Table 3 *^{14}C-L-proline utilisation pattern in NaCl and PEG stressed sugarcane leaves following 2 hr light absorption*

	Control	NaCl (1 MPa)	PEG (1 MPa)
Proline (non-pro)*	90.0 (±4.8)	86.0 (±2.6)	66.0 (±10.3)
Proline (Pro)*	34.0 (±3.5)	85.0 (±6.7)	49.0 (±8.3)
Aspartate (Non-pro)*	9.5 (±3.8)	8.8 (±4.3)	15.0 (±5.6)
Glutamate (Non-pro)*	–	3.0 (±0.8)	6.0 (±1.6)
Glutamate (Pro)*	7.0 (±2.3)	Trace	Trace
Citrate (Non-pro)*	–	–	5.0 (±1.2)
Sugars (Non-pro)*	–	–	8.0 (±2.7)
Origin (Non-pro)*	–	–	–
Origin (Pro)*	59.0** (±5.2)	15.0 (±8.3)	50.0 (±9.1)

*: Values expressed as a percent distribution of radioactivity on chromatogram; **: Average of ten figures. Non-pro: Non-protein fraction. Pro: Protein fraction.

control and stressed sugarcane leaves is not utilized effectively. Most of the radioactivity from ^{14}C-L-proline was recovered as proline. The PEG-stressed leaves show conversion of proline to compounds like aspartate, glutamate, citrate and sugars. The results indicate that the oxidation of proline is inhibited in the case of sugarcane leaves by NaCl treatment and is slightly stimulated by PEG stress. These observations are also contrary to those reported earlier[6,12] where effective metabolism through TCA cycle in other plants was noticed. In sugarcane var CO 740 uptake of proline and its conversion to proteins was inhibited due to ionic and nonionic stress. The small amount of proline infiltrated into the leaf discs was not metabolized effectively in non-stressed and NaCl-stressed sugarcane leaves but is metabolized in PEG-stressed sugarcane leaves *via* the accepted path of its oxidation[10]. The results confirm the ineffective role of proline metabolism in sugarcane var CO 740 under stress conditions.

20 July 1985

1. Levitt, J., *Response of plants to environmental stresses*, Vol. II. *Water radiation, salt and other stresses*. Academic Press, New York, 1978, p. 58.
2. Kemble, A. R. and Macpherson, H. T., *Biochem. J.*, 1954, **58,** 46.
3. Naik, G. R. and Joshi, G. V., *Proc. Indian Acad. Sci. (Plant Sci.)*, 1983, **92,** 265.
4. Singh, T. N., Aspinall, D. and Paleg, L. G., *(Nature) New Biol.*, 1972, **236,** 188.
5. Huber, C. and Guerrier, D., 1972 cited by Stewart, G. R. and Lee, J. A., *Planta* (Berl) 1974, **120,** 279.
6. Nurit Bur Nun and Poljakoff-Mayber, A., *Ann. Bot.*, 1977, **41,** 173.
7. Mizusaki, S., Noguehi, M. and Tamaki, E., *Arch. Biochem. Biophys.*, 1964, **105,** 599.
8. Boggess, S. F., Stewart, C. R., Aspinall, D. and Paleg, L. G., *Plant Physiol.*, 1976, **58,** 398.
9. Naik, G. R. and Joshi, G. V., *Plant Soil*, 1979, **53,** 505.
10. Stewart, C. R., *Plant Physiol.*, 1972, **50,** 551.
11. Barnard, R. A. and Oakes, A., *Can. J. Bot.*, 1970, **48,** 1155.
12. Sumio, I., Kawashima, N. and Matsuyama, S., *Phytochemistry*, 1979, **18,** 1155.

TOXICITY OF *PSEUDOMONAS FLUORESCENS* TOWARDS RICE SHEATH-ROT PATHOGEN *ACROCYLINDRIUM ORYZAE* SAW

N. SAKTHIVEL and S. S. GNANAMANICKAM
Centre of Advanced Studies in Botany, University of Madras, Madras 600 025, India.

SHEATH-ROT of rice caused by *Acrocylindrium oryzae* Saw is a disease of increasing importance to Indian rice ecology. It was first reported in India during 1973–74[1,2]. Amin *et al*[2] found the disease to be more severe on densely planted high yielding dwarf rice cultivars in Andhra Pradesh, West Bengal and other states of Northern and Southern India causing 10 to 20% or even higher crop losses. Although sources of resistance to *A. oryzae* are known[3], the disease is widely prevalent on commonly cultivated high yielding rice cultivars. We have been interested in the possible use of antagonistic rhizobacteria in controlling soil-borne plant pathogens[4,5]. In this report, we describe the susceptibility of the sheath-rot fungus to strains of *Pseudomonas fluorescens*.

Naturally-infected rice sheath samples showing characteristic sheath-rot symptoms were collected

from North Arcot (cv White Ponni), Periyar (cv IR 20 and Co 44) and Coimbatore (cvs Co 43, IR 60 and TKM 9) districts. The pathogen *A. oryzae* was isolated following the method described by Amin *et al*[2]. Several strains of rhizobacteria of *P. fluorescens* type isolated from plant rhizospheres are available in our collection[4,5]. Two such strains were used in this study. These were strain Pfc isolated from citrus leaves and strain Pfo isolated from rice-roots and characterized following the biochemical criteria outlined in Bergey's manual[6].

In vitro tests for antagonism between *P. fluorescens* and fungal pathogens have been described earlier[5]. Bacterial plugs of 48 hr grown *P. fluorescens* strains were removed from King's medium B (KB)[7]. The plugs (6 mm dia) containing the fluorescent green pigment (siderophore) and bacteria were transferred to the centre of KB plates and inoculated by spreading with a fungal suspension of *A. oryzae*. After incubation at 23°C for one week, inhibition of the growth of *A. oryzae* appeared as growth-free inhibition zones.

Both the citrus strain (Pfc) and rice strain (Pfo) were equally toxic to rice sheath-rot fungus *A. oryzae* (figure 1). Large zones of mycelial growth inhibition were seen in plates containing a bacterial plug whereas in non-treated controls thick white mycelium of *A. oryzae* showed normal, spreading growth (figure 1).

P. fluorescens strains of plant-growth promoting rhizobacteria (PGPR) group have been successfully used for enhancing crop growth and for suppressing plant pathogens[5,8–13]. The siderophore pigments produced by these bacteria complex the environmental iron, making it less available to pathogens and thus suppress their growth[8]. Mew and Rosales[14] recently showed that bacteria (*Pseudomonas*) can be used for obtaining significant control of the sheath blight disease of rice caused by *Rhizoctonia solani*. Our earlier results[5] showed that growth of rice seedlings was enhanced by 27% by PGPR treatment. Results reported here, although preliminary, suggest the possibility that sheath-rot can be controlled by bacterization of rice seeds/plants with *P. fluorescens* strains. To achieve this further screening and field experiments are in progress.

One of the authors (NS) thanks the UGC, New Delhi for financial support through a fellowship.

7 March 1985

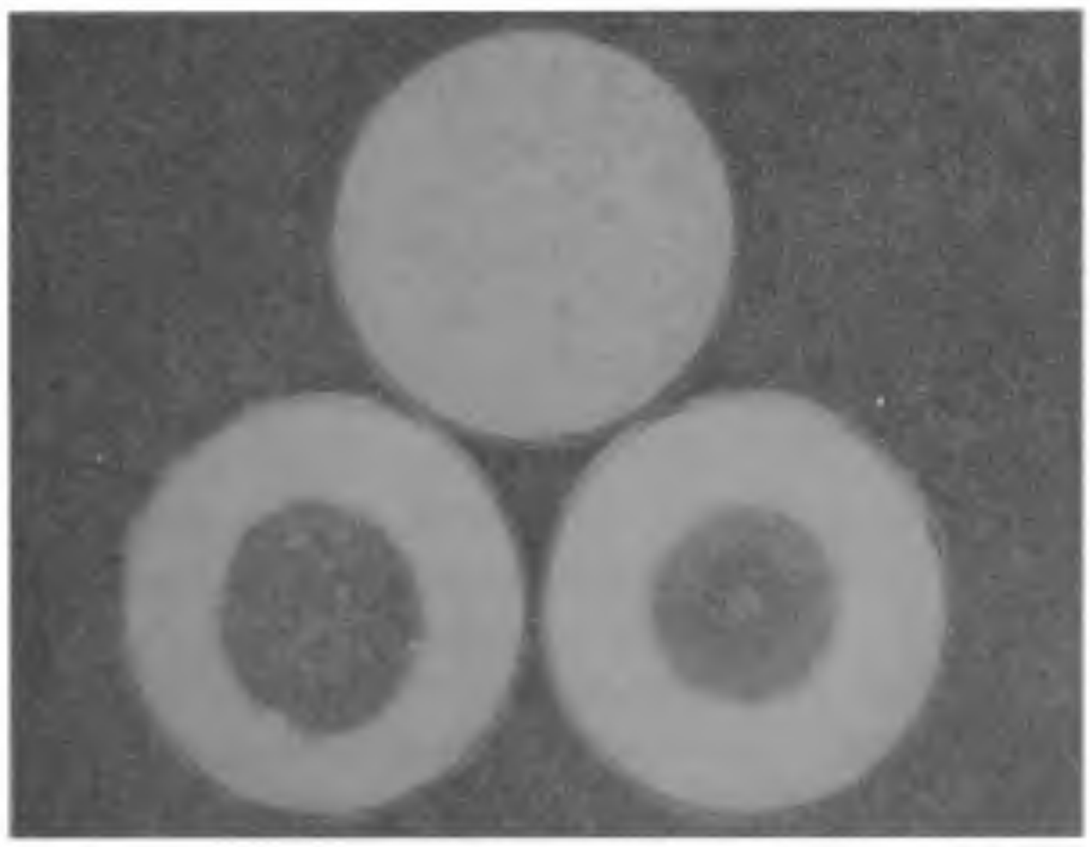

Figure 1. Plate showing *Pseudomonas fluorescens*-induced inhibition of growth of *Acrocylindrium oryzae*. Top: Control, *A. Oryzae* Bottom right: *P. fluorescens* (Pfo) × *A. Oryzae* Bottom left: *P. fluorescens* (Pfc) × *A. Oryzae*

1. Agnihothrudu, V., *Kavaka*, 1973, **1,** 69.
2. Amin, K. S., Sharma, B. D. and Das, C. R., *Plant. Dis. Reptr.*, 1974, **58,** 358.
3. Amin, K. S., *Plant. Dis. Reptr.*, 1976, **60,** 72.
4. Unnamalai, N. and Gnanamanickam, S. S., *Curr. Sci.*, 1984, **53,** 703.
5. Sakthivel, N., Sivamani, E., Unnamalai, N. and Gnanamanickam, S. S., *Curr. Sci.*, 1985, **54,** in press.
6. Buchanam, R. E. and Gibson, N. E., *Bergey's manual of determinative bacteriology*, 8th edn, Williams and Wilkins Co., Baltimore, 1974.
7. King, E. O., Ward, M. K. and Raney, D. E., *J. Lab. Clin. Med.*, 1954, **44,** 301.
8. Kloepper, J. W., Leong, L., Teintze, M. and Schroth, M. N., *Nature* (*London*), 1980. **286,** 885.
9. Burr, T. J., Schroth, M. N. and Suslow, T., *Phytopathology*, 1978, **68,** 1377.
10. Suslow, T. V. and Schroth, M. N., *Phytopathology*, 1982, **72,** 199.
11. Scheffer, R. J., *Ann. Appl. Biol.*, 1983, **103,** 121.
12. Howell, C. R. and Stipanovic, R. D., *Phytopathology*, 1980, **70,** 712.
13. Weller, D. M. and Cook, R. J., *Phytopathology*, 1983, **73,** 463.
14. Mew, T. W. and Rosales, A. M., In: FFTC Book series No. 26, *Soil-borne Crop Disease in Asia*. 1984, 147.