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Survey and collection of lentil collar rot in Chhattisgarh

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Abstract
Present investigation on Survey and Collection of Lentil Collar Rot in Chhattisgarh was carried out in the Department of Plant Pathology, College of Agriculture, Indira Gandhi Krishi Vishwavidyalaya, Raipur (C.G.). Collar rot of lentil (*Sclerotium rolfsii* Sacc.) is caused by the ubiquitous soil- born pathogen *Sclerocium rolfsii* and reported almost all over the world wherever lentil is grown. The survey of fourteen locations in seven lentil growing district of Chhattisgarh state (Raipur, Mungeli, Bemetara, Bilaspur, Kawardha, Baloda bazaar and Dhamtari) was made for the occurrence and severity of lentil collar rot. The maximum mean disease incidence was observed in Mungeli district and lowest in Dhamtri district. Forteen isolates of *S. Rolfsii* Were Isolated From disease samples collected from different locations. The survey for the occurrence and severity of lentil collar rot were undertaken at seedling and vegetative stage of the crop from fortune locations in seven lentil growing districts of Chhattisgarh state (Raipur, Mungeli, Bilaspur, Dhamrari, Balodabajar, Kawardha, and Bemetara,) during 2018 and 19. It is apparent that lentil collar rot disese incidence was more sever in Raipur, Mungeli, Bemetara, Raipur, Bilaspur districts of Chhattisgarh than other surveyed districts of Chhattisgarh, during different cropping seasons. The average collar rot incidence of lentil (*Sclerotium rolfsii.*) in different districts varied from 12.57 to 39.97 per cent. In Mungeli district, it was maximum (39.63%) followed by Bemetara (37.63%), Kawardha (32.00%), Raipur (23.73%), Balodabazar (16.89) Bilaspur (16.84%), Dhamtari (12.57%), Least wilt incidence was observed in Dhamtri (12.57%) district of Chhattisgarh.

Keywords: Disease incidence, lentil, collar rot, *Sclerotium rolfsii*

Introduction
The Lentil (*Lens culinaris*) belonging to the family Leguminosae is a cool season legume crop and a bushy annual grown for its seeds. The name came from its characteristic lens shaped seeds. It also known by many common names viz., Malka masoor (bold seeded), Masuri (small seeded), Massour, Mangu/Margu, Masura, Renuka, Mangalaya etc. (Kay, 1979). It is a bushy annual self-pollinated diploid (2x=2n=14) (Muehlbauer, 1995) and self-pollinating with a haploid genome size of an estimated 4063 Mbp (Arumuganathan and Earle, 1991). The plant grows up to the height of 40 cms and the seeds are developed in pods, each pod containing two seeds within in it. Protein amount in Lentil ranges from 22 – 30% (Wang and Daun, 2006) and is the vegetable with highest level of protein after soybean (Bhattacharya *et al*., 2005). 100 g of dried seeds contain 340 – 346 calories, 12% moisture, 20.2g protein, 0.6 g fat, 65.0 g total carbohydrate, about 4 g fibre, 2.1 g ash, 68 g Ca, 325 mg P, 7.0 mg Fe, 29 mg Na, 780 mg K, 0.46 mg thiamine, 0.33 mg riboflavin, 1.3 mg niacin (Adsule *et al*., 1985; Muehlbauer *et al*., 1985). Lentil is the richest in the amino acids than that of other vegetarian diets that are imposed by poverty on different people throughout the world (Iqbal *et al*., 2006).

Currently the leading producers of lentil in the world are India, Canada, Turkey, China and Syria. India stands in 2nd position next to Canada with annual production of 1.61 MT (INDIASTAT, 2018). The major lentil producing states are Madhya Pradesh, Uttar Pradesh, Bihar, Uttarakhand and Bengal (Kumar *et al*., 2013). Among rabi pulses, lentil next to chickpea, being grown on an area of 1.55 m ha with a productivity of 1034kg/ha in India. The consumption of lentil is more in India than any other country in the world and produces more than 50 varieties in different states. Chhattisgarh contributes around 0.34% of total lentil production with an annual production of 0.05 M tonnes and being grown in around 0.16 m ha of area annually. The varieties K – 75, JG – 14, Vishal, IPL -81, Lens – 4076 etc., were mostly grown in Chhattisgarh.

Collar rot of lentil disease caused by *Sclerotium rolfsii* Sacc. is very important and a polyphagus pathogenic fungus causing substantial losses in quality and productivity of yield. *Sclerotium rolfsii* Sacc. is very fast spreading and nonspecialized soil borne fungal pathogen having worldwide importance and has a host range of over 500 species, includes ornamentals,

vegetables, fruits and field crops (Punja and Grogan, 1988). It has wide geographic diversity and commonly found in tropics, sub tropics and other temperate regions. It causes many diseases like leaf spot, leaf blight, southern blight, collar rot, stem rot, root rot etc., on various hosts. This ability to survive on various hosts, prolific growth and production of sclerotia contributes to the great economic losses associated with this pathogen. Its profuse growth rate makes it well suited facultative parasite and a most successful pathogen throughout the world.

Materials and Methods

Survey and collection of collar rot of lentil infected plants

An intensive survey was conducted during *rabi* season, 2018-19 and 2019-20, on the incidence of collar rot in lentil growing districts of Chhattisgarh. Symptoms were evident as yellowing collapse. The affected roots showed rotting at the collar region and down ward with the whitish mycelium in earlier stages of infection, rapeseed like sclerotia can be observed attached to mycelium around the collar, at seedling to flowering stage stage were collected from different locations of Chhattisgarh state (Ambikapur, Dhamtari, Bemetara, Bhatapara, Balod, Durg, Dhamdha, Gandai, Kanker, Kawardha, Narayanpur, Patan, Raigarh, Raipur , Rajnandgaon, Saragaon and Sitapur) during Januray to Feburary 2013. Samples of infected roots were collected from farmer‘s fields. Total 10-12 spots were selected randomly for taking root samples representing the whole field. Randomly 50 plants were selected in different locations in a field and numbers of plants infected were counted and the mean disease incidence was expressed in percentage. Wherever required, the complete infected plants were also collected for isolation of the pathogen and other studies. The per cent disease incidence was calculated by using the following formula.

$$\text{Per cent disease incidence} = \frac{\text{Number of plant affected}}{\text{Total number of plants observed}} \times 100$$

Each sample was kept in paper bag and tied with a rubber band and labelled immediately. Information pertaining to the locality, crop history, etc. was also obtained about the samples. Samples and roots were brought in the laboratory and analysed after collection. The roots of affected plant showing the symptoms of collar rot t were incised and isolation were made for the presence or absence of the causal agent.

Preservation and transportation of specimens

Each diseased samples was taken in brown envelopes / paper bags and then packed in 15×20 cm polyethylene bags and labeled, samples were brought to the lab and analysed on the day of collection or keeping under refrigerated conditions (4°C) until processed for identification. Root samples were used for detection of fungi associated with wilted plants

Result and discussion

Survey and collection of collar rot samples in major lentils growing areas of the state

Survey for the occurrence of collae rot disease of lentil was undertaken during *rabi* 2018-2019 and 2019-20 from fourteen locations in seven lentil growing districts of Chhattisgarh state. 7 districts of Chhattisgarh Raipur, Mungeli, Bemetara, Bilaspur, Kawardha, Baloda bazaar and Dhamtari. Observations were recorded from farmer‘s fields under natural condition.

During the survey, discussions were held with the farmers concerned, regarding occurrence and incidence of the disease. As a result of this discussion, it was revealed that disease appeared in most of the fields wherever, lentil crop was taken continuously for the last 5-6 years. Extensive survey revealed that the disease was prevalent in varying disease incidence in all the districts.

Symptomatic collar rot infected plants were collected from fourtin lentil growing areas of Chhattisgarh state (Raipur IGKV farm- SR1, Agronomy, Field-SR2, Khurha-SR3, Mungeli, Temari SR4, Chilfi-SR5, Bhtha-Bhurka SR6, Bilaspur, takhatpurSR7, Dhamtari Kurud, Gobra SR8, Baloda bazaar, Simga Surgi-SR9, Bhatapara, Gogiya-SR10, Kawardha, Pandariya- kapadah-SR11, ghuterkudi-SR12, Bemetara Gadamod- SR13, Matia-SR14) for isolation of the causal fungus in the laboratory. Fourteen isolates of *Sclerotium rolfsii* were isolated from collected samples and designated as mention in Table 2.

Distribution and incidence of the disease

It is apparent from the data depicted in (Table-2 and Fig- 1) that lentil collar rot disese incidence was more sever in Raipur, Mungeli, Bemetara, Raipur, Bilaspur districts of Chhattisgarh than other surveyed districts of Chhattisgarh, during different cropping seasons. The average collar rot incidence of lentil (*Sclerotium rolfsaii.*) in different districts varied from 12.57 to 39.97 per cent. In Mungeli district, it was maximum (39.63%) followed by Bemetara (37.63%), Kawardha (32.00%), Raipur (23.73%), Balodabazar (16.89) Bilaspur (16.84%), Dhamtari (12.57%), Least wilt incidence was observed in Dhamtri (12.57%) district of Chhattisgarh.

The disease made its appearance at seedling to maturity stage (10-60 days old crop). Initially the leaves of infected lentil plants turns light pale in color , plant start drying and finally die (Plate -7). During survey. Mono-cropping also increase disease incidence was observed. Similarly, a striking correlation was noted between disease incidence and number of irrigations in lentil crop. The disease incidence was significantly higher in fields having less irrigation at as compared to the fields receiving higher number of irrigations. It was also noted that collar rot incidence was more where the crop was cultivated in heavy textured soils of the Chhattisgarh. Highest incidence was found in sandy loam soil followed by clay loam and clay.

Variation was also observed in soil types red, yellow and black soil types were found in one, four and fifty two locations of Chhattisgarh respectively. Results presented in Table 1 and fig.3 indicated that the maximum average disease incidence was recorded in black soil (16.77 per cent) followed by red soil (15.85 per cent). Minimum disease incidence was recorded in yellow soil (9.27 percent).

Observations of disease incidence were also recorded on improved and local lentil varieties. Improved varieties were found in Forty five locations while, local varieties found in twelve locations. Results presented in Table 1 and Fig.3 indicated that the disease incidence was more in local varieties (19.31 per cent) in comparison to improved varieties (15.40 per cent).

The disease incidence was maximum in untreated seed (19.31 per cent) found in twelve locations as compare to treated seed (15.40 per cent) found in forty five locations. (Fig.4)

Results also indicated that the disease incidence was more in irrigated condition (19.45 per cent) found in forty one locations. While, in rainfed conditions in sixteen location disease incidence recorded was 7.94 per cent (Fig. 5).

The disease made its appearance at seedling to maturity stage (10-60 days old crop). Initially the leaves of infected lentil plants turns light pale in color, plant start drying and finally die During survey. Mono-cropping also increase disease incidence was observed. Similarly, a striking correlation was noted between disease incidence and number of irrigations in lentil crop. The disease incidence was significantly higher in fields having less irrigation at as compared to the fields receiving higher number of irrigations. It was also noted that collar rot incidence was more where the crop was cultivated in heavy textured soils of the Chhattisgarh. Highest incidence was found in sandy loam soil followed by clay loam and clay.

Gosh *et al.*(2013) conducted survey in 2010-2011 *rabi* cropping season to obtain information on the distribution and incidence of lentil diseases in respect to soil type, cultivar used, seed treatment in central and southern parts of India. Collar rot diseases were found at all of the sites and incidence ranged from 7.1% - 10.5% respectively irrespective of cultivar type and locations. Kadam *et al.* (2011) [7] conducted field surveys in the Marathwada region of Maharashtra to determine the prevalence of diseases on groundnuts, the pathogen associated with the disease and the performance of different groundnut cultivars against collar rot in the field. The results showed that maximum disease incidence occurred in Renapur Tahsil (17.8%), followed by Udgir (16.7%), Ausa (14.7%) and Latur (14.3%). The lowest disease incidence was recorded in Nilanga (8.9%).

Table 1: survey of infected lentil field

S. No.	District	Block	Village/ Location	Soil type	Seed type	Seed Treated/ Untreated	Rainfed/ Irrigated
1	Raipur	Raipur	IGKV, Farm	Black	Improved	Treated	Irrigated
2			Agronomy, Field	Black	Improved(Experimental seed)	Untreated	Irrigated
3		Abhanpur	Khurha	Black	Local	Untreated	Rainfed
4	Mungeli	Mungeli	Temari	Black	Local	Untreated	Irrigated
5		Lormi	Chilfi	Black	Local	Untreated	Rainfed
6			Bhtha-Bhurka	Black	Local	Untreated	Rainfed
7	Bilaspur	Bilaspur	takhatpur	Black	Local	Untreated	Irrigated
8	Dhamtari	Kurud	Gobra	Black	Local	Treated	Rainfed
9	Baloda bazar	Simga	Surgi	Black	Local	Treated	Irrigated
10		Bhatapara	Gogiya	Black	Local	Untreated	Irrigated
11	Kawardha	Pandariya	kapadah	Black	Local	Treated	Rainfed
12			ghuterkudi	Black	Local	Treated	Rainfed
13	Bemetara	Bemetara	Gadamod	Black	Local	Untreated	Irrigated
14			Matia	Black	Local	Untreated	Irrigated

Table 2: Per cent disease incidence of lentil Collar rot of lentil fields in various districts of Chhattisgarh

S. NO.	Isolates	District	Village /Location	*Average PDI		**Mean
				2018-2019	2019-2020	
1	SR-1	Raipur	IGKV, Farm	9.51	12.44	10.97
2	SR-2		Agronomy, Field	40.97	37.15	39.06
3	SR-3		Khurha	21.47	20.87	21.17
4	SR-4		Temari	50.83	47.58	49.20
5	SR-5	Mungeli	Chilfi	26.74	31.48	29.11
6	SR-6		Bhtha-Bhurka	43.42	39.76	41.59
7	SR-7		takhatpur	17.89	21.35	19.62
8	SR-8	Bilaspur	Gobra	11.64	16.48	14.06
9	SR-9	Dhamtari	Surgi	10.56	14.58	12.57
10	SR-10	Baloda bazar	Gogiya	15.12	18.65	16.885
11	SR-11		kapadah	25.74	29.54	27.64
12	SR-12	Kawardha	ghuterkudi	36.36		36.36
13	SR-13		Gadamod	23.12	22.85	22.98
14	SR-14	Bemetara	Matia	35.72	39.54	37.63

* Average of three villages **Mean of total wilt incidence of two year (2018-19 and 2019-20)

Table 3: Per cent disease incidence of lentil collar rot fields in various districts of Chhattisgarh

District	Per cent Disease Incidence
Raipur	23.73
Mungeli	39.97
Bilaspur	16.84
Dhamtari	12.57
Baloda bazar	16.89
Kawardha	32.00
Bemetara	37.63

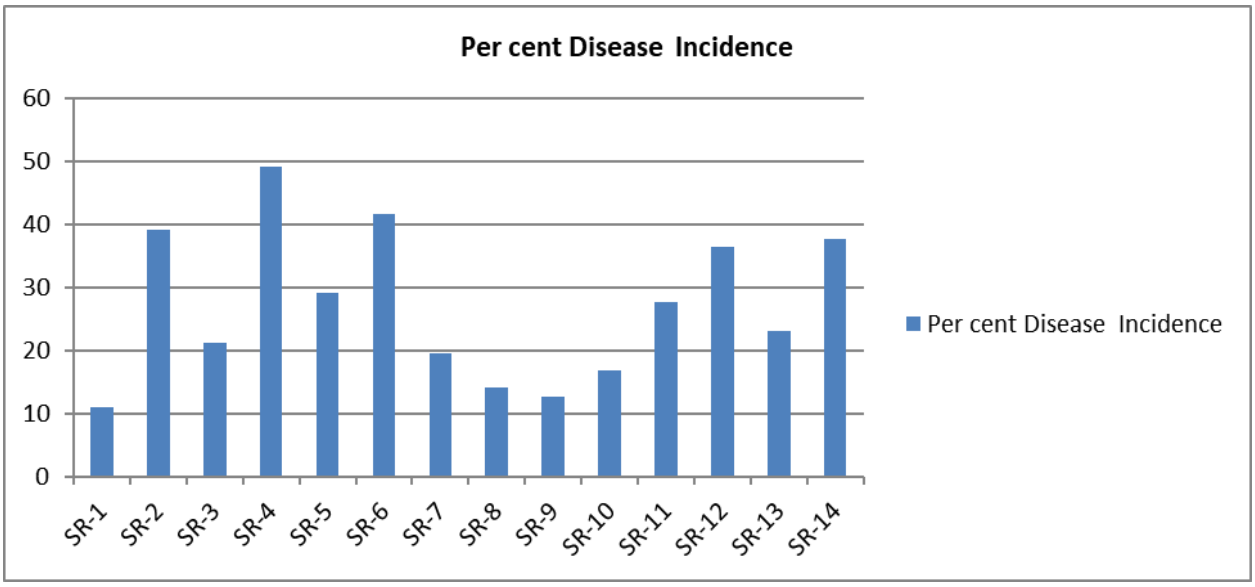

Fig 1: Per cent disease incidence of isolates of collar rot of lentil of Chhattisgarh

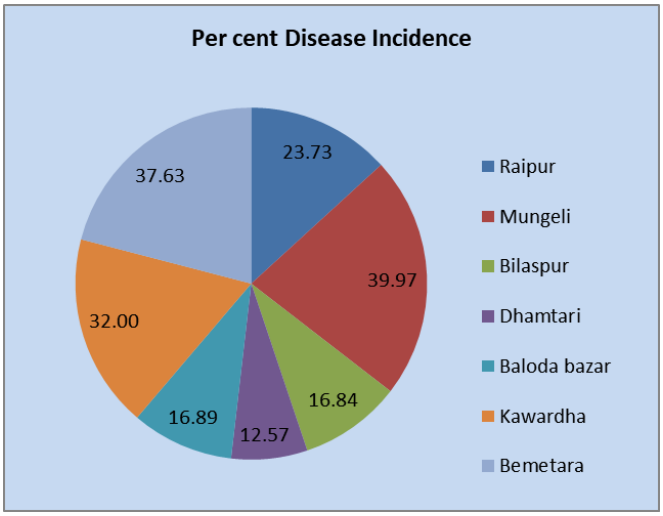

Fig 2: Disease incidence in different lentil growing areas of Chhattisgarh

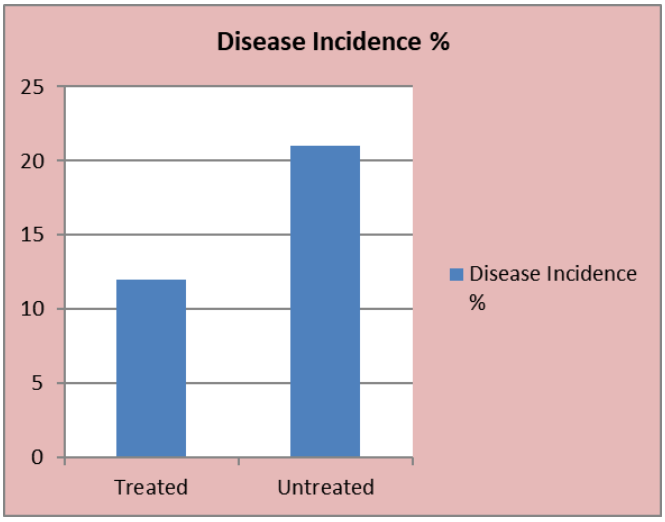

Fig 4: Disease incidence in treated and untreated seed in Chhattisgarh

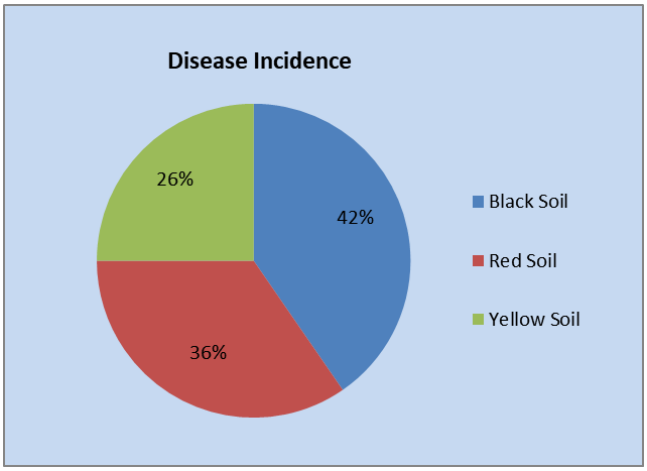

Fig 3: Disease incidence in different soil types of Chhattisgarh

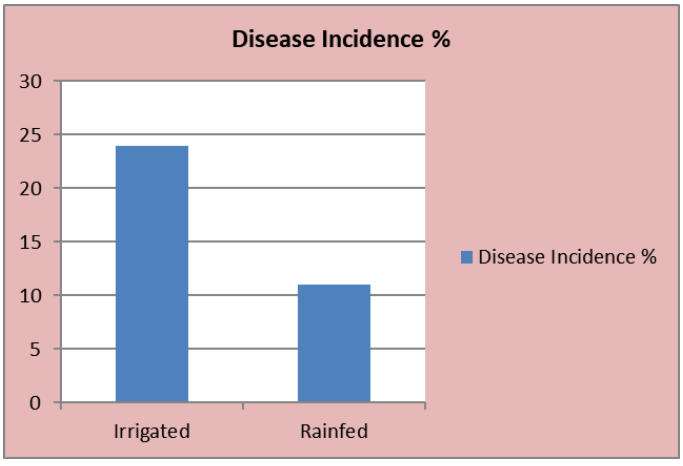

Fig 5: Disease incidence in Irrigated and Rainfed Condition in Chhattisgarh

Fig 6: Survey of infected lentil field

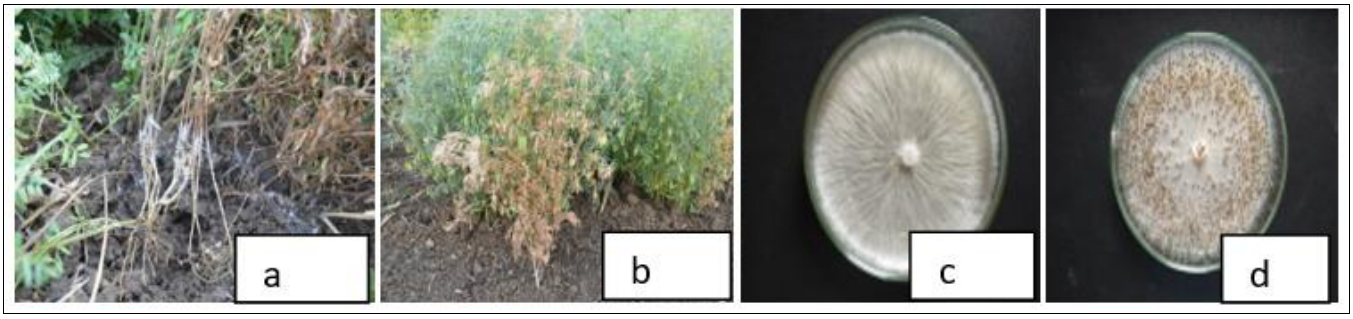

Fig 7: Field symptoms of collar rot of disease of lentil (a); Sclerotia production on collar rot region (b); isolated pure culture of *S. rolfsii* (c); Sclerotia formation in pure culture (d)

Conclusion

The survey for the occurrence and severity of lentil collar rot were undertaken at seedling and vegetative stage of the crop from fortin locations in seven lentil growing districts of Chhattisgarh state (Raipur , Mungeli, Bilaspur, Dhamrari, Balodabajar, Kawardha, and Bemetara,) during 2018 and 19. It is apparent that lentil collar rot disese incidence was more sever in Raipur, Mungeli, Bemetara, Raipur, Bilaspur districts of Chhattisgarh than other surveyed districts of Chhattisgarh, during different cropping seasons. The average collar rot incidence of lentil (*Sclerotium rolfsaii.*) in different districts varied from 12.57 to 39.97 per cent. In Mungeli district, it was maximum (39.63%) followed by Bemetara (37.63%), Kawardha (32.00%), Raipur (23.73%), Balodabazar (16.89) Bilaspur (16.84%), Dhamtari (12.57%), Least wilt incidence was observed in Dhamtri (12.57%) district of Chhattisgarh.

Symptoms of collar rot disease was observed in lentil under natural field conditions. The characteristic symptoms found were drying plants whose foliage turns slightly yellow scattered throughout the field was observed. Affected young seedling turned yellow and collapsed but the older seedlings dried without collapsing. No clear cut drooping of leaves was seen. Uprooted seedling showed rotting at the collar region and downwards. The collar portion was covered with whitish mycelia strands. White mycelia growth was also observed on the tap root of a completely dried seedling and rapseed-like sclerotia were observed attached to mycelia growth around the collar region.

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