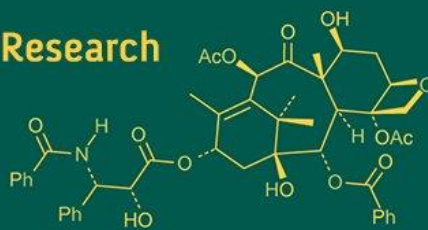


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Survey and collection of different isolates of *Sclerotium rolfii* from different linseed growing districts of Chhattisgarh

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Abstract

Linseed occupies a great importance among oilseeds and it is the sixth largest oilseed crop in the world and an important *Rabi* oilseed crop of India. This crop is susceptible to numerous biotic and abiotic stresses. Among various biotic diseases, collar rot is one of the highly destructive disease caused by *Sclerotium rolfii* which causes great loss and it develops in all the growing stage of the plant and responsible for 55-95% yield losses under favorable conditions. Keeping because of the importance of the disease, a roving survey was conducted and collection of 14 isolates was done during *Rabi* season 2020-21 and 2021-22 in the linseed growing districts of Chhattisgarh. The study revealed variations in disease prevalence per cent and mortality per cent. Linseed collar rot disease prevalence per cent was maximum in Mungeli district 44.97 % followed by Rajnandgaon district 42.31 %, Balod district 40.97 % and Kanker district 36.75 %. A minimum disease prevalence per cent was recorded in Bilaspur district 29.73 %. The results have also shown that among the 14 isolates collected from the different linseed cultivars grown in the mentioned linseed growing locations shown variations in mortality per cent. Maximum mortality per cent was recorded in village Baraidehra, Mungeli district (44.34 %) followed by village Madanpur, Bilaspur district (41.47%) and village Charbhatha, Bemetara district (40.60%) whereas, minimum mortality per cent was recorded in village Pahanda (A) Durg district (23.23%).

Keywords: Survey, linseed, collar rot, *Sclerotium rolfii*, disease prevalence per cent and mortality percent

1. Introduction

Linseed (*Linum usitatissimum* L.), a member of the Linaceae family belongs to the order Malpighiales with chromosome number $2n = 30$, $X = 15$ commonly known as Alsí, Jawas, Ulsee or Tisee and Aksebija in various languages of India. Linseed is mostly cultivated in the temperate, sub- tropical and tropical regions of the world. Linseed possesses a versatile nature and it predominantly cultivated in India as a *Rabi* crop for its oil production and extraction. It is the 6th largest oilseed crop in the world and an important *Rabi* oilseed crop of India. Linseed crop possessed numerous industrial and medicinal attributes with addition to its value as a good food source also. If we talk about its oil per cent in seed 37.8 to 43 % and contain a high-level protein 20.00 to 24.8% and oil of linseed contains more than 50% linolenic acid. On other hand dietary fiber content of 28% and 6% carbohydrate respectively. Linseed is cultivated as a most important commercial crop or as subsistence crop in over 30 countries worldwide. The important linseed growing countries are Canada, China, USA, Russian Federation and India with annual production of 3.06 million tons (Anonymous, 2000) [2]. After Canada, India ranks second largest (21.21%) linseed producing country in the world. India ranks 4th (8.20%) production wise after Canada (40.51%), China (18.68%) and USA (10.89%) in the world. In India the major linseed grown states are Himachal Pradesh, Uttar Pradesh, Madhya Pradesh, Bihar, Jharkhand, Odisha, Chhattisgarh, Assam, Maharashtra and Karnataka occupying for more than 97% of the total area (Biradar *et al.*, 2016). During the cropping year 2020-21 in India, linseed was grown in an area of about 1.69 lakhs hectares with the total production of 1.124 lakhs tones of seeds with productivity of 666 kg/ha respectively (Anonymous, 2020) [3]. In Chhattisgarh after mustard, linseed is the

second most important *Rabi* oilseed crop. Basically, it is grown as “*Utera*” in rainfed condition after Paddy. It is grown in an area of 11.5 thousand hectare with annual production of 3.89 thousand MT having an average productivity of 338 kg/ha (Anonymous, 2021-22) [4]. The purpose of growing linseed is to achieve high oil production as well as good fiber quality but the production level is very low due to various biotic and abiotic factors. There is a great scope to increase the production and productivity of this crop but the major constraints are non-availability of high yielding and disease resistant varieties to the farmers and numerous pest and diseases occurrence.

Among the fungal disease, Collar rot caused by *Sclerotium rolfsii* is one of the most significant serious disease in linseed. The pathogen attacks the host plant at all stages when the conditions are favorable. Collar rot caused by *Sclerotium rolfsii* develops at intermediate soil moisture level (70%) of field capacity and at temperature ranges between 25-30°C. *S. rolfsii* the incitant of linseed collar rot is a soil inhabitant, polyphagous, facultative parasite. The pathogen has a wide host range of over 500 plant species in 100 families, throughout the world. This fungus survives in the soil for many years by producing sclerotial bodies and causing the disease either in the form of stem rot or foot rot or root rot or collar rot in addition to leaf blight on several of its hosts. The first symptoms of collar rot produced by *S. rolfsii* on linseed plants under natural field conditions were characterized by yellowing and wilting of lateral branches and affected leaves become chlorotic and turn brown with rapidly dry out. The hyphae grew upward on the surface of the infected plant near root zone covering with a cottony, white mass of mycelium, scattered inside and outside of infected stem nearby the soil surface. A ‘white-washed’ appearance has been clearly visible on the soil surface and on affected plant. The fungus produces numerous small round, white sclerotia of uniform size when immature and later on when it at mature stage, it turns dark brown. In India collar rot of linseed caused by *Sclerotium rolfsii* was first

reported by Khati *et al.*, (1980) [10]. Collar rot of linseed was reported regularly from Raipur and other Chhattisgarh area (Singh *et al.*, 2017) [15].

In order to increase self-sufficiency in linseed production, the area is being increased to yield good productivity and the disease is being reduced by taking up plant production measures. Since, in Chhattisgarh there is no systematic study taken on collar rot disease in linseed and their control measures. The survey would ultimately help in indicate the areas with high disease incidence which can be managed timely to avoid linseed collar rot disease epidemic.

2. Materials and Methods

An intensive survey was conducted during *Rabi* season, 2020-21 and 2021-22, for the incidence of collar rot in linseed growing seven districts of Chhattisgarh. 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 were collected from different locations of Chhattisgarh state (Bastar, Bemetara, Balod, Durg, Kanker, Kawardha, Mungeli, Raipur, Rajnandgaon and Bilaspur) during January to February (Table 1). The field visits and collection of collar rot sample were undertaken during seedling and vegetative stages of the crop. 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 infected plants were counted and the mean disease incidence was expressed in percentage. The incidence of disease was recorded by random throwing of quadrat (1m²) in 5 farmer's fields of the different villages. The number of healthy and diseased plants (Collar rot) was counted in quadrat and percent disease prevalence and mortality per cent was calculated by using the following formulas:

$$\text{Disease prevalence (\%)} = \frac{\text{Number of fields showing linseed collar rot}}{\text{Total number of field visited}} \times 100$$

$$\text{Mortality (\%)} = \frac{\text{Number of plants affected}}{\text{Total number of plants observed}} \times 100$$

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

3. Results and Discussion

For the occurrence of linseed collar rot disease, a survey was undertaken during *Rabi* 2020-2021 and 2021-22 from fourteen locations in ten linseed growing districts of Chhattisgarh. Ten districts of Chhattisgarh are Bemetara, Mungeli, Kawardha, Durg, Rajnandgaon, Kanker, Balod, Bastar, Raipur and Bilaspur. Observations were recorded under natural condition from farmer's fields. During the survey, discussions were held with the concerned farmers, 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 linseed crop was taken continuously for the last 4-5 years. Extensive survey

revealed that the disease was prevalent in all the districts, with varying levels of disease incidence. Symptomatic collar rot infected plants were collected from selected fourteen linseed growing locations of Chhattisgarh state *viz.* Lawatara, Charbhatha, Baraidehra, Mudiapara, Ghothiya, Damapur, Pahanda (A), Rajpur, Vijaypur, Kaharpuri, Ganji, Baranji, KVK Farm and Madanpur then fourteen isolates of *Sclerotium rolfsii* were isolated from collected samples in the laboratory.

3.1 Disease prevalence and mortality percentage

It is apparent from the data depicted that the prevalence of linseed collar rot disease was higher in Mungeli, Rajnandgaon, Kanker, Bastar and Raipur districts than in the other surveyed districts of Chhattisgarh during different cropping seasons. The disease prevalence percentage of linseed at different districts varied from 29.73 to 44.97 per cent. At Mungeli district, it was maximum (44.97%) followed by Rajnandgaon (42.31%), Balod (40.97%), Bastar (39.53%), Kawardha (38.71%), Bemetara (37.39%) and Kanker (36.75%). The lowest disease prevalence (29.73%) was observed in Bilaspur district of Chhattisgarh (Table 2).

Likewise, mortality percentage of linseed at different locations varied from 23.23 to 44.34 per cent. Maximum mortality percentage was recorded in Mungeli (44.34%) followed by Bilaspur (41.47%) and Bemetara (40.60%). Minimum mortality percentage were recorded in Durg (23.23%). The results are presented in (Table 3).

Similar findings were reported by Kadam *et al.* (2011) [9] conducted field surveys in the Marathwada region of Maharashtra to determine the prevalence of collar rot 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%). Ghosh *et al.* (2013) [6] who conducted survey in 2010-2011 during Rabi cropping season to obtain information on the distribution and incidence of lentil diseases and found collar rot disease incidence ranged from 7.1% - 10.5%. Altaf *et al.* (2014) [1] surveyed nine districts of Pakistan with 28 locations during the crop season of year 2012-13 and out of which 21 showed 100% disease prevalence of lentil". Latha and Rajeshwari (2019) [12] observed Jasmine Sclerotium wilt caused by *S. rolfsii* during surveys conducted between December 2015 and March 2016 with incidence level between 5.27% to 17.00% and the highest being in Pavuthampalayam (17.00%) followed by Dhandapalayam (15.65%) and Sultanpet (14.66%). Koshariya *et al.* (2020) [11] surveyed seven lentil growing districts of Chhattisgarh with the conclusion that maximum mean disease incidence of *S. rolfsii* (39.63%) was observed in Mungeli district and lowest in Dhamtari district (12.57%). Modi and R. Udhaya (2021) [14] surveyed major brinjal growing areas of Tamil Nadu and concluded that highest disease incidence of *S. rolfsii* was at Kaveripattinam village of Krishnagiri district (36.16%) whereas least disease

incidence (7.73%) was recorded in Kottur village of Theni district. Gyanendra *et al.*, (2022) [8] documented variable collar rot incidence in chickpea across Madhya Pradesh ranging from 18.2% IN Batiyagarh block of Damoh to 8.08% in Goteagaon block of Narsinghpur. Tejaswi *et al.* (2023) [17] survey different groundnut growing areas of Khammam district of Telangana state and concluded that the highest disease incidence of *S. rolfsii* per cent was in Thimmineniapalem village of Chintakani mandal (52.0%) and least per cent disease incidence was observed in Dhammapet village of Dhammapeta mandal of Khammam district (7.0%). Meena *et al.* (2024) [13] observed that highest disease incidence 33.08% and least disease incidence of 15.04% was recorded in a roving survey of collar rot disease of chickpea caused by of *S. rolfsii* at different chickpea growing location of Rajasthan. Gunaseeli and Muthukumar (2025) [7] recorded percent disease incidence of *S. rolfsii* ranging from 8.28% to 34.79% in a roving survey across major brinjal growing areas of Tamil Nadu and concluded there findings with the result of maximum incidence of 34.79% at Kottumulai village in Cuddalore district, while minimum incidence of 8.28% was at Navakurichi village in Salem district. Soni *et al.*, (2025) [16] surveyed at major cluster bean growing district of Northern Madhya Pradesh and concluded that disease incidence of *S. rolfsii* in Gwalior districts ranges from 2.6% to 25.33% with highest disease incidence was recorded in Panihar (25.33%) and least disease incidence at Patai (2.67%). Likewise, disease incidence in Morena districts ranges from 1.33% to 18.67% with highest disease incidence was recorded in Mitawaligoan (18.67%) and least disease incidence at Jaura (1.33%). In Shivpuri district disease incidence recorded ranging from 2.67% to 20.00% and in this context highest disease incidence was recorded at Karyawati (20.00%) least disease incidence was at Karsena (2.67%).

Table 1: Survey and collection of collar rot infected plant samples from different districts of Chhattisgarh

Isolate code	District	Block	Village/ location	Latitude and longitude	Cultivation practice	Soil type and land type	Variety	Seed treatment
SRCG25-1	Bemetara	Berla	Lawatara	21°45'9" N 81°32'42" E	Broadcasting	Black/Irrigated	Local	Untreated
SRCG25-2	Bemetara	Bemetara	Charbhatha	21°44'29" N 81°32'29" E	Broadcasting	Black/Rainfed	Local	Untreated
SRCG28-3	Mungeli	Mungeli	Baraidehra	22°3'10" N 81°34'55" E	Broadcasting	Black/Rainfed	Local	Untreated
SRCG28-4	Mungeli	Mungeli	Mudiyapara	22°46'28" N 81°32'46" E	Broadcasting	Clay loam/Rainfed	Local	Untreated
SRCG09-5	Kawardha	Kawardha	Ghothiya	22°3'52" N 81°25'36" E	Line sowing	Black/Irrigated	RLC-148	Treated
SRCG09-6	Kawardha	Bodla	Damapur	22°2'40" N 81°27'50" E	Broadcasting	Black/Rainfed	Local	Untreated
SRCG07-7	Durg	Patan	Pahanda (A)	21°39'29" N 81°54'16" E	Line sowing	Black/Irrigated	RLC-148	Treated
SRCG07-8	Durg	Dhamdha	Rajpur	21°18'33" N 81°28'56" E	Broadcasting	Black/Rainfed	Local	Untreated
SRCG08-9	Rajnandgaon	Manpur mohla	Vijaypur	21°16'29" N 81°48'2" E	Broadcasting	Black/Rainfed	Local	Untreated
SRCG19-10	Kanker	Kanker	Kaharpuri	20°20'36" N 81°13'37" E	Utera	Clay loam/Rainfed	Local	Untreated
SRCG24-11	Balod	Dondi	Ganji	20°37'42" N 81°4'10" E	Utera	Black/Rainfed	Local	Untreated
SRCG17-12	Bastar	Lohandiguda	Baranji	19°15'23" N 81°52'28" E	Utera	Clay loam/Rainfed	Local	Untreated
SRCG04-13	Raipur	Dharsiwa	KVK Farm, Dharsiwa	21°14'13" N 81°42'49" E	Line sowing	Black/Irrigated	RLC-148	Treated
SRCG10-14	Bilaspur	Belha	Madanpur	22°6'5" N 81°34'22" E	Broadcasting	Black/Rainfed	Local	Untreated

Table 2: Survey and collection of collar rot infected plant samples from different districts of Chhattisgarh

Sr. No.	District	No. of block visited		No. of village visited		Total No. of field visited		No. of affected field		Disease prevalence (%)		Mean disease prevalence (%)
		2020-21	2021-22	2020-21	2021-22	2020-21	2021-22	2020-21	2021-22	2020-21	2021-22	
1.	Bemetara	1	1	4	4	13	12	5	4	38.46	36.32	37.39
2.	Mungeli	1	1	4	4	13	14	6	6	46.15	43.79	44.97
3.	Kawardha	2	3	3	3	12	13	5	4	41.66	35.76	38.71
4.	Durg	2	5	6	6	16	14	6	4	37.59	34.25	35.92
5.	Rajnandgaon	3	2	4	4	11	12	5	5	45.41	39.21	42.31
6.	Kanker	2	2	3	3	12	14	5	6	40.66	32.85	36.75
7.	Balod	2	2	6	6	15	11	7	3	46.69	35.25	40.97
8.	Bastar	2	2	3	3	11	11	5	4	41.45	37.62	39.53
9.	Raipur	2	3	4	4	12	12	4	5	36.21	32.46	34.33
10.	Bilaspur	2	1	5	5	13	11	5	3	32.25	27.21	29.73

Table 3: Mortality (%) of linseed collar rot on field at different districts of Chhattisgarh during *Rabi* 2020-21 & 2021-22

Sr. No.	District	Village/ location	Total no. of plant population		Total no. of mortality		Mortality (%)		Mean of mortality (%)
			2020-21	2021-22	2020-21	2021-22	2020-21	2021-22	
1	Bemetara	Lawatara	38	29	12	09	31.57	31.03	31.30
2		Charbhatha	28	31	11	13	39.28	41.93	40.60
3	Mungeli	Baraidehra	55	32	23	15	41.81	46.87	44.34
4		Mudiyapara	52	30	21	14	40.38	46.66	43.52
5	Kawardha	Ghothiya	49	44	12	13	24.48	29.54	27.01
6		Damapur	45	32	12	12	26.66	37.50	32.08
7	Durg	Pahanda (A)	39	47	09	11	23.07	23.40	23.23
8		Rajpur	35	32	09	12	25.71	37.50	31.60
9	Rajnandgaon	Vijaypur	47	27	20	09	42.55	33.33	37.94
10	Kanker	Kaharpuri	29	49	13	17	44.82	34.69	39.75
11	Balod	Ganji	37	27	12	11	32.43	40.74	36.58
12	Bastar	Baranji	46	31	12	12	26.08	38.70	32.39
13	Raipur	KVK Farm	32	22	09	08	28.12	36.36	32.24
14	Bilaspur	Madanpur	59	19	21	09	35.59	47.36	41.47



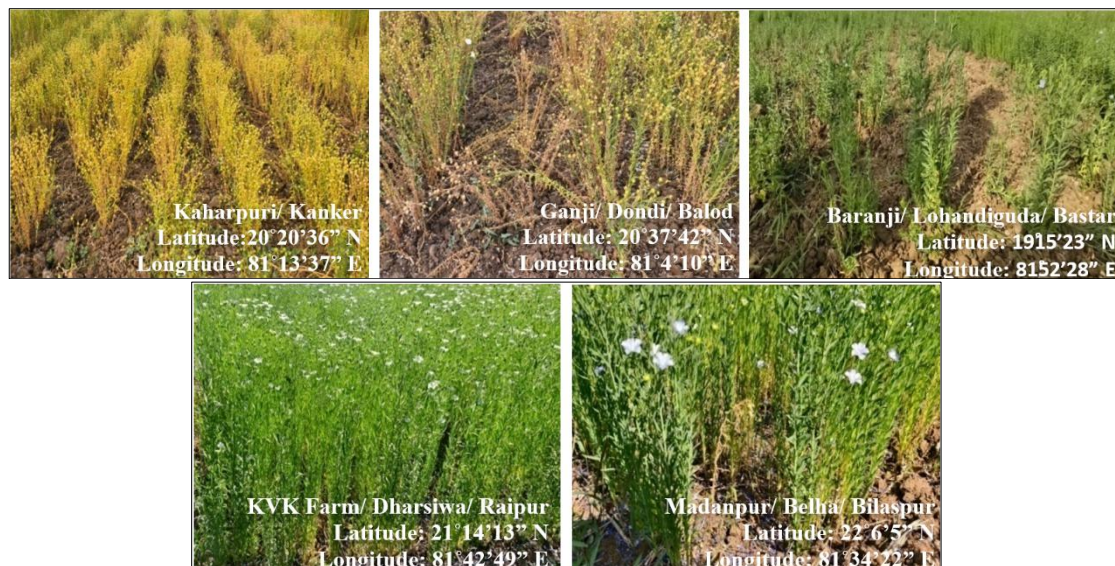


Fig 1: Survey of linseed affected field at different districts of Chhattisgarh

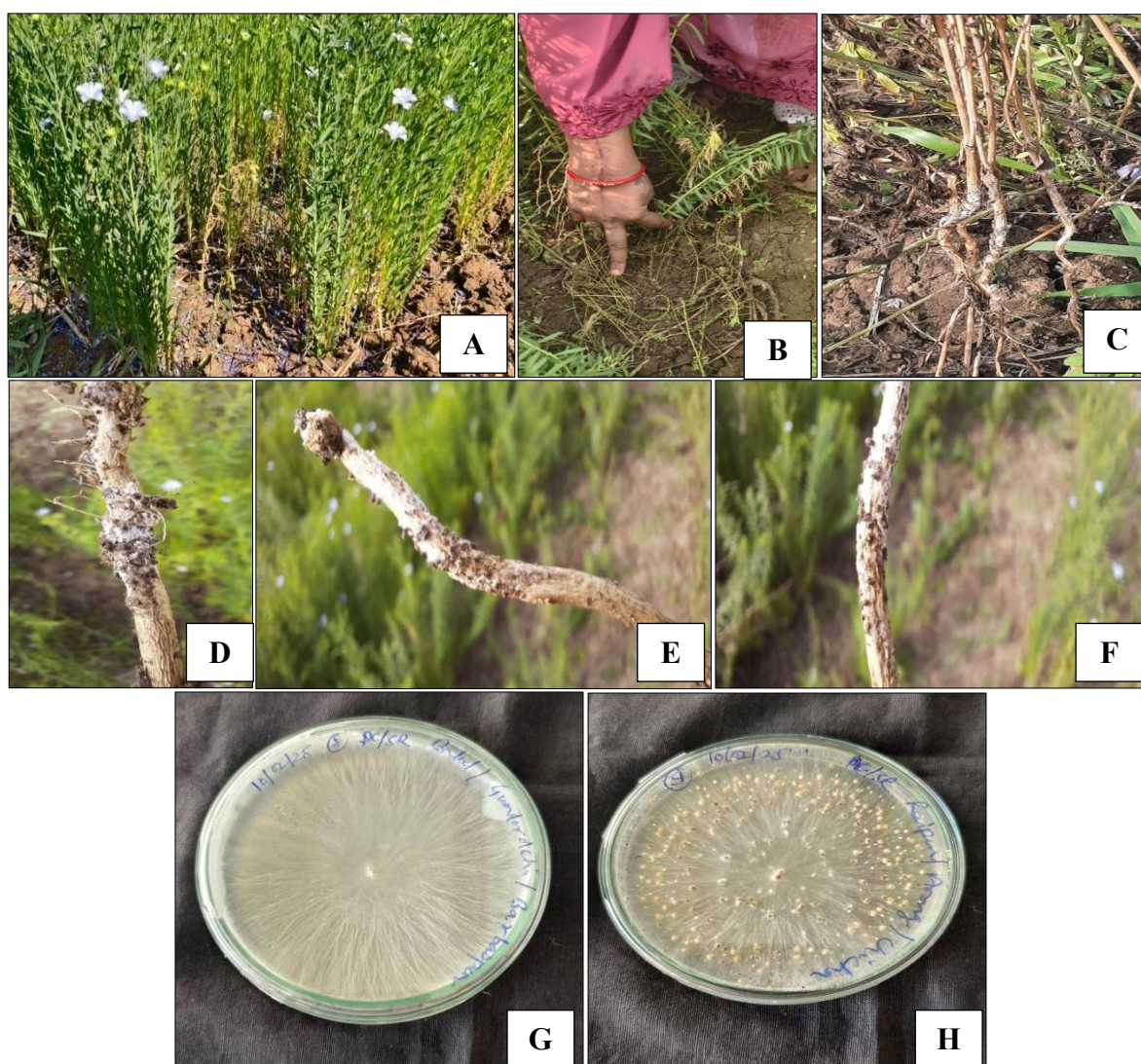


Fig 2: Field symptoms of Linseed collar rot disease (A and B); Rotting and sclerotia production at collar region (C and D); Uprooted seedling shows rotten at collar region and downwards (E and F); Isolated pure culture of *S. rolfsii* (G); Sclerotia formation in pure culture (H)

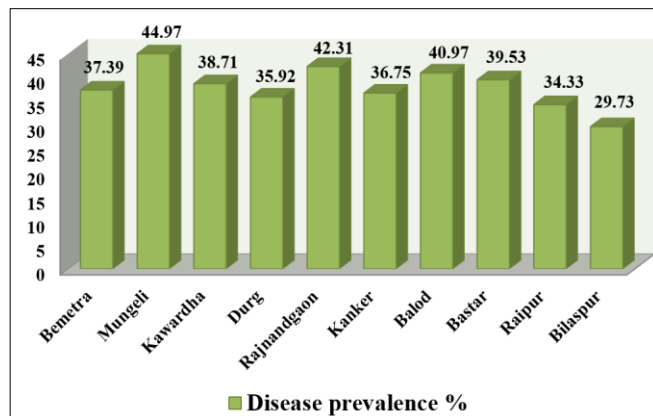


Fig 3: Disease prevalence (%) of linseed collar rot on field at different districts of Chhattisgarh during Rabi 2020-21 & 2021-22

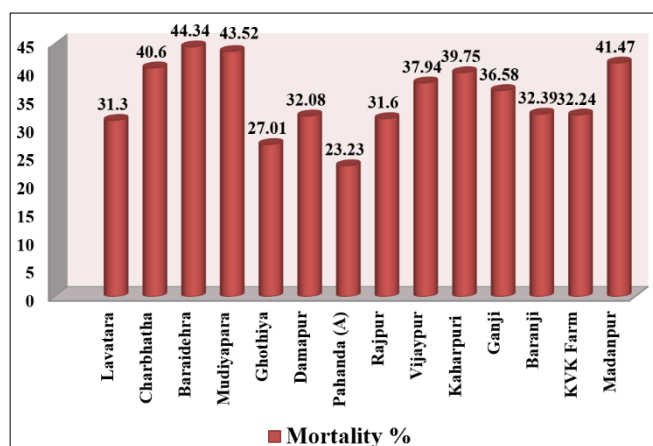


Fig 4: Mortality (%) of linseed collar rot on field at different districts of Chhattisgarh during Rabi 2020-21 & 2021-22

3. Conclusion

The present findings from the survey conducted and collection of 14 isolates done during Rabi season, 2020-21 and 2021-22 in the linseed growing districts of Chhattisgarh. During survey made at 14 locations in 10 linseed growing districts of Chhattisgarh, the occurrence and severity of linseed collar rot disease was very high during crop season. The highest collar rot prone area was Mungeli district followed by Rajnandgaon, Balod and Kanker district. Linseed collar rot disease prevalence per cent was maximum in Mungeli district 44.97 % followed by Rajnandgaon district 42.31 %, Balod district 40.97 % and Kanker district 36.75 % whereas, minimum disease prevalence per cent was recorded in Bilaspur district 29.73 %. 14 isolates collected from the different linseed growing locations shown variations in mortality per cent. Maximum mortality per cent was recorded in village Baraidehra, Mungeli district (44.34 %) followed by village Madanpur, Bilaspur district (41.47%) and village Charbhatha, Bemetara district (40.60%) whereas, minimum mortality per cent was recorded in village Pahanda (A) Durg district (23.23%).

Disclaimer (Artificial Intelligence)

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (Chat GPT, COPILOT, etc.) and text-to-image generators have been used during writing or editing of this manuscript.

Competing interests

Authors have declared that no competing interests exist.

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