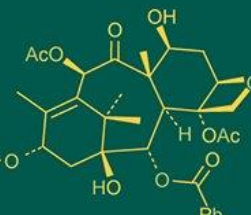
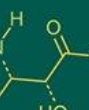
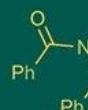


International Journal of Advanced Biochemistry Research



ISSN Print: 2617-4693
ISSN Online: 2617-4707
NAAS Rating (2026): 5.29
IJABR 2026; SP-10(9): 1758-1762
www.biochemjournal.com
Received: 01-06-2026
Accepted: 06-07-2026

Ruparani Diwakar
Department of Plant
Pathology, College of
Agriculture, Indira Gandhi
Krishi Vishwavidyalaya,
Raipur, Chhattisgarh, India

Ashulata Kaushal
Department of Plant
Pathology, College of
Agriculture, Indira Gandhi
Krishi Vishwavidyalaya,
Raipur, Chhattisgarh, India

Corresponding Author:
Ruparani Diwakar
Department of Plant
Pathology, College of
Agriculture, Indira Gandhi
Krishi Vishwavidyalaya,
Raipur, Chhattisgarh, India

Mapping soil-borne disease induced mortality in linseed (*Linum usitatissimum* L.) caused by *Fusarium oxysporum* f. sp. *lini*, *Rhizoctonia solani* and *Sclerotium rolfsii* across Chhattisgarh plains and northern hill agro-climatic zones

Ruparani Diwakar and Ashulata Kaushal

DOI: <https://www.doi.org/10.33545/26174693.2026.v10.i9Sv.10074>

Abstract

To map soil borne disease induced mortality in linseed (*Linum usitatissimum* L.) across Chhattisgarh plains and Northern hill agroclimatic zones, eleven district of Chhattisgarh were selected where linseed is predominantly grown and conducted survey in two successive seasons 2022-2023 and 2023-24. The data revealed that the mortality percentage ranged from 16.20% to 39.52% in different districts of Chhattisgarh. The highest percentage mortality was recorded from Raipur 34.08% (39.52 and 28.65%) followed by Balrampur 28.54% (32.19 and 24.89%) in two successive years whereas, lowest percentage mortality was recorded from Kawardha district 19.36% (18.21 and 20.52%) followed by Balodabazar 22.44% (25.95 and 18.92%) in two successive years. The association of three pathogens *Fusarium oxysporum* f. sp. *lini*, *Rhizoctonia solani* and *Sclerotium rolfsii* was confirmed as the major cause of mortality.

Keywords: Linseed, soil-borne diseases, mortality, *Fusarium oxysporum*, *Rhizoctonia solani*

Introduction

Linseed (*Linum usitatissimum* L.) is an important oilseed crop grown all over the world, since the very beginning of the human civilization. It belongs to the genus *Linum* of the family Linaceae. *Linum usitatissimum* (chromosome no. $2n=30$) (Tammes, 1928) is the only cultivated species of the genera *Linum*. Linseed is a highly nutritious crop rich in essential nutrients that contribute to human health. It contains fat (40-45%), dietary fiber (25-30%), proteins (18-22%), lignans and essential micronutrients including vitamin B1 (thiamine), magnesium, phosphorus, and selenium, contributing to various physiological functions. Flax is also one of the richest plant based sources of α -linolenic acid (ALA), a polyunsaturated fatty acid known for its nutritional and health benefits (Alister and Neil, 2003) [1]. Additionally, linseed oil is utilized in products like paint, varnish and linoleum, while its fibers are used in textiles, ropes and paper manufacturing. However, the area under linseed cultivation is declining due to its low productivity. Among various abiotic and biotic stresses, diseases are the most significant factor affecting its yield. A number of diseases however, act as yield limiting factors for the crop. Among the different diseases, major diseases include rust (*Melampsora lini*), powdery mildew (*Oidium lini*), *Alternaria* blight (*Alternaria linicola*), and soil borne fungal diseases such as *Fusarium* wilt, seedling blight/ root rot and collar rot (*Fusarium oxysporum* f.sp. *lini*, *Rhizoctonia solani* and *Sclerotium rolfsii*) etc. Among biotic factors, soil-borne diseases pose a significant threat to both seed production and fiber quality, which highlights the economic importance of these diseases (Moyse *et al.*, 2023) [4]. The infection by soil borne pathogens results in pre- and post- emergence mortality which directly reduces plant stand per unit area. The percent mortality due to these diseases varies from location to location depending upon cropping history, soil type, moisture and inoculums load. So the present investigation was undertaken to document the occurrence and percent mortality due to soil borne diseases of linseed in major linseed growing districts of Chhattisgarh.

Materials and Methods

For survey, eleven district of Chhattisgarh were selected where linseed is predominantly grown. Survey was conducted in two successive seasons 2022-2023 and 2023-24. For the disease survey, villages were randomly selected and within each village, a few fields were surveyed. Disease reaction was observed in five farmers' fields per village, with three random observations recorded at different locations within each field. The fields were visually assessed for wilt, root rot and collar rot. The mean

percentage mortality due to diseases was calculated for each village. During the survey, the total number of linseed plants in a quadrat of 1 meter square was counted and infected plants were recorded separately to determine the percentage of mortality. Using the numerical data collected on the total number of linseed plants and the number of infected plants per surveyed field, the percentage mortality was calculated following the method described by Mayee and Datar (1986) [3].

$$\text{Percentage mortality/ Incidence(\%)} = \frac{\text{Infected plants in quadrat}}{\text{Total number of plants assessed in quadrat}} \times 100$$

Diseased samples showing three different symptoms were brought to the Department of Plant Pathology, IGKV, Raipur. Isolation was done on Potato Dextrose Agar (PDA) medium. Pure cultures were obtained by single hyphal tip technique. Identification was done on the basis of mycelia characters, spore morphology and sclerotial characters with standard descriptions. Pathogenicity was proved by soil inoculation method in pots as per Koch's postulates. The mortality observed in surveyed fields was attributed to three pathogens i.e. *Fusarium oxysporum* f.sp. *lini*, *Rhizoctonia solani* and *Sclerotium rolfsii*.

Results and Discussion

Survey of linseed growing areas of Chhattisgarh for the percentage mortality due to soil borne diseases was conducted during two successive years 2023-24 and 2024-25 (table 1). Total eleven districts viz., Raipur, Rajnandgaon, Bemetara, Mahasamund, Durg, Kanker, Surajpur, Balrampur, Surguja, Balodabazar and Kawardha were surveyed during the cropping seasons. Percentage mortality of the disease, cultivation practices applied, variety used, soil type of the region and geographical coordinates were recorded during the course of investigation. The data revealed that the percentage mortality ranged from 16.20% to 39.52% in different districts of Chhattisgarh. The highest mean percentage mortality was recorded from Raipur 34.08% (39.52 and 28.65%) followed by Balrampur 28.54% (32.19 and 24.89%) and Surguja 28.02% (33.78 and 22.25%) in two successive years. Lowest mean percentage mortality was recorded from Kawardha district 19.36% (18.21 and 20.52%) followed by Balodabazar 22.44% (25.95 and 18.92%) and Kanker 22.65% (22.78 and 22.52%) in two successive years. Moderate mean percentage mortality was recorded from Rajnandgaon 24.11% (28.24 and 19.98%), Mahasamund 24.97% (29.88 and 20.06%), Bemetara 25.47% (29.78 and 21.16%), Durg 27.78% Surajpur 27.7% (31.59 and 23.94%) and Surguja 28.02% (33.78 and 22.25%) in two successive years.

During the present investigation diseased samples exhibiting three distinct symptoms viz., vascular wilt root rot and collar rot were collected from surveyed locations. The samples were subjected to isolation, purification and pathogenicity tests under laboratory and pot culture conditions. On the basis of cultural, morphological characteristics and pathogenicity, the pathogens were identified and confirmed as *Fusarium oxysporum* f. sp. *lini*, *Rhizoctonia solani* and *Sclerotium rolfsii*

Thus the roving survey conducted across major linseed-

growing regions of Chhattisgarh demonstrated that the percentage mortality was significantly influenced by cropping year, cultivation practices, varietal response, soil type and crop growth stage (table 2). The overall mean percentage mortality was higher during 2023–24 (29.42%) than 2024–25 (22.43%) indicating that the environmental conditions prevailing during 2023–24 were more favourable for the development of the disease. Among the cultivation practices, broadcast sowing recorded the higher mean percentage mortality (28.70%), whereas line sowing exhibited comparatively lower mean percentage mortality (23.80%). Varietal response also showed marked differences with improved varieties recording a lower mean percentage mortality (24.32%) than local varieties (27.60%), while the susceptible variety exhibited the highest mortality (35.06%). These observations indicate the importance of host resistance in minimizing disease severity under field conditions. Soil type also had a noticeable influence on mean percentage mortality. The mortality was comparatively higher in Kanhar (27.08%) followed by Dorsa (26.73%) soils, whereas Matasi soil recorded the lowest mean percentage mortality (25.59 %). The variation among soil types suggests that differences in soil physical and chemical properties such as texture, moisture retention, drainage, and microbial activity, may influence the establishment and survival of the wilt pathogen. Furthermore, disease incidence varied with crop growth stage, with the seedling stage (26.67%) recording slightly higher percentage mortality than the vegetative stage (26.37%), indicating that the younger seedlings are comparatively more vulnerable to infection by the soil-borne pathogen as compared to the older ones. Among Northern hills and Chhattisgarh plains, northern hills recorded higher percentage mortality (28.10%) as compared to Chhattisgarh plains (25.10%) that may be due to differences in adaptation of cultivation practices and varieties by the farmers.

The results of the present investigation are in accordance with earlier reports on the occurrence of linseed wilt in different regions of India. Verma *et al.*, (2023) [7] reported that during 2018–19 *rabi* season in Uttar Pradesh, the highest average wilt incidence was recorded in Mirzapur (28.33%) followed by other districts. Similarly, Naik and Sahoo (2016) [5] observed wilt incidence ranging from 0 to 7.6% over nine years (2000–2009) in Mayurbhanj district of Odisha. Kumar *et al.*, (2014) [2] also reported a maximum wilt incidence of 9% in Gopalpur and Aliapur areas of Kanpur. These reports demonstrate the persistent occurrence of linseed wilt across different regions.

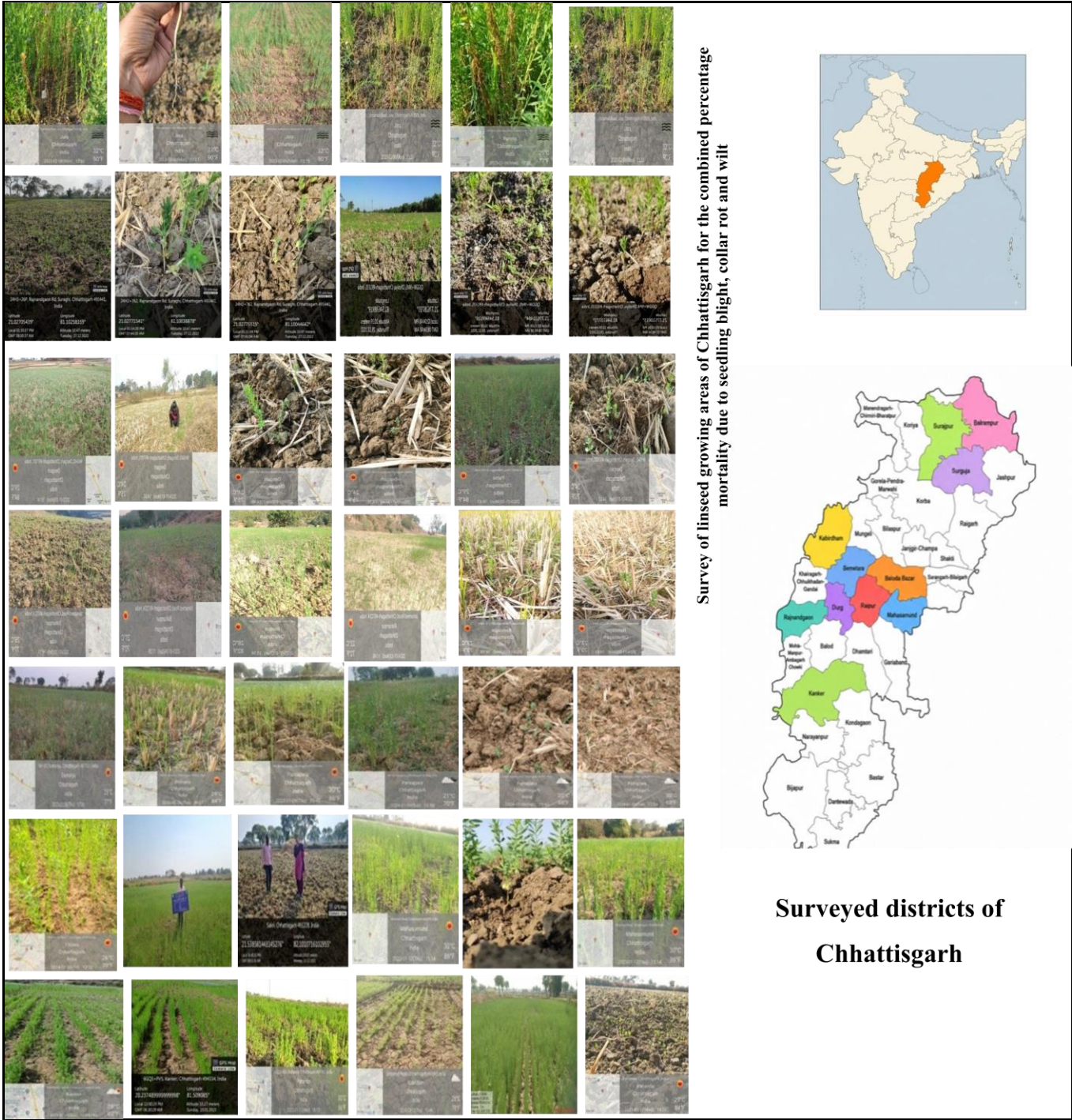


Plate 1: Survey of linseed crop for the percentage mortality in different districts of Chhattisgarh

Table 1: Survey of linseed growing areas of Chhattisgarh for the percentage mortality due to soil borne diseases during the year 2023-24 and 2024-25

S. No.	Districts	Village	Geographical Coordinates		Cultivation Practices	Variety	Soil type	Stage of the crop	Percentage mortality		Total mean
									(2023-24)	(2024-25)	
1.	Raipur	Serikhedi	81.718854°	21.233896°	Broadcasting	RLC 148	Kanhar	Vegetative growth	38.40	27.82	33.11
		Krishak Nagar	81.715203°	21.228683°	Line	Neelam	Kanhar	Seedling	40.64	29.48	35.06
								Mean	39.52	28.65	34.08
2.	Rajnandgaon	Surgi 1	81.1003888°	21.02771541°	Broadcasting +Utera	Local	Dorsa	Seedling	27.38	18.08	22.73
		Surgi 2	81.102583°	21.0205439°	Broadcasting +Utera	Local	Dorsa	Seedling	29.10	21.88	25.49
								Mean	28.24	19.98	24.11
3.	Bemetara	Dholiya 1	81.54649516°	21.77631484°	Line	RLC 143	Dorsa	Seedling	28.66	19.93	24.30
		Dholiya 2	81.54635904°	21.77626545°	Broadcasting	RLC 153	Dorsa	Seedling	30.91	22.40	26.66
								Mean	29.78	21.16	25.47
4.	Mahasamund	Kuliya 1	82.084689°	21.059344°	Line	RLC 143	Matasi	Flowering	22.70	12.50	17.60
		Kuliya 2	82.082584°	21.059901°	Broadcasting	Deepika	Matasi	Vegetative growth	37.06	27.62	32.34
								Mean	29.88	20.06	24.97
5.	Durg	Pahanda	81.531105°	21.203069°	Broadcasting	RLC 133	Kanhar	Seedling	28.74	22.00	25.37
		Bendri	81.4246°E	21.1470°N	Broadcasting	Local	Kanhar	Vegetative growth	34.67	25.74	30.21
								Mean	31.70	23.87	27.78
6.	Kanker	Kanker	81.509085°	20.23748999°	Line	RLC143	Matasi	Vegetative growth	22.78	22.52	22.65
								Mean	22.78	22.52	22.65
7.	Surajpur	Tilsiwa	82.886654°	23.212093°	Broadcasting	Local	Dorsa	Seedling	33.00	28.76	30.88
		Parsapara	82.826004°	23.234637°	Broadcasting +Utera	Local	Dorsa	Flowering	36.94	13.91	25.43
		Dumariya	82.722716°E	23.266963°N	Broadcasting +Utera	Local	Dorsa	Flowering	28.60	25.78	27.19
		Patrapara	82.8259°	23.233782°	Broadcasting +Utera	Local	Dorsa	Seedling	27.78	26.44	27.11
		Krishnapur	82.802138°	23.245028°	Broadcasting +Utera	Local	Dorsa	Seedling	31.63	24.79	28.21
								Mean	31.59	23.94	27.76
8.	Balrampur	Benipur	83°51'2"E	23°19'2"N	Broadcasting	Local	Matasi	Seedling	28.96	18.88	23.92
		Jiganiyan	83°52'21"E	23°18'59"N	Broadcasting	Local	Matasi	Vegetative growth	34.54	27.33	30.94
		Ramnagar	83.848316°	23.317092°	Broadcasting +Utera	Local	Matasi	Seedling	33.08	28.46	30.77
								Mean	32.19	24.89	28.54
		Parsa	83.267907°	23.19438°	Broadcasting	Local	Dorsa	Flowering	30.91	18.92	24.92
9.	Surguja	Deogarh	83°14'14"E	23°10'27"N	Broadcasting +Utera	Local	Dorsa	Seedling	36.91	25.58	31.11
								Mean	33.78	22.25	28.02
								Seedling	25.95	18.92	22.44
10.	Balodabazar	Sakri	82.101071°	21.5385814°	Broadcasting + Utera	RLC143	Matasi	Mean	25.95	18.92	22.44
								Flowering	16.20	22.44	19.32
11.	Kawardha	Birkona	81.32135°	21.96939°	Line+Utera	RLC143	Kanhar	Seedling	20.22	18.64	19.43
		Newari	81.254153°	22.026342°	Line	RLC143	Kanhar	Mean	18.21	20.52	19.36
								Seedling	20.22	18.64	19.43

Table 2: Effect of different variables on the mean percent mortality of the linseed crop

S. No.	Variables	Category	No. of Fields	Mean Percentage Mortality
1	Year	1. 2023-24	12	29.42
		2. 2024-25	12	22.43
2	Cultivation Practices	1. Broadcasting	9	28.70
		2. Line sowing	6	21.65
		3. Broadcasting + Utera	9	26.72
3	Variety	1. Local	13	27.60
		2. Improved	10	24.32
		3. Susceptible	1	35.06
4	Soil type	1. Matasi	3	25.59
		2. Dorsa	11	26.73
		3. Kanhar	6	27.08
5	Crop stage	1. Seedling	14	26.67
		2. Vegetative growth	10	26.37
6.	Zones	1. Northern hills	10	28.10
		2. Chhattisgarh plains	14	25.10

Conclusion

Overall, the survey findings clearly indicate that the percentage mortality of linseed by soil borne pathogen are governed by the combined effects of seasonal environmental conditions, agronomic practices, varietal susceptibility, soil characteristics, and crop growth stage. These factors should therefore be considered while developing effective disease management strategies and selecting suitable production practices for minimizing wilt incidence under field conditions.

References

1. Alister MD, Neil WD. Flax: the genus *Linum*. 2003.
2. Kumar JML, Tripathi UK, Tomer A, Kumar P, Singh A. Screening of linseed germplasm for resistance/tolerance against *Fusarium oxysporum* f. sp. *lini* (Bolley) disease. Journal of Plant Pathology & Microbiology. 2014;5:235.
3. Mayee CD, Datar VV. Phytopathometry. Parbhani: Marathwada Agricultural University; 1986. p. 146.
4. Moyse J, Lecomte S, Marcou S, Mongelard G, Gutierrez L, Höfte M. Soil-borne diseases of flax (*Linum usitatissimum*). In: Encyclopedia. 2023. Available from: <https://encyclopedia.pub/entry/47607>
5. Naik BS, Sahoo KC. Survey of diseases of linseed (*Linum usitatissimum* L.) in Mayurbhanj district of Odisha. International Journal of Advanced Research. 2016;4(4):1407-1410. doi:10.21474/IJAR01.
6. Tammes T. The genetics of the genus *Linum*. Bibliographia Genetica. 1928.
7. Verma PK, Patel S, Srivastava V, Yadav SK, Singh G. Studies on survey and management of linseed wilt (*Fusarium oxysporum* f. sp. *lini*). The Pharma Innovation Journal. 2023;12(6):3540-3543.