The Orchard.

THE BANANA IN QUEENSLAND.

DISEASES OF THE BANANA.

We have lately received so many inquiries by actual and intending banana-growers concerning the disease to which the banana is subject, especially with respect to the newly introduced Gros Michel variety, that we consider it advisable, before continuing our instructions for the cultivation of the plant and harvesting the fruit, to first publish Mr. Tryon's exhaustive paper on the "Natural Enemies of the Banana occurring in Queensland."

The banana in Queensland is, happily, one of the plants which suffers very little from disease of any serious kind, and in this respect other banana-growing countries are in the same fortunate position. Still, even the banana has some enemies in the shape of insects and fungi, as will be seen by the following notes on "Diseases and Insect Pest of Bananas," by Mr. H. Tryon, Entomologist and Vegetable Pathologist to the Department of Agriculture and Stock:—

NATURAL ENEMIES OF THE BANANA OCCURRING IN QUEENSLAND.

By HENRY TRYON, Entomologist and Vegetable Pathologist.

DISEASES.

No. 1.—ROOT DISEASE.

This disease is one that primarily attacks the roots; but in its case the Cavendish Banana either escapes its onslaught altogether or is highly resistent thereto.

It has long been prevalent in Southern Queensland. The late Dr. Joseph Bancroft investigated it in 1874-6, when it already attacked the Sugar Banana and "the old large Banana"—then considered to be *Musa maculata*—that is actually killed; but it also affected, in 1876, "many of the new kinds of Banana introduced." At the present time it is still with us, proving very prejudicial to the Sugar Banana as well as to the Plantain (*M. paradisiaca*) in the southern parts of the State.

When affecting a Banana plant, we find the roots under its influence being gradually destroyed, dying back gradually from their extremities. When they are traced to the corm, whence they originate, it will be seen also that where they emerge there occur dark-reddish-purple or red spots —the central bundles of the disease-smitten roots cut across. At first, when the roots are commencing to perish, those spots are orange-yellow but as it progresses they soon darken. Meanwhile brown patches of greater or less extent are developed, and these are revealed also on sectioning the part of the plant referred to.

The effects of this injury or destruction of the roots are soon gradually realised in the parts of the plant above ground, and appear to result from a transference of morbid products through the vessels or the passage of specific organisms, and not only from the cutting off of the rising sap and its contained nutrients that it involves. The leaves turn yellowish-green, and then yellow, and drooping die—first the older, then the younger. Again, the stems after a while topple over or can be readily pushed over. If this do not happen the sick plants acquire a ragged stunted habit and are unprolific. These effects are, as a rule, witnessed during January, February, and March, the period of the year in which Bananas in Southern Queensland usually ripen. No situation or particular class of soil appears to save the plant from being attacked where the disease is already established; but when Bananas liable to it are grown on dry hillsides it appears to assume a more chronic form, and it seems to occasion a peculiar change in the fruit, the flesh or starch-containing tissue becoming persistently dense and compact and clouded with a brownish colour, being evidently infiltrated with gum. Banana-growers here have observed that when once the disease is in a field it never leaves it; also, that it spreads through the ground during wet weather. Again, it is commonly remarked that "suckers" or shoots, although apparently sound and healthy, give rise to a disease-affected plant, if derived from a Banana that has been already attacked. However, they have, in the coloured points and fibres brought to light in slicing off pieces from the base of the sucker, a guide to indicate to them—when the history of the sucker is not known—whether the young plant is affected or is not.

From the foregoing statements it may be concluded that this Banana trouble is brought about by some organism that can live in the soil and assume parasitic habits in relation to the plant mentioned, and that is disseminated by plants in which such parasitism has been established.

With regard to this question regarding the cause of the disease, it may be mentioned that Dr. J. Bancroft, when in 1876 recording his observations, spoke of a fungus that invaded the tissue, using the discoloured vessels as the channels through which it effected its passage. Thus referring to these vessels, he wrote:—"This spiral thread, which forms the wall of the air-vessel, is the part first to suffer by the invasion of the mycelium, which, passing through the interior of the stool, attacks the new buds"; and again: "Passing down the inner face of the sheath may be seen ruby-red spots and streaks traceable to the attachments to the stool."* The invasion of the vessels passing from the roots into the stool by the spawn-threads or mycelium of a fungus is illustrated by E. Essed, who prosecuted investigations similar to the local inquiries of the Brisbane savant, but in Surinam twenty-five years afterwards. These observations of Essed are alluded to later on. The root disease—described in the preceding paragraphs—as may be concluded from a consideration of its symptoms—is evidently identical with, or is closely

* Bancroft (Dr. J.). "Report (First) of the Board appointed to Inquire into the Causes of Disease affecting Live Stock and Animals," p. 22. Brisbane, by Authority, 1876.

related to, the malady that attacks with special virulence the Gros Michel variety [*Musa sapientum var.*], in Central America, and in some of the West Indian islands (Cuba, Jamaica, Surinam), and is known generally as the "Panama Disease."

Dr. Erwin F. Smith, from evidence before him in 1904, suggested that this latter malady was probably caused by a parasitic fungus belonging to the genus *Fusarium* growing in the tissue.*

E. Essed, a more recent writer, working in Surinam, has arrived at approximately the same conclusion, identifying the organism as *Ustilaginaidella musæperda,* related to *Ustilaginoidea,* one of the *Hypocreales.*†

A Banana malady, apparently caused by a *Fusarium*-like fungus has been reported as existing in Hawaii.

The cure of the disease is obviously beyond attainment; its prevention may be effected by avoiding the use of land in which affected plants have grown, and of suckers derived from such plants, when establishing the banana plantation.

No. 2.—Root Disease.

In this disease we find, as a characteristic symptom, a conspicuous reddish-brown colouration of the interior of the fruit in part, especially brought into view on cutting it across, when blotches of this altered tissue are revealed, a brown band on each side just beneath the peel, corresponding to these, being present, when the Banana is split longitudinally.

These appearances are developed when the fruit is still green.

In addition to the internal features, obscure external ones may also be remarked. However, they will not escape the notice of the "trained eye"; affected fruit having, in fact, its angular edges well defined and its faces somewhat flat instead of lowly convex—symptoms that suggest arrested development.

The mode in which the internal browning progresses is as follows:—It is first manifested by the loose convolute walls of the 3-rayed space that exists in the interior of the elongated expanded portion of the central axis, and that is continuous with the channel in the style from the stigma downwards. It then extends outwards along the dissepiments of the united carpels to their outer walls, where blotches are produced. With its further progress the chemical changes thus inaugurated are communicated to the compact starch-containing tissue, that develops in the inner cells of the carpellary walls filling the ovarian cavities. This tissue—the fruit substance proper—is then transformed into a transparent gelatinous substance; or—it may be—the original jelly-like substance contained within cell walls of extreme tenurity does not change as is usual to starch-containing tissue as the outcome of the influences in operation. The fibro-vascular bundles do not appear to be availed of for the passage of any morbid products.

Frequently these changes do not proceed further than is denoted by the earliest internal alteration, especially should the weather continue to be dry.

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* Science, xxxi., p. 754 55, 1904.

† "Annals of Botany," xxiv., p. 488, 1910; and "Agricultural News," Imp. Dep. Agr., Pt. I., No. 233, p. 110, April, 1911.

This internal browning of the fruit is not the sole abnormal feature that the sick plant presents. It commonly, too, has an unusual development of dark, almost black, pigment on the ordinarily green leaf stalks, towards their bases where they unite to form the false stem.

Again, its older or lower leaves exhibit reduced vitality, turning yellow and then brown, and meanwhile gradually drooping and dying—in fact, fail to thrive.

In the case of neither fruit nor foliage do we find any parasite capable of occasioning the alternations described; but accompanying them in the same plant there is an abnormal condition of the cord-like roots radiating from the root-stock. Along the course of these we find patches of black, sometimes extending continuously for several inches, but commonly shorter than this. At first these affected parts are of the ordinary calibre, but soon there is a general collapse, and the surface involved may exhibit fissured wounds developed with shrinkage. The injury denoted by these dark blotches is deep-seated, but is for the most part confined to the parenchyma that surrounds the central cylinder or stele, although it may occasionally travel along it. This tissue is first purple, and then darkens with time. The rootlets that spring from the affected areas, as well often as those derived from healthy root sections, will be found generally to have earlier died-off, being in the first place discoloured in manner described. In some cases affected roots have quite succumbed and decayed. Where they merge with the root-stock or corm, their central cylinders as seen on section are often pale-brown coloured.

The extent to which the roots of an affected plant suffer injury in this manner may be concluded from the fact that in one instance out of thirty-seven long cord-like roots present, only six were met with that for the time being were perfectly healthy.

No parasites are constantly present in the blackened root-tissue. A few one-septate obtuse-ended elongate large spores containing conspicuous vacuoles may be met with in this—more commonly nematodes distinct from the gall-producing *Heterodera radicola*. Seeing the frequency with which soil-frequenting nematodes resort to altering and decaying plant-tissue, their occurrence in this connection is not of much significance in deciding the cause of the trouble. This, therefore, must be left for the present an open question.

The disease is more apparent during the wet months (February and March) than at any other time of the year; and it is not equally pronounced every season.

It has been met with in the Cairns district, and affecting the Cavendish variety of Banana (*Musa chinensis*)—the one whose cultivation predominates there—and has been responsible for great loss. It is the malady that the local growers (Chinese) name "Colour."

It is commonly stated that it is perpetuated by the employment of "suckers" derived from affected plants, even although these suckers evince no evident sign of disease themselves.