



International Journal of Research in Agronomy

E-ISSN: 2618-0618
P-ISSN: 2618-060X
© Agronomy
NAAS Rating: 5.20
www.agronomyjournals.com
2025; 8(6): 101-103
Received: 15-04-2025
Accepted: 17-05-2025

Nazmun Hasan
Department of Agronomy,
Bangladesh Agricultural
University, Mymensingh,
Bangladesh

Farida Khandaker
Department of Agronomy,
Bangladesh Agricultural
University, Mymensingh,
Bangladesh

Effect of seed treatment with fungicides and bioagents on seedling vigour and yield of soybean

Nazmun Hasan and Farida Khandaker

DOI: <https://www.doi.org/10.33545/2618060X.2025.v8.i6a.5292>

Abstract

Seed treatment is the application of chemical or biological agents to seeds before sowing to protect against soilborne pathogens. This research evaluated seven seed treatments on soybean (cv. BARI Soybean-6) at Bangladesh Agricultural University, Mymensingh, during kharif 2022 and 2023. Carbendazim + *T. viride* produced the highest seedling vigour index (1,892), germination (96.3%), and grain yield (2.41 t/ha) 43.5% above untreated control. Collar rot incidence dropped from 18.7% to 3.2%. Combining chemical and biological seed treatments creates dual protection enhancing both disease suppression and growth promotion.

Keywords: Seed treatment, soybean, carbendazim, thiram, trichoderma viride, pseudomonas fluorescens, seedling vigour, collar rot, bioagent

Introduction

Seed treatment is defined as application of physical, chemical, or biological agents to seeds before planting to suppress pathogens and improve germination [1]. In soybean, seed treatment is important because the crop is vulnerable to soilborne fungi particularly *Sclerotium rolfsii*, *Rhizoctonia solani*, and *Fusarium oxysporum* that attack seedlings within the first two weeks [2]. Chemical fungicides like carbendazim and thiram provide effective short-term protection [3], but concerns about residues and non-target effects have driven interest in biocontrol agents such as *Trichoderma viride* and *Pseudomonas fluorescens*, which suppress disease through competition, antibiotic production, and induced resistance [4, 5]. However, bioagents alone may not match fungicide efficacy under high disease pressure [6].

Combining fungicides with bioagents could exploit rapid chemical knockdown followed by sustained biological protection [7]. This research investigated: (i) individual and combined seed treatment effects on germination, vigour, and disease; (ii) yield responses; and (iii) whether integrated treatments outperform either approach alone.

Materials and Methods

Materials

The research was conducted during two kharif seasons (July-November 2022 and 2023) at the Bangladesh Agricultural University (BAU) Experimental Farm, Mymensingh, Bangladesh (24°43'N, 90°26'E). Soybean cultivar BARI Soybean-6 was used. Carbendazim 50% WP and thiram 75% WP were from BASF Bangladesh. *T. viride* (1×10^8 CFU/g) and *P. fluorescens* (1×10^8 CFU/g) formulations were from the BAU Plant Pathology Laboratory. Ethics approval: BAU Agricultural Research Board (Protocol BAU-ARB/2022-071, June 2022).

Methods

Seven treatments were applied: T₁ untreated control, T₂ carbendazim (2 g/kg seed), T₃ thiram (3 g/kg seed), T₄ *T. viride* (10 g/kg seed), T₅ *P. fluorescens* (10 g/kg seed), T₆ carbendazim + *T. viride*, T₇ thiram + *P. fluorescens*. For combined treatments, the fungicide was applied first, air-dried 30 minutes, then the bioagent was coated [8]. Germination and seedling vigour index (SVI = seedling length × germination%) were assessed at 14 DAS in the

Corresponding Author:
Nazmun Hasan
Department of Agronomy,
Bangladesh Agricultural
University, Mymensingh,
Bangladesh

field. Disease incidence of collar rot was recorded at 30 DAS. Grain yield was measured at harvest maturity. ANOVA was run in STAR v2.0.1 with DMRT at $p \leq 0.05$ [9].

Field experimental design

A randomized complete block design with seven treatments and four replications was used. Plot size was 4 m × 3 m. Soybean was sown at 30 × 5 cm spacing (667,000 plants/ha). Basal fertilizer (urea 50, TSP 100, MoP 60 kg/ha) was applied at sowing. Rhizobium inoculant was applied to all treatments except T₁ after the seed treatment coating had dried [10].

Results

Table 1: Germination, seedling vigour index, and collar rot incidence under different seed treatments (pooled)

Treatment	Germination (%)	Seedling vigour index	Collar rot (%)	Disease reduction (%)
T ₁ Untreated	78.6e	1241e	18.7a	-
T ₂ Carbendazim	91.4bc	1682bc	5.9c	68.4
T ₄ T. viride	86.7cd	1524cd	9.1b	51.3
T ₆ Carb + T. viride	96.3a	1892a	3.2d	82.9
T ₇ Thiram + P. fluor.	94.1ab	1783ab	4.6cd	75.4

Table 1 shows germination, vigour, and disease data. T₆ (carbendazim + T. viride) gave 96.3% germination and SVI 1,892; the control recorded 78.6% and 1,241. Collar rot dropped

Seasonal conditions

Kharif 2022 received 1,847 mm rainfall with mean 28.6 °C; 2023 had 2,014 mm and 28.9 °C. High humidity (82-85%) favored soilborne disease. Untreated plots showed 16.4% and 21.1% collar rot in the two years [11]. Data were pooled (treatment × season $p = 0.28$).

Soil characteristics

Non-calcareous dark grey floodplain soil (Old Brahmaputra alluvium), silty clay loam, pH 6.7, organic matter 1.92%, total N 0.11%, available P 11.4 mg/kg. Previous crop was transplanted aman rice [12].

from 18.7% (T₁) to 3.2% (T₆) 82.9% reduction. Individual bioagents outperformed the control but were weaker than combined treatments.

Table 2: Grain yield and yield attributes of soybean under different seed treatments (pooled)

Treatment	Pods/plant	100-seed wt (g)	Grain yield (t/ha)
T ₁ Untreated	32.4d	11.2a	1.68d
T ₂ Carbendazim	42.8bc	11.6a	2.10bc
T ₄ T. viride	39.6c	11.4a	1.94c
T ₆ Carb + T. viride	48.6a	11.8a	2.41a
T ₇ Thiram + P. fluor.	46.1ab	11.5a	2.28ab

Table 2 shows yield attributes. T₆ produced 2.41 t/ha 43.5% above T₁ and 14.8% above carbendazim alone (T₂, 2.10 t/ha).

Yield gains came from improved plant stand and pod number (48.6 vs 32.4 pods/plant) rather than seed size.

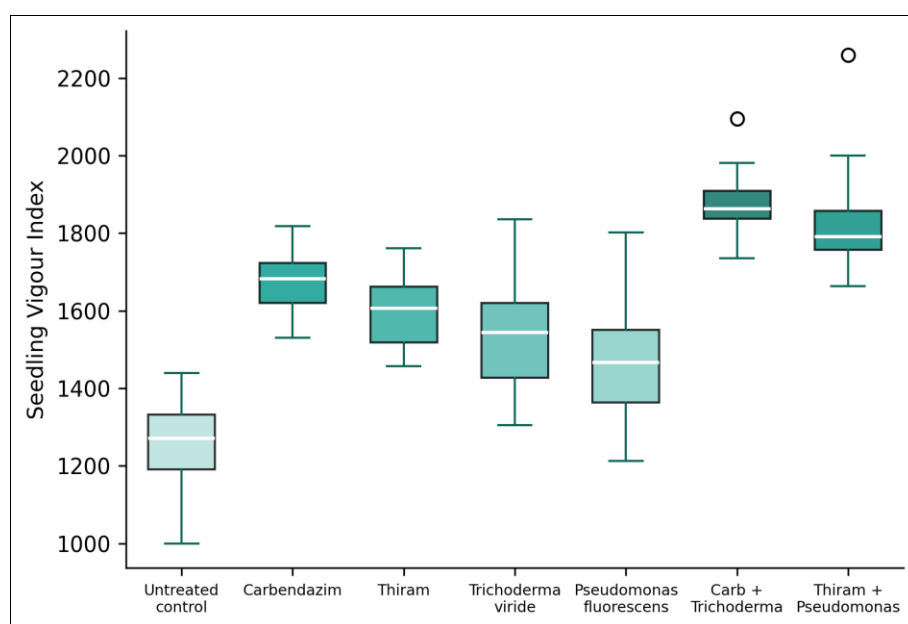


Fig 1: Distribution of seedling vigour index across seven seed treatments at 14 DAS (pooled over two seasons).

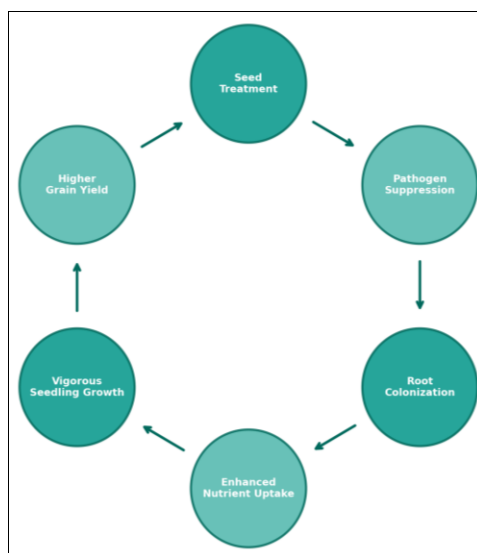


Fig 2: Proposed mechanism cycle of combined fungicide-bioagent seed treatment leading to enhanced soybean productivity.

Figure 1 displays seedling vigour distributions, with combined treatments showing higher medians and tighter spread. Figure 2 illustrates the proposed dual mechanism cycle linking pathogen suppression with growth promotion.

Discussion

The superiority of combined treatments confirms that integration outperforms either approach alone. Carbendazim likely provided immediate pathogen control in the first 7-10 days, creating a window for *T. viride* to colonize the rhizosphere [3, 5]. Once established, *T. viride*'s mycoparasitism and auxin production sustained protection and root growth [6].

The 82.9% collar rot reduction under T_6 exceeded carbendazim alone (68.4%), indicating synergistic effects consistent with Harman *et al.*'s [7] complementary modes of action model. The 14.8% yield advantage of T_6 over T_2 represents *T. viride*'s growth-promoting contribution beyond disease control [4, 8].

Conclusion

Combined seed treatment with carbendazim + *T. viride* produced the best soybean performance: 96.3% germination, highest seedling vigour index (1,892), 82.9% collar rot reduction, and 2.41 t/ha grain yield (43.5% above control). The integrated approach exploits rapid chemical protection followed by sustained biological disease suppression and plant growth promotion. For soybean growers in humid tropical environments with high soilborne disease pressure, combining a systemic fungicide with a *Trichoderma*-based bioagent at sowing is a practical and effective strategy.

Acknowledgements

This research was supported by institutional funds from the Bangladesh Agricultural University. The authors thank BAU for field station access and the Plant Pathology Laboratory for bioagent formulations, and acknowledge field staff for assistance with plot management.

References

- Sharma KK, Singh US, Sharma P, Kumar A, Sharma L. Seed treatments for sustainable agriculture. *Plant Disease*. 2015;99(12):1655-1665.
- Wrather JA, Koenning SR. Estimates of disease effects on soybean yields in the United States 2003 to 2005. *Journal of Nematology*. 2006;38(2):173-180.
- Davidse LC. Benzimidazole fungicides: mechanism of action and biological impact. *Annual Review of Phytopathology*. 1986;24:43-65.
- Meena RS, Kumar S, Datta R, Lal R, Vijayakumar V, Brtnicky M. Impact of agrochemicals on soil microbiota and management. *Land*. 2020;9(2):34-34.
- Harman GE, Howell CR, Viterbo A, Chet I, Lorito M. *Trichoderma* species: opportunistic, avirulent plant symbionts. *Nature Reviews Microbiology*. 2004;2(1):43-56.
- Vinale F, Sivasithamparam K, Ghisalberti EL, Marra R, Woo SL, Lorito M. *Trichoderma*-plant-pathogen interactions. *Soil Biology and Biochemistry*. 2008;40(1):1-10.
- Harman GE. Multifunctional fungal plant symbionts: new tools to enhance plant growth and productivity. *New Phytologist*. 2011;189(3):647-649.
- Nakkeeran S, Fernando WGD, Siddiqui ZA. Plant growth promoting rhizobacteria formulations and its scope in commercialization. In: Siddiqui ZA, editor. *PGPR: Biocontrol and Biofertilization*. Dordrecht: Springer; 2005. p. 257-296.
- International Rice Research Institute (IRRI). *STAR statistical tool for agricultural research v2.0.1*. Los Baños: IRRI; 2014. p. 1-18.
- Solaiman ARM, Talukder MS, Rabbani MG. Influence of *Rhizobium* inoculant on nodulation and yield of soybean. *Bangladesh Journal of Microbiology*. 2006;23(2):113-117.
- Bangladesh Meteorological Department. Mymensingh climate station data 2022-2023. *BMD Annual Report*. 2023. p. 1-18.
- Soil Resource Development Institute. Land and soil resources of Mymensingh district. *SRDI Technical Report*. 2018. p. 1-42.
- Dubey SC, Suresh M, Singh B. Evaluation of *Trichoderma* species against *Fusarium oxysporum*. *Biological Control*. 2007;40(1):118-127.
- Lorito M, Woo SL, Harman GE, Monte E. Translational research on *Trichoderma*: from omics to the field. *Annual Review of Phytopathology*. 2010;48:395-417.
- Pal KK, McSpadden Gardener B. Biological control of plant pathogens. *The Plant Health Instructor*. 2006. doi:10.1094/PHI-A-2006-1117-02.