

Guardians of the Root: Eco-Friendly Control of Dry Root Rot in Blackgram Using *Trichoderma* and *Bacillus*

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Blackgram (*Vigna mungo*) is a major pulse crop valued for its high protein content, short growth cycle, and soil-enriching properties. However, its productivity is often threatened by **dry root rot**, a destructive soil-borne disease caused by *Macrophomina phaseolina*. This pathogen thrives in hot, dry, and nutrient-depleted soils, leading to sudden wilting and death of plants during crucial growth stages. Traditional chemical control methods often prove inadequate due to the **persistent nature of the pathogen** and environmental concerns. In this context, the use of **beneficial microbes like *Trichoderma* and *Bacillus*** has emerged as an innovative, sustainable, and farmer-friendly alternative to tackle the disease.

Biocontrol Agents: Nature's Silent Protectors

1. *Trichoderma* spp.

Trichoderma is a genus of fungi well-known for its **antagonistic behavior** against soil-borne pathogens. It controls *Macrophomina* through:

- **Mycoparasitism:** Direct attack on the pathogen's hyphae
- **Production of enzymes** (e.g., chitinases, glucanases) that degrade fungal cell walls
- **Induced systemic resistance (ISR)** in the host plant
- **Improvement of root growth and nutrient uptake**

2. *Bacillus* spp.

Species such as *Bacillus subtilis* and *Bacillus amyloliquefaciens* act as **plant growth-promoting rhizobacteria (PGPR)** and suppress pathogens by:

- **Secreting antibiotics and lipopeptides**
- **Competing for nutrients and colonization space**
- **Boosting plant immunity through ISR**
- **Enhancing soil microbial diversity**

When used together, *Trichoderma* and *Bacillus* provide a **synergistic effect**, leading to greater suppression of the dry root rot pathogen.

Mechanism of Action

These microbes work in complementary ways to protect blackgram roots:



Mode of Action	<i>Trichoderma</i>	<i>Bacillus</i>
Direct Antagonism	Mycoparasitism, enzyme secretion	Antibiotic and metabolite production
Plant Defense Induction	Triggers ISR	Triggers ISR
Growth Promotion	Enhances root architecture	Promotes nutrient uptake
Soil Health Improvement	Suppresses pathogens, enriches flora	Builds resilient rhizosphere

Application Techniques

For effective control of dry root rot, timing and method of application are key.

1. Seed Treatment:

- Mix *Trichoderma viride* (4 g/kg seed) or *Bacillus subtilis* (5 ml/kg seed) with jaggery solution.
- Dry in shade before sowing.

2. Soil Application:

- Incorporate *Trichoderma* or *Bacillus*-enriched compost (2.5 kg/acre) during final land preparation.
- Apply *neem cake* with the biocontrol agent for enhanced effectiveness.

3. Root Dipping (For Transplants):

- Dip seedlings in a solution of biocontrol agent before planting for better root colonization.

4. Drip or Drenching Application:

- Apply suspension near root zones at 15-day intervals during early crop growth.

Field Success and Research Backing

Recent trials conducted by various agricultural universities and ICAR research stations have shown:

- **35–60% reduction** in disease incidence with *Trichoderma* + *Bacillus* applications
- **Improved plant vigor**, flowering, and pod yield compared to untreated controls
- Enhanced **soil enzyme activity** and **microbial diversity**

Farmer field schools in Tamil Nadu and Andhra Pradesh have successfully **adopted biocontrol kits** as part of integrated pest management (IPM) programs.

Advantages Over Chemical Fungicides

- **Eco-friendly and residue-free**
- **Cost-effective** in the long run
- No risk of **pathogen resistance buildup**
- Improves **soil health and fertility**
- Safe for **beneficial insects and pollinators**

Challenges and the Way Forward

Despite their benefits, widespread use of *Trichoderma* and *Bacillus* faces some hurdles:

- **Short shelf life** of formulations if not stored properly
- **Lack of awareness** among smallholder farmers
- Need for **standardized commercial products** with good viability

To overcome these, the following strategies are essential:

- Establish **local biocontrol production units**
- Promote **ready-to-use formulations** with extended shelf life
- Include biocontrol training in **KVK and extension programs**
- Support farmer cooperatives to adopt **community-based IPM models**

Conclusion

Dry root rot of Black gram poses a persistent threat to pulse farmers, especially in arid and semi-arid zones. Harnessing the power of beneficial microbes like *Trichoderma* and *Bacillus* offers a **holistic and sustainable approach** to disease management. These microbial allies not only defend the roots but also build a resilient soil ecosystem, ensuring better yields and a greener future.

By making biocontrol a part of routine farming, we move closer to achieving **climate-smart agriculture** that protects both **crops and the environment**.

References

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