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Approaches for effective management of stem rot in groundnut

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ABSTRACT

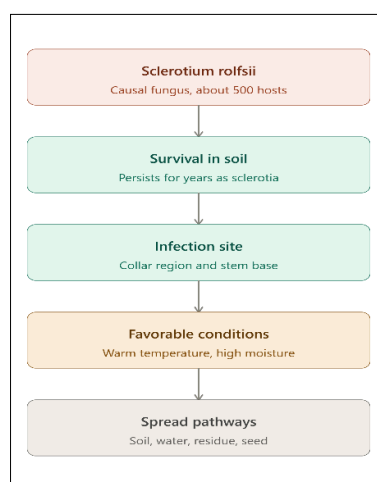
Groundnut is an important leguminous oilseed crop cultivated worldwide for its high oil and protein content and its significant contribution to farm income. Stem rot, caused by *Sclerotium rolfsii* Sacc., also referred to as *Athelia rolfsii* in its teleomorph stage, is one of the major soil-borne diseases affecting groundnut production. The disease typically begins in the collar region, initially causing yellowing and wilting, followed by the development of white fungal growth and characteristic mustard-seed-like sclerotia on infected tissues and adjacent soil. Yield losses may range from 10-25% under normal disease conditions to 40-55% during severe outbreaks, with losses reaching up to 80% under highly favourable conditions. The long-term survival of sclerotia in soil makes disease management challenging, and no single control measure provides adequate protection. Therefore, an integrated disease management approach combining cultural practices, biological control, resistant or tolerant cultivars, and judicious use of chemical fungicides is essential for effective and sustainable stem rot management.

Keywords: Stem rot, Groundnut, Stem rot, Fungus, Disease

1. Introduction

Groundnut (*Arachis hypogaea* L.) is a major oilseed crop and a critical food and commercial crop across the tropics and subtropics. However, its productivity is constrained by a range of biotic stresses, including fungal, bacterial and viral infections that reduce both pod yield and haulm quality. Stem rot has become a particular concern because, once established in a field, it tends to persist, causing clustered outbreaks, plant death and significant economic losses. Field surveys have shown that the disease affects about 16.57–39.55% of crops in some parts of Tamil Nadu and 18.89–36.28% in north-eastern Karnataka. Using fungicides alone can be costly, less effective, and harmful to the environment in the long term. Therefore, researchers are focusing on safer and more sustainable methods, such as integrated disease management and biological control (Ambika *et al.*, 2023) [1].

2. Disease characteristics



Sclerotium rolfsii Sacc. is a soil borne fungal pathogen with an unusually broad host range; approximately 500 plant species have been reported as susceptible. Several papers note the accepted sexual-stage name, *Athelia rolfsii*, although most field pathologists and the management literature still refer to it as *S. rolfsii*. Morphological and molecular studies on groundnut confirm the pathogen's identity through characteristic

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traits such as white mycelium and brown spherical sclerotia, together with ITS (Internal Transcribed Spacer) sequencing and multigene based identification methods (Chowdary *et al.*, 2024) [2]. The biology of the fungus helps explain its persistence. It survives in soil and crop debris for extended periods through hardy resting structures known as sclerotia. Infection usually starts near the soil surface, where the fungus attacks the lower part of the stem or collar and then spreads to the roots, pegs, and pods. Warm and moist conditions help the pathogen grow and survive. It can spread through contaminated soil, water, crop residues, and the movement of sclerotia during normal field activities (Chowdary *et al.*, 2024) [2].

3. Field symptoms of stem rot

Symptoms appear in patches across a field rather than spreading evenly.

- Early signs: yellowing leaves, loss of vigour, wilting of lateral branches or whole plants



Figure. Field view of a patch of wilted groundnut plants infected with stem rot.

The disease spreads more when temperature is 25-35 °C, humidity is high, and undecomposed plant material is present near the plant base. Continuous groundnut cropping, dense planting, poor drainage and throwing soil on plant crowns during weeding make the problem worse.

4. Integrated approach for stem rot control

No single method provides long-term control of groundnut stem rot. The pathogen is soil-borne, persists for years, and once inoculum has built up in a field it is difficult to suppress with any one approach. Recent work therefore emphasises integrated disease management that combines cultural, biological and chemical tools rather than relying on a single measure. (Babu and Deepika, 2023; Hotkar *et al.*, 2025) [3, 4]

4.1 Cultural practices

- **Summer deep ploughing and field cleaning:** After harvest, remove all crop residues, volunteer plants and weeds. In summer (May–June) plough the field deep (20–25 cm) with a mould-board plough. This buries sclerotia deeper than 8 cm, where germination is restricted. Avoid shallow cultivation that brings them back to the surface. (Babu *et al.*, 2023) [3]
- **Crop rotation:** Do not grow groundnut in the same field every year. Rotate with maize, sorghum, pearl millet, wheat, cotton or onion/garlic for at least two years. These crops are poor hosts and help reduce soil inoculum. (Babu *et al.*, 2023) [3]
- **Sowing and intercultural care:** Use healthy certified seed and maintain proper plant spacing. Avoid throwing soil onto the plant base during weeding or earthing-up. Keep weeds and plant debris away from the crown area. Ensure good drainage and avoid waterlogging.

- Brown to dark brown lesions develop at the collar or stem base, causing tissue rot and premature drying
- White, cottony fungal growth appears at the soil line around infected plants
- Round sclerotia form soon after, white at first then turning brown, resembling mustard seeds on the stem base and nearby soil
- In severe cases, infection spreads to pegs and pods, causing pod rot and leaving damaged pods in the soil at harvest

Figure. Basal stem lesion showing tan-coloured sclerotia on a groundnut plant affected by stem rot.

Figure. White fungal mycelium growing at the base of a groundnut plant.

Field indicators to watch for: yellowing/wilting on one branch or the whole plant, brown collar lesions with fast stem-base drying, and white mycelium with brown sclerotia around the base and surrounding soil.

- **Choice of Varieties:** Complete resistance to stem rot is rare. Some varieties show lower disease incidence. Farmers should consult their local agricultural university or seed supplier for recommended varieties suited to their area. Growing a moderately tolerant variety together with the practices described above provides additional protection.

4.2 Soil organic amendments and biological control

- **Organic cakes:** Apply neem cake, castor cake or mustard cake at 400-500 kg ha⁻¹, 15-20 days before sowing or in the seed furrow. These cakes release natural compounds that suppress the fungus and improve soil fertility. (Hotkar *et al.*, 2025) [4]
- **Seed treatment with beneficial fungi:** Treat seed with *Trichoderma harzianum* or *T. viride* at 10 g kg⁻¹ seed. For better results, use a mixture of *Trichoderma* and *Pseudomonas fluorescens* (5 g each per kg seed). Treat the seed in the shade and sow the same day. (Hotkar *et al.*, 2025; Meena *et al.*, 2024) [4, 5]
- **Soil application of bio-agents:** Mix 2.5–4 kg of *Trichoderma* powder with 50–250 kg of well-decomposed farmyard manure or vermicompost. Keep the mixture moist under shade for 7–10 days, then apply in the seed furrows at sowing. Field trials show this can reduce disease by more than 70% and increase pod yield. (Hotkar *et al.*, 2025) [4] (Hotkar *et al.*, 2025; Meena *et al.*, 2024) [4, 5]

4.3 Chemical management

Chemical control should be considered a supplementary component of integrated disease management, rather than a substitute for cultural and biological control measures. For seed treatment, tebuconazole 2% DS at 1–1.5 g kg⁻¹ of seed or carboxin + thiram at 2–3 g kg⁻¹ of seed may be used for effective disease management. When disease occurs in localized patches, soil drenching around infected plants with a recommended fungicide may be undertaken following consultation with the local Krishi Vigyan Kendra (KVK) or agricultural university. All fungicides should be applied strictly according to the recommended

label dose, with appropriate personal protective equipment, and the prescribed pre-harvest interval should be maintained to ensure safe and effective use (Babu and Deepika, 2023; Hotkar *et al.*, 2025) [3, 4].

5. Modern approaches for stem rot control in groundnut

Recent research has increasingly shifted from the use of individual biocontrol agents toward microbial consortia, bio-based formulations, and comprehensive soil health management strategies. *Microbial consortia* are gaining attention because the combined action of different microorganisms can suppress pathogens through multiple and complementary mechanisms, including competition, antibiosis, and other antagonistic interactions. In addition, increasing emphasis is being placed on integrating biological control agents with botanicals and other bio-based products to enhance disease suppression and promote plant growth. Recent studies have reported that neem based combinations and the application of seaweed extracts in combination with *Trichoderma asperellum* can reduce disease severity while improving plant growth. Furthermore, emerging technologies such as precision fungicide application, digital disease detection, and AI- or image-based early-warning systems show considerable potential for improving disease management. However, these technologies are still under development, and current research primarily highlights a broader transition toward integrated, sustainable, and reduced-chemical disease management systems, rather than fully validated field-level disease forecasting approaches (Meena *et al.*, 2024; Hotkar *et al.*, 2025) [3, 4].

6. Challenges and future prospects

Stem rot is difficult to manage because *Sclerotium rolfsii* can survive in soil as sclerotia for years, spreads through crop residue and routine field activity and often goes unnoticed until plants begin to wilt. Chemical control alone is limited by cost, environmental impact, and the risk of harming beneficial soil microbes or selecting for reduced pathogen sensitivity. Biological agents show promise, yet their field performance can be inconsistent, and reliable access to quality formulations remains a practical constraint for farmers (Babu and Deepika, 2023; Hotkar *et al.*, 2025) [3, 4]. Future progress is likely to come from several complementary directions, improved resistant cultivars, validated resistance markers, microbial consortia, a deeper molecular and proteomic understanding of induced resistance, and tighter integration of biological and chemical tools. Climate resilient management strategies and early detection methods will also become increasingly important, as warm, moist conditions continue to drive outbreaks.

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7. Conclusion

Stem rot of groundnut is a serious soil-borne disease caused by *Sclerotium rolfsii* that can sharply reduce plant stand, pod development, yield and farm income when conditions favour infection. Characteristic symptoms include collar lesions, wilting, white mycelial growth and brown, mustard-seed-like sclerotia. No single method provides reliable long-term control. Sustainable management depends on the integrated use of healthy seed, crop rotation, field sanitation, biological control, resistant or tolerant varieties, and need-based chemical protection. When these measures are applied together, they offer the most effective means of protecting groundnut yield. (Babu *et al.*, 2023) [3]

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