ease is severe particularly in the rainy season[2–4]. In addition to defoliation, the pathogen has also been reported to reduce the nutritive quality of mulberry leaves[2,3]. *E. coronaria* remains infected throughout the year and may play a role as collateral host for the pathogen and spread besides helping in the spread of leaf spot disease in mulberry.

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SOLANUM SPIRALE ROXB.: OCCURRENCE AND CYTOLOGY

PHILOMENA KURIACHAN and
OMANA MATHEW
Department of Botany, University of Kerala, Trivandrum 695 581, India.

SOLANUM SPIRALE is one of the 19 species of the genus native to the Indian subcontinent. It is a medicinal plant, the root of which is employed as a diuretic and narcotic[1,2]. This species is limited[3–5] to Assam and Meghalaya to Bangladesh and Burma up to 1170 m. Its occurrence in South India and its cytology are reported here for the first time.

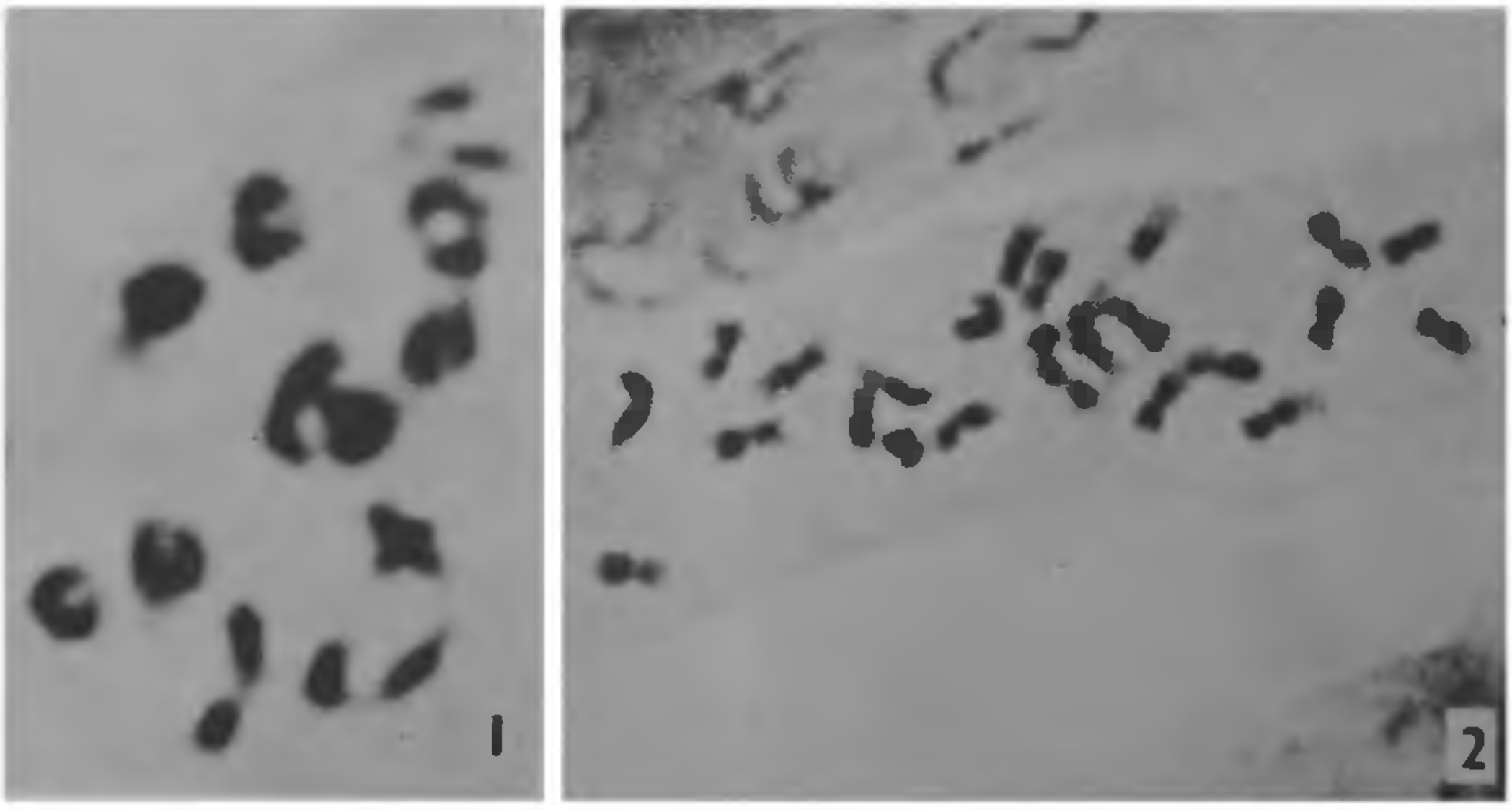
Solanum spirale Roxb., Hort. Beng. 16. 1814 (normen) and Fl. Ind., ed. Carvey, 1: 566. 1832; C.B. Clarke in Hooker f., Fl. Brit. India 4: 230. 1883; Prain, Bengal Plants 2: 745. 1903. Deb, in the biology and taxonomy of the Solanaceae 87. 1979.

An unarmed shrub 1–1.5 m. Leaves elliptically lanceolate, 3.5–8 cm, glabrous; petiole 1 cm. Inflorescence raceme, many-flowered, extra-axillary; pedicel 1–2 cm. Calyx cupular; lobes 5, acute. Corolla white, 1 cm across; lobes 5, oblanceolate. Stamens 5; anthers oblong, 2 mm. Ovary 2 mm; style 3 mm, stigma capitate. Berry 1 cm across; seeds discoid, 2 mm across, smooth.

S. spirale was collected from Ootacamund, Nilgiris at about 2200 m. Flowers in dense spiral recemes. Berries small, glossy yellow.

Cytological studies on *S. spirale* showed that the PMCs have 12 bivalents (figure 1). The root tip cells showed 24 chromosomes (figure 2) of which one pair was of the *sm* type and the rest, *m* types. Three pairs of *m* chromosomes showed heterochromatin in the long arms. The chromosomes varied from 1.3 μm to 2.7 μm in length.

Most of the *Solanum* species native to India are widely distributed and also occurs in other countries. Based on a floristic survey and well-authenticated



Figures 1 and 2. (× 3100) **1.** PMC of Solanum spirale with 12 bivalents, and **2.** Mitotic metaphase of *S. spirale* with 24 chromosomes.

herbarium records, it is shown that *S. spirale* is restricted in distribution to the North-Eastern region of India and the contiguous parts of Bangladesh and Burma. The present results indicate that *S. spirale* can hardly be treated as endemic to the North-Eastern region. It is reported[6] that 17% plant species described in Nilgiri and Pulney hill-top occur in Khasia hills also, about 2200 km away. These two areas are sufficiently distant to envisage dissemination of the species from one area to the other. On the other hand it may be suggested that the species also occupied the intervening land in the past and during evolution got localized in the North-Eastern hilly areas and temperate climatic zones at high altitudes in South India. The chromosome number $n = 12$ and $2n = 24$ in this species conforms to the reports on other non-tuber bearing species of *Solanum*.

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DILUTION OPTIMA OF BROTH CULTURES FOR MAXIMIZING PRODUCTION OF CARRIER-BASED INOCULANTS

K. S. JAUHRI
Division of Microbiology, Indian Agricultural Research Institute, New Delhi 110 012, India.

MANY developed countries produce rhizobial broth cultures in automatic and semiautomatic fermentors. However, for a developing country like India, fermentors are expensive not only to acquire and maintain but to install and operate. Special skills are required for their operation. Often they get contaminated if proper precautions are not taken during their operation resulting in loss of time and expensive nutrients. Most of the commercial units in India, therefore, use rotary shakers despite limited output of the broth cultures. Therefore, any method which improves production of broth cultures from shakers is welcome.

The present study was undertaken to test whether or not carrier-based inoculants prepared from prediluted broth culture of a very slow growing strain of *Rhizobium* cowpea sp. (ARS-112) can attain and sustain an acceptable number, during the incubation period. The utility of cheaper substitutes in place of yeast extract in diluent solution was also examined.

The broth culture of *Rhizobium* cowpea sp. (ARS-112) was prepared by inoculating yeast-extract-mannitol (YEM)[1] broth with a 10-day-old agar culture and incubating the same on a rotary shaker for 7 days at 30 ± 2°C. The rhizobial population of the broth culture after 7 days incubation was 96×10^9 viable cells/ml. Glass distilled water, 10% solution of commercial grade molasses and malt extract and YEM medium (full strength) were prepared and sterilized at 121°C (15 p.s.i.) for 30 min and used for diluting the broth culture of *Rhizobium* cowpea sp. (ARS-112) in the ratio of 1:0, 3:1, 1:1, 1:3 and 1:9 before blending it with the carrier. Finely powdered (100 mesh) and air-dried charcoal and soil (sandy-loam) were mixed in the ratio 3:1. Calcium carbonate (0.02%) and K_2HPO_4 (0.05%) were added to this mixture along with 10% of moisture. A sample of 200 g of this carrier mixture was packed in autoclavable polypropylene bags ($6 \times 10''$ size, 75 μ thick) and heat sealed. The carrier material in sealed bags was sterilized in an autoclave at 121°C (15 p.s.i.) for 3 h. On cooling, an aliquot of 60 ml of undiluted and diluted broth cultures with each diluent was injected aseptically into separate bags containing 200 g of sterilized carrier using a syringe. This gave 40% moisture content into the inoculant packet. Each treatment was replicated thrice. The bags were kept unmixed overnight to allow the mixture to get absorbed into the carrier. Next day, the contents of the bags were mixed thoroughly by massaging from outside. These packets were incubated in a BOD incubator at 30°C for 180 days. The rhizobial population in carrier was enumerated at regular intervals of storage by dilution-plate count method using YEMA medium containing congored[1].