J.Mycopathol.Res. 63(3) : 647-656, 2025, ISSN : 0971-3719 (Print), 2583-6315 (Online) 10.57023/JMycR.63.3.2025.647

Evaluation of different natural organic inputs for the management of Sclerotium rot in Groundnut (*Arachis hypogaea* L.)

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Received : 13.05.2025 Accepted : 02.08.2025 Published : 29.09.2025

This study evaluated the bio-efficacy of different organic inputs for managing Sclerotium rot in groundnut (*Arachis hypogea* L.) over three cropping seasons (2021-2023) in Gujarat, India. *Sclerotium rolfsii*, a significant soil-borne pathogen, causes substantial yield losses in groundnut crops. The primary objective was to identify effective organic alternatives to chemical pesticides. Eleven treatments were tested, focusing on the use of *Beejamrutha*, *Trichoderma harzianum*, and vermicompost enriched with beneficial microorganisms.The results demonstrated that the treatment involving seed soaking with *Beejamrutha*, seed treatment with *Trichodermaharzianum*, and soil application of vermicompost enriched with *T.harzianum* (T_4) was the most effective, showing a minimum sclerotium rot incidence of 5.23%, which was comparable to the incidence in T_5 (6.04%). Both treatments were significantly better than the control, which had a 36.15% incidence of the disease. Additionally, T_4 resulted in the highest seed yield and had no adverse effects on seed germination rates.These findings suggest that organic inputs can be highly effective in managing soil-borne diseases in groundnut, providing a sustainable and eco-friendly alternative to conventional chemical methods. This study supports the wider adoption of organic farming practices to enhance crop health and productivity while reducing environmental impacts.

Keywords : Groundnut, Sclerotium rot, Natural organic inputs

INTRODUCTION

Groundnut (*Arachis hypogaea* L.) is a major legume and oilseed crop in India, occupying nearly half of the area under oilseeds. Several factors contribute to its low productivity, among which diseases such as leaf spot, collar rot, stem rot, and bud necrosis are significant. Stem rot, caused by *Sclerotium rolfsii* Sacc., is particularly problematic, causing yield losses of up to 80-90 per cent under severe conditions (Akgul*et al*. 2011; Kumar *et al*. 2008; Yan *et al.* 2018).

The reliance on chemical pesticides has led to issues such as rising cultivation costs, fungicide resistance, and environmental contamination. In response, organic farming practices, which utilize locally available inputs, are gaining attention for their potential to provide effective and sustainable disease management solutions (van Brueggen*et al*. 2015; Subhalakshmi, 2019). This study evaluates the efficacy of various organic inputs in managing sclerotium rot in groundnut.

MATERIALS AND METHODS

The study was conducted using the groundnut variety GJG-32 during the *Kharif* seasons of 2021-22, 2022-23 and 2023-24. A randomized block design (RBD) was employed with four replications per treatment to minimize experimental error and ensure robust statistical analysis. Castor cake was used as the source of fertilizer, applied at a rate of 700 kg/ha uniformly across all plots before sowing. Seeds were sown at a rate of 120 kg/ha to maintain consistency and uniformity across experimental plots. The pathogen was artificially inoculated as per the inoculation techniques given by Shokes*et al.* (1996.). For treatments T_6 to T_{10}, drenching volume of 1000 lit. per ha. was used.Seeds were soaked for 05 min. in T_1 and T_3-T_{10}. Treatments

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T_6 to T_{10} were applied twice as drench (1000L/ ha.) at 30 and 45 DAS.

Observations recorded

1. Germination counts 10 days after sowing
2. No. of diseased plants/plot (Sclerotium rot at 30, 45 & 60 DAS)
3. Seed yield

Treatment details

1.	Seed soaking with *Beejamrutha*@ 300 ml per kg seeds for 10 min
2.	Seed treatment with *Trichoderma harzianum*1 WP (1 X 10^8cfu/g) @ 10g/kg seeds
3.	Seed soaking with *Beejamrutha*@ 300 ml per kg seeds + seed treatment with *Trichoderma harzianum*1 WP (1 X 10^8cfu/g) @ 10g/kg seeds
4.	T_3+ soil application of vermicompost (dose: 1 ton/ha) enriched with *T. harzianum*1 WP (1 X 10^8cfu/g) (10 g *T. harzianum*per kg vermicompost)
5.	T_3+ soil application of vermicompost (dose: 1 ton/ha) enriched with *Pseudomonas fluorescens* 1.75 WP(2 X 10^6cfu/g) (10 g *P. fluorescens* per kg vermicompost)
6.	T_3+ soil drench of 10% cow urine
7.	T_3+ soil drench of 10% *panchgavya*
8.	T_3+ soil drench of 10% *neemastra*
9.	T_3+ soil drench of 10% *jeevamrutha*
10.	T_3+ soil drench of 10% *brahmastra*
11.	Untreated check

RESULTS AND DISCUSSION

Germination Percentage

Germination counts were recorded at 10 days after sowing (DAS) for each treatment over the three-year study period (2021-2023). The data indicated no significant differences in germination rates across treatments. This consistency suggests that the application of various organic inputs, including seed treatments and soil amendments, did not adversely affect seed germination. All treatments maintained a high germination percentage, indicative of the non-toxic nature of the organic inputs used.

Sclerotium Rot Disease Incidence

The percentage of sclerotium rot incidence was calculated by counting the number of diseased plants per plot at 30, 45, and 60 DAS. The pooled data over the three years showed significant differences among the treatments.

Treatment 4 (Seed soaking with *Beejamrutha*@ 300 ml per kg seeds + seed treatment with*Trichoderma harzianum*1 WP (1 X 10^8cfu/g) @ 10g/kg seeds + soil application of vermicompost (dose: 1 ton/ha) enriched with *T. harzianum*1 WP (1 X 10^8cfu/g) (10 g *T. harzianum*per kg vermicompost)exhibited the lowest disease incidence (5.23%), demonstrating a highly effective control of sclerotium rot. The combination of seed soaking, seed treatment, and soil application of organic inputs enriched with *T. harzianum* effectively suppressed the pathogen.

Treatment 5 (Seed soaking with *Beejamrutha*@ 300 ml per kg seeds + seed treatment with*Trichoderma harzianum*1 WP (1 X 10^8cfu/g) @ 10g/kg seeds + soil application of vermicompost (dose: 1 ton/ha) enriched with *Pseudomonas fluorescens* 1.75 WP(2 X 10^6cfu/ g) (10 g *P. fluorescens* per kg vermicompost) was at par with T_4, showing a disease incidence of 6.04 per cent. The presence of *P. fluorescens*, a known biocontrol agent, contributed to the reduction in disease incidence.Prajapati *et al.* (2015) conducted an evaluation of several *Trichoderma* spp. against *Sclerotiumrolfsii* Sacc., the causal agent of collar rot in chickpea. Their study revealed that the liquid culture filtrate produced by *T. viride* and *T. harzianum* exhibited the highest effectiveness in inhibiting the mycelial growth of the pathogen.Johnson *et al.* (2008) evaluated treatments incorporating *Pseudomonasfluorescens* with farm yard manure

Table 1: Evaluation of different organic inputs on germination of groundnut 10 days after sowing

Tr. No.	Treatments		Per cent germination		
		2021-22	2022-23	2023-24	Pooled
T_1	Seed soaking with *Beejamrutha*@ 300 ml per kg seeds for 10 min	71.88^{ab} (90.33)	70.05^{a} (88.35)	70.99^{a} (89.39)	71.84^{a} (90.29)
T_2	Seed treatment with *Trichoderma harzianum* 1 WP (1 X 10^8cfu/g) @ 10g/kg seeds	72.16^{ab} (90.62)	68.93^{a} (87.07)	69.98^{ab} (88.28)	71.49^{a} (89.92)
T_3	Seed soaking with *Beejamrutha*@ 300 ml per kg seeds + seed treatment with *Trichoderma harzianum* 1 WP (1 X 10^8cfu/g) @ 10g/kg seeds	73.77^{a} (92.19)	71.02^{a} (89.43)	68.06^{ab} (86.04)	71.33^{a} (89.75)
T_4	T_3+ soil application of vermicompost (dose: 1 ton/ha) enriched with *T. harzianum* 1 WP (1 X 10^8cfu/g) (10 g *T. harzianum*per kg vermicompost)	73.09^{ab} (91.54)	70.61^{a} (88.98)	67.83^{ab} (85.90)	71.06^{a} (89.46)
T_5	T_3+ soil application of vermi compost (dose: 1 ton/ha) enriched with *Pseudomonas fluorescens* 1.75 WP (2 X 10^6cfu/ml) (10 ml *P. fluorescens* per kg vermicompost)	74.12^{a} (92.52)	69.06^{a} (87.22)	69.13^{ab} (87.31)	70.79^{a} (89.17)
T_6	T_3+ soil drench of 10% cow urine	74.66^{a} (93.00)	70.47^{a} (88.82)	69.79^{ab} (88.07)	70.70^{a} (89.08)
T_7	T_3+ soil drench of 10% *panchgavya*	75.33^{a} (93.59)	71.07^{a} (89.48)	70.61^{ab} (88.98)	70.40^{a} (88.75)
T_8	T_3+ soil drench of 10% *neemastra*	73.95^{a} (92.36)	70.43^{a} (88.78)	70.43^{ab} (88.78)	70.33^{a} (88.67)
T_9	T_3+ soil drench of 10% *jeevamrutha*	74.07^{a} (92.47)	71.04^{a} (89.44)	68.78^{ab} (86.90)	69.95^{a} (88.25)
T_{10}	T_3+ soil drench of 10% *brahmastra*	72.75^{ab} (91.20)	68.15^{ab} (86.15)	68.16^{ab} (86.16)	69.44^{a} (87.67)
T_{11}	Untreated check	65.91^{b} (83.34)	63.89^{b} (80.63)	66.89^{bc} (80.81)	64.43^{b} (81.37)
S.Em. $\pm$	T	2.26	1.56	1.30	4.43
	Y	-	-	-	1.00
	T X Y	-	-	-	0.33
CD 0.05	T	NS	NS	NS	1.40
	T X Y	-	-	-	NS
C.V. (%)		6.21	4.50	3.78	2.68

Note: 1. Figures outside the parentheses are arcsine transformed values and those inside the parentheses are retransformed values
2. Treatment means followed by the same letter are not significantly different by Duncan's New Multiple Range Test (DNMRT) at 5% level of significance

Table 2 : Evaluation of different organic inputs against sclerotium rot of groundnut (2021-22)

Tr. No.	Treatments	Per cent sclerotium rot incidence			
		30 DAS	45 DAS	60 DAS	Pooled
T_1	Seed soaking with *Beejamrutha*@ 300 ml per kg seeds for 10 min	15.68^{bcd} (07.30)	26.57^{ab} (20.00)	33.94^{b} (31.17)	25.39^{b} (18.39)
T_2	Seed treatment with *Trichoderma harzianum* 1 WP (1 X 10 ^{8}cfu/g) @ 10g/kg seeds	14.30^{cd} (06.10)	22.64^{b} (14.82)	30.65^{bc} (25.99)	22.53^{b} (14.68)
T_3	Seed soaking with *Beejamrutha*@ 300 ml per kg seeds + seed treatment with *Trichoderma harzianum* 1 WP (1 X 10^{8}cfu/g) @ 10g/kg seeds	15.68^{bcd} (07.30)	22.64^{b} (14.82)	29.00^{bc} (23.50)	22.44^{b} (14.57)
T_4	T_3+ soil application of vermicompost (dose: 1 ton/ha) enriched with *T. harzianum* 1 WP (1 X 10^{8}cfu/g) (10 g *T. harzianum*per kg vermicompost)	00.96^{e} (00.30)	11.07^{c} (3.69)	16.77^{d} (8.32)	09.60^{c} (2.78)
T_5	T_3+ soil application of vermicompost (dose: 1 ton/ha) enriched with *Pseudomonas fluorescens* 1.75 WP (2 X 10 ^{6}cfu/ml) (10 ml *P. fluorescens* per kg vermicompost)	00.96^{e} (00.30)	12.92^{c} (5.00)	18.14^{d} (9.70)	10.67^{c} (3.43)
T_6	T_3+ soil drench of 10% cow urine	18.43^{ab} (10.00)	25.53^{b} (18.58)	30.71^{bc} (26.08)	24.89^{b} (17.72)
T_7	T_3+ soil drench of 10% *panchgavya*	17.06^{bc} (08.60)	23.59^{b} (16.01)	29.09^{bc} (23.63)	23.24^{b} (15.57)
T_8	T_3+ soil drench of 10% *neemastra*	18.43^{ab} (10.00)	22.64^{b} (14.82)	27.28^{c} (21.01)	22.79^{b} (15.00)
T_9	T_3+ soil drench of 10% *jeevamrutha*	12.92^{d} (05.00)	25.62^{b} (18.70)	29.94^{bc} (24.92)	22.83^{b} (15.05)
T_{10}	T_3+ soil drench of 10% *brahmastra*	14.30^{cd} (06.10)	22.64^{b} (14.82)	30.65^{bc} (25.99)	22.53^{b} (14.68)
T_{11}	Untreated check	21.70^{a} (13.67)	31.61^{a} (27.46)	42.12^{a} (44.99)	31.81^{a} (27.78)
S.Em. $\pm$	T	1.07	1.70	1.84	0.91
	P	-	-	-	0.47
	T X P	-	-	-	1.57
CD 0.05		3.09	4.90	5.32	2.13
C.V. (%)		15.67	15.10	12.74	14.51

Note: 1. Figures outside the parentheses are arcsine transformed values and those inside the parentheses are retransformed values

2. Treatment means followed by the same letter are not significantly different by Duncan's New Multiple Range Test (DNMRT) at 5% level of significance

(FYM) and found them significantly effective in reducing stem rot incidence (22.8% & 25.2%). Moreover, these treatments substantially increased pod yield (1441 kg/ha & 1372 kg/ha) and haulm yield (3045 kg/ha & 2953 kg/ha), while also reducing residual pods in soil (118 kg/ha & 117 kg/ha) and leaf drop (259 kg/ha & 280 kg/ha) compared to other experimental treatments. The untreated check plot had a significantly higher disease incidence of 36.15 per cent, highlighting

Table3 : Evaluation of different organic inputs against sclerotium rot of groundnut (2022-23)

Tr. No.	Treatments	Per cent sclerotium rot incidence			
		30 DAS	45 DAS	60 DAS	Pooled
T_1	Seed soaking with *Beejamrutha*@ 300 ml per kg seeds for 10 min	21.34^{b} (13.24)	28.27^{bc} (22.44)	35.20^{b} (33.22)	28.26^{cd} (22.43)
T_2	Seed treatmen t with *Trichoderma harzianum* 1 WP (1 X 10 ^{8}cfu/g) @ 10g/kg seeds	21.34^{b} (13.24)	24.61^{c} (17.34)	31.58^{b} (27.42)	25.83^{cb} (19.00)
T_3	Seed soaking with *Beejamrutha*@ 300 ml per kg seeds + seed treatment with *Trichoderma harzianum* 1 WP (1 X 10^{8}cfu/g) @ 10g/kg seeds	19.92^{b} (11.61)	24.04^{c} (16.59)	31.03^{b} (26.57)	24.99^{d} (17.86)
T_4	T_3+ soil application of vermicompost (dose: 1 ton/ha) enriched with *T. harzianum* 1 WP (1 X 10^{8}cfu/g) (10 g *T. harzianum*per kg vermicompost)	5.74^{c} (1.00)	14.72^{d} (6.45)	19.72^{c} (11.39)	13.39^{e} (5.36)
T_5	T_3+ soil application of vermicompost (dose: 1 ton/ha) enriched with *Pseudomonas fluorescens* 1.75 WP (2 X 10^{6}cfu/ml) (10 ml *P. fluorescens* per kg vermicompost)	9.24^{c} (02.58)	15.22^{d} (6.89)	20.39^{c} (12.14)	14.94^{e} (6.65)
T_6	T_3+ soil drench of 10% cow urine	21.21^{b} (13.09)	31.07^{b} (26.63)	34.74^{b} (32.47)	29.00^{b} (23.51)
T_7	T_3+ soil drench of 10% *panchgavya*	23.91^{b} (16.43)	28.19^{bc} (22.31)	32.11^{b} (28.26)	28.06^{bcd} (22.14)
T_8	T_3+ soil drench of 10% *neemastra*	20.59^{b} (12.37)	25.96^{bc} (19.17)	30.40^{b} (25.60)	25.64^{cd} (18.74)
T_9	T_3+ soil drench of 10% *jeevamrutha*	22.01^{b} (14.04)	27.08^{bc} (20.72)	32.61^{b} (29.04)	27.22^{bcd} (20.94)
T_{10}	T_3+ soil drench of 10% *brahmastra*	21.96^{b} (13.98)	28.74^{bc} (23.12)	32.03^{b} (28.13)	27.56^{bcd} (21.43)
T_{11}	Untreated check	33.67^{a} (30.74)	38.73^{a} (39.15)	44.04^{a} (48.33)	38.80^{a} (39.29)
S.Em. $\pm$	T	1.63	1.59	1.80	0.97
	P	-	-	-	0.51
	T X P	-	-	-	1.69
CD 0.05		4.72	4.60	5.20	2.29
C.V. (%)		16.28	12.22	11.52	13.07

Note: 1. Figures outside the parentheses are arcsine transformed values and those inside the parentheses are retransformed values

2.Treatment means followed by the same letter are not significantly different by Duncan's New Multiple Range Test (DNMRT) at 5% level of significance

the severity of sclerotium rot in the absence of any treatment.

Impact on Yield

Yield data, pooled over the three years, revealed significant improvements in groundnut seed yield with the application of organic treatments.The highest seed yield was observed in this treatment T_4, with an average of 28.89 q/ha. The synergistic effect of *Beejamrutha*, *T. harzianum*, and enriched vermicompost provided optimal conditions for plant growth and health, resulting in superior yields.

Treatment T_5 yielded 27.34 q/ha, which was statistically at par with T_4. The use of *P.*

Table 4: Evaluation of different organic inputs against sclerotium rot of groundnut (2023-24)

Tr. No.	Treatments	Per cent sclerotium rot incidence			
		30 DAS	45 DAS	60 DAS	Pooled
T_1	Seed soaking with *Beejamrutha*@ 300 ml per kg seeds for 10 min	28.85^{b} (23.29)	33.16^{b} (29.92)	36.20^{b} (34.89)	32.74^{bc} (29.25)
T_2	Seed treatment with *Trichoderma harzianum* 1 WP (1 X 10^{8}cfu/g) @ 10g/kg seeds	29.94^{b} (24.90)	33.17^{b} (29.94)	36.16^{b} (34.82)	33.09^{b} (29.81)
T_3	Seed soaking with *Beejamrutha*@ 300 ml per kg seeds + seed treatment with *Trichoderma harzianum* 1 WP (1 X 10^{8}cfu/g) @ 10g/kg seeds	26.46^{b} (19.85)	29.39^{bc} (24.08)	32.64^{bc} (29.09)	29.50^{cd} (24.25)
T_4	T_3+ soil application of vermicompost (dose: 1 ton/ha) enriched with *T. harzianum* 1 WP (1 X 10^{8}cfu/g) (10 g *T. harzianum*per kg vermicompost)	12.73^{e} (4.86)	17.44^{e} (8.98)	19.92^{e} (11.61)	16.70^{f} (8.26)
T_5	T_3+ soil application of vermicompost (dose: 1 ton/ha) enriched with *Pseudomonas fluorescens* 1.75 WP (2 X 10^{6}cfu/ml) (10 ml *P. fluorescens* per kg vermicompost)	12.49^{e} (4.68)	18.31^{e} (9.87)	20.47^{de} (12.23)	17.08^{f} (8.63)
T_6	T_3+ soil drench of 10% cow urine	26.37^{b} (19.73)	29.39^{bc} (24.08)	31.44^{bc} (27.21)	29.07^{d} (23.61)
T_7	T_3+ soil drench of 10% *panchgavya*	25.65^{b} (18.74)	29.94^{bc} (24.90)	32.95^{bc} (29.38)	29.51^{cd} (24.26)
T_8	T_3+ soil drench of 10% *neemastra*	19.92^{cd} (11.61)	24.04^{d} (16.59)	26.16^{cde} (19.44)	23.37^{e} (15.73)
T_9	T_3+ soil drench of 10% *jeevamrutha*	25.17^{bc} (18.09)	28.77^{bcd} (23.16)	32.13^{bc} (28.29)	28.69^{d} (23.05)
T_{10}	T_3+ soil drench of 10% *brahmastra*	18.98^{d} (10.58)	24.66^{cd} (17.41)	27.10^{cd} (20.76)	23.58^{e} (16.00)
T_{11}	Untreated check	37.24^{a} (36.62)	40.08^{a} (41.46)	43.54^{a} (47.46)	40.30^{a} (41.83)
S.Em. $\pm$	T	1.83	1.66	2.29	1.09
	P	-	-	-	0.57
	T X P	-	-	-	1.90
CD 0.05		5.29	4.79	6.61	2.58
C.V. (%)		15.29	11.83	14.86	13.79

Note: 1. Figures outside the parentheses are arcsine transformed values and those inside the parentheses are retransformed values

2. Treatment means followed by the same letter are not significantly different by Duncan's New Multiple Range Test (DNMRT) at 5% level of significance

Table 5: Evaluation of different organic inputs against sclerotium rot of groundnut (Pooled over year)

Tr. No	Treatments	2021-22	2022-23	2023-24	Pooled over years
T_1	Seed soaking with *Beejamrutha*@ 300 ml per kg seeds for 10 min	25.39^{b}	28.26^{cd}	32.74^{bc}	28.79^{b}
		(18.39)	(22.43)	(29.25)	(23.19)
T_2	Seed treatment with *Trichoderma harzianum* 1 WP (1 X 10^{8}cfu/g) @ 10g/kg seeds	22.53^{b}	25.83^{cb}	33.09^{b}	27.14^{bcd}
		(14.68)	(19.00)	(29.81)	(20.81)
T_3	Seed soaking with *Beejamrutha*@ 300 ml per kg seeds + seed treatmen t with *Trichoderma harzianum* 1 WP (1 X 10^{8}cfu/g) @ 10g/kg seeds	22.44^{b}	24.99^{d}	29.50^{cd}	25.63^{def}
		(14.57)	(17.86)	(24.25)	(18.71)
T_4	T_3+ soil application of vermicompost (dose: 1 ton/ha) enriched with *T. harzianum* 1 WP (1 X 10^{8}cfu/g) (10 g *T. harzianum*per kg vermicompost)	09.60^{c}	13.39^{e}	16.70^{f}	13.22^{g}
		(2.78)	(5.36)	(8.26)	(5.23)
T_5	T_3+ soil application of vermicompost (dose: 1 ton/ha) enriched with *Pseudomonas fluorescens* 1.75 WP (2 X 10^{6}cfu/ml) (10 ml *P. fluorescens* per kg vermicompost)	10.67^{c}	14.94^{e}	17.08^{f}	14.23^{g}
		(3.43)	(6.65)	(8.63)	(6.04)
T_6	T_3+ soil drench of 10% cow urine	24.89^{b}	29.00^{b}	29.07^{d}	27.64^{bc}
		(17.72)	(23.51)	(23.61)	(21.52)
T_7	T_3+ soil drench of 10% *panchgavya*	23.24^{b}	28.06^{bcd}	29.51^{cd}	26.93^{bcd}
		(15.57)	(22.14)	(24.26)	(20.51)
T_8	T_3+ soil drench of 10% *neemastra*	22.79^{b}	25.64^{cd}	23.37^{e}	23.93^{f}
		(15.00)	(18.74)	(15.73)	(16.45)
T_9	T_3+ soil drench of 10% *jeevamrutha*	22.83^{b}	27.22^{bcd}	28.69^{d}	26.32^{cde}
		(15.05)	(20.94)	(23.05)	(19.55)
T_{10}	T_3+ soil drench of 10% *brahmastra*	22.53^{b}	27.56^{bcd}	23.58^{e}	24.55^{ef}
		(14.68)	(21.43)	(16.00)	(17.26)
T_{11}	Untreated check	31.81^{a}	38.80^{a}	40.30^{a}	36.96^{a}
		(27.78)	(39.29)	(41.83)	(36.15)
	S. Em. $\pm$ T	0.91	0.97	1.09	0.58
	P	0.48	0.51	0.57	0.30
	Y	-	-	-	0.30
	T X P	1.57	1.69	1.90	1.01
	T x Y	-	-	-	1.01
	P X Y	-	-	-	0.53
	T X P X Y	-	-	-	1.75
CD 0.05 T		2.13	2.29	2.58	1.61
	T x Y	-	-	-	NS
C.V. (%)		14.09	13.07	13.79	13.99

Note: 1. Figures outside the parentheses are arc sign transformed values and those inside the parentheses are retransformed values, 2. Treatment means followed by the same letter are not significantly different by Duncan's New Multiple Range Test (DNMRT) at 5% level of significance

Table 6 : Evaluation of different organic inputs on seed yield of groundnut (Pooled over year)

Tr. No.	Treatments	Seed yield (q/ha.)			
		2021-22	2022-23	2023-24	Pooled
T_1	Seed soaking with *Beejamrutha*@ 300 ml per kg seeds for 10 min	14.78^{c}	13.98^{d}	11.48^{cd}	13.41^{f}
T_2	Seed treatment with *Trichoderma harzianum* (2 X 10^8cfu/g) @ 10g/kg seeds	15.43^{bc}	13.38^{d}	12.74^{c}	13.85^{ef}
T_3	Seed soaking with *Beejamrutha*@ 300 ml per kg seeds + seed treatment with *Trichoderma harzianum* (2 X 10^8cfu/g) @ 10g/kg seeds	16.23^{bc}	14.56^{d}	13.63^{c}	14.80^{def}
T_4	T_3+ soil application of vermicompost (dose: 1 ton/ha) enriched with *T. harzianum* (2 X 10^8cfu/g) (10 g *T. harzianum* per kg vermicompost)	29.93^{a}	28.55^{a}	28.19^{a}	28.89^{a}
T_5	T_3+ soil application of vermicompost (dose: 1 ton/ha) enriched with *Pseudomonas fluorescens* (2 X 10^8cfu/ml) (10 ml *P. fluorescens* per kg vermicompost)	28.39^{a}	26.57^{a}	27.08^{a}	27.34^{a}
T_6	T_3+ soil drench of 10% cow urine	16.48^{bc}	14.85^{cd}	13.88^{c}	15.06^{def}
T_7	T_3+ soil drench of 10% *panchgavya*	18.34^{b}	15.95^{bcd}	14.11^{c}	16.13^{cd}
T_8	T_3+ soil drench of 10% *neemastra*	18.23^{b}	17.54^{bc}	17.29^{b}	17.68^{bc}
T_9	T_3+ soil drench of 10% *jeevamrutha*	16.80^{bc}	15.24^{cd}	13.79^{c}	15.27^{de}
T_{10}	T_3+ soil drench of 10% *brahmastra*	18.89^{b}	18.46^{b}	17.03^{b}	18.12^{b}
T_{11}	Untreated check	10.50^{d}	9.51^{e}	9.80^{d}	9.94^{g}
S.Em. ±	T	1.05	0.88	0.88	0.56
	Y	-	-	-	0.29
	T X Y	-	-	-	0.96
CD 0.05	T	3.03	2.54	2.53	1.30
	T X Y	-	-	-	NS
C.V. (%)		11.32	10.25	10.76	11.11

Note: Treatment means followed by the same letter are not significantly different by Duncan's New Multiple Range Test (DNMRT) at 5% level of significance

fluorescens in conjunction with other organic inputs also contributed to enhanced plant growth and productivity.The untreated plots had the lowest yield of 9.94 q/ha, underscoring the detrimental impact of sclerotium rot on groundnut production. Dhage and Kumbhar (2018) conducted a field experiment during the *Kharif* seasons of 2014-15 to evaluate the efficacy of *Pseudomonasfluorescens* and *Trichoderma* spp. in managing stem rot caused by *Sclerotiumrolfsii* in groundnut. Treatments where both *P.fluorescens* and *Trichoderma* spp. were inoculated into both seeds and soil showed notable improvements in seed germination rates, shoot length, branching, dry plant weight, and pod yield. These findings underscore the potential of biocontrol strategies to enhance crop health and productivity in groundnut cultivation, offering sustainable alternatives for disease management in agricultural systems Aydogdu (2023)also conducted field experiments including four treatments: a negative control (only groundnut seedlings), a positive control (groundnut seedlings + *S. rolfsii*), Treatment A (groundnut

Table 7. Economics of various treatments

Tr. No.	Material required (L or kg/ha.)	Cost of material (? /ha.)	Labour cost (?)	Total cost of treatment (?) (C+D)	Yield (q/ha.)	Gross realization (? /ha.)	Net realization	Net gain (? /ha.)	PCBR
A	B	C	D	E	F	G	H	I (H-E)	J (I/E)
T_1	36	468	1125	1593	13.41	80460	20820	19227	1:12.07
T_2	1.2	192	1125	1317	13.85	83100	23460	22143	1:16.81
T_3	36+1.2	660	1125	1785	14.80	88800	29160	27375	1:15.34
T_4	36+1.2+1+10	10260	2250	12510	28.89	173340	113700	101190	1:8.08
T_5	36+1.2+1+10	10260	2250	12510	27.34	164040	104400	91890	1:7.34
T_6	36+1.2+200	1660	2250	3910	15.06	90360	30720	26810	1:6.85
T_7	36+1.2+200	16660	2250	18910	16.13	96780	37140	18230	1:0.96
T_8	36+1.2+200	1260	2250	3510	17.68	106080	46440	42930	1:12.23
T_9	36+1.2+200	1260	2250	3510	15.27	91620	31980	28470	1:8.11
T_{10}	36+1.2+200	2660	2250	4910	18.12	108720	49080	44170	1:8.99
T_{11}	--	--	--	--	9.94	59640	--	--	--

Beejamrutha: ? 13/L
Panchgavya: ? 80/L
Jeevamrutha: ? 03/L
Trichoderma harzianum: ? 160/kg
Pseudomonas fluorescens= ? 160/L
Price of groundnut: ? 6000/q
Cow urine: ? 05/L
Neemastra: ? 3/L
Brahmastra: ? 10 /L
Labours required= 6/ha; Labour cost= ? 375/day
Labours for preparation= 2/ha.

seedlings + *Trichoderma* isolate), and Treatment B (groundnut seedlings + *S. rolfsii* + *Trichoderma* isolate). The results demonstrated that treatments with *Trichoderma* isolates effectively suppressed *S. rolfsii* infection, as evidenced by reduced lesion length and enhanced plant vigour compared to the positive control.Raja *et al*. (2023) conducted field trials over two years (2019 and 2020) and validated the efficacy of *Trichoderma harzianum*. Soil application, seed treatment, and drenching with *Trichoderma harzianum* formulation significantly reduced stem rot disease incidence caused by *Sclerotium rolfsii*to 59.45 and 53.79 per cent, respectively, compared to untreated controls. Moreover, pod yield increased to 2.85 t/ha and 2.68 t/ha, respectively indicating its potential for enhancing groundnut yield.

Economics

Economic analysis was conducted to evaluate the profitability of the treatments. The net realization and net gain were highest in the following treatments:

T_4 yielded a net realization of ¹ 113700, making it the most economically viable option. The high yield and low disease incidence contributed to significant cost savings and increased profitability. With a net realization of ¹ 1,04,400, T_5 also proved to be economically beneficial. The use of P. fluorescens, though slightly less effective than *T. harzianum*, still provided a substantial economic advantage over the control. The highest profit-cost benefit ratio (PCBR) was recorded in T_2 (seed treatment with *T. harzianum*), which had a PCBR of 1:16.81, followed by T_3 (1:15.34). These treatments, while simpler and less costly, still offered considerable economic returns.

DECLARATION

Conflict of Interest: Authors declare no conflict of interest.

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