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Some Diseases of Crops in the Andaman Islands

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Some Diseases of Crops in the Andaman Islands.

(Received for publication on 19th December 1928.)

At the invitation of Lt.-Col. Ferrar, Chief Commissioner of the Andaman and Nicobar Islands, I visited the settlement accompanied by Mr. Md. Taslim, a Fieldman in the Mycological section, in February 1927 with a view to make a survey of the diseases present on various crops. We stayed in Port Blair for 18 days and visited most of the plantations in the settlement. The Assistant Commissioner very kindly gave us a guide and made all arrangements for our visiting the various places.

The crops examined were coconut palms, Hevea rubber, jack-fruit, mango, mangosteen, lime, orange, tea, coffee, plantain, sugarcane, tomato and rice and the diseases seen were as follows.

I. Coconut palms.

Altogether 13 gardens of a total area of about 2,000 acres were visited. In the Andamans this palm is little subject to disease at present as the planters take immediate steps to destroy diseased trees in order to save the healthy ones.

1. Root-disease caused by *Botryodiplodia* sp.

This does not cause much damage and only a few cases were found in coconut gardens at Minne Bay, North Bay and Mithkhari. Specimens supposed to illustrate Bud-rot have been sent from time to time to Pusa for examination but these have been proved to be cases of *Botryodiplodia* sp. The latter is a root disease. A similar disease has been described by Stockdale in Trinidad and British Guiana, by Butler in Travancore and by Ridley in Borneo. The disease is said to infect healthy trees through the roots in the soil but the progress is slow. Though the disease is really one of the root system the first obvious symptom is that the leaves turn yellow, beginning at the top of the coconut, become dry and hang down. Sometimes however the outermost circle of leaves is the first to wilt. After the yellowing of the leaves, trees bearing a good crop of nuts as a rule gradually shed

most if not all of them and the flowers subsequently produced do not set. The general appearance is similar to that produced by drought. On digging up the roots they are found to be dark brown, soft and rotten.

Remedial measures. (1) Destruction of all diseased materials including roots in order to prevent the fungus infecting healthy trees; (2) isolation of the diseased area by digging a trench two feet deep round each diseased plant; (3) giving a rest of one year to the infected land; (4) good cultivation and drainage; (5) addition of quick lime to the soil. This procedure tends to hasten the rotting of any portion of the host and fungus left after removing the roots.

2. Stem bleeding disease caused by *Thielaviopsis paradoxa.*

This disease is fairly common in all the coconut gardens in the Andamans but so far has not done much damage. A reddish brown fluid oozes out through a crack or perforation that may be found on the surface of the stem and later on turns dark brown as it dries. Below the bleeding portion, the tissue is found on examination to be decayed and yellow. If a knife is thrust below the dark brown patch to remove a portion of the bark, a yellowish fluid will gush out. In early stages of the disease the discoloration or decay of the tissue is localized, in advanced stages when more than one bleeding patch can be seen, a general decay of the internal tissue takes place. When this stage is reached the tree ceases to bear nuts, the crown dwindles and finally the tree dies. To prevent secondary infection all diseased parts of the trunk should be cut away and burnt; for if they are left lying about they will serve as a source for infecting healthy trees.

Remedial measures. The diseased parts of the coconut stem should be completely cut out as early as possible and even a little more of the healthy tissue should be removed to make sure that the diseased tissue has been altogether removed. An antiseptic such as tar should be applied hot, thus securing its penetration to about half an inch into tissue. As the cut surface is wet and the antiseptic will not stick to a wet surface, the wet portion should be dried by scorching it either with a lighted torch made of coconut leaves or with a cloth soaked in oil tied to the end of a stick. This method has been found to be effective in Madras and elsewhere.

3. Bud-rot disease caused by *Phytophthora palmivora.*

The first definite external indication that a coconut tree is affected is to be found in the yellowing of the spike and adjoining central leaves.

If the bud is cut open, darkened water-soaked spots will be seen at the base of the leaves and at a later stage the uppermost part of the stem and its young developing leaves become soft and rotten, the whole emitting a putrid odour.

This disease is rare in the Andamans and only six cases were found in all the gardens. These trees were destroyed by burning so that there is no likelihood of the disease spreading in the settlement as long as proper precautions are taken. This disease has done much harm in some countries so that it is to be looked upon as a dangerous one which should be carefully watched. The cabbage of infected trees should be completely destroyed by burning to prevent the disease from spreading to healthy trees. One diseased tree may infect a large number of healthy trees in a year's time, hence the necessity for a careful inspection of the plants by each owner and the removal of diseased ones. The bolos and axes used in splitting and chopping the diseased trees should be heated in a flame in order to kill any fungus that may adhere to them. It is better to sacrifice a few diseased trees than to run the risk of hundreds rotting.

4. Nut-fall disease caused by a species of *Phytophthora*.

This disease resembles if it is not actually identical with one found in Malabar and Ceylon. Young as well as mature nuts fall off in large numbers. The fallen nuts are of dark brown or blackish brown colour at the base or place of attachment. These discoloured patches are in some cases confined to the basal region of the nuts alone or on others extend nearly over the whole basal half of the fruits. On breaking open a fallen nut, the husk is found to be soft and rotten in patches. The kernal is soft and rotten, emits an unpleasant odour and is unfit for consumption. The milk of the nut is brown and emits a putrid smell. The main axis of the inflorescence and the individual nut branches turn dark brown and rot with the result that all the nuts on a diseased inflorescence drop off.

Remedial measures. All diseased and rotten nuts should be picked up and burnt along with the rotten and decayed stalks and inflorescences. If the disease becomes severe inflorescences should be sprayed with Bordeaux mixture just before the rain sets in and once again during a spell of clear weather.

5. Leaf diseases.

A leaf spot disease caused by *Pestalozzia palmarum* is very common in the Andamans. It does no particular damage but it reduces the vitality of the trees. The spots, at first small are brown to black and

circular; later they become irregular to slightly oblong and have a light brown to ashy-grey centre with a narrow dark brown border. Another leaf spot disease is caused by *Exosporium palmivorum*. This disease produces black tubercles or wart-like bodies on the surface of affected leaves. A species of *Myco-Sphaerella* has also been seen on many leaves. Little can be done against such spots except in the nursery where, when the spotting becomes very severe, spraying with Bordeaux mixture will protect the healthy leaves.

A large number of plants were found to be in an unhealthy condition with leaves drooping. They were examined in large numbers but no fungus was found in the crown or roots. Perhaps this unhealthy condition may be due to some soil factor and the only likely remedy is improved cultivation. In most gardens this is rather neglected.

II. Hevea rubber.

1. Leaf spot diseases.

(*a*) *Helminthosporium heveae*. This fungus attacks the leaves of nursery plants when the latter are 3 or 4 feet high. It produces minute round purple spots which later on become white and semi-transparent, surrounded by a narrow purple brown border. This disease is not serious.

(*b*) Rim blight (*Sphaerella heveae*). Numerous minute yellowish spots crowded together in groups appear from the margin inward between the veins. The spots become thickened, purple or purple brown and later on grey. The fructifications appear as minute black points on the margin of the spots. The disease does no appreciable damage and was recorded only on young plants in the nursery.

(*c*) Leaf spot caused by *Colletotrichum heveae*. This fungus also forms dry, greyish-brown spots of irregular shape on the leaves. The damage produced is slight.

2. Root disease caused by *Botryodiplodia Theobromae*.

A large number of young plants about 1 foot in height were found dying or dead in a nursery. Examination of the roots showed the presence of *Botryodiplodia Theobromae* a fungus which is also responsible for die-back disease. The fungus can live in the soil. Application of lime to the infected soil after removal of the diseased plants is suggested as a control measure. Alternately seedlings should be grown in baskets in sterilized soil.

3. Die-back disease caused by *Botryodiplodia Theobromae.*

Dying of the branches and twigs from their tips downwards is the first symptom. The wood of the affected parts becomes blackened and the cambium and the innermost layers of the cortex discoloured. In young plants the main shoot is attacked, in older plants only the lateral shoots. The fungus grows and fructifies freely on the dead and dying wood. The disease at present does no great harm. If however it were to become serious a suggested control measure would be the collecting and burning of all dead wood. Diseased branches should be removed by cutting back until sound wood is reached.

4. Pink disease caused by *Corticium salmonicolor.*

This disease affects the main stem and branches. It is easily recognized by the pinkish incrustation of the fungus mycelium which occurs on the parts attacked. The fungus penetrates the bark thus causing it to crack and peel away from the wood. The disease gradually extends and finally surrounds the stem and branches. In advanced cases it forms cankers. The diseased branch should be cut off a foot below the infected part and the cut end tarred and painted with Bordeaux mixture. The affected branches should be burnt.

5. Black thread blight and canker disease.

These diseases are also suspected to be present in the Andamans on rubber but the fungus could not be isolated on account of the extreme dry weather. Unseptate mycelium of *Phytophthora* was seen though no sporangia were noticed.

In order to recognize these diseases the symptoms are given below :—

Black thread. The appearance of vertical, narrow, slightly depressed, black lines parallel to one another. These penetrate the exposed bast to the cambium and the wood. The blackening spreads laterally and may cover the entire surface of the cut area. The latex oozes out of the vertical cracks and deeply sunken areas and coagulated latex collects on the new bark forming the margin of the cut with the result that the renewed bark bulges and finally decays. The affected parts later on cease to produce latex. The disease is favoured by the presence of humid, stagnant air in the plantation. It is caused by *Phytophthora meadii.* The only certain method of controlling this disease is to abstain from tapping during the spells of wet weather. When the disease is slight in amount, its spread may be prevented by painting the exposed surface of the bark with an antiseptic such as a thin mixture of tar and tallow or with brunolineum and similar wood preservative.

Canker. This disease is recognized easily by the longitudinal and transverse splitting of the bark and the formation of loose scales, usually surrounding wounds where canker is formed. Removal of the diseased area of bark (canker) as a control measure is suggested with the application of tar to the wounded portion.

III Jack fruit.

Only one fungus was noticed on the tree, *viz.*, *Rhizopus artocarpi*, which causes fruit mould. It produces no serious effects, and hence no remedial measures are required.

IV. Mango.

Sooty mould on leaves caused by *Capnodium* sp. and a leaf spot disease caused by *Pestalozzia* sp. are common. They do no damage.

V. Mangosteen.

A disease which resembles die-back was noticed but the cause could not be found. Dried twigs should be cut off and burnt and the garden should be kept clean.

VI. Lime and Orange.

1. ANTHRACNOSE (WITHER TIP) CAUSED BY *Colletotrichum gloeosporioides.*

This disease is very prevalent in the settlement and a very large number of plants (up to 90%) were more or less affected. Older plants seemed to be more susceptible than young plants. The growers call this disease also by the name of "Die-back" because the twigs die from the tip downwards and the leaves wither. This disease is serious and care should be taken at once to deal with it. The diseased parts should be cut out and burnt, care being taken to cut far enough back to get all injured parts and the plants should be sprayed with Bordeaux mixture.

2. SOOTY MOULD (*Meliola Butleri*).

This desease has also been noticed on the leaves and fruits but it is not serious. The disease covers the fruits and leaves with a black, velvety, membranous coating which may be stripped from the leaves.

VII. Tea.

There is only one tea garden in the Andamans. This was in very bad condition and appears to have been much neglected. However the present owner is trying his best to put it in order. The first step

towards controlling the diseases is to improve the sanitary condition of the garden. Effort should be concentrated on increasing the vigour of growth of the bushes so as to strengthen their capacity to resist diseases. The cultivation and drainage system should be improved.

1. Red Rust (*Cephaleuros mycoidea*).

This is an algal parasite which occurs on a very large number of plants growing in the jungle and as weeds in tea gardens. It attacks leaves, petioles, leaf stalks and stems on all of which it forms red patches. The damage is greater after pruning and after the first heavy rain. The pruned stems become red in irregular patches. Red rust is a disease of weak bushes and does not become serious unless the bushes are for some reason or other not in a vigorous condition. Weakness of the bush may be due to one of several causes—lack of drainage, shallow soil, formation of a hard pan, poverty of the soil and lack of manure, hard plucking, etc.

2. Grey blight (*Pestalozzia Theae*).

Attack by this fungus leads to the formation on the leaves of spots which are often irregularly circular or oval in shape. The upper surface is concentrically zoned with pale and dark brown, or with pale brown and grey. The spot is at first surrounded by a narrow greenish-yellow zone. On the under surface it is greyish brown and less evidently zoned. When old the patch becomes grey or greyish white.

The remedial measures are the same as for red rust.

3. Brown blight (*Colletotrichum Camelliae*).

The first symptom is the appearance of small, yellowish-brown spots on the upper surface of the leaf, which extend both laterally and through the leaf, causing similar spots on the under surface. The colour deepens to chocolate brown and the margin becomes marked by concentric zones of lighter and deeper shade. Sometimes several spots coalesce and form irregular patches.

Remedial measures. Good cultivation, and if the disease is persistently severe, handpicking and burning of infected leaves.

4. Thread blight (Sterile *Mycelium*).

The attack becomes visible by the appearance of white threads or strands of fungous tissue which pass along the branches and spread out into fine, web-like films on the under surface of the leaves. The effect on the leaves is that browning and death of the leaf cells set in. The

treatment usually adopted is to cut out all the parts affected at the pruning season.

5. TEA SEED MOULD.

Tea seeds were found the insides of which were affected by a mould though the surface appeared sound. The cause is a common mould, a species of *Penicillium*. The latter is a weak parasite but its presence lessens the percentage of germination. Care in handling to prevent the seed-coat from cracking is the only practical remedy.

6. In addition to the above *Massarina usambarensis and Massaria* sp. were collected from the bark of tea. The damage done by them is not known.

VIII. Coffee.

1. RUST (*Hemileia vastatrix*).

This disease is mostly confined to the leaves of coffee, but sometimes it occurs on the fruits and even on the tips of the young branches. In its early stages coffee rust appears as small yellowish spots on the under-surface of the leaves. As the disease develops the colour deepens to orange. The coloured powdery substance consists of the fungal spores. In advanced stages of the disease the same kind of spots become visible on the upper surface of the leaves. Usually plants of all ages are affected and in severe infection the plants may be entirely defoliated. A large number of seedlings were found dying or in a very unhealthy condition on account of this disease.

The disease may be controlled by collecting and burning all the infected leaves. Spraying with Bordeaux mixture is also recommended. Resistant varieties should be planted in future and these can be had in South India.

2. "DIE-BACK."

A disease of coffee which resembles "die-back" was also found. The affected twigs were blackened and appeared life-less or with no or very few leaves. The twigs later on become dry and brittle. The fungus responsible for this disease is not definitely known. *Colletotrichum* sp. and *Hemileia* were found and are suspected of causing the trouble but it is not known which of these fungi is the primary cause. Some planters attribute the disease to physiological conditions of the soil and say that it is more prevalent in stony and eroded hilly plantations.

IX. Plantains.

1. FRUIT-ROT OR ANTHRACNOSE CAUSED BY *Gloeosporium musarum*.

This disease is a very common disease of bananas. It is characterized by small black circular specks on the skin. These spots increase in size, become sunken, coalesce and form larger spots. In severe cases of infection the entire "hand" and branch may be completely covered. In the dead sunken area there develop characteristic moist pinkish groups of spores which in the later stages of the disease are dry and hard. Ripe fruits when infected rot very rapidly.

To avoid field infection the spacing should be adequate in not less than 12 feet by 12 feet, and general cleanliness should be maintained in the plantation.

2. BANANA WILT.

This disease is recognized by the yellowing and wilting of the leaf blades and petiole, usually beginning at the lowest or outermost. Infection takes place from the roots and the organism responsible is possibly *Fusarium* sp. Often the affected plants are stunted and appear as if water starved. Internally the tissue becomes discoloured.

Remedial measures. Dig up and burn affected plants.

In the Philippines the use of resistant varieties such as Lacatan, Suba, Tarnato, etc., is recommended.

X. Sugarcane.

Very little sugarcane is grown in the settlement and only one thick variety of unknown name, probably got from Burma, was seen. The sugarcane suffers more from borers than from fungous diseases. Leaf spot disease caused by *Leptosphaeria Sacchari* and another known as "Rind disease" caused by *Melanconium Sacchari* were noticed. These do not do much damage. There was no red-rot or mosaic noticed. It is suggested that the Government Sugarcane Expert, Coimbatore, should be asked for suitable varieties of cane for trial. Setts should be carefully selected at the time of planting.

XI. Tomato.

Wilt of tomato caused by *Fusarium* probably *F. Lycopersici* is very severe in the settlement. It is characterized by yellowing, by upward and inward rolling of the leaves and by wilting followed by death.

No treatment is possible except to avoid having tomato more often than once every three or four years on the same land. The fungus

is a soil dweller and can doubtless, like its allies, remain for a considerable time in land that has borne a diseased crop.

Sterilization of the soil, or its replacement from an uncontaminated source, has been employed with success in the large glass house tomato industry in Europe and America. Much progress has been made in the development of wilt resistant strains and the only successful means of controlling wilt is through the introduction of resistant varieties, such as 'Duke of York' and 'Buckeye state.' 'Livingston's glove' is also resistant but not so markedly as the two just mentioned. "Marvel," "Arlinglow" and "Norton" are new varieties which produce heavy crops of excellent fruits and are wilt-resistant.

Wilt is carried to some extent by seed and it has been noticed that the amount of wilt increased from year to year when seed from infected plots was saved for planting. The most important method of spreading wilt is through infected seedlings from seed beds. The fungus frequently occurs in the seed bed soil in wilt infected places. As such soil is rich in organic matter, the fungus multiplies rapidly and soon invades the roots of the seedlings.

XII. Rice.

At the time of visiting, the crop had been harvested and therefore little opportunity was available for studying the fungus pests. A sclerotial disease caused by *Sclerotium Oryzae* Catt was observed here and there on the stubble of small groups of plants. Plants are more or less shrunken with light poorly filled panicles. Sometimes no grain formation takes place, large numbers of brownish black, spherical sclerotia were found in the tissue on splitting the stalk or inside the leaf sheath. These are the seeds by which the disease is propogated. This disease is probably of minor importance.

CONTROL OF PLANT DISEASES.

There are several ways of avoiding diseases in plants, *e.g.*, (1) to avoid the bringing in of diseases when plants are introduced from outside sources, (2) to destroy diseased parts of plants, wherever found in order to reduce the amount of the disease-carrying organism (this is what is meant by sanitation), (3) to give the plants the best possible conditions so that they will be vigorous, (4) to grow resistant varieties, *i.e.*, varieties which have been found by experience to be resistant or immune to disease, (5) to protect the healthy plants by placing on them a fungous killing substance. The first three methods require all the thought, energy and perseverance that a good cultivator can give to his business and need not be elaborated here, though they are of

the utmost importance in combating disease. The fourth method depends on what resistant varieties have been evolved by people who have worked on diseases. It must be remembered that a variety that is resistant to one disease may be susceptible to others to which the plant is liable. A cultivator of the permanent crops like rubber, coconut, tea or coffee can himself choose plants that are not or little affected by disease for purposes of future planting.

The fifth method requires some description. What is wanted is to enclose the susceptible parts of a plant in a covering that will prevent the fungus from entering the plants. This involves the use of fungicides :

(*a*) applied to the host (i) by spraying with sprayers, (ii) by dusting, as with sulphur, (iii) by disinfecting seeds or other propagating stock, *e.g.*, seed disinfection for oat smut, etc., (iv) by disinfecting wounds as in the bleeding disease of coconut palms and rubber canker, etc.

(*b*) applied to the environment (i) soil sterilization, (ii) sterilization of tools, such as those used for bark cutting in rubber cultivation, (iii) disinfectant of containers, carriers, storage quarters, etc.

The term " fungicide " means any agent of whatever nature that is applied either to the plants or plant's parts or to the environment of the plant, such as soil, tools, containers, carriers, ware-house, etc., for the purpose of disinfecting the plant or plant parts, or the environment or for the purpose of protecting the plant against infection. Various fungicides have been tried with varying success, Bordeaux mixture is the most useful because it is most easily prepared, the ingredients are easily available, the cost is moderate, the efficiency good and it is easily seen when dry on the plant. The best practical way of putting it on the plant is to spray it on them with a sprayer. In spraying plants the ideal to aim at is the production of a fog that settles on the foliage as a dense mist, forming minute droplets that evaporate, leaving on the surface of the foliage a uniform layer of the dried mixture. A spray like Bordeaux mixture is preventive in its action and not curative. It kills or prevents the germination of spores or bits of fungi that come to the outside of a plant on which it is sprayed and so prevents the plant being attacked. It cannot cure a plant of a disease already present and it cannot affect a fungus already inside the plant. Remember then in deciding to use Bordeaux mixture that it is preventive and not curative.

Bordeaux mixture 1 per cent.

Bordeaux mixture can be applied in various strengths. A safe and efficient formula for general use is 5 lb. of copper sulphate and 5 lb.

of good lime in 50 gallons of water. Copper sulphate consists of translucent blue crystals and is fairly pure. The best available lime in the islands is probably that made from shells. To make the mixture, dissolve the copper sulphate in half the water in a wooden vessel. Metal vessels should not be used because the metal will react with the copper of the mixture and thereby weaken the latter.

Bordeaux mixture. Copper sulphate dissolves slowly, so for convenience it should be suspended over night in a piece of gunny sack just immersed. Slake the lime in a second vessel adding the water little by little, till the lime has swelled and heat ceases to be evolved. Keep the lime moist, then pour in the rest of the water and stir. Mix the two solutions together by pouring into a third vessel, vigorously stirring all the time. Pour the mixture through a strainer to remove all grit and lumps before pouring into the sprayer. Care in doing so will save much time that will otherwise be wasted in cleaning blocked nozzles.

Bordeaux mixture as generally prepared is alkaline, containing an excess of lime but if the lime is not very good there may be an excess of copper compounds in the mixture and this is dangerous to the young foliage of some plants. Well prepared Bordeaux mixture should turn red litmus paper blue. Another way of determining if the mixture contains an excess of copper is to clean a knife blade in sand or earth and immerse it in the liquid. If no change occurs the mixture is safe, but if a deposit of copper forms on the metal the mixture is unsafe and more milk of lime should be added till further tests indicate that the mixture is right.

When lime is very dear, washing soda may be substituted for it. The mixture is called "Burgundy mixture." The proportions are:—copper sulphate 5 lb., washing soda 6¼ lb., and water 50 gallons. Make up exactly as in Bordeaux mixture, using washing soda instead of lime. Test as before with blue litmus paper and if it reddens add more soda to the solution. Excess of soda may cause scorching and can be detected by red litmus paper turning blue in which case more copper sulphate solution must be used. A neutral solution is required, *i.e.*, red litmus paper should remain red and blue litmus paper should remain blue. If red litmus paper turns blue add more copper sulphate solution and if blue litmus paper turns red add more soda.

Bordeaux mixture has the more important advantage over Burgundy in that it is easily seen on the plants and work done can be readily checked.

Bordeaux mixture deteriorates very rapidly upon standing. If sugar is added at the ratio of 1 oz. for every 8 lb. of lime used, the mixture will last for some time. Make enough for each day's spraying.

For other fungicides and details see Butler "Fungi and Diseases in Plants."

Sprayers. Very many different types are in use and several are available in India. Among the most useful sprayers are those intended to be slung on the back or shoulder and worked either by a single charge of compressed air or by continuous pumping. The compressed air forms are in various sizes, those holding 5 gallons being most useful for ordinary work. They are filled with spray fluid and air is pumped in until the pressure for complete discharge is reached. Any firm that supplies planters' stores will be able to supply knap-sack sprayers at a moderate price from their stock.

The writer wishes cordially to thank Mr. L. S. Subramanium and Mr. R. R. Sen for the assistance rendered in determining the specific identification and for comparing the fungi with the type collection in Pusa herbarium.

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