

A LEAF SPOT DISEASE OF ZINGIBER OFFICINALE CAUSED BY *PHYLLOSTICTA ZINGIBERI* N.SP.

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IN 1938 and succeeding years a leaf spot disease has been reported on ginger from Godavari and Malabar districts. The disease is common in the months of August, September and October. The spots vary in size. Some are small and roundish being a millimeter in length and half in breadth. Others are oval or elongated having a size of $9-10 \times 3-4$ mm. (Fig. 1). The spots are almost white in the centre and have a dark brown margin. Just surrounding the spot is a halo of yellowish colour. The central portion is thin and papery and more often torn up. In this portion are also seen a number of minute blackish pycnidia. The pycnidia are formed immersed in the tissues of the leaf under the epidermis. But later they become erumpent and can be seen distinctly on the surface as the mesophyll tissue collapses and the leaf becomes thin in the affected areas. The spots are usually isolated but they may also become confluent resulting in big patches. Sometimes a large number of spots develop on a leaf and in consequence the entire leaf turns brown and dries up.

Microscopic examination revealed that the pycnidia are those of *Phyllosticta*. Each pycnidium measures $78-150 \mu$ in diameter and has a definite ostiole. When mounted on slide the characteristic worm-like mass of spores coming out of the ostiole can be seen under the microscope. The spores are hyaline, oblong and measure on an average $4.3 \times 1.6 \mu$ the range being $3.7 - 7.4 \times 1.2-2.5 \mu$.

Other leaf spot diseases have been recorded on ginger. Sundararaman (1922) has described *Colletotrichum zingiberæ* as the cause of a leaf spot disease in Godavari district of the Madras presidency. Stevens and Atienza (1932) have reported from the Philippines a leaf spot of ginger caused by *Coniothyrium zingiberi*. In the description of the fungus they have stated that it may be mistaken for a *Phyllosticta*. The same has been observed in Hawaii (1937).

Examination of the specimens from Godavari and Malabar districts showed only *Phyllosticta* on the spots. The fungus was readily brought into

culture by transferring bits of affected portions of leaves to french bean agar plates after having previously sterilised them by immersion in mercuric chloride solution (1/1000 strength) for 2 minutes and washing in sterile water. In a week's time pure growths developed and began to form pycnidia on agar. From these further isolations were made.

The fungus grows readily on agar media. The following statement gives the growth characters of the fungus on the different media tried.

TABLE I
Growths on Different Media

Medium	Nature of growth
French bean agar	Thin, greyish white aerial growth, pycnidia in plenty on the medium or slightly immersed, zones faintly visible.
Quaker oats agar	Thick growth, aerial growth white, but submerged portion dark olive, pycnidia in plenty but hidden by the aerial mycelium.
Potato dextrose agar	Thick growth, aerial growth smoke grey, submerged growth dark-olive, zones visible, pycnidia numerous.
Richards' agar	Thick growth, aerial mycelium creamy white, submerged growth dark, margin irregular, pycnidia formed.
Sterilised ginger leaves ..	No aerial growth but entire leaves studded with numerous pycnidia.

On culture media the pycnidial formation starts on the 4th or 5th day. The pycnidia are light in colour in the beginning but with age the colour deepens and finally they turn light to deep brown. They are isolated or in groups. Each pycnidium has an ostiole and a very short neck. Sometimes a pycnidium shows two ostioles (Fig. 4) in all probability formed by the fusion of two pycnidia. The wall of the pycnidium is thin. The pycnidia formed in cultures are much bigger than those in nature. Some are spherical but in most cases they are only subglobose. They measure on an average 177.6μ (range $100-270 \mu$). The ratio of the two diameters is 1:1.1.

The hyphæ are hyaline or coloured. Sometimes several hyphæ unite to form strands. Coloured hyphæ are common on potato dextrose, quaker oats and Richards' agars. On french bean agar and sterilised ginger leaves coloured hyphæ are rare. The hyphæ very often form swollen cells of various shapes. Round glistening bodies are found inside these and some coloured hyphæ (Fig. 6).

The spores are hyaline and oblong with rounded ends. They are often biguttulate (Fig. 5). Even after keeping in culture for over three years no coloured spore was ever noticed in any of the cultures.

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The fungus grows well over a wide range of H-ion concentration. It was grown on Richards' agar of different pH values and the diameters of growths are represented below:

TABLE II
Growth on Media of Different pH Values

pH value of media	3.5	4.3	4.9	5.8	6.7
Diameter in mm. in 7 days ..	50	63.5	62	62.5	56

The best growth is formed between 4.3 and 5.8 with a falling off on both sides of this range.

Pathogenicity.—The parasitism of this fungus was tested by inoculations on the leaves of ginger plants. When bits of culture and spore suspensions from growths on agar media were used, successful infections were obtained only when the leaves were previously wounded. The controls and inoculations made on unwounded surfaces remained healthy without developing any pathological symptoms. But inoculations on wounded leaves produced small water-soaked spots on the third day. Later there was an increase in size of the spots. The central portions of these spots became yellowish and thin and still later dried into white membranous patches showing tearing of the tissues (Fig. 2). Pycnidia developed in the central portions in 8 days.

Wound infections were successful on the leaves of turmeric (*Curcuma longa*). Spots with white thin membranous centres developed and in these pycnidia were formed.

Inoculations were made on ginger leaves using cultures grown on sterilised ginger leaves. Two series of experiments were conducted, one within 6 months of the isolation of the fungus and another after two years. In the earlier inoculation experiments successful infection was obtained on unwounded ginger leaves but it took a longer time for the spots to develop. On wounded leaves evidences of infection were noticed in 60 hours but on unwounded leaves these were visible only after 6 days. In the second series of experiments an isolate which had been for two years in culture was grown on sterilised ginger leaves and spore suspensions from this were used for inoculation purposes. But no successful infection was obtained when the leaf surface was free from wounds. The parasitism of the old culture was not improved by one passage through sterilised portions of the host tissue. In nature injuries caused by insects might help in easy infection of leaves.

The symptoms of the disease agree with those described by Stevens and Atienza (1932). But the fungus under study is undoubtedly a *Phyllosticta* whereas the fungus responsible for the disease in the Philippines is described as a *Coniothyrium* though the authors state that it may be mistaken for *Phyllosticta*. The local isolate did not show any coloured spores though it has been under observation for over three years. Stevens and Atienza give the range of spore size as $3.5-4 \times 7-10 \mu$ but the average is not given. The average of 200 measurements of the spores of the local isolate is $1.6 \times 4.3 \mu$ the range being $1.2-2.5 \times 3.7-7.4 \mu$. This is decidedly much less than that recorded for the Philippine organism. For these reasons and since no *Phyllosticta* has been recorded on ginger till now the local organism is named *Phyllosticta zingiberi*.

The diseased plants were obtained from the same village where Sundaraman (1922) had first noticed leaf spot caused by *Colletotrichum zingiberæ*. But this fungus was not noticed on any of the specimens.

Control.—At present this is not a very serious disease of ginger. But it has been observed to be common in Godavari and Malabar districts and in some years causes a reduction in yield of rhizomes due to the destruction of large areas of chlorophyllous tissue. Preventive measures have been carried out against this disease with success in Godavari district. The plants are sprayed with 1% Bordeaux mixture before the outbreak of the disease and once again if necessary and these operations are reported to have given good protection against infection.

Phyllosticta zingiberi.—Spots oval or elongated, centre whitish, pycnidia on both sides of the spot, subglobose, dark brown in colour, ostiolate, pycnidia from infected plants $78-150 \mu$ in diameter; spores hyaline one-celled, oblong, $4.3 \times 1.6 \mu$, ($3.7-7.4 \times 1.2-2.5$) biguttulate. On culture media pycnidia generally larger.

Habitat.—In spots on the leaves of *Zingiber officinale*.

Phyllosticta zingiberi.—Maculæ ovales vel elongatæ, centro subalbidæ; pycnidiis in utraque superficie maculæ, subglobosis, colore fuscis, ostiolatis; pycnidiis plantarum infectarum diametro $78-150 \mu$; (pycnidiis autem mediæ culturæ generatim latioribus); sporis hyalinis, unicellularibus, oblongis $4.3 \times 1.6 \mu$ ($3.7-7.4 \times 1.2-2.5$) biguttulatis.

Habitat.—Maculæ foliorum *Zingiberi officinalis*.

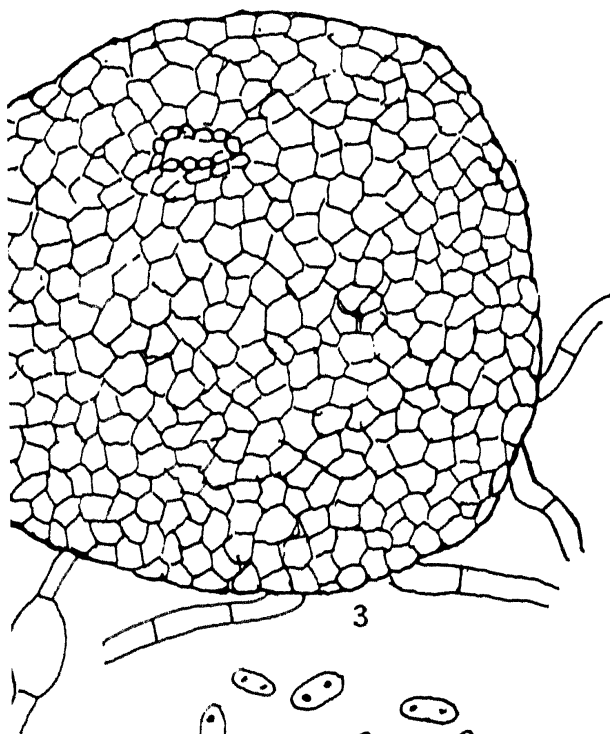
The type specimen is deposited in the herbarium of the Government Mycologist, Agricultural Research Institute, Coimbatore, S. India.



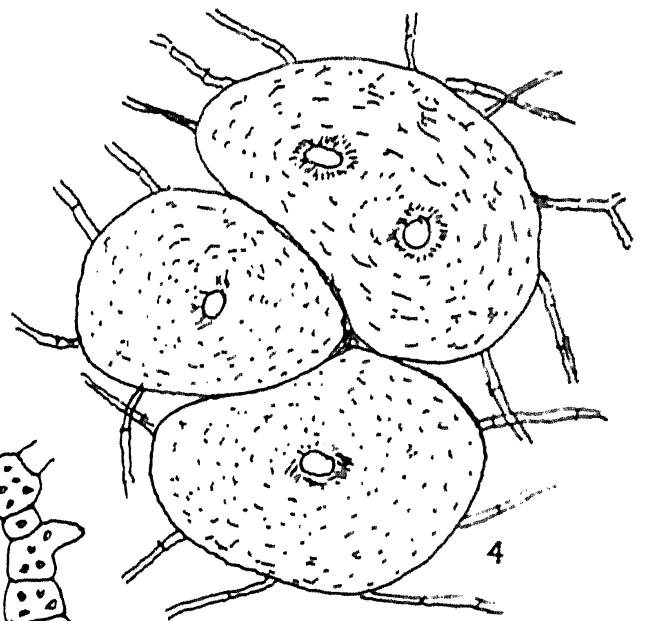
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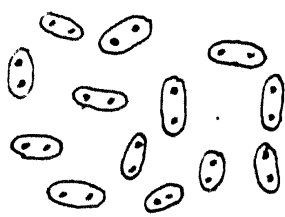
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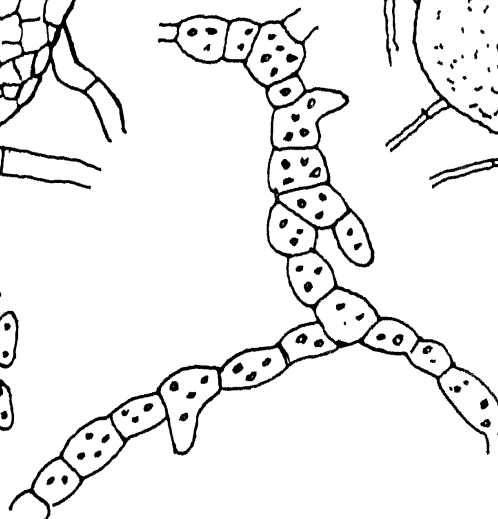
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Phyllosticta zingiberi n.sp.

Diseased leaves from nature.
 Spots formed on inoculated leaves.
 A pycnidium from culture. $\times 200$.

FIG. 4. Group of pycnidia (diagrammatic).
 FIG. 5. Spores. $\times 600$.
 FIG. 6. Irregularly swollen hyphae from culture. $\times 600$.

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Summary

A leaf spot disease caused by *Phyllosticta zingiberi* is common in Godavari and Malabar districts. Spots with whitish centres develop on the leaves and in these pycnidia of the fungus are formed. Wound inoculations were successful on ginger and turmeric. Soon after isolation, cultures on ginger leaves are able to infect unwounded ginger leaves.

This fungus does not agree with the description of *Coniothyrium zingiberi*. The spores are smaller and never coloured. Hence it is given the name of *Phyllosticta zingiberi*.

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