through natural outcrossing is also borne out by the present study.

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1. Flory, W. S. Jr. *Proc. Amer. Soc.*, 1944, 44, 525.

THE ROOT-KNOT NEMATODE ON *GLADIOLUS* FROM INDIA

DURING a survey of plant parasitic nematodes undertaken during 1977-78 at the Experimental Station, Indian Institute of Horticultural Research, Hessaraghatta, Bangalore, it was observed that the root-knot nematode, *Meloidogyne incognita* (Kofoid and White, 1919) Chitwood, 1949 was commonly associated with glandiolus (*Gladiolus* spp.) causing heavy root galling. Numerous adult females and egg masses of the root-knot nematode were observed by dissection of the root galls. The infested plants were stunted in growth, with chlorotic foliage and short and thin floral stalks. Besides invading roots, the nematode was also found on daughter corms and cormels which develop after flowering. The nematodes may survive in corms and cormels which are used as planting material and may serve as source of inoculum for next season and dispersal of the nematode to newer areas. Four varieties of gladiolus, *viz.*, Blue lilae, Cherry blossom, Jowagnar and a hybrid were found infected with *M. incognita.*

Root-knot nematode infestation on gladiolus had been reported from other countries (Minz[1] and Overman[2]). This is the first report of the occurrence of root-knot nematode on field grown gladiolus from India.

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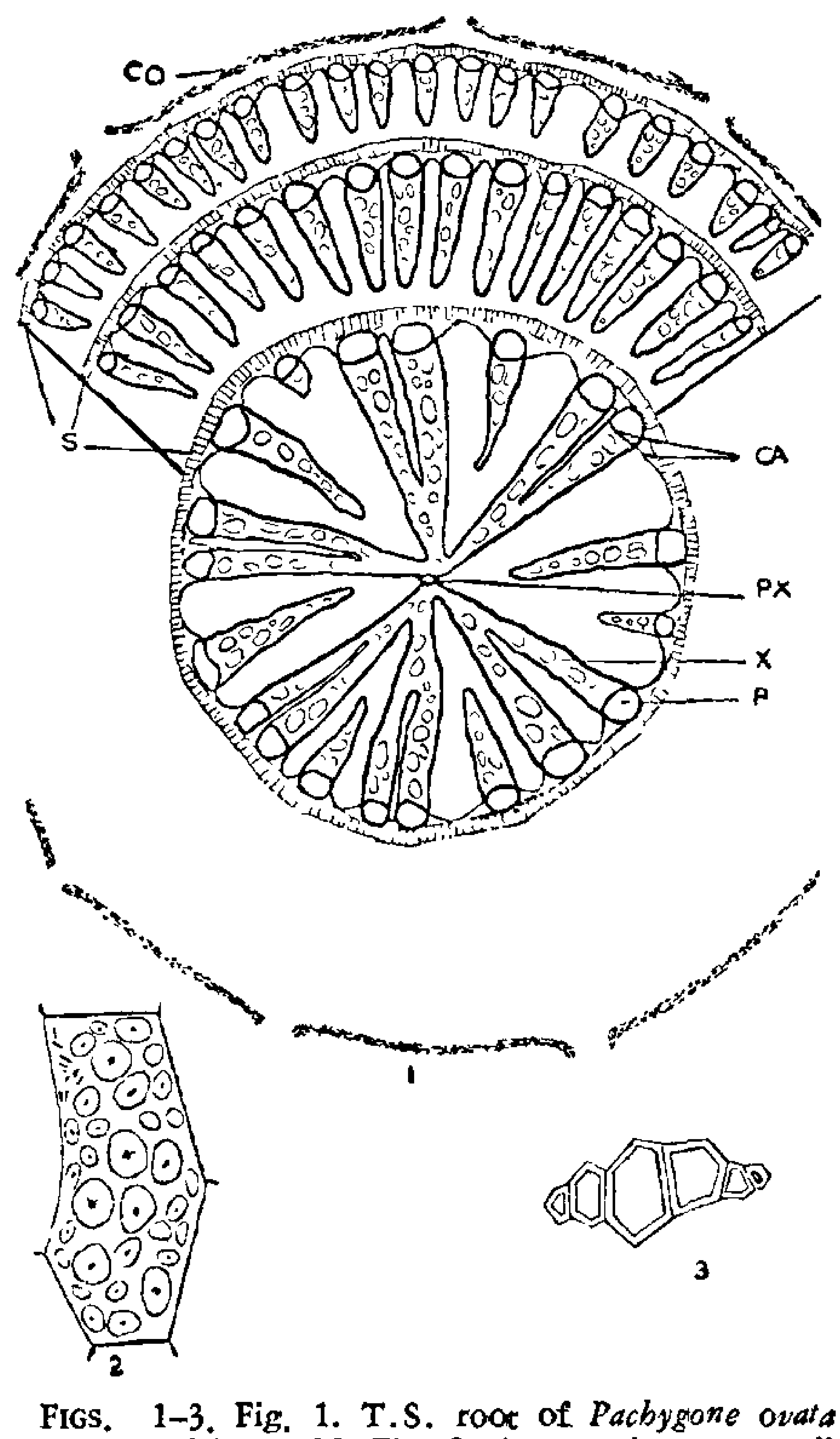
1. Minz, G., *Plant Disease Reptr.*, 1956, 40, 798.
2. Overman, A. J., *Proc. Fla. Sta. Hort. Soc.*, 1969, 82, 362.

ANOMALOUS SECONDARY THICKENING IN THE ROOTS OF *PACHYGONE OVATA* MIERS.

ANOMALOUS secondary thickening, by the formation of supernumerary rings of cambium, is known to occur in the stems of some of the climbers of Menispermaceae[1] but the nature of the secondary thickening in the roots of such plants remains practically uninvestigated. *Pachygone ovata* exhibits anomalous secondary thickening in the stem but its root anatomy has not so far been investigated. As such a study of the anatomy of the root is reported here.

The root is diarch and each of the exarch primary xylem groups comprises usually three elements (Figs. 1, 3). Secondary thickening commences normally as in dicotlydonous roots by the formation of a cambium and forms secondary xylem towards inside and



FIGS. 1–3. Fig. 1. T.S. root of *Pachygone ovata* (Diagrmmatic), × 10. Fig. 2. A parenchymatous cell showing starch grains and raphides, × 160. Fig. 3. Diarch and exarch primary xylem, × 160. (*Ca*–cambium; *Co*–cork; *Px*–Primary xylem; *P*–Phloem; *S*–sclerenchyma; *X*–xylem.)

secondary pholem towards outside which lies on the same radius. However, the larger strands of xylem that are so formed meet at the centre of the stele and merge with the primary xylem and give rise to a stellate appearance while the smaller xylem strands do not meet at the centre of the stele. The vascular strands that are formed are imbedded in the parenchymatous cells that are formed also from the cambium and the parenchymatous cells are elongated radially.

In thicker roots successive rings of cambium arise outside the normal core of vascular tissue and each cambial ring produces collateral strands of xylem and phloem imbedded in the parenchyma (Fig. 1), In some of the xylem vessels tyloses are formed and abundant starch grains accumulate in the cells of the parenchyma. The presence of crystals of calcium oxalate in some of the parenuchymatous cells is a common feature (Fig. 2). A ring of sclerenchyma encircles each ring of vascular tissue. In the peripheral part of the root, a phellogen arises and forms cork to the exterior and one or two layers of phelloderm to the interior.

The anomalous secondary thickening that is described above could also be observed in the roots of *Tiliacora acuminata,* Miers. and *Cissampelos periera,* Linn.

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October 5, 1978.

1. Metcalfe, C. R. and Chalk, L., *Anatomy of the Dicotyledons,* Vol. I. Oxford, Clarendon Press, 1950.

A FREAK IN THE ANATOMY OF SANDALWOOD (*SANTALUM ALBUM* LINN.)

DURING the course of examining the smuggled but seized sandal billets (*Santalum album* L.) and the residuary stumps remaining on the field in sandal forests, the author had the opportunity of cutting a large number of wood sections—transverse, radial and tangential—of several billets and stumps, preparing their microslides and examining them under microscope. During a re-examination of one of the slides prepared in 1959, (No. R-3-B) of the Shikaripur Police Station sandal case, a huge multi-seriate medullary ray was observed in the tangential section, *vide* Fig. 1. It is having 6 cells in width in the middle and 200 μ wide, the cells being alternately and irregularly arranged. In height there are approximately 35 cells, measuring 840 μ. According to Pearson and Brown[1], sandalwood rays are "1–2 seriate, heterogeneous, the largest 25–30 μ wide, and 12 plus cells and 200 plus μ high (max. 18 cells and 335 μ)", and so the medullary ray under report does not conform to this description. It does not either agree wi h the description recorded by Metcalfe and Chalk[2]. It is, therefore, a freak ray which is many times wider and higher than the normal rays around it. The walls between the ray cells are abnormally thick. A few of the ray cells are several times bigger than the normal ray cells. Amidst the normal rays, this freak looks like a huge giant.

FIG. 1

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1. Pearson, R. S. and Brown, H. P., *Commercial Timbers of India,* Vol. II. Government of India, Central Publication Branch, Calcutta. 1932.
2. Metcalfe C. R. and Chalk L., *Anatomy of the Dicotyledons,* Vol. II, Clarendon Press, Oxford, 1950.