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Evaluation of Sesame Genotypes for Field Resistance Against *Antigastra catalaunalis*, *Macrophomina phaseolina* and Phyllody

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Abstract: One hundred three genotypes of sesame (*Sesamum indicum* L.) representing varied geographic and genetic diversity were tested against major insect pests and diseases. None of the evaluated genotypes were found to be free from infestation by leaf webber and capsule borer, (*Antigastra catalaunalis)*. The average plant, flower and capsule damage varied from zero to 50%, 6.85% to 57.14% and 4.23% to 88.89%, respectively. Three genotypes *viz*., S-0292, IC-131943 and S-0301 were found moderately resistant to *A. catalaunalis* at all the three stages (vegetative, flower and capsule stages). Among the 103 genotypes evaluated for *Macrophomina* stem & root rot and phyllody disease, 11 genotypes namely S-0644, KMR-53, IS-1672, NIC-16256, IS-245, TC-30, IC-131943, EC-334974, NIC-7935, GRT-8245, and NIC-8439-B showed excellent performance with less disease incidence.

Key words: *Sesamum indicum, Antigastra catalaunalis, Macrophomina* stem and root rot, Phyllody.

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Sesame, *Sesamum indicum L*. is one of the oilseed crops widely grown in Asia for its high quality nutritional seeds. During 2020-21, area under sesame was 1.625 Mha with a total production of 0.812 Mt and an average productivity of 500 kg ha^{-1}. Madhya Pradesh, Uttar Pradesh, Rajasthan and West Bengal together contributed 78% of the total sesame area in the country (Anonymous, 2021). The yield potential of this crop has not been fully realized due to biotic factors (Egonyu *et al*., 2005; Guzmán *et al*., 2022). The crop is host of 29 species of insect pests (Rai, 1976), of which the sesame leaf webber and capsule borer *Antigastra catalaunalis* are the major one which can damage the crop at different stages of plant growth. It causes yield losses in the range of 10-90% in different agro-climatic regions of India (Ahuja and Bakhetia,1995; Saxena and Jakhmola, 1993; Wazire and Patel, 2016). Sesame cultivation is also severely affected by *Macrophomina* stem and root rot (MSRR) and phyllody. MSRR is a serious fungal disease caused by *Macrophomina phaseolina*, which results in stem and root rot, ultimately leading to plant death (Abawi and Corrales, 1990). Phyllody, on the other hand, is a phytoplasmal disease, which results in the abnormal development of floral organs, leading to flower deformation and sterility. These major diseases of sesame are reported to cause a considerable yield loss in the world. Vyas (1981) reported *M. phaseolina* as a very destructive pathogen in all the sesame growing areas which causes 5-100% yield loss while Maiti *et al.* (1988), Usha Rani *et al*. (2009) and Chattopadhyay *et al*. (2002) estimated yield loss of 42-57%. In India, the incidence of sesame phyllody disease reaches from 10 to 100% in some croplands (Nagaraju *et al*., 2005). Akhtar *et al*. (2013) and Salehi *et al*. (2017) reported that sesame phyllody has been a destructive disease and may cause 80% seed yield loss.

Chemical pesticides play a major role for the management of insect pests and diseases but their widespread and indiscriminate use has resulted in a number of issues, including the killing of the beneficial insects, environmental pollution, human & animal health problems and development of resistance in pests (Pedigo and Rice, 2006; Stevens *et al*., 2012; Hirooka and Ishii, 2013; Nderitu *et al*., 2020). To meet these challenges, it is necessary to move towards more sustainable and modern agricultural practices. Moreover, these detrimental non-target effects have motivated researchers around the world to develop novel and environment-friendly, alternative insect pest and disease management strategies. Host plant resistance can form the backbone of such pest and disease management strategies in different agro-ecosystems (Sharma, 2007; Horgan *et al*., 2020; El-Dessouki*et et al*., 2022; Jeger *et al*., 2021). It is the consequences of heritable plant characteristics that make a plant more tolerant than the one lacking these qualities. The present study was therefore planned to identify the tolerant or less susceptible genotypes against major insect pests and diseases in sesame.

Materials and Methods

A field experiment was conducted to evaluate 103 genotypes of sesame which were obtained from Project Coordinating Unit, AICRP on sesame, Jabalpur along with a susceptible check (TC 25) and a resistant check (SI 250) to know their relative resistance/ susceptibility against major insect pests and diseases. The experiment was carried out at Agricultural Research Station, Mandor during kharif 2021. Each genotype was sown in 5 m row length with spacing of 30 cm between rows and 10 cm between plants in augmented block design with three replications. Different genotypes were sown in the first fortnight of July with recommended agronomic practices. Five plants of each genotype were selected randomly and tagged and observations were recorded at vegetative, flowering and capsule stages by counting the number of damaged and total number of plants, flowers and capsules per plants.

$$\text{Per cent leaf/flower/capsule damage} = \frac{\text{Number of infested leaf/flower/capsule}}{\text{Total number of leaf/flower/capsule}} \times 100$$

The plants were observed for *Macrophomina* stem & root rot and phyllody symptoms. The incidence of *Macrophomina* stem & root rot and phyllody was recorded by counting the infected plants in 5 m row and based on infected and total number of plants, per cent disease incidence (PDI) was calculated using the formula:

$$\text{Percent Disease Incidence} = \frac{\text{Number of plants infected}}{\text{Total number of plants}} \times 100$$

Range of damage per cent of each reaction was recorded according to AICRP on Sesame and Niger (Anonymous, 2014) presented in Table 1.

Results and Discussion

Results showed that in some cases plants were more predisposed and in others flower or capsule were more prone to damage but none of the genotype was immune to the attack of *A. catalaunalis* during the growth cycle. The plant infestation varied from zero

Table 1. Resistant or Susceptibility rating scale on the basis of overall damage at different stages of plant growth

S. No.	Per cent plant and flower infestation	Category	S. No.	Per cent capsule damage	Category
1	< 10	Resistant	1	<5	Resistant
2	10-20	Moderately resistant	2	5-10	Moderately resistant
3	21-30	Moderately susceptible	3	11-15	Moderately susceptible
4	31-50	Susceptible	4	16-25	Susceptible
5	>50	Highly susceptible	5	>25	Highly susceptible

(in 29 genotypes) to 50% (in five genotypes). Flower damage by *A. catalaunalis* varied from 6.85% (NIC-8473) to 57.14% (NIC 8164) while the capsule damaged varied from 4.23% (B-240) to 88.89% (N-66-39) (Table 2). Among the 103 genotypes, 14 genotypes showed < 10% infestation and categorized as "resistant", 49 genotypes showed 10-20% infestation and categorized as "moderately resistant", 24 genotypes showed 21-30% infestation and categorized as "moderately susceptible", 15 genotypes showed 31-50% infestation and categorized as "susceptible" and 1 genotype showed >50% infestation and categorized as "highly susceptible" at flowering stage while at capsule stage, 2 genotypes showed <5% infestation and categorized as "resistant", 19 genotypes showed 5-10% infestation and categorized as "moderately resistant", 33 genotypes showed 11-15% infestation and categorized as "moderately susceptible", 35 genotypes showed 16-25% infestation and categorized as "susceptible" and 14 genotypes showed >25% infestation and categorized as "highly susceptible" (Table 3). Three genotypes *viz*., S-0292, IC-131943 and S-0301 were found moderately resistant to *A. catalaunalis* at all the three stages (vegetative, flower and capsule stages). The per cent plant, flower and capsule damage of S-0292 genotype were 20.00, 16.67 and 10.34, respectively while the plant, flower and capsule damage of IC-131943 and S-0301 genotypes were 18.75, 12.50 and 6.25 and 16.67, 11.94 and 10.59, respectively (Table 2). Similar studies were conducted by Baskaran *et al*. (1994); Ahuja and Kalyan (2001); Manisegaran *et al*. (2001) and Singh (2002) they reported that the genotypes KMR-14 and TKG-22 were moderately resistant to *A. catalaunalis.* Similarly, Pandey *et al*., 2020 reported that Krishna, RT-46, JTS-8, TKG-22, RT-103, Usha, Hima, RT-54, MT-75, N-32, TKG-21, HTC-1B and OC-201 were moderately resistant against *A. catalaunalis*. The tolerant or resistant genotypes to *Antigastra* can be used in transferring the resistance in to the commercially acceptable varieties. Even partially resistant cultivars may also provide adequate control even with minimum usage of insecticides. It will also help to prolong the commercial life of existing insecticides by discouraging the development of insecticides resistance strains of the insect pest.

The evaluation of sesame genotypes for resistance against major diseases such as *Macrophomina* stem and root rot and phyllody is important for identifying promising genotypes for further cultivation (Foolad *et al*., 2000). In this study, it was found that the incidence of *Macrophomina* stem and root rot ranged from zero to 37.50% and phyllody from zero to 4.68% varying from genotype to genotype. The genotype EC-303304 had the maximum root rot disease incidence, while the genotype NIC-17452 had the highest phyllody incidence. It is important to note that some genotypes did not exhibit any incidence of either disease, but still had poor growth or less capsule development, leading to low yields. This highlights the need for evaluating multiple traits in addition to disease resistance when selecting genotypes for cultivation. However, there were some genotypes that performed well in terms of seed yield and low disease incidence percent. Among the 103 genotypes evaluated, 11 genotypes (S-0644, KMR-53, IS-1672, NIC-16256, IS-245, TC-30, IC-131943, EC-334974, NIC-7935, GRT-8245, and NIC-8439-B) showed excellent performance with less disease incidence. Ezhilarasi and Meena (2019) while evaluating 24 breeding lines for *Macrophomonia* root rot resistance found that only two breeding lines, VS 16 004 and VS 16 008, recorded less disease incidence. Similarly, Choudhary *et al*. (2014) screened 27 entries against stem and root rot and identified only three entries, viz., IC-205477, IC-205506 and Krishna, as resistant. Magar *et al*. (2022) conducted an experiment to evaluate 32 varieties of sesame for resistance to phyllody disease under natural field conditions and found that TBS-05, TBS-09, TBS-02, Shweta, KMR-69, TKG-22, and Pragati varieties were resistant. Manjeet *et al*. (2020) evaluated 24 sesame genotypes against phyllody and root rot disease and reported that only four genotypes, namely JLS 110-12, HT 9913, T 78, and KMR 60, possessed multiple disease resistance with zero to 8.80% disease incidence. Mahadevaprasad *et al*. (2017) evaluated 43 sesame lines against phyllody disease under field conditions and found that three genotypes, viz., KAU-05-2-12, PC-14-2, and Kanakapura local, showed a resistant reaction. Palanna *et al*. (2015) reported that GT-1 and DS-9 were resistant to phyllody. Dandnaik *et al*. (2002); Singh *et al*. (2007); and Tan (2010) also reported about the resistance sources against phyllody of sesame. Based

Table 2. Evaluation of sesame genotypes for field resistance against major insect pest, Antigastra catalaunalis and diseases of sesame

S. No.	Name of entry	*Antigastra* infestation			Percent disease incidence	
		Per cent plant infestation	Per cent flower damage	Per cent capsule damage	*Macrophomina* stem & root rot	Phyllody
1	S-0644	32.00	19.23	8.60	0.00	1.33
2	75-120	33.33	27.66	14.77	0.00	0.00
3	KMR-53	33.33	21.74	12.33	0.00	0.00
4	IS-1672	21.43	16.28	11.25	0.00	0.00
5	SI-3274	33.33	13.56	12.94	0.00	1.00
6	EC-303304	0.00	11.76	4.35	37.50	0.00
7	IS-3051	0.00	15.69	6.02	25.16	0.00
8	IC-204200	0.00	18.97	5.80	25.25	0.00
9	S-0314	33.33	23.73	17.86	2.56	0.00
10	NIC-16256	28.57	30.77	21.79	0.00	0.00
11	IS-722-I	30.00	17.86	20.55	0.00	2.25
12	IS-265-B	26.67	33.33	12.50	2.50	1.33
13	NIC-17452	21.43	20.83	21.69	17.54	4.68
14	NAL/78/3041431/2	25.00	32.20	17.98	5.25	0.00
15	S-0292	20.00	16.67	10.34	5.16	0.00
16	NIC-8463	0.00	10.71	10.26	2.50	0.00
17	IS-245	28.57	26.15	21.18	0.00	0.00
18	KMR-49	18.75	18.37	12.35	5.16	0.00
19	EC-52-1-84	26.67	31.37	18.67	2.57	0.00
20	TC-30	0.00	35.29	15.63	0.00	0.00
21	SI-1004-B	0.00	33.33	11.11	0.00	0.00
22	S-0271	0.00	50.00	5.88	0.00	0.00
23	NIC-8473	0.00	6.85	9.76	0.00	0.00
24	EC-334974	0.00	14.12	26.92	0.00	0.00
25	IC-131943	18.75	12.50	6.25	0.00	0.00
26	S-0351	36.67	34.78	17.95	0.00	0.00
27	S-0301	16.67	11.94	10.59	0.00	0.00
28	KIS-306	0.00	14.89	11.29	0.00	0.00
29	EC-334976	25.00	16.67	23.19	0.00	0.00
30	NIC-16248	23.08	17.20	12.33	0.00	0.00
31	ES-47	0.00	9.38	7.59	25.11	0.00
32	NIC-8164	33.33	57.14	28.89	0.00	0.00
33	NIC-17930	50.00	27.27	12.90	0.00	1.11
34	K-2	23.53	32.14	20.51	5.00	0.00
35	IS-112-B	0.00	25.00	10.29	0.00	0.00
36	KIS-380	17.65	14.52	12.31	0.00	0.00
37	IS-646-2-84	16.67	18.18	13.04	0.00	0.00
38	IS-127	20.00	13.46	12.68	0.00	0.00
39	B-240	0.00	10.00	4.23	5.23	0.00
40	IS-191	20.00	12.90	14.29	15.15	0.00
41	IS-101-3-A	0.00	21.88	13.11	0.00	0.00
42	N-62-32	0.00	13.64	8.62	0.00	0.00
43	SI-958-23	21.43	20.00	13.33	0.00	0.00
44	GRT-8623	0.00	12.28	10.14	0.00	0.00
45	N-66-39	0.00	32.00	88.89	0.00	0.00
46	JT-66-177	21.43	17.19	21.88	0.00	0.00
47	EC-303433-I	25.00	39.39	25.86	0.00	0.00
48	NSS	25.00	15.15	12.68	0.00	3.32
49	NIC-16219-A	21.43	17.19	18.75	2.55	2.46
50	03-Oct	23.08	17.46	9.88	0.00	0.00
51	RJS-82-A	0.00	10.61	11.25	5.00	0.00
52	NIC-8439-A	35.00	18.31	17.28	2.55	1.24

Table 2. Continued ...

S. No.	Name of entry	*Antigastra* infestation			Percent disease incidence	
		Per cent plant infestation	Per cent flower damage	Per cent capsule damage	*Macrophomina* stem & root rot	Phyllody
53	S-0445	33.33	19.44	21.25	0.00	0.00
54	S-0392	27.27	14.29	14.81	0.00	0.00
55	SI-2630-A	30.00	18.42	23.61	2.55	0.00
56	S-0636	0.00	10.00	11.67	33.34	0.00
57	NIC-6292	0.00	14.29	21.05	2.53	0.00
58	EC-834983-A	25.00	18.52	14.71	0.00	0.00
59	IS-723-B	30.77	20.51	24.19	2.53	0.00
60	KMR-32-A	0.00	7.69	11.11	0.00	2.93
61	NIC-16439	30.00	14.93	12.66	0.00	0.00
62	IS-16-A	50.00	27.91	25.81	0.00	0.00
63	S-0268	30.00	16.67	17.46	0.00	0.00
64	IC-423	0.00	13.46	9.33	0.00	0.00
65	NIC-8558-B	40.00	24.07	19.48	0.00	4.52
66	S-0232	27.27	26.92	25.45	0.00	0.00
67	IS-56-A	25.00	17.46	16.22	0.00	0.00
68	NIC-16278-A	25.00	30.43	15.63	0.00	0.00
69	KMR-7	50.00	33.33	42.86	0.00	0.00
70	ES-36-B	0.00	33.33	62.50	0.00	0.00
71	IS-129	25.00	18.00	9.86	0.00	0.00
72	KMR-30-B	36.36	27.78	32.69	0.00	0.00
73	SI-1865-1-A	0.00	14.52	13.04	2.53	0.00
74	RJS-350	25.00	25.00	20.63	0.00	0.00
75	KMR-80	30.00	22.22	12.31	0.00	0.00
76	RJS-8301	33.33	26.92	19.64	5.10	0.00
77	NIC-161-90-B	23.08	18.52	11.11	2.53	0.00
78	RJS-8315	27.27	16.39	18.03	0.00	0.00
79	NIC-11044	33.33	25.00	24.56	14.30	0.00
80	NIC-17362	21.43	15.15	17.24	7.56	0.00
81	NIC-16289	30.77	25.93	33.33	6.00	0.00
82	NIC-16241	30.00	14.00	12.24	0.00	0.00
83	RJS-34	36.36	24.59	27.45	0.00	0.00
84	NIC-8439-B	33.33	33.96	24.59	0.00	0.00
85	SI-8008-A	27.27	22.45	17.54	0.00	0.00
86	SI-1847	0.00	7.69	17.31	0.00	0.00
87	EC-334983-B	0.00	0.00	12.73	0.00	0.00
88	IS-723-A	0.00	0.00	19.23	0.00	0.00
89	KMR-32-B	0.00	0.00	15.38	0.00	0.00
90	KMR-4-259-A	0.00	0.00	21.15	0.00	0.00
91	KMS-423	0.00	0.00	11.86	0.00	0.00
92	NIC-8538-A	33.33	23.53	22.22	0.00	0.00
93	IS-56-B	0.00	8.22	8.00	0.00	1.88
94	KMR-30-A	0.00	12.50	12.50	0.00	1.72
95	IS-731	20.00	22.39	11.43	0.00	0.00
96	IS-3197-A	30.77	20.29	26.03	0.00	0.00
97	S-0242	50.00	22.73	27.78	0.00	0.00
98	BM-59	50.00	40.00	40.91	0.00	0.00
99	GRT-8245	33.33	15.52	16.07	0.00	0.00
100	NIC-7935	0.00	0.00	41.67	0.00	0.00
101	SI-7871-B	21.43	17.54	15.09	0.00	0.00
102	IS-294	0.00	10.87	8.70	33.32	0.00
103	VCR/81/No/80/NS/972	21.43	8.06	14.00	0.00	0.00
104	TC-25 (Susceptible Check)	37.50	41.94	32.93	-	-
105	SI-250 (Resistant Check)	5.00	6.32	8.40	-	-

Table3. Categorization of genotypes on the basis of their reaction against Antigastra catalaunalis in sesame

S. No.	Reaction	Based on per cent plant damage		Based on per cent flower damage		Based on per cent capsule damage	
		No. of genotypes	Genotypes	No. of genotypes	Genotypes	No. of genotypes	Genotypes
1	Resistant	34	EC-303304, IS-3051, IC-204200, NIC-8463,TC-30, SI-1004-B, S-0271, NIC-8473, EC-334974, KIS-306,ES-47, IS-112-B, B-240, IS-101-3-A, N-62-32, GRT-8623, N-66-39, RJS-82-A, S-0636, NIC-6292, KMR-32-A, IC-423, ES-36-B, SI-1865 – A, SI-1847, EC-334983-B, IS-723-A, KMR-32-B, KMR-4-259-A, KMS-423, IS-56-B, KMR-30-A, NIC-7935, IS-294	14	NIC-8473, ES-47, B-240, S-0636, KMR-32-A, EC-334983-B, SI-1847, IS-723-A, KMR-32-B, KMR-4-259-A, KMS-423, IS-56-B, NIC-7935,VCR/81/No/80/NS/972	2	EC-303304, B-240
2	Moderately resistant	9	S-0292, KMR-49, IC-131943, S-0301, KIS-380, IS-646-2-84, IS-127, IS-191, IS-731	49	S-0644, IS-1672, SI-3274,EC-303304, IS-3051, IC-204200, IS-722-1, S-0292, NIC-8463, KMR-49, EC-334974, IC-131943, S-0301, KIS-306, EC-334976, NIC-16248, KIS-380, IS-646-2-84,IS-127, IS-191, N-62-32, SI-958-23, GRT-8623,JT-66-177, NSS, NIC-16219-A, 03-Oct, RJS-82-A,NIC-8439-A, S-0445, S-0392, SI-2630-A, NIC-6292, EC-834983-A, NIC-16439, S-0268,IC-423, IS-56-A, IS-129, SI-1865-1-A, NIC-161-90-B, RJS-8315, NIC-17362, NIC-16241, KMR-30-A, IS-3197-A, GRT-8245, SI-9871-B, IS-294	19	S-0644, IS-3051, IC-204200, S-0292, NIC-8463, S-0271, NIC-8473, IC-131943, S-0301, ES-47, IS-112-B, N-62-32, GRT-8623, 03-Oct, KMR-32-A, IC-423, IS-129, IS-56-B, IS-294
3	Moderately susceptible	35	IS-1672, NIC-16256, IS-722-1, IS-265-B, NIC-17452, NAL/78/3041431/2, IS-245, EC-52-1-84, EC-334976, NIC-16248, K-2, SI-958-23, JT-66-177, EC-303433-I, NSS, NIC-16219-A, 03-Oct, S-02392, SI-2630-A, EC-834983-A, NIC-16439, S-0268, S-0232, IS-56-A, NIC-16278-A, IS-129, RJS-350, KMR-80, NIC-161-90-B, RJS-8315, NIC-17362, NIC-16241,SI-8008-A, SI-7871-B, VCR/81/No/80/NS/972	24	75-120, KMR-53, S-0314, NIC-17452, IS-245, NIC-17930, IS-112-B, IS-101-3-A, IS-723-B, IS-16-A, NIC-8558-B, S-0232, NIC-16278-A, KMR-30-B, RJS-350, KMR-80,RJS-8301 NIC-11044, NIC-16289, RJS-34, SI-8008-A, NIC-8538-A, IS-731, S-0242,	33	75-120, KMR-53, IS-1672, SI-3274, IS-265-B, KMR-49, SI-1004-B, KIS-306, NIC-16248, NIC-17930, KIS-380, IS-646-2-84, IS-127, IS-191, IS-101-3-A, SI-958-23, NSS, RJS-82-A, S-0392, S-0636, EC-834983-A, NIC-16439, SI-1865-1-A, KMR-80, NIC-161-90-B, NIC-16241, EC-334983-B, KMR-32-B, KMS-423, KMR-30-A, IS-731, SI-7871-B, VCR/81/No/80/NS/972
4	Susceptible	24	S-0644, 75-120, KMR-53, SI-3274, S-0314, S-0351, NIC-8164, NIC-8439-A, S-0445, IS-723-B, IS-16-A, NIC-8558-B, KMR-7, KMR-30-B, RJS-8301, NIC-11044, NIC-16289, RJS-34, NIC-8439-B, NIC-8538-A, IS-3197-A, S-0242, BM-59, GRT-8245,	15	NIC-16256, IS-265-B,NAL/78/3041431/2, EC-52-1-84, TC-30, SI-1004-B, S-0271, S-0351, K-2, N-66-39, EC-303433-I, KMR-7, ES-36-B, NIC-8439-B, BM-59	35	S-0314, NIC-16256, IS-722-I, NIC-17452, NAL/78/3041431/2, IS-245, EC-52-1-84, TC-30, S-0351, EC-334976, K-2, JT-66-177, NIC-16219-A, NIC-8439-A, S-0445, SI-2630-A, NIC-6292, IS-723-B, S-0268, NIC-8558-B, S-0232, IS-56-A, NIC-16278-A, RJS-350, RJS-8301, RJS-8315, NIC-11044, NIC-17362, NIC-8439-B, SI-8008-A, SI-1847,IS-723-A, KMR-4-259-A, NIC-8538-A, GRT-8245,
5	Highly susceptible	1	NIC-17930	1	NIC-8164	14	EC-334976, NIC-8164, N-66-39, EC-303433-I, IS-16-A, KMR-7, ES-36-B, KMR-30-B, NIC-16289, RJS-34, IS-3197-A, S-0242, BM-59, NIC-7935

on the research findings, resistant genotypes are recommended for further evaluation and potential cultivation. However, it is essential to evaluate multiple traits, including disease resistance and yield, before selecting the best genotypes for cultivation.

Conclusion

Among the tested genotypes, none of the genotype was found to be free from infestation of leaf webber and capsule borer, *A. catalaunalis* but three genotypes viz., S-0292, IC-131943 and S-0301 were found moderately resistant. Eleven genotypes *viz*., S-0644, KMR-53, IS-1672, NIC-16256, IS-245, TC-30, IC-131943, EC-334974, NIC-7935, GRT-8245, and NIC-8439-B showed excellent performance with lower incidence of *Macrophomina* stem & root rot and phyllody diseases.

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