A NOTE ON THE BIOLOGICAL CONTROL OF A STEM ROT PATHOGEN AFFECTING SUGARCANE

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Stem rot disease of sugarcane was first recorded in April, 1964, in a high altitude area in the Natal midlands. The disease affects the lower part of the stalk, producing water-soak marks on the rind extending downwards from the region of the leaf scar. These marks are at first pale pink in colour and are accompanied by a cottony white mycelium, which appears on the leaf sheath and around the bud. The pink discolouration gradually turns bright red, and at this stage the epidermis of the stalk can be easily peeled away, exposing the stalk fibres. The affected stalks, and finally whole shoots, die, creating widening gaps in the field of cane.

Studies have shown that more than one organism is usually associated with the symptoms of the disease. The causal organism, a fungus, has been isolated, but it has not been induced to sporulate either in the field or in the laboratory. Despite this, transfer of infection can be achieved within three to five days, by keeping healthy material in contact with diseased stalks under conditions of 95 to 100% relative humidity.

Cane stalks when attacked usually die, but in some instances the vigorous mycelium of the parasite deteriorates, following which the stalks suddenly may survive. This deterioration was due to the infective fungus being, in turn, parasitised by hyphae of another fungus, which produced green coloured conidia. This destruction of the disease-causing fungus is a form of natural biological control. Stalks severely infected by the stem rot organism may die, but fresh shoots usually suffer less seriously from the disease, or not at all (Plates 1 and 2).

When the hyper-parasite affects the stem rot organism, the disease symptoms change. In place of the red discolouration of the leaf sheath and the white cottony mycelium, compact, pulvinate, blue-green tufts appear on the surface. Later, the affected area takes on a soft, fleshy, rugose appearance, and turns a pale pink colour. The hyperparasite has been identified in the conidial stage as *Trichoderma lignorum*. The change in colour from green to pink, which takes place over five to twelve weeks, is due to development of the perfect stage, when it is known as *Hypocrea rufa*.

Laboratory Studies

Cultures of the stem rot fungus and its parasite were isolated from diseased sugarcane and used in pure and cross inoculation experiments. Typical stem rot symptoms were produced on cane setts by inoculating them with a pure culture of the pathogenic fungus, following which the setts deteriorated rapidly. However, when the hyperparasitic fungus was sprayed on the infected cane, the stem rot fungus lost its activity and disintegrated quite quickly. No sign of damage was found when healthy cane was inoculated with the hyperparasite alone.

This hyperparasitic fungus has been identified as *Trichoderma lignorum*. Colonies of this species raised on agar are almost circular in shape, tufted in appearance, but not floccose. The mycelium is white in colour at first, but subsequently becomes blue-green, the change in colour extending from the centre outwards. The conidia are globose and about 3 to 4 μ in diameter. Used to inoculate two-week-old cultures of the stem rot organism, it breaks this down in 48 to 60 hours. The mycelium of *Trichoderma* was seen to entwine itself through that of the stem rot fungus, the hyphae of which then lost their natural structure and disintegrated. Subsequently, *T. lignorum* grew luxuriantly and soon covered the agar with a mass of green conidia. The medium, which had been transparent, developed a brown-yellow pigmentation. Attempts to grow the stem rot fungus on this medium failed, indicating that *Trichoderma* produces toxic substances which inhibit the growth and development of the host.

Once *Trichoderma* has killed its host the stem rot fungus, conidial development ceases. A pale reddish coloured stroma spreads over the previously infected parts of the stem, the papillate ostioles of the perithecia being evident as light areas within the darker vegetative mass of the hemispherical enlargements. This phase of development is the perfect stage of *Trichoderma*, and is named *Hypocrea rufa* Pers. Each perithecium contains 8 two-celled ascospores which vary from 57.7 to 78.0 μ in length, and 4.0 to 5.5 μ in width. The different stages of development was studied by sectioning samples and examining these at consecutive stages of maturity. Details of the complete study are to be published elsewhere.

Summary

Losses caused by a stem rot disease of sugarcane usually occur because the hyperparasite, a fungus called *Trichoderma lignorum*, is absent. Laboratory and field studies, and observations in commercial fields of cane, show that *T. lignorum* successfully parasitises the disease-causing organism. It is considered that, under certain conditions, this secondary parasite might be deliberately used to provide biological control of stem rot disease in the field.

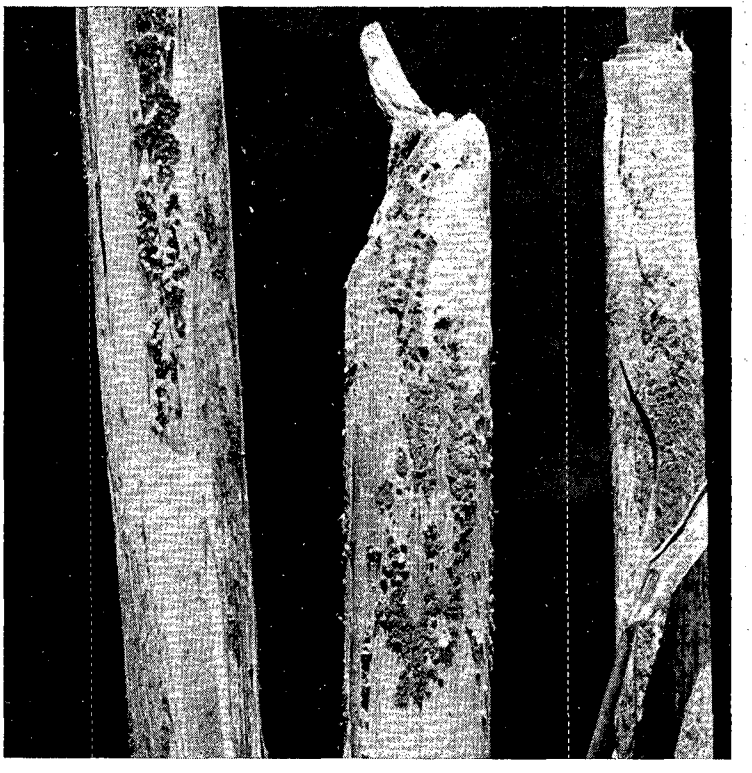

PLATE 1: Stem rot fungus being attacked by **Trichoderma lignorum.** Note the development of the conidial phase of the hyperparasite on the mycelium of the stem rot disease.

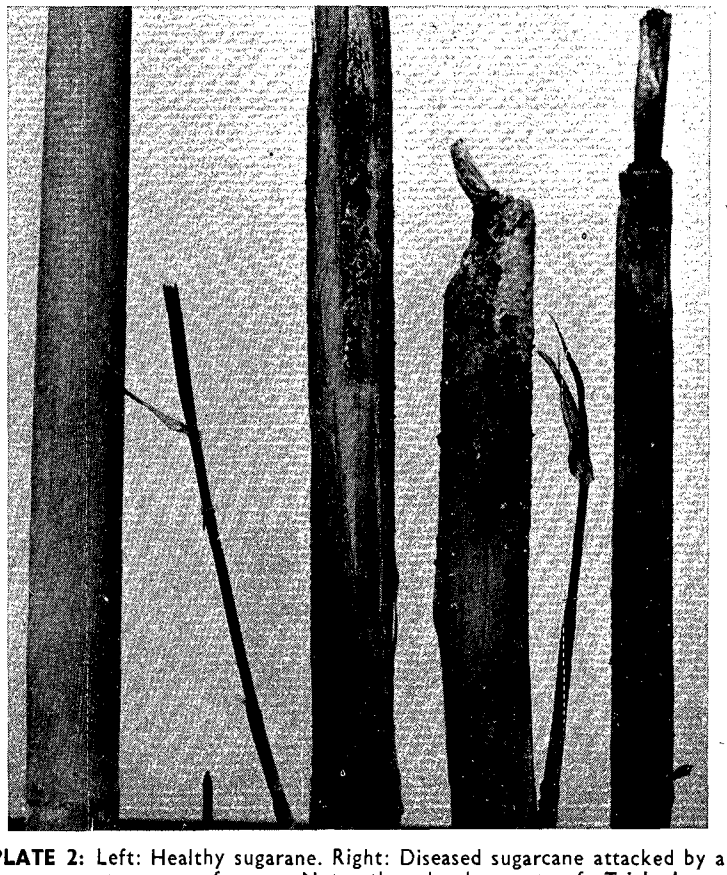

PLATE 2: Left: Healthy sugarane. Right: Diseased sugarcane attacked by a stem rot fungus. Note the development of **Trichoderma lignorum,** parasitising the stem rot fungus. When this occurs the stalk may recover. Buds slightly damaged by stem rot fungus are germinating following suppression of the disease by the hyperparasite.

Discussion

Mr. Wilson: Is this hyperparasite specific to the stem rot fungus or does it affect other fungi?

Dr. Roth: *Trichoderma lignorum* is known to be a parasite on other fungi also, such as Pythium, Rhizoctonia and others.

It grows quite well on filter cake and is propagated in this way. We have now advanced further in our identification of the fungus and have sent specimens to Kew. On special media a sexual reproduction phase as sporangium formation was observed which gives indication that it might be a phytomycete.

Mr. Whellan: Regarding the control of the fungus by the *Hypocrea rufa* does the cane recover or is the control merely to prevent the spread of the disease?

Dr. Roth: Under laboratory conditions there is the possibility of complete recovery of the cane. Damaged tissue will not recover but new shoots will appear without any infection.

Mr. Thomson: There is need for further investigation into this disease, particularly in the Midlands, where the main variety concerned is NCo 376.

The fact that *Trichoderma* can successfully control root rot organisms is very important as we appear to be running into a root rot complex in some Midland soils.

We have seen black stem rot in NCo 376 and NCo 393 and the major symptom is very similar to that of the stem rot we are discussing at the moment. The infected tissues are black instead of red.

Dr. Roth: It is not certain whether the two fungi are related or not. It may be that the black symptoms appear only on older cane, that could be a late stage of attack by *Trichoderma*, and other antagonists. If *Trichoderma* attacks the fungus severely it will never recover. I cannot say anything further until I have investigated more samples of the black stem rot in the laboratory. From a few isolates which I made a week ago, it seems that we are dealing with a complete other fungal disease as it is in the case of red stem rot.