AN ASCOMYCETOUS PARASITE OF CEPHALEUROS

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Species of Cephaleuros are well known algal parasites on the leaves and tender shoots of many economic plants. Cephaleuros mycoidea Karst, commonly found distributed on various hosts is regarded as a very superficial parasite. On the other hand Cephaleuros parasiticus Karst. according to Petch (1923) and others, is a very serious parasite on account of the fact the algal filaments penetrate the epidermis and spread within the mesophyll tissue. The red rust disease of tea is caused by this species and the damage is particularly significant when the shoots are parasitised. The heavy infestation of the parasite results in the production of numerous necrotic spots causing severe defoliation of the shoots.

Both Cephaleuros parasiticus and C. mycoidea have been collected on a large number of hosts in Mysore and particularly the former causes fruit blemishes in Psidium Suajava. In most of the collections the algal patches appeared to have been killed by an ascomycetous fungus the entire patch being studded with the fructifications of the fungus (Figs. 1 and 2). In a healthy patch the thallus is discoid with large number of erect branching filaments. Laterally borne stalked sporangia are produced in profusion. The contents of the cells in the entire thallus are orange red on account of the presence of haematochrome which masks the green colour of the chloroplast. But after the parasitisation of the algal filaments by the fungi, the growth along the margin of the radiating filaments ceases, the entire patch becoming gradually crustose and white in colour. The erect branching trichomes and the stalked sporangia which impart a hairy appearance to the thallus can no longer be observed in the infected patch. This difference can be very clearly noticed in the case of a partially infected patch when we can notice that the reproductive structures of the alga are no longer produced after the invasion by the fungus. Microscopic examination of the algal filaments from such areas reveal that they are completely devoid of the characteristic orange red contents and are in fact killed by the fungus. In later stages, the development of the fructifications of the fungus can be observed throughout the crustose patch.
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The perithecia are black, minute and semiglobose appearing prominently on the surface as black specks. There is a small ostiolar pore at the apex, which in some cases appears to be situated on a slight elevation over the wall of the perithecium. The asci (Fig. 4) are numerous, clavate-cylindric, paraphysate, the paraphyses being free and persistent and not becoming mucilagenous at maturity. The ascus is 8-spored, the spores being long and spindle shaped, 4-septate and hyaline (Fig. 3). Small groups of spermogonia with hyaline spores have been noticed occasionnally.

Figs. 1-4.—Fig. 1. Algal patches of Cephaleuros on leaves of Dubanga sp. nat. size. Fig. 2. Enlarged view of the parasitised thallus showing perithecia. ×3 Fig. 3. Ascospores ×1800. Fig. 4. Section through the perithecia. ×200.

Study of literature indicates that the form under study is identical with the ascolichen genus Strigula E. Fr. and comes very near the species S. astridiza Vain. recorded from the Philippines. The genus Strigula included under the Verrucariaceae by Zahlbruckner (1926), is stated to be formed by the association of algae like Cephaleuros, Phyllactidium and Heterothallus with an ascomycetous fungus. The genus was founded as far back as 1821, and according to Zahlbruckner includes about 25 species.

The true nature of the relationship of the algal and fungal components within a lichen has been much debated without any final opinion. At least in those cases wherein there is some sort of symbiotic relationship usually termed as helotism, the alga and the fungi live in mutual association. But the work of Fry (1928) working on the subject of the penetration of the gonidia by the fungal constituent in Lecania candidans and other workers indicate the true parasitic nature of the fungus. The development of the haustoria within the gonidial cells by the fungus resulting in the gradual
depletion of the cell contents and the death of the algal cells confirms the parasitic nature of the fungal component. It is for this reason that workers like Bessey (1935) and Clements and Shear (1931) consider the lichens as fungi parasitic on the algal substrata during all or part of their life-cycle. They hold the view that the algal component might be neglected, and according to the nature of the fungus they are grouped in Ascomycetes or Basidiomycetes.

The species of *Strigula* under study appears to furnish a very suitable example for the point of view that the fungus is primarily a parasite. In this connection the observations by Butler (1918) on the same subject with reference to *Cephalouros* on tea plants might be quoted, “The death of the alga is sometimes hastened by an invasion of fungal hyphae which are found very frequently intermingled with the thallus. Some observers have considered that lichen formation is brought about by this invasion, the two organisms living in association, but it seems more probable that the fungus is wholly injurious, and from the first, an enemy of the alga”.

The observations made by the writer completely support Butler’s findings, the crustose lichen-like appearance is due to the cementing up of the dead algal filaments by the gelatinous hyphal masses.

In the case of lichens such as *Lecania candicans* the gonidial cells are no doubt parasitised by the fungus, the empty cells being discarded during exfoliation. On account of rapid multiplication of the algal cells and possibly by the weak parasitisation by the fungus, the algal component continues to be present within the lichen thallus. As against this, the filaments of the *Cephalouros* thallus are completely killed by the invasion of the fungus and it is very doubtful whether the alga could be regenerated at all from such an infected patch. *Strigula* thus presents an extreme type in which the algal component does not exist as a living partner but only serves as a source of nutrition for the parasitic fungus; thereby lending support to the views of Bessey and Clements and Shear.

In the description of the genus *Strigula*, Zahlbruckner (1926) refers to the fructification of the fungus as an apothecium characteristic of the Discolichens though in the illustration it is presented as a perithecium (probably taken along with the original figure). Clements and Shear (1931) include *Strigula* and all the members classed under Veruccariaceae of Zahlbruckner in the Sphaériales with perithecia and ostiole. While the presence of perithecia and ostiole are correctly described by Smith (1911), and Clements and Shear, the semiglobose nature of the perithecium simulating the upper portion of a perithecium and other characters indicate that it could more properly be classed under Hemisphaériales (Microthyriaceae of Clements and Shear).
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The methods of control of the red rust disease on tea as practised in India and the measure of success by the application of each method have been described in detail by Butler (1918). The possibility of the disease, which also occurs on the jungle trees, being blown over on to the tea plants cannot be overlooked. Improving the vigor of the tea bushes by cultural practices and the raising of new estates from plants showing a high degree of resistance to red rust, are indirect but very important methods of reducing the prevalence of the disease. The difficulty of wetting the algal patches when they are in fruiting has been pointed out by Butler, as rendering the Bordeaux mixture spraying quite ineffective. In concentrating all our efforts in checking the red rust disease of tea and other plants by such methods as pruning off diseased twigs, spraying with Bordeaux mixture, selection of resistant varieties, etc., the possibility of utilising the hyperparasite as a means of controlling the disease biologically, might deserve consideration.

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LITERATURE CITED