NOTES ON TWO PINEAPPLE DISEASES IN QUEENSLAND.

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SUMMARY.

The isolation of Thielaviopsis paradoxa (De Seynes) von Höhn from white leaf spot lesions and the reproduction of typical symptoms by inoculation with this fungus are described.

The results of inoculations with a Fusarium and two types of Penicillium isolated from fruitlet core rot are given. Circumstantial evidence is presented that mealy bugs and mites provide a means of entry of the causal organism.

WHITE LEAF SPOT.

White leaf spot, or " white leaf," as it is often known, is a common disease of pineapples in Queensland but one which rarely causes serious damage.

Its occurrence is usually restricted to the months of March to May and then only to periods of overcast, rainy weather. It is most prevalent in young, quick-growing plantations, rarely attacking the harder foliage of older or ill-nourished plants.

Symptoms.

The first symptom is a small yellow to brown spot on the leaf which rapidly elongates under moist conditions. During prolonged periods of rainy weather, the lesions may reach several inches in length and spread right to the tip of the leaf. If the lesion spreads across the leaf and girdles it, the part above droops over and withers (Fig. 1).

The extent of the damage depends on the duration of the favourable conditions, since fine weather results in a rapid drying of the affected areas to give straw-coloured, or almost white, papery lesions. The margins of the spots often remain brown in colour and discoloured areas may extend through the lesions.

On inspection, the lesions will be seen to commence where two leaves have rubbed, or where a leaf has broken over, been punctured by an insect, or been injured in some other manner.

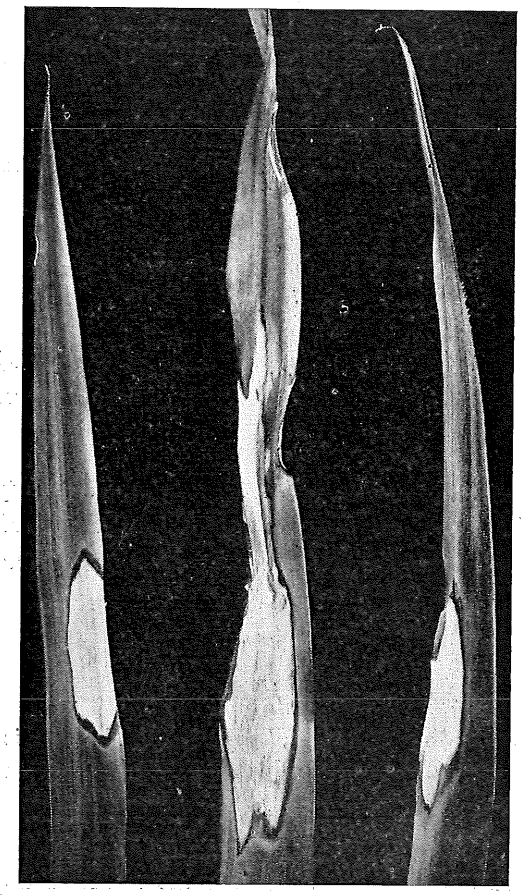

Fig. 1.

Pineapple Leaves Showing Natural Infection with White Leaf Spot.

Causal Organism.

According to Cook (1933), white leaf spot was reported by Fawcett from Puerto Rico in 1908, and Nowell (1922) also described the symptoms. In Hawaii, Larsen (1910) attributed the disease to a wound infection by *Thielaviopsis paradoxa* (De Seynes) von Höhn ; he published experimental work showing the manner of infection and describing the associated weather conditions. However, Cook (1933) could not isolate the causal fungus in the Puerto Rico area, and suspected weather conditions as being responsible, without the influence of any other agency.

Although white leaf spot was described in Queensland by Lewcock (1947), the causal organism was not identified.

In the autumn of 1952 a series of isolations was made from the margins of white leaf spot lesions by the author, and in a number of cases *Thielaviopsis paradoxa* was obtained amongst the isolates.

Only small developing lesions were selected for isolation work, which was timed to coincide with periods of suitable weather for leaf spot development. It was found that with the onset of fine weather the organism rapidly died out in the leaf tissue and isolation attempted then was fruitless.

Inoculation of healthy leaves on potted plants was carried out in the following manner.

The leaves were surface sterilized with corrosive sublimate and 12 inoculations were made by pricking with a sterile needle through a spore suspension of *T. paradoxa* in a drop of sterile water. In another 12 cases a drop of spore suspension was placed on the leaves without subsequent injury. The controls consisted of plants on which 12 leaves had been pricked through drops of sterile water. All plants were placed under bell jars.

In 48 hours, oblong, light-brown lesions with dark-brown margins had developed at each point where inoculation included injury, and in five days these lesions were several inches long. No lesions developed where the leaves were not pricked or in the controls (Fig. 2).

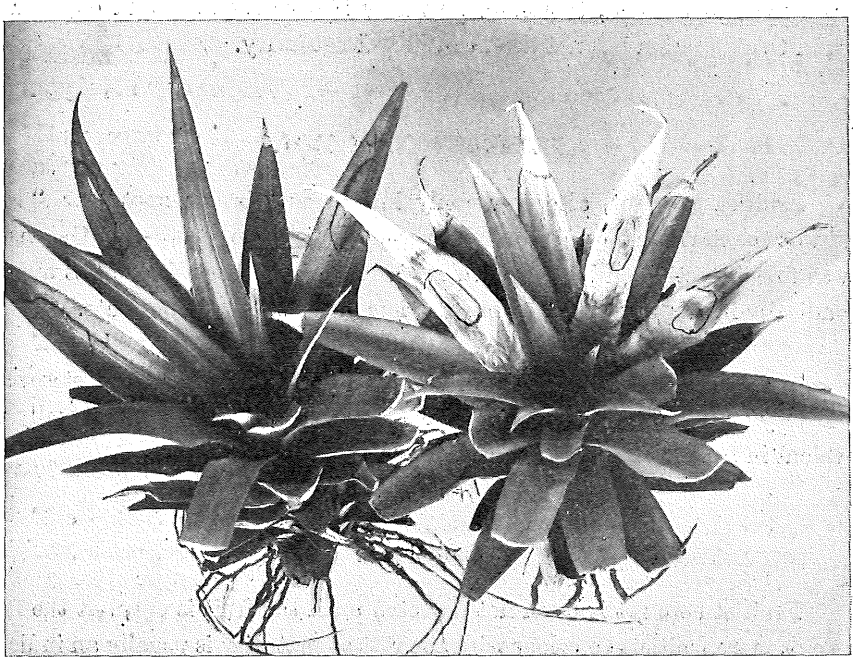

Fig. 2.

Result of Inoculating Pineapple Plants with *Thielaviopsis paradoxa*. *Left*—Four leaves pricked without inoculation. *Right*—Three leaves pricked and inoculated.

Isolations were made from the margin of each lesion and *T. paradoxa* obtained in every case.

Once the bell jars were removed from the inoculated plants, the affected areas rapidly dried out and assumed the pale, papery appearance which is typical of the disease in the field.

Re-inoculations were made into healthy plants using the same technique as before, but as the work was timed to coincide with showery weather, one treated plant was not placed under a bell jar. Both the plants inside and outside the bell jars, however, developed lesions and re-isolation of *T. paradoxa* was again successful.

Discussion.

Thielaviopsis paradoxa may be commonly found in pineapple plantations during the summer months growing on decaying fruit, tops and other pineapple material, and thus there is an ample supply of inoculum for infection. As the fungus, however, is purely a wound parasite of pineapples and requires special weather conditions before attacking the injured leaves, field damage is not serious. Control measures would, therefore, be rarely if ever required and experimental work in this direction has not been considered necessary.

FRUITLET CORE ROT.

Fruitlet core rot, also commonly known as "brown spot" or "brown rot," was the first fungous disease of pineapple fruit to be recorded in Queensland. It was first investigated by Tryon in 1898. Since then the disease has appeared sporadically in all pineapple-growing districts in the south of the State.

The disease affects fruit of all varieties of pineapple but is most severe in the Ripley Queen. Its seasonal incidence is variable, although it is usually most prevalent in fruit maturing in the winter or spring.

Symptoms.

Fruitlet core rot is often not detected until the fruit is cut, but the failure of one or more fruitlets to colour with the rest at maturity is usually an indication that the disease is present. Some badly affected "eyes" become brown and sunken as the fruit ripens, and brown fissures may appear between the fruitlets. This is particularly the case if the fruit is held until it is over-ripe.

Internal symptoms consist of a browning of the centre of the fruitlet starting immediately below the floral cavity, and in severe cases extending to the core. The lesions are firm and vary in size from a small speck to a rotten area involving the whole of one or more fruitlets.

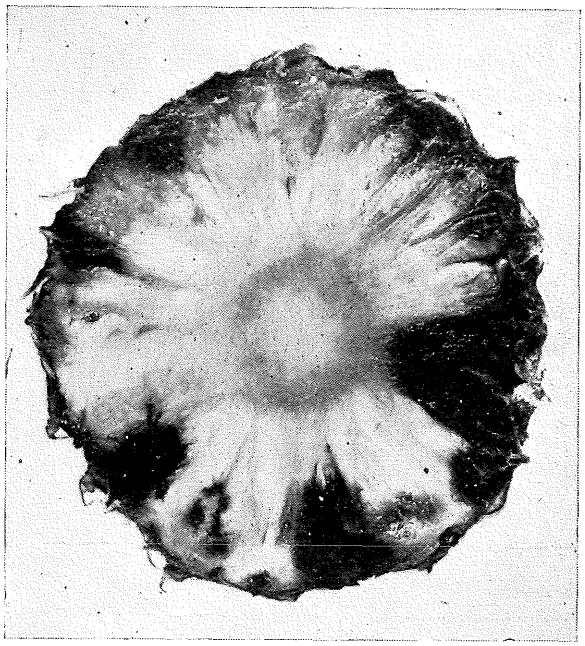

Fig. 3.

Fruitlet Core Rot. Natural infection.

Causal Organisms.

Tryon, following his investigations in Queensland (Tryon, 1898), attributed fruitlet core rot in the Ripley Queen variety to injuries caused by a Tarsonemus mite followed by infection with *Monilia* sp. The disease in the Smooth Cayenne variety appeared to differ in that the associated organism was a *Penicillium*. Mealy bugs, although present occasionally, were not thought to be implicated. Tryon considered later (Tryon, 1928) that minute growth cracks also provide the necessary injury in smooth-leaf pines. Later, Simmonds (Veitch and Simmonds, 1929) associated a *Penicillium* and a *Fusarium* with the disease in the Ripley variety.

Larsen in Hawaii (Larsen, 1910) found a *Fusarium* to be the chief causal organism there, and Linford (1952) reported fungi of the genera *Penicillium* and *Fusarium*, as well as certain yeasts and bacteria, to be capable of causing the disease in Mexico.

Recent Investigations.

During 1951–1952, growers in the Brackenridge district near Brisbane experienced considerable losses of Ripley Queen pineapple fruit from fruitlet core rot. The disease, although present all the year round, appeared to be most prevalent in the winter fruit, and was worse in ratoon than in plant crops.

Mealy bug (*Pseudococcus brevipes* (Cockerell)) infestation was evident on both the plants and the fruit in the affected plantations. Few fruit did not at least have the insects present on the attached leaves. The infestation had increased during the 1951 drought and populations were greater in the ratoon than in the plant crops.

Four longitudinal sections were made through each fruit examined. It was found that many of the floral cavities under the " eyes " contained mealy bugs. Counts were made of the eyes affected by fruitlet core rot and of the eyes containing mealy bugs. These figures are recorded in Table 1. It is seen from this table that 96·3 per cent. of the eyes affected by fruitlet core rot contained mealy bugs, while only 69·2 per cent. of the total number of eyes examined were infested. There appears to be some association between mealy bug infestation and the presence of fruitlet core rot.

Table 1.

Association of Mealy Bugs and Fruitlet Core Rot in Pineapple Fruit.

Serial No. of Fruit.	Number of Fruitlets Examined.	Number Containing Mealy Bugs.	Number with Fruitlet Core Rot.	Number of Affected Fruitlets Containing Mealy Bugs.
1	19	14	5	5
2	23	17	9	9
3	22	16	1	1
4	19	18	14	13
5	27	15	8	8
6	25	14	11	11
7	21	11	3	2
8	20	19	8	8
9	17	14	4	4
10	24	20	4	4
11	19	13	1	1
12	25	2	2	1
13	18	17	2	2
14	24	21	5	5
15	18	11	3	3
Totals—				
15	321	222	80	77

Percentage of fruitlets containing mealy bugs .. .. 69·2%

Percentage of diseased fruitlets containing mealy bugs .. .. 96·3%

Investigation of the Causal Organism.

Isolations were made from infected fruitlets and a *Fusarium* and two types of *Penicillium*, differing in cultural characteristics, were obtained.

Fruit nearing maturity were then surface-sterilized and inoculated on the plant with each of the fungi isolated. Each eye to be inoculated was pricked through the centre with a sterile needle and the inoculum was then introduced on the point of another needle. The eye was marked with India ink. Control fruit were pricked through the eyes with a sterile needle but inoculum was not introduced.

After a week the fruit were harvested and sectioned, and isolations made from any lesions which had developed. The three organisms were readily recovered from the fruitlets which had been inoculated. The symptoms produced by the various fungi differed to some degree and are described below.

(1) *Fusarium* sp.—The lesions produced were brown in colour but very restricted and not extending far beyond the floral cavity. In some cases there was a slight brown discoloration of the fruit tissue but no distinct lesion.

(2) *Penicillium* sp.—The lesions produced varied somewhat in size but they were all of a rather dark brown colour and extended towards the core (Fig. 4).

(3) *Penicillium* sp.—The lesions varied from glossy-brown to reddish-brown in colour and they were quite extensive, spreading as far as the core.

In the control fruit pricked but uninoculated, only one fruitlet developed a lesion, and from this *Thielaviopsis paradoxa* was isolated.

In an endeavour to determine whether an injury to the lining of the floral cavity was needed before infection took place, further inoculations were carried out in the laboratory. Spore suspensions of the three organisms were each introduced with a micro-pipette into the floral cavities of 12 fruitlets. Where necessary the opening was enlarged with the point of a sterile needle. Sterile water was introduced into 12 fruitlets as a control. In each case six of the fruitlets were pierced with a sterile needle and six were not injured. The fruit were sectioned after seven days.

A lesion developed in 15 out of 18 fruitlets in which the floral cavity had been injured after inoculum was inserted, and in only one fruitlet that had not been damaged. The controls were unaffected.

Discussion.

Macroscopic examination of the floral cavities reveals the presence of fungal mycelium and spore masses growing on the floral remnants. *Penicillium* sp. can be readily detected.

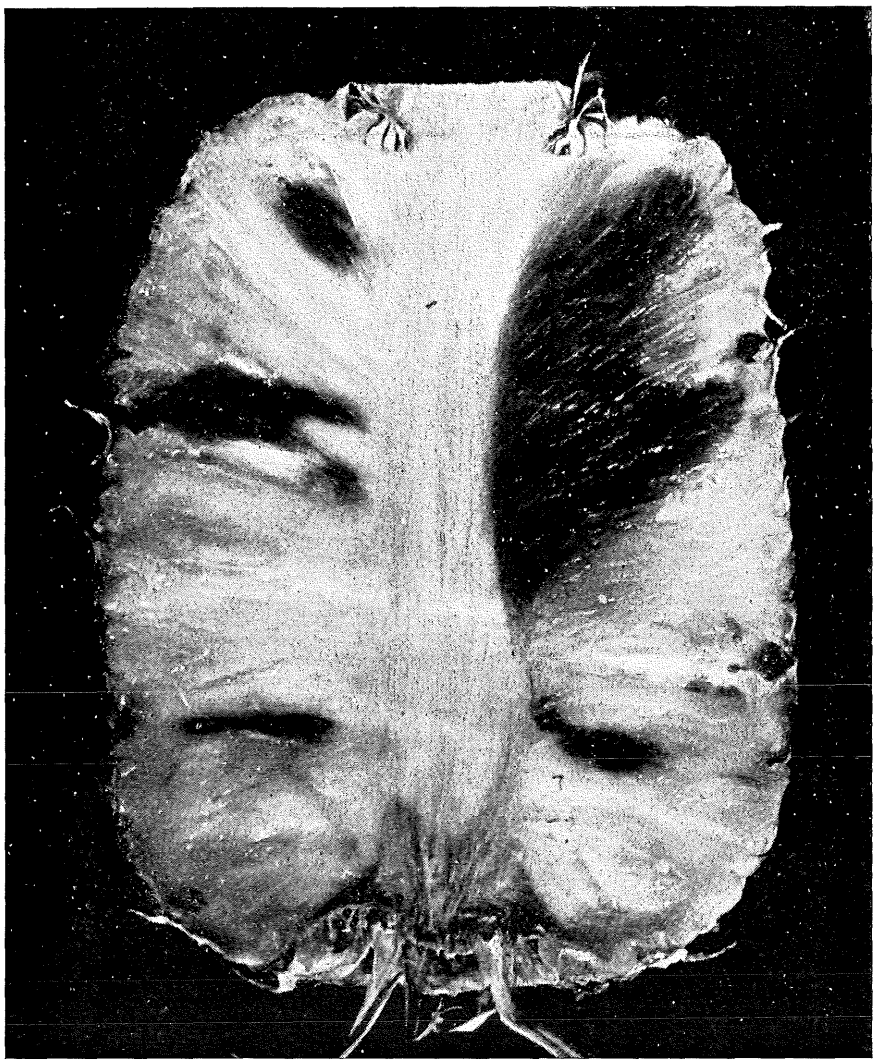

Fig. 4.

Fruitlet Core Rot. Artificial infection with *Penicillium* sp. (Only the upper right fruitlet is in median section).

These organisms do not appear to be able to break down the fruit tissue unless the hard lining of the cavity is injured in some manner to allow their entry. Pricking with a sterile needle has been found sufficient. It is likely therefore that in the Brackenridge area the feeding activities of mealy bugs in the cavities provided the necessary site for infection of fruit.

Subsequent examination of affected fruit of the Smooth Cayenne variety from the Maroochy, Blackall Range, and Cooroy districts showed either mealy bugs or mites to be commonly present in the floral cavities above fruitlet core rot lesions. There is ample circumstantial evidence that mites are capable of playing a similar part to mealy bugs in providing a means of entry for the causal fungi into the fruit. Small growths such as those which develop on the surface of the fruit following certain climatic conditions may also provide the necessary injury to the lining of the floral cavities.

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