Int.J.Curr.Microbiol.App.Sci (2017) *6*(12): 3899-3907

International Journal of Current Microbiology and Applied Sciences
ISSN: 2319-7706 **Volume 6 Number 12 (2017) pp. 3899-3907**
Journal homepage: http://www.ijcmas.com

Original Research Article https://doi.org/10.20546/ijcmas.2017.612.450

Screening of Pigeonpea Genotypes against Webbing Caterpillar, *Maruca vitrata* Geyer and Gram Pod Borer, *Helicoverpa armigera* Hubner

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Keywords

Pigeonpea, *Maruca vitrata*, *Helicoverpa armigera*, Screening, Resistant sources.

Article Info

Accepted:
28 October 2017
Available Online:
10 December 2017

A B S T R A C T

A resistance screening study was conducted under field conditions at National Pulses Research Centre, Vamban from 2013 to 2015 to identify the sources of resistance in pigeonpea to the spotted pod borer, *Maruca vitrata* and gram pod borer, *Helicoverpa armigera.* Based on the pest susceptibility index, entries were categorized in to various resistant categories. Among the 145 nos. of entries screened, nine entries i.e., ICP 11007, H 23, BAHAR, DA 322, GR 28, ICP 49114, ICP 11957, SMR 1693158, BRG–10–02 were promising by exhibiting stable resistant reaction to *M. vitrata*. Seventeen entries showed resistance consistently to *H. armigera* during all the three years. In case of *M. vitrata*, minimum pest susceptibility index (PSI) of 2.0 was noted in ICP 11957 followed by 2.3 in SMR 1693158 and 2.7 in BRG-10-02, Bahar and H 23. For *H. armigera*, less PSI was noted in CORG 9900134, H 23, JKE 110, GR 28, WRG 42, ICP 11957 and ICPL 8719 (2.3). The PSI of 2.7 was recorded in the entries, ICP 10175 and RVKT 261. Less pest susceptibility index in an entry indicates high resistance levels and hence, the above entries with less pest susceptibility indexes may be used as resistant donors in the breeding programme. Pigeonpea entries found to be resistant to both the pod borers were ICP 11007, H 23, DA 322, GR 28, ICP 49114, ICP 11957 and BRG-10-02.

Introduction

Pigeon pea is an important legume crop of rainfed agriculture in the semiarid tropics. It is a rich protein source and affords a major share of the protein requirement in the vegetarian diet in our country. As pulses contain 20-25 per cent of protein in dried seeds more than the cereals, pigeonpea ensures nutritional security to the poor masses of the country. As pigeonpea is a leguminous plant, it can fix atmospheric nitrogen and enriches the soil. Moreover, pigeonpea is a drought-resistant crop and hence can be grown in areas with less than 650 mm annual rainfall also. Pigeon peas are frequently inter-planted with other short term crops, including cereals and other grain legumes, for higher productivity per unit land area and reduced risks associated with some crop failures (Madang A. Dasbak *et al.*, 2012).

Due to the above reasons, pigeonpea is cultivated in various parts of the country. Among the various constraints limiting the production of pigeonpea, insect pests are the

major ones. As per an estimate, losses due to these insect pests may vary from 27 per cent to even 100 per cent in pigeonpea (Srilaxmi and Paul, 2010). Among the insect pests causing economic loss by attacking the crop at flowering and pod development stages, spotted pod borer, *Maruca vitrata* Geyer (Crambidae: Lepidoptera) and gram pod borer, *Helicoverpa armigera* Hubner (Noctuidae: Lepidoptera) are the most important ones. The key pest status of *H.armigera* is due to the feeding preference of it's larva on nitrogen rich plant parts like reproductive structures and plant tips (Fitt, 1989).

Though approximately 200 insect and mite pests attack pigeonpea, the major insect causing heavy loss is *H.armigera* and thus determining the yield potential in pigeonpea crop (Saxena, 2012). *M. vitrata* cause heavy losses in early, medium and late maturing pigeonpea genotypes (Shanower *et al.,* 1999). *M. vitrata* larvae feed by remaining inside the webbed mass of leaves, flowers and pods. This concealed feeding complicates the management of this pest as pesticides and natural enemies have difficulty in penetrating the shelter to reach the larvae (Sharma, 1998).

When the severity and important of these insect pests in limiting the production of pigeonpea is considered developing resistant varieties is having advantage over long time. Moreover, as *M. vitrata* is having a concealed habitat, management of this insect with insecticides is not that much effective and the best alternative to is may be development of a resistant variety.

Considering these points, a resistance screening study was conducted at National Pulses Research Centre, Vamban from 2013 to 2015 to identify the resistant pigeonpea sources to pod borers, *M. vitrata* and *H. armigera.*

Materials and Methods

Three years screening study

During kharif 2013, one hundred and forty five (145 nos.) pigeonpea germplasm were screened for resistance or tolerance to pigeonpea pod borers i.e., spotted pod borer, *Maruca vitrata* and gram pod borer, *Helicoverpa armigera.* Among them, forty one (41 nos.) pigeonpea germplasm which were found to be resistant to any one of the or both the pod borers during kharif 2013 were selected and sown during kharif 2014 for further conformational screening. Among the forty one (41 nos.) pigeonpea germplasm, twenty five (25 nos.) entries which showed consistently resistant reaction to the pod borers during kharif 2013 and 2014 were selected and sown during kharif 2015 for further confirmation of their resistance. At the end of three years, pigeonpea entries which showed consistent resistant reaction in all the three years were selected as the resistant entries.

Method of screening

All the entries were raised in the field by following common agronomic practices and the crop was maintained under unprotected conditions without any insecticidal spray. VBN (Rg) 3 was raised as local check. At the time of harvest, three hundred (300) pods were collected from each entry and observations on pod damage due to *M. Vitrata* and *H.armigera* were taken separately for each insect and entry.

Based on the pod damage by individual insect in the entries and local check, pest susceptibility per cent (PSP) and pest susceptibility index (PSI) were calculated for each entry. Based on the PSI, category of resistance was given for each entry for each insect.

Pest susceptibility per cent (PSP) was calculated by the following formula

$$PSP = \frac{\text{Per cent damage in check} - \text{Per cent damage in entry}}{\text{Per cent damage in check}} \times 100$$

Results and Discussion

Kharif 2013

During kharif 2013, among the 145 pigeonpea entries screened, damage per cent of *M. vitrata* and *H. armigera* ranged from 0.0 to 25 per cent and 0.0 to 32 per cent respectively (Table 1). All the above highly resistant, resistant and moderately resistant with the pest susceptibility index of 3 & 4 were selected for further screening during kharif 2014 for conformational studies.

Kharif 2014

During kharif 2014, 41 pigeonpea entries selected from the previous year study were screened. Among them, *M. vitrata* and *H. armigera* damages ranged from 2.0 to 31 per cent and 1.0 to 20 per cent respectively (Table 2).

Table.1 Per cent damage of *M. vitrata* and *H. armigera* in the selected pigeonpea entries (Kharif 2013)

S. No.	Name of the Entry	Per cent damage		S. No.	Name of the Entry	Per cent damage	
		H. armigera	*M. vitrata*			*H. armigera*	*M. vitrata*
1	ICP 49114	2.0	3.0	21	DA 322	2.0	2.0
2	ICP11007	2.0	3.0	22	VRG 05-011	0.0	3.0
3	CORG 9900134	2.0	1.0	23	CORG 990014	2.0	5.0
4	VRG 11	2.0	2.0	24	JKE 110	2.0	4.0
5	ICP 14505	1.0	0.0	25	GR 28	2.0	4.0
6	P 112001 A	1.0	1.0	26	WRG 42	6.0	3.0
7	H 23	3.0	5.0	27	V 150	7.0	4.0
8	JKM 209	0.0	4.0	28	ICP 11174	7.0	1.0
9	PLS 476 A	2.0	4.0	29	ICP 11957	1.0	1.0
10	V 127	1.0	0.0	30	SMR 1693158	1.0	0.0
11	ICP 11293	2.0	3.0	31	ICP 139184	2.0	6.0
12	ICP 10175	3.0	2.0	32	ICPL 8719	0.0	0.0
13	ICP 763-C	1.0	2.0	33	RVKT 261	5.0	7.0
14	BAHAR	2.0	0.0	34	BRG-10-02	6.0	1.0
15	NRG 101	2.0	1.0	35	BRG-11-01	9.0	1.0
16	CO 6	2.0	2.0	36	UPAS120	11.0	12.0
17	V 87	4.0	2.0	37	CORG 7	6.0	18.0
18	V 521	5.0	3.0	38	WRG 157	6.0	9.0
19	ICP 7624	1.0	4.0	39	WRP 1	7.0	12.0
20	ICP 8863	4.0	4.0	40	PA 409	3.0	8.0
	VBN 3 (Local check)	25.0	12.0	41	PT-04-307	5.0	15.0

Table.2 Per cent damage of *M. vitrata* and *H. armigera* in the selected nineteen pigeonpea entries (Kharif 2014)

S.No.	Name of the Entry	Per cent damage		S. No.	Name of the Entry	Per cent damage	
		M. vitrata	*H. armigera*			*M. vitrata*	*H. armigera*
1	ICP11007	7.0	9.0	11	ICP 11174	14.0	9.0
2	CORG 9900134	5.0	1.0	12	ICP 49114	6.0	8.0
3	H 23	5.0	4.0	13	ICP 11957	3.0	6.0
4	ICP 11293	9.0	10.0	14	SMR1693158	5.0	14.0
5	ICP 10175	7.0	4.0	15	ICPL 8719	16.0	9.0
6	BAHAR	6.0	13.0	16	RVKT 261	11.0	6.0
7	V 87	17.0	5.0	17	BRG-10-02	2.0	10.0
8	DA322	3.0	7.0	18	WRP 1	13.0	8.0
9	GR 28	7.0	6.0	19	JKE 110	20.0	10.0
10	WRG 42	10.0	3.0		VBN 3 (local check)	11.0	15.0

Table.3 Per cent damage of *M. vitrata* and *H. armigera* in the selected pigeonpea entries (Kharif 2015)

S. No.	Name of the Entry	Per cent damage		S. No.	Name of the Entry	Per cent damage	
		M.vitrata	*H. armigera*			*M. vitrata*	*H. armigera*
1	ICP11007	5.0	8.0	11	ICP 11174	6.0	7.0
2	CORG 9900134	12.0	4.0	12	ICP 49114	3.0	9.0
3	H 23	2.0	2.0	13	ICP 11957	2.0	1.0
4	ICP 11293	9.0	4.0	14	SMR1693158	3.0	3.0
5	ICP 10175	9.0	5.0	15	ICPL 8719	2.0	2.0
6	BAHAR	7.0	11.0	16	RVKT 261	4.0	5.0
7	V 87	9.0	10.0	17	BRG-10-02	6.0	5.0
8	DA322	8.0	4.0	18	WRP 1	7.0	2.0
9	JKE 110	5.0	3.0	19	WRG 42	4.0	6.0
10	GR 28	8.0	1.0		VBN 3	11.0	15.0

Table.4 Resistance categories and mean PSI of the selected redgram entries to pod borers during three years of screening (kharif 2013 to 2015)

S. No.	Name of the Entry	*M. vitrata*				*H. armigera*			
		Category of Resistance			Mean PSI	Category of Resistance			Mean PSI
		I year	II year	III year		I year	II year	III year	
1	ICP11007	R	MR4	MR3	3.0	R	MR4	MR4	3.3
2	CORG 9900134	--	--	--	--	R	R	MR3	2.3
3	H 23	MR3	MR3	R	2.7	R	MR3	R	2.3
4	ICP 11293	--	--	--	--	R	MR4	MR3	3.0
5	ICP 10175	--	--	--	--	R	MR3	MR3	2.7
6	BAHAR	HR	MR3	MR4	2.7	--	--	--	--
7	V 87	--	--	--	--	R	MR3	MR4	3.0
8	DA 322	R	MR3	MR4	3.0	R	MR4	MR3	3.0
9	JKE 110	--	--	--	--	R	MR3	R	2.3
10	GR 28	MR3	MR4	MR4	3.7	R	MR3	R	2.3
11	WRG 42	--	--	--	--	R	R	MR3	2.3
12	ICP 11174	--	--	--	--	MR3	MR4	MR3	3.3
13	ICP 49114	R	MR4	MR3	3.0	R	MR4	MR4	3.3
14	ICP 11957	R	R	R	2.0	R	MR3	R	2.3
15	SMR1693158	HR	MR3	MR3	2.3	--	--	--	--
16	ICPL 8719	--	--	--	--	HR	MR4	R	2.3
17	RVKT 261	--	--	--	--	R	MR3	MR3	2.7
18	BRG-10-02	R	R	MR4	2.7	R	MR4	MR3	3.0
19	WRP 1	--	--	--	--	MR3	MR4	R	3.0

MR 3 – Moderately resistant with PSI 3 MR 4 – Moderately resistant with PSI 4

Table.5 The following scale was followed for categorizing the resistance in various germplasm entries

PSP	PSI	Category of resistance
100	1	Highly Resistant
75 to 99.9	2	Resistant
50 to 74.9	3	Moderately Resistant
25 to 49.9	4	Moderately Resistant
10 to 24.9	5	Moderately Susceptible
(-10) to (9.9)	6	Moderately Susceptible
(-25) to (-9.9)	7	Susceptible
(-50) to (-24.9)	8	Highly Susceptible
Less than -50	9	Highly Susceptible

Table.6 Based on the pest susceptibility index (PSI), pigeonpea entries found to be promising against *M. vitrata* and *H. armigera* during kharif 2013 are as following

Name of the Pest	Entries	PSI	Category of resistance
Spotted pod borer, *Maruca vitrata*	ICP 14505, V 127, BAHAR, SMR 1693158 and ICPL 8719.	1	Highly resistant
	ICP 49114, ICP 11007, CORG 9900134, VRG 11, CO 6, P 112001 A, ICP 11293, ICP 10175, ICP 763-C, NRG 101, V 87, V 521, DA 322, WRG 42, VRG-05-011, ICP 11174, ICP 11957, BRG 10-02 and BRG 11-01.	2	Resistant
	H 23, PLS 476 A, JKM 209, ICP 7624, ICP 8863, CORG 990014, JKE110, GR 28, V 150, ICP 139184 and PA 409.	3	Moderately Resistant
	RVKT 261	4	Moderately Resistant
Gram pod borer, *Helicoverpa armigera*	JKM 209, VRG 05–011 and ICPL 8719	1	Highly resistant
	ICP 49114, ICP 11007, CORG 9900134, VRG 11, ICP14505, CO 6, P 112001 A, H 23, PLS 476 A, V 127, ICP 1129-3, ICP 10175, ICP 763-C, BAHAR, NRG 101, V 87, V 521, ICP 7624, ICP 8863, DA 322, CORG 990014, JKE110, GR 28, WRG 42, ICP 11957, SMR 1693158, ICP 139184, RVKT 261, BRG 10-02, CORG 7, WRG 157, PA 409 and PT-04-307	2 2	Resistant
	V 150, 1CP 11174, BRG 11-01, UPAS 120 and WRP 1	3	Moderately Resistant

Table.7 Based on the pest susceptibility index (PSI), pigeonpea entries found to be promising against *M. vitrata* and *H. armigera* during kharif 2014 are as following.

Name of the Pest	Entries	PSI	Category of resistance
Spotted pod borer, *Maruca vitrata*	ICP11957 and BRG-10-02	2	Resistant
	CORG 9900134, H 23, ICP 10175, BAHAR, DA 322 and SMR1693158	3	Moderately Resistant
	ICP11007, GR 28 and ICP 49114	4	Moderately Resistant
Gram pod borer, *Helicoverpa armigera*	CORG 9900134 and WRG 42	2	Resistant
	H 23, ICP 10175, V 87, DA 322, GR 28, ICP 11957 and RVKT 261	3	Moderately Resistant
	ICP11007, ICP 1129, DA 322, ICP 11174, ICP 49114, ICPL 8719, BRG-10-02, WRP 1 and PA 409	4	Moderately Resistant

Table.8 Based on the pest susceptibility index (PSI), entries found to be promising against *M. vitrata* and *H. armigera* of pigeonpea are as following

Name of the Pest	Entries	PSI	Category of resistance
Spotted pod borer, *Maruca vitrata*	H 23, ICP 11957 and ICPL 8719	2	Resistant
	ICP11007, PLS 476 A, V 127, ICP 8863, JKE 110, WRG 42, ICP 49114, SMR 1693158, ICP 139184 and RVKT 261	3	Moderately Resistant
	BAHAR, DA322, GR 28, ICP 11174, BRG-10-02, WRG 157, WRP 1 and PA 409	4	Moderately Resistant
Gram pod borer, *Helicoverpa armigera*	H 23, PLS 476 A, V 127, JKE 110, GR 28, ICP 11957, SMR1693158, ICPL 8719 and WRP 1	2	Resistant
	CORG 9900134, ICP 11293, ICP 10175, ICP 8863, DA 322, WRG 42, ICP 11174, ICP 139184, RVKT 261, BRG-10-02 and WRG 157	3	Moderately Resistant
	ICP11007, BAHAR, V 87 and ICP 49114	4	Moderately Resistant

Chart.1

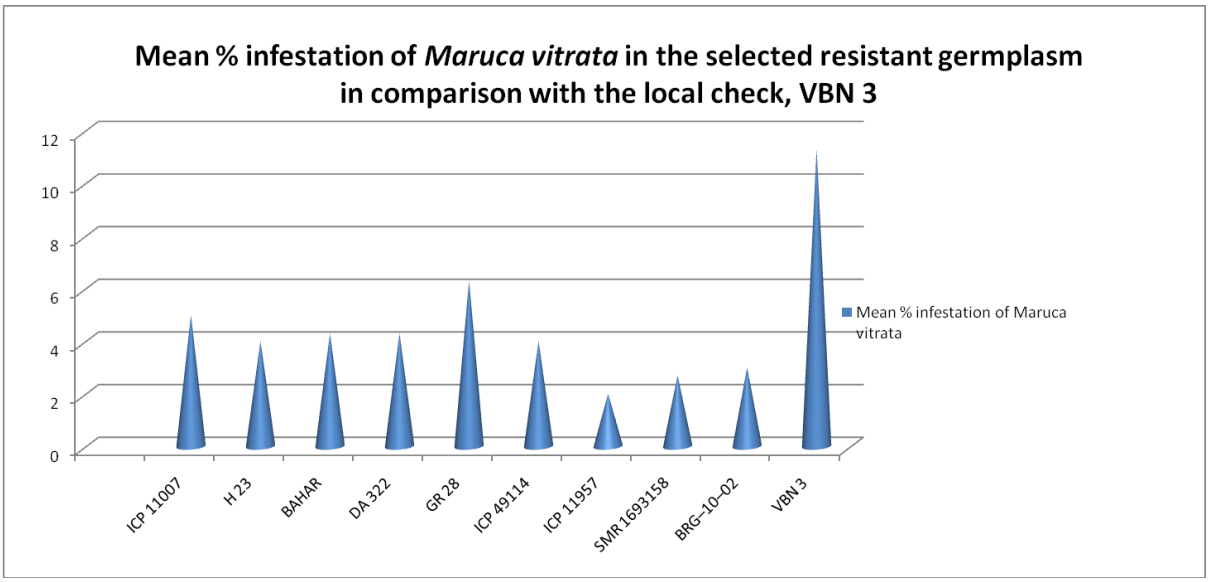
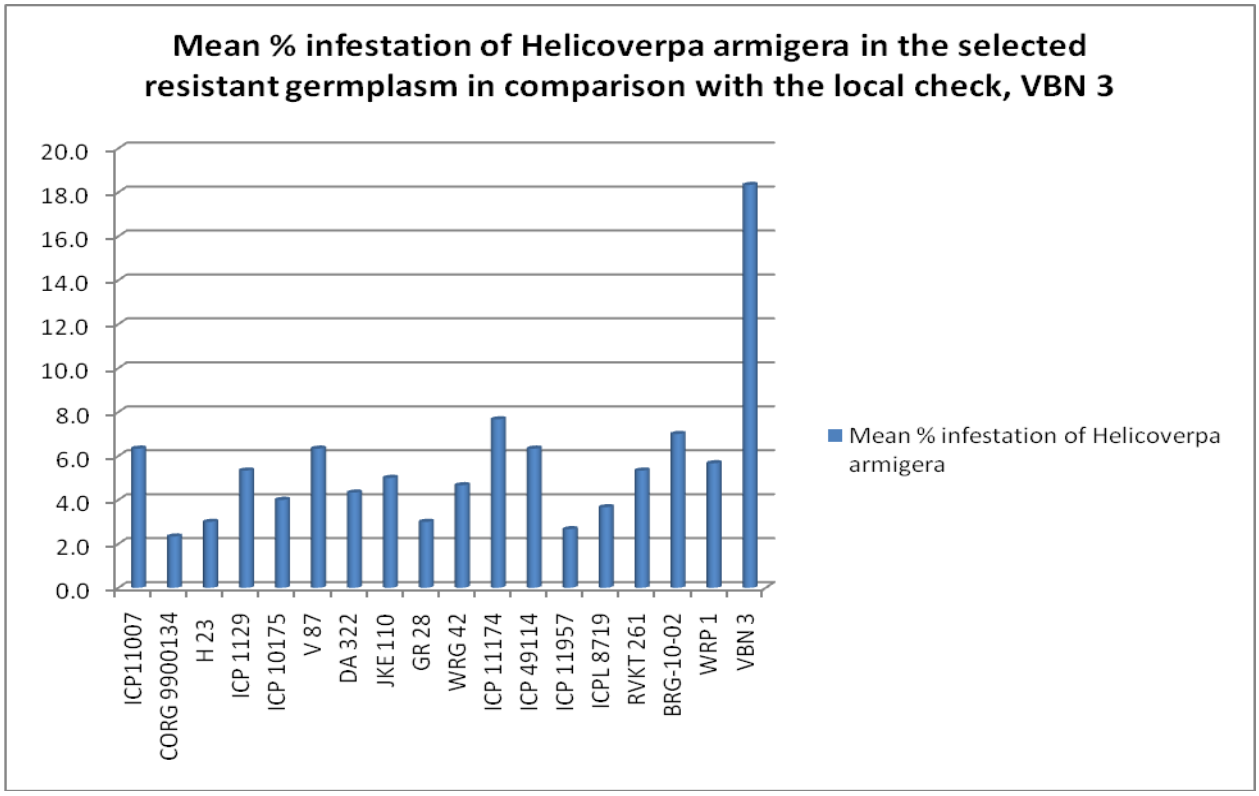


Chart.2



Kharif 2015

During kharif 2014, among the 41 pigeonpea entries screened, nineteen entries were selected for further screening during the III year (kharif 2015). All the nineteen entries were found to be having various degrees of resistance levels to both the pod borers. Among them, per cent damage of *M. vitrata* and *H. armigera* ranged between 2.0 and 12

per cent and 1.0 and 12 per cent respectively (Table 3).

Among the 145 nos. of entries screened during three years, nine entries i.e., ICP 11007, H 23, BAHAR, DA 322, GR 28, ICP 49114, ICP 11957, SMR 1693158, BRG–10–02 exhibited consistent resistant reaction to the spotted pod borer, *M. vitrata* (Table 4). Lower pod damage by *M. vitrata* in ICPL 98003 and ICPL 98008 was reported by Sunitha *et al.,* (2008). Less pigeonpea pod borer infestation and grain damage in BAHAR was also reported by Ram Keval *et al.,* (2017).

For the gram pod borer, *H. armigera,* 17 nos. of entries showed resistance during all the three years. Rizwana Banu *et al.,* (2007) reported low per cent damage of *H. armigera* in ICPL 3201 with high grain yield. Bant Singh Kooner and Harpreet Kaur Cheema, 2006 reported that the pigeonpea entries, AL 1498, AL 1502 and AL 1340 were found to be promising with mean pod damage of 11.21 to 13.71% (PSR 3 - 3.50) and they suggested their use as resistant donors in the crossing programme to evolve pod borer resistant/tolerant varieties of pigeonpea.

During the present screening study, with regard to the spotted pod borer, *M. vitrata,* minimum PSI of 2.0 was noted in ICP 11957 followed by 2.3 in SMR 1693158 and 2.7 in BRG-10-02, Bahar and H 23. For gram pod borer, *Helicoverpa armigera,* less PSI noted was 2.3 in CORG 9900134, H 23, JKE 110, GR 28, WRG 42, ICP 11957 and ICPL 8719.

The PSI of 2.7 was recorded in the entries, ICP 10175 and RVKT 261. As low PSI indicates high resistance levels in that particular entry, the above entries with less pest susceptibility indexes may be used as resistant donors in the breeding programme (Tables 6–8).

Multiple resistant pigeonpea entries identified

The pigeonpea entries found to be resistant to both the pod borers were ICP 11007, H 23, DA 322, GR 28, ICP 49114, ICP 11957 and BRG-10-02.

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How to cite this article:

Zadda Kavitha and Vijayaraghavan, C. 2017. Screening of Pigeonpea Genotypes against Webbing Caterpillar, *Maruca vitrata* Geyer and Gram Pod Borer, *Helicoverpa armigera* Hubner. *Int.J.Curr.Microbiol.App.Sci*. 6(12): 3899-3907.
doi: https://doi.org/10.20546/ijcmas.2017.612.450