Table 1 *Distribution of various chemical constituents.*

Chemical constituents	*Name of the taxon** 1	2	3	4	5	6	7
Secondary metabolites							
Alkaloids	−	−	−	−	−	−	−
Anthraquinones	+	+	−	+	−	−	−
Aucubin-compounds	−	−	−	−	−	−	−
Catechol-tannins	+	+	+	+	+	−	+
Flavonoids	+	+	+	+	+	+	+
Indoles	+	+	−	−	−	−	+
Juglone	−	+	−	−	−	+	−
Leucoanthocyanins	+	+	−	+	−	+	+
Lignans	−	−	−	−	−	−	−
Methylene-dioxy compounds	−	+	−	−	+	−	−
Activity of Polyphenolase	+	+	−	+	−	−	+
Saponins	−	+	−	−	−	+	−
Steroids	+	+	−	+	−	+	+
Syringin	−	−	−	−	−	−	−
Syringyl radicals	+	+	+	+	+	+	+
Tannins	+	+.	−	+	−	+	−
Free Aminoacids							
hRf 30	+	+	+	+	+	+	+
hRf 50	+	+	+	−	+	+	+
hRf 54	−	−	−	−	+	+	−
Phenolic acids							
p-hydroxybenzoic acid	+	+	+	+	+	+	+
Salicylic acid	+	+	+	+	−	+	+
Vanillic acid	+	+	+	+	+	+	+
hRf 32/30	−	+	+	−	+	−	+
hRf 42/27	+	+	+	+	+	+	+
hRf 42/55	+	+	+	+	+	+	+
hRf 52/50	+	−	−	−	−	−	−
hRf 66/70	+	+	+	+	+	+	+
hRf 68/25	−	+	−	+	+	−	+
hRf 68/50	−	+	−	+	+	−	+

*1 = *Cynometra*, 2 = *Bauhinia*, 3 = *Intsia*, 4 = *Trachylobium*, 5 = *Hardwickia*, 6 = *Ceratonia*, 7 = *Saraca*.
+ = Present. − = Absent.

respectively. Similarly the percentage of affinity of *Hardwickia* with *Ceratonia*, *Saraca* and *Cynometra* works out to be 47, 65 and 43 respectively. Though a perusal of available chemical data of these two taxa seem to indicate that they are more coherent and concurrent with the phylogenetic grouping of Hutchinson[9], than with traditional Cynometreae, a detailed study of a large number of species, on various aspects, is imperative, before any final conclusion, regarding the proposed taxonomic shift is drawn.

The authors are grateful to the Director, Botanical Survey of India, for permission to collect the live material from the Indian Botanic Garden, Howrah. GN is grateful to CSIR for the award of a fellowship.

5 July 1985; Revised 23 August 1985.

1. Nageshwar, G., Radhakrishnaiah, M. and Narayana, L. L., *Indian J. Bot.*, 1985 (in press).
2. Nageshwar, G., Radhakrishnaiah, M. and Narayana, L. L., *Proc. Indian Acad. Sci (Plant Sci.)*, 1984, **93**, 621.
3. Nageshwar, G., Radhakrishnaiah, M. and Narayana, L. L., *J. Econ. Tax. Bot.*, 1984, **5**, 1189.
4. Nageshwar, G., Radhakrishnaiah, M. and Narayana, L. L., *Curr. Sci.*, 1984, **53**, 813.
5. Bentham, G. and Hooker, J. D., *Genera Plantarum*, R. Reeve & Co., London, 1862–1893.
6. Willis, J. C., *A dictionary of the flowering plants and ferns* (Revised by H. K. Airy Shaw) Univ. Press, Cambridge, 1973.
7. Gibbs, R. D., *Chemotaxonomy of flowering plants.* I, McGill Queen's Univ. Press, Montreal and London, 1974.
8. Sokal, R. R. and Sneath, P. H. A., *Principles of numerical taxonomy*, W. H. Freeman, San Francisco and London, 1963.
9. Smith, P. M., *Chemotaxonomy of plants*, Edward Arnold, London, 1976.
10. Flück, H., *Chemical plant taxonomy* (ed.), T. Swain, Academic Press, London, 1963.
11. Hutchinson, J., *Genera of flowering plants*, Clarendon Press, Oxford, Vol. 1, 1964.
12. Ellison, W. L., Alston, R. E. and Turner, B. L., *Am. J. Bot.*, 1962, **49**, 599.

METABOLISM OF EXOGENOUS PROLINE IN SUGARCANE VAR CO 740 UNDER SALINITY AND PEG STRESS

G. R. NAIK* and G. V. JOSHI
Department of Botany, Shivaji University, Kolhapur, 416 004, India.
** P.G. Department of Studies in Botany, Gulbarga University, Gulbarga 585 106, India.*

RAPID and extensive accumulation of free proline in water and salt-stressed plants has been fairly documented[1]. However, the mechanism of proline accumulation and the role of proline are unresolved although several papers have been published since it was first reported by Kemble and Macpherson[2]. Our earlier communication[3] on proline metabolism in salt-sensitive sugarcane var reported lack of this adaptive mechanism under stress conditions. There are reports[4–6]

on other non-resistant plants showing exogenous addition of proline to counteract the inhibitory effect of stress conditions. The present investigation attempts to study the response of exogenous application of proline to non-resistant sugarcane cultivar under stress conditions. The studies also include the uptake and further metabolism of ^{14}C-L-proline to understand the proline metabolism in salt-sensitive sugarcane variety.

Sugarcane seedlings were grown in aerated Hoagland nutrient solution and the NaCl and PEG (6000) treatment (1 MPa) was employed as described earlier[3]. Exogenous application of proline (5 ppm) was carried out by adding it in salinized nutrient solution. The nutrient solution was changed frequently for 40 days. The 100-day-old plants with stress injury symptoms were used for ^{14}C-L-proline uptake studies. The sugarcane leaves from the seedlings growing in NaCl (1 MPa), PEG (1 MPa) and control (non-stressed) were harvested and cut transversely into 5 mm wide slices and used for ^{14}C-L-proline feeding experiments as described by Mizusaki *et al*[7] and Bogges *et al*[8]. The condensed extracts of protein and non-protein fractions were used for two-dimensional paper chromatography and autoradiography[9]. The radioactivity was counted with continuous gas flow proportional counter.

Table 1 gives growth data of the treated and untreated plants recorded for 3 weeks after the respective treatments. It is clear that the salt stress significantly inhibited the growth of sugarcane. The exogenously added proline to the culture solution is effective in stimulating the root growth of the salt-stressed plants. This increased root growth is responsible for the slight stimulation of total dry matter and fresh weight than that of either NaCl treated or control plants. A slightly higher photosynthetic leaf area and number of leaves per plant was also noticed. However, the marginal recovery noted during the present investigation in sugarcane Var CO 740 is not as significant as that observed by other workers in barly[4], *Carex* sp[5] and in pea[6] in case of non-resistant plants.

Proline is one of the aminoacids contained in proteins of all organisms and the plant tissues readily incorporate exogenously added proline into protein. As reported in table 2, the ^{14}C-L-proline is not taken up by the sugarcane leaf slices effectively in NaCl- and PEG-stressed sugarcane. On the contrary the control (non-stressed) leaves showed a higher uptake. The values of the incorporated ^{14}C-L-proline into protein and non-protein fraction and their ratio clearly indicate that the conversion of proline to protein fraction was also inhibited under stress condition. These results are quite different from earlier observations on bean[10], maize[11] and pea[6] where salinity stress apparently stimulated the metabolism of externally supplied proline.

Utilization of ^{14}C-L-proline in the NaCl and PEG stressed sugarcane leaves is also studied using autoradiography. The conversion pattern of ^{14}C-L-proline to various compounds in TCA soluble and TCA insoluble fraction is shown in table 3. The results clearly indicate that most of the incorporated ^{14}C-L-proline in

Table 2 *^{14}C-L-proline uptake in NaCl and PEG stressed sugarcane leaves following 2 hr light absorbtion*

Treatment	Non-protein fraction*	Protein fraction*	Total uptake*	Protein/non protein ratio
Control	115.0 (±11.2)**	23.5 (±1.8)	138.5 (±13.0)	0.20
NaCl (1 MPa)	40.0 (±3.5)	6.5 (±1.6)	46.5 (±5.1)	0.16
PEG (1 MPa)	48.5 (±6.8)	5.5 (±1.9)	54.0 (±8.7)	0.11

*: Values expressed as cpm mg^{-1} plant material;
**: Average of ten figures.

Table 1 *Effect of exogenous application of proline on sugarcane growth under NaCl stress conditions*

Treatment	Total seedling fresh weight (g)	Dry matter content g/seedling	Fresh weight of roots g/seedling	Average leaf area cm^2/seedling	Number of leaves
Control	7.3	0.97	0.75	254.0	7.0
NaCl (1 MPa)	2.31	0.37	0.57	71.0	3.0
NaCl (1 MPa) +proline (5 ppm)	4.3	0.48	1.6	93.0	3.5
C.D. at 0.05% level	0.324	0.0432	0.057	13.32*	0.442

* C.D. at 5% level.

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