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HOST PLANT RESISTANCE IN BLACKGRAM AGAINST CHARCOAL ROT (*MACROPHOMINA PHASEOLINA* (TASSI) GOID)

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ABSTRACT

One hundred blackgram (*Vigna mungo* L.) germplasm accessions were evaluated for resistance against charcoal rot caused by *Macrophomina phaseolina* under artificially created disease conditions in greenhouse as well as in the field at National Agricultural Research Centre (NARC), Islamabad. The disease at seedling stage in green house and at reproductive stage in the field was recorded using 1-9 ratting scale. The genotypic response to disease development was quite variable both in the field and green house. At seedling stage, 5 genotypes appeared to be highly resistant, 11 resistant and 30 tolerant in green house whereas rest of the 54 genotypes showed susceptible to highly susceptible response. Twelve genotypes were found to be highly resistant, 17 resistant and 25 as tolerant, whereas 16 genotypes appeared to be susceptible and 30 highly susceptible under field conditions. Three genotypes viz., 013468, 013663 and 013468 showed resistance both at seedling and reproductive stages. These lines can further be exploited as a source of resistance against charcoal rot in mash breeding programs.

Key words: blackgram, charcoal rot, *Macrophomina phaseolina*

INTRODUCTION

Charcoal rot incited by *Macrophomina phaseolina* (Tassi) Goid is a threatening disease as the pathogen is distributed in diverse climatic conditions from arid to tropical regions with broad host range (Cottingham, 1981; Abawi and Pastor-Corrales, 1990). *M. phaseolina* is soil and seed-borne pathogenic fungus; produces cushion shaped black sclerotia (Wheeler, 1975). Its prevalence can be enhanced by different physiological and ecological factors such as low moisture contents, high temperature, heat etc. (Dhingra and Sinclair, 1978; Papavizas 1977) and disease severity is correlated with viable sclerotia present in the soil. There are more than 500 hosts of the fungus including legume and cereal plants (Dhingra and Chagas, 1981; Sinclair, 1982). Mashbean, an important kharif legume of Pakistan, is subjected to different constraints; charcoal being the serious one. Charcoal rot infects plants on almost all growth stages. Dark lesions appear on the epicotyls and hypocotyls followed by seedling death due to obstruction of xylem vessels. In plants, the pathogen causes red to brown lesions on roots and stems with production of dark mycelia and black microsclerotia and ultimately the plant becomes defoliated and wilted (Abawi and Pastor-Corrales, 1990). The disease may cause up to 100% yield losses (Bashir and Malik, 1988) depending upon severity.

Different strategies have been adopted to control the disease such as application of fungicides to inhibit fungal growth and infection, use of antagonists for destruction and competition with pathogen and crop rotation for reducing density of sclerotia in soil below damaging level (Francl *et al*., 1988; Pineda, 2001; Choudhary *et al.,* 2004). The host plant resistance occupies a high value among integrated management techniques because it is easily adopted, requires few inputs and economically advantageous. Smith and Carvil (1997) identified four resistant cultivars among 24 soybean cultivars screened for resistance to *M. phaseolina*. Three hundred thirteen genotypes of cowpea were screened by Songa *et al*., 1997 against charcoal rot disease he found a significant resistance level in cowpea. Screening of different crops against *M. phaseolina* has been investigated (John *et al.,* 2005 (sesame); Pande *et al.,* 2004 (chickpea); Abawi and Pastor-Corrales, 1990 (cowpea); Mirza *et al.,* 1982 (sunflower). The present study was aimed at finding out resistant sources in mashbean germplasm against charcoal rot.

MATERIALS AND METHODS

Isolation of *Macrophomina phaseolina:* Stem bark tissues of mashbean bearing fungal sclerotia and characteristics charcoal rot symptoms were collected for isolation of the pathogen. The tissues were cut into small pieces of 5-10 mm length and 2-3 mm thickness, surface sterilized with 1% sodium hypochlorite for 2 minutes and then rinsed thrice in sterile distilled water. These pieces were placed on chloroneb

mercury rose bengal agar medium (Meyer *et al*., 1973).The Petri dishes containing infected tissue were incubated in dark at 26±2°C for 6 days.

Preparation of *M. phaseolina* inoculum: Seeds of the sorghum were water soaked over night, air dried under room temperature and placed in conical flasks. The mouth of each flask was plugged with cotton wool and wrapped in aluminum foil before autoclaving at 15 psi (121°C) for 20 minutes. After cooling, the flasks were inoculated with 4 mm mycelial plug from a 7-day old culture of *M. phaseolina* and incubated at 26±2°C for 15 days for the colonization of sorghum seeds. The presence of the pathogen was confirmed by plating colonized seeds on PDA plates at 26±2°C.

Screening of Mashbean germplasm for charcoal rot Resistance.: One hundred mashbean germplasm accessions were planted at NARC in artificially inoculated soils in the field and greenhouse in 2006-07. Each genotype was planted in a single row of 4 m. A plant to plant and row to row distance of 10 cm and 30 cm was maintained respectively. Plots were inoculated with inoculum @ 2g per meter of row. In the greenhouse 2-3 sorghum seeds infected with *M. phaseolina* were placed around each seed of mash sown in pots. Five seeds were planted in each pot. Data was recorded using 1-9 disease rating scale (Abawi and Pastor-Corrales, 1990), where, 1 = No symptoms on plants (highly resistant): 3 = Lesions are limited to cotyledonary tissues (resistant): 5 = Lesions have progressed from cotyledons to about 2 cm of stem tissues (tolerant): 7 = Lesions are extensive on stem and branches (susceptible) and 9 = Most of the stem and growing points are infected. A considerable amount of pycnidia and sclerotia is produced (highly susceptible).

RESULTS

The results revealed that all genotypes differed in their response to charcoal rot disease. The disease severity

Table: 1. Resistance/susceptibility of Mashbean germplasm against charcoal rot

Disease Reaction	Greenhouse	Field
Highly resistant (HR)	013468,013477,013663,013667, 013668	013664,013663, 013662, 013655, 013654, 013652, 013651, 013643, 013482, 013468, 013454, 013453
Resistant (R)	013676,013680,013672,13669, 013662,013655,13652,013651, 013645, 013643, 013492	013672, 013668, 013667, 013660, 013658, 013657, 013656, 013653, 013648, 013630, 013507, 013506, 013493, 013487, 013477, 013469, 013462
Tolerant (T)	013453,013462,013482,013487, 013488,013493,013506,013507, 013570,013576,013592,013620, 013625,013626,013627,013628, 013629,013630,013648,013653, 013654,013656,013674,013675, 013677,013697,013699,013664, 013660, 013658	013492, 013503, 013505, 013511, 013568, 013615, 013616, 013618, 013625, 013626, 013628, 013629, 013634, 013640, 013645, 013669, 013671, 013673, 013674, 013675, 013676, 013677, 013680, 013696, 013699
Susceptible (S)	013454,013469,013470,013503, 013511,013563,013564,013568, 013590,013591,013600,013615, 013616,013619,013624,013640, 013657,013671,013673,013687, 013694, 013696, 013700	013703, 013700, 013697, 013687, 013686, 013684, 013670, 013627, 013622, 013620, 013600, 013570, 013562, 013550, 013488, 013470
Highly susceptible (HS)	013703,013705,013707,013710, 013711,013712,013713,013714, 013715,013716,013719,013695, 013693,013692,013690,013686, 013684,013670,013639,013636, 013634,013623,013622,013618, 013562,013561,013554,013553, 013551,013550, 013505	013705,013707,013710,013711, 013712,013713,013714,013715, 013716,013719,013690,013692 013693,013694,013695,013636, 013639,013619,013623,013624, 013551,013553,013554,013561, 013564,013563,013592,013591, 013590, 013576

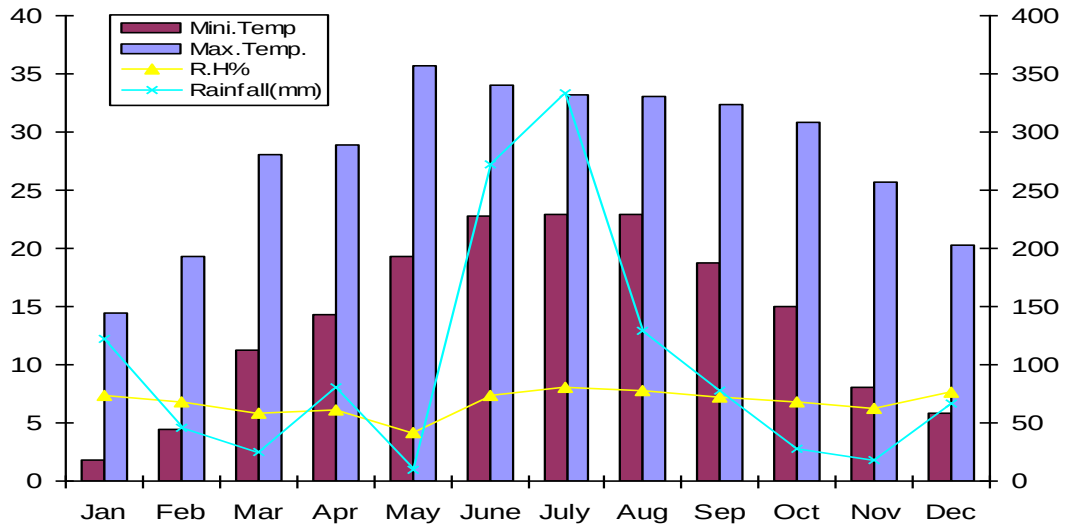

Fig.1. Precipitation, Temperature and R.H% at NARC during the kharif season 2006.

of various genotypes ranged from 1-9 in greenhouse as well as in the field. Out of one hundred accessions, five genotypes including 013468, 013477, 013663, 013667 and 013668 with disease rating score '1' were highly resistant whereas 11 genotypes with disease rating score '3' were found as resistant. Thirty Genotypes with disease rating '5' acted as tolerant lines whereas rest of 54 genotypes with rating scale '7' and '9' showed either susceptible or highly susceptible response (Table-1). Under field conditions, 12 genotypes, 013664, 013663, 013662, 013655, 013654, 013652, 013651, 013643, 013482, 013468, 013454 and 013453 appeared as highly resistant, whereas 17 were resistant, twenty five tolerant, 16 genotypes were susceptible and 30 were highly susceptible.

DISCUSSION

Charcoal rot is a devastating disease of mashbean in Pakistan that may cause up to 100% yield losses under epidemic condition. The host plant resistance is the most feasible and economical measure to reduce yield losses due to this disease. Identification of resistant sources is an important pre requisite for initiation of breeding program aimed at developing resistant varieties.

Our study revealed a considerable variability among mashbean germplasm for resistance against this disease both under field and green house conditions. More genotypes were found resistant in the field than green house. The high disease development in green house was due to highly conducive environment where the isolates expressed their potential virulence. Due to this factor 54% genotypes were found susceptible in green house as compared to 46% under field conditions. Miklas *et al*, (1998) also reported that mash genotypes showed resistance at seedling stage under higher disease pressure.

The high disease pressure under green house may have been due to the use of sterilized soil, which reduced the interaction between the pathogen and the soil microbiota causing less chance of disease escape. On the contrary, there was sufficient microflora in the field which compete with the pathogen and also there is much more variation in the field environment as compared to that of green house. Pastor-Corrales and Abawi (1988) and Songa *et al* (1997) observed that artificial inoculation increased disease severity.

In the present studies, it was observed that temperature during the months of July and August was higher and highest incidence and severity was observed in these months(Fig-1). Abawi and Pastor-Corrales (1990) and Diaz (1992) suggested that high temperature and moisture stress favors the *M. phaseolina* incidence. From the present studies it is concluded that the highly resistant genotypes could be utilized in the development of mash verities with resistance to charcoal rot.

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