

on record⁴⁻⁶. In order to determine whether the variation in nucleolar condition referred above has also some such significance, serial microtome sections of developing roots were studied after staining them with Mallory's triple stain. Significantly, the cells with a single but enlarged nucleolus, those showing nucleolar budding and binucleolate condition were found to constitute a single row in the centre of the root. By virtue of their size, appearance and position, they represent metaxylem initials. Nucleolar studies on *Zea mays*⁵ and *Pisum*⁶ indicate that during root differentiation, nuclei of different regions vary with respect to nucleolar size. They have recorded that nuclei of the stelar region contain largest nucleoli. Numerical increase in nucleolus is also on record in metaxylem initials⁴. These authors report that in place of the normal count of two nucleoli per nucleus, some cells of *Allium cepa* carry as many as three. Another similarity between this and the present report is the occurrence of nucleolar budding in some root tip cells (figure 4). These authors attribute nucleolar budding and consequent increase in nucleolar number to the extra replication of nucleolus associated DNA within developing xylem cells. Using cytophotometry and autoradiography they have demonstrated six-fold difference in nucleolar material of these cells and the ones neighbouring them. Measurements of nucleolar surface area indicate that even in the present case amplification of nucleolar material is six-fold. Thus, while nucleolus measures 89.6 μ^2 in surface area in neighbouring cells, individual nucleoli of the binucleolate nuclei are as large as 234.8 μ^2 .

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OCCURRENCE OF IMPIETRATURA DISEASE OF CITRUS IN INDIA

Y. S. AHLAWAT, V. V. CHENULU,
N. K. CHAKRABORTY*
and S. M. VISHWANATH

Division of Mycology and Plant Pathology,
Indian Agricultural Research Institute,
New Delhi 110 012, India.

*Present address IARI Regional Station, Kalimpong (W.B.), India.

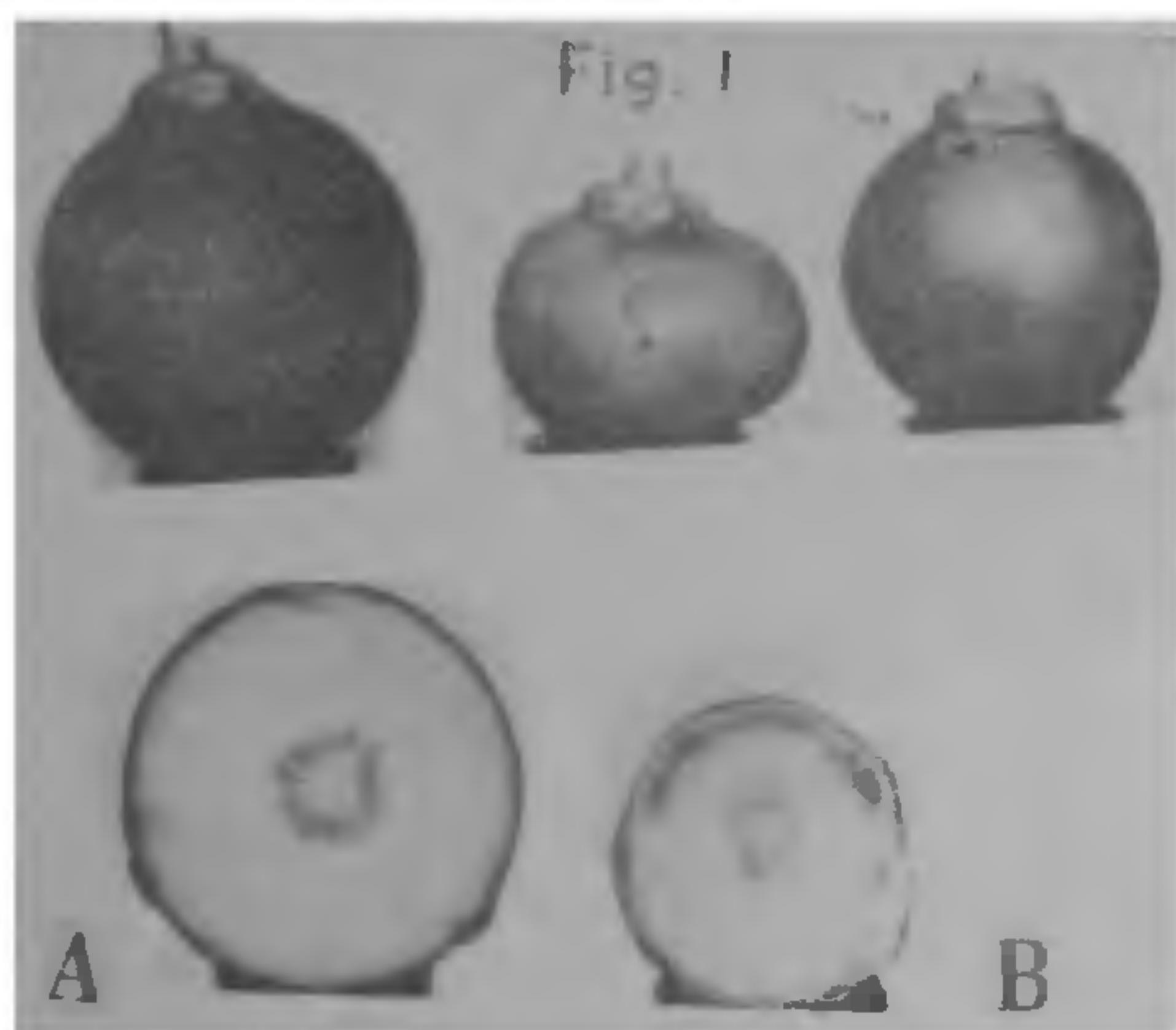
IN 1973, during a survey for virus diseases of Citrus in Darjeeling district of West Bengal, a 15-year old tree of Pummelo [*Citrus grandis* (Linn) Osbeck] at Churchill Ville, Kalimpong was observed to bear abnormal small fruits. These fruits never developed to normal size and became stony-hard, lop-sided and often fell prematurely during June-July. The fruit bearing branches had depressed brownish spots. There were gum deposits under such spots on the wood. During further surveys in June 1974 and 1975, the incidence of the disease was observed upto 15% at Kalimpong and 3% at Gyalsing, Sikkim. No fungus or bacterium could be isolated from the affected branches.

Five 3-year old seedlings of each Washington navel, pummelo and grape fruit inoculated by bud grafts, from naturally affected plants showed typical bark-lesion symptoms after 3 years in a glasshouse. To obtain quick transmission of the disease agent and establish fruit symptoms, four diseased buds of pummelo were grafted on an apparently healthy pummelo tree in the field. Similarly four buds from a healthy plant maintained in the glasshouse were grafted on another field pummelo tree to serve as control.

Bark lesions developed on branches upon grafting with buds during the following year. Typical fruit symptoms of albedo gumming were observed three years later (figure 1B). However, on the control tree the branches remained healthy bearing normal fruits (figure 1A). Glasshouse inoculated plants also showed the fruit symptoms after seven years.

In the host range studies, typical symptoms of the disease were developed only on grape fruit, pummelo and sweet orange but not on lemon, lime and mandarin since they did not show any symptoms on back inoculation to grape fruit which is an indicator host.

The typical symptoms of the disease viz smalling, stony-hardness and albedo gumming of fruits, gum deposits in the wood of affected branches suggested the disorder to be similar to impietratura disease caused by a virus reported from Mediterranean region¹⁻⁴. During a survey in 1980, typical symptoms



Figures 1A & B. A. Healthy pummelo fruit and its transverse section. B. Impietratura affected pummelo fruits and a transverse section showing albedo gumming.

of the disease were observed on a grape fruit tree at IARI orchard and recently in May, 1983 on four trees of Mosambi at Hyderabad.

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CRYSTAL AND MOLECULAR STRUCTURE OF (*d*-LYSINATO) (*l*-LYSINATO) DICHLORO COPPER (II) DIHYDRATE

K. VENKATASUBRAMANIAN and
N. N. SAHA

*Crystallography and Molecular Biology Division,
Saha Institute of Nuclear Physics, Calcutta 700 009, India.*

THE crystal and molecular structure of dichloro (*d*-lysinate) (*l*-lysinate) copper (II) dihydrate has been

investigated as a part of our research programme on the structure and function of biomolecules. The compound was prepared by reacting DL-lysine hydrochloride with basic copper carbonate. Single crystals, suitable for x-ray work, were obtained by slow evaporation of the resulting blue solution over a period of days. Preliminary studies indicated the space group to be $P2_1/n$ and density measurements showed that there are 2 molecules in the unit cell.

Diffraction data were obtained using an Enraf-Nonius CAD4 automated diffractometer with monochromatized Cu-K α radiation in the range $4^\circ \leq 2\theta \leq 130^\circ$. This yielded 1481 reflections of which 1191 had $I \geq 3\sigma(I)$ and were considered observed. Accurate cell dimensions obtained by a least-squares fit of 25 arbitrarily chosen higher order reflections were: $a = 5.152(1)$, $b = 17.394(2)$, $c = 11.325(2)$ Å and $\beta = 96.81(1)^\circ$.

The structure was solved by the heavy-atom method. A difference map, based on the positions of copper and chlorines, revealed all the non-hydrogen atoms; isotropic, followed by anisotropic refinement yielded an R value of 0.059. Inclusion of hydrogens and a mixed-mode refinement led to the final R value of 0.039 for all the observed data.

The coordination of the copper atom corresponds to a distorted octahedron with four short and two long bonds. The basal valencies are provided by the hydroxyl oxygens of the carboxyl group and nitrogens of the alpha-amino group (and their centrosymmetrically related partners) at distances of 1.937(1) Å and 1.970(2) Å respectively. These values can be compared with those reported for copper iminodiacetate dihydrate (2.014 and 1.945 Å, 1.995 and 1.961 Å, average $\sigma = 0.008$ Å)¹, bis (L-leucinato) copper (1.996 and 1.989 Å, 1.960 and 1.960 Å, average $\sigma = 0.004$ Å)², and *trans*-bis-(L-methionate) copper (2.01 and 1.97 Å, average $\sigma = 0.02$ Å)³. The angle N_1CuO_1 is $84.6(1)^\circ$. Chlorines approach the apical positions of the octahedron at distances of 3.047(1) Å. The angles N_1CuCl and O_1CuCl are $90.5(1)^\circ$ and $85.7(1)^\circ$ respectively. These observations show that the base is very nearly square-planar and the Cu-Cl vector is nearly perpendicular to $O_1N_1CuO_1$ 'N₁' plane. The view of the molecule showing a minimum overlap is displayed in figure 1.

C(sp³)-C(sp³) distances in the lysine moiety range from 1.485(3) to 1.535(3) Å, while the C-N distances are 1.485(3) and 1.479(3) Å. The C-O distances are 1.230(3) and 1.270(3) Å, suggesting that this moiety is approaching a zwitterionic form. The distances and angles in the lysine moiety compare well with those