Influence of Environmental Factors on Growth and Sporulation of *Fusarium oxysporum*: Temperature, pH, and Photoperiod Effects

Tarendra Kumar Sahu 1, Dr. Sushma Dubey1*

Department of Biotechnology Kalinga University Naya Raipur Chhattisgarh,Pin 492101 India

ABSTRACT:

Fusarium oxysporum is a widespread soil-borne fungal pathogen with significant implications for both crops and weeds. Understanding how environmental conditions influence its growth and sporulation is crucial for optimizing its use in bioherbicidal strategies and managing its pathogenicity. This study investigated the impact of varying temperatures (5°C–50°C), pH levels (3.0–9.0), and photoperiod regimes (dark, 12 h light/12 h dark, and continuous light) on radial growth and spore production of *F. oxysporum* isolates obtained from rice weeds. The fungus showed optimal mycelial growth at 28°C, pH 6.5, and a 12 h light/12 h dark photoperiod. Deviations from these conditions led to reduced growth and sporulation, indicating the organism's sensitivity to abiotic stress. These findings provide a foundational understanding for enhancing the efficacy of *F. oxysporum* in mycoherbicidal development under field-specific conditions.

Keywords: *Fusarium oxysporum*, temperature, pH, photoperiod, fungal growth, sporulation, mycoherbicide, rice weeds

INTRODUCTION

Fusarium oxysporum is a ubiquitous fungus known for its dual roles as a plant pathogen and potential bioherbicide (Agrios, 2005). It causes vascular wilt in various crops and has also shown strong phytotoxic effects against several weed species, including *Cyperus rotundus* and *Echinochloa crus-galli* (Booth, 1971). The pathogenicity and virulence of *F. oxysporum* are significantly influenced by environmental parameters such as temperature, pH, and light

conditions, which affect mycelial growth, sporulation, and metabolite production (Nelson et al., 1983).

Previous studies have demonstrated that optimal growth conditions vary across isolates and host specificity. However, few studies have systematically evaluated how abiotic factors modulate the biological activity of weed-infecting *F. oxysporum* strains. Understanding these interactions is critical, particularly for its development as a mycoherbicide, where field conditions can vary drastically. This study aims to elucidate the influence of different temperature regimes, pH ranges, and photoperiod exposures on the growth and sporulation behavior of *F. oxysporum*. The outcomes are expected to support selection and deployment strategies of fungal isolates under varying agroclimatic conditions.

MATERIALS AND METHODS

Fungal Growth: Fusarium oxysporum were isolated from Rice weed diseased plant from Dhamtari, Gariyaband, Raipur and Durg Chhattigarh, India. This strain was isolated on PDA media through pour plate and serial dilution technique. For further experiment Fusarium oxysporum(FSRW#04) selcted based on research literature and stored at 4°C for further study.

Effect of temperature on growth: To assess the influence of temperature on the radial growth of *F. oxysporum*, PDA medium was prepared and sterilized at 121°C for 15 minutes. After cooling, the medium was poured into sterile 90 mm Petri dishes. A 5 mm mycelial disc from a 7-day-old culture was inoculated at the center of each plate under aseptic conditions (Dhingra & Sinclair, 1995). The plates were incubated at 5°C, 10°C, 15°C, 20°C, 28°C, 30°C, 40°C, and 50°C (±1°C) in BOD incubators. Each temperature treatment was replicated three times. After 7 days, colony diameters were measured in two perpendicular directions, and the average radial growth (mm) was recorded.

Effect of pH on growth: To examine the effect of pH, PDA medium was adjusted to pH values of 3.5, 4.5, 5.5, 6.0, 6.5, 7.0, 8.0, and 9.0 using 1N HCl or 1N NaOH before autoclaving (Singh et al., 2018). Sterilized media were poured into Petri dishes, inoculated with a 5 mm mycelial disc of *F. oxysporum*, and incubated at 28 ± 1°C for 7 days. Radial growth was measured, and average colony diameters were calculated. Each treatment was replicated three times.

Effect of Photoperiod on growth: The influence of photoperiod on biomass production was evaluated using Modified V8 juice agar medium. Petri plates were inoculated with a 5 mm disc from a 7-day-old actively growing culture (Jackson, 1958) and incubated at 28 ± 1°C under three photoperiod regimes: (1) continuous light (24 h; ~1000 lux), (2) alternating 12 h light / 12 h dark cycle, and (3) complete darkness (0 h; plates wrapped in aluminum foil). Each treatment was replicated three times. After 7 days, colony diameters were recorded and mycelial biomass was harvested, dried in a hot air oven at 60°C, and weighed (g/100 ml) to determine dry biomass.

RESULTS:

Effect of temperature: *Fusarium oxysporum* (FSRW#04) showed temperature-dependent growth in V8 juice broth at pH 5.0, evaluated on days 3, 5, and 7. No growth occurred at 5°C. At 10°C, growth was minimal (3.5 mm on day 3; 17.2 mm on day 7). Moderate growth was recorded at 15°C (28.6 mm) and 20°C (35.3 mm) by day 7. Optimal growth was observed at 28°C (61.5 mm), followed by a slight decline at 30°C (56.3 mm). At 40°C, growth reduced significantly to 24.1 mm, and at 50°C, only 6.3 mm of growth was recorded. These findings indicated 28 ± 1°C as the optimum temperature, consistent with earlier reports (Nelson et al., 1983; Booth, 1971; Sivanesan, 1987).

Graph 1: Show the Effect of Temperature on Growth of *Fusarium oxysporum* (FSRW#04)

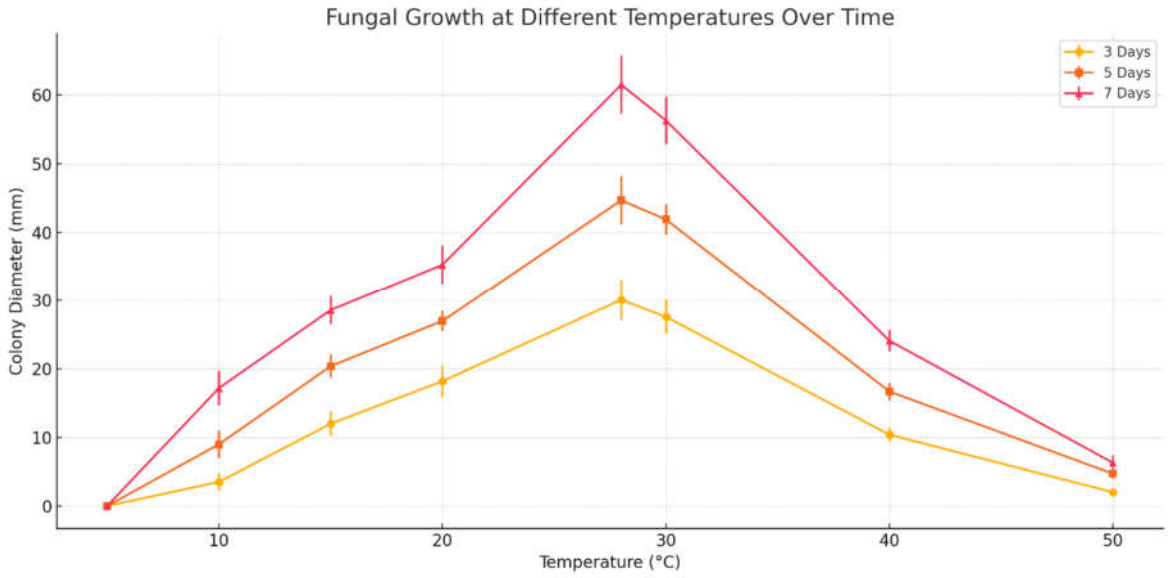
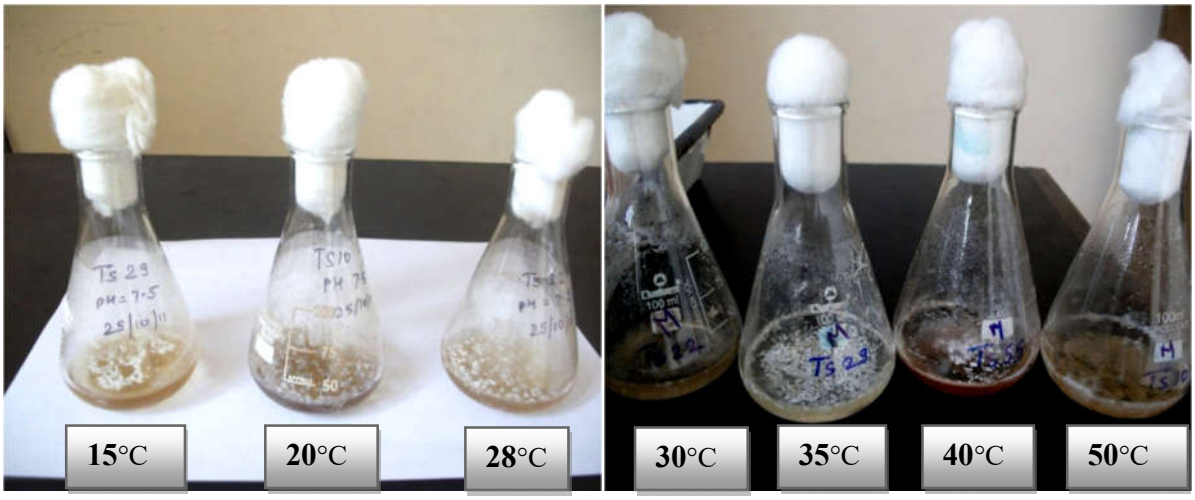


Figure 1: Fungal culture filtrates at different temperature grown in 100 ml conical flasks



Effect of pH:

Radial growth of *F. oxysporum* was significantly influenced by the pH of the growth medium. Minimal growth occurred at pH 3.0 and in alkaline conditions (pH 8.0–9.0). The highest growth was observed at pH 5.0 (66.8 mm), followed closely by pH 4.5 (61.5 mm). Substantial growth was also noted at pH 6.0 and 7.0, but performance declined sharply beyond pH 7.5. These results indicated that *F. oxysporum* preferred slightly acidic environments, particularly around pH 5.0, supporting its acidophilic nature (Booth, 1971; Fravel et al., 2003).

Graph 2: Effect of Hydrogen Ion Concentration on Growth of *Fusarium oxysporum* (FSRW#04)

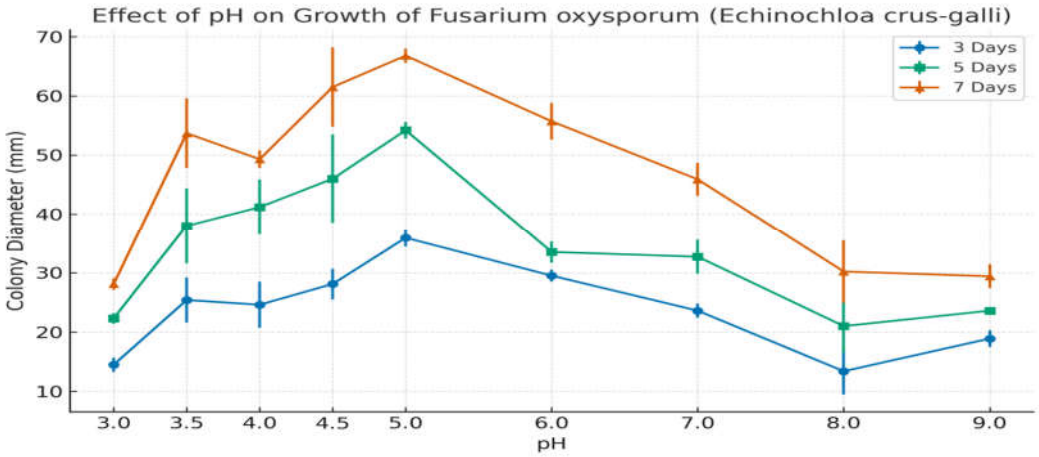
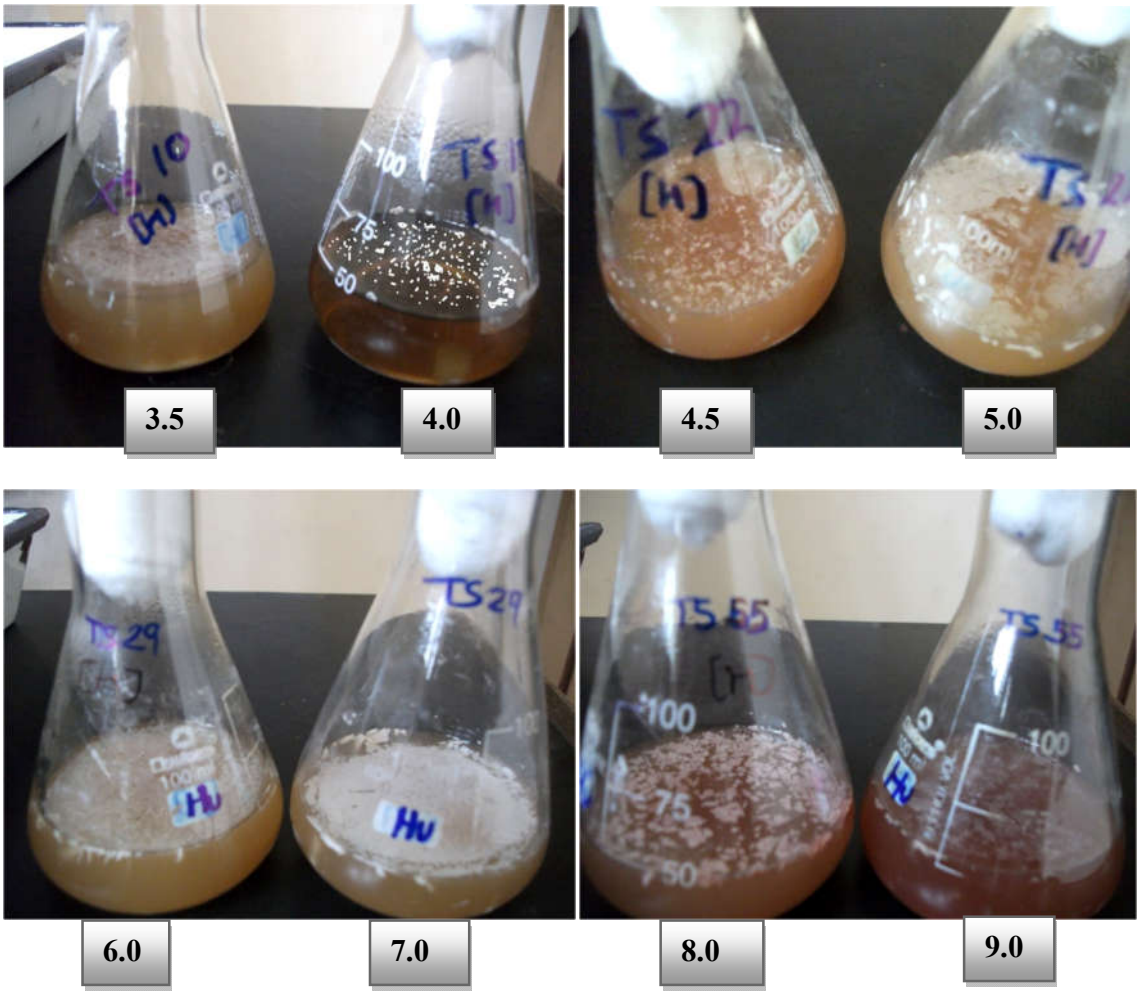
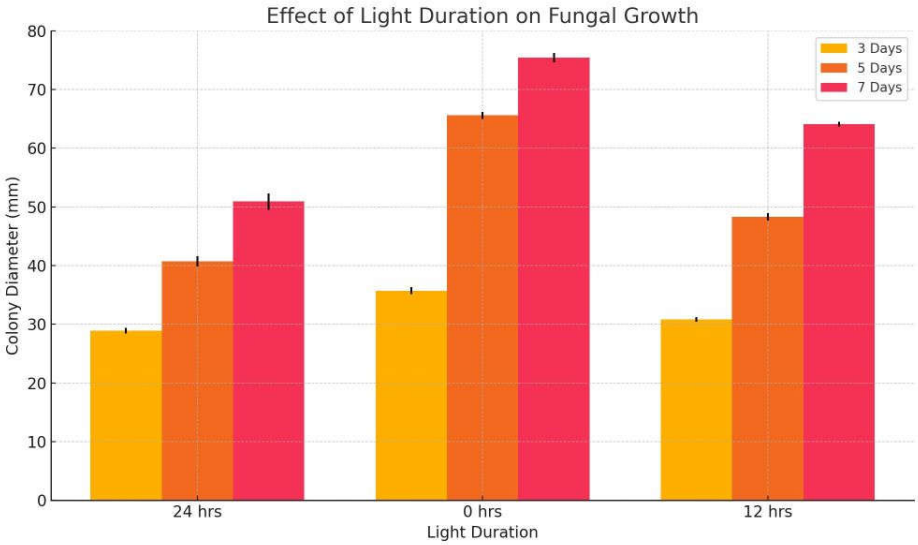


Figure2: Fungal culture of *Fusarium oxysporum* (FSRW#04) at different pH (3.5 to 9.0)



Effect of photoperiod: The photoperiod had a notable impact on fungal biomass and colony expansion. Growth initiation was rapid under all regimes. However, complete darkness (0 h light) promoted the highest biomass accumulation, with colony diameters of 35.7 mm (day 3), 65.6 mm (day 5), and 75.4 mm (day 7). The 12 h light/dark cycle resulted in moderate growth (64.1 mm at day 7), while continuous light (24 h) produced the least growth (50.9 mm at day 7). These findings suggested that *F. oxysporum* grew best under dark conditions, likely due to reduced photo-inhibition or stress (Ramakrishnan, 1954; Calistru et al., 1997; Papavizas, 1985).

Graph 3: Show the effect of Photoperiod on Growth of *Fusarium oxysporum* (FSRW#04)



CONCLUSION:

Based on the experimental findings, it can be concluded that environmental factors such as pH, temperature, and photoperiod significantly influence the growth of *Fusarium oxysporum* (FSRW#04). Optimizing these parameters is essential for maximizing fungal biomass and bioefficacy, which is crucial for its development as a potential mycoherbicide against major rice weeds. This study provides a foundation for scaling up *F. oxysporum* production under controlled conditions. However, further research is needed to evaluate its performance under varying field conditions, including humidity, soil composition, and nutrient availability, as well as its formulation stability and safety in integrated weed management systems.

ACKNOWLEDGEMENT:

The Authors acknowledge their sincere thanks towards the Supervisor, Dr. Sushma Dubey, HOD, Dept. of Biotechnology, Kalinga University, Raipur for providing all the laboratory research facilities along with the technical support.

REFERENCES

1. Agrios, G. N. (2005). *Plant Pathology* (5th ed.). Elsevier Academic Press.
2. Booth, C. (1971). *The Genus Fusarium*. Commonwealth Mycological Institute.
3. Calistru, C., McLean, M., & Berjak, P. (1997). *In vitro* studies on the potential for biological control of maize grain fungi by *Trichoderma* species. *Mycopathologia*, *137*, 103–110.
4. Dhingra, O. D., & Sinclair, J. B. (1995). *Basic Plant Pathology Methods*. CRC Press.
5. Jackson, C. R. (1958). The use of V8 juice in culture media for fungi. *Phytopathology*, *48*(1), 461.
6. Nelson, P. E., Toussoun, T. A., & Marasas, W. F. O. (1983). *Fusarium species: An Illustrated Manual for Identification*. Pennsylvania State University Press.
7. Papavizas, G. C. (1985). *Trichoderma* and *Gliocladium*: Biology, ecology, and potential for biocontrol. *Annual Review of Phytopathology*, *23*, 23–54.
8. Ramakrishnan, K. (1954). Studies on the influence of light on fungal growth. *Proceedings of the Indian Academy of Sciences, Section B*, *39*(3), 111–117.
9. Singh, P. K., Singh, A. K., & Yadav, S. K. (2018). Effect of environmental factors on the growth of *Fusarium oxysporum*. *Journal of Pharmacognosy and Phytochemistry*, *7*(5), 2495–2498.
10. Sivanesan, A. (1987). *Graminicolous Species of Bipolaris, Curvularia, Drechslera, Exserohilum and Their Teleomorphs*. C.A.B. International.