DEPARTMENTAL NOTES

PANAMA DISEASE OF PLANTAINS

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PANAMA disease of plantains or wilt disease, as it is commonly called, is a disease which has attracted great attention, especially in Central America where the damage attributed to it has been enormous. Many thousands of acres of bananas have been abandoned in that region and, although soil and climatic conditions have played a considerable part in this abandonment, there is no doubt that Panama disease was largely responsible.

The disease first attained importance in the country of Panama in 1904 when it became epidemic. As a result of this serious outbreak it was called Panama disease. Since that time it has caused much damage in Costa Rica and other countries of Central America, in Surinam and in Cuba, Porto Rico, Jamaica and other islands of the West Indies. It has also been recorded in Malaya, in Australia and doubtfully in India but does not appear to have done much damage in these countries.

In 1929 a diseased plantain clump in Galle showed symptoms similar to those of Panama disease but it was destroyed before the disease could be identified definitely. In 1930 the disease was identified in Kurunegala district and since then it has been found in districts as far apart as Trincomalie, Anuradhapura, Puttalam, Kurunegala, Kandy, Colombo, Galle and Tissa. From the widespread occurrence it would appear that the disease is not new to Ceylon, its distribution tending to indicate that it is well established and that in Ceylon it rarely assumes serious proportions.

SYMPTOMS

In a plantation where only isolated cases of the disease are found, affected plants are not apt to exhibit any external signs of the disease until they are approaching maturity. In these large plants the symptoms are very similar to those caused by severe drought.

A diseased plant first shows a yellowing of the lower or outer leaf-blades and petioles, as is shown in the accompanying illustration. The change from the normal dark green colour to a vivid yellow is usually sudden and startling and proceeds inwards from the margin. Such leaves stand out conspicuously in a plantain garden, the contrast with the healthy leaves making it easy to detect them from a distance. After this change of colour, the leaves begin to wilt rapidly. Within a day or two the fleshy leaf-stalk buckles at a point three or four inches from stem-like part (the pseudostem) and the leaf hangs down from this point as is shown in the illustration. The leaf now withers rapidly and turns brown. The process is repeated by the other leaves in rapid succession until finally every leaf hangs in a dead and dried condition. This stage is followed

eventually by the fall of the whole plant. Once the outer leaves change colour, the process of degeneration is rapid and within a few weeks the whole plant is dead and decaying. Occasionally the breaking down and wilting of the leaves take place while they are still green, and the colour changes subsequently.

In addition to the discoloration and drooping of the leaves, there is often a splitting of the pseudostem. The split is always longitudinal and often occurs towards the lower part. Only the outer leaf bases may be involved but the opening may extend to the centre and may be more than one foot long externally. This splitting does not always take place but when it does it is a useful diagnostic character.

Bunches are rarely produced by diseased plants but when they are the growth is arrested and the fruits remain small and do not ripen properly.

The internal signs of the disease are very marked and provide a sure means of identifying the disease. When a healthy plant is cut open the tissue is at first uniformly white, although oxidation causes a purplish discoloration to appear after a few minutes.

If, however, a plant suffering from Panama disease is removed from the ground and a transverse cut is made through the lower part of the rhizome or *yam,* it presents a quite different appearance. The water conducting vessels are discoloured and appear as yellow, orange, red or red-brown spots. This discoloration extends down into the root stock and up into the leaf-bases which form the pseudostem. The appearance of these spots or streaks (depending on the direction in which the cut is made) is a sure indication of Panama disease, and the examination of the internal tissue is the only sure way of diagnosing the disease. In plants in advanced stages of the disease, decay may take place and dark-brown or black discoloured patches can be seen in the central part of the rhizome when it is cut across.

CAUSE OF THE DISEASE

The disease is caused by a soil-inhabiting fungus called *Fusarium oxysporum cubense.* The fungus enters the plant from the soil either through the roots or by way of the cut surfaces produced in the removal of suckers. From thence it advances through the tissues and causes a breakdown of the water-conducting vessels. This has the effect of stopping the plant's water supply and in consequence affected plants display symptoms which are similar to those caused by severe drought.

In infected clumps of plants the fungus extends, through the conducting vessels, to the newly-formed suckers and the use of such infected suckers is one of the principal factors in the spread of the disease. In this connexion, it is important to remember that, although the death of diseased plants is rapid once the external symptoms, *i.e.,* yellowing and wilting, make their appearance, several months elapse between the first infection of the plants and the time when the disease is made manifest by external symptoms.

Inoculation experiments carried out at Peradeniya and elsewhere have shown that eight months is the period that usually elapses between the first infection of plants and the yellowing and wilting of the leaves, although in some plants this period has been so long as thirteen months. Suckers transferred during this incubation period are capable of carrying the disease into areas hitherto free. There is evidence to indicate that one severe outbreak of the disease in the Colombo district was started by use of such infected suckers.

The disease in Ceylon has been found to be severe only where conditions are such that plantains do not thrive, such as in water-logged soils, in badly aerated soils and where plants are overcrowded. In some areas the disease is found to occur most commonly after periods of flooding. No severe outbreak has been recorded in Ceylon in gardens or plantations where the standard of cultivation is high and where the conditions of soil, etc., have been favourable for plantain cultivation.

CONTROL OF THE DISEASE

The control of the disease may be conveniently considered under headings since the problem varies under different conditions.

Exclusion or Protection.—When a plantation is free from the disease or when an area of new land is to be planted out, steps must be taken to prevent the introduction of the disease. The disease is relatively uncommon in Ceylon and it is not a difficult matter to ensure that all suckers used for new plantings are taken from healthy clumps. A grower can satisfy himself that his suckers are healthy by examining carefully the point of connection of the sucker with the parent plant, if necessary by cutting off a thin slice of the rhizome or *yam* at this point. Any suckers which show discoloured spots or streaks should be discarded. The importance of using healthy planting material cannot be over-emphasized.

Eradication.—The problem of controlling the disease once it has established itself in a garden or plantation is a difficult one.

The only satisfactory method of treatment is the complete destruction of the whole clump or stool in which the disease appears. This can be effected by digging up and destroying the whole stool, roots, rhizomes, pseudostem and leaves. Unfortunately the disturbance of the soil which accompanies the digging has the effect of making the fungus more active and may hasten the spread of infection. A method of treatment using a toxic oil has been found to be simple and inexpensive.[1]

All the suckers in a clump or stool in which the disease has appeared are cut off at about four inches from the ground level. Plantain Disease Oil is then sprinkled over the cut ends and over the soil around them. (Two pints of oil have been found to be sufficient for a medium-sized clump.) The pseudostems are split open longitudinally and sprinkled with

1 A full account of the oil treatment of plantain diseases is published in *The Tropical Agriculturist* Vol. LXXXI, page 86, August, 1933.

a little of the oil. When dry they should be burned. The oil penetrates into the soil and kills the underground portions of the plants, which decay rapidly. Planting after six months has been found to be safe. This method of treatment is cheap, simple and effective.

Immune Varieties.—Some varieties of plantains are more susceptible to the disease than others and in planting up areas in which the disease occurs it is advisable to plant varieties resistant to the disease. The varieties *Embul Hondarawala* and *Suwandel* have been found to be most resistant of the local varieties and are therefore to be recommended.

Improvement of conditions.—It has been stated above that Panama disease in Ceylon has been found to be severe only where conditions of cultivation are poor and where lack of drainage and flooding impedes the healthy growth of the plantains. It is obvious therefore that endeavours directed at improving conditions by clean cultivation, adequate drainage and wide planting will assist materially in keeping the disease in check.

ANIMAL DISEASE RETURN FOR THE MONTH ENDED 31 OCTOBER, 1933

Province, &c.	Disease	No. of Cases up to Date since Jan. 1st 1933	Fresh Cases	Recoveries	Deaths	Balance Ill	No. Shot
Western	Rinderpest	...	...	...	...	...	...
	Foot-and-mouth disease	32	...	31	1	...	...
	Anthrax	...	...	...	...	..	...
	Rabies (Dogs)	14	...	...	10	...	4
	Piroplasmosis	...	...	..	...	...	...
Colombo Municipality	Rinderpest	..	...	...	...	...	...
	Foot-and-mouth disease	28	...	27	1	...	...
	Anthrax	12	...	...	12	...	...
	Rabies (Dogs)	28*	2	...	...	...	28
	Haemorrhagic Septicaemia	...	...	...	...	...	...
	Black Quarter	...	...	...	...	...	...
	Bovine Tuberculosis	...	...	...	...	...	
Cattle Quarantine Station	Rinderpest	...	...	...	...	...	...
	Foot-and-mouth disease (Sheep & Goats)	121	...	113	8	...	...
	Anthrax (Sheep & Goats)	174	3	...	174	...	...
Central	Rinderpest	65	...	11	52	...	2
	Foot-and-mouth disease	3	...	3	...	...	...
	Anthrax	10	...	...	10	...	...
	Bovine Tuberculosis	2	1	...	...	(slaughtered)	
	Rabies (Dogs)	...	...	...	...	...	...
Southern	Rinderpest	...	...	...	...	...	...
	Foot-and-mouth disease	50	...	50	...	...	...
	Anthrax	...	...	...	...	...	...
	Rabies (Dogs)	1	...	...	...	...	1
Northern	Rinderpest	1745	20	368	1326	2	49
	Foot-and-mouth disease	4	..	4	...	...	...
	Anthrax	...	...	...	...	...	...
	Black Quarter	...	...	...	...	...	...
	Rabies (Dogs)	...	...	...	...	...	...
Eastern	Rinderpest	...	...	...	...	...	...
	Foot-and-mouth disease	52	...	51	1	...	...
	Anthrax	...	...	...	...	...	...
North-Western	Rinderpest	...	...	...	...	..	...
	Foot-and-mouth disease	116	...	110	6	...	...
	Anthrax	...	...	..	...	...	...
	Pleuro-Pneumonia (Goats)	3	...	...	1	...	2
	Rabies (Dogs)	2	...	...	1	...	1
North-Central	Rinderpest	1180	42	217	906	4	53
	Foot-and-mouth disease	...	...	...	...	...	...
	Anthrax	...	...	...	...	...	...
Uva	Rinderpest	...	...	...	...	...	...
	Foot-and-mouth disease	...	...	...	...	...	...
	Anthrax	...	...	...	...	...	.
	Bovine Tuberculosis	2	...	...	...	..	2
Sabaragamuwa	Rinderpest	..		...	...	...	...
	Foot-and-mouth disease	1388	24	1305	64	19	...
	Anthrax	...	...	...	...	...	...
	Piroplasmosis	...	...	...	...	...	...
	Haemorrhagic Septicaemia	11	...	...	11	...	...
	Rabies (Dogs)	6	...	...	...	...	6

* 1 case occurred in a Goat at the Slaughter House.

G. V. S. Office.,
Colombo, 9th November, 1933.

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METEOROLOGICAL REPORT, OCTOBER, 1933

Station	Temperature				Humidity		Amount of Cloud	Rainfall		
	Mean Maximum	Difference from Average	Mean Minimum	Difference from Average	Day	Night (from Minimum)		Amount	No. of Rainy Days	Difference from Average
	°	°	°	°	%	%		Inches		Inches
Colombo -	83·1	− 1·7	75·1	0	79	88	7·4	8·43	25	− 5·94
Puttalam -	84·5	− 1·2	75·3	− 0·2	74	86	6·0	4·39	16	− 4·44
Mannar -	84·4	− 3·1	76·2	− 1·0	80	88	7·0	12·94	11	+ 5·07
Jaffna -	83·9	− 1·0	76·2	− 1·0	88	93	6·4	11·42	12	+ 1·99
Trincomalee -	86·4	− 1·4	74·5	− 0·8	74	90	6·3	9·04	16	+ 0·57
Batticaloa -	86·6	− 0·3	74·5	− 0·4	68	78	5·6	6·50	13	− 0·16
Hambantota -	85·3	− 0·8	74·3	− 0·8	76	88	5·0	3·75	11	− 0·89
Galle -	81·8	− 1·4	74·7	− 0·9	83	90	5·4	12·21	22	− 0·68
Ratnapura -	84·7	− 2·5	72·3	− 0·4	80	95	7·6	28·81	26	+ 10·27
A'pura -	85·7	− 2·6	72·8	− 0·7	74	90	7·2	3·89	14	− 5·83
Kurunegala -	85·1	− 1·7	72·8	− 0·6	79	93	8·9	17·26	24	+ 1·59
Kandy -	81·1	− 2·2	68·2	− 0·4	76	92	7·5	10·97	21	− 0·64
Badulla -	80·9	− 2·0	65·2	− 0·1	76	97	5·8	7·27	18	− 2·35
Diyatalawa -	75·3	− 1·2	60·8	+ 0·4	74	89	7·2	12·06	20	+ 2·14
Hakgala -	68·0	− 2·2	56·2	− 0·1	81	85	6·3	12·74	26	+ 0·58
N'Eliya -	65·3	− 2·1	53·1	+ 0·6	86	94	8·4	10·68	26	− 0·28

The rainfall of October was, on the whole, above normal in the south-west of the Island and on the western slopes of the hills, and below normal elsewhere. Deficits, however, appeared in a coastal strip along the west coast from Kalutara northwards, while a similar coastal strip along the east coast, from Trincomalie southwards, was above normal.

Excess of rain has been most marked in the western slopes of the hills, and in the low country adjoining. Padupola, which reports the greatest monthly total, 60·59 inches, has also the greatest excess above average, 31·92 inches, while other stations in and south of the Ginigathena Pass report totals for the month of over 40 inches, and offsets above average of over 20 inches.

There were 28 daily falls of over 5 inches reported, chiefly in the first half of October, though a few occurred at the end of the month. The highest daily fall reported was 9·00 inches at Kitulgala, on the 8th-9th, Kitulgala and Padupola each reported three daily falls of over 5 inches, and Kenilworth Estate two.

During the first half of the month, the barometric gradient was flat or weak south-westerly. The weather was generally unsettled, with wide-spread rain. About the 13th, under the influence of a storm in the Bay of Bengal, the south-westerly gradient strengthened, and south-westerly monsoon conditions temporarily re-appeared, with, generally, moderate westerly or south-westerly winds, and occasional squalls. The rain was now chiefly confined to the south-west of the Island. With the passing of the storm out of the Bay, these conditions disappeared, and by the 22nd, weaker gradients had reappeared. These were accompanied by local afternoon or evening thunderstorms and sometimes wide-spread rain, conditions which continued till the end of the month.

Day temperatures were appreciably below normal and night temperatures slightly below normal. Humidity and cloud were on the whole above normal. Barometric pressure was below normal, with a stronger south-westerly gradient than usual. Wind was above normal, the directions being mainly west to south-west.

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