

Thrips-fungus interactions with special reference to their vector potential

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Abstract. Vector potential of mycophagous thrips as well as the nature of thrips-fungus interactions, in relation to the carrying of the fungal pathogens such as *Lasiodiplodia theobromae*, *Pestalotia* sp., *Aspergillus* sp., and *Penicillium* sp., are discussed.

Keywords. Vector potential; mycophagous thrips; thrips-fungus interactions; plant pathogenic fungi.

1. Introduction

The ability of mycophagous thrips in general to exploit a variety of niches and the adaptational trends involved therein, particularly regarding their feeding and breeding biology are of considerable significance in view of their associations with plant pathogenic fungi. Mycophagous thrips through such associations in habitats like litter, bark and dry twigs in forest ecosystems assumes greater importance in terms of incidental transmission of species of plant pathogenic fungi by 'external contamination' (sensu Carter 1973) during their feeding. The relationship between the insect and the fungus is apparently closer in view of their dependence on fungal food. Although extensive work on the taxonomy and distribution of mycophagous thrips is on record during the last three decades or more, (Ananthakrishnan 1973; Mound 1974a, b; Mound and Palmer 1983; Palmer and Mound 1978) information on the nature of their associations, in particular their vector relations appear very restricted. The large number of such species reported from various geographical regions in particular the tropics, occupy a wide variety of niches which offer protection and fungal food. The tendency to form aggregations is typical of some mycophagous species like *Tiarothrips subramanii*, *Bactrothrips idolomorphus*, and *Priesnerina kalandha* and such aggregations therefore provide an opportunity for multiplication of the species. Dispersal of such aggregates involving movement to fresh niches, necessarily facilitate fungal spore dissemination, being carried on various parts of the body. In view of the constant association of mycophagous thrips with plant pathogenic fungi (Ananthakrishnan and William James 1983; Ananthakrishnan *et al* 1983; Ananthakrishnan and Suresh 1983; Suresh and Ananthakrishnan 1983), the indirect role played by mycophagous species in dissemination cannot be overruled.

2. Do mycophagous thrips act as vectors of fungal plant pathogens?

Field-oriented studies of forest and some plantation ecosystems in some parts of southern India (ranging in altitude from sea level to 2000 m above mean sea level)

indicated two major component parts inhabited by mycophagous Thysanoptera *i.e.*, (i) drying and decaying leaf litter and (ii) loose bark, dead and decaying twigs and branches of trees. Because of the availability of both protection and food for the thrips species occupying these habitats, it is important to recognise the inoculum build up in certain habitats, by associated plant pathogenic fungi, by their effective saprophytic growth potential at the niches inhabited by thrips. This in turn promotes effective, though incidental, dispersal of the fungal propagules to fresh live host plants growing near such sites. Such site selection both for protection and food is exemplified by species like *Dinothrips sumatrensis* which was found inhabiting drying and decaying bark and twigs of different host plants *i.e.*, *Anacardium occidentale*, *Piper nigrum*, *Mangifera indica*, *Hevea brasiliensis*, *Mallotus alba* and *Lannea coromandelica*, harbouring heavy saprophytic growth (in turn, heavy inoculum build-up takes place through production of large numbers of pycnidia and conidia) of *Lasiodiplodia theobromae*. In species like *Tiarothrips subramanii*, the polyphagous food requirements are met within a single host species and hence their distribution seems restricted to drying leaves of *Borassus flabellifer* (where inoculum build up through fructifications of pathogenic fungi takes place in large quantities). Within the same host plant the site selection by different mycetophagous species differ in relation to the fungal flora present as in *Areca catechu* leaves (table 1). The specificity/diversity of site selection by diverse mycophagous thrips species in adjacent habitats (as in *Dinothrips sumatrensis* inhabiting different host sites near plantations of live host plants) is indicative of 'between habitat' diversity (*sensu* MacArthur 1965) which suggests that thrips are more sensitive to small differences in microclimate. Site selection within a habitat by diverse species was also exemplified by mycetophagous and sporophagous species (as in *Areca* leaves), inhabiting different sites of the same habitat at different times, which

Table 1. Distribution of mycophagous thrips and species of fungi in different niches of *Areca catechu* leaves.

| Niches inhabited | Thrips species | Associated fungal species |
|-----------------------------------|----------------------------------|--|
| Drying rachis of crown leaves | <i>Stictothrips fimbriata</i> | <i>Aspergillus flavus</i> |
| | <i>Ecacanthothrips tibialis</i> | <i>Aspergillus</i> sp. <i>Mucor</i> sp. <i>Macrophoma</i> sp. |
| Yellowing and drying crown leaves | <i>Stictothrips fimbriata</i> | <i>A. niger</i> |
| | <i>Elaphrothrips denticollis</i> | <i>A. flavus</i> |
| | <i>Mecynothrips simplex</i> | <i>Aspergillus</i> sp. <i>Penicillium</i> sp. <i>Pithomyces</i> sp. <i>Pestalotia</i> sp. |
| Drying rachis of fallen leaves | <i>Ecacanthothrips tibialis</i> | <i>A. flavus</i> |
| | <i>Stigmothrips limpidus</i> | <i>Aspergillus</i> sp. |
| Drying fallen leaves | <i>Hoplandrothrips flavipes</i> | <i>Mucor</i> sp. <i>Macrophoma</i> sp. |
| | <i>Elaphrothrips denticollis</i> | <i>A. niger</i> |
| | <i>Stigmothrips limpidus</i> | <i>A. flavus</i> |
| | <i>Mecynothrips simplex</i> | <i>Aspergillus</i> sp. <i>Penicillium</i> sp. <i>Pithomyces</i> sp. <i>Pestalotia</i> sp. |

again probably implies that the thrips within a habitat, are more sensitive to and thus recognize, changes (in particular the food requirements) that define microhabitats. Such 'within habitat changes' may induce dispersal of some solitary/aggregated species facilitating in turn the dissemination of the fungal propagules through incidental carrying. Such dispersive movements were evident in species like *Loyolaia indica*, *Priesneriana kabandha* and *Elaphrothrips denticollis* which tend to feed on spores of plant pathogenic fungal species such as *Fusarium oxysporum* (causing post emergence damping off of *Acacia dealbata*, and wilt of *Dalbergia sissoo* seedlings), *Penicillium* sp., (seed pathogen of forest trees), *Pestalotia* sp., (causing leaf spot disease of areca leaves and leaf spots of cashew leaves), *Phomopsis tectonae* (causing leaf spot disease in *Tectona grandis*), and *Cytospora* sp. (nursery pathogen of *Eucalyptus* sp.). Dispersive behaviour of such species can be of extreme importance in view of the plant pathogenic spore carrying ability of thrips and the presence of some of the above mentioned susceptible plantation and forest trees near such selected sites inhabited by mycophagous thrips species.

In so far as has been known to the authors, studies on the aspects relating to the feeding diversity of different sporophagous thrips species have indicated highly restricted feeding preferences coupled with the dispersive movements to diverse host plants (as in *Dinothrips sumatrensis*), restricted feeding preferences coupled with dispersive movements (as in *Elaphrothrips denticollis* and *Priesneriana kabandha*) and oligophagous feeding with restricted dispersive movements (as in *Tiarothrips subramanii*). Feeding restrictions along with dispersive movements to different susceptible host plants might facilitate easier dispersal of propagules of fed plant

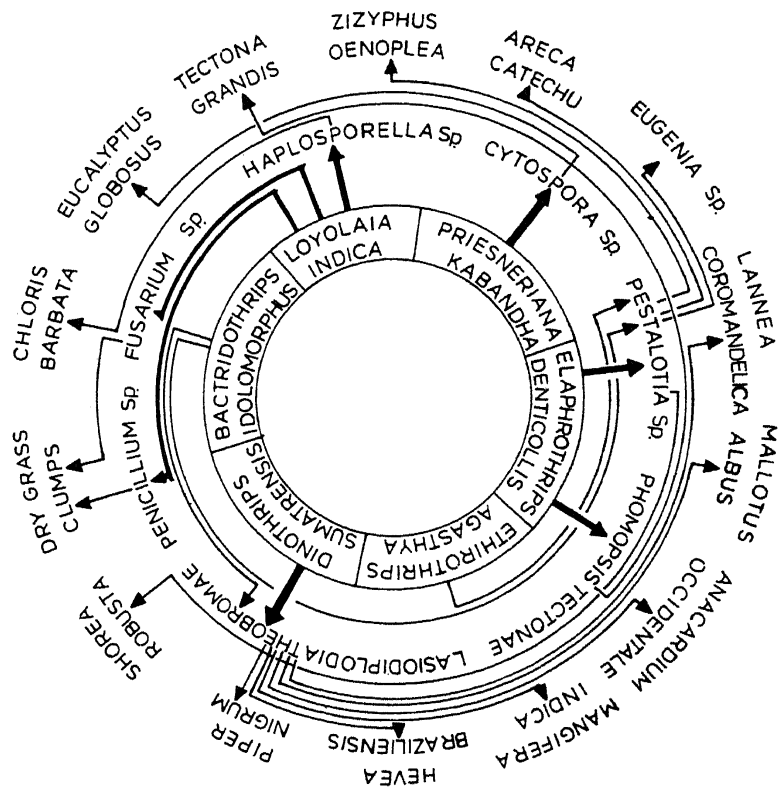


Figure 1. Diagrammatic representation of the sporophagous thrips associated with plant pathogenic fungi with their respective host plants.

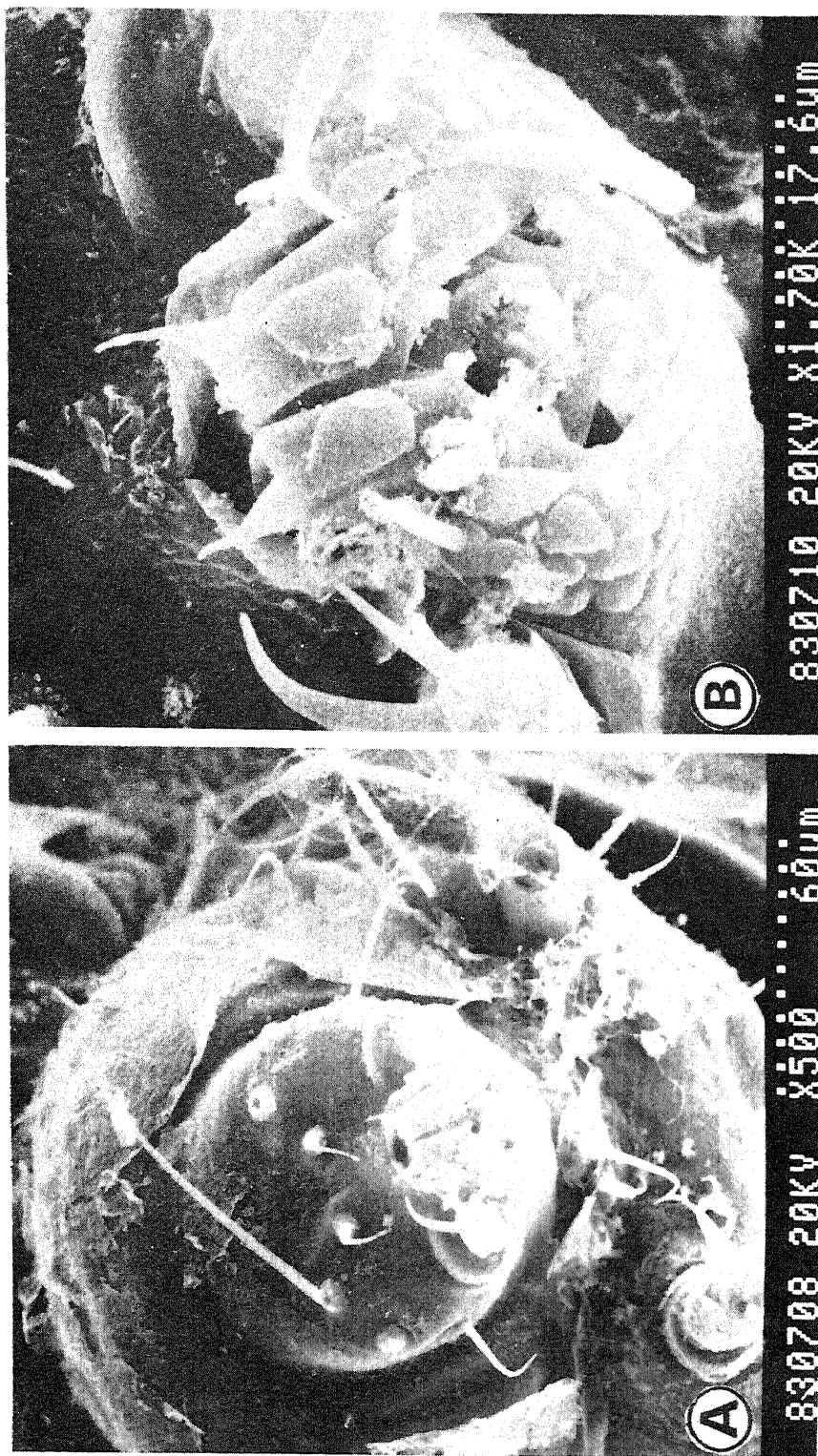


Figure 2. Scanning electron micrographs of the oral area surrounding the mouth of *Loyolaita indica* to show the sensory areas and oral pads. (A and B).

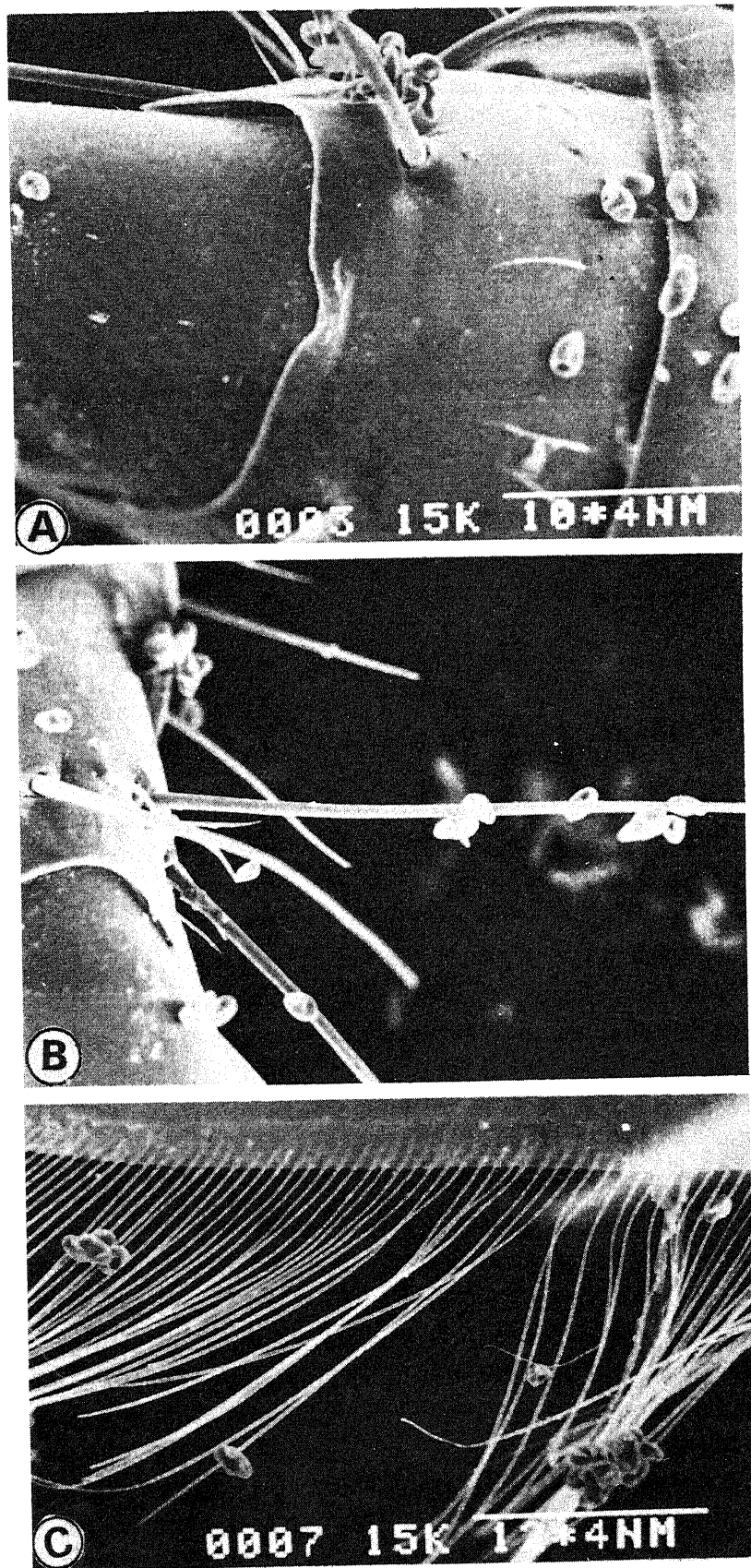


Figure 3.

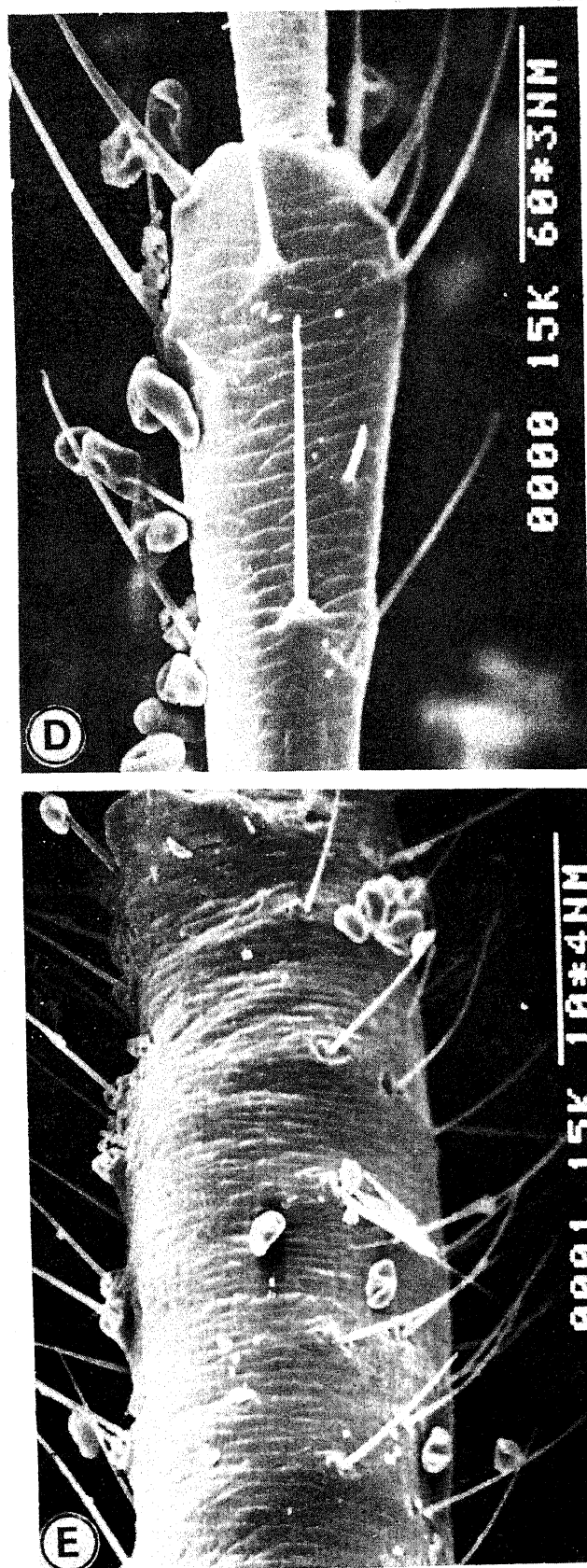


Figure 3. *Dinothrips sumatrensis* carrying spores of *Lasiodiplodia theobromae* on its A. IXth segment and base of the tube with spores attached B. body setae, C. wings, D. an antennal segment and E. portion of foretibia.

pathogenic fungi as well as other species available at the niches inhabited (for details of species of fungal pathogens refer figure 1). Hence recognition of their fungal food namely, the spores, by sporophagous Thysanoptera is of considerable importance in determining their vectorial status.

Scanning electron microscopic studies of mouthparts with special reference to the sensory areas of the maxillary and labial palps as well as around the mouth determines spore selectivity. A preliminary investigation revealed the presence of such structures and their distribution in *Loyolaia indica* (figure 2). Spores which constitute the principal inoculum of pathogenic fungi are present in extremely variable appearance being adapted to many different types of dissemination. SEM studies of spores of some of the principally occurring fungal species at the niches inhabited by mycophagous idolothripines indicated such diverse patterns, *i.e.*, with external ornamentations (*Aspergillus* sp.), with appendages (*Pestalotia* sp.), sticky types of spores (*Lasiodiplodia theobromae*) and with smooth surface (as in *Fusarium Polyporus* sp. and *Penicillium*) (figure 4). Spore carrying potential on the body surface by sporophagous idolothripines also depends on the number and distribution of the body setae (figure 3) and their body ornamentation if any (as in *Stictothrips fimbriata*). In *Dinothrips sumatrensis*, the spores of *Lasiodiplodia theobromae* were found sticking to the body setae, antennal

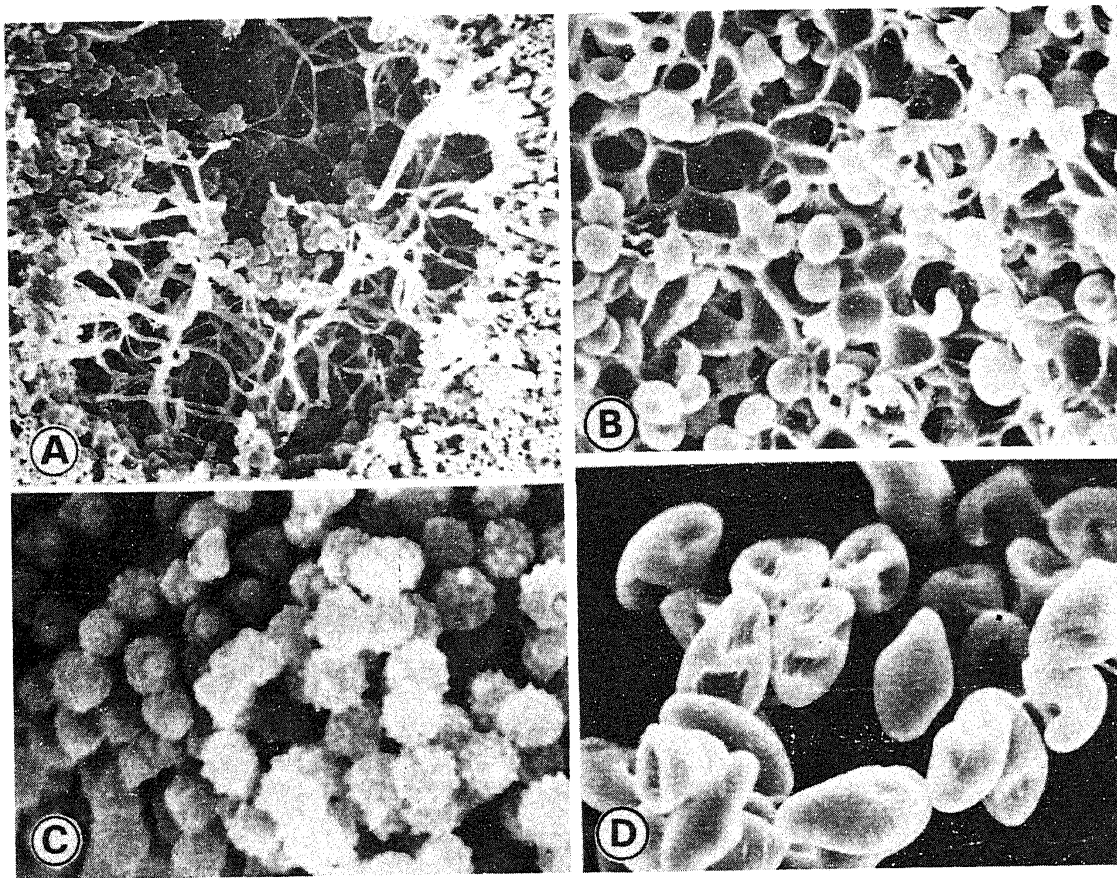


Figure 4. Spores of some plant pathogenic fungi associated with mycophagous thrips, A and B – TS and LS of the hymenial cavity of *Polyporus* sp. showing basidiospores borne on the basidia (fed by *Hoplothrips fungosus*) ($\times 750$ and $\times 1500$ respectively), C. spores of *Aspergillus niger* showing surface ornamentations ($\times 3000$), D. Spores of *Lasiodiplodia theobromae* ($\times 1000$).

setae, antennae, legs, wings, tube setae, and the tube itself, both individually as well as in clusters (figure 3). Observations also revealed the presence of only spores of *Lasiodiplodia theobromae* sticking to the body surface of this thrips. Analyses of litter-thrips-fungus associations revealed associations involving diverse groups of plant pathogenic fungi including Ascomycetes, Coelomycetes, Hyphomycetes, Basidiomycetes and in some cases Zygomycetes. A diagrammatic representation of the sporophagous thrips associated with plant pathogenic fungi, with their respective host plants is provided (figure 1) which is self-explanatory of the incidental mechanical vectorial status of some sporophagous Thysanoptera.

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