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Chlamydospore Production and Lysis of Macroconidia of *Fusarium solani* Causing Root Rot of Guar in Amended Soils

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Nitrogen amendments reduced the chlamydospore production and macroconidial lysis of *F. solani* in black and red sandy loam soils. The combined addition of ammonium- and nitrate-nitrogen was more effective in reducing the lysis of conidia. Chitin-amendment significantly reduced the chlamydospore formation and conidial lysis while cowdung amendment moderately reduced these chlamydospores and lysis. Cellulose and oatmeal amendments were non-effective as there is little reduction when compared to non-amended natural soils.

Key Words: **Chlamydospore, *Fusarium*, Guar, Lysis, Soil amendments, Soil-borne disease**

Introduction

The fungal hyphae and conidia of pathogenic fungi, when introduced into soil, get lysed or otherwise form chlamydospores. The survival of *Fusarium solani* depends on the chlamydospore production in soil. Factors influencing the formation of chlamydospores and conidial lysis are important in the management of a soil-borne disease. Several workers studied the mechanism of lysis and chlamydospore formation in soil and could control diseases with different amendments (Mitchell & Alexander 1963 b, Ko & Lockwood 1970, Schippers 1972, Schippers & de Weyer 1972, Eck 1978, Zakaria et al. 1980). In the present investigation an attempt has been made to study the influence of various amendments on the formation of chlamydospores and on the lysis of macroconidia of *F. solani* in soil.

Materials and Methods

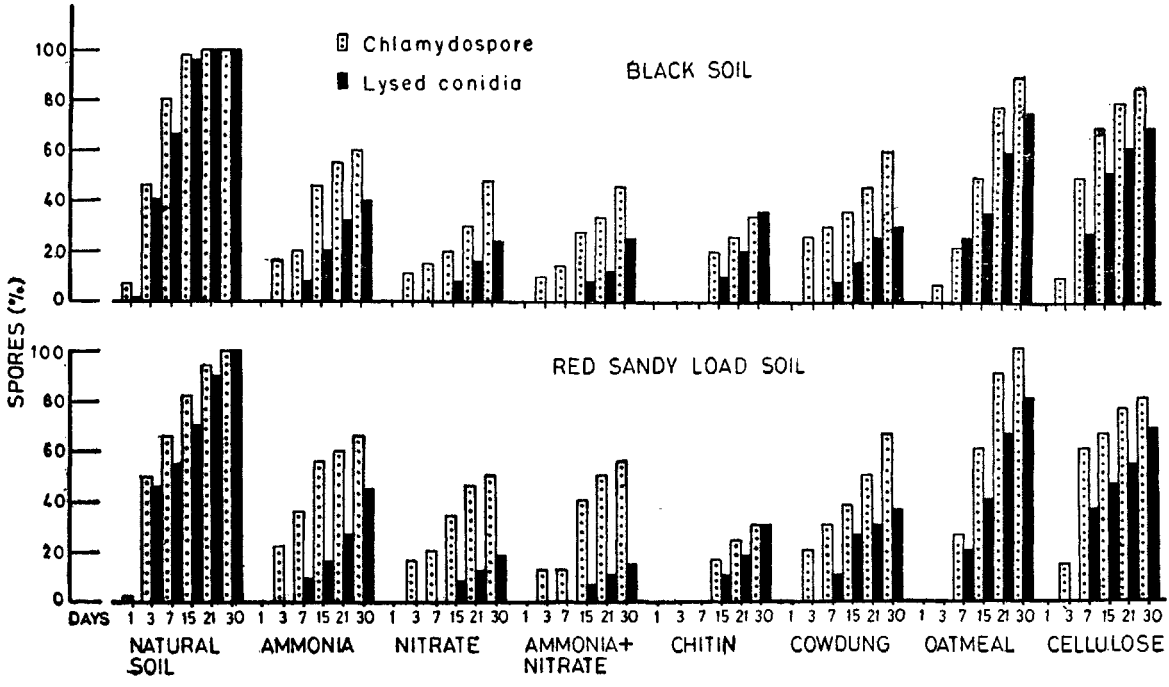
Fusarium solani (Mart.) Sacc. causing root rot of guar (Satyaprasad & Ramarao 1981) was used in the present study. The cultures of the pathogen were maintained on potato sucrose agar. Red sandy loam soil (sand: 74.80%; silt: 17.2%; clay: 8.0%) and black soil (sand: 25.11%; silt: 35.16%; clay: 39.53%) were employed in the present study. The soils were amended separately with different sources of nitrogen viz., ammonium chloride, potassium nitrate, $NH_4Cl+KNO_3$ at 0.5 gN/100 g soil and chitin, cowdung, cellulose and oatmeal at 1% level. Non-amended soils served as the control.

Chinn's (1953) agar slide technique was employed to study the fate of macroconidia in soil (Chinn 1953). Macroconidia from one-week-old cultures were washed twice with

sterile distilled water and transferred into cool melted 1% agar. The sterile glass slides were then dipped into the spore seeded 1% agar and allowed to solidify. The spore seeded slides were then inserted into soil in porcelain jars. The formation of chlamydospores and lysis of macroconidia were observed at different intervals up to one month after removing the agar from one side of the slide.

Results and Discussion

Conidia germinated to produce chlamydospores at the tip of the germ tube after 24 hr of incubation. Chlamydospores also formed due to the transformation of conidial cells within the conidia. No lysis of conidia was observed in the first 24 hr incubation while it reached to 100% after 30 days of incubation in both the soil types tested. Chitin was the most effective among various amendments in reducing chlamydospore production (figure 1). Nitrogen amendments reduced the chlamydospore production as well as conidial lysis. The chlamydospore production was minimised to 45% in nitrate-amended soils. The combined addition of ammonia- and nitrate-nitrogen delayed the lysis of conidia to 15 days and reduced the chlamydospore production. Lysis of macroconidia was delayed by one week in chitin-amended soils and chlamydospore production was similarly reduced to 30% and 35% in red sandy loam and black soils, respectively. A decline (35–40%) in chlamydospore number was noticed in cowdung amended soils while the conidial lysis was also reduced moderately. Oatmeal-amendment on the other hand produced maximum number of chlamydospores and lysed conidia as in the controls. In cellulose-amended soils a good number(>80%) of chlamydospores were produced and the conidial lysis was enhanced to about 70% by 30th day. Of all the amendments, chitin proved to be the most effective in reducing the chlamydospore production



followed by nitrogen amendments. Lysis of macroconidia was highly reduced in the soils amended with both ammonium and nitrate-nitrogen together. Both the soil types behaved more or less similarly with respect to conidial lysis and chlamydospore production.

The production of chlamydospores in soil depends on many abiotic and biotic factors. Chlamydospore formation was closely associated with the presence of bacteria in soil (Venkatram 1952, Ford et al. 1970 b) Ford et al. (1970a) identified specific soil substances inducing chlamydospore formation by *Fusarium* in soil. Schippers and de Weyer (1972) observed a reduction in lysis and chlamydospore formation of *F. solani* f. *cucurbitae* by chitin amendment. Similar results were obtained when the soils were amended with the required amounts of NH_4- and NO_3-nitrogen which were equivalent to those found in chitin-amended soils. (Schippers 1972). Zakaria et al. (1980) obtained reduction in *Fusarium* population densities by oil seed meal amendments which they attributed to volatile degradation products; particularly ammonia. The results in the present study also suggest the influence of soil amendments on the soil microflora which in turn affected the production of chlamydospores.

The mechanism of lysis of live fungal mycelium in soil may be an autolytic process induced by toxic metabolites and antagonistic microorganisms (Lloyd et al. 1965, Ko & Lockwood 1970). The addition of chitin to soil stimulates the microflora, which may be involved in mycolysis in soil (Mitchell & Alexander 1963a). Lysis of chlamydospores of *F. solani* f. *cucurbitae* was enhanced both in chitin and laminarin amended soils due to increase in bacteria, actinomycetes and chitinoclastic microflora possibly by autolysis (Eck 1978). Singh and Singh (1981) observed an increase in mycelial lysis of *F. oxysporum* f. *udum* due to the increase in bacterial populations of *Bacillus subtilis*. Enhanced activity of soil microflora in amended soils causes nutrient deprivation and the conidia lyse due to autolysis, chitin and nitrogen amendments proved to be useful in reducing the chlamydospore populations of *F. solani* in soil affecting their long term survival in the present study.

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References

Chinn S H F 1953 A slide technique for the study of fungi and actinomycetes in soil with special reference to *Helminthosporium sativum*; *Can. J. Bot.* **31** 718–723

Eck W H V 1978 Autolysis of chlamydospores of *Fusarium solani* f. *cucurbitae* in chitin and laminarin-amended soils; *Soil Biol. Biochem.* **10** 89–92

Ford E J, Gold A H and Snyder W C 1970a Soil substances inducing chlamydospore formation by *Fusarium*; *Phytopathology* **60** 124–128

_____, _____ and _____ 1970b Induction of chlamydospore formation in *Fusarium solani* by soil bacteria; *Phytopathology* **60** 479–484

Ko W H and Lockwood J L 1970 Mechanism of lysis of fungal mycelia in soil; *Phytopathology* **60** 148–154

Lloyd A B, Noveroske R L and Lockwood J L 1965 Lysis of fungal mycelium by *Streptomyces* spp., and their chitinase systems; *Phytopathology* **55** 871–875

Mitchell R and Alexander M 1963a Lysis of soil fungi by bacteria; *Can. J. Microbiol.* **9** 169–177

Mitchell R and Alexander M A 1963b Addition of fungal cell wall components to soil for biological disease control; *Phytopathology* **53** 1068–1071

Satyaprasad K and Ramarao P 1981 Root rot of guar caused by *Fusarium solani*; *Indian Phytopath.* **34** 523–524

Schippers B 1972 Reduced chlamydospore formation and lysis of macroconidia of *F. solani.* f. *cucurbitae* in nitrogen-amended soil; *Neth. J. Pl. Path.* **78** 189–197

_____ and de Weyer W M M M 1972 Chlamydospore formation and lysis of macroconidia of *F. solani* f. *cucurbitae* in chitin-amended soil; *Neth. J. Pl. Path.* **78** 45–54

Singh N and Singh R S 1981 Lysis of mycelium of *F. oxysporum* f. *udum* in soil amended with organic matters; *Pl. and Soil* **59** 9–15

Venkatram C S 1952 Soil bacteria and chlamydospore formation in *Fusarium solani*; *Nature* **170** 889

Zakaria A M, Lockwood J L and Filonow A B 1980 Reduction of *Fusarium* population density in soil by volatile degradation products of oil seed meal amendments; *Phytopathology* **70** 495–499