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SEASONAL INCIDENCE AND REACTION OF GREENGRAM GENOTYPES AGAINST SPOTTED POD BORER, *Maruca vitrata* (FABRICIUS)

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AUTHORS' CONTRIBUTIONS

This work was carried out in collaboration between both authors. Authors MR and VS study conception and design of the manuscript. Author MR data collection and interpretation of results of the manuscript. Authors MR and VS draft manuscript preparation. Both authors read and approved the final manuscript.

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ABSTRACT

Greengram cultivation is hampered by various insect pests, among which the spotted pod borer, *Maruca vitrata* (Fabricius) inflicts extensive damage. Insecticides are widely used to suppress this damage but are found to culminate in undesirable effects in the environment and humans. Exploring and exploiting host plant resistance in the gene pool of crop plants is an effective, ecofriendly alternative approach to manage such insect pests. Considering this, 333 greengram genotypes were gathered and screened under field condition to identify resistance sources against spotted pod borer during *Rabi* 2020 and *Kharif* 2021 at Sivapuri village, Chidambaram, Tamil Nadu, India. The larval population and their active webbing were accessed from flower bud initiation to end of crop growth period and per cent pod damage was worked out after harvest. The results of this study revealed that, the larval population and active webbing and per cent pod damage were the least on IC-39301-1 followed by IC-311451 and IC-39301-1 followed by IC-103207 during *Rabi* 2020 and *Kharif* 2021 respectively. In both seasons, the larval population, active webbing, and percent pod damage were higher in the genotype IC-39317, followed by IC-103981. Based on per cent pod damage 4 and 10 genotypes were found resistant, while 182 and 175 genotypes were moderately resistant, 70 and 78 genotypes were tolerant, 56 and 63 genotypes moderately susceptible and 21 and 7 genotypes were highly susceptible in *Rabi* 2020 and *Kharif* 2021 respectively. The genotypes which were grouped under resistant and tolerant category in both the seasons were selected for further evaluation to develop desirable varieties.

Keywords: Greengram (*Vigna radiata*); genotypes; pod borer; resistance.

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1. INTRODUCTION

Among the pulses, greengram (*Vigna radiata* (L.) Wilczek) is a significant protein source that can serve as nourishment to humans and is in considerable demand, particularly among vegetarians. Worldwide, greengram is cultivated in an area of around 7.3 million hectares, with an average yield of 721 kg/ha and a global production of approximately 5.3 million tonnes Nair and Schreinemachers [1]. India is the world's leading greengram producer and consumer, producing around 2.50 million tonnes per year from an area of 4.5 million hectares with an average productivity of 548 kg/ha Indiastat [2]. However, in greengram cultivation severe yield loss is experienced because of substantial incidence of insect pest complex. Among the insect pests, the spotted pod borer, *Maruca vitrata* (Fabricius) is quite threatening and a serious pest on food legumes of Asian and African countries. Being an oligophagous pest, it feeds on above 70 kinds of Fabaceae species Srinivasan et al. [3]. In greengram, *M. vitrata* causes yield loss up to 2-84 % and economic loss up to 20-25% Vishakanthaiah and Jagadeesh babu [4].

The spotted pod borer occurs from bud initiation stage to final crop maturity stage. This pest causes damage by feeding as well as by webbing. The adult female lays the eggs mostly on underside of the leaf, sometimes on upper side of the leaf, flower buds, and petioles and also on infected pods. The larva constructs a web by using leaf, peduncle, buds, flowers and pods and feeds inside by hiding themselves. One, two or more than two larvae are present in the single web. The webs soon turn black and dry because of fungal infection.

Though several insecticides are used by farmers to manage spotted pod borer, the insecticides cannot reach the insect fully due to its cover up feeding habit and this feeding behavior also protect the insect from its natural enemies. Hence, this pest cannot be managed satisfactorily. `Among the alternative management tactics, such as cultural, physical, mechanical, biological and chemical method, exploiting the resistance traits in greengram genotypes is a promising option. But, attempts to screen greengram germplasm against pod borer are scarce except by few earlier workers and hence currently greengram varieties with viable resistance to pod borer are not available Srinivasan et al. [3]. Therefore, keeping this in view, this present study was conducted to evaluate the greengram genotypes for resistance to *M. vitrata.*

2. MATERIALS AND METHODS

The screening study was conducted in a farmer’s field located at Sivapuri village, Chidambaram, Tamil Nadu, India during *Rabi* 2020 (December–March) and *Kharif* 2021 (July–October). Greengram genotypes were obtained from various institutions such as Regional station-NBPGR, Jodhpur and National Pulses Research Centre, Vamban besides personal collection from farmers. And all the 333 genotypes were grown in the field in three replications. For each replication, the genotypes were sown in 3-meter length row with spacing of 30X10 cm. Throughout the crop period, all the suggested agronomical practices were followed except plant protection measures.

The spotted pod borer incidence was recorded by observing five randomly selected plants per row. Spotted pod borer population was recorded at weekly intervals from bud initiation to final harvesting stage. Pod damage by *M. vitrata* was recorded at harvest by identifying the characteristic symptom Soundararajan and Chitra [5]. Total number of pods and number of damaged pods were recorded and the mean damage was worked out by using the following formula.

Per cent pod damage = (Number of damaged pods / Total number of pods) X 100

Based on the per cent pod damage, the damage score for each genotype was calculated and the resistance rating in a scale of 1-9 as suggested by Rani et al. [6] with minor modifications was followed.

Table 1. Pest incidence and reaction details

Score	Pest incidence	Reaction
1	0 % pod damage	Resistant
3	1-10% pod damage	Moderately resistant
5	11-20% pod damage	Tolerant
7	21-40% pod damage	Moderately susceptible
9	>40% pod damage	Highly susceptible

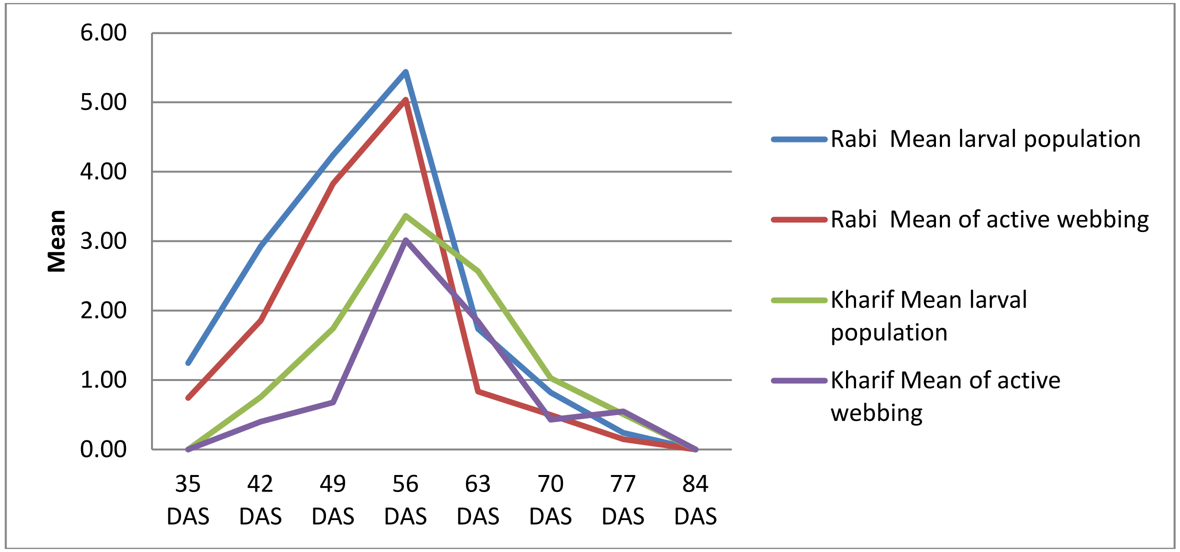

Fig. 1. Incidence of *Maruca vitrata* larva and their active webbing during *Rabi* 2020 and *Kharif* 2021

Table 2. Field screening of greengram genotypes against *Maruca vitrata* incidence during *Rabi* 2020

Category of resistance	Per cent pod damage	Score	No. of genotypes	Name of the genotypes
Resistant	No damage	1	4	IC-39301-1, IC-311451, IC-103833, IC-311424
Moderately resistant	<10% pod damage	3	182	IC-103238, IC-39306, IC-39368, IC-370498, IC-39276, IC-39447, IC-311445, IC-52074, IC-39334, IC-39290, IC-39307, IC-285192, IC-370532, IC-39376, IC-52051, IC-8837, IC-323998, IC-39399, IC-395787, IC-39372, IC-39359, IC-329039-1, IC-39329-1, IC-369823, IC-311425, IC-39230, IC-39374, IC-102898, IC-52064, IC-52073, IC-285161, IC-103788, IC-39574-1, IC-311394, IC-39394, IC-39349, IC-39446, IC-103207, IC-103878, IC-39278, IC-39400, IC-39304, IC-39344, IC-39351, IC-39457, IC-103300, IC-329057-1, IC-369819, IC-39303, IC-39362, IC-370721, IC-325853, IC-103054, IC-52082, IC-102870, IC-39918, IC-39354, IC-39422, IC-39288-1, IC-39352, IC-325833, IC-39406, IC-52067, IC-370731, IC-39326, IC-325752, IC-370735, IC-333213, IC-39300, IC-285168-1, IC-39450, IC-370497, IC-325799, IC-39370, IC-39367, IC-39305, IC-39271-1, IC-52078-1, IC-103974, IC-113984, IC-39408, IC-103838, IC-39477, IC-329067, IC-39493, IC-75811, IC-39397, IC-10993, IC-311408, IC-

Category of resistance	Per cent pod damage	Score	No. of genotypes	Name of the genotypes
				311395, IC-285192-1, IC-39323, IC-39353, IC-39610, IC-329078, IC-311430, IC-39274, IC-103177, IC-394011, IC-39388, IC-39360, IC-39399-1, IC-39381, IC-39599, IC-102864-1, IC-39350, IC-39363, Tindivanam local, IC-325774, IC-39272, IC-370474, IC-103993, IC-103059-1, IC-39343, IC-103243, IC-325853-1, IC-39290-1, IC-39270, IC-39309, IC-52077-1, IC-52059, IC-39292, IC-103224, IC-52076, IC-39403, IC-103245, IC-103868, IC-329057, IC-39294, IC-103880, IC-39465, IC-39322, IC-103059, IC-370733, IC-39369, IC-39325, IC-39375, IC-52053, IC-311409, IC-103316, IC-324012, IC-325791-1, IC-311437, IC-102914, IC-325782, IC-8888, IC-39302-1, IC-103830, IC-5190, AKM 4, IC-325810, IC-488722,IC-103821, IC-39550, IC-103154, IC-39275-1, IC-103219, IC-39319, IC-8593, IC-103184, IC-39491, IC-285168, IC-103245-1, Sivagangai kattupayiru, IC-39474, IC-39411, IC-373426, IC-39350-1, IC-39340, IC-39308, IC-39296, IC-39392-1, Kattumannarkudi local, IC-39271, Aandipatti kattupayiru, PDM 11, Utkarsh, BM-2002-1, VBN 2, IPM-02-14, ADT 2, Pusa vishal
Tolerant	11-20% pod damage	5	70	IC-39272-1, IC-329039, IC-39383, IC-39384, IC-39454, IC-33537, IC-311418, IC-311426-1, IC-39583, IC-39355, IC-39288, CO 7, IC-39315, IC-39380, IC-39385-1, Vaibav, IC-325791, IC-102963, IC-39444, IC-39500, IC-39436, IC-52078, IC-311397, ML 5, IC-39524, IC-39373, IC-52069, IC-285165, IC-39459, IC-39298, IC-39295-1, Vandhavasi local, AKM 0503, IC-39405, IC-52077, IC-39280, IC-103181, IC-39324, IC-102864, IC-103190, IC-325788, IC-39430, CO 4, Bhuvanagiri local, IC-39330, IC-258102, IC-39378, IC-39432, IC-52049, IC-39356, AKM 8803, IC-39505, IC-39333, IC-39423, IC-9121, IC-39311, ADT 3, IC-39365, IC-16563, TAP 7, IC-39329, VBN 5, IC-39327, IC-39511, IC-39273, AKM 1502, IC-39314, IC-39530, VBN 3, IC-102857
Moderately susceptible	21-40% pod damage	7	56	IC-39471, IC-39448, VBN 7, IC-39295, IC-325817, IC-39563, CO 8, IC-285161-1, IC-285165-1, IC-39393, IC-52074-1, IC-39445, IC-39392, IC-311419, IC-39358, IC-39298-1, Paiyur 1, IC-39275, IPM-99-125, IC-39332, IC-39287, IC-103017, IC-52080, IC-311420, IC-39316, IC-103204, IC-39425, TARM-2, Sengalmedu local, IC-39301, IC-311446, IC-103861, IC-52066, IC-39328, IC-39574, IC-39414, IC-39302, Melanakudi local, IC-39357, IC-311418-1, IC-305292, IC-39299, IC-39482, IC-39281, IC-39385, IC-52079, IC-39382, IC-52060, IC-39342, IC-39404, IC-39341, IC-39291, IC-102821, IC-39606, IC-311426, IC-324021
Highly susceptible	>40% pod damage	9	21	IC-39438, IC-103981-1, IC-103986, IC-103975, IC-39495, IC-39496, Madurantakam local, IC-39412, IC-39395, IC-325933, IC-39508, IC-102821-1, IC-39279, IC-39320, IC-39321, IC-103862, IC-420310, IC-7856, IC-415117, IC-103981, IC-39317

Table 3. Field screening of greengram genotypes against *Maruca vitrata* incidence during *Kharif* 2021

Category of resistance	Per cent pod damage	Score	No. of genotypes	Name of the genotypes
Resistant	No damage	1	10	IC-39301-1, IC-103207, IC-103878, IC-103833, IC-103788, IC-39574-1, IC-311394, IC-39446, IC-39349, IC-39394
Moderately resistant	<10% pod damage	3	175	IC-39376, IC-52051, IC-8837, IC-323998, IC-395787, IC-370532, IC-39447, IC-311425, IC-39230, IC-311445, IC-39372, IC-39359, IC-370498, IC-329039-1, IC-39334, IC-52074, IC-39329-1, IC-39276, IC-369823, IC-39399, IC-39307, IC-52064, IC-52073, IC-102898, IC-285192, IC-39290, IC-39374, IC-285161, IC-39306, IC-39368, IC-103238, IC-39278, IC-39400, IC-39304, IC-39344, IC-39351, IC-39457, IC-103300, IC-329057-1, IC-311451, IC-369819, IC-39303, IC-39362, IC-370721, IC-325853, IC-103054, IC-52082, IC-102870, IC-39918, IC-39354, IC-39422, IC-39288-1, IC-39352, IC-325833, IC-39406, IC-52067, IC-370731, IC-39326, IC-325752, IC-370735, IC-333213, IC-39300, IC-311424, IC-285168-1, IC-39450, IC-370497, IC-325799, IC-39370, IC-39367, IC-39305, IC-39271-1, IC-52078-1, IC-103974, IC-113984, IC-39408, IC-103838, IC-39477, IC-329067, IC-39493, IC-75811, IC-39397, IC-10993, IC-311408, IC-311395, IC-285192-1, IC-39323, IC-39353, IC-39610, IC-329078, IC-311430, IC-103177, IC-39274, IC-39388, IC-394011, IC-39360, IC-39399-1, IC-102864-1, IC-39599, IC-39381, IC-39350, IC-39363, Tindivanam local, IC-325774, IC-39272, IC-370474, IC-103059-1, IC-103993, IC-103243, IC-39343, IC-325853-1, IC-39290-1, IC-39270, IC-39309, IC-103224, IC-52059, IC-52077-1, IC-39292, IC-52076, IC-103245, IC-39403, IC-103868, IC-329057, IC-39294, IC-103880, IC-39322, IC-39465, IC-103059, IC-39369, IC-370733, IC-39375, IC-39325, IC-52053, IC-311409, IC-325791-1, IC-103316, IC-324012, IC-311437, IC-102914, IC-325782, IC-8888, IC-39302-1, IC-103830, AKM 4, IC-5190, IC-488722, IC-325810, IC-103821, IC-39550, IC-103154, IC-39275-1, IC-103219, IC-103184, IC-8593, IC-39319, IC-325791, IC-285168, IC-102963, IC-39444, IC-39491, IC-39500, Sivagangai kattupayiru, IC-39436, IC-103245-1, IC-39474, IC-52078, IC-311397, IC-373426, IC-39411, ML 5, IC-39524, IC-39350-1, IC-39340, IC-39373, IC-39308, IC-52069
Tolerant	11-20% pod damage	5	78	IC-39454, IC-39296, IC-39459, IC-39392-1,IC-39298, Kattumannarkudi local, IC-39295-1, Aandipatti kattupayiru, IC-39271, Vandhavasi local, AKM 0503, PDM 11, IC-39405, Utkarsh, IC-52077, BM-2002-1, IC-39280, IC-103181, IPM-02-14, VBN 2, IC-39324, ADT 2, IC-102864, Pusa vishal, IC-39272-1, IC-39384, IC-103190, IC-329039, IC-39383, IC-325788, IC-285165, IC-33537, CO 4, IC-311418, IC-39430, Bhuvanagiri local, IC-311426-1, IC-39355, IC-39330, IC-39583, IC-258102, IC-39378, IC-39288, CO 7, IC-39432, IC-52049, IC-39356, IC-39315, IC-39380, AKM 8803, IC-39505, Vaibav, IC-39333, IC-9121, IC-39423, IC-39311, ADT 3, IC-

Category of resistance	Per cent pod damage	Score	No. of genotypes	Name of the genotypes
				39385-1, IC-39365, IC-16563, TAP 7, IC-39329, VBN 5, IC-39327, IC-39511, IC-39273, AKM 1502, IC-39314, IC-39530, VBN 3, IC-102857, IC-39471, IC-39448, VBN 7, IC-39295, IC-325817, IC-39563, CO 8
Moderately susceptible	21-40% pod damage	7	63	IC-285165-1, IC-285161-1, IC-39393, IC-39445, IC-52074-1, IC-311419, IC-39392, IC-39358, IC-39298-1, IC-39275, Paiyur 1, IPM-99-125, IC-39332, IC-103017, IC-39287, IC-52080, IC-39316, IC-311420, IC-103204, TARM-2, IC-39425, Sengalmedu local, IC-39301, IC-311446, IC-52066, IC-103861, IC-39281, IC-39574, IC-39385, IC-39328, IC-52079, IC-39414, IC-39302, IC-39357, Melanakudi local, IC-52060, IC-39382, IC-39342, IC-311418-1, IC-39404, IC-305292, IC-39341, IC-39299, IC-39482, IC-39291, IC-102821, IC-39606, IC-311426, IC-324021, IC-39438, IC-103986, IC-39495, IC-39496, IC-103975, Madurantakam local, IC-39412, IC-39395, IC-39279, IC-102821-1, IC-103981-1,IC-39508, IC-325933, IC-420310
Highly susceptible	>40% pod damage	9	7	IC-39320, IC-39321, IC-103862, IC-7856, IC-415117, IC-103981, IC-39317

3. RESULTS AND DISCUSSION

A substantial difference in resistance reaction to spotted pod borer was observed between the tested genotypes during *Rabi* 2020 and *Kharif* 2021 and the data on active webbing and larval incidence are presented in Fig. 1. In *Rabi* season, *M. vitrata* infestation started from 35 days after sowing and remained up to the end of the crop growth. The mean larval population was ranged from 0.00 to 4.29 and the number of active webbing is ranged from 0.00 to 3.74. The overall initial larval population (1.25) and active webbing (0.74) was minimum on 35 DAS and it reached its peak on 56 DAS. In *Kharif* season, the *M. vitrata* population was observed from 42 DAS, one week later than *Rabi.* The mean larval population and active webbing ranged from 0.00 to 3.19 and 0.00 to 2.48 respectively. The overall initial larval population (0.75) and active webbing (0.40) was minimum and it reached its peak level by 56 DAS. In both the seasons, the population attained its peak on 56 DAS synchronizing with peak flowering and pod forming stage. Thereafter, the larval population declined because of the pod maturation and the pest population was passing from sight at the time of final harvest. These results are in line with the reports of Sravani et al. [7] in mungbean and Sampathkumar and Durairaj [8] in pigeonpea. Both of them reported that, the larval population reached its peak during flowering stage and declined afterwards coinciding with physiological maturity. The larva preferred to feed on unopened flower buds rather than opened flowers. It may due to the fact that the larva prefers concealed or hidden environment. They consumed more flower buds and flowers than pods, possibly due to the delicate and soft tissues that allow larva to easily make webs and consume the flowers.

Though larva prefers flower buds and flowers than pods, data based on pod damage could only be recorded because the larva webs the flower buds and flowers, making it impossible to record flower bud or flower damage.

Among the 333 greengram genotypes screened under field condition, the lowest mean larval population, active webbing and per cent pod damage was observed on IC-39301-1 followed by IC-311451 in *Rabi* season and IC-39301-1 followed by IC-103207 in *Kharif* season. Both *Rabi* and *Kharif* season, the mean larval population, active webbing and per cent pod damage was the highest on IC-39317 followed by IC-103981. This finding is accordance with the findings of Soundararajan and Chitra [9], among the 44 genotypes screened during *Rabi* and *Kharif* season, the minimum larval population was observed on 7 genotypes during Rabi season and 5 genotypes during *Kharif* season. The maximum population occurred on the check entry ML-5 during both *Rabi* and *Kharif* seasons. They also reported that, the *M. vitrata* incidence was the maximum during *Kharif* than *Rabi* season. But, in our study, the *M. vitrata* was the maximum during *Rabi* than *Kharif* season. In most of the case, the genotype which recorded lower larval population also recorded lowest pod damage. But in some cases, though the larval population was present in the plant for one or two weeks the pod damage did not occur. This may due to the larva eats on flowers will shed off and new flowers may produce or else the pods are not preferred by the larva due to pod thickness or some other host plant resistance mechanism.

Both *Rabi* and *Kharif* season, based on per cent pod damage, the 333 screened genotypes were categorized into five groups as depicted in Table 2 and Table 3. Of these, 4 and 10 genotypes were resistant, 182 and 175 were moderately resistant, 70 and 78 were tolerant, 56 and 63 were moderately susceptible and 21 and 7 were highly susceptible in *Rabi* and *Kharif* respectively. Similarly, Chhabra et al. [10] observed seven greengram cultivars showing resistance to pod borer complex, while Pandey and Mishra [11] observed 5 mungbean crosses showing moderate resistance to pod borer complex. In contrast, Sandhya Rani et al. [12] reported 21 genotypes as moderately susceptible and 13 genotypes as highly susceptible to *M. vitrata.* Halder et al. [13] reported that the genotype LGG 497 to be highly tolerant to *M. vitrata.* Though some varieties grouped under resistant category during *Kharif* season, did not fall under the same category in *Rabi* season. Due to heavy thrips infestation during *Kharif* season, the crop suffered heavy flower shedding and also failed to produce healthy pods. This may be the reason for such variation in resistance between the seasons.

4. CONCLUSION

From the above, it is concluded that the greengram genotypes recording low level of pod damage may be selected for further field evaluation at different locations and upon confirmation, these promising genotypes may be used in future breeding programmes.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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