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Effect of various solid and liquid media on growth and sclerotial size of *Rhizoctonia solani*

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Abstract

Rhizoctonia solani Kühn is an economically important soil-borne fungal pathogen causing severe diseases in several agricultural and horticultural crops. Nutritional and cultural requirements greatly influence fungal growth, sclerotial development, and pathogenic variability. The present investigation was conducted to evaluate the effect of different solid and liquid culture media on mycelial growth and sclerotial formation of *R. solani* under *in vitro* conditions. Seven solid media, namely Potato Dextrose Agar (PDA), Asthana and Hawker's agar, Czapek's Dox agar, Richard's agar, Brown's agar, Ashby's agar, and Richard's synthetic agar were tested for radial growth and sclerotial production. Observations on colony diameter, colony colour, growth pattern, number of sclerotia, and sclerotial size were recorded at regular intervals. Among the tested media, PDA supported maximum radial growth and abundant sclerotial formation, followed by Richard's agar and Asthana and Hawker's agar. Minimum growth and poor sclerotial development were observed on Ashby's agar. The study indicated that nutrient composition significantly affects growth and morphogenesis of *R. solani*. The findings may be useful for routine culturing, pathological studies, and mass multiplication of the pathogen for research purposes.

Keywords: *Rhizoctonia solani*, culture media, radial growth, sclerotia, fungal growth, PDA

Introduction

Rhizoctonia solani Kühn is one of the most destructive soil-borne fungal pathogens affecting a wide range of crops including vegetables, pulses, oilseeds, cereals, and ornamentals. The pathogen causes diseases such as damping-off, root rot, collar rot, stem canker, and sheath blight, resulting in significant yield losses worldwide. The fungus survives in soil and infected plant debris mainly through mycelium and sclerotia, which serve as primary survival structures under adverse environmental conditions.

The growth and development of fungi are greatly influenced by the availability of nutrients in the culture medium. Different synthetic and semi-synthetic media vary in their carbon and nitrogen sources, vitamins, minerals, and growth-promoting substances, which ultimately affect fungal growth, pigmentation, sporulation, and sclerotial formation. Cultural studies are important for understanding the physiology and biology of fungal pathogens and for selecting suitable media for isolation, purification, and maintenance of cultures.

Sclerotia are compact masses of hyphae that help the pathogen survive under unfavorable environmental conditions. The size, number, and distribution of sclerotia differ according to the nutritional status of the medium. Therefore, evaluation of various culture media is essential for determining the optimum conditions for mycelial growth and sclerotial development of *R. solani*. Keeping these aspects in view, the present investigation was undertaken to study the effect of various solid and liquid media on growth and sclerotial size of *Rhizoctonia solani* under laboratory conditions.

Review of Literature

Several researchers have studied the nutritional requirements of *Rhizoctonia solani* and related fungi on different culture media. Potato Dextrose Agar (PDA) is commonly reported as the most suitable medium for rapid mycelial growth and sclerotial production. Richard's agar and Czapek's

Dox agar also support satisfactory fungal growth due to the presence of adequate carbohydrate and nitrogen sources.

Asthana and Hawker's medium has been reported to promote moderate fungal growth and pigmentation in several soil-borne fungi. Brown's agar and Ashby's agar are comparatively less favorable due to limited nutrient availability. Variation in colony morphology, texture, pigmentation, and sclerotial characteristics among different media has also been documented.

Previous studies have demonstrated that the carbon:nitrogen ratio in the medium significantly influences fungal biomass and sclerotial development. High carbohydrate concentration generally favors sclerotial initiation and enlargement. Environmental factors such as pH, temperature, and light further modify the response of fungi to nutrient media.

However, information regarding comparative performance of different solid and liquid media for growth and sclerotial formation of *R. solani* under local laboratory conditions remains limited. Hence, the present study was undertaken.

Materials and Methods

Experimental Site

The experiment was conducted 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 using tissue isolation technique. Small infected bits were surface sterilized with 0.1% mercuric chloride solution for 30 seconds followed by washing with sterile distilled water three times. The sterilized bits were transferred aseptically onto sterilized PDA plates and incubated at $27 \pm 1^\circ\text{C}$. The fungal growth obtained was purified through hyphal tip culture technique and maintained on PDA slants.

Culture Media Used

The following media were evaluated:

1. Potato Dextrose Agar (PDA)
2. Asthana and Hawker's agar
3. Czapek's Dox agar
4. Richard's agar
5. Brown's agar
6. Ashby's agar
7. Richard's synthetic agar

Composition of Important Media

Potato Dextrose Agar (PDA)

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

Richard's Agar

- Sucrose: 50 g
- Potassium nitrate: 10 g
- Potassium dihydrogen phosphate: 5 g
- Magnesium sulphate: 2.5 g
- Ferric chloride: trace
- Agar: 20 g
- Distilled water: 1000 ml

Czapek's Dox Agar

- Sucrose: 30 g
- Sodium nitrate: 2 g
- Dipotassium phosphate: 1 g
- Magnesium sulphate: 0.5 g
- Potassium chloride: 0.5 g
- Ferrous sulphate: 0.01 g
- Agar: 20 g
- Distilled water: 1000 ml

Sterilization

All glassware was sterilized in a hot air oven at 160°C for 2 hours. Culture media were sterilized in an autoclave at 121°C and 15 psi pressure for 20 minutes.

Inoculation Procedure

Twenty milliliters of sterilized medium were poured into sterilized Petri plates. After solidification, each plate was inoculated aseptically with a 5 mm mycelial disc taken from the periphery of an actively growing seven-day-old culture of *R. solani*. Three replications were maintained for each treatment.

Incubation

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

Observations Recorded

Radial Growth

Radial growth of the fungus was measured in millimeters after 24, 48, 72, and 96 hours of incubation until the colony reached the edge of the plate.

Sclerotial Formation

Observations on:

- Time taken for initiation of sclerotia
- Number of sclerotia
- Distribution pattern
- Colour and texture
- Sclerotial size were recorded.

Statistical Analysis

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

Results and Discussion

Effect of Different Solid Media on Radial Growth of *Rhizoctonia solani*

The results revealed significant differences among various media with respect to radial growth of *R. solani*. Maximum radial growth was observed on Potato Dextrose Agar (90.00 mm), followed by Richard's agar (85.33 mm) and Asthana and Hawker's agar (82.67 mm). Moderate growth was recorded on Czapek's Dox agar and Brown's agar. Minimum growth was observed on Ashby's agar.

The superior performance of PDA may be attributed to the presence of readily available carbohydrates and growth-promoting nutrients derived from potato extract. Richard's agar also supported good growth due to high sucrose content and balanced mineral composition.

Table 1: Effect of Different Solid Media on Radial Growth of *Rhizoctonia solani*

S. No.	Culture Medium	Radial Growth (mm)	Colony Character
1	Potato Dextrose Agar	90.00	Dense, fluffy white growth
2	Asthana and Hawker's agar	82.67	Cottony growth
3	Czapek's Dox agar	76.33	Moderately dense
4	Richard's agar	85.33	Compact and vigorous
5	Brown's agar	70.67	Sparse growth
6	Ashby's agar	62.00	Thin mycelial growth
7	Richard's synthetic agar	80.33	Uniform growth

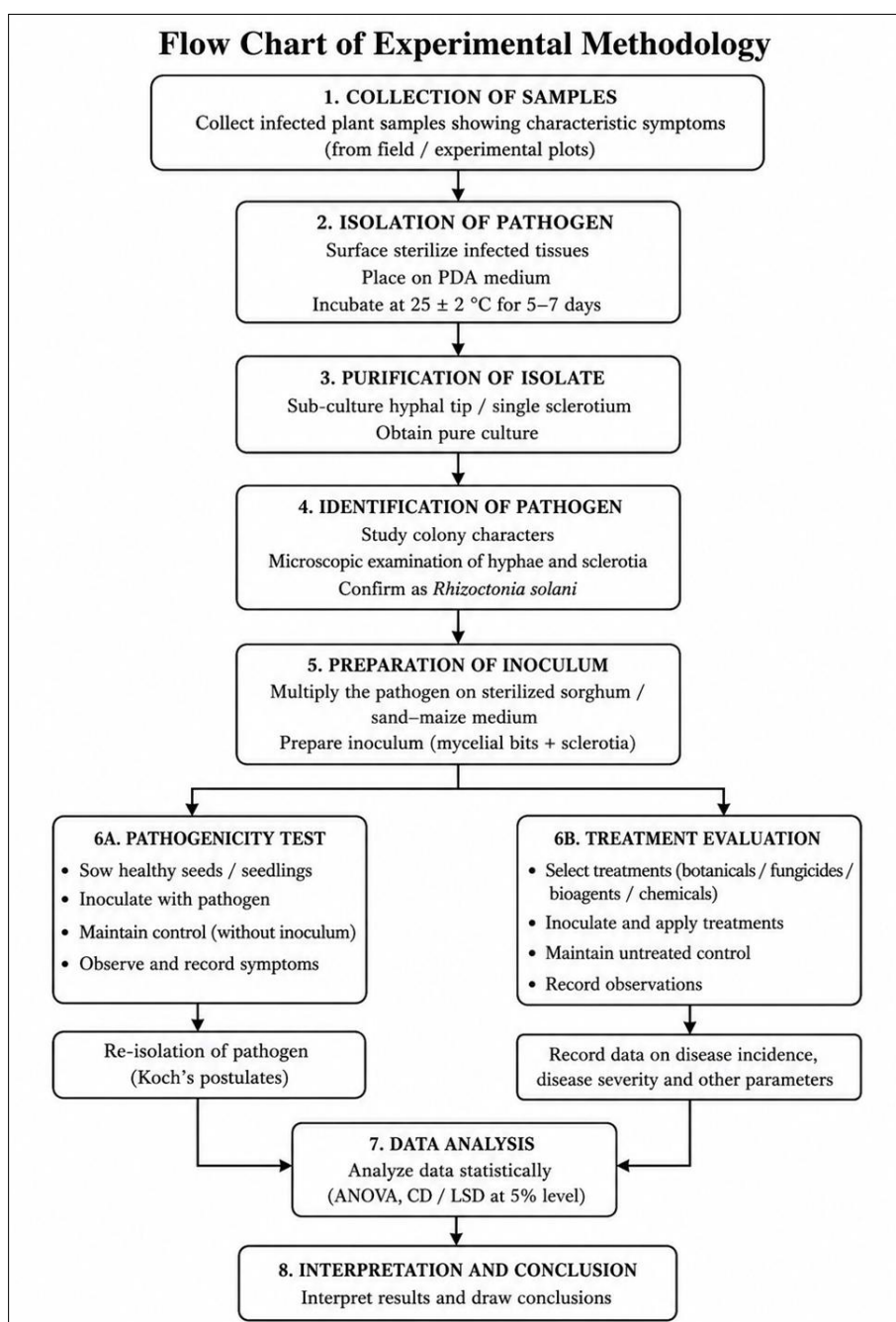
Effect of Different Media on Sclerotial Formation

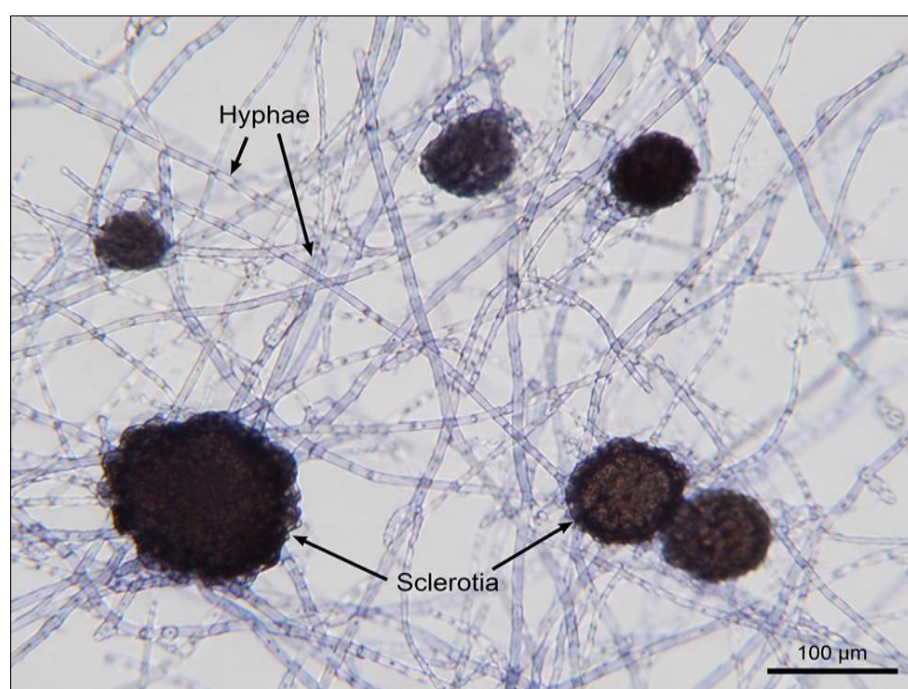
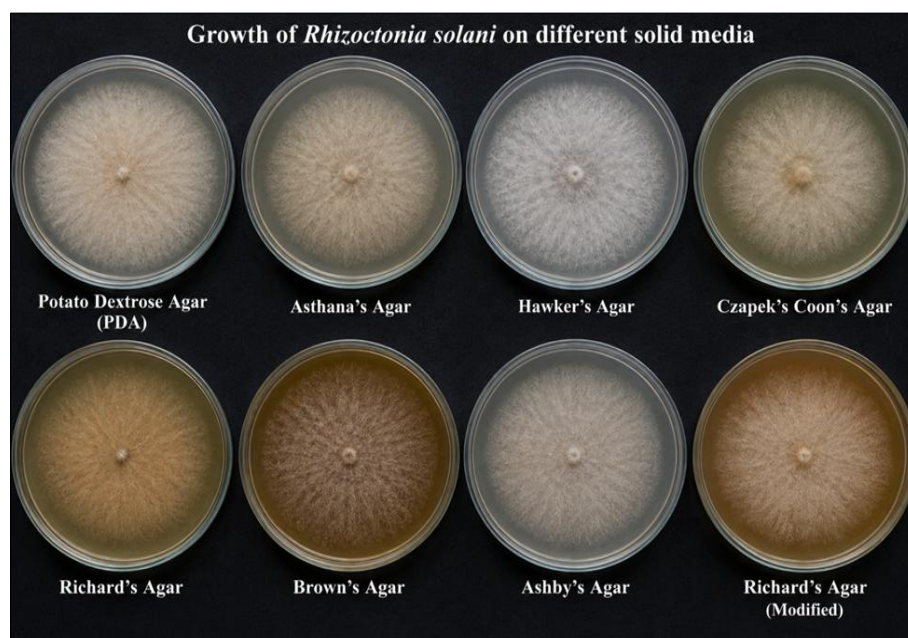
Considerable variation was observed in sclerotial initiation, number, and size on different media. PDA produced maximum number of large, dark brown sclerotia followed by Richard's agar. Sclerotia formed on PDA were compact and uniformly distributed throughout the plate.

Ashby's agar recorded poor sclerotial formation with small and scattered sclerotia. Nutrient-rich media favored early initiation and increased size of sclerotia.

Table 2: Effect of Different Media on Sclerotial Formation of *Rhizoctonia solani*

S. No.	Culture Medium	Sclerotial Formation	Sclerotial Size
1	Potato Dextrose Agar	Excellent	Large
2	Asthana and Hawker's agar	Good	Medium
3	Czapek's Dox agar	Moderate	Medium
4	Richard's agar	Very good	Large
5	Brown's agar	Moderate	Small
6	Ashby's agar	Poor	Very small
7	Richard's synthetic agar	Good	Medium

Flow Chart of Experimental Methodology



Discussion

The present findings clearly indicate that nutrient composition of the medium significantly influences growth and sclerotial development of *R. solani*. PDA proved to be the best medium for mycelial growth and sclerotial production. Similar findings have been reported by several workers who observed luxuriant growth of *R. solani* on PDA and Richard's agar.

The enhanced growth on PDA may be due to the availability of soluble carbohydrates, vitamins, and organic nutrients present in potato extract. Richard's agar also supported vigorous fungal growth because of its high sucrose concentration and balanced nutrient composition.

Poor growth on Ashby's agar may be attributed to limited availability of nutrients and unsuitable carbon:nitrogen balance. Sclerotial development is closely associated with nutritional stress and availability of carbohydrates, which influence aggregation and melanization of fungal hyphae.

The variations in colony morphology and sclerotial characteristics observed in the present investigation may also be related to

physiological adaptability of the pathogen to different nutrient environments.

Conclusion

Among the various culture media evaluated, Potato Dextrose Agar (PDA) was found to be the most suitable medium for growth and sclerotial formation of *Rhizoctonia solani*, followed by Richard's agar and Asthana and Hawker's agar. Ashby's agar was least effective for fungal growth and sclerotial development.

The study demonstrated that nutritional composition of the medium plays an important role in fungal physiology and morphogenesis. The results may be useful for routine culturing, pathogenicity studies, physiological investigations, and mass multiplication of *R. solani* for future research work.

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