This appears to be the first report of VAM fungi in banana, grown either as a continuous crop or as a component crop in high density multispecies cropping system.

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UROMYCES PISI IN INDIA

IDA BHARTI, M. M. PAYAK,
D. K. AGARWAL and A. K. SARBHOY
Division of Mycology and Plant Pathology,
Indian Agricultural Research Institute,
New Delhi 110 012, India.

THE occurrence of *Uromyces pisi* in India was first reported by Barclay[1] on *Cicer arietinum* L. and *Lathyrus sativus* L. A critical examination of Barclay's description has shown that the only rust conforming to true *U. pisi* is the one reported on *L. sativus* from Dumaraon, Bihar but that on *C. arietinum* has been considered as *U. ciceris-arietini*. Recently, *U. pisi* was again recorded[2] on *Medicago denticulata* Willd. (HCIO, 35233) from Hazratbal, Jammu and Kashmir, India.

Specimens of rusts affecting different species of *Medicago* deposited in HCIO have been studied including the one found on *M. denticulata* from Hazratbal, Jammu and Kashmir. A collection on *L. sativus* by S. P. Singh at Delhi (HCIO 28236) was also determined as *U. pisi*. An exsiccatum material on *U. pisi* on *L. latifolius* L. from Romania (Herb. Mycol. Romanicum Nr. 2833) has been examined for establishing the true identity of the Indian collections.

A complete description of *U. pisi* based on the Indian collection HCIO 28236 is provided here.

Uromyces pisi (Pers.) de Bary

Uredinia orbicular, subepidermal, hypophyllous, also caulicolus, erumpent, scattered, coalescent, pulverulent, Wood Brown in colour (Ridgway[3]), 0.5–2.0 mm in diameter; urediniospores subglobose to broadly ellipsoid, obovoid, Pinard yellow (Ridgway), 21–25(−30) × 18–24 μm, wall echinulate, uniformly thick, 1.5–2.5 μm with 3–5 scattered germ pores (figure 1A). Telia-like uredinia except that they are Bone brown in colour (Ridgway); teliospores single-celled, sub globose to ellipsoid, Chestnut brown (Ridgway), with a hyaline papilla at the apex up to 4 μm high and 8 μm broad, 21–28(−32) × 16–24 μm; wall verruculose, 1.5–2.5 μm thick; pedicels hyaline, non-persistent, up to 20 μm long (figure 1B).

II, III on living leaves and stems of *Lathyrus sativus* L. March, 1962, Delhi; S. P. Singh, HCIO, 28236.

The occurrence of *U. pisi* in India has been considered as somewhat doubtful. What Barclay[1] reported as *U. pisi* on *L. sativus* was questioned by Butler and Bisby[4] with a comment that perhaps Barclay was dealing with *U. fabae* rather than *U. pisi*. However, since we do not have access to Barclay's collection, a judgement has to be made on the basis of his description and figures. The characters given by Barclay indicate that he was dealing

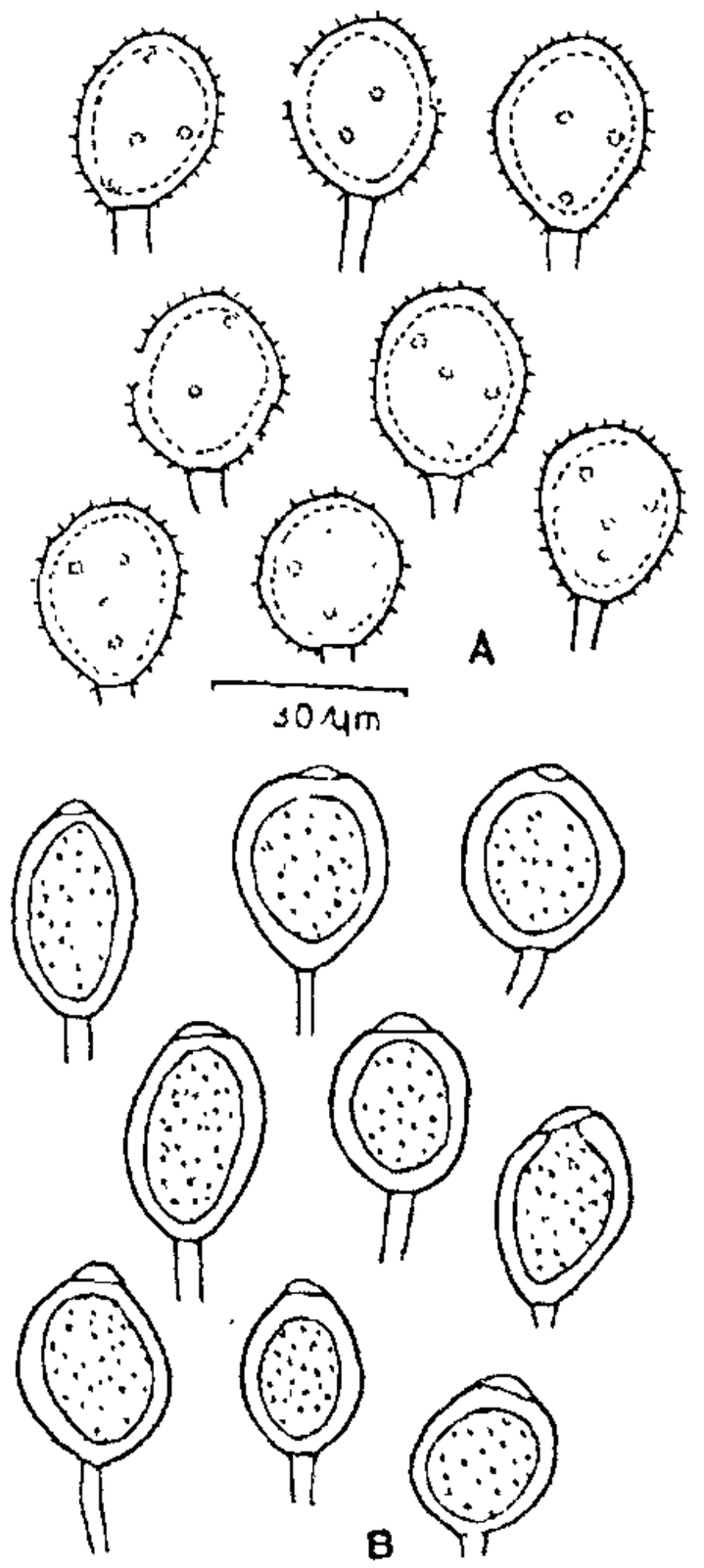

Figure 1A, B. A. Urediniospores, **B.** Teliospores.

with a rust conforming to *U. pisi* in its identity. The identification of a rust on *Medicago denticulata* as *U. pisi* by Bano *et al*[2] requires critical consideration. They also cited *U. striatus* as a synonym of *U. pisi* without offering any comment as to the basis for invalidating a well-recognized taxon like *U. striatus*. The latter has been exhaustively dealt with by Parmelee[5] which has *Euphorbia cyperissias* in Europe as its aecial host with *Medicago*, *Trifolium* and *Pisum* as hosts for the teliomorphic stage. So far as *U. pisi* is concerned, the hyaline papilla on the apex in teliospores with urediniospores having 4–6 scattered germ pores constitute its distinctive characters. In the Kashmir material, the urediniospores possess 3–5 germ pores which are equatorial and hence following Parmelee[5], the rust does not belong to *U. pisi*. In teliospore characters, it appears to be closer to *U. viciae-fabae* though the teliospores are smaller and pedicels non-persistent. Fortunately we came across a collection of a rust on *Lathyrus sativus* made by Singh in 1962 from Delhi. The rust was correctly determined as *U. pisi*. However, this has remained unpublished so far and hence a full description has been provided.

The exsiccatum material of *U. pisi* (Herb. Mycol. Romanicum Nr. 2833) on *Lathyrus latifolius* was examined and Singh's collection agreed in all important characters of uredinial and telial stages with this European material.

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PROPAGATION OF VESICULAR-ARBUSCULAR MYCORRHIZAL FUNGI IN MOONG (*VIGNA RADIATA* L.) THROUGH NUTRIENT FILM TECHNIQUE (NFT)

JOSE MATHEW and B. N. JOHARI
Department of Microbiology, G. B. Pant University of Agriculture and Technology, Pantnagar 263 145, India.

VESICULAR-ARBUSCULAR fungi (VAM) improve plant growth both in green house and field conditions[1,2]. Seedlings pre-infected with VAM are generally transplanted[3] for this purpose since they cannot be grown in artificial culture. Among the various approaches that have been applied to raise VAM inoculum, circulating nutrient solution system has attracted recent attention[2,4]. The mycorrhizal roots of bean plants produced by nutrient film technique (NFT) were capable of infecting maize and bean seedlings[2] besides their use as inoculum for red clover in field experiments[5].

In this report we describe an NFT system for multiplication of *Glomus caledonium*, *G. fasciculatum*, *Gigaspora margarita* and *G. calospora* on moong and its efficacy under soil against maize.

The NFT system was designed such that a continuous and constant flow of the nutrient solution could be maintained[6]. Enamel trays to which copper tubes had been attached were connected serially with rubber tubings. A plastic container was used as the reservoir for nutrient solution. The nutrient solution flowing from the last tray was collected in another container and recirculated to the first tray using a pump. The trays were of 30 cm long, 20 cm wide and 5 cm in height. Each tray was covered with thermocol in which serial holes were punched to support the seedlings of moong (figure 1).

Moong seeds (variety, Pant moong-2) were grown initially in pots to which sand inoculum of VAM fungi containing infected root pieces and spores was added; 15-day-old seedlings were transplanted to the system. The NFT system was maintained under laboratory conditions and plants were provided with artificial fluorescent light. A 1/10th concentration of original Hoagland's solution with micronutrients in normal concentration was used[6]. The pH of the nutrient solution was adjusted daily to 6. Four endophytes were used viz. *G. caledonium*, *G. fasciculatum*, *G. margarita* and *G. calospora*; they were maintained as soil culture on maize.

The rate of mycorrhizal spread in NFT grown moong varied considerably for the four endophytes (table 1). Infection level reached 68% after 40 days in the case of *G. caledonium*; for *G. fasciculatum* it was 50% after only 25 days. *G. margarita* was most effective as it attained a root infection level of 86% in 25 days. Extensive arbuscular development occurred in all four endophytes in the NFT system; numerous vesicles also developed at a later stage which were especially characteristic of *G. margarita* (figures 2–6). The normal nutrient level in Hoagland's solution permitted proliferation of moong roots but the mycorrhizal spread was limited; only 1/10th of the nutrient concentration was, therefore,