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Effect of various pH levels on growth and sporulation of *Rhizoctonia solani*

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Abstract

Rhizoctonia solani Kühn is an important soil-borne fungal pathogen causing severe economic losses in a wide range of agricultural crops. Environmental and nutritional factors play a significant role in the growth, development, and pathogenic behavior of the fungus. Among these factors, hydrogen ion concentration (pH) is one of the most important parameters affecting fungal physiology and metabolism. The present investigation was conducted to study the effect of different pH levels on the growth and sporulation of *Rhizoctonia solani* under *in vitro* conditions. Seven pH levels viz., 5.0, 5.5, 6.0, 6.5, 7.0, 7.5, and 8.0 were evaluated using Potato Dextrose Agar medium. The experiment was conducted under laboratory conditions using Completely Randomized Design with three replications.

Observations on radial growth and sporulation were recorded at 24-hour intervals up to seven days of incubation. The results indicated that pH significantly influenced fungal growth and sporulation. Maximum radial growth and abundant sporulation were observed at pH 6.5 followed closely by pH 7.0, whereas minimum growth and poor sporulation were recorded at pH 5.0 and pH 8.0. Moderate growth was observed at intermediate pH levels. The study revealed that slightly acidic to neutral pH conditions were most favorable for the growth and sporulation of *R. solani*.

The findings of the present study may be useful for understanding the physiological requirements of the pathogen and developing suitable management strategies under field and laboratory conditions.

Keywords: *Rhizoctonia solani*, pH, radial growth, sporulation, fungal physiology, culture conditions

Introduction

Rhizoctonia solani Kühn is one of the most destructive soil-borne fungal pathogens affecting numerous economically important crops worldwide. The fungus is known to cause diseases such as damping-off, root rot, collar rot, stem canker, black scurf, and sheath blight in cereals, vegetables, pulses, and ornamental crops. The pathogen survives in soil through mycelia and sclerotia and remains active under favorable environmental conditions.

The growth and development of fungi are highly influenced by environmental factors including temperature, moisture, nutrient availability, aeration, and hydrogen ion concentration (pH). Among these factors, pH plays an important role in regulating enzymatic activities, nutrient absorption, membrane permeability, and metabolic processes of fungal pathogens. Variation in pH can influence mycelial growth, pigmentation, sporulation, sclerotial formation, and pathogenicity.

Different fungal species exhibit different pH requirements for optimum growth. Most plant pathogenic fungi prefer slightly acidic to neutral conditions for vegetative growth and reproduction. Knowledge regarding optimum pH conditions for fungal growth is essential for routine culturing, pathological investigations, inoculum preparation, and understanding disease epidemiology.

Although several studies have been conducted on nutritional and environmental requirements of fungal pathogens, information regarding the effect of varying pH levels on growth and sporulation of *Rhizoctonia solani* under local laboratory conditions remains limited. Therefore, the present investigation was undertaken to evaluate the effect of different pH levels on the growth and sporulation behavior of *R. solani*.

Review of Literature

Several workers have reported that hydrogen ion concentration significantly affects the growth and development of plant pathogenic fungi. Fungal metabolism and enzyme activity are directly associated with the pH of the growth medium.

Previous studies have shown that *Rhizoctonia solani* grows well under slightly acidic conditions. Potato Dextrose Agar adjusted to pH levels between 6.0 and 7.0 generally supports maximum mycelial growth and sclerotial development. Extreme acidic or alkaline conditions adversely affect fungal growth due to disruption of cellular activities and nutrient imbalance.

Researchers have also observed that sporulation and pigmentation vary considerably with changes in pH. Slightly acidic pH promotes better mycelial density, colony development, and reproductive structures in many soil-borne fungi. Neutral pH conditions are also reported to support good fungal biomass production.

The influence of pH on fungal pathogens has been studied in species such as *Fusarium*, *Alternaria*, *Sclerotium*, and *Aspergillus*. However, reports on comparative evaluation of different pH levels on growth and sporulation of *Rhizoctonia solani* are comparatively limited under controlled laboratory conditions.

Hence, the present study was conducted to determine the optimum pH requirement for growth and sporulation of *R. solani*.

Materials and Methods

Experimental Site

The present investigation was carried out in the Plant Pathology Laboratory, Department of Plant Pathology during the year 2025–26 under controlled laboratory conditions.

Isolation and Maintenance of Pathogen

Pure culture of *Rhizoctonia solani* was isolated from infected plant tissues by tissue isolation technique. Small infected tissue bits were surface sterilized with 0.1 per cent mercuric chloride solution for 30 seconds followed by washing three times with sterile distilled water. The sterilized bits were transferred aseptically onto sterilized Potato Dextrose Agar plates and incubated at $27 \pm 1^\circ\text{C}$.

The fungal growth obtained was purified by hyphal tip culture technique and maintained on PDA slants for further studies.

Preparation of pH Media

Potato Dextrose Agar medium was used for the experiment. The pH of the medium was adjusted to different levels using 0.1 N hydrochloric acid (HCl) and 0.1 N sodium hydroxide (NaOH) solutions before sterilization.

The following pH levels were tested

1. pH 5.0
2. pH 5.5
3. pH 6.0
4. pH 6.5
5. pH 7.0
6. pH 7.5
7. pH 8.0

Composition of Potato Dextrose Agar (PDA)

- Peeled potato: 200 g
- Dextrose: 20 g
- Agar: 20 g
- Distilled water: 1000 ml

Sterilization

All glassware used in the experiment was sterilized in a hot air oven at 160°C for two hours. The culture media were sterilized in an autoclave at 121°C and 15 psi pressure for 20 minutes.

Inoculation Procedure

Approximately 20 ml of sterilized medium was poured into sterilized Petri plates. After solidification, each plate was inoculated aseptically with a 5 mm diameter mycelial disc taken from the actively growing margin of a seven-day-old culture of *R. solani*.

Three replications were maintained for each treatment.

Incubation

The inoculated Petri plates were incubated at $27 \pm 1^\circ\text{C}$.

Observations Recorded

Radial Growth

The radial growth of the fungus was measured in millimeters at 24-hour intervals up to seven days after inoculation or until the colony covered the entire plate.

Sporulation

Observations regarding sporulation intensity were recorded visually based on colony density, pigmentation, and development of reproductive structures.

Sporulation was categorized as

- Excellent (++++)
- Good (++++)
- Moderate (++)
- Poor (+)
- Very poor (-)

Statistical Analysis

The experiment was conducted in Completely Randomized Design (CRD) with three replications. The data obtained were analyzed statistically and treatment means were compared using standard statistical procedures.

Results and Discussion

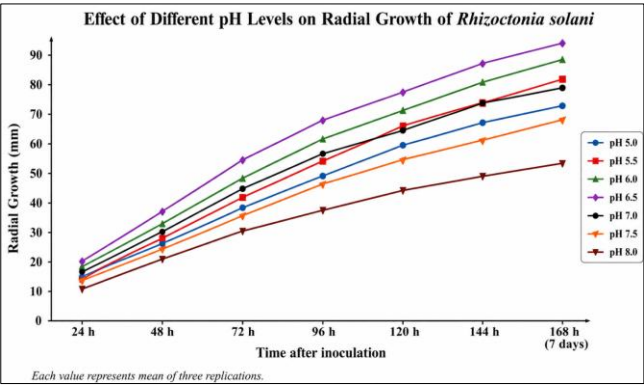
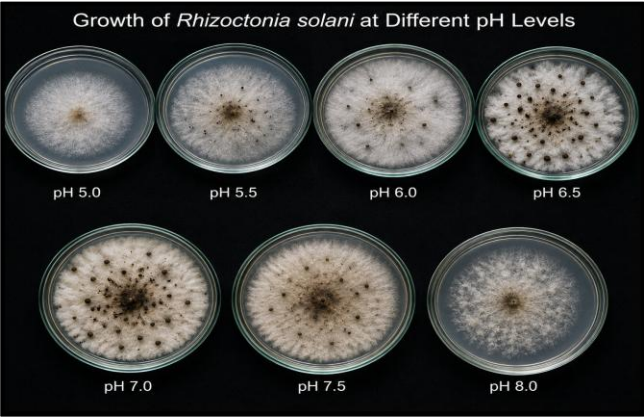
Effect of Different pH Levels on Radial Growth of *Rhizoctonia solani*.

The results revealed significant variation in radial growth of *Rhizoctonia solani* under different pH levels. Maximum radial growth was observed at pH 6.5 (90.00 mm), followed by pH 7.0 (87.67 mm) and pH 6.0 (84.33 mm). Moderate growth was recorded at pH 5.5 and 7.5, whereas minimum growth was observed at pH 5.0 and 8.0.

The fungus exhibited luxuriant growth under slightly acidic to neutral conditions, indicating that these pH levels are most suitable for fungal metabolism and nutrient utilization. Reduced growth at highly acidic and alkaline pH levels may be due to unfavorable physiological conditions affecting enzymatic activity and nutrient absorption.

Table 1: Effect of Different pH Levels on Radial Growth of *Rhizoctonia solani*

S. No.	pH Level	Radial Growth (mm)	Colony Character
1	5.0	60.33	Thin and sparse growth
2	5.5	72.67	Moderate fluffy growth
3	6.0	84.33	Dense cottony growth
4	6.5	90.00	Luxuriant white growth
5	7.0	87.67	Compact vigorous growth
6	7.5	76.33	Moderately dense growth
7	8.0	64.67	Poor and restricted growth



Effect of Different pH Levels on Sporulation of *Rhizoctonia solani*

The pH of the medium also significantly affected sporulation of the fungus. Excellent sporulation was observed at pH 6.5 followed by pH 7.0. Moderate sporulation was recorded at pH 6.0 and 7.5. Poor sporulation was observed at pH 5.0 and pH 8.0. The results indicate that slightly acidic pH conditions favor reproductive development and colony establishment of *R. solani*. The reduced sporulation under extreme acidic and alkaline conditions may be attributed to adverse effects on fungal physiology and reproductive processes.

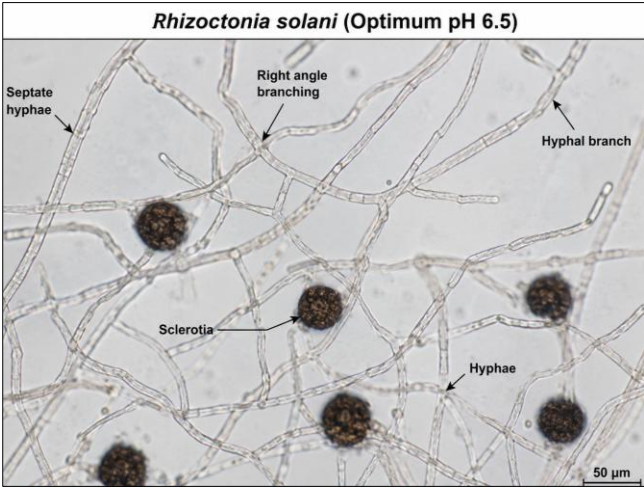
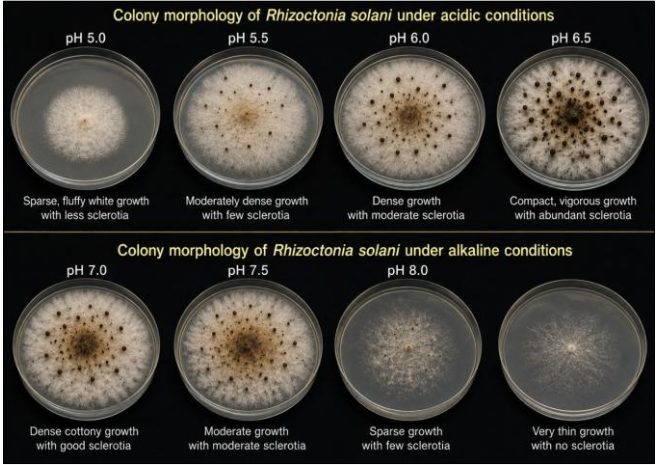


Table 2: Effect of Different pH Levels on Sporulation of *Rhizoctonia solani*

S. No.	pH Level	Sporulation	Colony Colour
1	5.0	Poor (+)	Light white
2	5.5	Moderate (++)	White
3	6.0	Good (+++)	Creamy white
4	6.5	Excellent (++++)	Dense white
5	7.0	Good (+++)	Off white
6	7.5	Moderate (++)	Dull white
7	8.0	Poor (+)	Thin pale growth

Discussion

The present investigation clearly demonstrated that pH significantly influences the growth and sporulation of *Rhizoctonia solani*. Maximum growth and sporulation were recorded at pH 6.5, indicating that slightly acidic conditions are highly favorable for the fungus. The enhanced growth at pH 6.5 may be due to optimum availability of nutrients and better enzymatic activity under

slightly acidic conditions. Similar observations have been reported by several researchers who found that most soil-borne fungi exhibit maximum growth between pH 6.0 and 7.0. Poor growth at pH 5.0 and pH 8.0 suggests that highly acidic and alkaline conditions adversely affect fungal metabolism. Extreme pH levels may alter membrane permeability, nutrient uptake, and enzyme stability, thereby reducing fungal growth and reproductive capacity. The variation in sporulation observed under different pH conditions indicates that reproductive development is closely associated with environmental factors. Favorable pH conditions enhance mycelial aggregation, colony establishment, and formation of reproductive structures. The findings of the present study are in agreement with earlier reports on the influence of pH on fungal growth and sporulation.

Conclusion

The present study concluded that pH significantly affects the growth and sporulation of *Rhizoctonia solani*. Among the

different pH levels tested, pH 6.5 was found to be the most suitable for maximum radial growth and sporulation, followed by pH 7.0 and pH 6.0.

The fungus showed poor growth and sporulation under highly acidic (pH 5.0) and alkaline (pH 8.0) conditions. Therefore, slightly acidic to neutral pH conditions are considered most favorable for the growth and development of *R. solani*.

The information generated from this study may be useful for routine culturing, inoculum production, physiological studies, and disease management research involving *Rhizoctonia solani*.

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