

# EXOBASIDIUM FROM SOUTH INDIA

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THE occurrence of the genus *Exobasidium* in India was observed as early as 1895 (McRae, 1910) when 'blister blight' of tea was investigated in upper Assam and the causal fungus was identified as *Exobasidium vexans* Masee. Since then six more species of this genus have been recorded in this country (Butler and Bisby, 1931) occurring on six genera of host plants. But all of them have been noticed only in North India especially in the Himalayan region.

In August, 1946 a severe epiphytotic of blister blight broke out on tea for the first time in South India. During the exceptionally wet and prolonged rainy weather experienced during that year the disease spread rapidly over most of the tea estates in Travancore, Anamalais, and the Nilgiris. Since the occurrence of this epiphytotic, interest in this genus was aroused and attempts were made to find out whether this fungus was prevalent in South India on any other host. In early stages tea planters were anxious to know how the disease appeared so suddenly and whether the parasite could have passed on to tea from some other wild host growing in the forests in the neighbourhood of tea estates. Numerous specimens of various plants showing hypertrophy or any sort of fungal growth were forwarded for identification. But so far no other host has been discovered for *Exobasidium vexans* in South India. However other species of *Exobasidium* have been collected during visits to some of these estates and these are described in this article. Three of these are new species and one is a new record for India.

## 1. *Exobasidium vexans* Masee.

Subba Rao, M. K., *Blister blight in South India*, 1946, Paper 4, United Planters Association of South India.

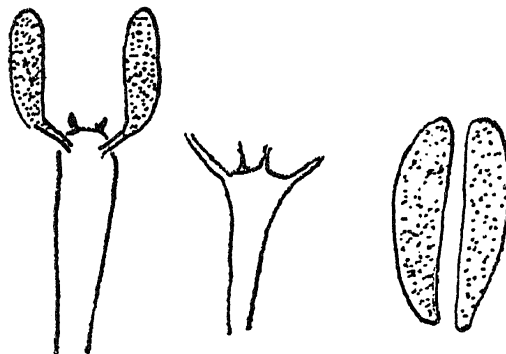
McRae, W., *Bull. Agri. Res. Inst. Pusa*, 1910, No. 18.

This parasite is now found in all the tea districts of South India. Its incidence is greatly influenced by the environmental and climatic conditions. Heavy incidence is common during the monsoon months with a decline during the months of January to May.

2. *Exobasidium vaccinii* (Fuck.) Wor.Saccardo, P. A., *Syll. Fung.*, 1888, 6, 664.Hotson, J. W., *Phytopath.*, 1927, 17, 207-16.Zeller, S. M., *Mycologia*, 1934, 26, 297.

Spots round or irregular, amphigenous, raised, light to deep pink in colour; hymenium hypophyllous, white, downy; basidia cylindric to clavate, emerging in groups between the epidermal cells,  $18-21 \times 8-10 \mu$ , normally with four sterigmata; basidiospores hyaline, 1-celled, oblong or slightly curved,  $8-15 \times 2-4 \mu$ .

On living leaves and twigs of *Vaccinium neilgherrense* W., Naduvattam, 21-5-47 T. S. Ramakrishnan and T. V. Subramanian; Coonoor, 13-10-47, T. S. Ramakrishnan; Chinnakallar (Anamalais) 5-2-1948, T. S. Ramakrishnan and K. Ramakrishnan.



TEXT-FIG. 1. *E. vaccinii*—Basidia and basidiospores ( $\times 500$ )

The diseased leaves can be readily distinguished by the bright pink colour on the upper surface and the white compact fungal growth on the lower. Old spots turn brown and the centre becomes dark and brittle with growth of saprophytic moulds. The young twigs are also infected and these dry up. Basidia are normally 4-spored but sometimes only two or three sterigmata may be present. Witches' brooms or gall formations are not seen.

A number of species of *Exobasidium* have been recorded on *Vaccinium* spp. Judging from the pathological symptoms and the size and characters of the basidia and basidiospores the fungus under study is identified as *E. vaccinii* (Fuck.) Wor. This is the first record of this species from India.

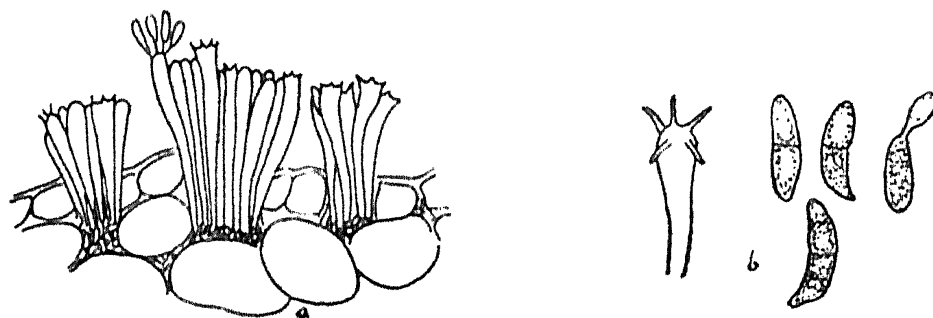
3. *Exobasidium butleri* Syd.Sydow H. et P. and Butler, E. J., *Ann. Myc.*, 1912, 10, 279.

Leaves reduced in size, pinkish yellow to bright pink; hymenium spread over the entire lower surface, white to very light pink; basidia club-shaped,

hyaline, usually with four sterigmata but sometimes 3-5 present; basidiospores hyaline, 2-celled, curved,  $16 \times 4 \mu$  ( $10-20 \times 3-5$ ); secondary spores formed by the germination of the basidiospores, smaller, 1-celled, oblong to cylindrical,  $6 \times 2 \mu$  ( $3-8 \times 1.5-3$ ).

On living leaves of *Rhododendron nilagiricum* Zenk. Ootacamund, 21-5-1947, T. S. Ramakrishnan and T. V. Subramanian.

The infection is apparently perennial and is confined to the young shoots at the apices of the branches. The diseased shoots are conspicuous by their pink colour and most of the leaves on the shoot exhibit the fungal growth on the lower surface. Later the leaves dry up and are shed. The basidiospores are 1-celled when attached to the basidium but later a distinct septum is formed in the middle and the spore is slightly constricted at the septum. Older spores become strongly vacuolated and often give an impression of being more than 2-celled. Numerous secondary spores formed by the germination of the basidiospores can be recognised. These are smaller than the basidiospores and always 1-celled. Sydow (1912) has described this fungus on *R. arboreum* from the Himalayas, and the fungus under study agrees with this. This is the first record of this fungus from South India.



TEXT-FIG. 2. *E. butleri*—(a) Section of leaf showing fascicles of basidia ( $\times 250$ )  
(b) Basidium and basidiospores—one germinating ( $\times 400$ )

4. *Exobasidium nilagiricum*. Ramakrishnan, T. S. and K. sp. nov.

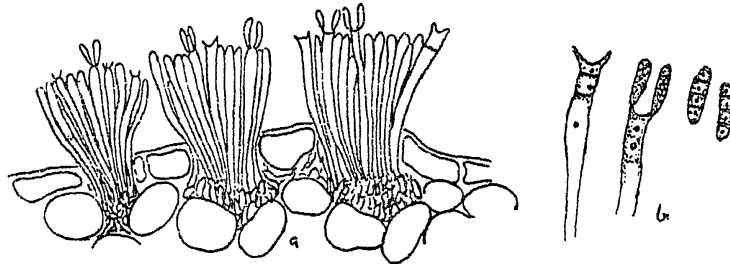
Spots amphigenous, 10-15 mm. diam., round or extensive by coalescence, raised; hymenium hypophyllous, compact, white; basidia long clavate, occasionally septate, hyaline,  $52 \times 6 \mu$  ( $32-80 \times 4-8$ ), sterigmata 2; basidiospore hyaline, 0-4 septate, cylindrical, straight or slightly curved,  $19 \times 4.5 \mu$  ( $12-24 \times 4-6$ ).

On living leaves of *Gordonia obtusa* Wall. Naduvattam (Nilgiris), 14-3-1946, (type) T. S. Ramakrishnan and K. Ramakrishnan; Coonoor, 25-2-48, K. Krishna Menon.

Maculae amphigenae, orbiculares, saepe confluentes, 10-15 mm. diam.; hymenio hypophyllo, albido, compacto; basidiis longis, clavatis, interdum

septatis, hyalinis, bisterigmatisis,  $52 \times 6 \mu$  ( $32-80 \times 4-8$ ); sporis hyalinis, 0-4 spetatis, cylindraceis, rectis vel curvatis,  $19 \times 4.5 \mu$  ( $12-24 \times 4-6$ ).

In vivis foliis et caulibus *Gordonia obtusa* Wall. Naduvattam (Nilgiris) 14-3-1946, T. S. Ramakrishnan et K. Ramakrishnan (typus) and Coonoor 25-2-1948, K. Krishna Menon.



TEXT-FIG. 3. *E. nilagiricum*—(a) Section of leaf with fascicles of basidia ( $\times 200$ )  
(b) Basidia and basidiospores ( $\times 300$ )

This fungus has been observed from different parts of the province, namely Naduvattam, Ootacamund, Coonoor and Kodaikanal. A herbarium specimen of *G. obtusa* collected by the late Sir A. Bourne from Kodaikanal in 1897 is now available in the Madras Herbarium, at the Agricultural College, Coimbatore. On one of the leaves a spot caused by this fungus is present and in sections of fragments of the spot the pathogen is clearly visible. Thus it would appear that the fungus under study has been in existence for a long time in the province though it is recognised only now.

The spots on young leaves are pink and slightly raised towards the upper surface with a corresponding depression on the lower surface. The latter is covered with white compact hymenium. The spots are usually circular but the shape changes when two or more spots coalesce or when these develop near the margin. Older spots are brown. Very often dark mouldy growths develop on both sides of the spots when they become old, obliterating the original fungus. The central portions of the spots may become torn and bits of leaf tissue may fall off. The hyphæ are intercellular and permeate the mesophyll of the leaf. The basidia develop in bundles which push aside the epidermal cells. Young twigs are also affected and these dry up presenting a scorched appearance.

Inoculation experiments carried out by Mr. K. Krishna Menon, Assistant Mycologist, Ootacamund, with this fungus on *Gordonia obtusa*, showed that positive infection took place in 14-16 days under humid conditions when spores from infected material in the early stages of infection were used. This fungus did not pass on to tea. Attempts to bring the fungus into culture on agar media failed.

An interesting feature of the fungus is the development of partition walls in the basidia. One or two septa are formed towards the apex of the basidium. Two sterigmata are developed and these bear one basidiospore each. Septation of the spores is evident only in late stages just before shedding. Conidia were not observed.

*Exobasidium monosporum* Saw. has been recorded on *Gordonia* sp. from Formosa (Diehl, 1933). The fungus under study produces two spores per basidium and is therefore different from the former in which only one spore is formed from each basidium. The formation of septa in the basidia and the development of a number of cells in the basidiospores coupled with the measurement of basidia and basidiospores differentiate this fungus from other species. Hence it is described as a new species and named *E. nilagiricum* taking into consideration its common occurrence in the Nilgiris.

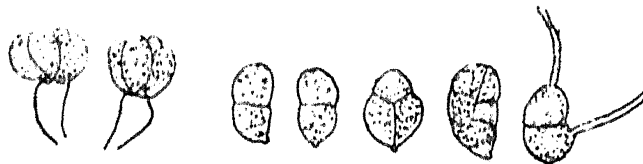
5. *Exobasidium celtidis* Ramakrishnan, T. S. and K. sp. nov.

Spots amphigenous, circular or irregular; hymenium hypophyllous, white; basidia clavate, hyaline, 4-spored; basidiospores oval or elliptical, hyaline, 1-many septate, sometimes muriform,  $12 \times 7 \mu$ , ( $9-15 \times 5-9$ ).

On living leaves of *Celtis tetrandra* Roxb., Ootacamund, 12-3-1946, T. S. Ramakrishnan and K. Ramakrishnan (type); Singampatti, 10-9-1947, Sladden.

Maculae amphigenae, orbiculares vel irregulares; hymenio hypophyllo, albido; basidiis clavatis, hyalinis, 4-sterigmatisis; sporis ovatis vel ellipticis, hyalinis, 1-pluri septatis, interdum muriformibus,  $12 \times 7 \mu$  ( $9-15 \times 5-9$ ).

In vivis foliis *Celtidis tetrandrae* Roxb., Ootacamund, 12-3-1946, T. S. Ramakrishnan et K. Ramakrishnan (typus); Singampatti 10-9-1947, Sladden.



TEXT-FIG. 4. *E. celtidis*—Basidia and basidiospores ( $\times 500$ )

The spots are prominent on the lower surface with a thick white growth of the hymenium. The basidia are stout and bear four short sterigmata. The basidiospores are two celled in the early stages with one transverse septum. There is a slight constriction at the septum. When the spores become older they become 4-5-celled with transverse and vertical septa. They germinate readily forming short germ tubes from one or more cells. The spores are rounded at the apex and have a small pointed projection at the base. The contents are granular.

The shape and structure of the spores differ from those of other described species. Further no species of this fungus has been described on this host. This fungus is unique in having large numbers of muriform basidiospores and hence it is described as a new species.

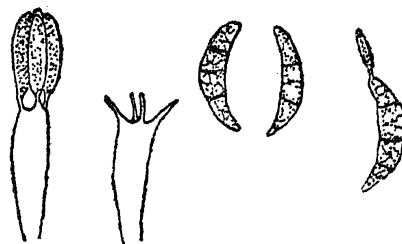
6. *Exobasidium triseptatum*. Ramakrishnan, T. S. and K. sp. nov.

Spots amphigenous, round, 1–3 cm. diam., upper surface convex and lower surface concave; hymenium mostly hypophyllous, compact, white; basidia clavate, hyaline, continuous, sterigmata 4; basidiospores hyaline, curved, 3-septate,  $20 \times 7 \mu$  ( $14\text{--}28 \times 3\text{--}8$ ).

On living leaves and twigs of *Vaccinium leschnaultii* W., Ootacamund (Nilgiris), 23–3–1948 (type) T. S. Ramakrishnan and G. Rangaswamy.

Maculæ amphigenæ, orbiculares, 1–3 cm. diam., superficie superiore convexum, inferiore concavum; hymenio sæpe hypophyllo, albido, compacto; basidiis clavatis, hyalinis, continuis, sterigmata 4; sporis hyalinis, curvatis, 3-septatis,  $20 \times 7 \mu$  ( $14\text{--}28 \times 3\text{--}8$ ).

In vivis foliis et rarius caulibus *Vaccinii leschnaultii* W., Ootacamund (Nilgiris) 23–3–1948 (typus) T. S. Ramakrishnan et G. Rangaswamy.



TEXT-FIG. 5. *E. triseptatum*—Basidia and basidiospores ( $\times 400$ )

Prominent raised (concavo-convex) spots are formed on the leaves. The upper surface is either pink or light-green in colour. The hymenium forms a white compact growth on the lower surface. In old spots basidia may be seen on the upper surface also. The basidia develop in closely packed groups and emerge in fascicles pushing aside the epidermal cells. These are broader at the apex with 3–4 prominent sterigmata. The four spores appear clumped at first when the sterigmata are straight but later the latter point outwards and the spores are separated. When fully mature the spores taper towards the base and are fusoid or falcate. Three distinct septa are visible.

Secondary spores which are hyaline and rod-shaped develop in large numbers from the old basidiospores. These originate from the ends or laterally near the septa. Each cell is capable of producing one or more

secondary spores. They measure  $6 \times 1.5 \mu$  ( $3-11 \times 1-2.5$ ). When scrapings from old spots are examined the secondary spores predominate.

The fungus under study differs in the possession of 4-spored basidia with 3-septate basidiospores from *E. vaccinii*, *E. vaccinii-uliginosi* Bond. and other species recorded on *Vaccinium* spp. Zeller (1934) has described *E. Burtii* on Azalea (*Rhododendron albiflorum*) from America which according to him is intermediate between *E. vaccinii* and *E. vaccinii-uliginosi* in the breadth of the spore but different in type of leaf-spot and in having 3-septate spores. In this species conidia are abundant and the basidiospores are allantoid or ellipsoid and have sometimes longitudinal septa. In the fungus under study conidia were not evident. The spores are different in shape with one end more tapering than the other. Vertical septa are not seen. *E. magnusii* Woron. (Saccardo, 1925) is another species with 1-3 septate basidiospores occurring on *Rhododendron flavus* in Caucasus. But the spores are cylindrical with curved apex. The fungus under study has curved spores which are 3-septate and occurs on *Vaccinium leschnaultii*. On account of these differences it is described as a new species and is named *E. triseptatum*.

This list does not pretend to include all the species of *Exobasidium* present in South India. This genus was not recorded from this region till the sudden outbreak of blister blight on tea in 1946. As a result of this it gained in importance and a preliminary search for other hosts of *E. vexans* has resulted in the discovery of the other species of *Exobasidium* from this area. The absence of previous records of this genus from South India is no indication of its recent introduction as is shown by the presence of *E. nilagiricum* in the herbarium material of *Gordonia* collected as early as 1897.

In conclusion the writers wish to acknowledge their sense of gratitude to the following gentlemen; Mr. K. Krishna Menon, Assistant Mycologist, Ootacamund, for kindly allowing us to use his results of inoculations with *E. nilagiricum* on *Gordonia*, Mr. Sladden of the Bombay-Burmah Trading Co., Singampetti, for the specimen of *Celtis tetrandra*, and the Government Lecturing and Systematic Botanist, Coimbatore, for kindly lending the herbarium specimen of *Gordonia obtusa*.

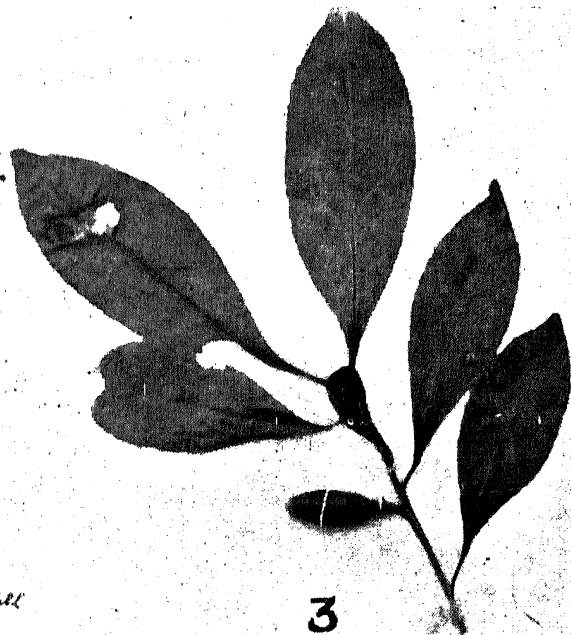
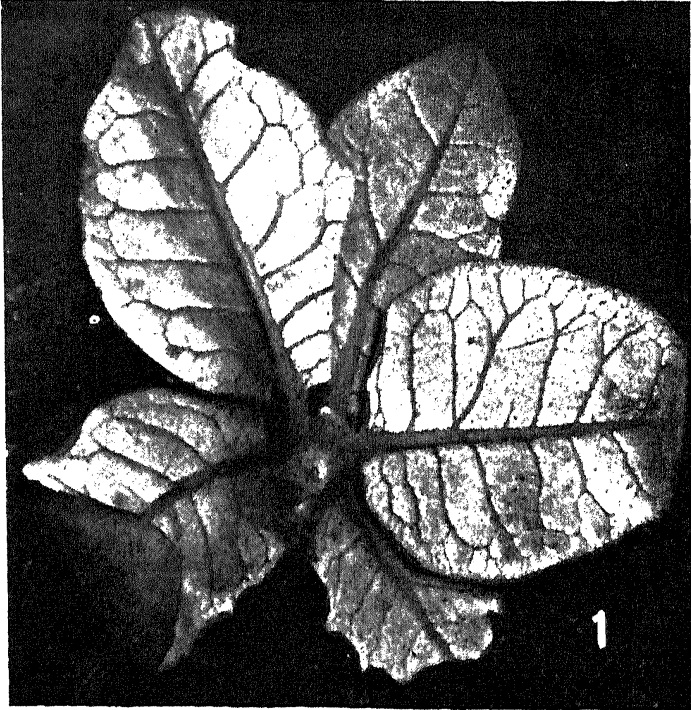
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## EXPLANATION OF PLATE

1. Leaves of *Rhododendron nilagiricum* showing white growth of *E. butleri*.
2. Leaves of *Celtis tetrandra* with hymenia of *E. celtidis*.
3. Photograph of the herbarium material of *Gordonia obtusa* showing infection by *E. nilagiricum* on one of the leaves.
4. Basidiospore of *E. triseptatum* showing formation of secondary spores ( $\times 1,000$ ).





*Gordonia obtusa*, Wall  
Madakamal - Pulnerp  
24 May 1897

FLORA DE MADRAS  
DUP 5 FOLIOLET  
6.11.1914

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