

RED ROT IN SUGARCANE IN NATAL.

By A. McMARTIN.

INTRODUCTION.

It has repeatedly been stressed that the introduction of new varieties of sugarcane to replace those which suffer from the virus diseases, mosaic and streak, does not mean that the problem of disease in Natal has been successfully settled. The quarantine restrictions at present in force greatly reduce the risk of introducing diseases not already present; there always remains the risk, however, of some species of pathogen adapting itself to cane from some of our local flora, or of some sugarcane disease which might have been introduced in the early days of the industry, and which has been perpetuated as a minor disease, becoming a major disease when another suitable variety is grown.

Prior to the days of strict quarantine restrictions, over seventy varieties had been introduced from more than a dozen countries, between which existed all the principal major and minor sugarcane diseases. It is not unreasonable, therefore, to suppose that diseases were introduced in those days—mosaic almost certainly was—when their true nature perhaps would not be appreciated nor their identity established; if a variety failed, it would probably be considered unsuited to the country and the matter left there. The disease organisms, however, might not be eradicated, but perpetuated by growing on varieties of sufficient resistance to keep the pathogen from becoming a serious disease, but susceptible enough to keep alive a source of infection for any more susceptible variety grown subsequently.

Ranking among one of the worst sugarcane diseases in some other countries is red rot, caused by the fungus *Colletotrichum falcatum*. It is widely distributed throughout the tropics, and is one of the most serious diseases in India, Louisiana and Australia; it has been attributed with losses of from 25 to 50 per cent. of the crop.

APPEARANCE IN NATAL.

Its absence in Natal has been remarked upon, and although numerous examinations of canes have been made in past years no sign of this disease could be found.

It was first found by the writer towards the end of 1941, while examining dead sticks in some new seedling varieties, and almost simultaneously was identified as a disease in the Eshowe district, where it was causing considerable damage on Co.290. Since then it has been found in the areas of Upper Tongaat, and Powerscourt, with, in addition, two cases on unreleased varieties under trial at Empangeni and Tongaat; in the latter two cases particularly susceptible varieties were concerned, and none of the neighbouring commercial cane was found infected.

SYMPTOMS.

The symptoms of this disease, briefly, are a wilting of the cane, accompanied by a red discoloration of the inside, which is not uniformly red, but striped or mottled with white.

In doubtful cases microscopic examination has to be resorted to, as spores of the disease can usually be found on the outside of a cane which has died from this disease.

The disease appears to become plainly visible about July or August, and increases in severity up till the next growing season.

The mottled appearance of the inside of the stem, together with the death of the cane, serve to distinguish this disease from the red discoloration so commonly found on Co.290, from which the fungus formerly known as *Cephalosporium sacchari* has repeatedly been isolated; moreover, this fungus has never been observed to kill the cane.

VARIETIES AFFECTED.

Of released varieties, Co.290 and P.O.]2725 are the only two on which it has been found; Co.281 and Co.301 appear resistant, while the position of Co.331 remains to be ascertained; in India, however, it has proved susceptible, though no cases have been found here yet of red rot on this variety. The position of Uba will be discussed later.

SEVERITY IN NATAL.

In areas where the disease is severe considerable loss of crop is being experienced—a reduction of about 50 per cent. seems not uncommon. In one case the cane yielded only 5 tons of cane per acre. In some seedlings at the Experiment Station counts have been made of the dead sticks in the infected plots, and a reduction of the number of millable sticks by half has been obtained. An interesting fact is that Co.290 and P.O.]2725 have so far remained much more healthy here than in those other areas specified previously, which perhaps indicates that these varieties suffering badly here are much more susceptible than these two released varieties.

TRANSMISSION OF THE DISEASE.

Apart from the question of how this disease arose, it is important to know how its spread is effected, and why it is confined, at any rate in a severe form, to certain areas.

That it is transmitted by cuttings seems fairly certain, as many canes suffering from red rot in its earlier stages, before the actual wilting commences, have been used as planting material. One case shown to the writer of a field of Co.290 with red rot, grown immediately after wattles, no doubt could be attributed to diseased planting material.

On the other hand, careful selection of planting material would probably not offer any measure of control if the disease is in the field to be planted, and selecting healthy sticks from an infected field has led in one case to disaster—as probably, although they appeared healthy, they may have had spores of the disease on them, derived from neighbouring infected sticks.

A specimen found at the Experiment Station of *Colletotrichum* sporulating on trash on the cane suggests that this portion of the cane could transmit the disease, although the stalks themselves were not affected.

The possibility of other plants, e.g., some grasses, harbouring the disease must be considered, but so far none have been seen here with it.

COURSE OF THE DISEASE.

The development of the disease in a field is not fully understood. Badly infected cuttings die, but probably slightly infected ones germinate if conditions for growth are favourable enough.

The question arises—does the fungus penetrate from the infected cuttings, to the inside of the stems which arise from these cuttings? On this point, evidence in different countries is conflicting; here, however, no case has been seen in which the fungus has been found to do so. Nevertheless, it must be borne in mind that these young stems are surrounded at their base by disintegrating infected material which might prove a source of infection for penetrating the stem from the outside when conditions are suitable. In support of this view, some specimens have been found by the writer, of cane about one year old, in which the leaf sheaths had discoloured areas on them not unlike large eye-spot markings, but which proved to be lesions of *Colletotrichum*; these discoloured areas penetrated to the stem and were causing a slight discoloration on the young soft rind of the young internodes. This does not appear to have been recorded in any other country; it suggests that here the fungus perhaps can grow from the infected material in the ground, up the outside of the stem or the leaf sheaths, and ultimately penetrate the stem itself. The sticks after death produce spores externally, which under suitable conditions would spread the infection.

CONDITIONS FOR SPREAD.

It is naturally of interest to know why the disease has only become serious in certain areas; as will be stated later, red rot is now suspected to be more widespread than at first thought, but not with any degree of severity except in the areas mentioned previously. It seems apparent then, that climatically Eshowe and these other areas are more suited to the spread of the disease. Till more is known about the cycle of the disease

in a crop, suggestions are tentative, but it has occurred to the writer that the mists experienced in these high altitudes, maintaining a dampness over the fields for a longer period than the lower lands nearer the coast, might be a contributing factor, providing more suitable conditions for the germination of spores.

CAUSE OF THE DISEASE.

Red Rot has always been attributed to the fungus *Colletotrichum falcatum*. It was early noted here, however, that *C. falcatum* was constantly associated with the fungus previously known as *Cephalosporium sacchari*, that cultures from red rot cane were usually a mixture of these two fungi. It is now considered that *C. sacchari* is more correctly a species of *Fusarium*, of the *F. moniliforme* group, a fungus well known in other countries as causing a top rot of sugarcane, and has been known in Natal as causing an internal red discoloration of the stems of this plant. It has recently also been found causing a top rot here.

Its regular occurrence in red rot cane led the writer to investigate the possibility that it might not be playing an unimportant role in causing the disease, and experiments are being conducted to elucidate this point.

It has been found that *F. moniliforme* can be grown in culture for a longer period than *C. falcatum* and remain capable of rotting cuttings; also, in one case, canes inoculated with both fungi from pure cultures produced more typical symptoms of red rot as found in the field than were produced in canes inoculated with these two fungi singly.

The symptoms produced by inoculating with a pure culture of *C. falcatum* appear to vary considerably; the age of the culture used appearing to be one determining factor; sometimes by using a culture of from four to six days old the most typical symptoms have been produced.

It has also been found that a thirty-days-old culture of *F. moniliforme* reduced germination when inoculated into cuttings, while the same age of *C. falcatum* did not, while the two mixed produced the same result as the *F. moniliforme* alone, suggesting that it was the latter component of the mixture that was causing the rotting. It may therefore be that *F. moniliforme* is not merely a secondary invader in diseased canes where red rot is most severe, but might eventually prove to be playing an important role in the damage done.

ORIGIN OF THE DISEASE IN NATAL.

The question naturally occurs when a disease breaks out, as has red rot here—where has it come from? As stated at the outset, the possibility must be borne in mind of diseases having been introduced in the early days; and being kept latent till a susceptible variety is grown. This possibility has led to the examination of dead sticks of Uba wherever the opportunity offered itself.

Never, however, have sticks been found with symptoms of red rot, nor have spores been found on the canes, nor cultures obtained of either *C. falcatum* or *F. moniliforme* from dead Uba. It has, nevertheless, been puzzling to find cases of wilted canes of Uba when grown in close proximity to varieties which are suffering from red rot, but which on examination show no cause for the wilted condition: no red discoloration has taken place internally—the canes have just died. At the same time from other areas samples of dead Co.290 have been examined which showed similar symptoms—viz., white internal tissue, but with a dead top.

It has further been found during close examination of the varieties at the Experiment Station, that sometimes, prior to finding typical cases of red rot in some varieties, the first stick or so found dead would have no discoloration.

It began to appear, then, as if this condition might be one caused by red rot, but not in its typical form; it only remained to find the fungus or fungi associated with such canes.

Recently one such case has been found—a specimen of Co.290 with a dead top, but no discoloration internally; *C. falcatum* spores, however, were found on the outside of some of the internodes.

This suggests, then, the possibility that these other cases may also have been red rot, in which perhaps the disease did not run its full course; if so, then isolated cases of dead sticks in Uba may also have been suffering from the same disease, which would account for the origin of the present outbreak.

It also suggests the possibility of dead sticks of Co.290 found in other areas having died from red rot although they showed no symptoms of it, in which case the infection may be fairly widely distributed throughout the sugarcane area, only developing into a disease of importance in areas with the suitable climatic conditions.

SUMMARY.

Investigations into the recent outbreak of red rot in Natal have shown that a cane can be dead and producing spores of *Colletotrichum falcatum* without showing any internal symptoms of that disease, in that no red discoloration has been produced.

This suggests the possibility that this disease might have existed undetected, especially if the incidence of infection was low, and also that it might exist in this form over a larger area than originally thought.

Its development into a serious disease in certain areas is probably conditioned by the climatic factors of the areas.

One method of infection in the field has been found to be through the leaf sheaths, where it produces lesions not unlike large eye-spot markings, from these passing into the young internodes.

Laboratory studies have suggested that *C. falcatum* alone might not be the only fungus concerned, but that a *Fusarium* of the *F. moniliforme* type might be of equal importance.

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Dr. McMARTIN, in reply to Dr. Hedley, said that the burning of cane was a measure recommended to combat the spread of red rot disease. It was, however, still possible to get cultures of *Colletotrichum* from cane after burning. Planters were, of course, also advised to plant resistant varieties, and where possible to fallow the land after ploughing. He had seen a field planted with Co.301 immediately after ploughing-out badly infected Co.290. The Co.301 was then one year old and the field was full of stalks of Co.290 which were getting red rot, but there was no sign of it in the Co.301.

In reply to Mr. Rault, the author stated that, unlike streak disease, red rot usually appeared suddenly and with epidemic intensity. It seemed as if conditions were not so favourable for the spread of red rot in the Mount Edgecombe area. A focus of infection existed at the Experiment Station, and yet only a few stalks of Co.290 and P.O.J.2725 had thus far been found with red rot.

Colletotrichum had not yet been found in Co.281, but this year for the first time *Fusarium* had been isolated from a stalk taken from a patch of dead Co.281.

Dr. McMARTIN stated that the association of the two fungi *Colletotrichum falcatum* and *Fusarium moniliforme* had been reported in India. So far, however, the *Fusarium moniliforme* had been considered a secondary invader, while it was his opinion that it might be playing a more important part in causing red rot. In reply to questions by Mr. Hayes, Dr. McMARTIN stated that the two fungi were not antagonistic to each other, but neither did they appear to assist each other. *Fusarium* was, however, so much easier to grow, that cultures had to be examined microscopically very frequently to find out whether *Colletotrichum* was still present. He had found *Fusarium* but no *Colletotrichum* present in certain cases of cane dying from what appeared to be red rot.

Mr. HAYES suggested that a line of investigation would be to grow cultures to see whether the resistance was due to the fibrous or rind structures of the cane or the presence of some antiseptic substance.

Dr. McMARTIN, in reply to Mr. Dodds, said that inoculation experiments indicated that P.O.J.2725 could be infected with red rot as readily as Co.290. It was difficult to compare field results, however, as P.O.J.2725 was not planted to the same extent in the existing red rot areas. P.O.J.2728, however, appeared to be extremely resistant to red rot.