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Screening of sunflower genotypes for resistance against collar rot

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Abstract
The sunflower genotypes were evaluated to identify the sources of resistance against collar rot caused by *Sclerotium rolfsii* Sacc. A total of thirty-six sunflower genotypes were screened for their relative resistance against collar rot disease in field under natural conditions at Oilseeds Research Area CCSHAU Hisar in 2014-2015. Only hybrid PSH-1962 showed resistant reaction and twenty one genotypes (nine hybrids, four CMS and eight restorers) showed moderate resistance against collar rot disease. Ten genotypes (one hybrid, four CMS and five restorers) showed moderately susceptible reaction while, three genotype (one hybrid, and two CMS) showed susceptible reaction and one genotype (Restorer) showed highly susceptible reaction against collar rot disease.

Keywords: Collar rot, sunflower, genotypes, resistance

Introduction
Sunflower (*Helianthus annuus* L.) popularly known as 'Surajmukhi' is an important edible oilseed crop belongs to the family *Compositeae*. It is a native of southern United States and Mexico where it is used in dyes, food preparation and medicines and later spread to European and Asian countries. In India, sunflower is grown in area of 0.83 million hectares with production of 0.54 million tonnes (Anonymous, 2013) [2]. It is cultivated in states of Karnataka, Maharashtra, Andhra Pradesh, Tamil Nadu, Punjab, Rajasthan and Haryana. Karnataka, Andhra Pradesh and Maharashtra account for nearly 79.96 per cent of total production and 87.95 per cent of area in India (Anonymous, 2013) [2]. In Haryana, sunflower is cultivated mainly in North Eastern districts in an area of 15,000 ha with a production of 26,000 tonnes and an average productivity of 1,733 kg/ha (Anonymous, 2013) [2]. Sunflower is a short duration crop which can be grown in all seasons and produce high quality edible and industrial oil, besides animal feed and fodders.

In the recent years, the acreage and production of sunflower is declining in the traditional sunflower growing areas due to several yield limiting factors like biotic and abiotic stresses. Among the several biotic factors, the susceptibility to diseases constitutes a major constraint in decreasing the yield level of sunflower crop. Large numbers of biotrophic and necrotrophic diseases have been reported to cause heavy loss in sunflower (Mehta *et al.,* 2005) [5]. Among the necrotrophic soil borne pathogens, collar rot disease caused by *Sclerotium rolfsii* Sacc. is the most important in Haryana conditions, where the warm and humid conditions prevail during the growing seasons for the development of this disease in sunflower. It causes both pre and post-emergence mortality of young seedlings beside inciting collar rot in adult plants. The typical symptoms of this disease are rapid wilting and sickly appearance of plants with brownish lesion at the stem base near the soil level which later girdles the stem (Okabe *et al.*, 2000; Gururaj, 2012) [6, 3]. White mycelial growth forms over the infected tissue and often radiates over the soil surface (Rasu *et al.,* 2013) [7]. Chemical and cultural practices have been the predominant control measures used in the past to manage soil-borne pathogens (Krishnakanth *et al*., 1999) [4]. Persistence of the pathogen in the soil and its wide host range often limits the effectiveness of the chemical and cultural control of the soil borne diseases. However, partial resistant varieties in comparison to susceptible one, has better resistance efficiency (Shew *et al*., 1984) [8]. Growing resistant varieties against collar rot disease is a cost effective control and unfortunately high degree of resistance to these soil borne diseases is not available among cultivable varieties. Only limited screening of genetic material of sunflower including Cytoplasmic male sterile (CMS) lines and hybrids has been attempted under reliable artificial epiphytotic conditions in India and elsewhere and there are very few reports of clear cut differences for resistance to collar rot disease. Hence, serious efforts are needed to find out sources of resistance against this pathogen, so that the material could be used in resistance breeding programmes in the country.

Hence, the present study was conducted to screen the sunflower genotypes against collar rot disaese for the identification of resistant sources.

Material and methods

Twelve hybrids, ten (10) Cytoplasmic Male Sterile lines and fourteen (14) restorer lines were screened for their relative resistance against collar rot disease under natural sick plot conditions. The soils of experimental plots at Oilseeds Research Area CCSHAU Hisar have become sick with *S. rolfsii* due to continuous cultivation of sunflower in the same field every year. Each genotype was planted in five rows per plot having 5 meter row length and 75 cm in row spacing with 10 plants in each row. The experiment was arranged in a randomized block design (RBD) with four replications per treatment. An observation of disease incidence was recorded as per cent number of plants infected. The final observation was taken 15 days before harvest.

Disease Incidence was calculated by the following formula:

$$\text{Disease Incidence} = \frac{Number\ of\ Disesed\ Plants}{Total\ Number\ of\ Plants}\ x\ 100$$

Finally, the genotypes were categorized as under for their relative resistance against *S. rolfsii*.

Table 1: Scale used for screening of resistance

Disease Reaction	Disease Incidence (%)
Resistant	≤ 5
Moderately Resistant	5.1-10
Moderately Susceptible	10.1-15
Susceptible	15.1-20
Highly Susceptible	> 20

Result and Discussion

Table 2 shows disease incidence for different sunflower genotypes that were screened against collar rot disease (*S. rolfsii*) under natural conditions. Based on the level of disease occurrence in terms of per cent disease incidence, the genotypes were categorized under different disease reactions as in table 7B. Sunflower genotype PSH-1962 (hybrid) showed resistant reaction (less than 5%) against collar rot disease under field conditions. Twenty one of the genotypes including nine hybrids, four CMS line and eight restorers showed moderately resistant reaction (5.1-10% incidence), ten genotypes (one hybrid, four CMS and five restorers) were moderately susceptible to the disease (10.1-15%), while three genotypes (one hybrid and two CMS line) showed susceptible reaction (15.1-20%) to this disease. One genotype RHA-586 (Restorer) showed highly susceptible reaction (more than 20%) against disease incidence. The present field screening of sunflower lines in this study indicates that differences in resistance to collar rot exist in genotypes of sunflower. Thus, screening sunflower genotypes for resistance to collar rot is very important and should be used in the development of new commercial hybrids with high yield potential and more resistant to *S. rolfsii*. There is lack of genetic vertical host resistance in sunflower to this necrotic soil borne pathogen, hence the genotypes showing horizontal resistance to this pathogen and multiple resistance to other diseases need to be exploited for sustainability.

Table 2: Evaluation of sunflower genotypes for resistance against collar rot (*S. rolfsii*) under natural conditions

Sr. No.	Genotypes	*Disease Incidence (%)	Sr. No.	Genotypes	*Disease Incidence (%)
Hybrids			8	CMSH-338 (C)A	7.58(15.68)
1	HSFH-1183	7.69(16.08)	9	HYDCMS-1A	9.39(17.46)
2	HSFH-1194	9.39(17.64)	10	CMS-2A	8.18(16.44)
3	HSFH-1200	8.46(16.87)	Restorer		
4	HSFH-1205	7.70(16.01)	1	RHA-AK1R	9.86(18.17)
5	HSFH-1213	8.77(17.17)	2	RHA-265	7.93(15.89)
6	HSFH-1544	12.23(20.39)	3	RHA-271	8.91(16.67)
7	HSFH-1551	8.30(16.40)	4	RHA-272	12.07(20.00)
8	HSFH-1555	9.61(18.00)	5	RHA-274	8.47(15.88)
9	HSFH-1595	11.22(19.35)	6	RHA-297	7.49(15.10)
10	HSFH-1596	7.29(15.35)	7	RHA-347	11.56(19.48)
11	HSFH848	6.19(13.78)	8	RHA-586	23.70(29.01)
12	PSH-1962	4.27(11.83)	9	RHA-856	8.46(16.87)
CMS Lines			10	RHA-859	12.33(20.05)
1	CMSH-84	19.46(26.00)	11	P28R	11.18(19.04)
2	CMSH-234	19.03(25.68)	12	P35R	7.65(15.76)
3	MODERN	14.17(22.04)	13	R-17	8.00(15.80)
4	CMSH-44A	13.39(21.28)	14	HRHA4-2	14.01(21.66)
5	CMSH-7-1A	14.06(21.84)		C.D @ 5%	(5.62)
6	CMSH-1A	8.12(16.43)			
7	CMSH-300A	12.71(20.64)			

*Mean of four replications. The values in parentheses are angular transformation.

Table 3: Disease reaction of sunflower genotypes screened under natural conditions in the field

Disease Reaction	Disease Incidence (%)	Genotypes
Resistant	< 5	Hybrid(1) : PSH-1962
Moderately Resistant	5.1 – 10	Hybrids(9): HSFH-848, HSFH-1183, HSFH-1194, HSFH-1200, HSFH-1205, HSFH-1213, HSFH-1551, HSFH-1555, HSFH-1596,
		CMS(4): CMSH-1A, CMSH-338(C)A, HYD-CMS-1A, CMS-2A
		Restorer (8): RHA-AK1R, RHA-856, RHA-265, RHA-297, RHA-271, RHA-274, P35R, R-17.
Moderately Susceptible	10.1 – 15	Hybrid(1): HSFH-1595
		CMS(4): MODERN, CMSH-44A, CMSH-7-1A, CMSH- 300A
		Restorer(5): RHA-272, RHA-347, P28R, RHA-859, HRHA4-2
Susceptible	15.1 – 20	Hybrid(1): HSFH-1544 CMS(2): CMSH-84A, CMSH-234A
Highly Susceptible	> 20	Restorer(1): RHA-586

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