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Field Screening of Rajmash Germplasm for Resistant against *Sclerotinia sclerotiorum* Causes White Mold

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Authors' contributions

This work was carried out in collaboration between all authors. All authors read and approved the final manuscript.

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ABSTRACT

White rot or stem rot caused by the polyphagous fungus *Sclerotinia sclerotiorum* (Lib.) de Bary is a serious threat to production and productivity of rajmash (*Phaseolus vulgaris*). The regular incidence of Sclerotinia blight in different states of India has been recorded as a limiting factor for this pulse crop grown in moister regions and wet years. Sclerotinia infection in pulses leads to stem and pod rot, crop lodging and reduced seed fill and causes considerable yield losses. Effective disease control measures against *S. sclerotiorum* continues to be a challenge because of the inefficiency of the chemical control in managing this disease and not environmentally safe. Therefore, cultivation of rajmash cultivars highly resistant to *Sclerotinia* would be most desirable for both ecological and economic reasons. Thirty two genotypes of rajmash, collected from All India Coordinated Research Project on MULLaRP, T.C.A., Dholi were screened against Sclerotinia rot. Out of these entries, Out of 32 genotypes evaluated, only one genotypes, Utkarsh was found to be resistance and five genotypes (RKR 1038-1, RKR 1011, Amber, Arun, and Uday) showed moderate resistance. Two genotypes i.e. SKUAB 341, and SKUAST WB 1634 exhibited moderately susceptible reaction. However, twenty-four genotypes showed a sensitive and highly susceptible reaction against this disease.

Keywords: Rajmash; white mold; Sclerotinia sclerotiorum; host cultivar; resistant.

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1. INTRODUCTION

Rajmash (*Phaseolus vulgaris*) is known as French bean, kidney bean, field bean, snap bean, haricot bean and black bean etc. is a comparatively newer introduction in north Bihar but is an important and remunerative legume crop. Among the diseases reported in north Bihar, white mould also known as Sclerotinia blight caused by *Sclerotinia sclerotiorum* (Lib.) de Bary occupies a rank of major importance. It is most common in crops grown in moister regions and wet years. The crop suffers substantial damage from this disease. *Sclerotinia sclerotiorum* is a soil-borne pathogen with wide host range and almost world-wide distribution [1,2,3,4]. The disease makes its first appearance in the field at about 45-55 days after sowing. The first field symptom of the disease appears as a watery rot on stems, leaves, branches and pods, but may occasionally occur at the base of the stem near the soil line. White mycelium is often visible on the surface of rotted tissue under moist conditions. The development of black, irregularly shaped sclerotia is the best diagnostic feature. Affected plant tissue dries quickly and bleaches to pale tan or almost white colour. Entire branches or stems may be killed, when the main stem is infected near the soil line, the entire plant may be killed. White mould diseases may affect both yield and quality of crops; the range of crop losses can vary from 0 to100% [1] varies widely from year to year and from location to location depending upon factors such as crop species/cultivars, locations and environmental conditions. Despite continuous research over the past century, control efforts have often met with limited success, due to the extensive host range and prolific growth of the pathogen and its ability to produce large number of sclerotia that may persist in soil for several years [5,6]. The white mould pathogen is difficult to manage by application of chemical. Moreover, the chemical control is costly and leads to residual effect. Alternate cost-effective, eco-friendly disease management is the need of the hour. Identification of genotypes/ varieties with resistance to *S. sclerotiorum* would provide an effective means of managing white mold, requiring little extra labour or expenses. In recent times, little work has been done for identification of resistant sources against the diseases occurring in the rajmash field. Therefore, an effort has been made in the present study to identify resistant sources of rajmash against the abovementioned diseases by a screening of germplasms in the natural field condition. The objective of this study was to evaluate rajmash germplasm/ varieties for potential resistance to this disease.

2. MATERIALS AND METHODS

Studies were undertaken to identify the resistance of rajmash germplasms against White mould. Field experiments were conducted during *Rabi,* 2016-17 and 2017-18 in the rajmash white mould sick plot developed at the farm for this purpose at Tirhut College of Agriculture, Dholi, Muzaffarpur (Dr. Rajendra Prasad Central Agricultural University, Bihar, Pusa, Samastipur). A total of 32 rajmash genotypes, collected from All India Coordinated Research Project on MULLaRP, T.C.A., Dholi were assessed for their reaction against white mold disease in sick plot by infector row technique in the augmented design having two replication by planting 2 rows of single test entries alternated with one row of HUR 137 as susceptible check. Each test entry was planted in a row of 4 meter in length with row to row distance 30 cm and within plant distance 10 cm. General cultural practices were adopted to maintain the experiment except that fungicides sprays were not applied in order to encourage the pathogen. Disease observations on white mould incidence were recorded from the seedling stage to maturity at 15 days interval. The plots were periodically observed and at reproductive stage data on disease incidence of test, entries were computed. The percent disease incidence of each test entry was calculated by the following formula:

White mold Incidence = (Number of plants infected / Total number of plants) X 100

The rajmash genotypes were later grouped into different categories of resistance and susceptibility based on a grading scale [7] from highly susceptible to Resistant. Data regarding white mould incidence was computed according to grades of resistance (Table 1).

Table 1. Grades of resistance

Category	Per cent disease incidence
Resistance	0 to 10
Moderately resistant	10.1-20
Moderately susceptible	20.1-30
Susceptible	30.1-40
Highly susceptible	Above 40

3. RESULTS AND DISCUSSION

In the present investigation, a total of 32 rajmash genotypes were assessed to identify the resistant genotypes against white mould in sick plot under field conditions during two consecutive season *Rabi,* 2016-17 and 2017-18. Germination was completed within a week and the first appearance of white mould was recorded in several genotypes 40-55 days after sowing. A watery rot on Younger twigs and leaves were first observed. These spots increased, coalesced and turned into blight. The severity of disease increased with the passage of time. Entire branches or stems may be killed, which results in yellow flagging in the field. When the main stem is infected near the soil line, the entire plant may be killed. The results revealed that there was a great variation among genotypes. All the genotypes were grouped into different categories of resistance and susceptibility based on a grading scale [7] [Table 1]. Results of disease reaction of rajmash genotypes during *Rabi,* 2016-17 and 2017-18have been presented in [Tables 2 & 3]. Out of 32 genotypes evaluated, only one genotypes, Utkarsh was found to be resistance with minimum disease incidence i.e. 9.5 per cent, whereas, five genotypes (RKR 1038-1, RKR 1011, Amber, Arun, and Uday) showed moderately resistance with 10.26 to 13.79 percent disease incidence. Two genotypes i.e. SKUAB 341, and SKUAST WB 1634 exhibited moderately susceptible reaction with 22.56 to 29.71 percent disease incidence. However, eight genotypes (RKR 1033, RKR 1009, RKR 1038-1, RKR 1009, GRB 701, GRB 702, HUR 1401, and IPR 98-3) showed susceptible reaction and disease incidence ranged from 30.25 to 38.93 percent and sixteen genotypes (RKR 1036, RKR 1033, RKR 1048, RKR 1005, RKR 1043, RKR 1025-2, RKR 1006, RKR 1043, RKR 1011, RKR 1036, PDR 14, GRB 902, SRJ 1014, SRJ 814, GR 1 , and HUR 137) recorded more than 30 percent disease incidence and showed highly susceptible reaction against this disease in field condition in sick plot. Maximum severity of the disease (93.54 %) was observed in RKR 1043 which was graded as highly susceptible (HS) to white mould. All plant entries tested under field conditions developed infection by *S. sclerotiorum*, but incidence and severity varied (Tables 2 & 3). Similar type of varietal evaluations concerning white mold resistance have been recently documented by several workers [8]; Souza et al., 2014; [9]. Reduction of white mould disease severity resulting from plant architecture of bean has been also observed in several studies [10,11,12]. Blad et al. [10] demonstrated that a dry bean variety with a ‘‘dense luxuriant canopy’’ had greater leaf wetness, cooler canopy temperature, and greater disease severity than a variety with an ‘‘open, upright growth form’’ with similar levels of genetic resistance. Park [11] demonstrated that upright bean varieties had lower disease incidence than short bush types. An increase in leaf area and canopy cover of the soil was also associated with increased disease severity in bean crops [10,12].

Table 2. Disease incidence of rajmash genotypes white mold in sick plot during two consecutive season *Rabi,* 2016-17 and 2017-18

Sl. no.	Entries	Incidence of *Sclerotinia* blight (%)*	Reaction
1.	RKR 1036	84.34	HS
2.	RKR 1033	83.75	HS
3.	RKR 1048	73.4	HS
4.	RKR 1005	91.61	HS
5.	RKR 1043	93.54	HS
6.	RKR 1025-2	73.87	HS
7.	RKR 1006	61.79	HS
8.	RKR 1043	63.76	HS
9.	RKR 1033	32.77	S
10.	RKR 1009	30.71	S
11.	RKR 1011	42.28	HS
12.	RKR 1038-1	34.43	S
13.	RKR 1036	48.44	HS
14.	RKR 1038-1	11.56	MR
15.	RKR 1011	13.79	MR
16.	RKR 1009	38.93	S
17.	GRB 701	36.88	S

Sl. no.	Entries	Incidence of *Sclerotinia* blight (%)*	Reaction
18.	GRB 902	44.46	HS
19.	GRB 702	32.96	S
20.	SRJ 1014	91.52	HS
21.	SRJ 814	88.46	HS
22.	HUR 1401	38.90	S
23.	IPR 98-3	30.25	S
24.	SKUAB 341	29.71	MS
25.	SKUAST WB 1634	22.56	MS
26.	GR 1	52.13	HS
27.	PDR 14	69.23	HS
28.	Amber	10.26	MR
29.	Utkarsh	9.5	R
30.	Arun	13.45	MR
31.	Uday	10.71	MR
32.	HUR 137 (S-Check)	86.94	HS

** Pooled data are mean value of 2 seasons*

R: Resistance, MR: Moderately resistance, MS: Moderately susceptible, S: Susceptible, HS: Highly susceptible

Table 3. Reaction of rajmash genotypes against white mold in sick plot during two consecutive season *Rabi,* 2016-17 and 2017-18

Genotypes	Total no. of entries	Reaction group
Utkarsh	1	R
RKR 1038-1, RKR 1011, Amber, Arun, and Uday,	5	MR
SKUAB 341, and SKUAST WB 1634	2	MS
RKR 1033, RKR 1009, RKR 1038-1, RKR 1009, GRB 701, GRB 702, HUR 1401, and IPR 98-3	8	S
RKR 1036, RKR 1033, RKR 1048, RKR 1005, RKR 1043, RKR 1025-2, RKR 1006, RKR 1043, RKR 1011, RKR 1036, PDR 14, GRB 902, SRJ 1014, SRJ 814, GR 1 , and HUR 137 (S- Check)	16	HS

R: Resistance, MR: Moderately resistance, MS: Moderately susceptible, S: Susceptible, HS: Highly susceptible

4. CONCLUSION

The present study highlights the field screening of Rajmash germplasm for resistant against *Sclerotinia sclerotiorum* causes white mold. The study also revealed that various levels of resistance to white mold exist in germplasm. The resistant germplasm could be used as a source of resistance for the development of resistant cultivars and also the resistant germplasm i.e. Utkarsh, RKR 1038-1, RKR 1011, Amber, Arun, and Uday showing stable and durable disease resistance may be further tested for yield performance and used for large scale cultivation at the tested location.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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