ground in premature condition when they were only 4–6 cm long and 2–3 cm in diameter. The extent of damage was evaluated which revealed that 40–60% fruits were dropped at a very early stage due to this disease resulting in 40–60% loss of yield.

The pathogen was isolated from the infected tissues on potato dextrose agar (PDA) medium. Colony on PDA was dark-brown. The pathogen was identified as *Colletotrichum circinans* (Berk.) Vogl. A brief description of this fungus is given below: acervuli showing abundant dark-coloured, pointed, septate, up to 120 μ long and 5–8 μ wide setae (figure 2); hyaline, one-celled, falcate, fusiform, thin-walled, guttulate, $19–21 \times 3.5–3.7$ μ conidia (figure 3) produced on short, unbranched, hyaline, thin-walled, $35.2–40.5 \times 3–5$ μ conidiophores.

Pathogenicity tests carried out with conidia from 10-days-old culture resulted in the development of typical symptom 12–18 days after inoculation. Reisolations from induced lesions established identity with the original isolate. The present note therefore makes an addition to the host index of *C. circinans*.

A survey of literature[1–3] reveals that the disease reported herein is a new record on papaya.

The author is indebted to Prof. A. Choudhury for the photographs. The author is also indebted to Dr J. A. von Arx, Director, Central bureau voor Schimmelcultures, The Netherlands for confirming the identification of the fungus.

19 May 1987; Revised 22 June 1987

1. Bilgrami, K. S., Jamaluddin and Rizwi, M. A., *Fungi of India*, Parts I and II, Today and Tomorrow's Printers & Publishers, New Delhi, 1979, 1981.
2. Fröhlich, G. and Rodewald, W., *Pests and diseases of tropical crops and their control*, Pergamon Press, Oxford, 1970.
3. Western, J. H., *Diseases of crop plants*, MacMillans, London and Basingstoke, 1971.

LEAF-SURFACE EFFECTS OF ENVIRONMENTAL POLLUTION ON *PUTRANJIVA ROXBURGHII*

S. C. DATTA and SUBRATA SINHAROY
Department of Botany, University of Calcutta, Calcutta 700 019, India

CONSIDERABLE information is available on the effects of pollution on plants under natural and controlled environmental conditions. Chamberlain[1] was one of the early workers to note the detrimental influence of air-pollution on conifers, particularly *Pinus banksiana*. Scheffer and Hedgcock[2] revealed the specific action of sulphur dioxide on leaves in the forests of north-western United States. Solberg and Adams[3] noticed the collapsed tissues of spongy mesophyll and epidermis as affected by sulphur dioxide and fluoride. Duggar *et al*[4] found that bean (*Phaseolus vulgaris*) plants were damaged by phytotoxins regardless of the closed and open condition of the stomata. Feder[5] claimed a decrease in floral productivity and branching in geranium subjected to oxidant-type pollutants. Although foliar traits have been employed in ecological work[6,7], only a few recent investigations[8–11] were devoted to a determination of the importance of leaf cuticular patterns as indicators of environmental pollution. The ever-increasing levels of atmospheric pollution have necessitated the development of a methodology to assess air quality easily and rapidly. The present study is aimed at understanding and identifying various plant species and their attributes as biomonitors of air-pollution. This communication deals with leaf-surface features in probing environmental pollution and ascertaining their potential as an index of pollution.

Putranjiva roxburghii Wall., a member of the family Euphorbiaceae, is a small tree of the Indo-Malayan region, being quite common in and around Calcutta. Fully grown leaves were collected in late winter (January 1987) from seven different areas

Table 1 *Distribution and environment of populations of P. roxburghii (no. of samples studied: 4 in each population)*

Population	Location	Relative pollution level	Source of pollution
A	BBD Bag	High	Automobiles
B	Esplanade	High	Automobiles
C	Dum Dum	High	Jet Airport, automobiles, domestic
D	Manicktala	Considerable	Automobiles, industry, domestic
E	Ballygunge	Marginal	Automobiles, domestic
F	Rashbehari Avenue	Marginal	Automobiles, domestic
G	Baruipur, 24 parganas	Minimal	Domestic

Table 2 *Epidermal effects of pollution on the leaf surface in P. roxburghii*

Traits	Population A	B	C	D	E	F	G
Leaf thickness (μ)	212.2 ±4.8	205.0 ±3.3	200.3 ±3.2	194.3 ±3.0	180.3 ±2.7	189.3 ±3.0	156.0 ±2.9
Epidermal layer thichkness (μ)	16.8 ±0.6	16.8 ±0.7	15.0 ±0.7	15.0 ±0.8	14.8 ±0.6	16.7 ±0.9	14.0 ±0.7
Stomatal frequency (mm^{-2})	372.8 ±16.0	350.0 ±6.5	355.8 ±10.8	408.3 ±16.2	544.9 ±20.2	465.1 ±10.7	596.5 ±10.7
Stomatal length (μ)	24.0 ±1.1	24.1 ±1.1	25.2 ±2.7	24.0 ±2.7	29.3 ±1.2	25.4 ±3.7	31.6 ±1.7
Stomatal breadth (μ)	18.7 ±1.1	18.7 ±0.9	15.2 ±1.2	18.7 ±1.3	20.0 ±1.2	20.0 ±2.7	23.3 ±1.4
Stomatal l/b ratio	1.3 ±0.4	1.3 ±0.6	1.6 ±0.7	1.3 ±0.3	1.5 ±0.5	1.3 ±0.5	1.3 ±0.7
Trichome density	55.3 ±2.7	54.8 ±2.3	44.3 ±1.5	40.8 ±1.7	12.8 ±1.4	34.0 ±1.3	11.8 ±1.9
Trichome length (μ)	174.0 ±3.0	174.0 ±2.9	159.5 ±3.3	179.0 ±3.6	215.2 ±6.3	159.2 ±4.4	223.2 ±7.2

(table 1), representing varying degrees of enviornmental pollution. For uniformity, third and fourth nodal leaves from the apex of all twigs were used. The leaves were washed with distilled water and air-dried. Quickfix, an adhesive cement, was used to prepare the impressions of lower leaf surface. Microscopic slides of the leaf impressions were examined (N=30) for cuticular characters (table 2) under compound microscope, using 10× oculars and 10× objective. Hand-sections of leaves were also prepared and treated with a saturated alcoholic solution of Sudan III for 20 min; these preparations were microscopically observed to measure the thickness of leaf epidermis and cuticle.

Woody plants generally do not bear stomata on the surface of upper leaves and this was true for the species under study. Though stomata and trichomes abound in the lower leaf surface, the upper surface contained relatively few trichomes and no stomata. It is safe to assume that population *G* was growing in a comparatively rural and less polluted environment, while populations from *A* to *E* were the products of polluted environments (tables 1 and 2). The high values of stomatal frequency in populations *E* and *G* (less polluted) were in sharp contrast to low stomatal frequency observed in populations from *A* to *D* (more polluted). The presence of a few stomata in the leaves of the polluted-area plants is presumably a distinct adaptive feature to exclude poisonous gases which would otherwise gain entry to the leaf, injure the tissues and cause death[12]. There do not seem to be any large difference in stomatal range (length: 24.0–31.6 μ; breadth: 15.2–23.2 μ) in the various populations, whereas the stomatal 1/b ratio varied from 1.3 (marginal pollution) to 1.7 (high pollution). Leaf thickness as well as epidermal layer thickness were maximum in population *A* and minimum in population *G*. As trichome density was high in all the populations of polluted environment and low in population *G* from the rural area, it is suggested that trichomes may serve as insulator and provide shade to the leaf surface. This may lower the leaf temperature and possibly slow down the rate of metabolic reactions associated with an array of toxic gases. While trichomes from populations *C* and *F* were of identical length, lower lengths arose from *A*, *B* and *D* and higher lengths from *E* and *G*. The longer trichomes may act as a filter against atmospheric pollutants, especially particulate matter. Several trichomes in populations of polluted environments were thought to be 'barbed', providing extra landing sites to the particulates which might hitherto clog the stomata and adversely affect the process of gaseous exchange.

The comparisons made in this study indicate that the leaves of *P. roxburghii* undergo modification in the leaf-surface pattern which are of adaptive significance in the polluted atmosphere. It has been theorized that many plants adapt to low levels of pollution[13]. Hence, it is postulated that these patterns may be indicative of the extent of air-pollution. Further investigation of additional taxa would help to establish these tentative relationships on a broader basis.

15 June 1987

1. Chamberlain, C. J., *Gymnosperms: structure and evolution*, Dover, New York, 1934.
2. Scheffer, T. C. and Hedgcock, G. G., *US Dept. Agric. Tech. Bull.*, 1955, **1117**, 1.
3. Solberg, R. A. and Adams, D. F., *Am. J. Bot.*, 1956, **43**, 755.
4. Duggar, W. M., Taylor, O. C., Cardiff, E. and Thomson, C. R., *Plant Physiol.*, 1962, **37**, 487.
5. Feder, W. A., *Environ. Pollut.*, 1970, **1**, 73.
6. Au, S. F., *Ecology*, 1969, **50**, 131.
7. Sharma, G. K., *Swest. Nat.*, 1972, **17**, 221.
8. Sharma, G. K. and Butler, J., *Environ. Pollut.*, 1973, **5**, 287.
9. Sharma, G. K. and Tyree, J., *Bot. Gaz.*, 1973, **134**, 179.
10. Sharma, G. K., *Can. J. Bot.*, 1975, **53**, 2312.
11. Bhiravamurthy, P. V., Kumar, P. V., Rethy, P. and Anuradha, Y., *Symp. Biomonitoring State Environ.*, 1985, p. 249.
12. Sharma, G. K., *Water, Air, Soil Pollut.*, 1977, **8**, 15.
13. Bennett, J. P., Resh, H. M. and Runeckles, V. C., *Can. J. Bot.*, 1974, **52**, 35.

NEW RECORDS OF COELOMYCETES FROM INDIA

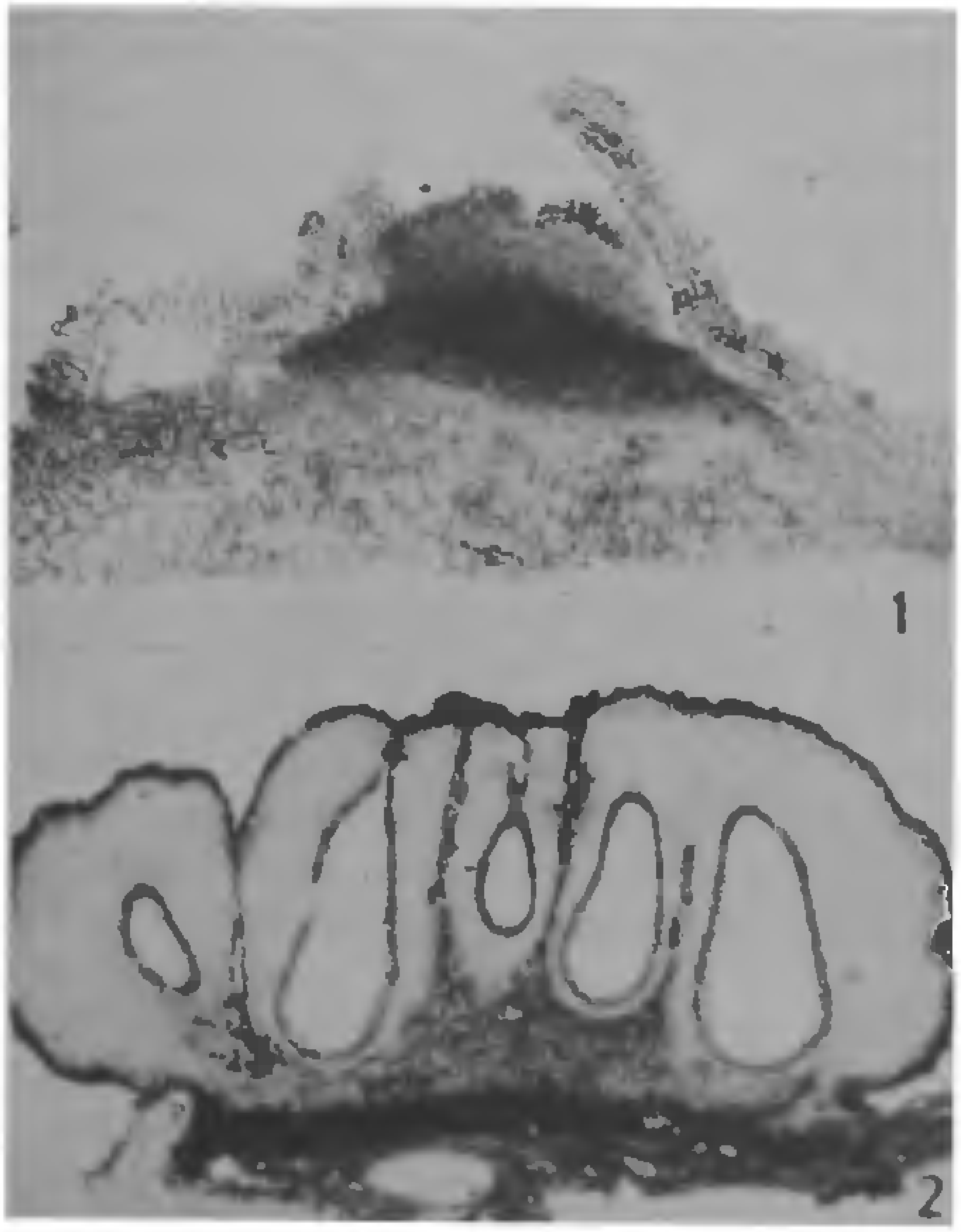
J. MUTHUMARY (ALIAS) KALAIVANI

CAS in Botany, University of Madras, Madras 600 025, India.

DURING the course of our study on Coelomycetes from South India several interesting fungi were collected. Two of these coelomycetes hitherto unrecorded from India are briefly described and illustrated in this paper. *Coryneum modonium* (Sacc.) Griff. & Maubl. and *Waydora typica* (Rodway) Sutton are being reported for the first time from India.

1. *Coryneum modonium* (Sacc.) Griff. & Maubl., *Bull. trimest. Soc. mycol. Fr.* **26**:379 (1910); Sutton, B. C. *Mycological Papers* **138**:38–40 (1975), (figures 1 and 3a, b).

Conidiomata aceruvular, abundant, subperidermal, scattered, rupturing the periderm, flat and effuse, 800–1000 μm in diameter, dark brown, composed of thick-walled, brown, textura angularis



Figures 1 and 2. 1. *Coryneum modonium.* Vertical section of acervular conidioma ($\times$250); **2.** *Waydora typica.* Vertical section of stromatic conidioma ($\times$250).