PATHOLOGICAL STUDIES OF *PESTALOTIA MANGIFERÆ*

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Introduction

Pestalotia has been observed on various parts of trees and has also been associated with storage rots of fruits.

It has been reported from many parts of the world. Averna Sacca (1921) reported it from the state of Sao Paulo. Manns and Adams (1925) from U.S.A. Wardlaw named *Pestalotia leprogena* as the casual organism of leaf spots of bananas in Trinidad. Shen (1932) and later Yu (1940) found that *P. congensis* caused brown spots on the leaves of 'loquat' in China. Mundkar and Keshwala (1942) observed a species of *Pestalotia* on citrus leaves in India. Kidd and Beaumont (1924) reported *P. hartigi* on stored apples in England. Tandon, Singh and Grewal (1952) studied leaf spots of 'litchi' while Tandon and Tandon (1948) carried out some investigations on diseases of apples and guavas caused by *P. malorum* and *P. psidii*, respectively.

Besides the above mentioned fruits, *Pestalotia* has been observed on a number of hosts of great economic importance. They include cocoanuts, tea, coffee, cocoa, pepper, camphor, cloves, wheat, barley, eucalyptus, rubber, cedar, cycas, etc.

Although *Pestalotia mangiferæ* was reported to cause a disease of *Mangiferæ indica* in the Dominica Republic (Ciferri and Gonzalez, 1926) as well as in Ceylon (Park, 1932), the pathogenicity was not established by any of them and even the symptoms were not fully described. Tandon observed it at Allahabad and also collected it from Raj Bhawan at Madras where it was causing severe damage to a number of young mango plants.

Mango is an important fruit of India and is found growing all over the country. *Pestalotia* infection does not kill the plant entirely but the capacity of the tree to synthesize its organic food material is undoubtedly reduced. No detailed account of the total amount of loss incurred has been estimated.

Guba (1929), however, states that " very little, if any, importance is to be attached to the published reports of the parasitism of species of *Pestalotia* on plants, since, as a rule, they are found on organs that have perished from other causes, and are usually associated with other parasites and saprophytes". In his opinion the interest presented is mostly taxonomic. This view, perhaps, has greatly contributed towards the neglect of pathological studies of this genus. The investigations of Tandon and Tandon (*l.c.*) as well as of Tandon, Singh and Grewal (*l.c.*), however, conclusively establish the pathogenicity of some of the species of *Pestalotia*.

Practically no work has been done on *P. mangiferæ*. It was, therefore, decided to undertake a detailed investigation of this organism. The results of the pathological studies only have been included in this paper.

MATERIAL AND METHODS

Artificial inoculations of *P. mangiferæ* were tried on various parts of trees at different stages of growth and development. Both the injured and uninjured portions were used for this purpose. Controls were maintained under identical conditions.

The areas on which inoculations were made were first washed thoroughly with sterile distilled water and they were then wiped with 90% alcohol so as to disinfect the inoculatory surface and to remove all sources of foreign material.

The inoculations on the leaves and stem were made by the following methods:—

1. By spraying with spore suspensions.
2. By spraying with germinating spore suspensions.
3. By mass inoculation.

Granger and Horne's method (1924) with slight modification was used for inoculating the fruits. Healthy fruits were washed thoroughly with sterile distilled water and rinsed with 90% alcohol. A sterile cork borer 0·3 cm. in diameter was then thrust into the fruit up to a depth of 0·5 cm. By this method a plug of mango flesh was removed. The inoculum was then quickly placed in the resulting cavity of the fruit and the plug was replaced by gently pushing it back with the help of a thin sterile glass rod passing through the cork borer. The whole area was again sterilized by rubbing it gently with a cotton pad soaked in 90% alcohol. The plug was then sealed with a mixture of bees-wax and paraffin. The fruits were stored in glass chambers for observation. Ridgeway's colour standards and colour

nomenclature (1912) was used for determining the colours of the infected leaves and fruits.

OBSERVATIONS

A. Symptoms on leaves.—*P. mangiferæ* develops light brown spots on the lamina of mango leaves. These spots may develop from the margins or from the tips (*vide* Plate XXIV, Fig. 1 A, B), but in some cases these spots are distributed irregularly on the leaves (*vide* Plate XXIV, Fig. 2). The infected portion finally changes to light olive gray in colour. At this stage black spots of pseudopycnidia may become visible in the infected region. They are more distinct on the upper surface of the leaf. It has been observed that when the disease spreads from the margin it never extends beyond the midrib of the leaf, but if the infection starts from the tip it advances regularly on either side of the midrib. Sometimes the infected and healthy portions are clearly demarcated by a dark brown band (*vide* Plate XXIV, Fig. 1 C and Fig. 2). Finally after three or four months the infected portion gets detached from the leaf (*vide* Plate XXIV, Fig. 1 D). The disease is more marked during winter.

Symptoms on fruits.—It causes a rot of the fruits. The colour of the infected part changes to snuff brown and then to olivaceous black (3). As the age advances the colour of the central portion of the fruit becomes darker, *i.e.*, blackish slate while the peripheral portion remains lighter in colour (*vide* Plate, XXIV, Fig. 3). In advanced stages the rotten area shrinks in the central region.

B. Artificial inoculations.—The organism was inoculated by the different methods on young as well as old leaves of *Mangiferæ indica*. The results are summarized in Table I.

Table I clearly shows that the disease appeared whenever any injured leaf was inoculated. Inoculation of the lower surface of older uninjured leaves showed symptoms of disease. The older leaves were more easily as well as more severely infected than the younger ones. The infection was quickest and slightly more pronounced when germinating spores were used for inoculation. These results clearly indicate that *P. mangiferæ* could act as a parasite.

The stems of different ages were also inoculated by the above methods and it was observed that only young injured parts of the stem were infected by the mass inoculation method.

TABLE I

Showing the Percentage of Infection of Old and Young Leaves of Mango Inoculated by Different Methods

Type of inoculum	Condition of leaf	Surface of leaf	Percentage of infection	
			Old leaves	Young leaves
			%	%
Mass inoculation ..	Injured	Upper	95	65
,, ..	Uninjured	Upper	0	0
,, ..	Injured	Lower	80	70
,, ..	Uninjured	Lower	15	0
Spore suspension ..	Injured	Upper	85	65
,, ..	Uninjured	Upper	0	0
,, ..	Injured	Lower	80	60
,, ..	Uninjured	Lower	0	0
Germinating spore suspension	Injured	Upper	100	75
,, ..	Uninjured	Upper	0	0
,, ..	Injured	Lower	90	80
,, ..	Uninjured	Lower	10	0

The following varieties of mango were used for the study of fruit rots:—

'Dasheri', 'Langra', 'Safeda' (*vide* Plate XXIV, Fig. 3), 'Fazli', 'Samarbahist' and 'Krishnabhog'. It was observed that *P. mangiferæ* was able to cause a rot of all the fruits of the above mentioned varieties. The disease also developed when healthy fruits were placed in contact with infected ones. There was, however, no infection of uninjured healthy fruits when spore suspensions were sprayed.

Isolations from the infected fruits and leaves invariably gave *Pestalotia mangiferæ*.

The role of temperature in the development of diseases has been studied for many fruits. The effect of different temperatures (8° C., 24° C., 30° C.

and 40° C.) on the fruit rot caused by *P. mangiferæ* was studied. It was observed that the fruits which were placed at 8° C. were not infected at all, while the damage was most severe at 24° C and 30° C. The rotten area was slightly less at 40° C. but the fruits had shrivelled up and were, therefore, not suitable for marketing.

C. Cross inoculations.—The organism was also inoculated on the leaves of *Psidium gujava, Mimusops hexandra, Butea frondosa, Eucalyptus* sp. and *Citrus* sp., but it could not infect any of them.

D. Control measures.—The laboratory evaluation of certain fungicides indicated that zinc sulphate prevented the growth of the organism. This was, therefore, used for dusting the leaves and the fruits. The results are summarized in Table II.

TABLE II

Showing the Effect of Dusting $ZnSO_4$ on Leaves and Fruits at Different Stages

Time of inoculation	Leaves	Fruits
Just after dusting	—	+
24 hours after dusting ..	—	+
48 hours after dusting ..	—	+
96 hours after dusting ..	—	+
I week after dusting	—	+
Just before dusting	—	+
24 hours before dusting ..	—	+
48 hours before dusting ..	—	+
96 hours before dusting ..	—	+
I week before dusting ..	+	+

(+) Indicates infection, (—) indicates absence of infection

It is evident from the above table that dusting with zinc sulphate controlled the disease on leaves but failed to control rot on fruits.

DISCUSSION

The results clearly indicate that *P. mangiferæ* is parasitic. Mundkar and Keshwala (*l.c.*), Tandon, Singh and Grewal (*l.c.*), Tandon and Tandon (*l.c.*) also observed similar pathogenic nature of various species of *Pestalotia*, investigated by them. These results, therefore, indicate that Guba's idea about completely saprophytic nature of *Pestalotia* is not correct. There is no doubt that *P. mangiferæ* is a weak parasite and can infect injured leaves, young stems or fruits and older uninjured leaves from the lower surface. In fact even healthy fruits may develop a rot when they are in contact with infected ones. Tandon and Tandon (*l.c.*) also observed that *P. malorum* and *P. psidii* could also cause a rot of apples and guavas under similar conditions. This appears to be due to a secretion of certain enzymes which help in the spread of the disease. Those enzymes are not sufficiently developed when spores are sprayed on healthy fruits. It appears that they develop after the fungus attains a certain amount of growth.

The lower temperatures are known to prevent fruit rots caused by various fungi. It is, therefore, not surprising that *P. mangiferæ* also fails to produce any rot below 8° C.

SUMMARY

Pestalotia mangiferæ has been observed on leaves of *Mangiferæ indica* at Allahabad and Madras. The pathogenicity of this organism has been established on leaves, stem and fruits of mango and symptoms have been described. Cross-inoculations on *Psidium gujava*, *Mimusops hexandra*, *Butea frondosa*, *Eucalyptus* sp. and *Citrus* sp. were unsuccessful. Storage of fruits at temperatures below 8° C. prevented fruit rot. Dusting the leaves with zinc sulphate controlled the disease but similar dustings on fruits failed to control the rot.

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REFERENCES

1. Averna Sacca .. *Bol. de. Agri. Sao Paulo*, Ser. 22, 1921, 1 and 2, 6–15.
2. Ciferri and Gonzalez, F. R. .. *Bol. R. Soc. Hispanalo. Hist. Nat.*, 1926, **26** (4), 248–58.
3. Guba, E. F. .. *Phyto*, 1929, **24**, 191–232.
4. Granger, K. and Horne, A. S. .. *Ann. Bot.*, 1924, **38**, 212–15.
5. Kidd, M. M. and Beaumont, A. .. *Trans. Brit. Mycol. Soc.*, 1924, 98–118.
6. Manns, T. F. and J. F. Adams .. *Ann. Rept. Delaware Agric. Expt. Sta.*, 1925, 24–34.

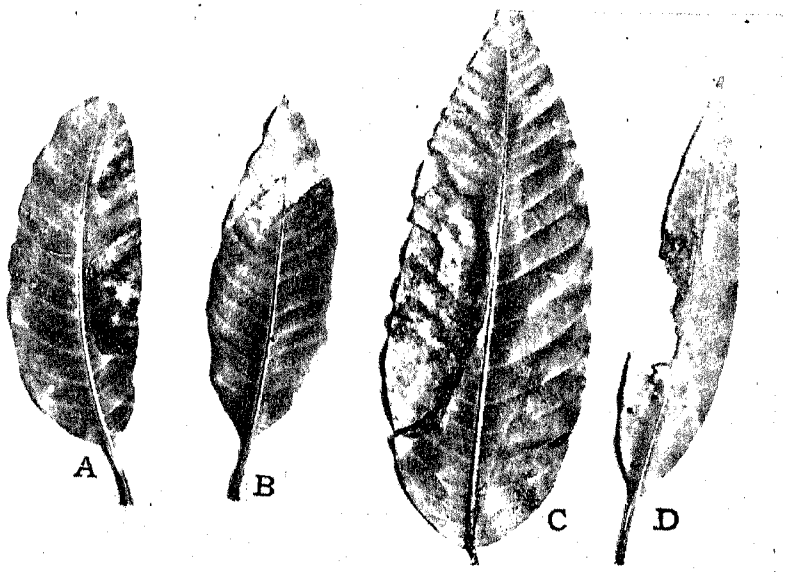

FIG. 1

FIG. 2

FIG. 3