P-ISSN: 2618-0723
E-ISSN: 2618-0731

NAAS Rating: 5.04
www.extensionjournal.com

International Journal of Agriculture Extension and Social Development

Volume 8; Issue 2; February 2025; Page No. 295-297

Received: 03-11-2024
Accepted: 05-12-2024

Indexed Journal
Peer Reviewed Journal

Sustainable approaches for biofumigation and rhizome rot management in ginger (*Zingiber officinale* Rose) cultivation in the Chhattisgarh plains

NC Banjara, Manisha Chaudhary and Savita Aditya

Krishi Vigyan Kendra, Raigarh, (C.G.) Indira Gandhi Krishi Viswavidyalaya, Raipur, Chhattisgarh, India

DOI: https://www.doi.org/10.33545/26180723.2025.v8.i2e.1648

Corresponding Author: NC Banjara

Abstract

Ginger (*Zingiber officinale*) is one of the most commercially significant spice crops. Rhizome rot is the most destructive disease affecting ginger, causing economic losses ranging from 50% to 90%. Three field experiments were conducted over the *kharif* seasons of 2017-18, 2018-19, and 2019-20 at farmers' fields in the villages of Badgaon, Chharratangar, and Badimal in Raigarh District. The trials included three treatments: T1 – farmers' practice, and T2 – biofumigation using mustard crop residues combined with seed treatment using Metalaxyl + Mancozeb at 2.5 g/kg of seed, *Trichoderma viride* at 10 g/kg of seed, and soil application with FYM at 250 kg/ha and 2.5 kg of *Trichoderma viride*.

All treatments significantly reduced the incidence and severity of the disease while improving germination rates and rhizome yields. Among the treatments, biofumigation combined with seed treatment (T2) was the most effective compared to farmers' practice.

Keywords: Biofumigation, ginger, *Pythium*, rhizome rot, *Trichoderma*

Introduction

Ginger (*Zingiber officinale*) is one of the most essential spice crops grown worldwide, including in India. It holds particular significance in tropical countries, where it is produced and consumed in large quantities (Rahim, 1992) [3]. Among the cultivated spices in India, ginger occupies a prominent position, ranking next to black pepper and cardamom. It is highly valued not only as a spice and condiment but also for its applications in perfumery, food flavoring, and its numerous medicinal properties.

Ginger cultivation faces several challenges, among which rhizome rot, caused by *Pythium aphanidermatum*, is the most prevalent and destructive disease. This pathogen, both seed- and soil-borne, can cause significant damage under favorable conditions during the growing period. The disease symptoms begin with yellowing and chlorosis of leaves, which progress downward, leading to leaf withering and death. The base of the plant and rhizomes become pale, watery, and soft, showing visible decay just above the ground level. Eventually, the rhizomes decompose into a decayed mass of tissue enclosed by a relatively tough rind (Singh, 1978) [4]. This results in substantial yield losses, sometimes ranging from 50% to 90%, especially in major production areas like the tropical regions of India (Dohroo, 2005) [2]. *Pythium aphanidermatum* and *P. myriotylum* are the primary pathogens causing rhizome rot, though Dohroo (2005) [2] listed eleven species of *Pythium* associated with the disease globally. Symptoms can appear at any stage of crop growth but are most common during rapid growth periods in summer and autumn. In mature plants, infections occur via the roots or collar region, with initial symptoms manifesting as leaf yellowing and shoot collapse. Below ground, water-soaked lesions develop on the rhizome near the base of infected shoots. Under conducive environmental conditions, the rhizome rapidly rots and is eventually destroyed.

In Chhattisgarh, spice cultivation is a significant agricultural practice due to its high-income potential and favorable price returns. The state accounts for 55,376 hectares of spice cultivation, with an annual production of 354,525 metric tons and a productivity rate of 6.4 metric tons per hectare (Anonymous, 2019-20). The Krishi Vigyan Kendra (KVK) in Raigarh has actively promoted improved agricultural practices to enhance production, productivity, and farmer incomes, even with limited resources. However, in recent years, rhizome rot has become endemic in the region, drastically reducing ginger cultivation. To address this issue, the KVK team conducted field visits to diagnose the problem and decided to initiate on-farm trials (OFT) to manage rhizome rot. These trials were conducted in the villages of Charratangar, Badgaon, and Badimal in the Gharghoda, Tamnar, and Pussore blocks, located approximately 30 km from KVK Raigarh. Information on controlling rhizome rot in ginger through various methods is limited in Chhattisgarh, and previous studies have been preliminary and inconclusive.

Given these circumstances, an attempt was made to identify effective management practices for rhizome rot using biofumigation, fungicides, and organic amendments. The approach focuses on eco-friendly and economically viable strategies, including improved cultural practices, physical methods, and biological interventions. These methods aim

to effectively control both soil- and seed-borne pathogens responsible for rhizome rot in ginger

Materials and Methods

Three independent experiments were conducted at farmers' fields under on-farm trials in the villages of Chharratangar, Badgaon, and Badimal in Raigarh district during the years 2017-18, 2018-19, and 2019-20. The fields were selected by KVK, Raigarh, as they had previously experienced severe ginger infections.

The trials consisted of three treatments:

- **T1:** Farmers' practice.
- **T2:** Biofumigation using mustard crops combined with seed treatment using Metalaxyl + Mancozeb at 2.5 g/kg of seed, *Trichoderma viride* at 10 g/kg of seed, and soil application of FYM at 250 kg/ha mixed with 2.5 kg of *Trichoderma viride*.

Along with the sowing of ginger seeds, mustard seeds were also sown simultaneously to serve as a biofumigant. During the earthing-up process, the mustard plants were incorporated into the soil using agricultural equipment. The mustard crop was properly mulched to release fumes that inhibit the growth of *Pythium* spp., the fungus responsible for rhizome rot in ginger

Results and Discussion

All treatments significantly reduced the incidence and severity of the disease while improving germination, tiller number, and rhizome yield compared to the control (Tables 1, 2, and 3).

In the control field, a disease infestation rate of 18.33% was recorded, with a yield of 130.91 q/ha and a benefit-cost (B:C) ratio of 1.58. However, in the treated fields, infestation was reduced to 8.33%, resulting in a higher yield of 155.61 q/ha and a B:C ratio of 1.80. These findings indicate that this technology is highly effective in controlling rhizome rot, a disease that causes significant losses for ginger farmers.

Table 1: Effectiveness of Fungicides, Biofumigants, and *Trichoderma* Against Rhizome Rot of Ginger (*Pythium aphanidermatum*)

Treatment	Yield q/ha				% changed in yield			
	2017	2018	2019	Average	2017	2018	2019	Average
T1	119.82	110.25	130.25	120.10	27.46	36.35	19.27	27.69
T2	152.73	150.33	155.36	152.80				

*T1: Control, T2: Treated parameters

Table 1 compares the yield of ginger under two conditions: farmers' regular practice (T1) and a special seedling preparation method (T2). The average yield in T1 was 120.10 q/ha, while in T2, it increased significantly to 152.50 q/ha, showing a 27.69% improvement in ginger production with the treatment.

Table 2: Effect of Treatments on Disease Incidence and% Change in Disease Incidence

Disease incidence (%)				%change in Disease incidence			
2017	2018	2019	Average	2017	2018	2019	Average
13.09	16.89	12.24	14.07	5.48	8.55	5.0	6.34
7.61	8.34	7.24	7.73				

*T1: Control, T2: Treated parameters

Table 2 shows how the treatment helped reduce disease in ginger crops. The average disease incidence in the control field (T1) was 14.07%**,** whereas in T2, it dropped to 7.73%**.** This means the treatment effectively reduced disease by 6.34%**,** improving plant health.

Table 3: Effect of Treatments on Net Income (Rs/ha) and Benefit-Cost Ratio

Net Income Rs/ha				Benefit Cost Ratio			
2017	2018	2019	Average	2017	2018	2019	Average
330830	462791	344450	379363.66	3.23	4.22	2.95	3.46
463250	678470	431185	524301.66	4.13	5.57	3.27	4.32

*T1: Control, T2: Treated parameter

Table 3 highlights the financial benefits of using the treatment. Farmers following the regular practice (T1) had an average net income of Rs. 3,79,363.66/ha with a benefit-cost ratio of 3.46. However, those using the improved method (T2) earned significantly more Rs. 5,24,301.66/ha—with a better benefit-cost ratio of 4.32**.** This proves that the new treatment is more profitable for farmers. Overall, T2 showed better results in yield, disease reduction, and profitability compared to T1.

The results align with those of Bandyopadhyay and Khalko, who observed that soil biofumigation with cabbage plant residues significantly, suppressed soil-borne pathogens, including bacterial wilt disease. For disease management, their study highlighted that biofumigation using cabbage was the most effective treatment, reducing bacterial wilt incidence in ginger to 5.92%.

Similarly, Ojaghian *et al.* found that *Brassica* crops used as green manure cover crops significantly reduced potato stem rot caused by *Sclerotinia sclerotiorum* in field trials. Neubauer *et al.* also reported that amendments with *Brassica juncea* shoot tissue significantly reduced the number of viable microsclerotia of *Verticillium dahliae*, achieving efficiencies between 69.3% and 81.3%. Wang *et al.* further demonstrated that biofumigation with rapeseed (*Brassica napus* 'Dwarf Essex') meal and chemical fumigation with dazomet effectively controlled pepper diseases caused by *Phytophthora capsici*.

These findings collectively support the potential of biofumigation as a sustainable and effective approach for managing soil-borne diseases, including rhizome rot in ginger

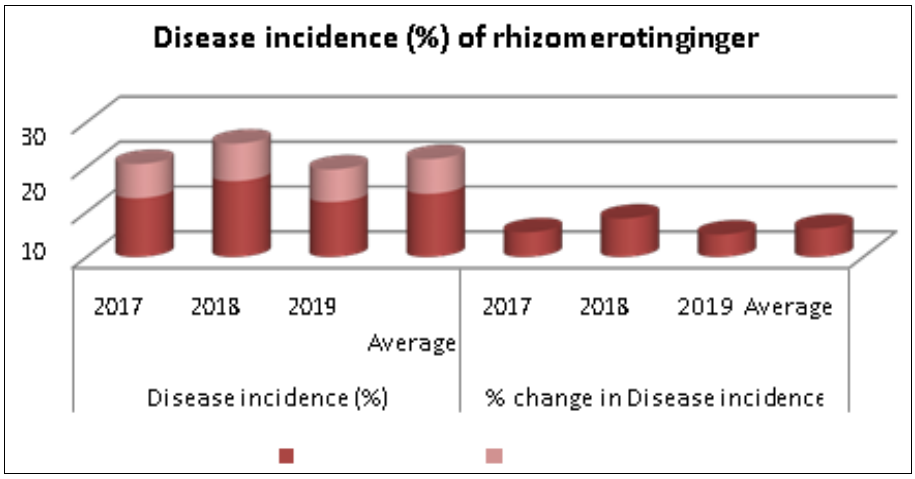

Fig 1: Disease incidence (%) of rhizomerotin ginger

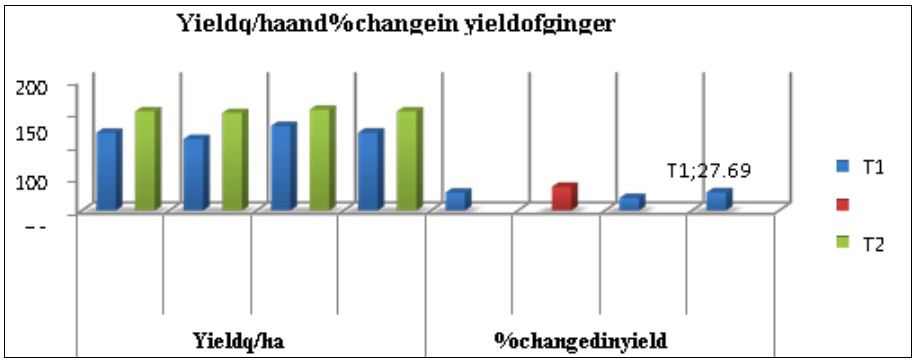

Fig 2: Yield q/ha and % change in yield of ginger

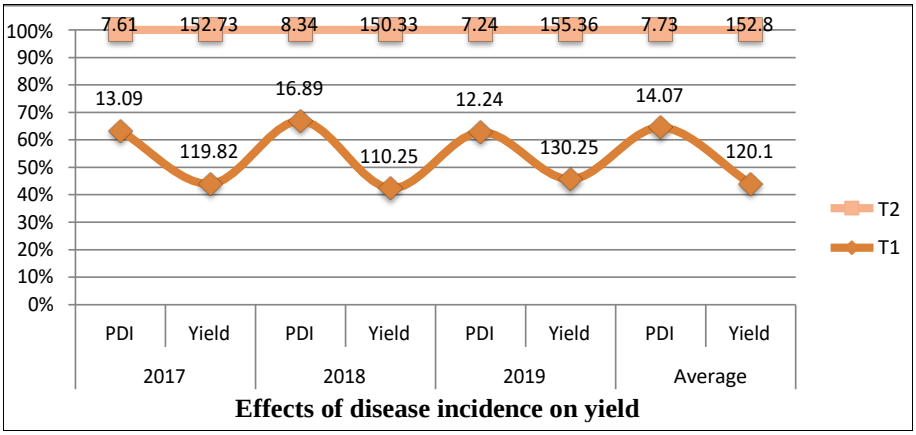

Fig 3: Effects of disease incidence on yield

References

1. Directorate of Horticultural and Farm Forestry State Govt. of Chhattisgarh, Raipur. Anonymous. 2019-2020.
2. Dohroo NP. Diseases of ginger. In: Ravindran PN, Nirmal Babu K, editors. Ginger, the genus Zingiber. Boca Raton: CRC Press; c2005. p. 305-340.
3. Rahim MA. Spices and plantation crops in the national economy. In: Proceedings of the Sixth National Horticulture Convention and Symposium; 1992; BAU, Mymensingh, Bangladesh.
4. Singh RS. Plant Diseases. 4th ed. New Delhi: Oxford and IBH Pub. Co.; 1978. p. 130.