STUDIES ON THE GREY LEAF BLIGHT DISEASE OF COCONUT PALM CAUSED BY *Pestalotia palmarum* Cooke.

By

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THESIS

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DECLARATIO..

I hereby declare that this thesis entitled " Studies on the grey leaf blight disease of coconut palm caused by Pestalotia palmarum Cooke " is a bonafide record of research work done by me during the course of research and that the thesis has not previously formed the basis for the award to me of any degree, diploma, associateship, followship, or other similar title, of any other University or Society.

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CERTIFICATE

Certified that this thesis, entitled " Studies on the grey leaf blight disease of coconut palm caused by Pestalotia palmarum Cooke " is a record of research work done independently by Shri. A.J.Francis, under my guidance and supervision and that it has not previously formed the basis for the award of any degree, fellowship, or associateship to him.

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INTRODUCTION

Ever since Cooke in 1875 reported the role of Pestalotia palmarum in decaying leaves of Cocos nucifera in Bengal, there has been moderate attention given to the problem of Pestalotia mediated leaf spots on different economically important crops. As far as conditions in Kerala are concerned, this disease is not causing much damage in connection with the yield, except the damage done to the leaves, which are used for thatching purpose. Some work has already been done on Pestalotia infected plants viz. Cocos nucifera, Manilkara hexandra (root stock for sapota), Achras sapota, Mangifera indica and Psidium guajava mainly laying emphasis on morphology, pathogenicity and host range.

The symptoms of the disease are characterized by circular deep red brown macules which are greyish at the edge and surrounded by a blackish brown margin on the under leaf surface and grey reddish brown on the upper leaf surface of the infected leaves.

Though this disease is of minor economic importance in Kerala, a severe out break was noted on the coconut palms at the " Coconut Research Station, Balaramapuram " where the palms are treated with different N.P.K. levels. At the same time the near by cultivator's fields were free from the incidence of this

disease. The finding that the coconut palms cultivated within the campus of the Research Station were exceptionally susceptible to Pestalotia infection (grey leaf blight) when compared with the palms cultivated in the neighbouring plots, prompted an investigation of the type presented here. This work, is mainly an attempt to elucidate the relationship, if any, between the application of different fertilizer levels and the susceptibility of the palms to grey leaf blight disease.

REVIEW OF LITERATURE

REVIEW OF LITERATURE

The genus *Pestalotia* was coined by de Notaris in 1839. The word is Latinized form of Pestalozza, the Italian Botanist after whom the genus was named. Guba (1920, 1932) made a monographic study of the genus *Pestalotia*. Steyaert (1949) suggested an amended description of the genus *Pestalotia* in which he included only a single representative, viz., *Pestalotia neroides*. The new genera namely *Truncatella* and *Pestalotiopsis* were created by him for accomodating the remaining species. Servazzi (1951) however, rejected the proposal, and preferred to retain the generic name *Pestalotia*. Galluci-Rangone (1954) considered that the genus *Pestalotiopsis* was superfluous and retained the name as *Pestalotia*. Dube and Dilgrami (1966) after conducting a study of 57 isolates of the genera *Pestalotiopsis* and *Pestalotia* causing leaf spot on a variety of plant species, concluded that all those isolates could be included in the original genus *Pestalotia*.

Cooke (1875) reported *Pestalotia palmarum* on decaying leaves of *Cocos nucifera* from Demerara and Bengal. Bertus (1927) made cross inoculation studies with *Pestalotia theae* and *Pestalotia palmarum* and reported that

the former species could attack injured leaves of tea and coconut, while the latter could infect coconut leaves only, through injury. Sarvazzi (1934) recorded Pestalotia palmarum on Howea forestoriana. Choudhury (1946) conducted inoculation experiments with Pestalotia palmarum and found that the fungus could infect the leaves of Borassus flabellifer, Areca catechu, Cocos nucifera and Phoenix sylvestris. The inoculations were successful only through wounds. Agnihothrudu et al; (1965) reported the natural occurence of Pestalotia palmarum on tea leaves.

Pestalotia psidii was first reported by Patouillard (1892) on the fruits of Psidium pomiferum from Ecuador. The fungus was reported from India by Chibber in 1911. Patel et al; (1950) made detailed studies on the morphology, physiology and pathogenicity of Pestalotia psidii. They noted that the fungus grew well on oat meal, Richard's and potato dextrose agar media. Best growth and sporulation of the fungus was obtained when mannitol, dextrin and sucrose were used as carbon source. Among the nitrogen sources, potassium nitrate, sodium nitrate and aspargine were found to be best for growth and sporulation of the pathogen. Inoculation experiments conducted by them revealed that the fungus was primarily a wound parasite.

Agarwall and Ganguli (1959) reported that Pestalotiopsis versicolor causing leaf spot of Anoreissus latifolia could infect the leaves of Psidium guajava on artificial inoculation. Tandon and Srivastava (1964) obtained infection on guava fruits with Pestalotia eruenta causing fruit rot of Emblica officinalis, by artificial inoculation. Bilgrami (1963) reported that Pestalotiopsis funerea isolated from leaf spots on Eucalyptus globulus was able to infect the leaves of a number of plants including Psidium guajava.

Bilgrami (1963) reported that Pestalotiopsis funerea was able to infect the leaves of Mangifera indica on artificial inoculation. Mundkur and Khoswalla (1942) considered the fungus to be Pestalotia mangiferae. Tandon et al; (1955) from their studies on the pathogenicity of Pestalotia mangiferae concluded that the organism was a weak parasite capable of infecting only injured leaves.

In India, Pestalotia sapotae was reported by Mundkur and Khoswalla (1942) on mature sapota fruits kept in cold storage. Srivastava et al; (1964) in their studies on fungal diseases of tropical fruits recorded a leaf spot and fruit rot of Achras sapota caused by Pestalotia sapotae

which was found to infect the fruits on artificial inoculation. Wilson et al; (1969) recorded a severe leaf spot of sapota plants from Vellayani. They found that the fungus could incite leaf spot and fruit rot of sapota on artificial inoculation. Sasikala (1969) has studied the morphology, pathogenicity and host range of Pestalotia spp. causing leaf spot on Manilkara hexandra.

Influence of substrate on the spore size of fungi

The size of spores of certain fungi is known to be influenced by the substratum on which they are produced. Dosdall (1923) working with Helminthosporium sativum stated that differences in length were found between spores produced on different substrates. Chowdhury(1944) found that the average length of the conidia of Cercospora sesami was greatest on sesamum stems and least on Dox agar, while the average width was same on Dox and Oat meal agar media and slightly more on sesamum stems. Mulkarni and Patel (1956) noted that the spores of Piricularia setariae from Setaria italica were larger on oat meal, Setaria italica leaf decoction with dextrose, and Elousine coracana leaf decoction agar media, than on the host

lesions. Increase in length occured on potato dextrose agar, Setaria italica leaf decoction without dextrose, and rice leaf decoction agar media, and increase in length accompanied by significant decrease in breadth on Brown's agar. Rangaswami and Sambandam (1960) found that the spore size of Alternaria melongenae was significantly less in pure culture than on natural host. Rangaswami and Pandurangan (1962) reported significant increase in the conidial size of Helminthosporium oryzae and Helminthosporium turcicum grown on potato dextrose agar medium. Gopalan (1963) found that the conidia of Corynespora cassiicola produced in culture were more slender and shorter than those produced on leaves kept in moist chamber. Varma (1967) reported that the spores of Alternaria sesamicola on the natural host were smaller than those on artificial media, while the spores of Alternaria zonbronae and Alternaria tenuis showed marked reduction in length when cultured on artificial media.

Choudhury (1946) reported that the maximum spore length of Pestalotia palmarum was obtained when produced on artificial culture media. Patel et al.,(1960) noted that the conidial size of Pestalotia psidii varied according to the substrate on which they are produced. Larger conidia were produced on lima bean and Richard's agar as compared to those produced on gram meal and oat meal agar. Agarwal and Ganguli (1963) reported

that the spores of Pestalotiopsis versicolor produced on its host plant, Anacolosus latifolia were smaller than those produced on artificial media.

Species differentiation in pathogenic fungi

The concept of species has undergone various changes since the Linnean era, due to the advances in genetics, ecology, morphology and physiology of fungi. Prasad et al; (1966) reported that in the early periods, a fungus parasitising a particular host was considered as an individual species but with the knowledge of polyphagic fungi, verified through cross inoculation tests, this criterion as such lost its value. Ramakrishnan (1941) suggested that pathogenic capacity alone should not be given much importance in distinguishing the species. He attributed the failure in cross inoculations to the absence of knowledge of the optimum environmental conditions necessary to produce infection.

Alexopoulos (1961) remarked that the custom of naming species of Deuteromycetes purely on the basis of the host on which they are found is admittedly unscientific and has resulted in the naming of hundreds of non-existent ' species This procedure is chiefly responsible for the recording of over 1000 species for such genera as Sentoria. These species are differentiated chiefly on the basis of their respective

hosts. Cross inoculations of different hosts would probably show that a great many of these so-called species represent one and the same fungus.

Munjal (1967) stated that many species of Collototrichum, Pestalotiopsis, Phoma, Phyllosticta and Septoria are plurivorus and that some stable characters should be worked out for species differentiation in these fungi.

Guba (1932) stated that the different species of Pestalotia can be adequately defined for monographic purposes on the basis of morphological and macroscopic characteristics. Further, he stated that a review of literature lead him to believe that very little, if any, importance is to be attached to published reports of parasitism of species of Pestalotia on plants, since, as a rule, they are found in organs that have perished from other causes and are usually associated with other parasites or saprophytes. Agarwal and Ganguli(1950) identified Pestalotiopsis versicolor (Pestalotia versicolor) isolated from the leaves of Anoreissus latifolia on the basis of morphology and pathogenicity to Carissa carandas, on which the fungus has been reported earlier by Mundkur and Khoswalla (1942). Based on the

pathogenicity to Dalbergia sissoo, Roy (1965) reported Pestalotia albo-maculans causing leaf spot of Inga dulcis in Assam. The fungus has been reported earlier on Dalbergia sissoo in Brazil(Guba, 1961). Sivaprakasam et al; (1969) conducted inoculation tests with the isolates of Pestalotiopsis (Pestalotia) from chillies and coconut and found that they were cross infective on to each other's host plant. Based on its pathogenicity to coconut leaves, they identified the fungus causing fruit rot of chillies in Thirunelveli as Pestalotiopsis palmarum (Cooke) Steyaert (Pestalotia palmarum Cooke).

Disease incidence in relation to nutrient status

The relationship between leaf magnesium levels and occurence of Pestalotiopsis leaf spot in oil palm (Elaeis guineensis) has been recognized for many years (Bull 1954) and would appear to provide excellent opportunity for detailed study of a weak pathogen which can become aggressive when there exists a suitable nutrient status. At least fifteen species of Pestalotiopsis occur on oil palms through-out the world (Steyaert 1953, Turner 1971). The natural occurrence and survival of these species

and details of host nutrition and exudates in relation to spore germination, penetration and lesion development would doubtlessly prove to be a facinating study. Many species of Pestalotiopsis have been recorded from oil palms through-out the world and their invasion appears to be associated with magnesium deficiency for which reason it is noted greatest in older fronds (Robertson et al; 1968). Turner (1971) noticed in both Malayasia and Indonesia that, seedlings raised in peat soil were very prone to nursery leaf spot, which was mainly due to the imbalance between the nutrients. It is likely that the magnesium level in leaf is important and analysis of nutrients in leaf would almost certainly provide the basic information to indicate lines along which further investigation should proceed. Umar Akbar et al; (1971) showed that the deficiency in the magnesium and nitrogen was the real cause of Ganoderma infection in Elaeis guineensis.

Andre' Voisin (1965) stated that the ' law of the maximum ' is particularly important where potassium fertilizers is concerned, the latter being responsible for the unavailability

of soil magnesium. Another problem that arises with magnesium is that the ratio of exchangable potassium to exchangable magnesium is too wide in many soils. This problem is further aggravated by continuous application of potassium fertilizers without considering magnesium levels. This was shown by Tisdale and Nelson (1970).

Menon et al; (1950) showed that the leaves of the coconut palms which showed sub-optimal levels of potassium were very susceptible to the attack by Pestalotia palmarum. Child (1950) found that omission of potassium from the soil led in course of time, to yellowing of foliage and incidence of attack by the fungus Pestalotia. Wallace (1928) showed that the N / K ratio, if wide, resulted in increased leaf scorching while a narrow ratio reduced such an incidence. Cooke(1950) found that magnesium aids the transport of phosphorous within the plant and that a deficiency of magnesium should reflect in terms of phosphorous deficiency in the tissues. Krackenberger and Peterson (1954) in a review pointed out a positive correlation between the phosphorous and magnesium contents of the coconut palms.

Various reports show the imbalance of nutrients as the fundamental cause of many diseases in plants. Gallasch (1974) showed the effect of nutrition on the incidence of

Drechslera incurvata leaf spot of coconut. The severity of Drechslera incurvata leaf spot disease on coconut seedlings was related to the level of nitrogen applied. Addition of nitrogen fertilizers increased the susceptibility of seedlings to the disease while potassium and phosphorous fertilizers decreased it. The application of sulphur fertilizer was not found to affect disease severity.

Various workers have reported that the response of plants to infectious agents, including viruses (Spencer 1935); may be altered by varying their mineral nutrition. The effect of nutrition has been studied with regard to the development of club root of cabbage caused by Plasmodiophora brassicae. Omission of potassium (Pryor, 1940) and potassium or / and phosphorous (Walker and Hooker, 1945) from the nutrient solution decreased the severity of club root. Pryor (1940) reported that increasing the nitrogen supply in the nutrient solution increased the severity of the disease. Walker and Hooker (1945) also studied the relationship between nutrition and the development of cabbage yellows, caused by Fusarium oxysporum f. conglutinans. In contrast to the effects of potassium on club root, the omission of potassium from the nutrient increased the disease rating for cabbage yellows; omission of either potassium or phosphorous reduced it. Neal (1928) reported that potassium salts reduced

the severity of cotton wilt in sand cultures and obtained comparable results under field conditions in Mississippi. In Maryland, Stoddard (1942) was successful in reducing the severity of Fusarium wilt of Cantaloupe caused by Fusarium oxysporum f. melonis by providing a high ratio of potassium to nitrogen in fertilizer. Fisher (1936); Edington and Walker (1938) showed that the severity of tomato wilt caused by Fusarium oxysporum f. lycopersici was usually increased by low calcium nutrition and decreased by excess calcium. Corden (1965) showed that citrus plants favoured infection by Thielavia basicola at high PO_4 concentrations. Chapman and Brown (1942) showed that lowering the pH from 5.0 to 3.5 reduced the severity of infection by this organism even in the presence of a relatively high PO_4 concentrations.

Robert Cecil (1975) studied the major nutrient composition of leaves from healthy and root (wilt) affected coconut palms and established the importance of their imbalance on the incidence of this disease. The nitrogen, phosphorous and potassium content was found to be similar in healthy and diseased palms. The calcium and magnesium content of healthy palms were significantly higher than those of apparently healthy or diseased palms. A general evaluation of nutrient element balance indicated that the palms in the root (wilt) affected areas are in a state of unbalanced nutrition.

MATERIALS AND METHODS

MATERIALS AND METHODS

1. INFLUENCE OF NUTRIENTS ON DISEASE INCIDENCE

The study was undertaken at the " Coconut Research Station, Balaramapuram, Trivandrum, Kerala ", where the palms are treated with 3 different levels of N.P.K. at all possible combinations. The palms are 13 years old and are maintained in a non-irrigated state. The details of the treatments are as follows.

Net plot size	: 4 trees with spacing 7 m X 7 m.
Treatments	: N.P.K. at 3 levels at all possible combinations.
Total No: of treatments	
Combinations	: 27
Replication	: 2
No: of blocks	: 6
No: of plot/block	: 9
No: of trees	
a) Experimental	: 216
b) Border	: 347
Total area	: 9 hectares
Experimental area	: 3.643 hectares
Lay out	: 3^3 confounded factorial design with 2 replications; confounding NPK^2 in replication I and NP^2K^2 in replication II

Levels of fertilizers	: n_0	: 0
	n_1	: 240 grams / tree / year
	n_2	: 480 grams / tree / year
	P_0	: 0
	P_1	: 225 grams / tree / year
	P_2	: 450 grams / tree / year
	k_0	: 0
	k_1	: 450 grams / tree / year
	k_2	: 900 grams / tree / year

Studies on the disease intensity at various NPK combinations

One tree from each treatment combination was taken for observation with respect to the disease intensity at various NPK combinations in different months. For this study, the total number of spots were grouped into 4 categories with the following descriptions.

Spot number I : Large grey spots where acervuli have been formed.

Spot number II : Large brown spots where there was no acervuli formation.

Spot number III : Medium spots with grey centre and dark brown or black margin.

Spot number IV : Very minute, completely black or brown coloured spots.

The observations were carried out for five months viz. May, June, July, August and September of 1976, as this disease was reported to be severe in those months. The observations were taken in the following manner.

Selection of the leaf and leaflets

From the initial study it was seen that each palm had about 30 to 40 leaves and of those, the oldest 10 to 15 leaves were severely affected by the disease. Hence 5th leaf from the base of the crown was taken as the representative leaf for the month of May and the 40th leaflet on either side of the rachis were plucked out and the spots were counted. This procedure was followed for the subsequent younger leaves for the corresponding months. The number of spots were recorded seperately for each treatment combination for each month.

Leaf analysis

Chemical analysis was carried out to find out the nutrient status of the leaf tissues of each palm under each treatment combination.

Selection of the material for chemical analysis

Samples of leaves were collected as per the method suggested by C.P.C.R.I. Total number of leaves in a palm were counted from the first fully opened leaf to the oldest leaf at the bottom. The leaf for analysis was selected based on the general formula $\frac{n+1}{2}$ in cases where the total number of leaves was odd and

$\frac{n}{2}$ in cases where the total number of leaves was even; ' n ' representing the total number of leaves in the palm. Two leaflets from the middle portion of the leaf on either side of the rachis were taken. The mid-ribs were removed from the leaflets and the middle 10 cm portion of the leaf lamina was taken. The samples were washed with tap water followed by 0.1N hydrochloric acid and finally with double distilled water. The materials thus treated were maintained in an air oven at a temperature range of 75 to 80°C for five days. These were taken and homogenised seperately using a blender.

Extraction of the material for micronutrient analysis

All the glass wares used (Pyrex) were thoroughly cleaned with tap water followed by double distilled water. These were dried and used for the extraction work.

1 gram of each sample was weighed into a 100 ml volumetric flask. 5 ml of concentrated nitric acid (BDH) was then added to the flask and heated over a hot plate at 70 to 80°C for about half an hour or till the frothing ceased. The material was cooled and about 15 ml of diacid mixture (nitric acid and perchloric acid in 2:1 ratio) was added into the partially digested material. Again heating was done over a hot plate till white fumes appeared or the volume of the contents reduced to 2 ml. The samples were then made up to 100 ml and filtered through " Whatman No: 40 ashless filter paper " into polythene

bottles, for removing silica. The extracts were then taken to " Indo-German Nilgiris Development Project " at Ooty for analysis of the micronutrients using " Atomic absorption Spectrophotometer " The observations were recorded and tabulated seperately.

Extraction of the material for macronutrients

The same extracts prepared for micronutrient analysis were used for analysing phosphorous and potassium using the method described by Jackson (1958) viz. phosphorous by colorimetry and potassium by flame photometry method. Nitrogen estimation was done using the Microkjeldahl method as given by Jackson (1958).

2. MORPHOLOGICAL STUDIES OF DIFFERENT SPECIES OF *Pestalotia*

Species of *Pestalotia*, affecting the following six plants were isolated and studied in this investigation.

1. *Pestalotia palmarum* Cooke on *Cocos nucifera* L.
2. *Pestalotia mangiferae* P.Henn on *Mangifera indica* L.
3. *Pestalotia sapotae* P.Henn on *Achras sapota* L.
4. *Pestalotia* sp. on *Manilkara hexandra* (Roxb.) Dub.
5. *Pestalotia* sp. on *Cinnamomum zeylanicum* Blume.
6. *Pestalotia* sp. on *Elaeis guineensis* Jacq.

Isolation of organisms

Parts of the plant showing freshly infected spots were cut into small bits, surface sterilized with 0.1% mercuric chloride solution and washed in three changes of sterile water. These

were then placed on potato dextrose agar (P.D.A.) medium in sterile petri-dishes and incubated at room temperature. After 2 to 3 days, when the growth of the fungus was visible to the naked eye, bits of mycelium were aseptically transferred to P.D.A. slants, by means of a sterile inoculation needle. Single spore isolations were made by dilution plate method and the cultures were maintained on P.D.A. slants at room temperature.

Growth and sporulation on different media

The colony and sporulation characteristics of the isolates were studied by growing them on solid media in petri-dishes.

Circular discs of 5 mm diameter were cut out from the outer edges of 3 days old petri-dish cultures, by means of sterile cork borer. These were transferred into sterile petri-dishes containing 15 ml of the solidified agar medium and were incubated at room temperature. Observations were taken over a period of 3 days, by which time, the growth of some of the isolates almost reached the edge of the petri-dishes. Measurements of radial growth of the organisms were taken from the 4th day onwards. The extent of sporulation was recorded 15 days after inoculation and was determined as follows:

3 five millimeter diameter culture discs were taken from three different areas of a petri-dish and put into 500 ml conical flask containing 300 ml sterilized water. The flask was agitated thoroughly for 10 minutes. One drop of this spore

suspension was placed on a clean glass slide under a cover slip and the number of spores in five different microscopic fields under low power magnification, was counted. Three seperate drops of spore suspension were examined from each flask and the average number of spores per microscopic field was calculated.

The intensity of sporulation was graded arbitarily as given below:

1. Good : 25 spores and more per microscopic field.
2. Moderate : 10 to 25 spores per microscopic field.
3. Poor : Below 10 spores per microscopic field.

Composition of media used

1. Potato dextrose agar

Peeled potato	:	200.00 g
Dextrose	:	20.00 g
Agar agar	:	20.00 g
Distilled water	:	1000 ml

2. Oat meal agar

Oat meal	:	40.00 g
Agar agar	:	20.00 g
Distilled water	:	1000 ml

3. Crandl's agar

$MgSO_4 . 7 H_2O$	:	0.50 g
KH_2PO_4	:	1.00 g
Kcl	:	0.50 g

$FeSO_4.7H_2O$	:	0.01 g
$NaNO_3$	:	2.00 g
Sucrose	:	30.00 g
Agar agar	:	20.00 g
Distilled water	:	1000 ml

4. Richard's agar

KNO_3	:	10.00 g
KH_2PO_4	:	5.00 g
$MgSO_4.7H_2O$	:	2.50 g
$FeCl_3.6H_2O$	:	0.02 g
Sucrose	:	50.00 g
Distilled water	:	1000 ml

5. Sabouraud's agar

Glucose	:	40.00 g
Peptone	:	10.00 g
Agar agar	:	20.00 g
Distilled water	:	1000 ml

Pathogenicity tests

Artificial inoculations were done with and without injury on the plant parts *in situ*. Injury was made by scraping the surface and also by pin pricks. Inoculations were done with mycelial bits as well as with spore suspensions. Culture bits were placed on the plant surface and then covered with moist cotton wool. The spore suspension prepared in sterile water

was applied by spraying with an atomizer. After inoculation, the plant part was covered with polythene bag. A swab of cotton wool soaked in water was placed inside the bag to ensure high humidity. The humidity arrangements were removed two days after inoculation. Once spots started showing up, the organisms were reisolated from those areas, in order to confirm their pathogenicity.

Measurement of conidial size

Conidial measurements were conducted both from the host plants as well as from 15 days old cultures. Water mounts were used for the purpose. Spores from the host were obtained by incubating the infected regions in moist chamber for 48 hours. The length, breadth of the conidia and the length of appendages of 10 spores were measured in the experiment to study the influence of substrate on spore size.

RESULTS

RESULTS

The biometric observations recorded were statistically analysed and the results are given hereunder.

1. Influence of nutrients on disease incidence

a. Dealt separately for each month

The mean data recorded for the months of May, June, July, August and September are presented in tables 1, 2, 3, 4 and 5 and the analysis of variance in Appendices I to V

From the result it is seen that, in the months of May, June, July, August and September, the available levels of potassium showed significant differences in the disease incidence. Similarly the available levels of phosphorous showed significant differences in the disease incidence in the months of June and August. Apart from potassium and phosphorous, the P X K interaction showed significant difference in the months of May, July and August; the N X P and N X K interactions in the month of August.

b. Dealt collectively for 5 months

The mean values for the pooled data are presented in table 6 and the analysis of variance in Appendix VI.

It is seen from the table that an increase in potassium and phosphorous contents showed an increased incidence of the disease, whereas an increase in nitrogen content showed a decrease

Table I

Effect of NPK on the disease intensity

for the month of May

	N 0	N 1	N 2	Mean
P 0	11.20	5.78	8.63	8.53
P 1	11.33	11.33	10.28	10.98
P 2	13.91	12.06	9.20	11.72
K 0	8.23	7.48	6.68	7.46
K 1	14.05	10.06	10.71	11.61
K 2	14.10	11.63	10.71	12.71
Mean	12.15	0.72	9.31	
	P 0	P 1	P 2	
K 0	8.75	7.88	5.76	7.46
K 1	9.23	13.06	12.53	11.61
K 2	7.68	12.00	16.88	12.17
Mean	8.53	10.98	11.72	

C.D. for marginal means : 2.8778

C.D. for combinations : 4.9846

No application of potassium reduces the disease intensity.

Table 2

Effect of NPK on the disease intensity

for the month of June

		N		
	0	1	2	Mean
0	10.06	7.15	9.05	8.75
P 1	10.40	9.83	12.21	10.81
2	13.60	17.43	9.26	13.43
0	6.86	6.41	6.21	6.50
K 1	14.76	10.78	12.25	12.60
2	12.43	17.21	12.06	13.90
Mean	11.35	11.47	10.17	
		P		
	0	1	2	
0	7.03	6.60	5.86	6.50
K 1	10.40	13.38	14.01	12.60
2	8.63	12.46	20.41	13.90
Mean	8.75	10.81	13.43	

C.D. for marginal means : 3.4014

C.D. for combinations : 5.8902

No application of phosphorous reduces the disease intensity.

No application of potassium reduces the disease intensity.

Table 3

Effect of NPK on the disease intensity

for the month of July

		N		
	0	1	2	Mean
0	7.81	3.86	7.83	6.50
P 1	8.18	5.31	7.30	6.93
2	11.26	11.26	5.85	9.45
0	5.58	2.90	5.50	4.66
K 1	11.70	6.35	7.86	8.63
2	9.96	11.20	7.61	9.59
Mean	9.08	6.81	6.99	
		P		
	0	1	2	
0	7.80	2.21	3.84	4.66
K 1	6.68	8.70	10.68	8.68
2	5.18	9.88	13.71	9.59
Mean	6.50	6.93	9.45	

C.D. for marginal means : 3.2977

C.D. for combinations : 5.7095

No application of potassium reduces the disease intensity.

Table 4

Effect of NPK on the disease intensity

for the month of August

	N 0	N 1	N 2	Mean
P 0	6.66	4.50	5.83	5.66
P 1	6.65	5.95	7.51	6.70
P 2	12.35	10.10	5.18	9.21
K 0	4.21	3.10	4.38	3.90
K 1	10.13	6.08	7.93	8.05
K 2	11.31	11.36	6.21	9.63
Mean	8.55	6.35	6.17	
	P 0	P 1	P 2	
K 0	6.03	2.13	3.48	3.90
K 1	4.36	8.73	10.50	8.05
K 2	6.10	9.15	13.65	9.63
Mean	5.66	6.70	9.21	

C.D. for marginal means : 2.0325

C.D. for combinations : 3.5205

No application of phosphorous reduces the disease intensity.

No application of potassium reduces the disease intensity.

Table 5

Effect of NPK on the disease intensity

for the month of September

	N 0	N 1	N 2	Mean
P 0	5.83	2.66	5.80	4.76
P 1	7.21	5.53	6.03	6.56
P 2	9.25	8.23	4.51	7.33
K 0	4.11	1.95	4.18	3.41
K 1	7.60	4.53	7.78	6.65
K 2	10.53	9.90	5.20	8.53
Mean	7.43	5.47	5.75	

	P 0	P 1	P 2	
K 0	5.15	2.00	3.10	3.41
K 1	3.76	8.45	7.75	6.65
K 2	5.38	9.23	11.18	8.53
Mean	4.76	6.56	7.30	

C.D. for marginal means : 2.5025

C.D. for combinations : 4.4708

No application of potassium reduces the disease intensity.

Table 6

Effect of NPK on the disease intensity

for the pooled data

	N 0	N 1	N 2	Mean
P 0	8.32	4.79	7.43	6.85
P 1	8.75	7.50	8.85	8.40
P 2	12.07	11.82	6.20	10.23
K 0	5.80	4.37	5.30	5.18
K 1	11.69	7.57	9.31	9.51
K 2	11.69	12.26	8.38	10.77
Mean	9.71	8.06	7.09	
	P 0	P 1	P 2	
K 0	6.95	4.17	4.43	5.18
K 1	6.96	10.47	11.09	9.51
K 2	6.62	10.51	15.16	10.77
Mean	6.85	8.40	10.23	

C.D. for marginal means : 1.2209

C.D. for combinations : 2.1134

Increase in phosphorous increases the disease intensity.

Increase in potassium increases the disease intensity.

Increase in nitrogen decreases the disease intensity but the application of nitrogen at 1 and 2 levels do not show any significant difference in the disease intensity.

in the incidence of disease. No significant difference was noted between nitrogen applications at level 1 and 2. A significant difference in disease incidence was also noted depending on the levels of nitrogen, phosphorous and potassium applied. The interactions N K P, N K K and P K K also showed significant differences in the disease.

c. Correlation studies

The values of simple correlation coefficients are presented in table 7 .

The nutrients like nitrogen, phosphorous, potassium, magnesium, zinc, manganese, and iron were correlated with the number of spots found during the months of May, June, July, August and September.

In the study, it was found that the positive influence of potassium on the disease incidence was highly significant. However it was found that the levels of magnesium and manganese showed a strong negative correlation. An increase in potassium content and a decrease in magnesium and manganese contents resulted in an increase in the number of spots.

d. Disease intensity at various NPK combinations

From the data it was seen that maximum disease intensity was recorded in the month of June and the minimum in September. The palms treated with 0 level of nitrogen, 2 levels of phosphorous and 2 levels of potassium showed maximum disease

Table 7

Correlation between No: of spots and nutrients

Sl.No.	Characters correlated	Months				
		May	June	July	Augu.	Sept.
1.	N and spots	-0.17	-0.19	-0.20	-0.19	-0.16
2.	P and spots	0.05	0.00	0.00	0.00	0.00
3.	K and spots	0.34*	0.49**	0.42**	0.45**	0.41**
4.	Mg and spots	-0.34*	-0.46**	-0.36**	-0.42**	-0.39**
5.	Zn and spots	-0.13	-0.11	-0.09	-0.04	-0.08
6.	Mn and spots	-0.45**	-0.49**	-0.44**	-0.38**	-0.41**
7.	Fe and spots	-0.08	-0.02	-0.02	-0.04	-0.09

* Significant at 0.01% level

** Significant at 0.05% level

intensity in the month of May. In all other months viz. June, July, August and September, the maximum disease intensity was seen in the palms treated with 1 level of nitrogen, 2 levels of phosphorous and 2 levels of potassium. Minimum disease intensity was noticed in the palms treated with 1 level of nitrogen, 1 level of phosphorous and 0 level of potassium in the months of July and September. Palms treated with 1 level of nitrogen, 0 level of phosphorous and 2 levels of potassium showed minimum disease intensity in the month of May and those with 2 levels of nitrogen, 0 level of phosphorous and 0 level of potassium in the month of June. In the month of August, minimum disease intensity was noticed in the palms treated with 0 level of nitrogen, 1 level of phosphorous and 0 level of potassium. (Tables 8 to 12)

From the pooled data, it was seen that the maximum disease intensity was recorded in the palms treated with 1 level of nitrogen, 2 levels of phosphorous and 2 levels of potassium. Minimum disease intensity was noticed in the palms treated with 0 level of nitrogen, 1 level of phosphorous and 0 level of potassium. (Table 13)

2. Morphological studies of different species of Pestalotia

a. Growth and sporulation on solid media

The growth of all the six isolates was rather rapid on the media tried. There was no significant difference between their

Table 8

Intensity of the disease for the month of May

	n_0			n_1			n_2		
	p_0	p_1	p_2	p_0	p_1	p_2	p_0	p_1	p_2
k_0	177	41	29	53	119	23	36	47	52
k_1	146	255	252	32	205	127	125	112	123
k_2	111	169	460	21	101	437	78	163	105

Table 9

Intensity of the disease for the month of June

	n_0			n_1			n_2		
	p_0	p_1	p_2	p_0	p_1	p_2	p_0	p_1	p_2
k_0	136	23	30	40	42	41	19	79	35
k_1	213	230	291	39	202	233	165	177	123
k_2	53	139	342	31	121	1032	103	231	144

Table 10

Intensity of the disease for the month of July

	n_0			n_1			n_2		
	p_0	p_1	p_2	p_0	p_1	p_2	p_0	p_1	p_2
k_0	138	8	17	27	4	6	105	9	31
k_1	101	120	366	20	55	60	45	91	58
k_2	25	165	142	6	52	594	77	90	24

Table 11

Intensity of the disease for the month of August

	n_0			n_1			n_2		
	p_0	p_1	p_2	p_0	p_1	p_2	p_0	p_1	p_2
k_0	129	60	7	16	12	4	18	11	34
k_1	20	71	377	25	65	40	40	126	40
k_2	56	158	228	21	57	505	47	78	13

Table 12

Intensity of the disease for the month of September

	n_0			n_1			n_2		
	p_0	p_1	p_2	p_0	p_1	p_2	p_0	p_1	p_2
k_0	92	2	3	10	1	9	32	8	10
k_1	19	90	148	6	55	24	31	108	56
k_2	45	142	200	9	71	361	40	57	3

Table 13

Intensity of the disease for the combined effect

	n_0			n_1			n_2		
	p_0	p_1	p_2	p_0	p_1	p_2	p_0	p_1	p_2
k_0	134	15	13	29	35	16	42	31	34
k_1	100	153	286	26	116	59	81	122	80
k_2	53	155	276	27	82	536	70	127	53

radial growth after 8 days on different media, except for the isolate from Manilkara hexandra. The colony diameter of this isolate was only 65.30 mm on Czapek's agar medium. (Tables 14 to 19) and (Appendices VII to XII)

The colony characters of all the isolates were more or less similar. The colour of mycelia of all isolates was white except on Sabouraud's agar on which they became light yellow on aging. The fructifications produced on Oat meal agar were partly submerged in the medium. All the six isolates showed good sporulation on potato dextrose agar and Czapek's agar and moderate sporulation on Oat meal agar. Pestalotia palmarum and Pestalotia sapotae failed to sporulate on Sabouraud's agar, while the isolates from Manilkara hexandra and Cinnamomum zeylanicum showed good sporulation on this medium. Pestalotia sapotae produced a light yellow pigment in potato dextrose agar and Czapek's agar and the manilkara isolate produced the yellow pigment in Sabouraud's agar. (Tables 20 to 25)

b. Pathogenicity tests

The pathogenicity of all the six isolates was proved by artificial inoculation in their respective hosts. Infection was obtained within 3 to 5 days after inoculation. Symptoms produced were similar to those observed in nature. Injury was found to be a pre-requisite for infection by all the isolates. Infection was obtained by placing culture bits as well as spraying spore suspension.

Table 14

Colony diameter of Pestalotia sp.

from Nandhara hexandra on solid media

Media	Age of culture in days				
	4	5	6	7	8
	Colony diameter in mm				
Potato dextrose agar	50.3	62.3	74.6	81.6	89.3
Oat meal agar	42.3	53.6	70.0	81.6	89.3
Richard's agar	51.0	63.0	76.6	80.0	90.0
Czapek's agar	40.3	45.3	51.1	60.3	65.3
Sabouraud's agar	60.0	75.3	85.3	87.3	90.0

Table 15

Colony diameter of *Pestalotia* sp.

from *Elaeis guineensis* on solid media

Media	Age of culture in days				
	4	5	6	7	8
	Colony diameter in mm				
Potato dextrose agar	49.3	55.0	60.6	75.3	83.0
Oat meal agar	41.0	53.3	64.0	82.6	87.3
Richard's agar	44.6	54.6	63.3	70.0	83.6
Czapek's agar	45.0	49.0	66.6	76.3	87.0
Sabouraud's agar	56.6	57.0	67.0	86.0	90.0

Table 16

Colony diameter of Pestalotia sp.

from Cinnamomum zeylanicum on solid media

Media	Age of culture in days				
	4	5	6	7	8
	Colony diameter in mm				
Potato dextrose agar	50.3	70.6	87.0	93.0	93.0
Oat meal agar	42.0	67.0	81.3	89.6	90.0
Richard's agar	41.0	59.3	79.3	81.6	89.0
Czapek's agar	39.3	52.0	72.0	79.3	80.6
Sabouraud's agar	42.0	69.0	88.6	91.3	93.0

Table 17

Colony diameter of Pestalotia mangiferae on solid media

Media	Age of culture in days				
	4	5	6	7	8
	Colony diameter in mm				
Potato dextrose agar	50.0	61.0	67.3	72.0	86.6
Oat meal agar	32.3	41.6	51.0	71.0	78.3
Richard's agar	38.6	48.3	64.6	78.3	90.0
Czapek's agar	50.6	59.0	72.3	73.6	82.0
Sabouraud's agar	42.0	51.3	70.6	82.3	90.3

Table 13

Colony diameter of Pestalotia sapotae on solid media

Media	Age of culture in days				
	4	5	6	7	8
	Colony diameter in mm				
Potato dextrose agar	58.6	78.6	89.0	93.0	93.0
Oat meal agar	54.0	71.3	90.3	92.0	93.0
Richard's agar	53.3	66.6	88.3	91.3	91.3
Czapek's agar	53.6	69.3	82.0	88.3	89.0
Sabouraud's agar	60.3	61.6	80.3	88.0	90.0

Table 19

Colony diameter of Postalotia palmarum on solid media

Media	Age of culture in days				
	4	5	6	7	8
	Colony diameter in mm				
Potato dextrose agar	39.3	51.0	63.6	78.3	93.0
Oat meal agar	32.0	49.3	67.0	85.6	99.3
Richard's agar	35.6	50.6	66.3	73.0	82.6
Czapek's agar	36.0	46.0	59.0	70.0	83.3
Sabouraud's agar	47.3	56.3	67.6	83.3	90.0

Table 20

Growth characters and sporulation of *Pestalotia* sp. from *Cinnamomum zeylanicum* on solid media

Sl.No.	Media	Colony characters	Sporulation
1	Potato dextrose agar	Colony cottony white and thick. Zonations present. Sporulation starts from the 6th day.	Good
2	Oat meal agar	Growth as above. Fructifications partly submerged in the medium. Sporulation starts from the 9th day.	Moderate
3	Richard's agar	Mycelium white when young, turning light yellow on aging. Zonations absent. Sporulation starts on the 10th day.	Poor
4	Czapek's agar	Mycelium thick, cottony white. Zonations not clear. Sporulation starts on the 9th day	Good
5	Sabouraud's agar	Same as in Richard's medium Sporulation starts on the 7th day.	Good

Table 21

Growth and sporulation of *Pestalotia* sp. from *Elaeis guineensis* on solid media

Sl. No.	Media	Colony characters	Sporulation
1	Potato dextrose agar	Mycelium white and cottony in appearance. Distinct zonations are present. Sporulation commences from the 10th day.	Good
2	Oat meal agar	Colony as above but zonations absent. Fructifications submerged in the medium. Sporulation starts from the 10th day.	Moderate
3	Richard's agar	Mycelium white, turning pale yellow on aging. Zonations faintly seen. Sporulation starts on the 8th day.	Poor
4	Czapek's agar	Same as in Richard's agar, but sporulation starts on 9th day.	Good
5	Sabouraud's agar	Colony characters same as above Sporulation starts on the 4th day.	Poor

Table 22

Growth characters and Sporulation of *Pestalotia palmarum* on solid media

Sl.No.	Media	Colony characters	Sporulation
1	Potato dextrose agar	Mycelium cottony white when young, turning palo yellow on aging. Colony with distinct zonations. Sporulation evident from the 4th day.	Good
2	Oat meal agar	Mycelium thick white and cottony in appearance. Zonations absent. Fructifications partly submerged in medium. Sporulation starts from the 9th day.	Moderate
3	Richard's agar	Mycelium cottony and light yellow in colour. Zonations faintly seen. Sporulation commences from the 11th day.	Moderate
4	Czapek's agar	Colony characters same as above. Sporulation starts from the 4th day.	Good
5	Sabouraud's agar	Same as above. No sporulation.	Nil

Table 23

Growth characters and sporulation of *Pestalotia mangiferae* on solid media

Sl.No.	Media	Colony characters	Sporulation
1	Potato dextrose agar	Mycelium cottony white, turning pale yellow on aging. Well defined zonations present. Sporulation starts from the 5th day.	Good
2	Oat meal agar	Colony white. Zonations absent. Fructifications partly submerged in medium. Sporulation starting from the 6th day.	Moderate
3	Richard's agar	Colony cottony white with well defined zonations. Sporulation starts from the 7th day.	Good
4	Czapek's agar	Colony characters same as above. Sporulation evident from the 5th day.	Good
5	Sabouraud's agar	Mycelium white, turning light yellow on aging. Zonation not clearly visible. Sporulation starts from the 8th day.	Moderate

Table 24

Growth characters and sporulation of *Pestalotia sapotae* on solid media

Sl.No.	Media	Colony characters	Sporulation
1	Potato dextrose agar	Colony cottony white, aerial, thick, with entire margin. Zonations not clearly seen. Sporulation starts after 8 days. Light yellow pigment production noted in the medium.	Good
2	Oat meal agar	Growth as above. Colony with slight zonations. Sporulation after 9 days. Fruiting bodies partly submerged in the medium.	Moderate
3	Richard's agar	Colony characters same as above.	Poor
4	Czapek's agar	Growth more or less similar to that on P.D.A. Light yellow pigment production noted in the medium.	Good
5	Sabouraud's agar	Mycelium yellowish white, thick and without sporulation.	Nil

Table 25

Growth characters and sporulation of *Pestalotia* sp. from *Manilkara hexandra* on solid media.

Sl.No.	Media	Colony characters	Sporulation
1	Potato dextrose agar	Colony cottony white, thick and entire margin. Zonations present. Sporulation starts after 6 days.	Good
2	Oat meal agar	Growth as above. Fructifications partly submerged in the medium.	Moderate
3	Richard's agar	Mycelium white when young, turning light yellow on aging. Zonations absent. Sporulation starts on the 9th day.	Poor
4	Czapek's agar	Mycelium thick, cottony white. Zonations not clear. Sporulation starts on the 9th day.	Good
5	Sabouraud's agar	Same as in Richard's medium. Sporulation starts on the 8th day. Light yellow pigment production noted in the medium.	Good

c. Cross inoculation tests

Cross inoculation tests conducted with the six isolates of Pestalotia revealed that each of them could infect all the six host plants viz. coconut, mango, sapota, manilkara, cinnamon, and oil palm. Injury was however found necessary for infection. Development of symptoms similar to those produced in nature was noticed within 3 to 6 days after inoculation. The pathogen was reisolated from the infected regions.

d. Influence of substrate on spore size of Pestalotia sp.

Spores of Pestalotia sp. produced on artificial media were longer than those obtained from the host plants, except in case of Pestalotia palmarum.

The average spore length in Pestalotia palmarum was maximum on coconut leaf, being 34.58 /u. The spores produced on culture media were significantly shorter than the above and they measured 24.07 /u on potato dextrose agar and 24.00 /u on Czapek's agar. The breadth of spores on potato dextrose agar, Czapek's agar and host was 9.43 /u, 9.58 /u and 9.65 /u respectively. The appendage length was maximum on host, being 25.85 /u and minimum on Czapek's agar medium with 23.97 /u. (Table 26)

In Pestalotia mangiferae the maximum spore length was obtained on potato dextrose agar. Spores produced on this were longer than those on Czapek's agar and mango leaf. The

Table 26

Spore measurements (in μ) of *Pestalotia palmarum* on different substrates

Symbol	Substrate	Mean	Range		S.D.	t value at 5% level		
			Minimum	Maximum				
Spore length								
A	Potato dextrose agar	34.07	20.90	41.50	7.01	A & B	0.01	NS
B	Czapek's agar	34.09	22.20	40.50	6.12	A & C	0.18	NS
C	Host	34.58	27.00	40.50	4.70	B & C	0.19	NS
Spore breadth								
A	Potato dextrose agar	9.43	8.75	10.50	0.66	A & B	0.47	NS
B	Czapek's agar	9.58	8.75	10.50	0.65	A & C	0.73	NS
C	Host	9.65	8.75	10.50	0.60	B & C	0.23	NS
Appendage length								
A	Potato dextrose agar	24.42	10.50	33.50	8.25	A & B	0.13	NS
B	Czapek's agar	23.97	10.50	31.50	6.68	A & C	0.37	NS
C	Host	25.85	12.50	35.50	8.27	B & C	0.53	NS

measurements were 33.07 /u on potato dextrose agar, 32.92 /u on Czapek's agar and 31.50 /u on host leaf. The breadth of spores showed only very little variation between substrates. This ranged from 9.45 /u on potato dextrose agar to 9.49 /u on host. Maximum appendage length was found in spores from the host viz. 24.21 /u. (Table 27)

In Pestalotia sapotae the spores produced on potato dextrose agar showed significant variation in length. The longest spores were found on potato dextrose agar viz. 34.78 /u. On Czapek's agar and sapota leaf they measured 33.91 /u and 28.73 /u respectively. The breadth varied from 9.22 /u on host plant to 9.52 /u on potato dextrose agar. Appendage length was maximum on potato dextrose agar viz. 21.03 /u. The shortest appendages were produced on Czapek's agar viz. 20.46 /u. (Table 28)

Spores of the isolates from manilkara produced on Czapek's agar were significantly longer than those produced on potato dextrose agar and host plant. They measured 30.00 /u on potato dextrose agar, 33.04 /u on Czapek's agar and 26.40 /u on the host. Their breadth varied from 9.20 /u on potato dextrose agar to 9.49 /u on host. Same breadth was noticed in the case of spores obtained from potato dextrose agar and Czapek's agar viz. 9.29 /u. The maximum length of appendages was 26.47 /u obtained on Czapek's agar and the minimum was 23.64 /u on the P.D.A. (Table 29)

Table 27

Spore measurements (in /u) of Pestalotia mangiferae on different substrates

Symbol	Substrate	Mean	Range		S.D.	t value at 5% level		
			Minimum	Maximum				
Spore length								
A	Potato dextrose agar	33.07	25.17	39.25	5.24	A & B	0.05	NS
B	Czapek's agar	32.92	22.00	43.00	7.04	A & C	0.69	NS
C	Host	31.50	27.00	40.15	4.43	B & C	0.51	NS
Spore breadth								
A	Potato dextrose agar	9.45	8.75	10.50	0.60	A & B	0.54	NS
B	Czapek's agar	9.31	8.75	10.50	0.52	A & C	0.15	NS
C	Host	9.49	8.75	10.50	0.55	B & C	0.75	NS
Appendage length								
A	Potato dextrose agar	23.73	10.00	33.50	7.94	A & B	0.42	NS
B	Czapek's agar	22.35	10.50	31.00	5.64	A & C	0.14	NS
C	Host	24.21	12.50	32.25	6.73	B & C	0.63	NS

Table 28

Spore measurements (in /u) of Pestalotia sapotae on different substrates

Symbol	Substrate	Mean	Range		S.D.	t value at 5% level		
			Minimum	Maximum				
Spore length								
A	Potato dextrose agar	34.78	22.00	45.25	6.91	A & B	0.28	NS
B	Czapek's agar	33.91	22.50	42.50	6.19	A & C	2.11	S
C	Host	28.73	22.50	39.00	5.14	B & C	1.93	NS
Spore breadth								
A	Potato dextrose agar	9.52	8.75	10.50	0.66	A & B	0.54	NS
B	Czapek's agar	9.37	8.75	10.50	0.51	A & C	1.00	NS
C	Host	9.22	8.75	10.50	0.61	B & C	0.58	NS
Appendage length								
A	Potato dextrose agar	24.03	10.50	31.50	6.14	A & B	1.14	NS
B	Czapek's agar	20.46	10.50	31.50	7.08	A & C	0.80	NS
C	Host	21.46	10.50	31.50	7.50	B & C	0.20	NS

Table 29

Spore measurements (in /u) of Pestalotia sp. from Manilkara hexandra on different substrates

Symbol	Substrate	Mean	Range		S.D.	t value at 5% level		
			Minimum	Maximum				
Spore length								
A	Potato dextrose agar	30.09	21.00	38.50	16.09	A & B	0.51	NS
B	Czapek's agar	33.04	22.20	40.50	6.74	A & C	0.66	NS
C	Host	26.40	20.09	35.50	4.97	B & C	2.38	S
Spore breadth								
A	Potato dextrose agar	9.29	8.75	10.50	0.57	A & B	0.00	NS
B	Czapek's agar	9.29	8.88	10.50	0.51	A & C	0.71	NS
C	Host	9.49	8.75	10.50	0.66	B & C	0.71	NS
Appendage length								
A	Potato dextrose agar	23.64	10.25	37.00	9.38	A & B	0.71	NS
B	Czapek's agar	26.47	12.50	37.50	7.55	A & C	0.03	NS
C	Host	23.74	11.25	31.00	5.86	B & C	0.86	NS

The length of spores of Pestalotia sp. from Cinnamomum zeylanicum were 31.10 /u on potato dextrose agar, 32.70 /u on Czapek's agar and 27.91 /u on cinnamon leaf. Maximum length was obtained on Czapek's agar being 32.70 /u. Spores produced on the host leaf were only 27.91 /u long. The breadth varied from 9.36 /u on potato dextrose agar to 9.53 /u on Czapek's agar. Appendages on spores produced on the host were the longest, measuring 29.62 /u, while those produced on potato dextrose agar were the shortest, viz. 24.13 /u (Table 30)

In the isolate obtained from oil palm, the maximum spore length was obtained on Czapek's agar. Spores produced on this medium were significantly longer than those on potato dextrose agar and oil palm leaf. The measurements were 32.71 /u on potato dextrose agar, 36.55 /u on Czapek's agar and 31.67 /u on host leaf. The breadth of spores showed only very little variation from substrate to substrate. The breadth of spores on potato dextrose agar, Czapek's agar and host was 9.39 /u, 9.43 /u and 9.53 /u respectively. The appendage length was maximum on Czapek's agar viz. 26.86 /u and minimum on potato dextrose agar viz. 22.24 /u. (Table 31)

Table 30

Spore measurements (in /u) of *Pestalotia* sp. from *Cinnamomum zeylanicum* on different substrates

Symbol	Substrate	Mean	Range		S.D.	t value at 5% level		
			Minimum	Maximum				
Spore length								
A	Potato dextrose agar	31.10	20.15	41.25	6.67	A & B	0.48	NS
B	Czapek's agar	32.70	20.12	41.25	7.42	A & C	1.10	NS
C	Host	27.91	21.00	39.25	5.62	B & C	1.55	NS
Spore breadth								
A	Potato dextrose agar	9.36	8.75	10.50	0.62	A & B	0.61	NS
B	Czapek's agar	9.53	8.75	10.50	0.56	A & C	0.42	NS
C	Host	9.47	8.75	10.50	0.56	B & C	0.23	NS
Appendage length								
A	Potato dextrose agar	24.13	11.25	37.50	7.25	A & B	0.69	NS
B	Czapek's agar	26.66	11.50	38.25	8.23	A & C	1.33	NS
C	Host	29.62	11.50	40.50	10.07	B & C	0.68	NS

Table 31

Spore measurements (in /u) of *Pestalotia* sp. from *Elaeis guineensis* on different substrates

Symbol	Substrate	Mean	Range		S.D.	t value at 5% level		
			Minimum	Maximum				
Spore length								
A	Potato dextrose agar	32.71	21.00	42.50	7.24	A & B	1.23	NS
B	Czapek's agar	36.55	22.20	42.50	5.90	A & C	0.31	NS
C	Host	31.67	21.00	41.22	7.16	B & C	1.57	NS
Spore breadth								
A	Potato dextrose agar	9.39	8.75	10.50	0.65	A & B	0.15	NS
B	Czapek's agar	9.43	8.75	10.50	0.50	A & C	0.50	NS
C	Host	9.53	8.72	10.50	0.56	B & C	0.42	NS
Appendage length								
A	Potato dextrose agar	22.84	10.25	32.00	7.80	A & B	1.15	NS
B	Czapek's agar	26.86	10.75	36.50	7.04	A & C	1.18	NS
C	Host	26.70	14.25	35.50	5.89	B & C	0.05	NS

Table 32

Leaf analytical results

Treatments	N (%)	P (%)	K (%)	Mg (%)	Zn (ppm)	Mn (ppm)	Fe (ppm)
000	1.75	0.12	0.40	0.36	26	300	195
001	1.98	0.10	1.55	0.14	10	350	220
002	1.66	0.12	0.99	0.07	24	450	230
010	1.46	0.12	0.14	0.30	23	535	315
011	1.39	0.11	0.53	0.15	17	370	245
012	1.47	0.11	1.45	0.09	6	275	250
020	1.61	0.14	0.18	0.30	40	450	265
021	1.15	0.13	1.04	0.16	32	365	215
022	1.50	0.13	1.05	0.09	13	340	215
100	1.77	0.11	0.63	0.35	20	525	210
101	1.64	0.12	0.98	0.15	16	530	260
102	1.86	0.12	1.10	0.06	13	435	215
110	1.92	0.13	0.14	0.29	11	395	210
111	1.71	0.13	0.73	0.15	37	510	195
112	1.82	0.12	0.99	0.10	41	350	215
120	1.83	0.14	0.12	0.27	29	665	210
121	1.74	0.13	0.62	0.12	23	330	195
122	1.57	0.14	1.06	0.08	8	270	265
200	1.70	0.10	0.14	0.34	23	555	215
201	1.90	0.12	0.44	0.13	22	680	200
202	1.71	0.11	1.45	0.12	11	355	245
210	1.88	0.12	0.11	0.30	50	755	300
211	1.74	0.13	0.93	0.12	13	440	230
212	1.75	0.12	0.89	0.07	16	470	230
220	1.73	0.13	0.17	0.33	18	670	210
221	1.99	0.12	0.47	0.13	21	505	235
222	2.13	0.13	1.25	0.05	6	490	230

DISCUSSION

DISCUSSION

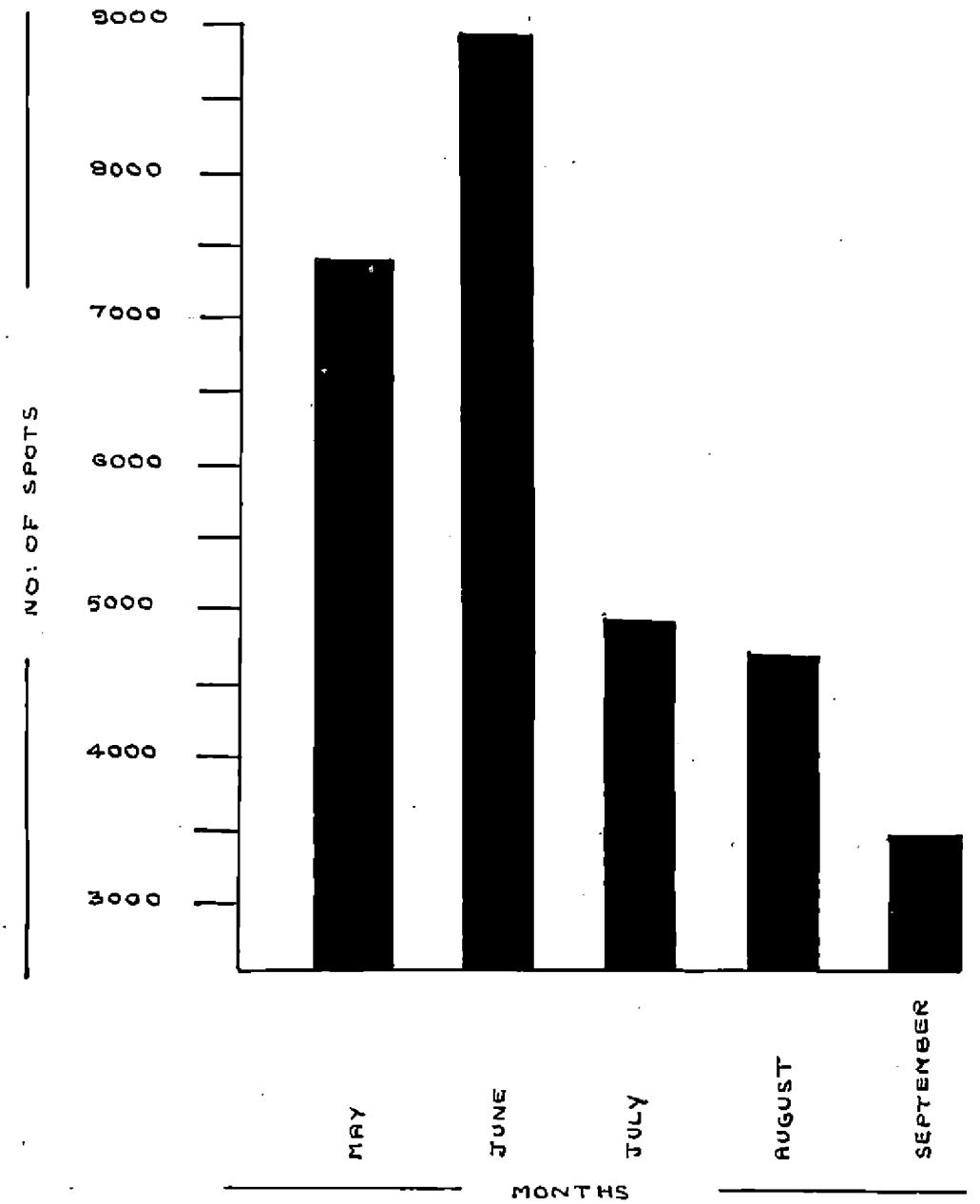
In this investigation two aspects were studied.

1. The nutritional aspects predisposing the coconut palms to the infection by Pestalotia palmarum.

2. The morphological characters of Pestalotia spp. from different host plants.

The maximum disease intensity was noticed in the month of June and the minimum in September for the five months studied viz. May, June, July, August and September. (Fig. 1) This aspect may be due to the influence of different parameters of climate on the host and the pathogen.

From the pooled data, the maximum disease intensity was recorded in the palms treated with 1 level of nitrogen, 2 levels of phosphorous and 2 levels of potassium. Minimum disease intensity was seen in the palms treated with 0 level of nitrogen, 1 level of phosphorous and 0 level of potassium. The level of potassium showed significant difference on the disease incidence in all the months studied. The level of phosphorous showed significant difference on the disease intensity in the months of June and August only. The combined results showed that an increase in the nitrogen content from 0 to 2 levels decreased the disease intensity whereas an increase in the phosphorous and potassium contents from 0 to 2 levels increased the disease severity. Correlation studies revealed that the effect of potassium on the disease intensity was highly



MONTH VAR DISEASE INTENSITY

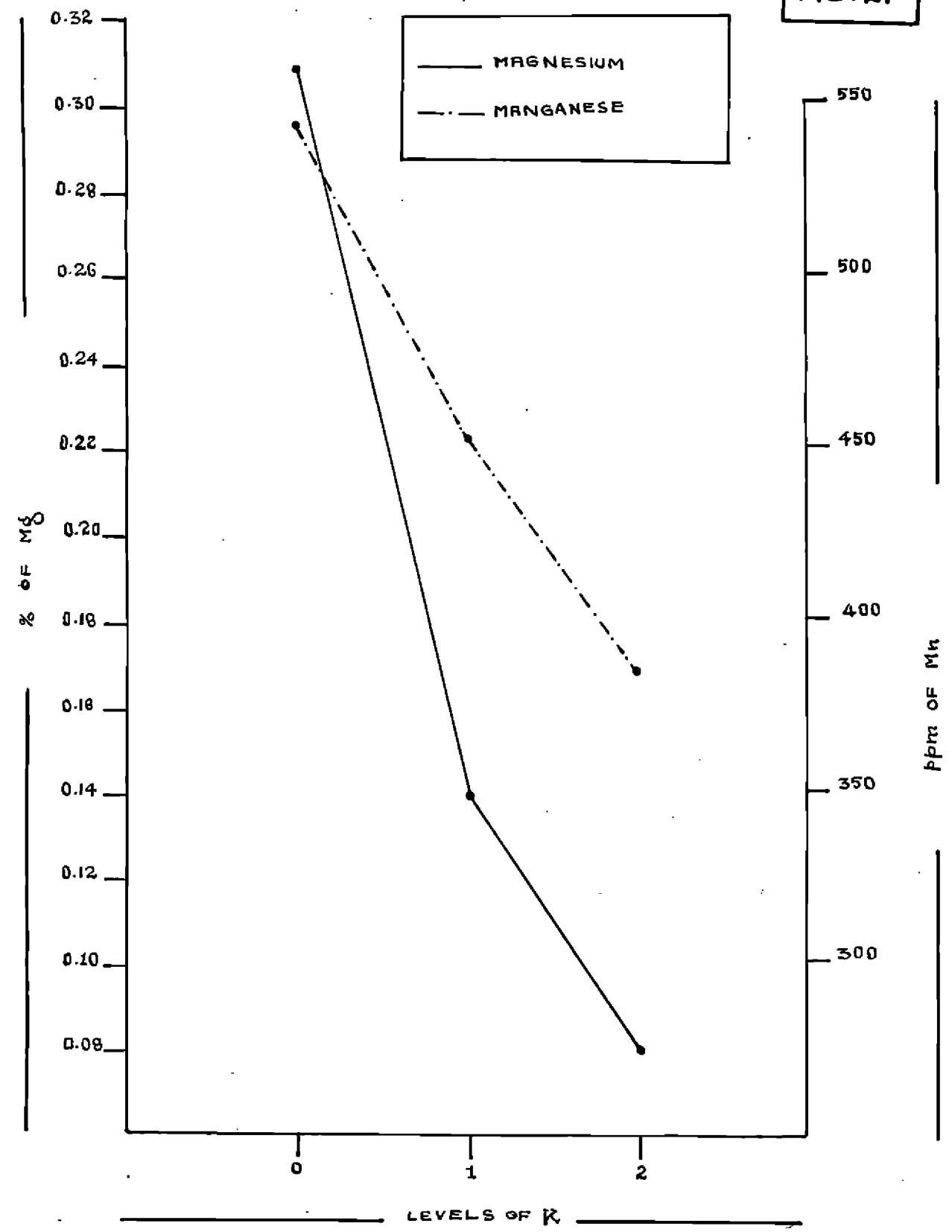
FIG. 1.

significant and showed a positive correlation. The effects of magnesium and manganese content in the leaf were also significant but showed a negative correlation. An increase in the potassium level resulted in a decreased magnesium and manganese content in the leaf tissues. Thus an increase in potassium content that led to a decrease in magnesium and manganese content resulted in an increased disease incidence.

Chemical analysis of leaf tissues revealed that at higher levels of potassium the disease intensity was highly significant. The content of magnesium and manganese showed significant negative correlation with disease intensity. The result thus revealed that an increase in potassium increased the severity of infection whereas a decrease in magnesium and manganese increased the severity of infection. The 1 - 2 - 2 treatment combination which gave the highest disease intensity showed a content of 1.06 % potassium, 0.08 % magnesium and 270 ppm manganese on leaf analysis. The treatment combination 0 - 1 - 0 which gave the least disease intensity contained 0.14 % potassium, 0.30 % magnesium and 535 ppm manganese on leaf analysis. (Table 32). Thus the results showed that an increase in the potassium content decreased the levels of magnesium and manganese in the palm and thereby increased the disease intensity. The illustration of the result is given in Fig. 2.

INFLUENCE OF K ON THE Mg AND Mn CONTENTS IN COCONUT PALM

FIG. 2.



Earlier workers showed that inadequacy of the dose of potassium was the real factor that predisposed the palms to the attack by Pestalotia palmarum. Menon et al;(1950) observed that the leaves of the coconut palms which were insufficiently supplied with potassium were very susceptible to the attack by Pestalotia palmarum. Child (1960) showed that omission of potassium led, in course of time to yellowing of foliage and incidence of attack by Pestalotia. Gallasch (1974) showed that increase in nitrogen content increased the seedling susceptibility to Drechslera incurvata leaf spot in coconut whereas both potassium and phosphorous fertilisers decreased it. But the present investigation revealed that an increase of potassium increased the grey leaf blight of coconut caused by Pestalotia palmarum. There are no reports available regarding the aggravation of grey leaf blight of coconut palm by the application of higher levels of potassium.

The chemical analysis revealed that the palms treated with 1 level of nitrogen, 2 levels of phosphorous and 2 levels of potassium contained maximum content of potassium and lower contents of magnesium and manganese in the leaf. The influence of magnesium on the disease intensity has been shown by several workers. Bull (1964) showed that there is a relationship between magnesium level and the occurence of Pestalotiopsis leaf spot of oil palm. Robertson et al;(1968) showed that magnesium deficiency was the real cause of the Pestalotiopsis

infection in Elaeis guineensis. Robert Cecil (1975) in his studies on the coconut (wilt) disease showed that the calcium and magnesium content of the healthy palms were significantly higher than those of apparently healthy or diseased palms.

The reason for the imbalance between potassium and magnesium has been shown by Tisdale and Nelson in 1970. They pointed out that the continuous application of potassic fertilizers to the soil can bring about a wide ratio of exchangable potassium to exchangable magnesium. The situation will be further aggravated by high levels of potassic fertilizers where the magnesium level of the soil is too low. Andre' Voisin (1965) stated that potassium has got antagonistic effect on elements like magnesium, calcium and sodium.

Based on the findings of Robertson et al;(1968). Umar Akbar et al;(1971), Tisdale and Nelson (1970), Bull (1964) and Andre' Voisin (1965), it may be assumed that the grey leaf blight of coconut caused by Pestelotia palmarum may be, atleast for a major part, is due to the lower contents of magnesium and manganese in leaf tissues. Due to the antagonistic property of potassium on magnesium and manganese, curtails the availability of these elements leading to an elemental imbalance in the leaves, a condition rendering them susceptible to infection by the fungus. It may be noted that the leaf analysis were performed only with regards to nitrogen, phosphorous, potassium, magnesium,

zinc, manganese and iron, this being the reason why other elements are not discussed. Whether the disease is aggravated by deficiencies of other elements like boron, molybdenum and copper could not be undertaken in the present investigation.

The species of Pestalotia isolated from the leaves of coconut, mango, sapota, oilpalm, cinnamon and Manilkara hexandra grew well on all the five culture media tested. A good degree of sporulation of all the isolates was obtained when grown on potato dextrose and Czapek's agar media, while moderate sporulation was noted on Oat meal agar.

The pathogenicity of the isolates was proved by artificial inoculation on their respective host plants. Slight injury was found to be necessary for successful infection. Earlier investigations of Bertus (1927), Guba (1932), Chowdhury (1946), Patel et al; (1950), Tandon and Srivastava (1964), Wilson et al; (1969) and Sivaprakasam et al; (1969) have shown that most of the species of Pestalotia are wound parasites and that they are not able to infect intact plant parts.

The spores of the isolates from mango, sapota, manilkara, oil palm and cinnamon, produced on artificial media, were longer than those produced on the host plant. The isolate from coconut, however, produced longer spores on the host leaf. The breadth of spores of all the isolates except Pestalotia sapotae and

Pestalotia sp. from cinnamon, was maximum on the host plant. Maximum spore breadth for Pestalotia saprae was seen on potato dextrose agar and Pestalotia sp. from cinnamon on Czapek's agar. Minimum spore breadth was noticed on potato dextrose agar for all the isolates except the isolates from sapota and mango. Minimum spore breadth for those isolates was noticed on host plant and Czapek's agar respectively. The appendage length of the spores of the isolates from coconut, mango and cinnamon was maximum on the host plant while those from oil palm and manilkara showed the maximum appendage length on Czapek's agar. The isolate from sapota showed the maximum length on potato dextrose agar. The minimum appendage length was noticed on Czapek's agar for the isolates from coconut, sapota and mango. The isolates from manilkara, oil palm and cinnamon showed minimum appendage length on potato dextrose agar. Variations in the spore size of certain fungi as influenced by different substrates have been reported by a number of workers. Increase in the size, particularly the length of spores produced on artificial media has been reported by Kulkarni and Patel (1956), Rangaswami and Pandurangan (1962) and Varma (1967) whereas Chowdhury (1944), Rangaswami and Sambandan (1960) and Gopalan (1963) reported decrease in the length of spores produced on culture media, in comparison with those produced on the host plant.

Cross inoculation tests revealed that all the six isolates are able to infect the leaves of coconut, mango, sapota, manilkara, oil palm and cinnamon as well. Injury to the host was however, found to be a prerequisite for the successful infection by all of them. This tallies well with the report by Robertson et al; (1968), that older leaves showed greater incidence of disease as compared to the younger ones. The greater degree of exposure of older leaves to mechanical shearing, insect bites etc. is obviously warranted. Nevertheless the role of a reduced magnesium and manganese levels should not be neglected in selective infection of the older leaves. The ability of certain species of Pestalotia to infect two or more host plants in nature or by artificial inoculation has been reported by Chowdhury (1946) and Sivaprakasam et al; (1969) in Pestalotia palmarum, Agarwall and Ganguli (1959) in Pestalotia versicolor, Bilgrami (1963) in Pestalotia funerea and Pestalotia leprodozae, Tandon and Srivastava (1964) in Pestalotia cruenta and Roy (1965) in Pestalotia albo-maculans.

From the foregoing discussion it can be noticed that eventhough the spore size of the different isolates was influenced by the substrate on which they are produced, it varied only within limits. Further, each of these isolates could infect all the six host plants tested, thereby indicating their plurivorus nature. Thus the opinion of Alexopoulos (1961) that " the

differentiation of species purely on the basis of the host from which they are isolated would result in the naming of a large number of non-existent species and that cross inoculations of different hosts would show that a number of these so called species represent one and the same fungus " becomes relevant in this context. However, earlier workers have treated the isolates from coconut, mango and sapota as distinct species namely, Pestalotia palmarum, Pestalotia mangiferae and Pestalotia sapotae respectively. This differentiation is mainly based on the host from which they were first isolated or recorded. But, on the basis of the results obtained during the present investigation it is apparent that the above speciation is no more tenable, because all the six isolates were able to cross infect each. other's host plant. Further support to this suggestion emerges from the following: Choudhury (1944) identified the isolate of Pestalotia from Borassus flabellifer as Pestalotia palmarum because of the ability of the fungus to infect coconut leaves. Sivaprakasam et al (1980) noted that the isolates of the fungus from chillies and coconut were cross inoculable and hence identified the one causing fruit rot of chillies as Pestalotiopsis palmarum (Cooke) Steyaert (Pestalotia palmarum Cooke).

It is therefore suggested that the isolates of Pestalotia (Guba, 1961) from coconut, mango, sapota, Manilkara hexandra, Elaeis guineensis and Cinnamomum zeylanicum should be brought

under one species and according to the existant rules of botanical nomenclature, the earliest name, Pestalotia palmarum Cooke should be adopted for the same.

It may be noted that Cinnamomum zeylanicum is a new host recorded for Pestalotia palmarum from India.

SUMMARY

SUMMARY

An investigation was carried out at the " Coconut Research Station, Balaramapuram " during the five months viz. May, June, July, August and September, to study the effect of different NPK combinations on the disease intensity. In the Research Station manurial treatments are given in a 3^3 confounded factorial design with 2 replications. The morphological characters of different species of Pestalotia have been studied along with this investigation.

The results of the experiment are summarised hereunder.

1. Maximum disease intensity was recorded in the month of June and minimum disease intensity was recorded in the month of September.

2. Maximum disease intensity was recorded in the palms treated with the following NPK combinations for the following months.

May : 0 level of nitrogen, 2 levels of phosphorous and 2 levels of potassium.

June : 1 level of nitrogen, 2 levels of phosphorous and 2 levels of potassium.

July : 1 level of nitrogen, 2 levels of phosphorous and 2 levels of potassium.

August : 1 level of nitrogen, 2 levels of phosphorous and 2 levels of potassium.

September : as above.

3. Minimum disease intensity was noticed in the palms treated

with the following NPK combinations for the following months.

May	: 1 level of nitrogen, 0 level of phosphorous and 2 levels of potassium.
June	: 2 levels of nitrogen, 0 level of phosphorous and 0 level of potassium.
July	: 1 level of nitrogen, 1 level of phosphorous and 0 level of potassium.
August	: 0 level of nitrogen, 1 level of phosphorous and 0 level of potassium.
September	: 1 level of nitrogen, 1 level of phosphorous and 0 level of potassium.

4. From the pooled data, the maximum disease intensity was recorded in the palms treated with 1 level of nitrogen, 2 levels of phosphorous and 2 levels of potassium. Minimum disease intensity was seen in the palms treated with 0 level of nitrogen, 1 level of phosphorous and 0 level of potassium.

5. The level of potassium showed significant difference on the disease incidence in all the months studied. The level of phosphorous showed significant difference on the disease intensity in the months of June and August only.

6. The combined results showed that an increase in the nitrogen content from 0 to 2 levels decreased the disease intensity whereas an increase in the phosphorous and potassium contents from 0 to 2 levels increased the disease severity.

7. Correlation studies revealed that the effect of potassium on the disease intensity was highly significant and showed a positive correlation. The effects of magnesium and manganese were also significant but showed a negative correlation. An increase in the potassium level resulted in a decreased magnesium and manganese content in the leaf tissues of the palm. Thus an increase in potassium content that led to a decrease in magnesium and manganese content resulted in an increased disease incidence.

8. The isolates of Pestalotia from coconut, mango, sapota, Manilkara hexandra, Elaeis guineensis and Cinnamomum zeylanicum grew well on potato dextrose, oat meal, Richard's, Czapek's and Sabouraud's agar media.

9. Good sporulation of all the isolates was obtained on potato dextrose and Czapek's agar media, while only a moderate sporulation was noted on oat meal agar.

10. Cross inoculation tests revealed that all the six isolates are able to infect the leaves of coconut, mango, sapota, cinnamon, oil palm and manilkara. Slight injury was found necessary for successful infection.

11. Though the spore size of the different isolates of Pestalotia was influenced by the substrate on which they are formed, it varied only within limits. The average length and breadth of spores produced by them on different media ranged between

34.07 - 34.53 /u x 9.43 - 9.65 /u in Pestalotia palmarum; 31.67 - 36.55 /u x 9.39 - 9.53 /u in the isolate from Elaeis guineensis; 28.73 - 34.78 /u x 9.22 - 9.52 /u in Pestalotia sapotae; 31.50 - 33.07 /u x 9.31 - 9.49 /u in Pestalotia mangiferae; 27.91 - 32.70 /u x 9.36 - 9.53 /u in the isolate from Cinnamomum zeylanicum and 26.40 - 33.04 /u x 9.29 - 9.49 /u in the isolate from Manilkara hexandra.

In this investigation the palms which were treated with 1 level of nitrogen, 2 levels of phosphorous and 2 levels of potassium showed high content of potassium and low contents of magnesium and manganese. So it was concluded that an increase in potassium content caused a decrease in the magnesium and manganese contents in leaf tissues. This decrease in magnesium and manganese contents resulted in an increase in the severity of the disease.

Based on the results obtained from the morphological study and the success not with in cross inoculation, it is suggested that the isolates of Pestalotia from coconut, mango, sapota, cinnamon, Manilkara hexandra and Elaeis guineensis should be brought under one species and that the earliest name Pestalotia palmarum Cooke should be adopted for the same.

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* Originals not seen.

APPENDICES

APPENDIX I

Analysis of variance table ($\sqrt{x+1}$ transformation)

Effect of NPK on the disease intensity

for the month of May

Source	S.S.	DF	M.S.	F ratio
Total	1422.62	53		
Block	107.70	5	21.56	1.24
N	82.25	2	41.53	2.37
P	100.19	2	50.95	2.94
N X P	73.12	4	18.28	2.11
K	237.80	2	118.90	6.86**
N X K	36.77	4	9.19	0.53
P X K	236.77	4	59.19	3.42*
N X P X K	2.73	2	1.37	0.08
N P^2K	92.96	2	46.48	2.68
N P K^2	30.61	2*	15.31	0.88
N P^2K^2	39.40	2*	19.70	1.14
Error	381.23	22	17.33	

** Significant at 0.01% level

* Significant at 0.05% level

APPENDIX II

Analysis of variance table ($\sqrt{x+1}$ transformation)

Effect of NPK on the disease intensity

for the month of June

Source	S.S.	DF	M.S.	F ratio
Total	2218.80	53		
Block	130.25	5	26.05	1.08
N	18.46	2	9.23	0.38
P	197.86	2	98.93	4.09*
N X P	226.78	4	56.70	2.34
K	562.54	2	281.27	11.63**
N X K	130.65	4	32.66	1.35
P X K	272.24	4	68.06	2.81
N X P X K	2.86	2	1.43	0.06
N P^2K	106.33	2	53.17	2.20
N P K^2	13.36	2*	6.68	0.28
N P^2K^2	55.40	2*	27.70	1.15
Error	532.07	22	24.19	

* Significant at 0.05% level

** Significant at 0.01% level

APPENDIX III

Analysis of variance table ($\sqrt{x+1}$ transformation)

Effect of NPK on the disease intensity

for the month of July

Source	S.S.	DF	M.S.	F ratio
Total	1217.07	53		
Block	209.55	5	41.91	1.84
N	57.20	2	28.60	1.26
P	91.49	2	45.75	2.01
N X P	112.43	4	28.12	1.24
K	246.45	2	123.23	5.41*
N X K	101.75	4	25.44	1.12
P X K	277.30	4	69.33	3.04*
N X P X K	14.97	2	7.49	0.33
N P^2K	44.22	2	22.11	0.97
N P K^2	80.26	2*	40.13	1.76
N P^2K^2	80.55	2*	40.28	1.77
Error	500.86	22	22.77	

* Significant at 0.05% level

APPENDIX IV

Analysis of variance table ($\sqrt{x+1}$ transformation)

Effect of NPK on the disease intensity

for the month of August

Source	S.S.	DF	M.S.	F ratio
Total	1627.96	53		
Block	213.79	5	42.76	4.88*
N	54.09	2	27.05	3.08
P	119.52	2	59.76	6.81**
N X P	128.83	4	32.21	3.67*
K	315.61	2	157.81	17.99**
N X K	106.16	4	26.54	3.01*
P X K	199.67	4	49.92	5.69**
N X P X K	14.17	2	7.09	0.81
N P^2K	10.53	2	5.27	0.60
N P K^2	77.63	2*	38.82	4.43*
N P^2K^2	196.12	2*	97.56	11.12**
Error	192.84	22	8.77	

* Significant at 0.05% level

** Significant at 0.01% level

APPENDIX V

Analysis of variance table ($\sqrt{x+1}$ transformation)

Effect of NPK on the disease intensity

for the month of September

Source	S.S.	DF	M.S.	F ratio
Total	1263.68	53		
Block	160.45	5	32.09	2.29
N	40.39	2	20.20	1.44
P	62.43	2	31.22	2.23
N X P	83.56	4	20.89	1.49
K	245.88	2	122.94	8.78**
N X K	117.48	4	29.37	2.10
P X K	148.33	4	37.08	2.50
N X P X K	6.22	2	3.11	0.22
N P^2K	13.44	2	6.72	0.48
N P K^2	47.06	2*	23.53	1.68
N P^2K^2	30.25	2*	15.13	1.08
Error	308.09	22	14.00	

** Significant at 0.01% level

APPENDIX VI

Analysis of variance table ($\sqrt{x+1}$ transformation)

Effect of NPK on the disease intensity

for the pooled data

Source	S.S.	DF	M.S.	F ratio
Treatment	5359.43	26	206.13	11.84
N	208.10	2	104.05	5.97**
P	516.96	2	258.48	14.85**
N X P	552.88	4	138.22	7.94**
K	1546.11	2	773.06	44.42**
N X K	339.54	4	84.89	4.87**
P X K	1018.34	4	254.59	14.63**
N X P X K	25.21	2	12.61	0.72
N P^2K	172.14	2	86.07	4.94**
N P K^2	208.95	2*	104.48	6.00**
N P^2K^2	335.98	2*	167.99	9.65**
Error	1915.09	110	17.40	

** Significant at 0.01% level

APPENDIX VII

Analysis of variance table

Effect of solid media on the growth of

Pestalotia sp. from *Manilkara hexandra*

Source	S.S.	DF	M.S.	F ratio
Total	6658.68	24		
Treatment	2038.25	4	509.56	2.21
Error	4619.99	20	231.00	

APPENDIX VIII

Analysis of variance table

Effect of solid media on the growth o

Pestalotia sp. from *Elaeis guineensis*

Source	S.S.	DF	M.S.	F ratio
Total	5663.70	24		
Treatment	197.33	4	49.33	0.18
Error	5471.37	20	273.57	

APPENDIX IX

Analysis of variance table

Effect of solid media on the growth of

Pestalotia sp. from *Cinnamomum zeylanicum*

Source	S.S.	DF	M.S.	F ratio
Total	8576.03	24		
Treatment	501.26	4	125.32	0.31
Error	8074.77	20	403.74	

APPENDIX X

Analysis of variance table

Effect of solid media on the growth of

Pestalotia macrifera

Source	S.S.	DF	M.S.	F ratio
Total	6896.37	24		
Treatment	591.36	4	147.84	0.47
Error	6305.01	20	315.25	

APPENDIX XI

Analysis of variance table

Effect of solid media on the growth of

Pestalotia sapotae

Source	S.S.	DF	M.S.	F ratio
Total	5190.34	24		
Treatment	149.74	4	37.44	0.15
Error	5049.60	20	252.48	

APPENDIX XII

Analysis of variance table

Effect of solid media on the growth of

Pestalotia palmarum

Source	S.S.	DF	M.S.	F ratio
Total	9141.35	24		
Treatment	186.78	4	46.70	0.10
Error	8954.57	20	447.73	

STUDIES ON THE GREY LEAF BLIGHT DISEASE OF COCONUT PALM CAUSED BY *Pestalotia palmarum* Cooke

By

A. J. FRANCIS

ABSTRACT OF A THE

Submitted in partial fulfilment of the

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ABSTRACT

Studies on the grey leaf blight disease of coconut palm caused by Pestalotia palmarum Cooke.

An investigation was carried out in the palms at the Coconut Research Station, Balaramapuram during the months of May, June, July, August and September of 1976 to study the influence of different nutrients on the intensity of disease caused by Pestalotia palmarum. The experiment was conducted on the palms which were treated with different combinations of NPK in a 3^2 confounded factorial design. Morphological characters of different species of Pestalotia were also studied along with this investigation.

Highest degree of infection was noticed in the month of June and the lowest in September. Higher disease intensity was noted in the palms which were treated with 1 level of nitrogen, 2 levels of phosphorous and 2 levels of potassium than in those that were treated with 0 level of nitrogen, 1 level of phosphorous and 0 level of potassium.

On leaf analysis the palms which showed highest degree of infection by Pestalotia palmarum were found to contain a sub-optimal level of magnesium and manganese, this being concomitant with a high level of potassium. So an increase

in potassium level decreased the levels of magnesium and manganese thereby predisposing the palms to attack by the fungus.

Different isolates of Pestalotia from different host plants viz. coconut, mango, sapota, manilkara, cinnamon and oil palm showed good sporulation on potato dextrose and Czapek's agar and moderate sporulation in oat meal agar. The influence of 5 media tried viz. potato dextrose, oat meal, Czapek's, Richard's and Sabouraud's agar did not show any effect on the growth of these isolates.

Cross inoculation tests revealed that all these isolates are able to infect each other's natural hosts.