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Diseases of Sugarcane and their Control in Puerto Rico

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INTRODUCTION

Many factors affect the incidence of sugarcane diseases in Puerto Rico. Mosaic was responsible for severe losses to the sugar industry when noble cane varieties Cristalina, B.H. 10/12 and S.C. 12/4 were cultivated extensively between 1921 and 1927. Mosaic today can be found only in certain fields of Central Aguirre where B. 37161 is still planted. Contrarily, chlorotic streak, a disease of minor importance in the period 1921–1948, became widespread when noble varieties were replaced by P.O.J. 2878. Liu in 1965 (*7*)[2] reported that in some areas of the northern humid regions where the soil is poorly drained, incidence of chlorotic streak was frequently observed in the neighborhood of 100 percent.

To safeguard our sugar industry, disease surveys were conducted over different ecological zones of Puerto Rico during the fall of 1969 and spring of 1970. This paper reports the findings and presents the major disease problems in each area, their economic importance, their transmission, and possible methods of control.

MATERIALS AND METHODS

The surveys were conducted over the following 10 mill zones: Central Cambalache and Central Monserrate in the north and Central Coloso in the northwest with an average annual rainfall of approximately 50 to 80 inches and an annual average temperature of approximately 77° F. (*1*); Central Aguirre, Central Mercedita and Central Guánica in the south and the Lajas area in the southwest with an average rainfall of approximately 20 to 30 inches and an annual average temperature of approximately 80° to 81° F.; Central Roig and Central Fajardo in the east with an annual rainfall of approximately 50 to 80 inches and an annual average temperature of approximately 78° to 79° F.; Central Igualdad in the west with an annual rainfall of approximately 80 to 100 inches and an annual average tempera-

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[2] Italic numbers in parentheses refer to Literature Cited, p. 146.

ture of approximately 77° F.; and Central Plata in the interior with an average annual rainfall of approximately 40 to 50 inches and an annual average temperature of approximately 73° F.

Cane diseases were recognized mainly by the symptoms visible on the affected plants. In the case of ratoon stunting disease, canes showing retarded growth and general unthriftiness were split longitudinally with a knife and orange or reddish vascular bundle discoloration used as a criterion tentatively to identify the disease in the fields. Chlorotic streak was differentiated from other leaf diseases by the presence of yellowish to whitish streaks with wavy, irregular margins on the leaves. *Fusarium* sett or stem rot was recognized by purplish red discoloration of the parenchyma cells and fibrovascular bundles in the seedpieces; pineapple disease by the breaking-down of the parenchyma tissue and fibrovascular bundles which become hollow and red and black in color. Affected plants in almost all the cases were collected and brought to the laboratory for isolation studies.

RESULTS

CENTRAL CAMBALACHE AREA

The principal sugarcane varieties planted in this area are B. 49119, P.R. 1028, P.R. 1117, P.R. 62258, H. 328560, P.R. 1016, P.R. 980, B. 4362, and P.R. 1059. The principal disease problems are: Poor germination caused by *Thielaviopsis paradoxa* and *Fusarium moniliforme*, and chlorotic streak disease.

In the Finca Matos, approximately 100 acres planted to variety B. 49119 germinated very poorly (fig. 1, A). The affected seedpieces showed purplish red discoloration of the parenchyma cells and fibrovascular bundles (fig. 1, B). *Fusarium moniliforme* was isolated from the diseased seedpieces. The same disease was reproduced in the greenhouse by inoculating healthy seedpieces of P.R. 980 with the isolated organism.

In Finca San Francisco, chlorotic streak was observed on plants of variety H. 328560. This same disease also was observed on varieties P.R. 1016 and B. 4362 in Finca Las Claras. In addition, brown stripe and ring spot were frequently observed on the foliage of varieties P.R. 62258, H. 328560, P.R. 980, and P.R. 1059 in Finca Valencia, Finca Consejo, and Finca Higuerito. However, no conspicuous symptoms of ratoon stunting were observed in canes in this area.

CENTRAL MONSERRATE AREA

The principal varieties planted in this area are P.R. 980 and B. 4362. The major disease problems are root rots. *Fusarium moniliforme* and *Pythium* spp. were isolated from the diseased roots of B. 4362 and P.R. 980. The isolates were used to inoculate healthy seedpieces of B. 4362 and

P.R. 980 in the greenhouse. The results indicate that *Pythium* spp. and *Fusarium moniliforme* are the causal agents of root rots of sugarcane in this area.

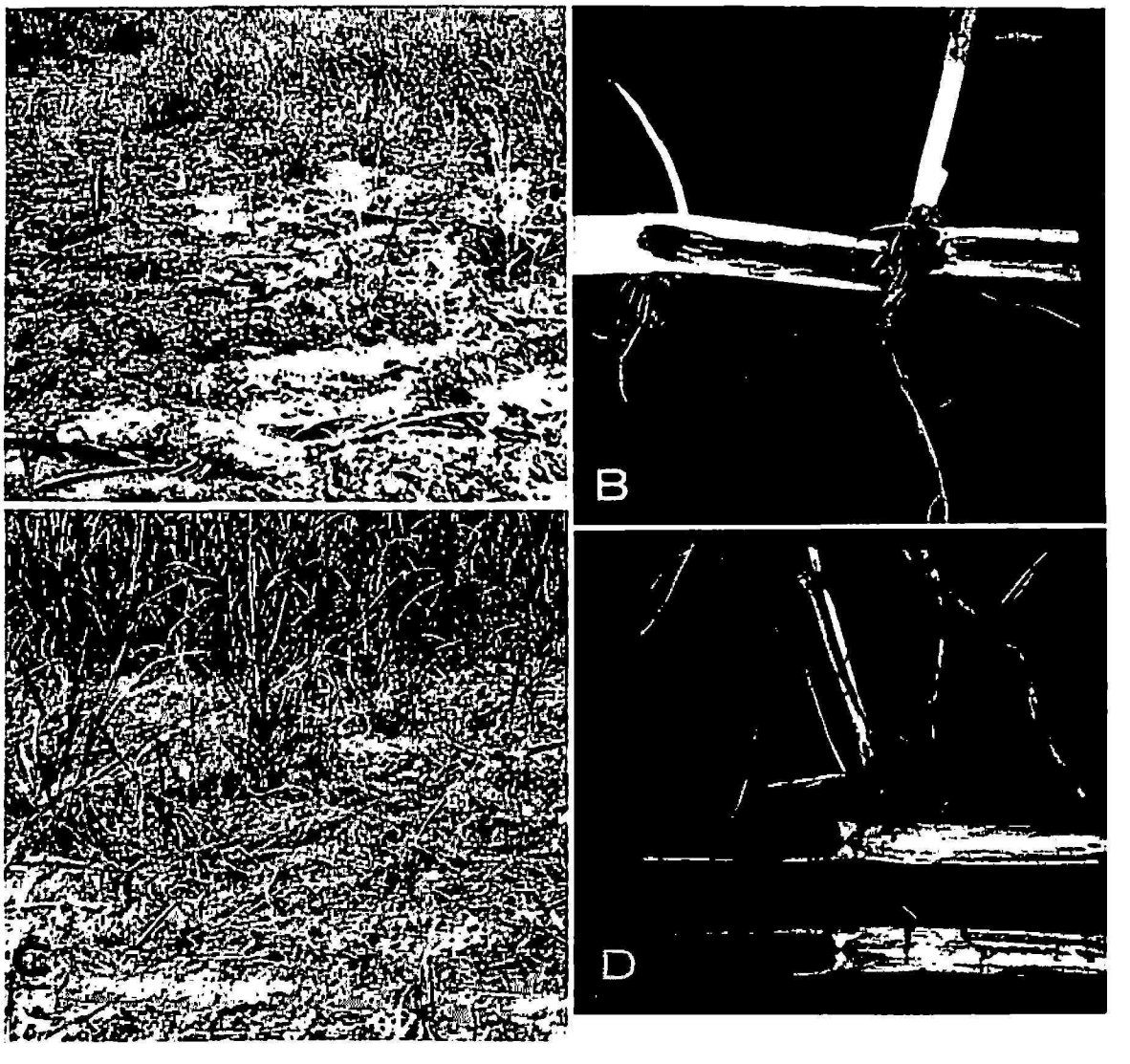

FIG. 1.—Incidence of sugarcane diseases: A, Poor germination of affected canes of B. 49119 in the Central Cambalache area; B, seedpieces of B. 49119 affected by *Fusarium moniliforme*; C, very poor germination of canes of H. 328560 in the Central Roig area affected by pineapple disease; D, pineapple disease affected canes of H. 328560 in the Central Roig area showing hollow and black discoloration of fibrovascular bundles.

CENTRAL COLOSO AREA

The major varieties planted in this area are P.R. 980, B. 49119, H. 328560, P.R. 1059, and P.R. 1016. The major disease problem is ratoon stunting disease. The affected canes of P.R. 1059 were stunted. In general, unthriftiness in growth of the canes was noted. Orange to reddish vascular

bundle discolorations appeared in the mature internodes of nearly 90 percent of the canes examined.

CENTRAL AGUIRRE AREA

The major varieties planted in this area are H. 507209, P.R. 1028, P.R. 1048, P.R. 1059, P.R. 1016, P.R. 1002, H. 328560, C.P. 5243, P.R. 1117, M. 317, B. 42231, P.R. 1241, B. 49119, and B. 34104. The major disease problems are ratoon stunting, root rots and mosaic. Symptoms of ratoon stunting were observed in varieties P.R. 1059, P.R. 1016, and H. 328560. However, no symptoms of ratoon stunting were observed in canes of varieties P.R. 1002, C.P. 5243, P.R. 1117, M. 317, B. 49119, B. 42231, P.R. 1241, and P.R. 980. The germination of B. 49119 was poor. Mosaic-affected stools of B. 34104 can still be found easily in this area.

CENTRAL MERCEDITA AREA

The principal varieties planted in this area are B. 49119, P.R. 980, C.P. 5243, P.R. 1117, P.R. 62258, and P.R. 62285. The major disease problems are ratoon stunting and root rots. Symptoms of ratoon stunting were found in plants of variety P.R. 62258, a very promising sugarcane seedling for that area. Roots of P.R. 980 and B. 49119 were found occasionally affected by *Pythium* spp. *Fusarium moniliforme* and *Thielaviopsis paradoxa* also were isolated from fields showing poor germination and depressed growth. The significance of *Fusarium*, *Thielaviopsis paradoxa* and *Pythium* on yield decline in those areas remains to be determined.

LAJAS AND GUÁNICA AREA

The major varieties planted in this area are P.R. 1117, P.R., 1028, P.R. 1048, P.R. 1059, H. 328560, and H. 507209. The major disease problems are chlorotic streak and ring spots. Chlorotic streak frequently was observed on plants of varieties H. 328560 and P.R. 980 growing near the Lajas Substation. Ring spots frequently were observed on the leaves of P.R. 1117, P.R. 1028, P.R. 1048, and P.R. 1059 in the Guánica area.

CENTRAL ROIG AREA

The major varieties planted in this area are H. 328560, H. 514336, P.R. 1059, B. 37161, P.R. 1117, B. 37172, P.R. 1085, and C.P. 5243. The prevalent diseases are the pineapple disease and chlorotic streak. *Thielaviopsis paradoxa* and *Fusarium moniliforme* were isolated from diseased seedpieces of H. 328560 as well as from seedlings bred by the Agricultural Experiment Station and grown in the Yabucoa area. As shown in figure 1, C, canes germinated very poorly in the areas affected by the pineapple disease. The

affected canes showed hollow and black discoloration of fibrovascular bundles (fig. 1, D).

B. 37172 and P.R. 1059 were affected seriously by the chlorotic streak disease in Colonia Josefina. The affected canes germinated slowly; missing stools were thus commonplace.

CENTRAL FAJARDO AREA

The major varieties planted in this area are P.R. 980, P.R. 1028, H. 328560, B. 49119, B. 41227, P.R. 1059, and P.R. 1048. The major disease problems are similar to those in the Central Roig area. P.R. 980, P.R. 1028 and B. 49119 germinated very poorly in fields having drainage problems. *Fusarium moniliforme*, as well as *Thielaviopsis paradoxa*, were isolated from seedpieces of P.R. 980 that failed to germinate. Nearly 95 percent of the stools of P.R. 980 were affected by chlorotic streak in Finca San Pedro. Chlorotic streak also was observed on varieties B. 41227, P.R. 1028, and P.R. 1048 in Finca Josefina and Finca Vapor. In one instance, symptoms of ratoon stunting were found in plants of variety P.R. 1059 in Finca San Pedro.

CENTRAL IGUALDAD AREA

The major varieties planted in this area are P.R. 980, P.R. 1028, H. 328560, B. 49119, P.R. 1016, and P.R. 1002. The major disease problems are chlorotic streak and root rots. B. 49119 germinated very poorly in this area. *Fusarium moniliforme* and *Thielaviopsis paradoxa* were isolated from the diseased seedpieces of B. 49119. Symptoms of chlorotic streak disease frequently were observed on the leaves of B. 49119 and H. 328560 in the Finca Barletta area.

CENTRAL PLATA AREA

The major varieties planted in this area are B. 49119 and P.R. 980. The major disease problems are ratoon stunting and chlorotic streak. Symptoms of ratoon stunting were found in plants of the variety B. 49119. Chlorotic streaks were observed on the leaves of P.R. 980, P.O.J. 2878, P.R. 1002, C.P. 62228, C.P. 5236, C.P. 62211, B. 54277, C.B. 4447, C.B. 4644, Q. 72, Q. 71, P.R. 1048, and M. 165/38.

DISCUSSION AND RECOMMENDATIONS

The results of these surveys generally agree with the findings of the previous surveys reported by Liu *et al.* (*7*). However, pineapple disease caused by *Thielaviopsis paradoxa*, reported by Cook (*4,5*) as an important disease of sugarcane during the period 1932 to 1933, appears now to be

widespread, especially in poor drainage areas. *Fusarium* seedpiece rot, caused by *Fusarium moniliforme*, not reported in the previous surveys, was observed frequently in the same general areas. Systemic fungicides such as Benlate are being studied for controlling the disease in the greenhouse. Better drainage and seed treatments with the systemic fungicide probably would help control the disease.

Ratoon stunting, presumably caused by a virus, still remains as a disease of major importance although generally low incidence was observed in commercial plantings. P.R. 62258, a very promising sugarcane seedling for the Central Mercedita area, was found susceptible to ratoon stunting disease. Because this seedling has been widely accepted for planting and may become a potentially excellent commerical variety, it is important to establish a disease-free nursery via hot-water treatment at this stage of acceptance to prevent spread of the disease. The following specific methods for control of this disease are recommended: 1, Every three years make seedbed plantings of hot-water-treated cane (at 50° C. for 3 hours); 2, sterilize knives, cutter planters and any other implements used for cutting and planting this variety and its progenies with a 15-percent solution of Lysol;[3] 3, sterilize harvesting knives and the base plates of harvesting machines with the same concentration of Lysol; 4, have the planting material examined every year by a qualified plant pathologist or an agronomist. If ratoon stunting is suspected, obtain further stocks of heat-treated canes. In 1970, López-Rosa and Adsuar (*8*) reported significant yield reductions (19.9 percent) on P.R. 980 due to inoculation with the ratoon stunting disease virus. A net profit of approximately $100 per acre could be achieved if growers would use hot-water-treated seedpieces for planting.

Chlorotic streak, presumably a virus transmitted mainly through water (*2,3*), is very widespread. To reduce losses caused by chlorotic streak, the hot water treatment of seedpieces at 52° C. for 20 minutes is recommended. In addition, better drainage probably would help control the disease to a great extent. It was estimated in 1965 that some 273,970 acres representing 86 percent of the total cane areas were planted with chlorotic streak susceptible varieties (*7*). According to Landrau and Adsuar (*6*), a decrease of about 45 percent in sugar production resulted from planting infected, diseased seedpieces of the variety P.O.J. 2878 instead of non-infected, healthy ones. Based on this information, a loss of 64,500 tons of sugar with a gross value of $6,450,000 was estimated for the damage caused by this disease.

[3] A disinfectant consisting of soap, O-phenyl phenol, O-benzyl-P-chlorophenol, alcohol, xylenols isopropyl alcohol, tetrapotassium ethylenediamine tetraacetate, water glycerine, and propylene glycol.

SUMMARY

A sugarcane disease survey was conducted over different mill zones of Puerto Rico during the fall of 1969 and the spring of 1970. It covered the plantations of 10 sugar mills. The results obtained to date indicate that the diseases of major importance are ratoon stunting, chlorotic streak, pineapple disease, and root rot caused by a complex of *Pythium*, *Fusarium* and nematodes. The specific disease problems are identified in each area. Special attention was given to disease distribution, economic importance, and possible methods of control.

Although in general low incidence of ratoon stunting was observed in commercial plantings, data obtained from previous variety tests indicate this malady to be potentially dangerous. Hot water treatment of seed-pieces should be conducted to prevent its further spread.

The significance of chlorotic streak disease as a factor in yield decline in Puerto Rico has not yet been completely evaluated. The high incidence of this disease, under present conditions, has given rise to concern.

Pineapple disease caused by *Thielaviopsis paradoxa* greatly affects the germination of P.R. 980, especially in areas with poor drainage.

Root rots caused by *Pythium*, *Fusarium* and nematodes reduced germination of P.O.J. 2878 and H. 328560 by as much as 40 percent in poorly-drained areas.

RESUMEN

Durante el otoño de 1969 y la primavera de 1970 se hizo un estudio de las enfermedades de la caña de azúcar en Puerto Rico. El estudio comprendió las siembras pertenecientes a 10 ingenios azucareros. Los resultados obtenidos indican que las enfermedades de más importancia en dichas zonas son las siguientes: El raquitismo, la estría clorótica, la enfermedad de la piña (*pineapple disease*), y la pudrición de la raíz causada por los hongos *Pythium* y *Fusarium* en combinación con los nemátodos. En el estudio se señala la distribución e importancia de estas enfermedades en las distintas zonas bajo estudio, habiéndose prestado atención especial a la distribución de las distintas enfermedades, su importancia económica y los métodos para combatirlas.

Aunque se observó una baja incidencia del raquitismo en las siembras comerciales que se visitaron, los resultados ya obtenidos en pruebas experimentales con diferentes variedades indican que esta enfermedad puede constituir una seria amenaza, de diseminarse en la Isla. Para impedir que se propague se recomienda que la semilla sea tratada con agua caliente.

La importancia de la estría clorótica como factor que afecta la producción

de caña en la Isla no ha sido debidamente evaluada. La alta incidencia de esta enfermedad es motivo de preocupación en estos momentos.

La enfermedad de la piña, causada por el hongo *Thielaviopsis paradoxa*, afecta grandemente la germinación de la variedad P.R. 980, sobre todo en los suelos con un desagüe inadecuado.

La pudrición de la raíz, causada por una combinación de los hongos *Pythium* y *Fusarium* y ciertos nemátodos, disminuye la germinación de las variedades P.O.J. 2878 y H. 328560 hasta en un 40 por ciento en terrenos con mal desagüe.

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