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EVALUATION OF SESAME (*SESAMUM INDICUM* L.) GENOTYPES FOR CHARCOAL ROT (*MACROPHOMINA PHASEOLINA*) RESISTANCE

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ABSTRACT

Charcoal Rot (CR) caused by *Macrophomina Phaseolina* has adverse effect on sesame crop in Pakistan. Use of host plant resistance is the cheapest and effective disease management strategy. In this research 52 local sesame genotypes were used to evaluate resistance against Charcoal rot disease in two consecutive summer seasons i.e. 2017 and 2018, in a sick field under natural conditions. The results showed that there was notable difference in disease infection percentage (DI%) of the varieties tested in two years. Furthermore, the results indicated that DI% for genotypes tested in 2017 ranged from 06.97% to 50.82%, whereas, DI% for genotypes tested in 2018 remained between 4.91% and 52.63%. In both seasons only 3 sesame lines L-7, ML-6-8/12 and L-100 were classified as a resistant (R) and they exhibited lower means of DI% 8.21 %, 7.84 %, 6.97% andDI% 8.19, 6.15, 4.91 during 2017 and 2018 respectively. On the other hand, 12 lines name Black Til, TH-6, No-7/12, ML-6-8-12, Cluster, 70004, L-41, 20011, 50022, L-24, No-6/12, and TS-3were classified as a moderately resistant (MR).Twenty three lines were grouped into moderately susceptible (MS)class and the susceptible (S) group contains 8 genotypes 95006-2, 97005, 97001, 97002, 92001-52-9, 96008, 16003 and Shan in both seasons but three lines such as 93003, 93005-3-4, and No-56 were moderately resistant MR in first season and moderately susceptible in second season. Similarly the genotypes 9600-4-1 and Agara were moderately susceptible (MS) in first season and susceptible (S) in second season. Line N-10 was highly susceptible to CR with maximum DI% 50.8 and 52.63 in both seasons.

Keywords: Sesame, Charcoal Rot, Resistance, Genotypes, Evaluation.

INTRODUCTION

Seasame (*Sesamum indicum* L.) is considered "queen of oilseeds" as its oil has high nutritional and therapeutic value (Biswas *et al.*, 2018). Sesame oil is very stable having a sweet flavor. Its meal is rich in protein makes it suitable for domestic and confectionary purpose. Due to its property of having potent antioxidant and high nutritive value sesame seed is regarded as "Seed of immortality"(Hansen, 2011).Sesame is innately a low-yield plant and its yield is further reduced by presence of different biotic and abiotic stresses. Sesame plants are severely affected by numerous pathogens that cause loss of about 7 million tons of yield per annum (Ara *et al.*, 2017). Charcoal Rot is the most important disease of sesame, caused by *Macrophmina Phaseolina* (Tassi) Goid .This is a soil borne fungus which can result into a severe yield loss of 5-100% (Meena *et al.*, 2018. According to a recent survey, total loss caused due to infection by *M. Phaseolina* amounts to 57% of total yield (Bashir *et al.*, 2017). First, it causes infection in roots and lower stem of seedling and damps them. However, at a more advanced stage it can also cause infection in developed plants until the stage of maturity. It develops Charcoal Rot symptoms on major part or the whole plant during hot and dry conditions in particular and thus reduce the plant growth and productivity (Shabana *et al.*, 2014). The fungus reportedly survives as sclerotia formed in crop residues and soil. Moreover, it has also appeared as seed-borne pathogen and such characteristics make it hard to control it (Bedawy and Moharm, 2019). However, certain agricultural practices such as soil

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solarization and use of systematic fungicides were recommended in the past to reduce its effects (Mahdy *et al*., 2005).

Application of fungicides for the management of disease can results in toxification of crop which is not safe for human consumption and also increase the input cost. It can leave harmful effects on environment as well. Moreover, it badly affects exports of the crop item to other countries. Due to these reasons there are various studies conducted on CR disease which discusses various biological methods that can effectively control the disease i.e. using bio agents such as bacteria and fungi (Abdul Sattar *et al.,* 2006), plant extracts by seed soaking (Ahmed *et al*., 2010), and cultivating resistant varieties (Thiyagu *et al*., 2007). Among all these, host plant resistance remains the best strategy for disease control. Therefore, selection of resistant genotypes is vital for controlling CR and reducing yield loss (Mahdy *et al*., 2005; Bedawy and Moharm, 2019; El-Bramawy and Abdul Wahid, 2006), however, this approach takes time. Viewing all the facts. This research was planned out to study the responses of sesame genotypes under artificial soil infestation with *M. Phaseolina* to check the resistance against CR through characterizing new sesame lines and enhancing yield. Although, host plant resistance is considered to be the most dependable and permanent disease management strategy, very little knowledge is available about gene sources and the level of tolerance they have.

MATERIALS AND METHODS

The experimental material for evaluation of resistance against charcoal rot consisted of fifty two genotypes from germplasm resource of Oilseeds Research Institute Faisalabad. These genotypes comprised of germplasm accessions, improved varieties, advanced breeding lines and a susceptible check. Field trials were successfully conducted during summers of 2017 and 2018 at Oilseeds Research Institute, Ayub Agricultural Research Institute Faisalabad, Pakistan. Each genotype was sown in two rows of 3m length that had inter-row spacing of 45 cm and each year the genotypes were sown on June 15. Recommended practices were followed to raise the crop. Three rows of susceptible check were planted across the field for easy spread of disease inoculum (sick field). Disease effected plants were counted in three repeats for each genotype during growth periodtil maturity. Percentage of the CR disease was calculated according to Bedawy and Mohamed 2018 as follow:

$$\text{Disease infection (DI) \%} = \frac{\text{the number of infectedplants}}{\text{total number of plants in row}} \times 100$$

Genotypes under observation scored different levels of resistance in the following observation the disease rating scale explained by Bedawy and Mohamed 2018 (Table 1).

Table 1. The disease scale used for evaluation of disease resistance in sesame lines.

Infection %	Category
1 – 10	Resistant (R)
11 – 20	Moderately Resistant (MR)
21 – 30	Moderately Susceptible (MS)
31 – 50	Susceptible (S)
51 – 100	Highly Susceptible (HS)

RESULTS

Highly pathogenic isolate was used for infestation of sesame plants in field trails during2017 and 2018 to test the performance of sesame genotypes for resistance to CR disease. Results showed that DI% value varied from 06.97 % to 50.82 % in first season (Table 2). Result obtained in first season showed that three sesame lines L-7, ML-6-8/12 and L-100 were classified into resistant (R) group as they exhibited lower means of DI% 8.21 %,7.84 % and 6.97% respectively. On the other hand, 15 lines (Black Til, No. 56, TH-6, 93003, 96005-3-4, No-7/12, ML-6-8-12, Cluster, 70004, L-41, 20011, 50022, L-24, No-6/12, and TS-3) were moderately resistant (MR) with DI% of 11.39, 11.9, 12.31, 13.04, 13.79, 13.98, 14.12, 14.56, 15.06, 15.07, 15.93, 16.13, 16.36, 18.68 and 19.05 respectively. Moreover, from rest of tested genotypes25 lines (96018, L-3, 93001-1/97, 16005, 9600-4-1, L-66, 96016, 93002-3-4, 92002, 96004, 90001-63/98, 96005, 97006, 90004, Agara, 95009, 95006, 97007, 96002, L-101, No.57, 95010, Korea-1, EL-8/14 and 96006-1) showed moderately susceptible (MS) behavior to CR with DI% of 20.73, 21.05, 21.05, 21.33, 21.56, 21.73, 21.91, 22.00, 22.03, 22.22, 22.90, 23.07, 23.45, 23.53, 24.00, 24.32, 24.41, 24.59, 25.64, 25.93, 26.51, 26.83, 27.50, 28.21 and 29.31 respectively.

Table 2. Screening results of Sesame germplasm against Charcoal rot disease

Sr. No.	Name of entries	2017				2018				
		Total No. of plants	Plants affected by Charcoal rot disease	Disease (%)	Remarks	Name of entries	Total No. of plants	Plants affected by Charcoal rot disease	Disease (%)	Remarks
1.	L-100	43	3	6.97	R	L-7	61	3	4.91	R
2.	ML-6-8/12	51	4	7.84	R	ML-6-8/12	65	4	6.15	R
3.	L-7	73	6	8.21	R	L-100	61	5	8.19	R
4.	Black Till	79	9	11.39	MR	No-7/12	57	7	12.28	MR
5.	No.56	84	10	11.9	MR	TS-3	73	9	12.33	MR
6.	TH-6	65	8	12.31	MR	Black Till	47	6	12.77	MR
7.	93003	69	9	13.04	MR	No-6/12	39	5	12.82	MR
8.	96005-3-4	58	8	13.79	MR	70004	37	5	13.51	MR
9.	No-7/12	93	13	13.98	MR	50022	21	3	14.29	MR
10.	ML-6-8-12	85	12	14.12	MR	Cluster	68	11	16.18	MR
11.	Cluster	103	15	14.56	MR	ML-6-8-12	29	5	17.24	MR
12.	70004	73	11	15.06	MR	96016	32	6	18.75	MR
13.	L-41	73	11	15.07	MR	L-24	37	7	18.91	MR
14.	20011	113	18	15.93	MR	16005	41	8	19.51	MR
15.	50022	93	15	16.13	MR	L-66	51	10	19.60	MR
16.	L-24	55	9	16.36	MR	93003	62	14	22.58	MS
17.	No-6/12	91	17	18.68	MR	93002-3-4	44	10	22.72	MS
18.	TS-3	63	12	19.05	MR	93001-1/97	35	8	22.85	MS
19.	96018	82	17	20.73	MS	96005-3-4	65	15	23.08	MS
20.	L-3	76	16	21.05	MS	EL-8/14	43	10	23.26	MS
21.	93001-1/97	76	16	21.05	MS	No.56	47	11	23.4	MS
22.	16005	76	16	21.33	MS	L-41	59	14	23.73	MS
23.	4/1/9600	52	11	21.56	MS	90001-63/98	58	14	24.13	MS
24.	L-66	69	15	21.73	MS	TH-6	57	14	24.56	MS
25.	96016	74	16	21.91	MS	96005	32	8	25	MS
26.	93002-3-4	87	19	22.00	MS	97007	52	10	25	MS
27.	92002	59	13	22.03	MS	97006	28	7	25	MS
28.	96004	72	16	22.22	MS	92002	47	12	25.53	MS
29.	90001-63/98	61	14	22.90	MS	96004	35	9	25.71	MS
30.	96005	39	9	23.07	MS	95006	27	7	25.92	MS
31.	97006	81	19	23.45	MS	Korea-1	53	14	26.42	MS
32.	90004	51	12	23.53	MS	No.57	86	23	26.74	MS
33.	Agara	75	18	24.00	MS	L-3	63	17	26.98	MS
34.	95009	74	18	24.32	MS	L-101	63	17	26.98	MS
35.	95006	86	21	24.41	MS	95010	37	10	27.02	MS
36.	97007	61	15	24.59	MS	20011	65	18	27.69	MS
37.	96002	78	20	25.64	MS	96006-1	54	15	27.77	MS
38.	L-101	81	21	25.93	MS	95009	36	10	27.77	MS
39.	No.57	83	22	26.51	MS	97005	39	11	28.20	MS
40.	95010	72	19	26.83	MS	96018	35	10	28.57	MS
41.	Korea-1	40	11	27.5	MS	97002	31	09	29.03	MS
42.	EL-8/14	78	22	28.21	MS	97001	48	16	33.33	S
43.	96006-1	58	17	29.31	MS	4/1/9600	47	16	34.04	S
44.	95006-2	71	22	30.99	S	92001-52-9	47	16	34.04	S
45.	97005	89	28	31.46	S	90004	41	14	34.15	S
46.	97001	79	25	31.65	S	96002	51	18	35.29	S
47.	97002	78	25	32.05	S	95006-2	39	14	35.9	S
48.	92001-52-9	91	30	32.97	S	96008	64	23	35.93	S
49.	96008	59	20	33.89	S	Agara	53	20	37.74	S
50.	16003	58	20	34.48	S	16003	41	18	43.9	S
51.	Shan	59	21	35.59	S	Shan	39	19	48.72	S
52.	No-10	61	31	50.82	HS	No-10	57	30	52.63	HS

The susceptible group contains 8 genotypes (95006-2, 97005, 97001, 97002, 92001-52-9, 96008, 16003 and Shan) had DI% 30.99, 31.46, 31.65, 32.05, 32.97, 33.89, 34.48 and 35.59 respectively. Line N-10 was highly susceptible to CR with maximum DI% 50.82. DI% had a wide range of means and varied from 4.91 to 52.63% (Table 2). The Resistant group included 3 lines L-7, ML-6-8/18, and L-100were the same from first season group but change in line sequence number with change in DI% 4.91, 6.15 and 8.19 respectively. Generally, the DI% value of the second seasons showed that, 12, 26, 10 and 1genotypes were MR, MS, S and HS, respectively these are mostly the same genotypes as in first but change in line sequence number with change in DI%. In the second season trait of DI% showed the same trend as first season but in few genotypes such as 93003, 93005-3-4, and No-56 were moderately resistant MR in first season and moderately susceptible in second season similarly the genotypes 9600-4-1 and Agara were moderately susceptible MS in first season and susceptible in second season. Line N-10 was highly susceptible to CR with maximum DI% 52.63 in year 2018.

DISCUSSION

Charcoal rot is the most destructive among major pathological constraints to sesame production. The causal organism of charcoal rot (*Macrophomina phaseolina)* is one of the most harmful soil and seed borne pathogen in both agricultural and ecosystems (Farooq *et al*., 2019). This pathogen has over 500 different kinds of host whereas at least 67 hosts have been recorded from Pakistan (Javed *et al.,* 2015). Typical symptoms of charcoal rot include dark and irregular lesions on stem, lower part wilting, chlorosis, early defoliation and finally plant death (Abwai and Corrales, 1990). In current studies resistant group included 3 lines L-7, ML-6-8/18, and L-100. DI% value showed that, 15, 25, 8 and 1 were MR, MS, S and HS, respectively in first season and 12, 26, 10 and 1genotypeswere MR, MS, S and HS, respectively in second season. In the second season trait of DI% showed the same trend as first season but in few genotypes such as 93003, 93005-3-4, and No-56 were moderately resistant (MR) in first season and moderately susceptible in second season similarly the genotypes 9600-4-1 and Agara were moderately susceptible MS in first season and susceptible in second season. Thiyagu *et al*. (2007) reported three resistant genotypes among fifteen parents and their F1's exhibiting 9.11, 8.34 and 7.92 DI% and all crosses were varied from susceptible to highly susceptible to CR disease. According to Shabana *et al*. (2014), the reaction of 24 F6 sesame lines and their parents for CR infection was three resistant lines (C3.8 , C6.3, C1.10) and one resistant parent, however, other three lines (C6.12, C6.11 andC9.6) were the highly susceptible and five from the six parents were moderately to highly susceptible.

CONCLUSION

This study evaluated the germplasm resource of sesame crop for charcoal rot disease. Results obtained through experimentation identified resistant and moderately resistant sesame lines for charcoal rot disease. These lines might be helpful in improving the breeding program of sesame crop. These sesame lines can be used for improvement of genetic resistance in already developed lines/varieties or development of new resistant varieties and cultivars through hybridization program.

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Maria Ghias	:	Designed the study and wrote manuscript
Salsabeel Rauf	:	Analyzed the results and finalized manuscript
Rizwana Qamar	:	Formatted and finalized the manuscript
Ahsan M. U. Din	:	Conducted the study and statistically analyzed the data
Tariq Mahmood	:	Designed the study and provided the material
Muhammad Aftab	:	Supervised the study