3)	1.33 (1.32)	2.53 (1.73)	2.73 (1.76)	3.13 (1.89)	2.46 (1.65)	0.33 (0.89)	2.08 (1.59)
11	H82-1 x UPAS 120 (P4)	2.13 (1.62)	3.20 (1.93)	3.53 (2.00)	4.53 (2.21)	2.86 (1.80)	0.40 (0.94)	2.77 (1.81)
12	UPAS 120 x H82-1 (P1)	1.33 (1.32)	1.86 (1.53)	2.46 (1.65)	3.53 (1.73)	2.46 (1.65)	0.33 (0.90)	1.99 (1.51)
13	UPAS 120 x H82-1 (P2)	0.93 (1.21)	2.33 (1.67)	2.73 (1.76)	2.93 (1.83)	1.86 (1.53)	0.20 (0.82)	1.83 (1.52)
14	UPAS 120 x H82-1 (P3)	0.93 (1.21)	1.86 (1.53)	2.46 (1.65)	2.80 (1.78)	1.66 (1.46)	0.20 (0.82)	1.65 (1.44)
15	AL 201 x PUSA 992 (P1)	1.13 (1.18)	1.86 (1.53)	2.46 (1.65)	3.13 (1.89)	2.06 (1.59)	0.33 (0.91)	1.82 (1.52)
16	AL 201 x PUSA 992 (P2)	1.34 (1.33)	2.53 (1.73)	2.73 (1.76)	3.57 (1.97)	2.46 (1.65)	0.33 (0.90)	2.16 (1.62)
17	AL 201 x PUSA 992 (P3)	0.93 (1.06)	2.13 (1.59)	2.46 (1.65)	2.80 (1.80)	1.66 (1.46)	0.20 (0.82)	1.69 (1.40)
18	AL 201 x UPAS 120 (P1)	1.33 (1.32)	1.86 (1.53)	2.26 (1.56)	3.13 (1.89)	2.26 (1.56)	0.33 (0.90)	1.86 (1.52)
19	AL 201 x UPAS 120 (P2)	1.33 (1.32)	2.13 (1.59)	2.93 (1.82)	3.73 (2.01)	2.26 (1.56)	0.33 (0.90)	2.11 (1.61)
20	AL 201 x UPAS 120 (P3)	1.86 (1.48)	2.33 (1.67)	2.86 (1.80)	4.06 (2.07)	2.73 (1.76)	0.33 (0.90)	2.36 (1.68)
21	AL 201 x UPAS 120 (P4)	1.53 (1.41)	2.53 (1.73)	2.73 (1.76)	3.13 (1.62)	2.46 (1.65)	0.20 (0.82)	2.09 (1.55)
22	UPAS 120 x PUSA 971 (P1)	1.33 (1.32)	1.86 (1.53)	2.86 (1.80)	3.73 (2.01)	2.13 (1.62)	0.20 (0.82)	2.01 (1.58)
23	UPAS 120 x PUSA 971 (P2)	0.93 (1.19)	2.26 (1.65)	2.46 (1.65)	2.80 (1.80)	1.86 (1.53)	0.33 (0.89)	1.77 (1.50)
24	UPAS 120 x PUSA 971 (P3)	2.33 (1.67)	2.73 (1.78)	2.86 (1.80)	3.46 (1.95)	2.26 (1.56)	0.20 (0.82)	2.30 (1.67)
25	UPAS 120 x PUSA 971 (P4)	1.93 (1.55)	2.33 (1.67)	2.93 (1.82)	3.73 (2.01)	2.73 (1.76)	0.20 (0.82)	2.30 (1.67)
26	PA 291 (check)	1.93 (1.55)	2.33 (1.67)	2.46 (1.65)	3.57 (1.97)	2.46 (1.65)	0.20 (0.82)	2.15 (1.62)
27	UPAS 120 x PUSA 885 (P1)	1.13 (1.22)	1.86 (1.53)	2.46 (1.65)	3.13 (1.88)	2.06 (1.59)	0.33 (0.90)	1.82 (1.52)
28	UPAS 120 x PUSA 885 (P2)	2.80 (1.80)	3.06 (1.88)	3.46 (1.95)	4.06 (2.07)	2.53 (1.68)	0.53 (1.00)	2.74 (1.79)
29	UPAS 120 x AL 1483	0.93 (1.12)	2.13 (1.59)	2.53 (1.68)	2.80 (1.78)	1.66 (1.46)	0.20 (0.82)	1.70 (1.47)
30	PUSA 992 (check)	0.00 (0.70)	0.00 (0.70)	2.86 (1.80)	3.40 (1.96)	2.33 (1.59)	0.40 (0.94)	1.49 (1.40)
31	UPAS120x*Cajanusacutifolius*(P1)	1.33 (1.32)	2.53 (1.73)	2.46 (1.65)	3.13 (1.88)	2.46 (1.65)	0.33 (0.89)	2.04 (1.58)
32	UPAS120x*Cajansacutifolius*(P2)	2.13 (1.62)	3.13 (1.62)	3.46 (1.95)	4.26 (2.14)	2.73 (1.76)	0.40 (0.94)	2.68 (1.73)
33	PUSA 992 x UPAS 120	0.93 (1.12)	2.26 (1.65)	2.46 (1.65)	2.93 (1.82)	2.06 (1.59)	0.33 (0.90)	1.82 (1.52)
34	UPAS 120 (check)	0.00 (0.70)	0.00 (0.70)	2.33 (1.59)	3.33 (1.94)	2.46 (1.65)	0.40 (0.94)	1.42 (1.37)
SEM ±	-	0.288	0.128	0.245	0.331	0.265	0.109	0.107
CD@5%	-	0.828	0.371	0.705	0.953	0.763	0.313	0.308

Table 3: Screening of different pigeonpea genotypes against percent webbing by *Maruca vitrata* during 2015-16

Treatments	Genotypes	Percent webbing by *Maruca vitrata* larvae /5 shoots^^						
		85 DAG	95 DAG	105 DAG	115 DAG	125 DAG	135 DAG	Over all mean
1	H82-1 x PUSA 992 (P1)	6.13(14.33)^^	9.33 (17.51)	9.06 (17.29)	11.46 (19.62)	5.86 (13.95)	3.20 (10.11)	7.50 (15.81)
2	H82-1 x PUSA 992 (P2)	2.93 (9.73)	5.06 (13.62)	7.46 (15.62)	8.80 (17.15)	4.00 (11.15)	1.86 (7.42)	5.01 (12.87)
3	H82-1 x PUSA 992 (P3)	4.00 (11.15)	8.26 (16.61)	9.60 (17.91)	10.93 (19.24)	6.13 (14.17)	2.13 (8.07)	6.84 (15.02)
4	H82-1 x PUSA 992 (P4)	6.13 (14.33)	9.33 (17.51)	9.06 (17.29)	11.46 (19.62)	5.86 (13.95)	3.20 (10.11)	7.50 (15.81)
5	H82-1 x PUSA 992 (P5)	6.13 (14.17)	9.33 (17.61)	9.46 (17.75)	11.46 (19.62)	6.13 (14.17)	3.20 (10.11)	7.61 (15.99)
6	H82-1 x PUSA 992 (P6)	2.40 (8.88)	5.60 (13.65)	6.66 (14.62)	7.73 (15.90)	4.53 (13.25)	2.13 (8.07)	4.84 (12.07)
7	H82-1 x PUSA 992 (P7)	4.13 (11.72)	8.26 (16.55)	9.60 (17.91)	10.93 (19.24)	6.33 (14.79)	2.13 (8.07)	6.89 (15.10)
8	H82-1 x UPAS 120 (P1)	3.33 (10.29)	5.46 (13.13)	7.66 (16.03)	9.00 (17.43)	4.33 (11.78)	1.86 (7.42)	5.27 (13.17)
9	H82-1 x UPAS 120 (P2)	4.20 (11.82)	8.26 (16.55)	9.66 (17.98)	10.93 (19.24)	6.13 (14.17)	2.33 (8.38)	6.91 (15.09)
10	H82-1 x UPAS 120 (P3)	3.33 (10.29)	5.46 (13.13)	7.66 (16.03)	9.00 (17.43)	4.33 (11.78)	1.86 (7.42)	5.27 (13.17)
11	H82-1 x UPAS 120 (P4)	6.13 (14.33)	9.33 (17.51)	9.60 (17.91)	11.46 (19.62)	6.33 (14.79)	3.20 (10.11)	7.67 (16.02)
12	UPAS 120 x H82-1 (P1)	2.80 (9.53)	5.06 (12.94)	7.40 (15.46)	8.80 (17.15)	4.00 (11.15)	1.86 (7.42)	4.98 (12.88)
13	UPAS 120 x H82-1 (P2)	2.40 (8.88)	5.40 (13.38)	6.66 (14.79)	7.73 (15.90)	4.53 (12.12)	2.00 (7.85)	4.78 (12.30)
14	UPAS 120 x H82-1 (P3)	1.60 (7.20)	4.26 (11.65)	6.66 (14.79)	7.20 (15.51)	3.53 (10.56)	1.06 (4.18)	4.05 (11.60)
15	AL 201 x PUSA 992 (P1)	2.00 (5.76)	5.60 (13.65)	6.66 (14.79)	7.60 (15.96)	4.33 (11.78)	2.13 (8.07)	4.72 (12.54)
16	AL 201 x PUSA 992 (P2)	3.33 (10.46)	5.46 (13.13)	7.66 (16.03)	9.00 (17.43)	4.33 (11.78)	1.86 (7.42)	5.27 (13.17)
17	AL 201 x PUSA 992 (P3)	2.40 (8.88)	4.20 (11.15)	4.53 (12.12)	6.40 (14.47)	3.20 (10.22)	1.33 (6.39)	3.64 (10.80)
18	AL 201 x UPAS 120 (P1)	2.40 (8.88)	5.60 (13.65)	6.66 (14.79)	7.73 (15.90)	4.53 (12.12)	2.13 (8.07)	4.84 (12.07)
19	AL 201 x UPAS 120 (P2)	3.33 (10.46)	5.86 (13.83)	7.66 (16.03)	9.00 (17.43)	4.53 (12.12)	1.86 (7.42)	5.37 (13.32)
20	AL 201 x UPAS 120 (P3)	3.53 (10.80)	5.46 (13.39)	8.53 (16.92)	9.60 (18.02)	7.20 (15.51)	6.13 (14.21)	6.74 (15.04)
21	AL 201 x UPAS 120 (P4)	3.33 (10.46)	5.46 (13.39)	7.46 (15.77)	9.26 (17.69)	4.33 (11.78)	1.86 (7.42)	5.28 (13.18)
22	UPAS 120 x PUSA 971 (P1)	3.33 (10.46)	5.46 (13.39)	7.66 (14.79)	9.00 (17.43)	4.33 (11.78)	1.86 (7.42)	5.27 (13.24)
23	UPAS 120 x PUSA 971 (P2)	2.00 (5.76)	4.26 (11.65)	6.66 (14.79)	7.73 (15.90)	3.53 (10.56)	1.06 (4.18)	4.20 (11.82)
24	UPAS 120 x PUSA 971 (P3)	3.46 (10.47)	7.73 (15.97)	8.53 (16.92)	10.66 (18.97)	6.40 (14.47)	2.13 (8.07)	6.48 (14.73)
25	UPAS 120 x PUSA 971 (P4)	3.46 (10.68)	6.93 (15.21)	8.40 (16.73)	10.93 (19.24)	6.33 (14.44)	2.13 (8.07)	6.36 (14.58)
26	PA 291 (check)	3.33 (10.46)	5.46 (13.39)	7.66 (16.03)	9.00 (17.43)	4.53 (12.12)	1.80 (7.20)	5.29 (13.20)
27	UPAS 120 x PUSA 885 (P1)	2.00 (5.76)	5.60 (13.65)	6.66 (14.79)	7.60 (15.96)	4.33 (11.78)	2.13 (8.07)	4.72 (12.54)

28	UPAS 120 x PUSA 885 (P2)	6.13 (14.33)	9.20 (17.43)	8.53 (16.92)	11.40 (19.57)	5.86 (13.96)	3.20 (10.22)	7.38 (15.75)
29	UPAS 120 x AL 1483	1.60 (7.20)	4.26 (11.65)	6.66 (14.79)	7.20 (15.51)	3.53 (10.56)	1.06 (4.18)	4.05 (11.60)
30	PUSA 992 (check)	0.00 (0.00)	0.00 (0.00)	8.53 (16.92)	9.60 (18.02)	7.20 (15.51)	6.13 (14.21)	5.24 (13.14)
31	UPAS120x*Cajansacutifolius*(P1)	3.53 (10.80)	5.46 (13.39)	7.66 (16.03)	9.00 (17.43)	4.53 (12.12)	1.86 (7.42)	5.34 (13.19)
32	UPAS120x*Cajansacutifolius*(P2)	6.13 (14.33)	9.33 (17.61)	9.13 (17.56)	10.66 (18.97)	5.86 (13.95)	3.13 (9.68)	7.37 (15.73)
33	PUSA 992 x UPAS 120	2.00 (5.76)	5.60 (13.63)	6.66 (14.79)	7.60 (15.96)	4.33 (11.78)	2.13 (8.20)	4.72 (12.54)
34	UPAS 120 (check)	0.00 (0.00)	0.00 (0.00)	7.20 (15.54)	8.53 (16.91)	6.13 (14.17)	4.26 (11.65)	4.35 (13.26)
SEM ±	-	2.217	1.809	1.832	1.759	2.061	2.593	1.348
CD@5%	-	6.380	5.207	5.272	5.061	5.931	7.463	3.880

Screening of different pigeonpea genotypes against percent webbing by *Maruca vitrata* during 2015-16

Table 4: Screening of pigeonpea genotypes against percent pod damage due to *Maruca vitrata* during 2015-16

Treatments	Genotypes	Pod damage (%) at harvest due to *Maruca vitrata*	Susceptibility	PSR^	Susceptibility category	Yield kg/ha
1	H82-1 x PUSA 992 (P1)	18.32 (25.38)^^	-75.6	9	Highly susceptible	516.66
2	H82-1 x PUSA 992 (P2)	07.93 (15.87)	23.96	5	Least susceptible	433.33
3	H82-1 x PUSA 992 (P3)	10.16 (18.37)	2.58	6	Moderately susceptible	266.66
4	H82-1 x PUSA 992 (P4)	15.00 (21.88)	-43.8	8	Highly susceptible	233.33
5	H82-1 x PUSA 992 (P5)	15.65 (23.33)	-50.0	8	Highly susceptible	433.33
6	H82-1 x PUSA 992 (P6)	07.67 (16.28)	26.46	4	Least susceptible	366.66
7	H82-1 x PUSA 992 (P7)	09.43 (18.42)	9.58	6	Moderately susceptible	166.66
8	H82-1 x UPAS 120 (P1)	08.29 (16.30)	20.51	5	Least susceptible	350.00
9	H82-1 x UPAS 120 (P2)	11.92 (20.60)	-14.28	7	Moderately susceptible	416.66
10	H82-1 x UPAS 120 (P3)	08.89 (18.34)	14.76	5	Least susceptible	383.33
11	H82-1 x UPAS 120 (P4)	15.20 (21.89)	-45.7	8	Highly susceptible	483.33
12	UPAS 120 x H82-1 (P1)	07.81 (15.18)	25.11	4	Least susceptible	333.33
13	UPAS 120 x H82-1 (P2)	06.20 (14.03)	40.55	4	Least susceptible	366.66
14	UPAS 120 x H82-1 (P3)	05.53 (13.45)	46.97	4	Least susceptible	516.66
15	AL 201 x PUSA 992 (P1)	07.28 (17.81)	30.20	4	Least susceptible	466.66
16	AL 201 x PUSA 992 (P2)	08.36 (15.94)	19.84	5	Least susceptible	416.66
17	AL 201 x PUSA 992 (P3)	06.14 (13.98)	41.13	4	Least susceptible	383.33
18	AL 201 x UPAS 120 (P1)	07.62 (15.20)	26.94	4	Least susceptible	483.33
19	AL 201 x UPAS 120 (P2)	10.82 (21.11)	-3.73	6	Moderately susceptible	183.33
20	AL 201 x UPAS 120 (P3)	13.44 (19.60)	-28.85	8	Highly susceptible	350.00
21	AL 201 x UPAS 120 (P4)	09.13 (17.03)	12.46	5	Least susceptible	566.66
22	UPAS 120 x PUSA 971 (P1)	10.65 (18.96)	-2.10	6	Moderately susceptible	633.33
23	UPAS 120 x PUSA 971 (P2)	06.50 (14.85)	37.67	4	Least susceptible	416.66
24	UPAS 120 x PUSA 971 (P3)	12.42 (18.24)	-19.07	7	Moderately susceptible	316.66
25	UPAS 120 x PUSA 971 (P4)	14.91 (22.62)	-42.95	8	Highly susceptible	316.66
26	PA 291 (check)	08.22 (16.58)	-	-	-	366.66
27	UPAS 120 x PUSA 885 (P1)	07.31 (15.98)	29.91	4	Least susceptible	350.00
28	UPAS 120 x PUSA 885 (P2)	25.45 (30.29)	-144.0	9	Highly susceptible	416.66
29	UPAS 120 x AL 1483	05.74 (15.52)	44.9	4	Least susceptible	433.33
30	PUSA 992 (check)	12.07 (20.29)	-	-	-	600.00
31	UPAS120x*Cajansacutifolius*(P1)	08.58 (16.60)	17.73	5	Least susceptible	433.33
32	UPAS120x*Cajansacutifolius*(P2)	09.70(18.24)	6.99	6	Moderately susceptible	233.33
33	PUSA 992 x UPAS 120	06.69 (16.19)	35.85	4	Least susceptible	466.66
34	UPAS 120 (check)	10.04 (18.63)	3.73	-	-	433.33
SEM±	-	3.123	-	-	-	-
CD@5%	-	8.987	-	-	-	-

^^ Indicate that the values in parenthesis are angular transformed values

4. Conclusion

From the above investigation studied the *Maruca vitrata* is a major or key pest of pigeonpea and in overcome the problem and loss caused by this pest, host plant resistance (HPR) plays a significant role and the first line of defense against insect pest is cultivation of resistant crop variety. Use of tolerant cultivars virtually does not involve any skill or costly investment in pest management. It can be considered as a principal component in pest management besides cultural, biological and chemical control measures. So, there is urgent need to evaluate germplasms to combat the ravages caused by *Maruca vitrata*. and result revealed that the seventeen genotypes found least susceptible to *M. vitrata* damage as they showed damage rating of 4-5 on a pest susceptibility rating scale of 1-9. While seven genotypes found moderately susceptible to *M. vitrata* damage as they showed damage rating of 6-7 on pest susceptibility rating scale of 1-9 and seven genotypes found highly susceptible to *M. vitrata* damage as they showed damage rating of 8-9 on a pest susceptibility rating scale of 1-9.

5. Acknowledgement

The authors are thankful to PCPGR (Pantnagar Center for Plant Genetic Resources) to provide the genotypes for investigations and thankful to all who directly and indirectly help in the investigations.

6. References

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