ANTAGONISM BETWEEN LEAF SURFACE MICROORGANISMS OF RICE

THE leaf surface of rice plants (*Oryza sativa* L.) is known to harbour a complex microflora containing fungi, bacteria, actinomycetes, virus particles and pollen[1-3]. While a few microorganisms are important pathogens of rice, the majority of fungi and bacteria found on the leaves are saprophytes. Inhibition of *Erysiphe polygoni* by saprophyte spores on clover leaf surface has been noted by Barnes[4]. Interactions between pathogens and nonpathogens have been studied on the leaves of bean[5], larch[6], *Croton* and *Petunia*[2]. Very little work is done on the interaction of microorganisms on rice leaves. Recently, Sarkar and Samaddar[7] showed that two surface isolates of *Streptomyces* inhibited spore germination of *Helminthosporium* (*Drechslera*) *oryzae*, a pathogen of rice. Since our knowledge of interactions of microorganisms on rice leaves is, at present, extremely fragmentary, a detailed study on the subject has been undertaken.

The following fungi isolated from rice leaves and subcultured in potato dextrose agar (PDA) slants were used for the study of interactions: *Drechslera oryzae* (Breda de Haan) Subram. and Jain, *Alternaria tenuis* Nees, *Curvularia lunata* (Wakker) Boedijn, *Cladosporium herbarum* Link ex Fries, *Penicillium* sp. and *Fusarium* sp. Two bacterial isolates, *Xanthomonas oryzae* (Uyeda and Ishiyama) Dowson and *Pseudomonas* sp. were also selected for the study. The interaction was studied *in vitro* as follows: The interacting organisms were inoculated side by side on PDA plates and the inhibition zones formed, if any, between the growing colonies were noted. Bacterial isolates were screened for inhibitory effects by streaking the bacterial suspension on the medium and inoculating two fungal isolates on each side of the streak. The effects of metabolites of some fungi were also studied using filter-sterilized culture-filtrates of the fungi.

The type of interactions between different microorganisms *in vitro* are described in Table I, and illustrated in Fig. 1 (A–G).

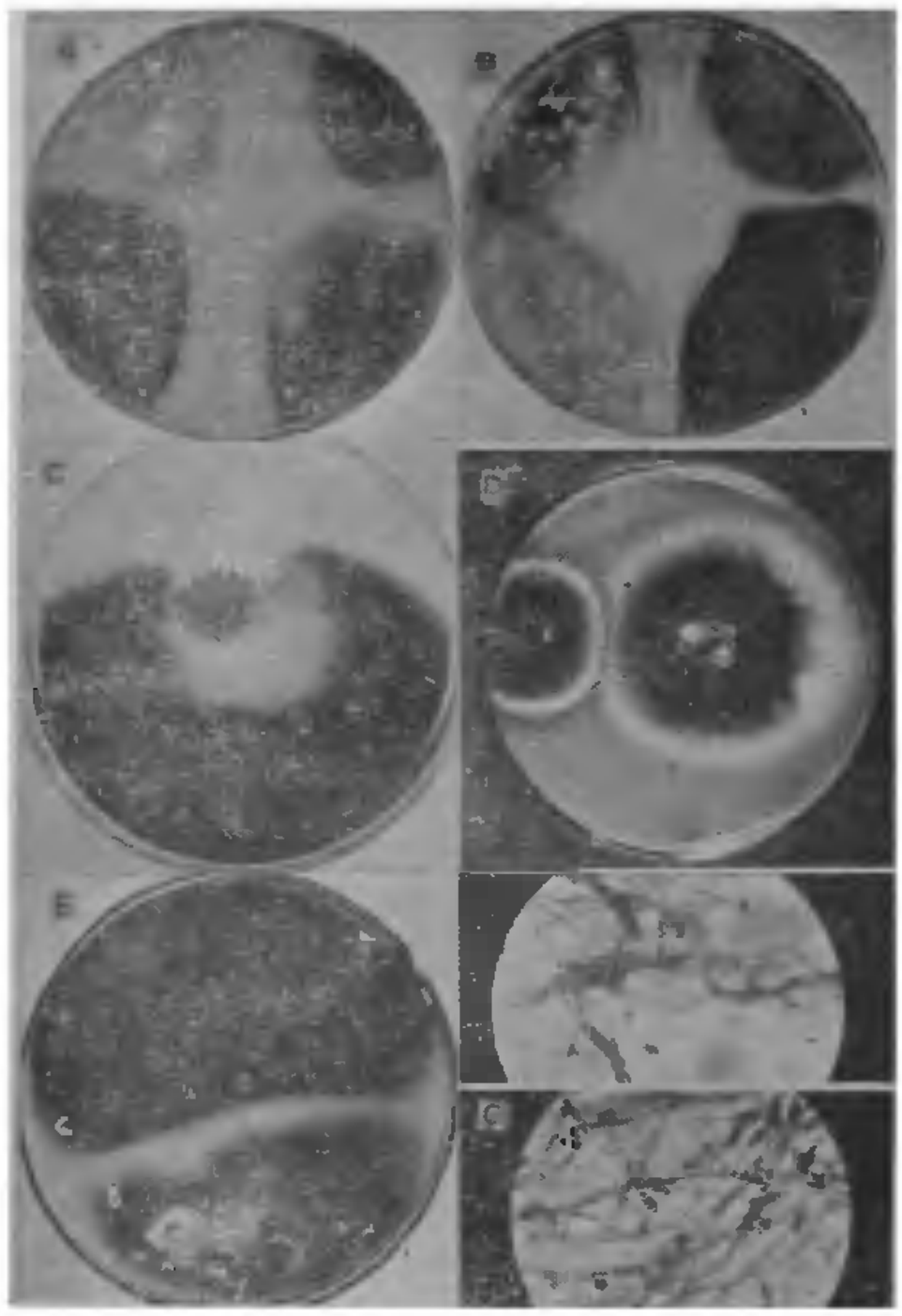

FIG. 1. Interaction between microorganisms *in vitro*: A. *Xanthomonas oryzae* (Central streak), Left: *Fusarium* sp. (above) and *Curvularia lunata* (below). Right: *Alternaria tenuis* (above) and *Drechslera oryzae* (below). B. *Pseudomonas* sp. (Central streak), Left: *Drechslera oryzae* (above) and *Fusarium* sp. (below). Right: *Alternaria tenuis* (above) and *Curvularia lunata* (below). C. *Penicillium* sp. (Centre) and *Curvularia lunata* (below). D. *Alternaria tenuis* (left) and *Drechslera oryzae* (right). E. *Curvularia lunata* (above) and *Drechslera oryzae* (below). F. Mycelial swellings of *Curvularia lunata*, induced by *D. oryzae* metabolite. G. Normal mycelia of *C. lunata*, with conidiophores and conidia.

TABLE I

Organism producing inhibiting substance	Organism inhibited	Effect on the inhibited organism
1. *Drechslera oryzae*	*Curvularia lunata*	Growth inhibition; mycelial swellings; reduction in conidial production.
2. *Alternaria tenuis*	*Drechslera oryzae*	Growth inhibition.
3. *Penicillium* sp.	*Curvularia lunata*	Growth inhibition; mycelial swellings.
4. *Xanthomonas oryzae*	*Drechslera oryzae*, *Curvularia lunata*, *Alternaria tenuis*, *Fusarium* sp.	Growth inhibition; mycelial swellings occurred only in *C. lunata*.
5. *Pseudomonas* sp.	*Drechslera oryzae*, *Curvularia lunata*, *Alternaria tenuis*, *Fusarium* sp.	Growth inhibition; swellings occurred in the mycelia of all the fungi except *Fusarium* sp.

Drechslera oryzae is an important pathogen of rice producing a disease known as "brown spot" or "sesame leaf spot". It is also known to directly infect the grains and cause great damage. The fungus is known to produce large amounts of biologically active metabolites such as auxins[8] and toxins[9,10]. There is a possibility that the toxins played a part in the suppression of growth of *C. lunata* and auxins caused mycelial swellings. That auxins can induce mycelial swellings is proved in the following experiment: PDA plates with different concentrations of indole acetic acid (IAA) [1, 10, 100 and 1,000 μg/ml] were inoculated with mycelial discs of *C. lunata* and incubated at 28°. All concentrations of IAA tested induced mycelial swellings in *C. lunata*. The swellings appeared in two days at 1,000 μg/ml, 3 days at 100 μg/ml and in 4 days at lower concentrations. Parallel studies on the effect of *D. oryzae* metabolite were made by incorporating in PDA the filter-sterilized culture filtrate of the fungus and inoculating it with *C. lunata*. The mycelium growing in this medium produced swellings after 4 days, morphologically similar to those induced by IAA.

It is obvious from the present studies that the pathogenic fungus *D. oryzae* is inhibited by saprophytes *A. tenuis* and *Pseudomonas* sp. The usefulness of the saprophytes in monitoring the phylloplane microflora to control leaf disease caused by *D. oryzae* is indicated from the present data, but *in vivo* studies are needed before specific recommendations can be made.

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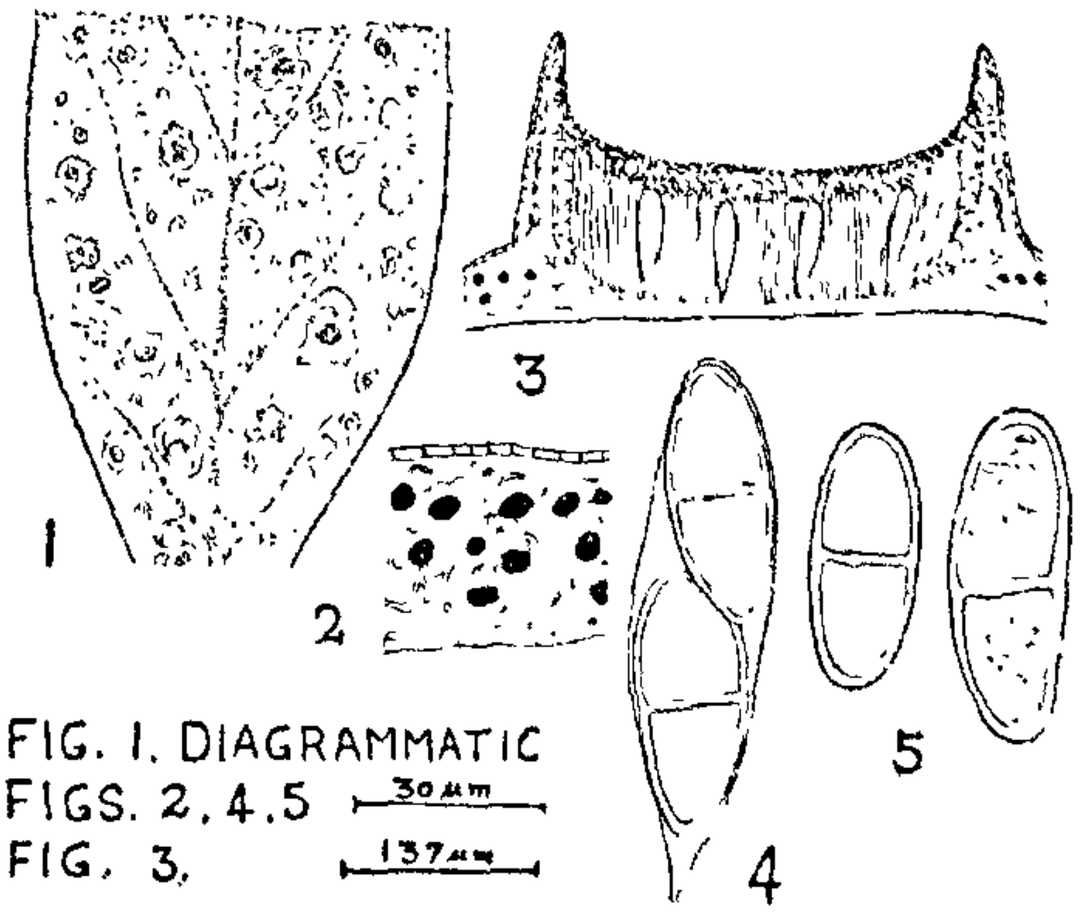
LICHEN GENUS *ASTEROTHYRIUM* MÜLL. ARG IN INDIA

During the course of taxonomic investigations on the lichens of Manipur, an interesting foliicolous lichen—*Asterothyrium pittieri* Mull. Arg. (Asterothyriaceae)—has been discovered as a new record for Indian lichen flora, and is therefore illustrated and described. The genus comprises eight species (Santesson[1]), which are distributed in tropical regions of Malaysia, America and Africa. The present finding of the taxon from Indian region is of great phytogeographical interest.

Asterothyrium pittieri Müll. Arg., *Bull. Soc. Bot. Belgique.*, 1891, **30**, 71; *Sant. Symb. Bot. Upsal.*, 1952, **12** (1), 326 (Figs. 1–5).

Thallus crustaceous, formed of small circular to irregular algiferous thallus patches, upto 1·5 mm in diam., whitish grey, smooth, 15–35 μm thick; cortex formed of single layered plectenchymatous cells, 4–9 × 2–4 μm; algal cells green, 9–12 × 6–9 μm.



Figs. 1–5. *Asterothyrium pittieri* Mull. Arg. Fig. 1. Habit. Fig. 2. V.s. through a portion of thallus showing details. Fig. 3. V.s. through apothecium. Fig. 4. 2-spored ascus. Fig. 5. Spores.

Apothecia dark brown, immersed but erumpent, circular, 0·2–0·25 mm in diam., eprumose, easily shed off and leave behind empty thalli with a hollow in the middle; margin thin, prominent, grey, formed