

SUGAR CANE DISEASES IN SOUTH AFRICA

By A. P. D. McCLEAN, Government Mycologist.

The position of the South African Sugar Industry in relation to diseases is a singularly favourable one, in that, there is no disease or insect pest which can justly be deemed as contributing to a serious depreciation of the crop. It should not be misunderstood, however, that diseases of consequence are absent; the presence of Mosaic and the closely related Streak Disease warrant very special consideration and attention.

Most of the serious cane diseases such as Sereh, Leaf Scald, Gummosis, Fiji, Downy Mildew, Dry Top Rot, Smut and Rust are absent from South Africa. This fortunate position is surprising when one considers the wholesale importation of cane varieties at the end of the last century and the inadequate system of quarantine then prevailing.

To-day, every precaution is taken to prevent the entrance of diseases and insects with imported varieties. The cuttings receive fumigation and disinfection treatment on arrival, and are planted in a quarantine greenhouse, equipped with special features to prevent disease dissemination. After a period of from one to two years, plant material is issued to the Sugar Experiment Station and grown in open quarantine for an indefinite period.

MOSAIC AND STREAK DISEASES.

Mosaic and Streak, the major cane disorders of this country, are closely related Virus diseases, each requiring its own specific insect carrier for the purpose of secondary transmission. Both produce a systemic infection and affected plants, as a general rule, do not recover. Plants subsequently established by vegetative means from such diseased material are invariably diseased. It is by this primary means that Mosaic and Streak are largely spread. For secondary transmission, the specific insect vectors are necessary, *Aphis maidis* for Mosaic, and *Cicadulina (Balclutha) mbila* for Streak. It is to these agencies that epidemic outbreaks must be credited.

The intermingling of irregular pale green and yellowish areas with normal green areas, giving to mosaiced leaves their typical mottled or blotched appearance, forms a chlorotic pattern quite distinct

from that associated with Streak. The latter produces narrow, almost colourless streaks. These vary from a quarter to half a millimeter in width, and from a half centimeter to over one centimeter in length, and are distributed generally over the leaves and run in the direction of the veins. These leaf markings, the only symptoms of diagnostic value are produced in marked regularity on all new foliage.

These diseases do not directly bring about the death of affected plants, but impede the normal metabolic processes, and so produce a condition of degeneration. The tendency is for stunting and the retarding of plant vigour. Generally, the ill-effects are cumulative and become more pronounced with the passage of time.

The general methods advocated for their control are as follows:—

- (1) The use of healthy material for planting purposes.
- (2) The removal of affected plants as soon as the disease is visible.
- (3) Substitution of susceptible with immune or highly resistant varieties.
- (4) Growing of tolerant varieties.

In their further aspects, I shall consider these disorders separately.

Varietal Susceptibility.

There are marked differences in the behaviour of the various varieties towards Mosaic. As a general rule, the thick tropical or noble canes are the most severely damaged, while at the other extreme, the thin canes of the Chinese type represent varieties which, in the main, are either immune or highly resistant. Intermediate is a class of tolerant types, which, while readily contracting the disease, do not suffer serious ill effects therefrom.

Mention must be made at this stage of the achievements of the Java Cane breeders, who, by the crossing of thick tropical canes and the thin hardy mosaic immune types, have evolved seedlings endowed with the desirable characters of the two parents. Amongst their early seedlings are P.O.J. 213, 36 and 234, typical examples of the

tolerant class. It is of interest to state that these have been instrumental in saving the Tucuman and Louisiana industries which almost passed out of existence under the influence of Mosaic. The later Javan seedlings include P.O.J. 2725 2714, 2727 and the famous P.O.J. 2878, a truly scientific achievement, combining almost total immunity to mosaic with high sucrose content and many other desirable qualities.

Amongst the imported varieties which have been established in open quarantine at the Experiment Station, outbreaks of Mosaic have been recorded in the following:—

D 1135, Badilla, 1900 Seedling, Q 813, Gingor, Clarke's Seedling, UD 1, SC 12/4, and CO 205.

Experiments are in progress at the Natal Herbarium to determine the susceptibility of the varieties established at the Experiment Station. These are conducted in special large cages. The varieties are raised from setts within the cage, together with a number of diseased plants. When the shoots are through the ground, large numbers of *Aphis maidis* are released in the chamber. The insects move naturally through the chamber, feeding on healthy and diseased plants.

Of the varieties tested, the following have definitely contracted mosaic in one or more of the plants exposed to infection:—

La Mercy Yellow, La Mercy Red, Rouillard Selection, Horne, P.O.J. 213, P.O.J. 36, D 1135, Gingor, Q 813, 1900 Seedling, CO 210, CO 213, SC 12/4, P.O.J. 2722 and UD 1.

While the following in all cases have remained healthy:—

Wade's Selection, CH 64/21, Merthi, Zwinga, Hinde's Special CO 214, CO 290, US 663, P.O.J. 2727, P.O.J. 2725, P.O.J. 2714.

Economic Position of Mosaic.

With the substitution of the Noble canes by immune Uba in the latter part of the nineteenth century, mosaic disease, in the light of a destructive agency, has never been of serious consideration in this country. Mosaic was first announced from Natal by Storey, in 1923, but there would seem little doubt that it had been in the country some years prior to this.

It was realized by Storey that the presence of Mosaic, while of little account at the time, would be a constant source of menace in the future development of new varieties. The susceptible varieties constituting but a small fraction (.2%) of the cane under cultivation, their eradication would involve comparatively little expense and present a reasonable expectation for the complete elimination of Mosaic. Such a policy was finally adopted in 1927 and the necessary legislation instituted, whereby a prohibition was declared on the growing or keeping

of all cane other than the variety Uba. With the exception of small isolated plots in inaccessible regions of native reserves, eradication of susceptible varieties has now almost completely been effected. That, there is a possibility of the survival of mosaic, is realized, and two sources of danger are presented:—

- (1) survival of diseased volunteer ratoons in Uba fields, and
- (2) survival of the disease in wild grasses.

The institution of a systematic and thorough row by row inspection of fields which in the past have carried susceptible varieties is proving most effective, and it is hoped in this way to remove the former of these dangers. It is with perennial grasses that the biggest danger of survival lies. It has been definitely established that *Setaria Sulcata* is susceptible to mosaic and the proof of transmission of the disease from this species to cane, renders it a doubtful point whether the full benefits of the eradication policy are to be attained. Mosaic has been found in this grass only very rarely at any distance from diseased canefields and, with few exceptions, only in a low proportion of the plants. A system of eradication should, therefore, not prove outside the realm of practicability. With this end in view, an inspection is being made of all localities where there exists a danger of the disease having passed over to this grass.

While the success and progress of the South African industry must be credited to Uba, the time is fast approaching when consideration must be given to its replacement in certain areas by certain of the varieties which are now being propagated in quarantine at the Experiment Station. This development is one which is intimately linked with the mosaic question. Owing to the achievements of cane breeders, there are now at the disposal of the cane planter, varieties not only excellent in quality but endowed with a high measure of mosaic resistance. It is with such varieties that this development must proceed in this country.

STREAK.

Varietal Susceptibility.

Some 18 varieties, including Noble, Chinese and North India types, have been found showing the typical symptoms of Streak. Amongst these are Uba, Oshima, Kavangire, Zwinga, CH 64/21 and Cuban Selection: varieties which are regarded as immune to Mosaic. The Coimbatore and later Javan seedlings have so far resisted infection and there is every hope that these will prove immune. The Javan varieties P.O.J. 2725, 2714 and 2878 have been exposed in localities in which one can normally expect almost 100% secondary infection within 12 months. These have in every case maintained an apparently healthy condition.

Economic position.

Streak Disease occurs generally through the Uba cane fields of Natal and Zululand. It was first announced by Storey in 1924, though records of its existence date back to 1914. A similar condition in Maize has been known in Natal since the end of the last century.

The variety Uba, though readily acquiring the disease under South African conditions shows a fairly high measure of tolerance.

In field experiments conducted at Umbogintwini during 1923-25 and at the Sugar Experiment Station 1927-29, the loss from Streak is estimated at from 10-13%. Moreover, these experiments have suggested that, provided the plant material is healthy, no appreciable loss is to be expected in the plant crops from secondary infection. The influence of Streak on ratoons, has not as yet been determined, but, by analogy with other diseases of this type, a progressive deterioration is to be anticipated.

Streak has been found to be readily controllable by selection and roguing methods in those localities where the degree of secondary infection is small. In Zululand and parts of Natal, South of Durban, secondary spread is rapid, and fields planted with healthy material are in most cases to be found 100% diseased within 12 or 18 months. In such areas, the cultivation of resistant varieties must provide the only satisfactory means of control.

INFECTIOUS DISEASES OF MINOR IMPORTANCE.

In addition to the two major diseases described in the foregoing, there are a few infectious disturbances of minor importance. While at the moment, with the variety Uba under cultivation, such are of no economic significance, it is not unreasonable to postulate that in the event of the extensive cultivation of other varieties that one or other of the lesser maladies may assume greater importance than at the moment. Generally all agricultural practices to promote vigorous growth will provide a satisfactory control of these diseases.

Leaf Diseases.

(a) Ring Spot (*Leptosphaeria sacchari*).— Though widespread, Ring Spot is of little importance since it only occurs on the older leaves which have passed their period of maturity and are tending to die off. The leaf spots are somewhat oval, irregular in outline, and about a quarter of an inch or more in length. The dead central tissue is an ashy colour and surrounded by a conspicuous reddish-brown or purple border, beyond which is often an indistinct yellowish margin. There would appear to be differences in varietal susceptibility and amongst the various varieties which are being grown under quarantine at the South African Sugar Experiment Station, P.O.J. 2714 shows the greatest severity of infection. Preliminary observations in-

dicating that under Natal conditions this variety may suffer some damage from the disease. Frequency of the spotting is high and with a tendency for a premature destruction of the leaves.

(b) Eye Spot (*Helminthosporium sacchari*) is another leaf disease of minor importance which is recorded as occurring in Natal and Zululand. This is characterised by narrower and more elongated spots which may extend to the younger leaves.

Stem Diseases.

(a) The Red Rot Disease of Cane stems due to the fungus *Cephalosporium sacchari* was recorded from South Africa by Dr. P. A. Van der Bijl in 1919. Though this would appear to be of little or no account in this country, it is recorded as of importance in India and is said to be an active parasite causing the rotting of affected stalks and the wilting of the leaves.

(b) Rind Disease (*Melanconium sacchari*).— This fungus would appear to be almost entirely saprophytic under South African conditions. The numerous black pustules of thread-like fruiting bodies which burst through the epidermis are a conspicuous feature of dead cane stumps and abandoned stalks. That the fungus is able to assert itself as a weak parasite under conditions unfavourable to growth or in cases of mechanical injury is the opinion generally held.

Root Diseases.

Root diseases have formed the subject of considerable study in most of the cane countries of the world, and it is generally held that such must be attributed to a number of contributing causes, on the one hand, to unfavourable environmental factors lowering the vigour and vitality of the cane plant, and on the other to the assertion of weak facultative fungus parasites on the weakened host. For this reason, root diseases must be regarded as a disease complex. The symptoms are those of physiological drought resulting in the rolling up of the leaves, premature drying up of older leaves and in severe cases, in a top-rot. The final stages are characterized by assertion of weak parasites in the aerial parts (*Melanconium*) and death of the plant.

Such disorders may explain the failure of Otaheite during the early part of the last century, but to quote Earle: "Although positive proof is usually lacking, there is good reason to believe that many of the noteworthy outbreaks of disease which have in the past caused serious crises in the Sugar Industry were really due to root troubles." It is not without the realm of possibility that some such trouble threatened our own industry in the eighties of the last century. In its more recent history, which one might even term the "Uba" period, a root disease complex has never reached proportions sufficient to demand serious consideration. This must, in no small measure, be due to the hardy nature of the Uba variety.

Dr. Van der Bijl, in 1921, records the fungus *Himantia stellifera* in association with root diseases, but he considers the fungus a weak parasite and advocates agricultural practices to promote a vigorous growth of cane.

NON-INFECTIOUS DISEASES.

Cold Chlorosis or Sectional Chlorosis.

During the winter months the symptoms of sectional chlorosis are commonly to be found on the leaves of Uba. The leaves are marked with white horizontal bands due to the inhibition of chlorophyll. The condition has been produced artificially by Dr. Faris by placing ice water in the bud spindle. Certain varieties appear to be more sensitive than others. D 1135 and 1900 Seedlings, and particularly UD 1, are the most sensitive under Natal conditions, while Uba shows markings to a less degree.

Chlorosis.

In the early stages of growth, particularly in ratoon crops, a chlorotic condition of Uba is apparent in most areas. Affected plants may either be found singly or in patches scattered in fields of otherwise normal cane. This condition is not confined to one particular type of soil, though it would appear to be more prevalent on sandy types deficient in organic matter.

Affected plants are a conspicuous uniform yellow, and in extreme cases may become almost whitish. The chlorotic condition is temporary, and after a few weeks plants recover and continue growth in a normal manner.

A similar trouble has been observed in Porto Rico, Cuba, British West India and Hawaii, and referred to as "Lime Chlorosis." While an excess of lime may be a contributing factor in other countries, some other explanation must be offered in South Africa, for the coastal soils of Natal and Zululand are for the most part deficient in this substance. Though this condition must have been apparent for many years past, no experimental work has been attempted to explain the disorder. Some attribute the cause to a nitrogen deficiency, others to nitrogen excess. The failure of chlorophyll suggests that some factor may be operating, resulting in a temporary fall in the amount of available iron during the early stages of growth.

That chlorosis is accompanied by a check in growth is apparent when affected stools are compared with healthy ones. This retardment at a stage when healthy vigorous growth is desirable would seem to me to warrant greater consideration than has been displayed in the past. Workers in Porto Rico and Hawaii have found that by spraying leaves with a solution of iron sulphate, or dusting with powdered iron sulphate, the green colour is restored.

Natal Herbarium,

Durban.

April, 1930.

CHAIRMAN: This is the last of the papers of the Congress but by no means the least in importance and interest. The diseases of sugar can affect the very foundation of the Industry and require very earnest consideration. There are many important matters raised in this paper, and I am only sorry we have not a larger audience to discuss them.

The SECRETARY: I want to take this opportunity of thanking Mr. McClean for the paper, and more particularly for the intensive persistent work which it signifies. My interest in this is contained in the question: When are we going to have the new canes released for general planting? Everybody have made up their minds that the Uba cane has got to be replaced, or if not altogether, at least we must have some other canes so that we shall not have all our eggs in one basket. The Uba has been a wonderful friend to the Natal Sugar Industry, but one never knows how long it will remain friendly, but with the advance of sugar technology, and improved cane practice in other parts of the world, we are being forced into the position of following the countries that are looking for other canes to reduce the cost of production of cane and make the production of sugar cheaper than it has been in the past. I think we are all agreed that this is shown in all our discussions, not only for the agriculturist, but for the miller, some other cane than Uba is very urgently required, and the position as I read it from this paper is that at the moment it cannot be said that the situation is so clear that we can immediately release the canes which are available. I understand that the difficulty arises from this susceptible grass. I am afraid we were rather led to believe at one time that the grass being an annual, was not a serious factor in infection, and I am rather struck with the change of view that is represented by this paper, because it would look as if, so far as the cane is concerned, within a very short time it will be ready, and the situation will be cleared sufficiently to allow of the release of new canes, but with this matter of the susceptible grasses in front of us, it looks as if that situation will have to be investigated with a view to finding out its habits and taking the necessary steps for getting this grass eradicated. I want this subject of the release of the new canes to be pressed, because we have been waiting now since the beginning of 1927, and it is now 1930, and the world's situation in regard to sugar is such that the sooner we can get a cane that gives us the larger sugar content and the better milling qualities, the better it will be for us. I understand the Experiment Station have the canes in possibly sufficient quantity to supply everybody, or at any rate sufficient to start growing on a field scale, and that they will very shortly have sufficient plants to supply everybody. I would like Mr. McClean to give us some idea—I do not want him to commit himself in any way, because this subject of disease is so difficult that to commit himself to a course of action might be the very worst thing for the Industry—but he may at any rate be

able to give us a general idea of the extent of the grass infection—from this paper it would seem to be considerable—and whether from his experience in dealing with that particular phase it will be a serious and lengthy process. I want to thank Mr. McClean personally, and would also like to convey to his predecessor (Mr. Storey), the thanks of the Industry as a whole for the work that has been done on Mosaic. When the time comes for planting out these new canes, it will be a monumental epoch and a triumph for the scientific side of the Industry, because we shall have achieved something which we never had before. It will be the scientific method instead of the rule of thumb method, which latter, in the past, has led us into difficulties that have not been fully appreciated.

Mr. McCLEAN: Since the adoption of this eradication policy and the creation of the cane regulations, there have come at the disposal of the Sugar Industries of the world, varieties which are not only excellent sugar producers, but endowed with a high measure of response to Mosaic. As I have already mentioned in this paper, it is with such varieties that development should proceed in this country. We have the famous P.O.J. 2878. It is true it has come here with a reputation built up in other countries, and still has to be proved in this country, but there would seem to be every hope that 2878 will be of extreme value in certain regions in South Africa. Then, on the other hand, we have the thinner type of cane, such as the C.O. 2090, which gives indications of being a good sugar producer, and at the same time being endowed with high resistance to Mosaic diseases. Without wishing to commit myself, I think the Government will consider the release of the varieties of those types which are among us, and which are highly resistant to Mosaic diseases, at a very early date. With regard to the survival of Mosaic, we have the two sources of danger—the danger from volunteer ratoons of old diseased canes, and we hope by systematic row inspection to remove that altogether, but it is rather an important point whether we are going to get rid of Mosaic because of the *Setaria Sulcata*, a perennial grass which is quite as tenacious as cane. Dig this out one month, and the ground will be covered with it next month, and with the persistence of underground stumps and roots it is a moot point whether we will entirely eradicate Mosaic in this country. But I do think the evolution of these new varieties should be by developing along the lines of P.O.J. 2878 and C.O. 2090.

Mr. PALAIRET: I think there has not been a full realisation of the great amount of work and trouble which the Mycologist's Department has taken. Just as you cannot see the pistons at work in your motor car, yet you cannot drive a car without them, and the scientific men in this room will realise how important the Mycologist's branch is and the tremendous amount of work the Mycologist and his staff are doing and have done. I am sorry

to hear *Setaria Sulcata* is a perennial, because I had gathered it was an annual, and now Mr. McClean tells us it is found in a diseased state close to cane. If it is a perennial this makes it a very serious matter.

Mr. McCLEAN: The annual is a species of sorghum.

Mr. PALAIRET: Generally speaking, history, not only in cane, but in general agriculture all over the world, shows that wherever a sudden change has taken place all sorts of difficulties have cropped up, and if we get a sudden release of many varieties together there is going to be in some quarters a wild rush, and if that happens there might be heavy losses. I was rather hoping that these new varieties would be given out gradually. All along Mr. McClean's paper makes very valuable reference to the canes from which we have been hoping for so much—C.O. 2090 and P.O.J. 214 and 2878—and when it comes to the release, we are told that we have only one variety which can be safely released at present. One wonders, if that is to carry on another year, whether we shall have the land available both for this variety and for those others from which we are expecting so much. I gathered from Mr. McClean, when he was up with us, that C.H. 64/21 would be released very soon, and I was disappointed to hear that there are no indications of it now.

Mr. McCLEAN: That variety can be considered with the others.

Mr. PALAIRET: Mr. McClean is doing the right thing, and doing it thoroughly, and although we are very anxious to get on with the planting of these new varieties, there is no doubt he is right, but I do hope this Congress will express its keenness to get started with the release of new varieties as soon as ever Mr. McClean feels it is really safe to do so. On behalf of the planting industry I wish to express our appreciation of the tremendous work done and the energy and keenness displayed by Mr. McClean and his department.

Mr. MOBERLY: Are there any statistics to show at what rate the new varieties can be established? How long did it take for P.O.J. 2878 to be successful cane after it was established?

CHAIRMAN: I could not answer from memory, but development of 2878 has been extremely rapid. The rate was very much accelerated with unlimited irrigation water, labour and tropical climate. We find we can multiply our stocks at a very rapid rate on a small scale, but on a field scale the ordinary rate of multiplication can be reckoned as 20 to 1 per annum under irrigation. On smaller blocks in the experimental stage the propagation can be very

much more rapid and is really only limited by the amount of irrigation water and labour available at the right time.

Mr. PALAIRET: Is the *aphis madis* one which lives in symbiotic relation with ants, and if so, is any degree of control achieved by the eradication of such ants?

Mr. McCLEAN: No, I do not think so. There seems to be no such practical scheme.

CHAIRMAN: I would like to endorse the useful work done on behalf of the Sugar Industry by the Department of Agriculture as represented by Dr. Storey and later by Mr. McClean and his assistant. Being a Government Department they do not advertise freely, but a lot of excellent work is being done, not only skilled scientific research work by Dr. Storey and Mr. McClean, but a vast amount of routine work in the inspection of canes and in the eradication of volunteer stools of susceptible varieties which has been carried out for the last two or three years by Mr. McClean's cane inspectors who have been thoroughly searching the cane belt from end to end.

The Chairman proposed a hearty vote of thanks to the Agricultural Department for this paper and for the assistance rendered in the past, and which he trusted would be continued in the future.—Carried by acclamation.

Mr. MOBERLY: At the beginning of the proceedings I moved a vote of thanks to Mr. Dodds, and since then he has occupied the chair for three days and conducted this meeting in a way which has been a pleasure to us all, and once again I would like to move a hearty vote of thanks to him for what he has done in this direction.—Carried with acclamation.

Mr. PALAIRET: On behalf of the planting industry I would like to express to the Technologists' Association cordial appreciation for the

work put in in the interests of the Industry. I do sincerely hope that these papers find their way to the planters and make them realise the immense study and work involved, and that they will gather round and we shall see more co-operation between the technical and planting sides of the Industry. Undoubtedly the future of the Industry in all branches lies in better working, and the Technologists' Association and the Experiment Station are definitely bound up in the future of this Industry. Having said that, I would like, on my own behalf, to add an expression of appreciation to the Chairman for his great patience with us and for the number of valuable papers which he has put forward himself.

CHAIRMAN: I would like to express my appreciation of the privilege it has been to me to have occupied the chair of this Association for the past two years in a critical period of its history. It is an event to which I will look back with pleasure all my life. I have great hopes for the future of this Technologists' Association, which I feel sure will take its place with the most renowned sugar technologists' associations in the world. It gives me great pleasure to hand over the chairmanship to Mr. Moberly, whom I would have chosen myself as my successor; retiring presidents are not always so fortunate. I would like to move a vote of thanks to the Press, and especially to Mr. Andrews, of the "South African Sugar Journal." While the daily Press of this country has hardly come to the standpoint of supporting the Sugar Industry to the extent that is done by the Press in other sugar-growing countries, there has been a very noticeable advance in the last two or three years which we much appreciate and which I hope will continue.

Mr. MOBERLY: I move a hearty vote of appreciation to the Secretary for the good work he has done.—Carried unanimously.

The Conference closed at 5 p.m. on Thursday, April 17th, 1930.