The optimum pH for the maximum α-amylase production was found to be 5.6 as with other fungi[7-9]. However, Yuanchi *et al*[7] had reported 55°C as optimum for α-amylase of *Monascus anka* v-2

It has been observed that enzyme production increases with the increase of the age of the fungal culture. Similar observations were made by Adams[10] in *Mucor pusillus* and *Humicola lanuginosa*.

Dermatophytes such as *Microsporum*, *Trichophyton* and *Epidermophyton* possess intracellular-α-amylase activity[11,12]. However, these organisms failed to produce extracellular amylase[13,14]. This difference in the production of enzyme might have contributed to the saprophytic nature of *R. capitata*.

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TOXICITY OF *PSEUDOMONAS FLUORESCENS* TOWARDS BACTERIAL PLANT PATHOGENS OF BANANA (*PSEUDOMONAS SOLANACEARUM*) AND RICE (*XANTHOMONAS CAMPESTRIS* PV. *ORYZAE*)

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AMONG the bacterial plant pathogens, *Pseudomonas solanacearum* which affects several of the economic crops and *Xanthomonas campestries* pv. *oryzae* which causes the bacterial leaf blight (BLB) of rice are the most important. The bacterial wilt pathogen, *P. solanacearum* causes heavy crop losses all over the world and has limited the production of diverse food crops like tomatoes and export of major agricultural products such as potatoes and bananas[1]. Gnanamanickam *et al*[2] reported the occurrence of bacterial wilt of banana from Southern India. The BLB pathogen of rice, *X. c.* pv. *oryzae* is a dreaded and destructive pathogen in India and the rest of Asia and causes heavy losses in grain yield. In India, annual losses due to BLB vary[3] between 6 and 60% and in Punjab, the losses are even higher[4]. In view of the absence of truly effective control measures for these pathogens, we have been interested in developing biological control with antagonistic rhizobacteria[5-10]. In this report, we describe the susceptibility of these pathogens to native strains of *Pseudomonas fluorescens*.

An Indian isolate of *P. solanacearum* (NCPPB 3214), the banana wilt pathogen and 3 isolates of *X. c.*pv. *oryzae* isolated from naturally infected rice plants (cv. IR 20 and ADT 36) were used in this study. Several strains of *P. fluorescens* isolated from rhizospheres of crops were available in our collection. A citrus strain (Pfc) and 2 rice strains (Pfr) were used in this study. These strains were characterized as biotype III of *P. fluorescens* following the biochemical criteria outlined in Bergey's manual[11].

Methods for testing *in vitro* antagonism have been described earlier[5-7]. Bacterial plugs or plugs containing cell-free siderophore (fluorescent pigment) (6 mm dia) were removed from King's medium B (KB)[12] and were transferred to the centre of KB agar plates seeded previously with cells (10^5 cfu/ml) of either *P. solanacearum* or *X. c.* pv. *oryzae*. After incubation at room temperature for 48 hr, these

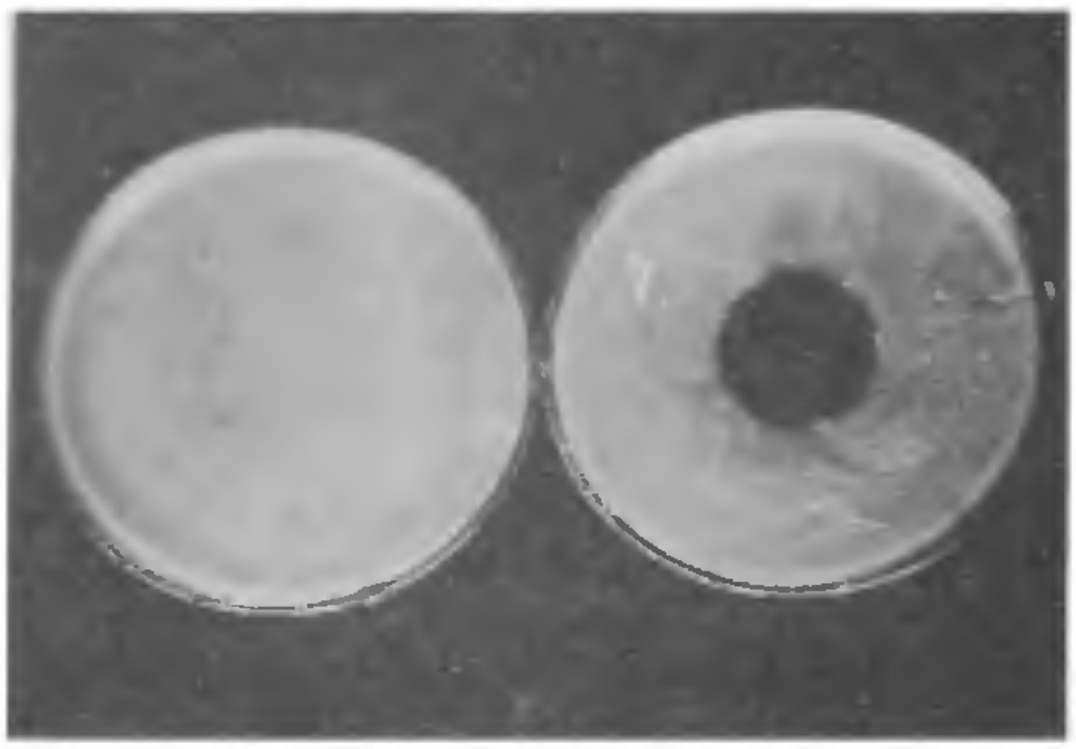

Figure 1. *In vitro* toxicity of *P. fluorescens* (Pf) to *P. solanacearum*. Plate on left: control; Right: Pfc X *P. Solanacearum*.

pathogens appeared as growth-free inhibition zones. The diameter of these inhibiton zones varied between 1.1 and 5.1 cm (figure 1). The rice strain (Pfr) caused maximum inhibition of *X. c.* pv. *oryzae*. In control plates there was normal growth. In an alternate method, 3 isolates of *X. c.* pv. *oryzae* streaked on KB agar containing the siderophore also failed to grow (figure 2).

Successful biological control of several important fungal pathogens and soft-rotting bacteria has been achieved with rhizobacteria of *P. fluorescens* and *P. putida* types[8–10, 13–17]. Previous work from our laboratory on the use of these strains have resulted in significant reductions in the severity of *Rhizoctonia solani*[9], *Sclerotium rolfsii*[10] on groundnut and *Sarocladium oryzae*, the sheath-rot pathogen of rice[8]. This, however, is the first preliminary report and the results suggest that native strains of *P. fluorescens* can possibly be used for affording control against *P. solanacearum* (banana) and *X. c.* pv. *oryzae* (rice). Greenhouse experiments are in progress.

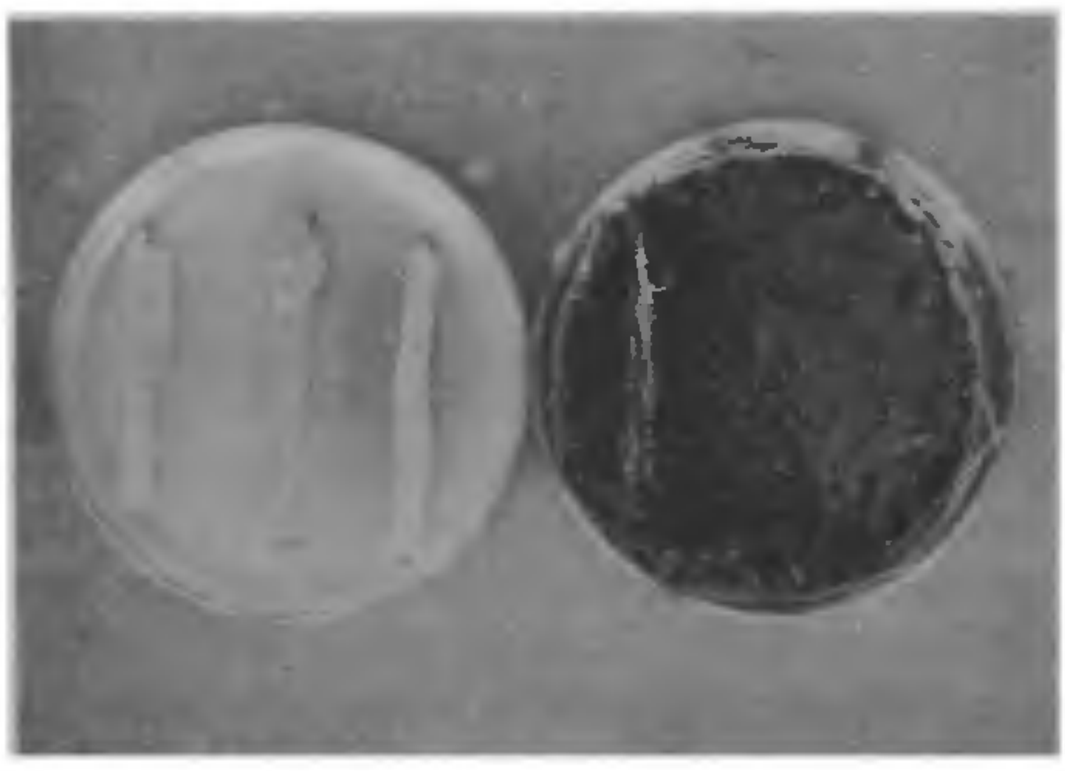

Figure 2. Cell-free siderophore of *P. fluorescens* inhibits the growth of *X. campestris* pv. *oryzae*. Left: control; (normal KB agar) Right: KB agar containing cell-free siderophore.

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