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The Pharma Innovation

ISSN (E): 2277- 7695
ISSN (P): 2349-8242
NAAS Rating: 5.23
TPI 2021; SP-10(8): 464-467

www.thepharmajournal.com
Received: 25-06-2021
Accepted: 27-07-2021

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Varietal screening of mothbean (*Vigna aconitifolia* (Jacq.) Marechal) against major sucking insect pests

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Abstract
The screening of ten genotypes/ varieties of mothbean, *Vigna aconitifolia* (Jacq.) Marechal *viz.*, RMB-25, RMO-40, RMO-225, RMO-257, RMO-435, RMO-2251, CZM-2, RMO-3-5-70, MBS-605 and RMO-4-1-6-09 were investigated against major sucking insect pests *viz*. leafhopper, *Empoasca motti* (Pruthi.), whitefly, *Bemisia tabaci* (Genn.) and thrips, *Caliothrips indicus* (Bagnall) during *Kharif*, 2019. During the investigation genotypes/ varieties RMO-40, RMO-257, CZM-2 and MBS-605 were found to be highly resistant to leafhopper and whitefly whereas, RMO-40, CZM-2 and MBS-605 to thrips. The genotypes/ varieties RMB-25, RMO-2251 and RMO-3-5-70 were found to be as moderately resistant to leafhopper and whitefly whereas, RMB-25, RMO-257, RMO-2251 and RMO-3-5-70 were categorized as moderately resistant to thrips and RMO-225, RMO-435 and RMO-4-1-6-09 were found to be as least resistant.

Keywords: mothbean, varietal screening, leafhopper, whitefly, thrips

Introduction
Mothbean, *Vigna aconitifolia* (Jacq.) Marechal is an important pulse crop arid and semi-arid regions of India and some other countries of Asia. Use of resistant crop variety is economically, ecologically, and environmentally advantageous. It is the most drought hardy annual legume in arid regions and it also protect the soil erosion. The mothbean seeds contain about 10.30 per cent moisture, 25.66 per cent protein, 2.78 per cent fat, 0.41 per cent mineral matter, 3.90 per cent fibre, 61.76 per cent carbohydrate and lysine, the essential amino acid (Despandey and Rao, 1954 [6]; Brown and Gaur, 1960 [4]; Pant and Tulsiani, 1963 [11]). The original palace of mothban is considered in India. India has the largest area under mothbean in the world. It is also grown in Sri Lanka, China, Pakistan and United States of America. In India, during 2017-18 mothbean have been grown on about 1.11 M ha area with 0.31 metric tones production and 277 kg/ ha productivity (Anonymous 2018) [1]. The major growing states are Rajasthan, Gujarat, Maharashtra, Jammu & Kashmir and Punjab. Rajasthan holds a key position with an area of 9.53 Lakh hectares and with annual production of 2.91 lakh tonnes and average productivity of 382 kg/ hectare. In Rajasthan, Bikaner, Churu, Barmer, Jodhpur, Nagour, and Hanumangarh are major growing districts (Anonymous, 2019) [2].
The mothbean crop is damaged at various stages of growth by a number of insect pests like whitegrub, *Holotrichia consanguinea* (Blanchard), termite, *Odontotermes obesus* (Rambur), Leafhopper, *Empoasca motti* (Pruthi), whitefly, *Bemisia tabaci* (Genn.), galerucid beetle, *Madurasia obscurella* (Jacoby), thrips, *Caliothrip sindicus* (Bagnall),stemfly, *Ophiomyia phaseoli* (Tryon). The major sucking insect pests leafhopper, whiteflies and thrips cause moderate to severe damage right from germination to maturity of the crop and leads to considerable decrease in yield (Puttaswami *et al.*, 1977) [12]. In present experiment ten different mothbean varieties and entries were evaluated for their performance against the major sucking insect pests with an objective to identify tolerant/resistant varieties for the IPM packages for mothbean.

Material and Methods
The experiment was laid out in a simple randomized block design (RBD) with ten varieties and entries as treatments, each replicated thrice in the plot of size 3 m x 2.4 m. The distance between row to row and plant to plant was kept 30 x 10 cm respectively. The crop was sown on third week of July, 2019. Ten mothbean genotypes/ varieties viz., RMB-25, RMO-40,

RMO-225, RMO-257, RMO-435, RMO-2251, CZM-2, RMO-3-5-70, MBS-605 and RMO-4-1-6-09 were screened in the experiment. All the genotypes/ varieties were allowed for natural infestation in the field. The observations on the population of major sucking insect pests *viz.*, leafhopper, whitefly and thrips were recorded soon after appearance on all the genotypes/ varieties, exposed to natural infestation. Weekly observations were recorded on five randomly selected and tagged plants in each plot.

Leafhopper, *Empoasca motti* (Pruthi.)
The population of leafhopper, *E. motti* was recorded by counting both nymphs and adults as per method described by Rawat and Sahu (1973) [13]. The population was recorded on three leaves, *i.e.* top, middle and bottom canopy of each tagged plant.

Whitefly, *Bemisia tabaci* (Genn.)
The population of whitefly, *B. tabaci* was counted visually on three leaves of mothbean from upper, middle and lower canopy of five selected and tagged plant of each plot. For counting both nymphs and adults of whitefly population, the leaf was held at the petiole by thumb and forefingers and twisted until the entire underside of leaf became clearly visible (Butter and Vir, 1990) [5]

Thrips, *Caliothrips indicus* (Bagnall)
The population of thrips, *C. indicus* was counted at fully opened leaves from five randomly selected and tagged plants of each plot with the help of magnifying lens on three leaves from upper, middle and lower canopy of each tagged plant of mothbean. The flower bud and flowers were also considered for taking population when it appeared on the plant. The population was counted early in the morning when thrips was not very active.
The data recorded on population leafhopper, whitefly and thrips at weekly interval were transformed into $\sqrt{X+0.5}$ (Gupta, 1996) [8] and were subjected to analysis of variance. The peak populations of leafhopper, whitefly and thrips on mothbean were categorized on the basis of formula given below:

$\bar{x} \pm \sigma$

Where,
$\bar{x}$ = Mean of peak insect population
σ = Standard deviation of peak insect population.

Result and Discussion
Leafhopper, *Empoasca motti* (Pruthi)
The presented in table 1 revealed that none of the tested genotypes/ varieties were found completely free from the infestation of leafhopper. The infestation of leafhopper was first observed in the first week of August (31st SMW), reached to peak in the fourth week of August (35th SMW).The minimum infestation was recorded on RMO-40 (2.66 leafhopper/ three leaves) followed by CZM-2 (3.11 leafhopper/ three leaves), MBS-605 (3.65 leafhopper/ three leaves) and RMO-257 (4.02 leafhopper/ three leaves)these were found at par with each other. The maximum infestation was recorded on RMO-4-1-6-09 (7.92 leafhopper/ three leaves) followed by RMO-435 (7.46 leafhopper/ three leaves) and RMO-225 (6.33 leafhopper/ three leaves) these were found at par with each other were graded as least highly resistance and least resistance respectively. The remaining genotypes/ varieties were ranked as moderately resistance. The results were in full conformity with the findings of Suman *et al.* (2016) [14] and Jakhar *et al*. (2018) [9] who reported that the variety RMO-225 was highly susceptible to leafhopper. Bairwa (2005) [3], Dhamaniya *et al.* (2005) [7] and Naga (2012) [10] who reported that the variety RMO-40 and RMO-257 were observed as moderately susceptible to leafhopper infestation also corroborates the present findings.

Whitefly, *Bemisia tabaci* (Genn.)
The data on screening of mothbean genotypes/ varieties against whitefly, *B. tabaci* presented in table 2 showed that none of the tested genotypes/ varieties were found completely free from the infestation. The infestation of whitefly was first observed in the first week of August (31st SMW), reached to peak in the first week of September (36th SMW). The minimum infestation was recorded on RMO-40 (3.05 whitefly/ three leaves) and was found at par with CZM-2 (3.20 whitefly/ three leaves) and MBS-605 (3.67whitefly/ three leaves). Jakhar *et al*. (2018) [9] reported that variety MBS-605 was found to be less susceptible to whitefly population also corroborates the present findings. The maximum infestation was recorded on RMO-4-1-6-09 (8.12 whitefly/ three leaves) followed by RMO-435 (7.10 whitefly/ three leaves) and RMO-225 (6.62 whitefly/ three leaves) these were found at par with each other were graded as least highly resistance and least resistance respectively. The remaining genotypes/ varieties were ranked as moderately resistance. Dhamaniya *et al.* (2005) [7], Naga (2012) [10] and Suman *et al.* (2016) [14] who reported RMO-40 and RMO-435 as moderately susceptible to whitefly infestation.

Thrips, *Caliothrips indicus* (Bagnall)
The infestation of thrips, *C. indicus* was presented in table 3 showed that first observed in the first week of August (31st SMW), reached to peak in the first week of September (36th SMW). The minimum infestation was recorded on genotypes/ varieties RMO-40 (2.73 thrips/ three leaves) followed by CZM-2 (2.86 thrips/ three leaves) and MBS-605 (3.93 thrips/ three leaves) were found at par with each other. The maximum infestation was recorded on genotypes/ varieties, RMO-4-1-6-09 (7.07 thrips/ three leaves) followed by RMO-435 (6.70 thrips/ three leaves) and RMO-225 (6.04 thrips/ three leaves) these were found at par with each other were graded as least highly resistance and least resistance respectively. The remaining genotypes/ varieties were ranked as moderately resistance. The present findings get support from the results of Suman *et al.* (2016) [14] reported that the genotype/ vaiety RMO-257 considered as highly susceptible. Dhamaniya *et al* (2005) [7] and Bairwa (2005) [3] reported that RMO-40 and CZM-2 as moderately susceptible to thrips infestation also corroborates the present findings. Bairwa (2005) [3] observed very high population of thrips on variety RMO- 435.

Table 1: Population of leafhopper, *Empoasca motti* (Pruthi) on genotypes/varieties of mothbean, *Vigna aconitifolia* (Jacq.) Marechal

S. No.	Genotypes/ varieties	Mean leafhopper population per three leaves									
		06-08-19	13-08-19	20-08-19	27-08-19*	03-09-19	10-09-19	17-09-19	24-09-19	01-10-19	Mean
1.	RMB-25	1.67 (1.47)	2.94 (1.85)	6.14 (2.58)	11.60 (3.48)	6.67 (2.68)	5.67 (2.48)	3.94(2.11)	2.27 (1.66)	1.47(1.40)	4.71 (2.28)
2.	RMO-40	0.67 (1.07)	1.80 (1.52)	3.00 (1.87)	6.34 (2.61)	4.54 (2.24)	3.14 (1.91)	3.20 (1.92)	0.94 (1.20)	0.34 (0.92)	2.66 (1.78)
3.	RMO-225	3.00 (1.87)	4.14 (2.15)	8.34 (2.97)	14.94 (3.93)	8.94 (3.07)	8.54 (3.00)	6.27 (2.60)	1.84 (1.53)	0.94 (1.20)	6.33 (2.61)
4.	RMO-257	2.33 (1.68)	5.00 (2.35)	3.67 (2.04)	9.07 (3.09)	5.80 (2.51)	4.67 (2.27)	2.67 (1.78)	2.34 (1.68)	0.67 (1.08)	4.02 (2.12)
5.	RMO-435	4.07 (2.14)	5.33 (2.42)	9.07 (3.09)	15.94 (4.05)	9.54 (3.17)	8.80 (3.05)	7.14 (2.76)	4.27 (2.18)	3.00 (1.87)	7.46 (2.82)
6.	RMO-2251	2.74 (1.80)	3.14 (1.91)	6.67 (2.68)	11.80 (3.51)	6.80 (2.70)	7.60 (2.85)	4.54 (2.24)	3.00 (1.87)	2.07 (1.60)	5.34 (2.41)
7.	CZM-2	0.94 (1.20)	1.94 (1.56)	3.33 (1.96)	6.60 (2.66)	4.47 (2.21)	4.60 (2.26)	4.67 (2.27)	0.94 (1.20)	0.47 (0.98)	3.11 (1.90)
8.	RMO-3-5-70	2.84 (1.83)	3.87 (2.09)	6.94 (2.73)	12.34 (3.58)	7.20 (2.77)	6.54 (2.65)	5.14 (2.37)	3.54 (2.00)	2.20 (1.64)	5.62 (2.47)
9.	MBS-605	1.20 (1.30)	2.67 (1.78)	5.07 (2.36)	8.33 (2.97)	6.27 (2.60)	3.00 (1.87)	3.67 (2.04)	1.74 (1.50)	0.94 (1.20)	3.65 (2.04)
10.	RMO-4-1-6-09	4.14 (2.15)	5.67 (2.48)	10.00 (3.24)	16.74 (4.15)	10.20 (3.27)	9.54 (3.17)	7.60 (2.85)	4.54 (2.24)	2.87 (1.83)	7.92 (2.90)
SEm±		0.09	0.09	0.12	0.16	0.13	0.12	0.10	0.10	0.07	0.11
CD (p=0.05)		0.27	0.26	0.35	0.47	0.39	0.36	0.30	0.30	0.22	0.34

*Peak population of leafhopper
Figures in the parentheses are √ X+0.5 values

Table 2: Population of whitefly, *Bemisia tabaci* (Genn.) on genotypes/ varieties of mothbean, *Vigna aconitifolia* (Jacq.) Marechal

S. No.	Genotypes/ varieties	Mean whitefly population per three leaves									
		06.08.19	13.08.19	20.08.19	27.08.19	03.09.19*	10.09.19	17.09.19	24.09.19	01.10.19	Mean
1.	RMB-25	1.87 (1.54)	2.47 (1.72)	5.27 (2.40)	6.67 (2.60)	11.67 (3.48)	6.33 (2.61)	5.14 (2.37)	4.67 (2.27)	2.00 (1.58)	5.12 (2.37)
2.	RMO-40	0.33 (0.91)	1.14 (1.28)	3.00 (1.87)	4.14 (2.15)	7.74 (2.87)	4.34 (2.20)	2.67 (1.78)	3.00 (1.87)	1.14 (1.28)	3.05 (1.88)
3.	RMO-225	3.14 (1.90)	4.00 (2.12)	8.34 (2.97)	7.27 (2.79)	14.47 (3.87)	7.74 (2.87)	7.20 (2.77)	5.27 (2.45)	2.20 (1.64)	6.62 (2.67)
4.	RMO-257	3.00 (1.91)	5.67 (2.48)	6.00 (2.55)	8.67 (3.03)	9.84 (3.21)	6.14 (2.58)	3.00 (1.87)	3.33 (1.96)	1.60 (1.45)	5.25 (2.40)
5.	RMO-435	4.07 (2.14)	5.60 (2.47)	6.20 (2.59)	9.33 (3.13)	16.14 (4.08)	9.27 (3.12)	5.47 (2.44)	5.94 (2.54)	1.87 (1.54)	7.10 (2.76)
6.	RMO-2251	2.07 (1.60)	5.33 (2.41)	4.74 (2.29)	7.00 (2.74)	12.00 (3.53)	6.33 (2.61)	5.67 (2.48)	5.00 (2.34)	2.67 (1.78)	5.64 (2.48)
7.	CZM-2	0.94 (1.20)	1.14 (1.28)	2.94 (1.85)	3.87 (2.09)	7.94 (2.90)	4.27 (2.18)	4.07 (2.14)	2.80 (1.81)	0.87 (1.17)	3.20 (1.92)
8.	RMO-3-5-70	2.67 (1.78)	3.27 (1.94)	7.80 (2.88)	6.80 (2.70)	12.54 (3.61)	7.27 (2.79)	6.84 (2.71)	4.34 (2.20)	2.74 (1.80)	6.03 (2.55)
9.	MBS-605	1.07 (1.25)	1.74 (1.50)	3.54 (2.00)	4.67 (2.27)	8.94 (3.07)	5.20 (2.39)	2.74 (1.80)	4.20 (2.17)	0.94 (1.20)	3.67 (2.04)
10.	RMO-4-1-6-09	4.33 (2.20)	5.00 (2.35)	8.20 (2.95)	11.47 (3.46)	16.94 (4.17)	9.67 (3.19)	8.34 (2.97)	6.14 (2.58)	3.00 (1.87)	8.12 (2.93)
SEm±		0.09	0.08	0.10	0.11	0.15	0.12	0.11	0.09	0.07	0.11
CD (p=0.05)		0.27	0.23	0.29	0.33	0.46	0.35	0.32	0.26	0.21	0.32

* Peak population of whitefly
Figures in the parentheses are $\sqrt{X+0.5}$ values

Table 3: Population of thrips, *Caliothrips indicus* (Bagnall) on genotypes/ varieties of mothbean, *Vigna aconitifolia* (Jacq.) Marechal

S. No.	Genotypes/ varieties	Mean thrips population per three leaves									
		06.08.19	13.08.19	20.08.19	27.08.19	03.09.19*	10.09.19	17.09.19	24.09.19	01.10.19	Mean
1.	RMB-25	1.33 (1.35)	2.47 (1.72)	6.47 (2.64)	6.87 (2.72)	10.47 (3.31)	7.14 (2.76)	4.07 (2.14)	2.74 (1.80)	1.94 (1.56)	4.83 (2.31)
2.	RMO-40	0.20 (0.84)	1.54 (1.42)	3.34 (1.96)	4.47 (2.23)	6.47 (2.64)	4.67 (2.27)	2.14 (1.63)	0.94 (1.20)	0.80 (1.14)	2.73 (1.80)
3.	RMO-225	2.20 (1.64)	3.34 (1.95)	6.47 (2.64)	8.94 (3.07)	13.74 (3.77)	8.94 (3.07)	5.74 (2.50)	2.27 (1.66)	2.74 (1.80)	6.04 (2.56)
4.	RMO-257	2.00 (1.58)	3.67 (2.04)	6.27 (2.60)	8.20 (2.95)	10.87 (3.37)	4.94 (2.33)	3.20 (1.92)	3.00 (1.87)	2.00 (1.58)	4.90 (2.32)
5.	RMO-435	2.67 (1.78)	4.34 (2.21)	8.34 (2.97)	8.47 (2.99)	14.54 (3.88)	9.34 (3.13)	5.54 (2.46)	4.14 (2.15)	2.94 (1.85)	6.70 (2.68)
6.	RMO-2251	1.74 (1.50)	2.67 (1.78)	7.74 (2.87)	6.84 (2.71)	10.84 (3.37)	6.74 (2.69)	4.07 (2.14)	2.34 (1.68)	2.20 (1.64)	5.02 (2.35)
7.	CZM-2	0.67 (1.08)	1.54 (1.42)	3.27 (1.94)	4.54 (2.24)	6.84 (2.71)	4.74 (2.29)	2.20 (1.65)	1.00 (1.22)	0.94 (1.20)	2.86 (1.83)
8.	RMO-3-5-70	2.07 (1.60)	3.00 (1.87)	5.94 (2.53)	6.34 (2.61)	11.27 (3.43)	7.00 (2.73)	5.74 (2.50)	3.34 (1.96)	2.07 (1.60)	5.20 (2.39)
9.	MBS-605	1.07 (1.25)	2.00 (1.58)	4.60 (2.26)	6.14 (2.58)	7.74 (2.87)	6.54 (2.65)	4.27 (2.18)	1.67 (1.47)	1.34 (1.36)	3.93 (2.10)
10.	RMO-4-1-6-09	3.00 (1.87)	4.94 (2.33)	8.80 (3.05)	9.14 (3.10)	14.94 (3.93)	9.60 (3.18)	5.94 (2.54)	4.34 (2.20)	3.00 (1.87)	7.07 (2.75)
SEm±		0.07	0.09	0.11	0.12	0.15	0.12	0.10	0.09	0.07	0.11
CD (p=0.05)		0.21	0.25	0.32	0.36	0.44	0.35	0.29	0.27	0.20	0.32

* Peak population of thrips
Figures in the parentheses are $\sqrt{X+0.5}$ values

Acknowledgement
The authors are grateful to Dean, Sri Karan Narendra College of Agriculture, Jobner, Rajasthan for provided necessary facilities.

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