MINI REVIEW

# A Comprehensive Review of *Sclerotinia* Stem Rot in Indian Mustard (*Brassica juncea*)

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## Abstract

Indian mustard (*Brassica juncea*), an important oilseed crop, is highly susceptible to the devastating disease called *Sclerotinia* stem rot, caused by the fungus *Sclerotinia sclerotiorum*. This review paper provides a comprehensive summary of the present understanding of the disease, encompassing its epidemiology, pathogen biology, interactions between the host and pathogen, management strategies, and the latest advancements in research. There is an urgent need for effective disease management strategies, as evident by the financial consequences of *Sclerotinia* stem rot on the production of Indian mustard. This review aims to comprehensively analyze research articles to enhance our understanding of the disease and expedite the development of enduring solutions to mitigate it's impacts. Rapeseed mustard is susceptible to various pathogens, including fungi, bacteria, viruses, and phytoplasma. *Sclerotinia* stem rot is the most severe fungal disease affecting Indian mustard. Extensive studies and development have been conducted on the occurrence of *Sclerotinia* rot in rapeseed mustard. This study examines these endeavors in relation to disease cycle, epidemiology, pathogen taxonomy, nature, and control. Moreover, the study aims to present a comprehensive summary of potential future goals and research methodologies concerning *Sclerotinia* rot in rapeseed.

**Keywords:** *Sclerotinia* stem rot, Disease cycle, Epidemiology rapeseed mustard, Symptom, management.

**Highlights**

- *Sclerotinia* stem rot, a fungal disease, poses a significant threat to Indian mustard crops.
- Yield losses can reach up to 50% due to the disease's ability to rapidly spread and infect plants.
- Cultural practices such as crop rotation and sanitation can help manage the disease.
- Fungicides can provide some control, but their effectiveness may vary depending on timing and application methods.
- Breeding for resistance traits remains a promising long-term strategy for combating *Sclerotinia* stem rot in Indian mustard.

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## Introduction

India is the top global producer of rapeseed mustard, ranking third in significance after soybeans and palms. India is the third-largest producer of this commodity, contributing to 19.8% of global production and occupying 28.3% of the total average. Shekhawat *et al.,* (2012) & Bandopadhyay *et al.,* (2013). India cultivates rapeseed-mustard crops on an area of 6.45 million hectares, producing a total of 7.28 million tons annually. The average yield per hectare is 1128 kg/ha. Anonymous, (2015). The nation is expected to achieve a historic level of oilseed production in the 2021-2022 period, surpassing the previous year's output by 2.55 million tonnes, reaching a total of 35.95 million tonnes. Production data for the years 2020 and 2021. in tons can be found on the MAFW website at pib.gov.in. This is denoted in (Table 1) Moreover, the oilseed production for the 2021-2022 period exceeds the typical level by 5.81 million tons.

*Brassica juncea, B. campestris* var. yellow sarson, *B. campestris* var. brown sarson, *B. campestris* var. toria, *B. napus*, and *B. carinata* are oilseed brassicas cultivated for edible oil. *B. napus* is also used for making condiments and pickles. Additionally, the young leaves of these plants are consumed as a green vegetable. Meena *et al.,* (2014) found that oilseed brassicas provide a substantial nutritional value and contain 38 to 57% erucic acid, 4.7 to 13% linolenic acid, and 27% oleic and linoleum acids. Each of these acids is essential for human well-being. Various diseases affect and hinder normal physiological processes during the growth and development of rapeseed-mustard. *Brassica juncea* (L.) Czern & Coss, a highly important oilseed crop.

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*Sclerotinia* rot, caused by *Sclerotinia sclerotiorum* (Lib.) de Bary, is the most anticipated disease that impacts oilseed *brassicas*. Mustard diseases have emerged as a significant peril in recent years, resulting in higher financial losses compared to earlier years as a consequence of the shifting climate. Owing to the varying geographical conditions of different countries, the severity of certain diseases that were earlier deemed hazardous has fluctuated, while other previously insignificant disease concerns have now become substantial. In India, the perception of *Sclerotinia* stem rot as a minor issue has shifted in recent years, since it has emerged as a substantial hindrance to the growth of rapeseed and mustard crops in India. The yield loss of this disease in different state indicate following Table 2 Rakesh *et al.,* (2014).

**Table 1:** State-wise production of rapeseed mustard (Ministry of agriculture annual report- (2021)

| *State* | *Area Lakh hectares* | *Production Lakh tonnes* | *Yield in Kg/ha* |
|---|---|---|---|
| Rajasthan | 30.763 | 42.024 | 1366 |
| Haryana | 6.413 | 11.499 | 1793 |
| Madhya Pradesh | 6.750 | 10.382 | 1538 |
| Uttar Pradesh | 7.593 | 9.567 | 1260 |
| West Bengal | 6.104 | 7.123 | 1167 |
| Jharkhand | 2.914 | 2.314 | 794 |
| Assam | 2.874 | 1.774 | 617 |
| Bihar | 0.752 | 0.893 | 1187 |
| Punjab | 0.310 | 0.459 | 1482 |

**Table 2:** Following table indicates some state show yield loss of oil seed mustard due to *Sclerotinia* stem rot

| *S. No.* | *State* | *Yield loss of mustard due to Sclerotinia stem rot in %* | *References* |
|---|---|---|---|
| 01 | Rajasthan | 72 | Shivpuri *et al.,* (2000) and Ghosolia *et al.,* (2004) |
| 02 | Punjab | 80 | Kang and Chahal, (2000) |
| 03 | Haryana | 49.2 | Sharma *et al.,* (2001) |
| 04 | Uttar Pradesh | 50.9 | Chauhan *et al.,* (1992) and Singh *et al.,* (1998) |

## History of Pathogen *Sclerotinia sclerotiorum*

Fuckel later changed the name of the species to *S. libertiana* in (1870), following Libert's first identification of *S. sclerotiorum* as Peziza *sclerotiorum* in (1837). Purdy (1979). In (1924), Wakefield changed the name *S. libertiana* to *S. sclerotiorum* (Lib.) Massee because it was found that this particular scientific name did not follow the International Rules of Botanical Nomenclature. Wakefield (1924) made a bogus claim that G.E. Massee was the first person to use the combination of *S. sclerotiorum* in the name *S. sclerotiorum* (Lib.). Massee was bestowed in 1895. Rakesh *et al*. (2016) confirmed that *S. sclerotiorum* (Lib.) de Bary is the correct and original name. However, it was then discovered that de Bary had previously used this Latin name. Shaw and Ajrekar (1915) identified India as the initial location where the occurrence of *Sclerotinia* blight on mustard and rapeseed was observed. Subsequently, Brazil and Australia, along with other countries, reported severe instances of the sickness. Duczek *et al.,* (1971) Canada, Shaw and Ajrekar (1915); Boland and Hall (1994) found that *S. sclerotiorum* (Lib.) de Bery has the ability to infect 75 families and around 408 distinct plant species. Purdy *et al.,* (1955) determined that *S. sclerotiorum* and several other taxa were synonymous. Subsequently, no additional evidence has arisen to warrant a revision of my viewpoint. The term "white blight" refers to the disease produced by *S. sclerotiorum,* as stated by Singh *et al.,* (2013).

Nevertheless, as stated by Rai and Dhawan (1976) the disease is alternatively referred to as white rot. White blight, also known as white rot or stem canker, is characterized by specific symptoms Klemm (1938). a conducted a study in Bharatpur, India, where they examined infected *B.juncia* and used several strains of *Sclerotina sclerotiorum* for their research. Stem rot poses a significant threat to Australian oilseed production Roy and Saikia (1976).

## Host Range and Distribution

*S. sclerotiorum*, a pathogen capable of infecting about 400 plant species more than 500 plant species Sharma *et al.,* (2016) at different phases of plant development, is responsible for causing *Sclerotinia* stem rot, also referred to as white stem rot, in rapeseed-mustard. It is omnipresent worldwide. The disease poses a significant risk to a diverse array of dicotyledonous crops, including lentils, different vegetables, chickpeas, peanuts, sunflowers, soybean, and rapeseed mustard. Studies have demonstrated that monocotyledonous plants, including tulips, onions, and others, are affected by this phenomenon Rakesh *et al.,* (2016).

## Symptoms of Illness

*S. sclerotiorum* produces powdery white mycelia and sclerotia when there is insufficient food or favorable conditions for sclerotia development. The outcome of this is the formation of lesions on leaves, stems, and siliquae that are remarkably similar. Christias and Lockwood, (1973). *Sclerotinia* stem rot in rapeseed mustard is distinguished by persistent, damp lesions, particularly in the vicinity of the plant's base or within the internodes. Subsequently, a white mycelial growth develops over these lesions, resulting in a whitish look of the affected plants when viewed from afar.

The disease can be transmitted through contaminated airborne flower petals and become trapped between the plant's primary stem and its side branches. Leaves also develop prominent oval to circular holes due to an airborne illness. An extensive infection leads to the loss of leaves, reduction in stem size, drooping, and dehydration of the plant. According to Meena *et al.,* (2014), crops that are infested will mature earlier and be easily distinguishable among the surrounding green plants. The study conducted by Rakesh *et al.,* (2016).


**Fig. 1:** A) Pea (*Pisum sativum*) B) Indian mustard (*Brassica juncea*) C) Wild Palak (*Beta vulgaris* var. *bengalensis*) D) Bathu (*Chenopodium album)* E) Papaya (*Carica papaya*)

## Host Plants of *S. sclerotiorum* symptoms observed in Field

Host plant of sclerotinia stem rot disease symptoms observed in different crop in field are as denoted below in Fig. 1 (a) pea (b) Indian mustard (c) wild palak (d) bathua (e) papaya.

## Disease Cycle

Due to the uncomplicated life cycle and diverse range of sexual and asexual forms exhibited by *S. sclerotiorum*, the disease persists and spreads annually. During the process of crop harvest, *Sclerotinia* produces dormant structures that become mixed with the soil and serve as the primary source of infection for the subsequent year. The sclerotia of this versatile pathogen can persist for up to five years under unfavorable conditions, such as contaminated seeds and soil-borne illnesses. Seeds impact the survival, spread, and interregional transmission of illness. Under optimal conditions, these sclerotia have the ability to sprout and produce either an apothecia or a mycelium. The infection of host tissue by sclerotia's mycelium synthesis is only possible at or below the soil's surface, as it requires an external energy supply to be significant. A significant number of ascospores, which were forcefully expelled, were carried by air currents over varying distances ranging from several kilometers to a few centimeters. The apothecia located in close proximity to the plant's base emit ascospores, which serve as the primary means of infection. When the mycelium-containing ascospores encounter susceptible and healthy host tissue, it develops an aspersorium. Alternatively, the infection can establish itself within the host either by exerting mechanical pressure to penetrate the cuticle or by the infection hypha infiltrating previously damaged or injured tissue. Ascospores give rise to infection hyphens. The fungus initially infiltrates the host plant and subsequently proliferates within the tissue, obliterating any cells obstructing the advancement of the hyphae. While no further infection spores are generated, contact between healthy tissue and an infected area might initiate a secondary infection. In order to fully complete the disease cycle, the sclerotia remain present in the soil and in plant debris. Yadav *et al.,* (2011)

## Epidemiological Studies

According to a study conducted by Chattopadhyay *et al.,* (2005), Sclerotinia rot is higher on Indian mustard when the crop is between 50 and 60 days old. Regarding the investigation, the occurrence of disease decreased when the sowing was delayed. The highest occurrence of disease, on average, happened on October 21st, with a rate of 10.5%. The crop that was sown on January 5 remained unaffected by *Sclerotinia* blight. The development of *Sclerotinia* blight exhibited an inverse correlation with the upper-temperature range of 20.5 to 25.4°C and the lower temperature range of 3.9-10.7°C during the flowering phase of the crop, which commenced on October 21 through planting. Increased relative humidity significantly enhanced the growth of *S. sclerotiorum*. Gupta *et al.,* (2004). The increase in relative humidity significantly accelerated the growth of the fungus. The highest fungal growth was observed at a relative humidity of 98.6%, with a radial growth of 90 mm and 15 *sclerotium* per plate. Prasad *et al.,* (2009) found that the timing of sowing has a notable impact on the occurrence and yield of *Sclerotinia* rot. Correlation study indicated a strong positive relationship between the highest and lowest temperature and the onset of illness. The data indicates that there is a positive correlation between *S. sclerotiorum* infection and the greatest temperatures (r = -0.697*), hours of sunshine (r = -0.855**), maximum level of relative humidity (r = 0.883**), and lowest relevant humidity (r = 0.871**). Furthermore, a regression analysis was conducted to predict the impacts of different climate conditions.

## Evaluation of Culture Media

Jensen and Lysek (1983) successfully cultured *Sclerotinia* fructi Gena on apple malt agar medium and malt agar media. Elgorban *et al.,* (2013) reported that potato dextrose agar, a semi-solid medium, produced the largest mycelia growth, sclerotia, and sclerotia dry weight, measuring 78 mm, 29 sclerotia, and 232 mg, respectively.

Potato dextrose broth was the most successful medium for fungal development, with 2.29 mg dry weight per flask. Bharti *et al.,* (2015) investigated the effects of ten solid culture medium, including Malt extract apple agar, Czapek's Dox agar, potato carrot agar, potato dextrose agar, Mustard leaf dextrose agar, and pea leaf dextrose. The lowest radial mycelia growth was 32 mm and 2.00 sclerotia in Czapek's Dox medium, whereas the highest radial mycelia growth was 82.66 mm and 12.00 *sclerotia* in potato dextrose agar, a semi-solid media. Bharti *et al.,* (2019). Discovered in his research growth of *S. sclerotiorum* on different media. The minimum redial growth of mycelium in both media is on the Asthana & Hawkar agar medium. Data is given in Tables 3 and 4.

**Table 3:** Growth of *S. sclerotiorum* on different solid media

| *S. No.* | *Solid media* | *Radial growth of mycelium (in mm) after days* | | *No. of days to fill petri-plate* | *No. of sclerotia formed per plate* |
|---|---|---|---|---|---|
| | | *3 Days* | *5 Days* | | |
| 1 | Potato dextrose agar | 54.67 | 90.00 | 5 | 36.33 |
| 2 | Mustard leaf decoction agar | 46.33 | 87.00 | 5 | 18.33 |
| 3 | Mustard stem decoction agar | 39.67 | 85.00 | 6 | 13.33 |
| 4 | Czepek's dox agar | 25.67 | 55.33 | 7 | 29.00 |
| 5 | Richard's agar | 23.67 | 47.67 | 8 | 31.67 |
| 6 | Asthana & Hawker's agar | 13.33 | 29.00 | 10 | 15.67 |

**Table 4:** Growth of *S. sclerotiorum* on different liquid media

| *S. No.* | *Liquid Media* | *Dry weight of mycelium (in mg) after 14 Days* | *No. of sclerotia formed* |
|---|---|---|---|
| 1 | Potato dextrose broth | 186.11 | 23.33 |
| 2 | Mustard leaf decoction | 139.46 | 16.67 |
| 3 | Mustard stem decoction | 129.29 | 10.00 |
| 4 | Czepek's(dox) medium | 88.74 | 9.67 |
| 5 | Richards' medium | 194.22 | 21.33 |
| 6 | Asthana & Hawker's medium | 54.28 | 4.66 |

### Assessment of *S. sclerotiorum* inoculation techniques

Prasad *et al.,* (2009) evaluated four alternative ways to achieve the best apothecia production. Placing inoculums was the most efficient way of inoculation, with an infection rate of 86.7%, followed by using a toothpick (55.6) and ascospores (53.3). The soil inoculation technique appeared to be less effective when compared to other methods.

Scott (1984) established a way for inoculation *S. sclerotiorum* into swede rape plants in both the area and the glass house using contaminated barley grains encased in parafilm-covered leaf litter. Bharti *et al.,* (2019). The pathogenicity is attained by diverse ways. According to the data, six techniques were proven to be effective in infecting *S. sclerotiorum*. Mycelia bit, toothpick, sclerotial placement, mycelia bit inside fragile bark, and mycelia bit on scraped stem were all found to be statistically superior to other inoculation strategies.

Although the paraffin wax film technique established a safe environment for early infection, sclerotia injection was discovered to be the cause of the infection's late establishment. According to, within 5 to 8 days of inoculation under ideal climatic conditions in plants 45 to 65 days old, Bharati *et al.,* (2019).

### Measurement of Disease Severity

A reliable disease assessment technique is required to diagnose Sclerotinia rot in rapeseed mustard. When the illness first emerges on the leaves and stem, sclerotia production on the stem and within the diseased piths of the stem causes reduced yields. Meena *et al.,* (2014).

Rathi *et al*. (2009) 0 to 4 scale was used with minimal alterations to measure the amount of the *Sclerotinia* rot. This is what the scale says: Lesion on the stem: 0 represents no evident lesion; 1 represents a 1/4 stem girdle; 2 represents a 1/2 stem girdle; 3 represents a 3/4 stem girdle; and 4 represents a more than 3/4 stem girdle. Rakesh *et al.,* (2016), among others.

### Chemicals and Botanicals Tested *in-vitro* against *S. sclerotiorum*

Despite the fact that *Sclerotinia* species have been shown to be susceptible to numerous fungicides, this fungus has not been consistently and profitably managed Singh and kapoor *et al.,* (1993). Calotropis leaf, eucalyptus leaf, tobacco leaf, neem leaf, *T. viride*, garlic bulb, neem oil, lantana leaf, and *B. pumalis* are the next most efficient compounds for preventing *S. sclerotiorum* development *in-vitro*, According to Chattopadhyay *et al.,* (2002), the fungicides carbendazim (0.1%) and mancozeb (0.2%) totally prevented the growth of *S. sclerotiorum* mycelia.

Allium sativum bulb extract (1%w/v) had the highest effectiveness of the plant extracts tested. According to Chaudhary *et al.,* (2010), benomyl and carbendazim are the most efficient fungicides for suppressing *Sclerotinia*-rot of Indian mustard seeds, whether used alone or in combination.

According to Chand *et al.,* (2009), carbendazim completely (100%) prevents the fungus from developing mycelia and producing sclerotia. Carbendazim, thiophanate-methyl, and phenyl pyrrole at all concentrations completely inhibited pathogen growth, resulting in the fewest sclerotia. Shivpuri and Gupta *et al.,* (2001).

Mancozeb at higher doses has been shown to be effective. Copper oxychloride was the least effective since it did not significantly slow *S. sclerotiorum* development when compared to the control. Extracts of *Allium staivum*, *Allium cepa*, *Azadirachata indica*, Dhatura stramonium, *Ocimum tenuiflorum, Polyathia longifolia,* T*agetes erecta*, *Catharathus roseus*, *Withania somnifera*, and *Polyathia longifolia* inhibited the formation of 0.71-1.77 *sclerotia* per plate. Shivpuri *et al.,* (1999) discovered that plant extracts from ten distinct plant species were toxic to fungus. Fewer plant extracts at higher concentrations were more effective.

Tripathi and Tripathi *et al.,* (2009) explore the efficacy of several plant extracts. Pathogen colony growth suppression was best in *A. Sativum* (71.11%) and A. indica (50.30%). *The two most powerful were C. procera extract (22.96%) and O. sanctum extract (38.15%)*. According to Tripathi and Tripathi *et al.,* (2010), the findings showed that, except for sulfur dust, none of the tested fungicides reduced the pathogen's colony growth by more than 93.33% compared to the control. According to Bharti *et al.,* (2015), propiconazole, thiram, and hexaconazole (80.46%, 0.667) completely stopped mycelia growth and sclerotia formation.

Mancozeb (69.53% and 0), ridomil (71.08 and 1.333), and 72.65% and 1.333 were shown to be the least effective. The development of sclerotia and inhibition of mycelia growth, on the other hand, were both at control levels (0.00% and 3.333) for sulfur (13.66% and 2.333) and copper oxychloride (44.13 and 1.333).

### *In-vitro* Evaluation of Amritjal against *sclerotiorum*

When comparing treated and untreated *sclerotia* with bovine urine, Basak *et al.,* (2002) discovered that the treated sclerotia of the chosen fungus considerably inhibited mycelia multiplication. Cow urine-treated sclerotia revealed no indications of mycelia proliferation for up to four days. After five days, treated sclerotia had just 0.9 mm of mycelial development, but untreated sclerotia had 42.6 mm. The inhibitory effects of cow dung and urine were also demonstrated when varying amounts of these chemicals were applied to developing plants exposed to the pathogen.

Allium sativum was standardized to 20, 40, and 60% in a study conducted by Bharti *et al.,* (2015). The results showed that these doses completely prevented mycelia growth and sclerotia development. *Zingiber officinalis* and *Curcuma longa* reduce mycelia growth and sclerotia number by 20% (41.93–81.23), 40% (56.59–78.29), and 60% (73.31–89.44), respectively. Though Eucalyptus demonstrated 20% (79.7%) and 40% (83.37%) mycelia growth rates and 3,00 and 2,50 sclerotia development, it also showed a 60% conc. (100%) percent suppression of mycelia growth and sclerotia development.

Amritjal botanical uses the fungus did not appear at 20% or 25%; instead, four sclerotia were observed at 10% (78.07%). Although no sclerotia formed at the par control, mycelia development was limited to 15% (90.05%). As a result, in previous in-vitro testing, mycelia growth and *Sclerotia sclerotiorum* production were reduced by 20% and 25%, respectively.

### Field Evaluation of the Selected Cultural, Biological, and for *S. sclerotiorum* Management

When it comes to handling *S. sclerotiorum*, plant pathologists face numerous obstacles. Control is difficult, irregular, and expensive because to the vast range of hosts and the long lifespan of dormant *Sclerotinia*. Because *S. sclorotiorum* cannot be treated with a single treatment, it is recommended to combine multiple eco-friendly remedies.

### Cultural Command

Weeds must be removed from the field and surrounding regions before planting to control the illness. Planting requires a high-quality seed. During summer field preparation, deep plowing and crop rotation with non-host crops such as barley, wheat, and maize. Use the recommended N:P:K:S fertilizer dosage of 60:40:40:40 kg/ha. Keep optimal plant development in the field. Wide leaf weeds, such as *Chenopodium spp*., are a pathogen's secondary host, according to Yadav *et al.,* (2012), so be cautious of them. One effective control method is to postpone the planting of mustard seeds.

### Biological Management

According to Bardin and Huang (2001), regulating biology is a realistic way to treating *Sclerotinia* rot diseases. To prevent pine seedling damping off, injected soil with 13 antagonistic funguses. Rakesh *et al.,* (2016). This was the first time plant diseases were controlled directly by bio-control antagonists.

Yadav *et al.,* (2011) proposed pre-incubating the product in 50 kg of farmyard manure per hectare before applying 2.5 kg of a *Trichoderma harzianum* and *Trichoderma viride*-based product to the soil. applied a mixture of *T. viride* and *T. harzianum* to seeds at a rate of 10g/kg.

When the first signs of *Sclerotinia* stem rot develop, a foliar spray with a 0.2% mixture of *T. viride* and *T. harzianum* may help limit the disease's progression. Yadav *et al.,* (2012).

### Chemical Management

*S. sclerotiorum* can live latently in the testate and cotyledon of contaminated seeds for up to three years. When contaminated seedlings were sown, 88-100% of them did not germinate. Seeds that did not germinate were killed by *S. sclerotiorum*, which produced three to six sclerotia for each seed. Tu, (1988). White mold eventually caused seedlings grown from contaminated seeds to die at a young age. These sclerotia collaborated to form inoculums. The fungus was completely removed when the infected seeds were treated with captan and thiophanate-methyl. Seed treatment with carbendazim also effectively prevented *Sclerotinia* rot (Sharma et al., 2011). During the full bloom stage, fungicides are often sprayed to canola leaves to prevent infections of the sensitive petals, which can fall over the leaf axil and induce infection of the stem. Kutcher and Wolf (2006). Fungicides can be costly and have a harmful influence on the environment. Furthermore, there is always the possibility that pathogen populations will develop resistance to fungicides. Gossen *et al.,* (2001).

Carbendazim (MBC), a benzimidazole fungicide, was widely employed in 2001 and 2002 to address failures linked to the development of MBC resistance in *sclerotiorum*. After more than 30 years of usage in Jiangsu Province, the use of MBC and related fungicides for SR control in China has been hampered since fludioxonil at 100, 200, and 300g/ml provided significant disease control. Kuang *et al.,* (2011).

## Discussion

Stem rot is a common disease in mustard plants caused by a variety of fungal infections. This damaging disease attacks the stem tissues, resulting in considerable yield losses in mustard crops. The fungus *S. sclerotiorum* and *Alternaria brassicae* are stem rot's most common causal agents.

*S. sclerotiorum*, a well-known necrotrophic fungus, is a major cause of stem rot. This disease is distinguished by the growth of hard, black formations known as sclerotia. These sclerotia can live in the soil for long periods of time, infecting following crops. During periods of high humidity and chilly temperatures, the fungus infects the mustard plants. The symptoms of mustard stem rot begin as water-soaked sores on the lower stem. These lesions grow slowly, creating a white mycelium that forms sclerotia. As the disease advances, afflicted stems become soft and mushy, resulting in plant withering and lodging. In severe circumstances, the fungus can spread to other plant parts, including as leaves and pods, causing yield losses to worsen. Effective management options for mustard stem rot combine cultural, chemical, and biological control measures. Crop rotation, avoiding dense plantings, and maintaining high sanitation to limit inoculum building in the soil are all important cultural practices. Depending on the severity of the disease, fungicides can be used either preventively or curatively. Furthermore, adopting resistant mustard types and biological control agents can help ensure long-term disease management.

## Conclusion And Future Prospects

*Sclerotinia* rot is without a doubt the most lethal rapeseed-mustard disease on the planet. *Sclerotinia* rot greatly affects the volume and quality of rapeseed mustard produced, and there is no known source of resistance for the oilseed brassica crop species farmed for their oil. Other management strategies could be used because planted Brassicas are susceptible to *Sclerotinia* rot. Fungicides are one of the most commonly used ways. Fungicides are commonly used to combat sickness, yet they are harmful to human health and pollute the environment. Various disease control methods, such as developing moderately resistant plant varieties, using organic and plant-based products, using bio-control agents, and modifying agronomic practices, are gaining popularity due to their greater practicability, environmental friendliness, and security.

The following factors must be addressed to prevent *Sclerotinia* rot in rapeseed mustard. When different strains of *Sclerotinia* decay pathogen-sensitive, tolerant, and resistant are infected, gene expression in pathogens and hosts varies. Look for sources of resistance and moderate resistance to *Sclerotinia* rot in oilseed brassicas and their wild relatives. Resistance can be induced as well as acquired systemically (SAR). IPM and IDM technology should be used to their full potential. Coordination, collaboration, and interaction with institutions, plant breeders, statisticians, soil scientists, and other researchers are all part of the process.

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## Authors Contribution

**D.R.** Planning of study, review and editing of MS. **S.S.** Conceptualization of idea & Head of Department and supervision of the study. **A.K.S.** Review and editing of MS and correction as per suggestion from reviewer and editor. **M.K.P.** correction as per suggestion from reviewer and editor. **A.S.** and **D.P.** conceptualization of idea and writing original draft of Manuscript and collection of review literature and compilation.

## Conflict Of Interest

We have no conflicts of interest to disclose.

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