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Evaluation of Germplasm Lines of Sorghum against Grey Leaf Spot incited by *Cercospora sorghi* Ellis and Everh

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ABSTRACT: Sorghum is an important crop for human consumption as well as animal feed. Grey leaf spot incited by *Cercospora sorghi* Ellis and Everh is the most serious disease as it causes premature drying and defoliation of leaves, reduces the quality and quantity of green fodder. The most efficient and economical way of disease management is the production of resistant cultivars development. A total of eighty five sorghum lines were evaluated for their reaction against grey leaf spot at research farm of Forage Section, CCS Haryana Agricultural University, Hisar during *Kharif* 2022. The germplasm lines were categorized as highly resistant (HR), resistant (R), moderately resistant (MR), susceptible (S) and highly susceptible (HS) according to the standard rating scale (1-9). Out of the eighty five germplasm lines screened, twenty three, twelve, twenty two, twenty five and three germplasm lines showed highly resistant, resistant, moderately resistant, suscptible and highly susceptible reactions, respectively. The resistant lines could be utilized in breeding programs for development of varieties of sorghum resistant against grey leaf spot disease.

Keywords: Grey leaf spot, *Cercospora sorghi*, Germplasm, Resistant.

INTRODUCTION

Sorghum (*Sorghum bicolor* L. Moench.) (2n=20) which belongs to family *Poaceae* is considered an important cereal crop for human consumption as well as animal feed. It is also known as great millet, Indian millet, *durra*, *milo*, *chari* or *jowar*. It ranks among the five main cereal crops in the world (Venkateswaran *et al.*, 2014) and is the staple food of billions of people (Mace *et al.*, 2009). Africa, Nile valley and Central India are considered to be the centre of origin of sorghum. It is now grown in India, China, South-East Asia and Southern Europe. Currently, USA has the world's greatest total sorghum production, followed by India, Nigeriaand Mexico, with an average global production of 50 megatons per year (FAO, 2019). India is the third largest producer of sorghum in the world. Sorghum is a multipurpose crop cultivated for grain, sweet stem, forage and broomcorn. It serves as a source of fuel, bio ethanol and alcoholic beverages. It is an annual crop grown in sub-tropical and temperate regions. In India, the crop is mostly grown during *Kharif* and *Rabi* seasons in Maharashtra, Karnataka, Andhra Pradesh and Madhya Pradesh, while in Haryana it is grown exclusively as fodder crop. Forage sorghum is characterized by quick growth, high biomass accumulation, and dry matter content and wide adaptability besides drought withstanding ability. It is also suitable for silage and hay making. In spite of its ability to tolerate adverse environmental conditions, this crop is attacked by many fungal, bacterial and viral diseases. There are over fifty sorghum diseases recorded, of which thirty are found in India, but only ten are economically significant (Lambay, 2018). In Haryana, only four diseases *viz*., grey leaf spot, anthracnose, sooty stripe and zonate leaf spot are economically important diseases. Recently klebsiella leaf streak disease reported from sorghum and Stem Rot of Pearl Millet in Haryana, India (Malik *et al*., 2023; Malik *et al*., 2022). These foliar diseases affect the grain yield and nutritive value of the crop (Pande *et al*., 2003). Additionally, it limits the profits from producing milk and selling fodder (Rama *et al.*, 2000). Among the foliar diseases of sorghum, grey leaf spot incited by *Cercospora sorghi* Ellis. and Everh. is the most serious disease as it causes premature drying and defoliation of leaves, reduces the quantity and quality of green fodder (Mathur *et al*., 2003). The disease is observed every year in all major sorghum producing areas of India. Grey leaf spot has potential to reduce yield upto 67% in susceptible cultivars (Tesso *et al*., 2012; Marley *et al.*, 2001). The grey leaf spot disease is characterized by the presence of small leaf spots which enlarge to become rectangular lesions on the leaf ranging from 5-15 mm and 2-5 mm in length and width, respectively. The spots are typically dark red to purple in colour with lighter centers. The lesions are mostly isolated, limited by veins and colour varies from red, purple, brown or dark depending upon the variety. Typically, the lower leaves are attacked first and then the infection spreads gradually upwards. The development of the disease is aided by high humidity, constant rains and warm temperatures (Singh *et al*.,

2020; Singh *et al*., 2016; Singh *et al*., 2017). Sorghum, which is grown as a fodder crop, fungicides are often not advised due to their residual effect. Recently released forage sorghum variety/hybrids CSV53F, HJ1513 and HJ1514 from CCS HAU, Hisar are moderately to highly resistant against grey leaf spot (Kumari *et al*., 2023). The most efficient and economically advantageous way of integrated disease management strategies is the production of resistant cultivars (Singh *et al*., 2018; Malik *et al*., 2018; Singh *et al.*, 2016).

MATERIALS AND METHODS

A total of eighty-five sorghum lines were evaluated for their reaction against grey leaf spot disease at the forage section, CCS Haryana Agricultural University, Hisar during *Kharif* 2022. A susceptible variety of sorghum was sown as check 10 days before sowing of the test accessions. Recommended package of practices were followed for raising the crop. The susceptible checks were spray inoculated with the culture of *Cercospora sorghi* raised in the laboratory (spore suspension 10^6 spores ml^{-1}) at 5 leaf stage (30 DAS). Disease score was recorded following the (1-9) scale when the susceptible check showed the maximum disease. Finally, the germplasm lines showing disease scores from 1-9 were categorized as highly resistant (HR), resistant (R), moderately resistant (MR), susceptible (S) and highly susceptible (HS) according to the standard rating scaleas mentioned in Table 1 (Ngugi *et al*., 2002; AICRP, 2021).

Table 1: Scale for scoring the grey leaf spot disease of sorghum (Ngugi *et al*., 2002; AICRP, 2021).

Grade	Description	Reaction
1	No disease symptoms seen	Highly Resistant (HR)
2	1-5% leaf area affected by spot	Resistant (R)
3	6-10% leaf area affected by spot	
4	11-20% leaf area affected by spot	Moderately Resistant (MR)
5	21-30% leaf area affected by spot	
6	31-40% leaf area affected by spot	Susceptible (S)
7	41-50% leaf area affected by spot	
8	51-75% leaf area affected by spot	Highly Susceptible (HS)
9	>75% leaf area affected by spot	

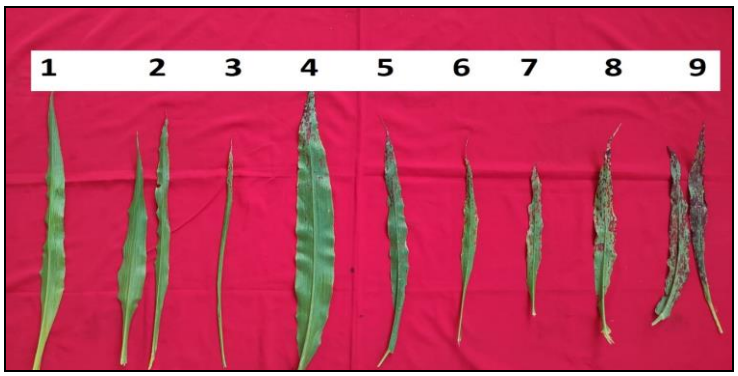

Fig. 1. Scale for scoring the grey leaf spot disease of sorghum

RESULTS

A total of eighty five sorghum germplasm lines were screened against grey leaf spot under field conditions at forage section, CCSHAU, Hisar during *Kharif* 2022. Out of eighty five lines screened, twenty three, twelve, twenty two, twenty five and three sorghum germplasm lines showed highly resistant, resistant, moderately resistant, susceptible and highly susceptible reactions, respectively (Table 2). A total of twenty three lines namely SOR 13853, SOR 13874, SOR 13924, SOR 13940, SOR 14379, SOR 14390, SOR 14391, SOR 14393, SOR 14217, SOR 14231, SOR 14251, SOR 14255, SOR 14268, SOR 14274, SOR 14170, SOR 14193, SOR 14203, SOR 14214, SOR 14399, SOR 14453, SOR 14479, SOR 14414, SOR 13620 showed highly resistant reaction with disease score of 1. Twelve genotype lines namely SOR 13982, SOR 14189, SOR 14204, SOR 14575, SOR 14276, SOR 14183, SOR 13852, SOR 14510, SOR 14215, SOR 14447, SOR 13303, SOR 13327 were found resistant with disease score of 2 and 3. Twenty two lines namely SOR 14184, SOR 13535, SOR 13291, SOR 14506, SOR 14567, SOR 13344, SOR 14347, SOR 14393, SOR 14268, SOR 14189, SOR 14443, SOR 14357, SOR 14480, SOR 14495, SOR 13841, SOR 13844, SOR 13292, SOR 13579, SOR 14503, SOR 13356, SOR 13304, SOR 13298 exhibited moderately resistant reaction with disease score of 4 and 5. Twenty five lines namely SOR 14304, SOR 14369, SOR 13547, SOR 13431, SOR 13382, SOR 13340, SOR 13216, SOR 13258, SOR 14041, SOR 14304, SOR 14275, SOR 14195, SOR 14484, SOR 13293, SOR 14066, SOR 14507, SOR 13346, SOR 13354, SOR 13257, SOR 13236, SOR 13234, SOR 14280, SOR 14181, SOR 14483, SOR 13278 exhibited susceptible reaction with disease score of 6 and 7 and only three lines namely SOR 13988, SOR 13995, SOR 14311 were found highly susceptible against grey leaf spot of sorghum with a disease score of 8. None of the genotype showed a disease score of 9.

Table 2: Screening of sorghum lines against grey leaf spot disease during *Kharif* 2022.

Score	Number of Germplasm Lines	Reaction	Genotypes
1	23	Highly Resistant (HR)	SOR 13853, SOR 13874, SOR 13924, SOR 13940, SOR 14379, SOR 14390, SOR 14391, SOR 14393, SOR 14217, SOR 14231, SOR 14251, SOR 14255, SOR 14268, SOR 14274, SOR 14170, SOR 14193, SOR 14203, SOR 14214, SOR 14399, SOR 14453, SOR 14479, SOR 14414, SOR 13620
2	4	Resistant (R)	SOR 13982, SOR 14189, SOR 14204, SOR 14575,
3	8		SOR 14276, SOR 14183, SOR 13852, SOR 14510, SOR 14215, SOR 14447, SOR 13303, SOR 13327
4	11	Moderately Resistant (MR)	SOR 14184, SOR 13535, SOR 13291, SOR 14506, SOR 14567, SOR 13344, SOR 14347, SOR 14393, SOR 14268, SOR 14189, SOR 14443
5	11		SOR 14357, SOR 14480, SOR 14495, SOR 13841, SOR 13844, SOR 13292, SOR 13579, SOR 14503, SOR 13356, SOR 13304, SOR 13298
6	14	Susceptible (S)	SOR 14304, SOR 14369, SOR 13547, SOR 13431, SOR 13382, SOR 13340, SOR 13216, SOR 13258, SOR 14041, SOR 14304, SOR 14275, SOR 14195, SOR 14484, SOR 13293
7	11		SOR 14066, SOR 14507, SOR 13346, SOR 13354, SOR 13257, SOR 13236, SOR 13234, SOR 14280, SOR 14181, SOR 14483, SOR 13278
8	3	Highly Susceptible (HS)	SOR 13988, SOR 13995, SOR 14311
9	-		Nil

DISCUSSION

A total of eighty five sorghum lines were screened against grey leaf spot disease under field conditions at forage section, CCSHAU, Hisar during *Kharif* 2022. Out of eighty five sorghum genotypes screened twenty three, twelve, twenty two, twenty five and three showed highly resistant, resistant, moderately resistant, susceptible and highly susceptible reactions, respectively. Dalmacio *et al*. (1980) screened 2116 lines of sorghum for resistance to grey leaf spot, target leaf spot and tar spot of sorghum. Out of them, only 19 lines showed resistance against the grey leaf spot pathogen. Sarwar *et al*. (1988) found only 6 lines resistant against pathogen causing grey leaf spot. Malik *et al*., 2018 evaluated one hundred and forty two hybrids of maize against maydis leaf blight and banded leaf and sheath blight at two locations. Similarly, one hundred and two maize inbred lines were evaluated, out of these six genotypes were found resistant, thirty six genotypes were moderately resistant, fifty genotypes showed moderately susceptible reaction and ten exhibited susceptible reaction against maydis leaf blight (Singh *et al*., 2018). Forty three sorghum genotypes were screened for varied levels of resistance during *Kharif* 2018 and 2019, eleven genotypes showed highly resistant disease reaction against sorghum anthracnose and all the genotypes exhibited resistant disease reaction to grey leaf spot (Atri *et al*., 2021).

CONCLUSIONs

A total of eighty five sorghum lines were screened for their relative resistance/ tolerance against grey leaf spot under field conditions at forage section, CCS HAU, Hisar during *Kharif*, 2022. Out of 85 genotypes screened, twenty three lines namely SOR 13853, SOR 13874, SOR 13924, SOR 13940, SOR 14379, SOR 14390, SOR 14391, SOR 14393, SOR 14217, SOR 14231, SOR 14251, SOR 14255, SOR 14268, SOR 14274, SOR 14170, SOR 14193, SOR 14203, SOR 14214, SOR 14399, SOR 14453, SOR 14479, SOR 14414, SOR 13620 showed highly resistant reaction against grey leaf spot of sorghum. Twelve, twenty two, twenty five and three sorghum lines showed resistant, moderately resistant, susceptible and highly susceptible reactions, respectively.The sources of highly resistant, resistant and moderately resistant lines need to be tested for their authenticity with artificial inoculation techniques and if they show resistant reaction may could be utilized in resistance breeding program for at least development of tolerant varieties of sorghum against grey leaf spot disease.

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Conflict of Interest. None.

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