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Screening of lentil cultivars against collar rot disease of lentil caused by *Sclerotium rolfsii* under artificially inoculated field conditions

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Abstract
The field experiments of screening of lentil cultivars against collar rot of lentil has been carried out at the field of Department of Plant Pathology, R.V.S.K.V.V. College of Agriculture, Gwalior (M.P.) during *rabi* 2019-20. A field experiment was carried out for evaluation of 20 genotypes of lentil against collar rot caused by *S. rolfsii*. Out of twenty genotypes, none of the genotype found highly resistant and resistant against collar rot. Three genotypes of lentil *viz.*, JL 3, PLL 1802 and RVL17-11 has been found moderately resistant reaction against the collar rot. Eleven genotypes were exhibited susceptible reaction. Remaining four genotypes *viz.*, showed highly susceptible reaction against collar rot disease.

Keywords: Lentil, collar rot, *Sclerotium rolfsii*, screening, genotype

Introduction
Lentil (*Lens culinaris* Medik.) is an important pulse crop in semiarid regions of Iran, India, Turkey and Canada and originated in the fertile crescent of the Near East and dates back to the beginning of agriculture itself (Sabaghpour *et al.*, 2004) [11]. Lentil takes a masterly position in the global of agriculture. Madhya Pradesh, Uttar Pradesh, West Bengal, Bihar, Haryana, Rajasthan, Punjab, Assam and Maharashtra are most lentil growing state of India. Lentil is utilized for human consumption as an edible protein resources and also is a best source of vitamin A and provides potassium, fiber, iron and vitamins B. (Kochhar, 2009) [6].
Production and productivity of Lentil in India is 1.61 million tonnes and 1106 kg/ha, respectively during 2017-18. In M.P. it covers an area of 590.0 ha with production and productivity of 679.0 tons and 1139 kg/ha. (Anon., 2017-18) [1]. In 2016-17 lentil has contributed 15.71% share in total pulse export. Numerous soil borne diseases like collar rot (*Sclerotium rolfsii*), root rot (*Rhizoctonia solani*), vascular wilt (*Fusarium oxysporum* f.sp. *lentis*), powdery mildew (*Erysiphe polygoni*) and downy mildew (*Peronospora lentis*) are potent threat to lentil (Singh and Tripathy and 1999 Khare *et al.*, 1979) [12, 5]. *S. rolfsii* attack living plants and occurs in soil by saprotrophic pathogen. Among the fungal diseases, collar rot of lentil caused by *S. rolfsii* (Dey *et al.*, 1993) [3] are generic and the most solemn disease. *Sclerotium rolfsii* can invade the crop during seedling to flowering stage. The pathogen *S. rolfsii* relatively more severe at the early phase. The fungus is soil-borne and produces survival structure sclerotia, which can survive very long time in the soil. Infected young seedlings show damping-off symptoms. At an advanced stage, the lentil plants generally turn pale, droop and dry (Njambere and Chen, 2011) [9]. Approximately 70 percent soil moisture and temperature range between 25 °C to 30 °C is congenial for the development *S. rolfsii* (Pinheiro, 2010) [10]. At maturity *S. rolfsii* produces little knots at the ends of mycelium which later changed into spherical to irregular shaped, mustard seed like sclerotia which were shiny, brown to black, hard.
S. rolfsii affects the lower stem and roots of lentil at or near the soil line. During infection whitish mycelia growth of the fungus can be seen at the junction of the branch with the stem close to the soil level, which is the most favorable point of attack. In advanced stage of disease, a white mycelial web dispersion over the soil and the basal plant part of the plant and sclerotia of mustard seed size are observed on the diseased area. In its advanced stage infection becomes prominent in the root system and subsequently the entire shoot withers and falls and finally the plant die.
The development to resistant varieties is the most effective solution to this problem (Kraft *et al.*, 2000 and Bayaa *et al.*, 1995) [15, 2].

Field evaluation of lentil genotypes has limitations like impact of drought and other diseases. Hence evaluation of lentil cultivars under controlled conditions is required. High level resistance against the disease has not been reported. Diversification for resistance has been showed by released varieties showed. For the breeding programme, static resources are required for development of disease resistant varieties. Hence the present investigation was conducted with specific objective of find lentil resistant genotypes to *S. rolfsii* through field screening.

Materials and Methods

The present investigation entitled "Studies on collar rot of lentil" was undertaken. The field experiments has been carried out at the field of Department of Plant Pathology R.V.S.K.V.V. Gwalior (M.P.) during *rabi* 2019. The present studies on collar rot of lentil were focused on screening of material /cultivars against *Sclerotium rolfsii*. The material used and methods followed are given below:-

The seed of lentil genotype were obtained from Department of Plant Pathology, College of Agriculture, Rajmata Vijayaraje Scindia Krishi Vishwavidyalaya, Gwalior, M.P. Seeds of lentil genotype were used for their reaction against collar rot. List of lentil genotypes are given in table-1.

Table 1: List of lentil genotypes

S. No.	Genotype	S. No.	Genotype
1.	L 4076	11.	PLL 1802
2.	RKL 605-3	12.	RKL 58 F 3715
3.	DPL 62	13.	RL 10
4.	JL 3	14.	L 4727
5.	L 4729	15.	PL 252
6.	RVL 18-4	16.	PLL 1801
7.	IPL 344	17.	TCA-DL-18-1
8.	SJL 6-3	18.	VL 531
9.	IPL 316	19.	RVL 17-11
10.	IPL 341	20.	RKL 61 F -215

Method

Isolation of pathogen *Sclerotium rolfsii* from diseased samples

The infected collar region and upper root portion was used for isolation of *Sclerotium rolfsii*. The infected tissues with healthy tissues were cut into small pieces of 0.5 to 1.0 cm long bits washed well in distilled water to remove dust adhered to the infected bits . The bits were surface sterilized by dipping in 1% sodium hypochlorite (NaOCl) solution for 1 min. finally washed well in three changes of sterilized distilled water. The excess water on the surface of the pieces was removed by blotting on sterilized blotting paper. The sterilized pieces were placed on potato dextrose agar medium supplemented with 200 ppm streptomycin sulphate with the help of inoculating needle under aseptic condition. The plates were incubated at 28 ± 1 °C and examined daily for the growth of mycelium of *Sclerotium rolfsii*. Hyphal tip transfer was made aseptically to potato dextrose agar (PDA) plates amended with 200 ppm streptomycin. After subsequent growth to ensure it is not contaminated with bacteria, the isolates were transferred to PDA slants in test tubes and were periodically transferred to new slants. For preservation of cultures the plugged end of the culture tubes were dipped in melted wax and stored in a refrigerator at 5±1 ºC.

Mass multiplication of *S. rolfsii* on sorghum seeds

The inoculum of *S. rolfsii* was multiplied on sorghum seed. Sorghum seeds were water soaked overnight, air dried under room temperature and placed in conical flasks. The mouth of each flask plugged with non-absorbent cotton wool, wrapped in aluminium foil and autoclaved at 15 Psi (121.6 °C) for 20 minutes. After cooling, the seeds in flasks were inoculated with 7 mm mycelial disc of 10 days old pure culture of *S. rolfsii* and incubated at 25±2 ºC for 15 days. The flasks were shaken at alternate days for uniform colonization of the seeds. The sorghum grains completely covered with fungal growth were used as inoculums. The inoculum produced was used @ 20 g/ meter in row for the field inoculation. Observations on germination, seed rot and seedling mortality were recorded.

Screening of lentil genotype against collar rot disease

Twenty genotypes of lentil were screened in the Rabi 2019 against collar rot caused by *Sclerotium rolfsii* in the field. The experiment was conducted in Randomized Block design with two replications. Twenty genotypes were sown with row to row spacing of 30 cm and plant to plant spacing of 10 cm with fertilizer dose of (N:P): 25:50 kg/ha. The observation on disease incidence of collar rot was recorded at 15 days interval from 15 DAS to 75 DAS. On the basis of disease incidence, Percent seedling mortality was calculated by using the formula given below;

Percent collar rot incidence = Infected Plants /Total Plant x100

The genotypes were classified as follows:

S. No.	Percent disease incidence	Reaction
1.	0 to 10 Percent	Resistant
2.	10.1 to 20 Percent	Moderately resistant
3.	20.1 to 30 Percent	Moderately susceptible
4.	30.1 to 50 Percent	Susceptible
5.	50.1 to 100 Percent	Highly susceptible

Result and discussion

The present investigations on various aspects of collar rot of lentil caused by *Sclerotium rolfsii* including screening of lentil cultivars, against *S. rolfsii*. The results obtained on these aspects are presented here under.

Evaluation of lentil cultivars against collar rot disease in artificially inoculated field conditions

A field experiment was carried out for evaluation of 20 genotypes of lentil against collar rot caused by *S. rolfsii*. None of the genotype found highly resistant and resistant against collar rot. Three genotypes of lentil *viz.*, JL 3, PLL 1802 and RVL17-11 has been found moderately resistant reaction against the collar rot. Only one genotype namely PL 252 showed moderately susceptible reaction. Eleven genotypes *viz.*, L 4076, RKL 605-3, L 4729, IPL344, IPL 341, RKL 58 F 3715, L 4727, PLL1801, TCA-DL-18-1, VL 531and RKL 61 F-215 exhibited susceptible reaction. Remaining five genotypes *viz.*, JL-3, RVL 18-4, SJL 6-3, RL 10, IPL 316 showed highly susceptible reaction against collar rot disease (Table 2 and Table 3)

To ensure the static production of *Lens esculenta*, disease management is essentials. Taylor *et al.* (2007) [14] stated that use of chemicals/fungicides is one of the solutions to defeat this problem but applications in field is not practicable because application of fungicides required high expenditure and also pollute the soil. Use of resistant/tolerant cultuvars is most effective and ecofriendly method to reduce the problem

(Bayaa *et al.*, 1995; Kraft *et al.*, 2000) [2, 15]. A field experiment was carried out for evaluation of 20 genotypes of lentil against collar rot caused by *S. rolfsii*. Out of twenty genotypes, none of the genotype found highly resistant and resistant against collar rot. Three genotypes of lentil *viz.*, JL 3, PLL 1802 and RVL17-11 has been found moderately resistant reaction against the collar rot. Eleven genotypes were exhibited susceptible reaction. Remaining four genotypes *viz.*, showed highly susceptible reaction against collar rot disease. Gaurkhede *et al.* (2015) [4] found nine genotypes as highly resistant against collar rot. Koshariya *et al*. (2020) [7] screened 271 lentil entries against *S. rolfsii*. Three entries *viz.*,VL-1, VL-4 and DPL-62 were found highly resistant against *S. rolfsii*, whereas, 10 entries *viz.*, NDL-1, Ranjan, DPL-15, PL-406, PL-234, ASHA, VL-103, PL-5, Kirsey, Dehati Masoor and fokar were showed resistant reaction.

Table 2: Field evaluation of lentil genotypes against collar rot under disease sick field

S. No.	Name of genotype	Percent disease incidence	Reaction
1.	L 4076	37.30	S
2.	RKL 605-3	43.61	S
3.	DPL 62	15.36	MR
4.	RKL 61 F-215	30.09	S
5.	L 4729	40.56	S
6.	RVL 18-4	54.14	HS
7.	IPL 344	36.88	S
8.	SJL 6-3	55.57	HS
9.	IPL 316	62.46	HS
10.	IPL 341	36.07	S
11.	PLL 1802	14.86	MR
12.	RKL 58 F 3715	31.95	S
13.	RL 10	55.22	HS
14.	L 4727	36.66	S
15.	PL 252	28.38	MS
16.	PLL 1801	44.50	S
17.	TCA-DL-18-1	38.35	S
18.	VL 531	45.29	S
19.	RVL 17-11	13.95	MR
20.	JL 3	52.61	HS

Table 3: Reaction of lentil genotypes against collar rot caused by *Sclerotium rolfsii*

Reaction	No. of Genotypes	Genotypes
Highly resistant (HR)	00	Nil
Moderately resistant (MR)	03	DPL 62, PLL 1802, RVL 17-11
Moderately susceptible (MS)	1	PL 252
		L 4076, RKL 605-3, L 4729, IPL
Susceptible (S)	11	344,IPL 341, RKL 58 F 3715,L 4727, PLL 1801, TCA-DL-18-1, RKL 61 F-
		215
Highly susceptible (HS)	05	JL-3, RVL 18-4, SJL 6-3, RL 10, IPL 316

Fig 1: Field evaluation of lentil genotypes against collar rot under disease sick field

Fig 2: Reaction of lentil genotypes against collar rot caused by *Sclerotium rolfsii*

Conclusion

A field experiment was carried out for evaluation of 20 genotypes of lentil against collar rot caused by *S. rolfsii*. Out of twenty genotypes, none of the genotype found highly resistant and resistant against collar rot. Three genotypes of lentil *viz.*, JL 3, PLL 1802 and RVL17-11 has been found moderately resistant reaction against the collar rot. Only one genotype showed moderately susceptible reaction. Out of 20 genotypes, three genotypes of lentil *viz.* JL 3, PLL 1802 and RVL17-11 has been found moderately resistant reaction against the collar rot.

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