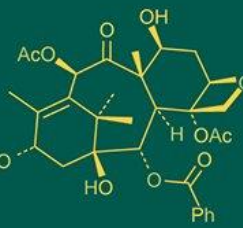
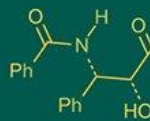


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In-vitro evaluation of natural farming inputs against *Macrophomina phaseolina* causing dry root rot of Chickpea

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Abstract

Dry root rot caused by *Macrophomina phaseolina* is an important soil-borne disease of chickpea, particularly under warm and moisture-deficit conditions. The present investigation was undertaken to study the symptomatology, isolation, identification and pathogenicity of *M. phaseolina* and to evaluate natural farming inputs, *in-vitro* using sick soil method for its management and poisoned food technique. Diseased chickpea plants exhibited lower leaf chlorosis, progressive wilting, drying, collar and root discoloration, root bark peeling and extensive root deterioration. The pathogen was isolated on Potato Dextrose Agar (PDA), producing dirty-white mycelium that gradually turned grey to black, with abundant black microsclerotia after 7-8 days. Microscopic examination revealed septate, light- to dark-brown hyphae and spherical to oval microsclerotia. Pathogenicity was confirmed under glasshouse conditions, with characteristic symptoms appearing within 15-20 days after sowing and successful re-isolation of the pathogen.

Seven natural farming inputs were evaluated *in-vitro* at 20% concentration using the poisoned food technique. Beejamrit recorded the greatest inhibition of mycelial growth (90.29%) with colony diameter (8.67 mm), followed by Jeevamrit (64.14%), Cow urine (40.35%), Ghanjeevamrit (27.58%), Neem cake (25.37%), Ramban (22.41%) and Sour buttermilk (11.95%). Under pot culture conditions, combined application of natural inputs was more effective than individual treatments. Treatment T₆, comprising Neem cake 1 t/ha (SA) + 20% Beejamrit 200 ml/kg (ST) + 10% Jeevamrit 500 L/ha at 30, 45, 60 DAS (FS), recorded the highest germination (86.67%), root length (12.60 cm), shoot length (26.17 cm), plant height (31.16 cm) and vigour index (3008.66). It also resulted in the lowest disease incidence (11.57%) and maximum disease reduction over control (85.23%). The study demonstrated that strategic integration of natural farming inputs, particularly Neem cake, Beejamrit and Jeevamrit, can effectively suppress dry root rot and promote chickpea growth.

Keywords: *Macrophomina phaseolina*, dry root rot, chickpea, natural farming inputs, Beejamrit, Jeevamrit, Neem cake, Ghanjeevamrit

Introduction

India is the leading producer of chickpea worldwide, followed by Australia, Turkey, Myanmar, Pakistan, and Ethiopia are other major producers that collectively contribute substantially to global chickpea production (Merga B. *et al.*, 2019). In India, the major chickpea-producing states are Madhya Pradesh, Maharashtra, Rajasthan, Karnataka, Andhra Pradesh, and Uttar Pradesh, which together accounted for more than 80% of the national chickpea area and production (Sharma S. *et al.*, 2020).

Although India is the world's largest pulse-producing country, chickpea productivity remains comparatively low because of several biotic and abiotic constraints. Among these, diseases represent a major limiting factor. Chickpea is susceptible to numerous fungal diseases, including dry root rot caused by *Macrophomina phaseolina*, Fusarium wilt caused by *Fusarium oxysporum* f. sp. *ciceris*, Ascochyta blight caused by *Ascochyta rabiei*, collar rot caused by *Sclerotium rolfsii*, powdery mildew caused by *Erysiphe polygoni*, rust caused by *Uromyces ciceris-arietini*, and Alternaria blight caused by *Alternaria alternata*. These diseases can cause substantial yield losses, particularly when environmental conditions favour pathogen development, thereby restricting chickpea production.

Dry root rot, caused by *Rhizoctonia bataticola* Butler [pycnidial stage: *Macrophomina phaseolina* Goid], is among the most destructive soil-borne diseases of chickpea, particularly

in the central and southern agro-climatic regions of India (Wagh P *et al.*, 2015). The disease was first reported in India by Mitra and has subsequently been observed across nearly all major chickpea-growing regions. Yield losses commonly range from 5-50% (Sharma S. *et al.*, 2017), although complete crop failure may occur under favourable environmental conditions and in susceptible cultivars. Yield reductions of 50-71% have also been documented (Gaikwad D J. *et al.*, 2022). Disease development is promoted by hot and dry conditions, especially when soil temperatures range from 30-35 °C and soil moisture is low (Sigillo L. *et al.*, 2025).

In chickpea, infection by *Macrophomina phaseolina* is predominantly associated with the reproductive phase, particularly flowering and pod development, although susceptibility during seed development has also been reported. The pathogen produces a characteristic dry root rot symptom with desiccation of the aerial plant parts. The initial symptoms include foliar chlorosis, followed by defoliation within and subsequently, irreversible wilting and plant death. Infected stems and leaves become brittle and develop a straw-coloured appearance. Elongated dark brown to black lesions may form at the collar region and, under severe infection, can girdle the stem. When infected plants are uprooted, extensive cortical decay is evident in the basal stem and primary root system. Greyish mycelial growth and abundant microsclerotia on the root surface and within cortical tissues at the collar region are considered characteristic diagnostic features. During advanced stages of disease development, numerous small, black sclerotia become embedded in the host tissues. (Rai A. *et al.*, 2022; Pandey A K. *et al.*, 2021).

Macrophomina phaseolina is a cosmopolitan, soil and seed-borne necrotrophic pathogen with broad host range. It infects both monocotyledonous and dicotyledonous hosts. The pathogen survives and spreads through efficient persistence mechanisms, occurring externally and internally within seed tissues and primarily in soil as microsclerotia. These survival structures are produced abundantly on infected plant residues and are subsequently returned to the soil during agricultural operations such as tillage, resulting in the prolonged accumulation of inoculum (Gosh T. *et al.*, 2018; Kaur S. *et al.*, 2012).

Chemical fungicides remain the most commonly adopted method for managing dry root rot because of their rapid and consistent efficacy. However, their indiscriminate and prolonged application lead to environmental pollution, the depletion of soil microbial diversity, and potential risks to human health. Therefore, the development of sustainable and integrated disease-management strategies based on environmentally safe alternatives is increasingly important. In this regard, natural farming has attracted considerable interest as an eco-friendly agricultural system that supports soil health, biodiversity, and environmental sustainability while reducing reliance on synthetic fertilizers and pesticides (M. Suganthi *et al.*, 2023; Giller *et al.*, 2011). By combining traditional agricultural practices with scientific principles, natural farming promotes the use of locally available inputs, including neem cake, Jeevamrit, Beejamrit, Ghanjeevamrit, cow urine, Ramban, and sour buttermilk. The use of these inputs, improves nutrient availability, enhances soil fertility, and supports the maintenance of soil health over the long term (Bhavan, K. *et al.*, 2025) ^[4].

The beneficial effects of natural farming inputs are primarily associated with their capacity to improve soil biological properties and suppress soil-borne pathogens. These inputs enrich the rhizosphere with beneficial microorganisms, enhance nutrient cycling, and promote the development of disease-suppressive soils through microbial antagonism, antimicrobial metabolite production, induction of systemic resistance, and increased biological activity in the soil. Neem cake is recognized for its antifungal, nematicidal, and soil-conditioning properties, whereas Jeevamrit, Beejamrit, and Ghanjeevamrit function as microbial bio-formulations that promote beneficial soil microflora. Cow urine and sour buttermilk also possess antimicrobial properties and are increasingly incorporated into natural farming-based disease-management practices (M. Suganthi *et al.*, 2023; Thakur *et al.*, 2026). Collectively, these inputs can enhance soil microbial diversity, improve plant health providing a sustainable alternative to chemical disease-management practices while preserving soil quality and strengthening crop resilience (Bharucha *et al.*, 2020; Saharan *et al.*, 2023; Warghane *et al.*, 2025) ^[3].

Materials and Methods

Experimental site

The laboratory and pot culture experiments were conducted at the Department of Plant Pathology in the College of Agriculture, VNMKV, Parbhani.

Disease sample

Chickpea plants exhibiting typical symptoms of dry root rot (*M. phaseolina*) disease were collected in paper bag and brought to the laboratory from the farmers Chickpea field and subjected aseptically to tissue isolation on Potato Dextrose Agar medium.

Seeds

Seeds of Chickpea used for pot culture experiment and field experiment and seeds of sorghum which was used as a substrate for mass multiplication of *M. phaseolina* were obtained from Department of Seed Science and Technology, College of Agriculture, VNMKV, Parbhani.

Chemicals, equipment and miscellaneous

Standard Chemicals, reagents etc. required for the experiment, the laboratory equipment viz., Autoclave, Hot air oven, Laminar airflow cabinet, BOD incubator, refrigerator, Binocular Research Microscope, Electrical balance etc. and the earthen pots (30 cm. dia.), Plant protection appliance, inoculation needle, forceps, blotter paper, paper bags, polythene bags, spirit lamp, soil, labels, screen house etc. used during the course of present investigation, available at Department of Plant Pathology, College of Agriculture, VNMKV, Parbhani were utilised.

Natural amendments

Natural amendments were prepared at Natural Farming Research and Training Centre in College of Agriculture, VNMKV, Parbhani.

Beejamrit: it was prepared by thoroughly mixing 5 kg of fresh dung, 5 liters of desi cow urine, 50-100 g of virgin soil (preferably collected from undisturbed locations), and 50 g of lime in 20 L of clean water (Mukherjee S. *et al.*, 2022).

Jeevamrit: it was prepared by mixing 10 kg of fresh cow dung, 10 L of desi cow urine, 2 kg of jaggery, 2 kg of pulse flour, 1 kg of virgin soil (preferably collected from undisturbed locations) in drum containing 200 L of water (Somdutt B. *et al.*, 2021).

Ghanjeevamrit: it was prepared by using 100 kg cow dung, 1kg gram flour, 1 kg jaggery, 5 L cow urine and handful of soil and was allowed to ferment for 2-3 days by covering it. After that it was dried and used in the experiment (Shivani Thakur *et al.*, 2021).

Neem cake: the dried kernels were subjected to oil extraction either through mechanical pressing. After removal of the oil, the remaining solid residue forms neem cake.

Ramban: it was prepared by mixing 8 litres of Jeevamrit and 3L of fermented buttermilk in a drum, followed by the addition of water making a final volume of 100L (Bhavan. K., *et al* 2025) ^[4].

Fresh Cow urine: it was collected from the cows present at well-maintained Cow shed.

Sour buttermilk: the cream layer was removed from the curd and the left over was allowed to ferment further for 3-5 days, leading a sour, microbially active liquid (Bhavan. K., *et al* 2025) ^[4].

***In-vitro* evaluation of natural farming inputs against *M. phaseolina* (Poisoned food technique)**

The required quantity of each natural farming inputs was added to the melted PDA medium separately in a conical flask thereby making it 20% concentration, mixed thoroughly and poured into sterilized Petri plates. After solidification of the mixed media, the 7 mm disk of 7 days old actively growing culture of *M. phaseolina* were placed in Petri plates under aseptic condition. These Petri plates were then transferred in BOD incubator incubated at 25±2 °C temperature. The data was observed at 7th day after inoculation (Yamunarani K. *et al.*, 2023). Per cent growth inhibition of the test pathogen was given by Vincent (1947), which is:

$$\text{PGI} = \frac{C-T}{C} \times 100$$

Where, PGI = Per cent growth inhibition, C = Growth in control, T = Growth in treatment

***In-vitro* evaluation of natural farming inputs against *M. phaseolina* (pot culture)**

The pathogen mass-multiplied on sterilized sorghum grains was ground and thoroughly mixed with sterilized soil @ 50 g/kg soil before sowing (Abhay K. Pandey *et al.*, 2020). Clay pots (30 cm diameter) were filled with 2 kg of the inoculated soil mixture per pot and incubated in the screen house for 10 days at room temperature to facilitate pathogen colonization and development of sick soil. Soil moisture was maintained at approximately 60% by watering as required. The test amendments were then applied as per treatment @ 5 g/kg soil, thoroughly mixed, and maintained under screen-house conditions. Surface-sterilized (0.1% HgCl₂) healthy chickpea seeds, treated with the respective

natural inputs, were sown at 10 seeds/pot. Adequate watering was provided, and foliar sprays were applied according to the treatments at 30, 45 and 60 DAS. Pots containing *M. phaseolina*-infested soil and untreated seeds, without any amendment, were maintained as the untreated control (Nasreen Sultana & Ghaffar, 2010; Iqbal & Mukhtar, 2014).

Experimental design and statistical analysis

The *in-vitro* experiment was conducted in a Completely Randomized Design (CRD) where experiment by poisoned food technique comprised of 3 replications and 8 treatments and experiment by pot culture (sick soil method) comprised of 3 replications and 9 treatments. Data was recorded to analysis of variance (ANOVA), and treatment means were compared at the 1% level of significance according to Gomez and Gomez (1984). The standard error of the mean [SE(m)] and critical difference (CD) were calculated to evaluate treatment effects using OPSTAT software.

Results

Isolation, identification and pathogenecity test of *M. phaseolina*

The pathogen responsible for dry root rot was isolated from the infected roots of chickpea plants using Potato Dextrose Agar (PDA) medium. Within 2-3 days of incubation, the fungal colony exhibited fluffy, dirty-white mycelial growth, which gradually changed from grey to dark black as the culture matured (Fig1). After 7-8 days, abundant black microsclerotia developed throughout the colony, representing a characteristic feature of *Macrophomina phaseolina*. For microscopic observation, a small portion of mycelium from the purified culture was carefully mounted on a clean glass slide and examined under a compound microscope. The fungal culture revealed septate hyphae, varying in color from light brown to dark brown, along with numerous black, spherical to oval microsclerotia, which are the distinguishing morphological characteristics of *M. phaseolina*. Chickpea plants grown in soil artificially inoculated with *Macrophomina phaseolina* developed characteristic symptoms of dry root rot within 15-20 days after sowing, whereas the uninoculated control plants remained healthy throughout the experimental period (Fig1). The pathogen was subsequently re-isolated from the diseased root tissues on Potato Dextrose Agar (PDA) medium. The re-isolated culture displayed cultural and microscopic characteristics identical to those of the original isolate. These findings conclusively satisfied Koch's postulates and confirmed *Macrophomina phaseolina* as the causal organism responsible for dry root rot of chickpea (Pratt *et al.* 1998; Gupta *et al.* 2012; Lakhran *et al.*, 2018; Karande *et al.*, 2024) ^[9, 15].

***In-vitro* evaluation of natural farming inputs against *M. phaseolina* causing dry root rot in chickpea.**

Poison food technique

Mycelial growth and percent inhibition.

Efficacy of 7 natural farming input were evaluated against *M. phaseolina* @20% concentration by poisoned food technique and the corresponding colony diameter in (mm) and percent growth inhibition under *in-vitro* conditions at 7 days after incubation (7 DAI) are presented in (Table 1) (Fig2). The results revealed that among all the treatments, Beejamrit @20% cnc. (T₄) was found to be the

most effective in inhibiting the growth of *M. phaseolina*, recording the minimum colony diameter of 8.67 mm and the highest mycelial growth inhibition of 90.29%, which was significantly superior over all other treatments. The next best treatment was Jeevamrit @20% (T_3), recorded colony diameter of 32.00 mm with 64.14% growth inhibition. This treatment was significantly superior to the remaining treatments except Beejamrit. This was followed by Cow urine @20% (T_5), with colony diameter of 53.34 mm and 40.35% inhibition, Ghanjeevamrit @20% (T_1), with colony diameter of 64.67 mm and 27.58% inhibition, Neem cake @20% (T_2) and Ramban @20% (T_7) also reduced the fungal growth, recording colony diameters of 66.67 mm and 69.33 mm, corresponding to 25.37% and 22.41% inhibition, respectively. The least effective treatment among the tested natural inputs was Sour buttermilk @20% (T_6), which recorded a colony diameter of 78.67 mm with only 11.95% growth inhibition. The untreated control (T_8) supported maximum fungal growth with a colony diameter of 89.33 mm and showed no growth inhibition (0.00%).

Pot culture (Sick soil method)

A total of seven amendments, applied in different combinations, were evaluated against *M. phaseolina* using the sick-soil method with chickpea cv. Akash under screen-house pot conditions. The effects on germination, root length (RL), shoot length (SL), plant height (PH), vigour index-I (VI-I), percent disease incidence (DI), and reduction over control are presented in Table 2 and Table 3 and Fig3 and Fig 4. Among the treatments, T_6 [Neem cake 1 t/ha (SA) + 20% Beejamrit 200 ml/kg (ST) + 10% Jeevamrit 500 L/ha at 30, 45 and 60 DAS (FS)] recorded the highest germination (86.67%) and lowest disease incidence (11.57%). It was followed by T_5 [Ghanjeevamrit 1 t/ha (SA) + 20% Beejamrit 200 ml/kg (ST) + Sour buttermilk 250 ml/10 L water, 500 L/ha at 30, 45 and 60 DAS (FS)] with 80.00% germination and 20.50% disease incidence, and T_8 [Neem cake 1 t/ha (SA) + 10% Cow urine 200 ml/kg (ST) + Sour buttermilk 250 ml/10 L water, 500 L/ha at 30, 45 and 60 DAS (FS)] with 76.67% germination and 21.43% disease incidence. The control (T_9) showed the poorest germination (46.67%) and maximum disease incidence (78.83%). T_6 was at par with T_5 but significantly superior to the remaining treatments, whereas T_9 was inferior to all treatments according to the statistical analysis. T_6 also produced the maximum shoot length (26.17 cm), root length (12.60 cm), plant height (31.16 cm), and vigour index (3008.66), followed by T_5 shoot length (24.10 cm), root length (11.70 cm), plant height (28.43 cm) and vigour index (2453.00), respectively and T_8 shoot length (23.37 cm), root length (11.36 cm), plant height (27.36 cm) and vigour index (2368.66), respectively. The control recorded the minimum shoot length (17.07 cm), root length (9.60 cm), plant height (19.73 cm), and vigour index (1264.00), and was significantly inferior to all treated pots.

Discussion

The present investigation successfully established *Macrophomina phaseolina* as the causal organism of dry root rot of chickpea through cultural, morphological and pathogenicity studies. The fungus produced fluffy, dirty-white mycelium initially, which gradually turned grey to dark black with age. Abundant black microsclerotia developed after 7-8 days, while microscopic examination revealed septate, light to dark brown hyphae and spherical to oval microsclerotia. These characteristics corresponded with

the typical morphology reported for *M. phaseolina*. Artificially inoculated chickpea plants developed typical dry root rot symptoms within 15-20 days, whereas control plants remained healthy. Successful re-isolation of the same pathogen from diseased roots confirmed the pathogenicity of the isolate and fulfilled Koch's postulates. Similar observations have been reported by earlier workers studying dry root rot of chickpea (Pratt *et al.*, 1998; Gupta *et al.*, 2012; Lakhra *et al.*, 2018) [9, 15].

The in-vitro evaluation demonstrated that all tested natural farming inputs suppressed the mycelial growth of *M. phaseolina* to varying degrees compared with the untreated control. Beejamrit @20 per cent was the most effective treatment, producing the minimum colony diameter of 8.67 mm and maximum growth inhibition of 90.29 per cent. Its strong antifungal activity may be associated with the diverse microbial population and metabolites developed during its preparation, which could interfere with fungal growth. Jeevamrit @20 per cent ranked second, with 32.00 mm colony diameter and 64.14 per cent inhibition. The relatively high efficacy of Jeevamrit may be attributed to the active microbial population and fermentation products generated from cow dung, cow urine, jaggery and pulse flour. Cow urine @20 per cent showed moderate inhibition of 40.35 per cent, followed by Ghanjeevamrit (27.58%), Neem cake (25.37%) and Ramban (22.41%). The inhibitory effect of Neem cake may be related to biologically active neem constituents, whereas the activity of fermented inputs may arise from microbial metabolites and organic compounds. Sour buttermilk was the least effective treatment, recording only 11.95% inhibition. The untreated control showed maximum fungal growth of 89.33 mm, confirming the suppressive effect of the tested inputs under in-vitro conditions. The variation among treatments indicates that antifungal activity depends on the composition, concentration and biological activity of individual natural formulations.

The pot culture experiment further demonstrated that integrated application of natural farming inputs was effective in reducing disease incidence and improving chickpea growth under pathogen-infested soil. Treatment T_6 [Neem cake @1 t ha⁻¹ + 20% Beejamrit @200 ml kg⁻¹ seed + 10% Jeevamrit @500 L ha⁻¹ at 30, 45 and 60 DAS] performed best, recording the highest germination (86.67%) and lowest disease incidence (11.57%). It also produced maximum shoot length (26.17 cm), root length (12.60 cm), plant height (31.16 cm) and vigour index-I (3008.66). The superior performance of T_6 may be due to the complementary effects of the three inputs, with Neem cake contributing to soil suppressiveness, Beejamrit protecting the seed and early seedlings, and Jeevamrit supporting microbial activity and plant growth during crop development. Treatment T_5 was the next best treatment, recording 80.00% germination and 20.50% disease incidence, while T_8 recorded 76.67% germination and 21.43% disease incidence. In contrast, the untreated control recorded the lowest germination (46.67%) and highest disease incidence (78.83%), along with the poorest plant growth. The marked difference between treated and untreated plants indicates that natural farming inputs reduced pathogen pressure and helped maintain better root and shoot development.

An important finding was that Beejamrit was most effective under in-vitro conditions, whereas the combination of Neem cake @1 t ha⁻¹ + 20% Beejamrit @200 ml kg⁻¹ seed + 10% Jeevamrit @500 L ha⁻¹ at 30, 45 and 60 DAS was most

effective under pot conditions. This suggests that disease suppression in soil involves not only direct inhibition of the pathogen but also interactions with soil microorganisms, nutrient availability and plant growth. Overall, the findings

indicate that integrated use of natural farming inputs, particularly when applied at appropriate crop stages, can provide effective management of *M. phaseolina* and improve chickpea growth.

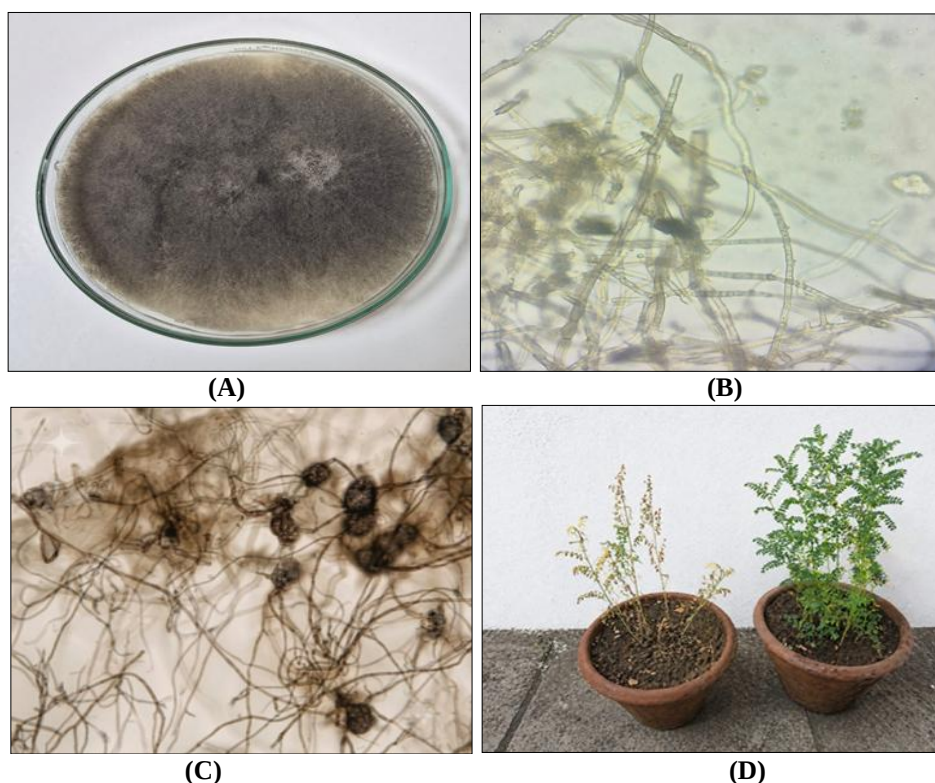


Fig 1: *Macrophomina phaseolina* (A) Pure culture (B) Septate hyphae (C) Microschlerotia (D) Proving pathogenicity

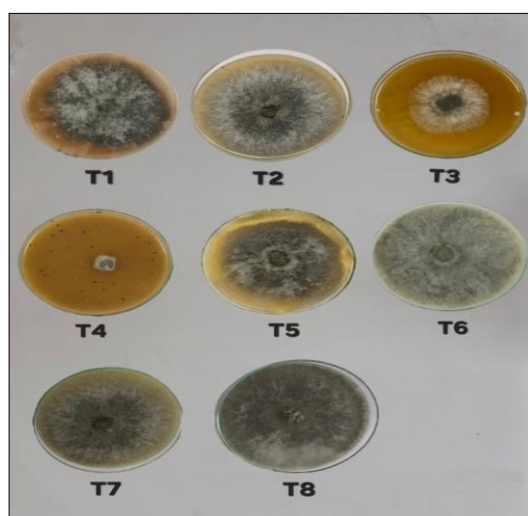


Fig 2: *In-vitro* evaluation natural inputs against *Macrophomina phaseolina* by poisoned food technique

Table 1: *In-vitro* evaluation of natural farming inputs against *Macrophomina phaseolina* at 7 DAI (poisoned food technique)

Tr. No.	Treatment Details	Conc. (%)	Colony Diameter (mm)	Percent growth inhibition (%)
T ₁	Ghanjeevamrit	20 %	64.67	27.58 (31.61)
T ₂	Neem cake	20 %	66.67	25.37 (30.20)
T ₃	Jeevamrit	20 %	32.00	64.14 (53.22)
T ₄	Beejamrit	20 %	8.67	90.29 (71.84)
T ₅	Cow urine	20 %	53.34	40.35 (39.32)
T ₆	Sour buttermilk	20 %	78.67	11.95 (20.13)
T ₇	Ramban	20 %	69.33	22.41 (28.21)
T ₈	Control	-	89.33	0.00 (0.00)
	SE ±		0.77	1.682
	CD @ 1 %		2.32	5.086

Table 2: *In-vitro* evaluation of natural farming inputs against *Macrophomina phaseolina* (pot culture)

Tr. No.	Treatment Details	Germination %	Root Length (cm)	Shoot Length (cm)	Plant height (cm)	Vigour Index
T ₁	20% Beejamrit 200 ml/kg (ST)	66.67 (54.75)	10.96	18.70	22.03	2169.33 (46.50)
T ₂	10% Cow urine 200 ml/kg (ST)	63.33 (52.75)	10.46	18.03	21.70	2082.66 (45.63)
T ₃	Ghanjeevamrit 1t/ha (SA) + 20% Beejamrit 200 ml/kg (ST)	70.00 (56.97)	11.03	19.87	23.20	2221.66 (47.06)
T ₄	Neem cake 1t/ha (SA) + 20% Beejamrit 200 ml/kg (ST)	73.33 (58.58)	11.23	21.10	25.10	2312.00 (48.05)
T ₅	Ghanjeevamrit 1 t/ha (SA) + 20% Beejamrit 200 ml/kg (ST) + Sour buttermilk (250 ml/10L water) 500 L/ha at 30, 45, 60 DAS (FS)	80.00 (63.89)	11.70	24.10	28.43	2453.00 (49.52)
T ₆	Neem cake 1 t/ha (SA) + 20% Beejamrit 200 ml/kg (ST) + 10% Jeevamrit 500 L/ha at 30, 45, 60 DAS (FS)	86.67 (68.82)	12.60	26.17	31.16	3008.66 (54.82)
T ₇	Ghanjeevamrit 1 t/ha (SA) + 10% Cow urine 200 ml/kg (ST) + Ramban (700ml Jeevamrit + 300 ml Sour buttermilk per 10 L water per acre) 500 L/ha at 30, 45, 60 DAS (FS)	70.00 (56.87)	11.20	20.87	24.53	2233.00 (47.19)
T ₈	Neem cake 1t/ha (SA) + 10% Cow urine 200 ml/kg (ST) + Sour buttermilk (250 ml/10L water) 500 L/ha at 30, 45, 60 DAS (FS)	76.67 (61.19)	11.36	23.37	27.37	2368.66 (48.64)
T ₉	Control	46.67 (43.05)	9.60	17.07	19.73	1264.00 (35.51)
	SE ±	2.87	0.50	1.10	1.10	1.39
	CD @ 1 %	8.58	1.49	3.31	3.30	4.17

Table 3: *In-vitro* evaluation of percent disease incidence and reduction over control using natural farming inputs.

Tr. No.	Treatment Details	Percent disease incidence (%)	Reduction over control (%)
T ₁	20% Beejamrit 200 ml/kg (ST)	34.92 (36.14)	55.56 (48.19)
T ₂	10% Cow urine 200 ml/kg (ST)	53.17 (46.85)	32.34 (34.23)
T ₃	Ghanjeevamrit 1t/ha (SA) + 20% Beejamrit 200 ml/kg (ST)	33.13 (35.09)	57.54 (49.34)
T ₄	Neem cake 1t/ha (SA) + 20% Beejamrit 200 ml/kg (ST)	23.21 (28.43)	70.19 (57.28)
T ₅	Ghanjeevamrit 1 t/ha (SA) + 20% Beejamrit 200 ml/kg (ST) + Sour buttermilk (250 ml/10L water) 500 L/ha at 30, 45, 60 DAS (FS)	20.50 (26.76)	73.75 (59.32)
T ₆	Neem cake 1 t/ha (SA) + 20% Beejamrit 200 ml/kg (ST) + 10% Jeevamrit 500 L/ha at 30, 45, 60 DAS (FS)	11.57 (19.87)	85.23 (67.37)
T ₇	Ghanjeevamrit 1 t/ha (SA) + 10% Cow urine 200 ml/kg (ST) + Ramban (700ml Jeevamrit + 300 ml Sour buttermilk per 10 L water per acre) 500 L/ha at 30, 45, 60 DAS (FS)	27.58 (31.37)	64.48 (53.69)
T ₈	Neem cake 1t/ha (SA) + 10% Cow urine 200 ml/kg (ST) + Sour buttermilk (250 ml/10L water) 500 L/ha at 30, 45, 60 DAS (FS)	21.43 (27.39)	72.52 (58.56)
T ₉	Control	78.33 (62.26)	0.00 (0.00)
	SE ±	2.79	3.45
	CD @ 1 %	8.36	10.33

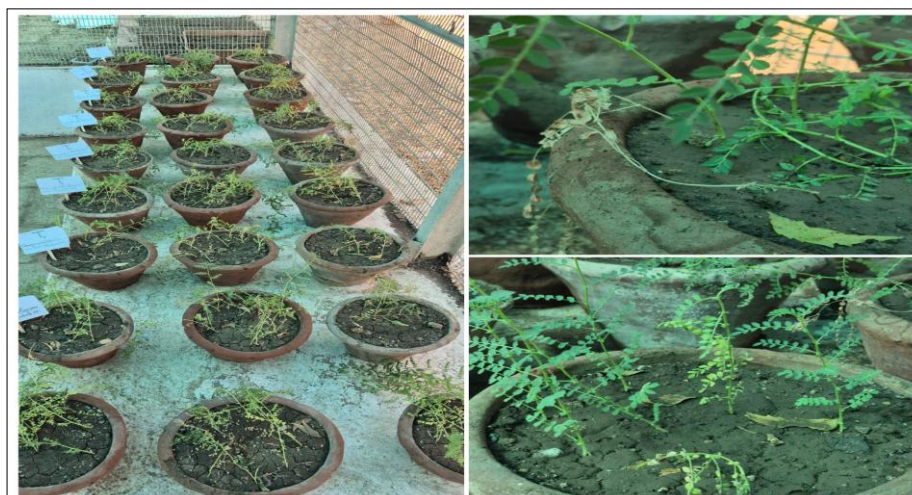
**Fig 3:** *In-vitro* evaluation of natural farming inputs against *Macrophomina phaseolina* by sick soil method



Fig 4: In-vitro evaluation of natural farming inputs against *Macrophomina phaseolina* by sick soil method

Conclusion

The present investigation confirmed *Macrophomina phaseolina* as the causal pathogen of dry root rot of chickpea through cultural, morphological and pathogenicity studies. The in-vitro evaluation showed that the tested natural farming inputs differed in their ability to suppress fungal growth, with Beejamrit @20 per cent showing the highest mycelial inhibition (90.29%), followed by Jeevamrit @20 per cent (64.14%). Under sick-soil pot conditions, integrated application of natural farming inputs proved more effective than individual inputs, with T6 comprising Neem cake @1 t ha⁻¹ + 20% Beejamrit @200 ml kg⁻¹ seed + 10% Jeevamrit @500 L ha⁻¹ at 30, 45 and 60 DAS recording the highest germination (86.67%), lowest disease incidence (11.57%) and superior plant growth. The results indicate that combining natural inputs through appropriately timed seed, soil and foliar applications can provide complementary protection against *M. phaseolina* while promoting healthier crop growth. Thus, natural farming inputs, particularly when used in an integrated manner and synchronized with crop growth and disease development, have considerable potential as an eco-friendly approach for managing dry root rot of chickpea.

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