

A NEW VASCULAR ORGANISM IN SUGAR CANE.

By J. MATZ.

In studying the internal structure of cane affected with yellow-stripe disease and cane which was free from this disease but which was affected with top rot or rather dry top, it was observed that the annular and spiral tracheides and pitted vessels in the fibro-vascular bundles, in the lower internodes of both classes of cane mentioned, were plugged with an organism consisting of spherical orange-brown colored spores embedded in a yellowish hyaline matrix. (Fig. 7.) Later this same occurrence was detected in roots of cane as well. Sometimes the vessels were filled with a mass of granular protoplasm containing all stages between numerous small immature ovate bodies of various sizes and the mature, spherical, larger spores. The larger spore bodies have more or less thickened, smooth walls with an interior of a darker, orange-brown mass of granular protoplasm; are uniformly spherical in shape but vary slightly in size; they measure from .014 to .016 millimeters in diameter. The smaller bodies, when pressed out of vessels under a cover glass, vary in size and form. They vary in size from four microns in diameter to nearly the full size of the larger spherical bodies. In form the smallest are devoid of any distinct wall and appear like an irregular dense granule; however, the larger of these possess a densely granulated small center surrounded by a hyaline mass of cytoplasm which is several times thicker than the central granular part. (Fig. 8.) At this stage the small bodies, owing to the soft consistency of their outer part, are mostly oval, due to pressure they exert on each other in the interior of the vessels. The cytoplasmic hyaline layer becomes thinner and the center larger as the individual grows into maturity. The actual growth of these organisms has not been observed as the mature spherical bodies have not germinated in several attempts made, but as the various smaller immature and the spherical mature bodies have been found in the interior of the same fibro-vascular bundles and even in the same vessels it is only reasonable to assume that they represent different phases in the life history of one or-

ganism. In examining fibro-vascular bundles it was found that the lowest portions contained the mature spore bodies and that these diminished and the smaller ones increased in numbers towards the upper part so that at the uppermost point of their visible penetration only granular cytoplasmic masses were found. In some bundles the organism appeared only as a mass of granulated nearly hyaline cytoplasm.

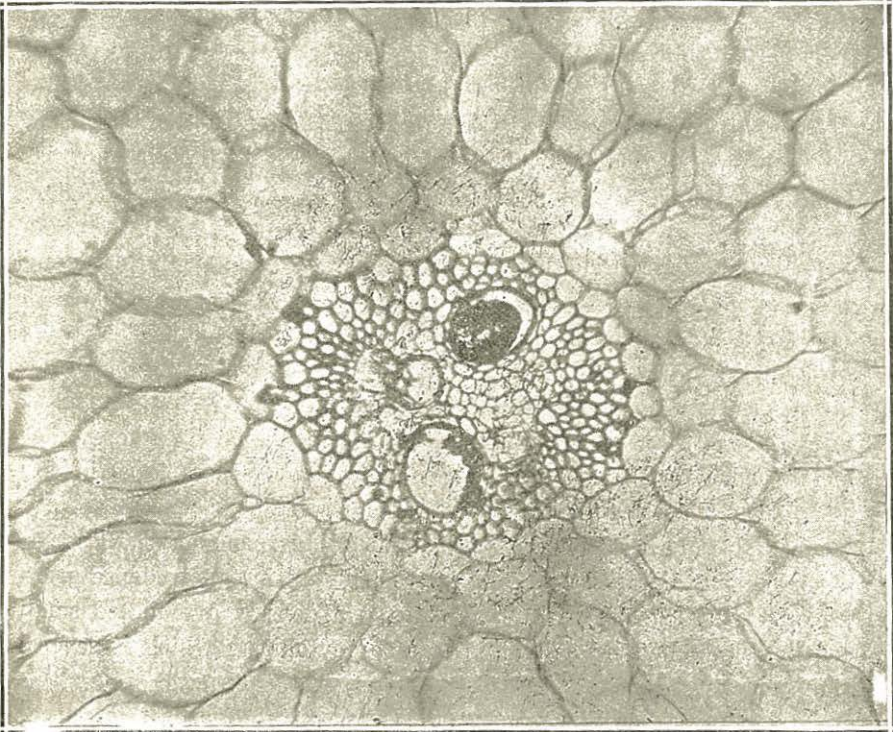


FIG. 7.—Fibro-vascular bundle of sugar cane, showing plugged tubes and vessels with spherical spores. $\times 100$.

The presence of this organism can be detected in cane which show, upon splitting lengthwise or cutting cross wise, bright yellow or orange-colored, sometimes reddish fibro-vascular bundles. These are usually located in the root region of the underground portion of the stalk. The number of orange or reddish-colored bundles in the cane examined were variable. Some canes showed only three

or four colored bundles and in sectioning these it was found that they were plugged with the above organism only for about two or three inches through the lowest nodes and internodes. Others have been found to be infested to a larger extent; that is, the organism was present in a majority of the bundles which were orange colored or reddish and to a height reaching the uppermost nodes. The degree of prevalence of the organism in cane is no doubt due to whether the cane has been growing in more or less infected soils and whether the seed was infected with the organism before planting.

It must be stated here that the fibro-vascular bundles of cane, due to various effects, become sometimes red, vinous or brown in color. To the naked eye it is sometimes difficult to distinguish be-

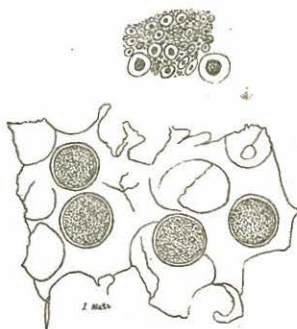


FIG. 8.—Camera lucida drawing of mature spores imbedded in a hyaline matrix, above immature spores. $\times 400$.

tween these and those which are infested with the above organism. Moreover, bundles infested with the latter are sometimes bright red, due to a later effect of the death of the phloem. Nevertheless many specimens have been recognized in the field as being infected with the above organism by the symptoms described in the previous paragraph, and this diagnosis proved correct later with the aid of the microscope. A homogenous, jelly-like, sometimes colored substance is sometimes found in the vessels of injured cane. This substance differs from the above organism in its lack of granulation. Gummy disease can be distinguished by its yellow exudation.

THE DISTRIBUTION OF THE ORGANISM IN PORTO RICO.

The first discovery of the organism was made in the fall of 1919 in yellow-striped diseased Cavengerie cane at Bayamón; later it was

found at Río Piedras in non-yellow-striped cane of a Porto Rico seedling. It was also found at Mayagüez in the varieties Otaheite and Crystalina, at Santa Rita in Rayada, near Cayey in Rayada, near San Germán in non-yellow-striped Crystalina and near Loíza in D-109. In all of these localities cane is known to suffer from what is usually known as "root disease." In looking for the organism

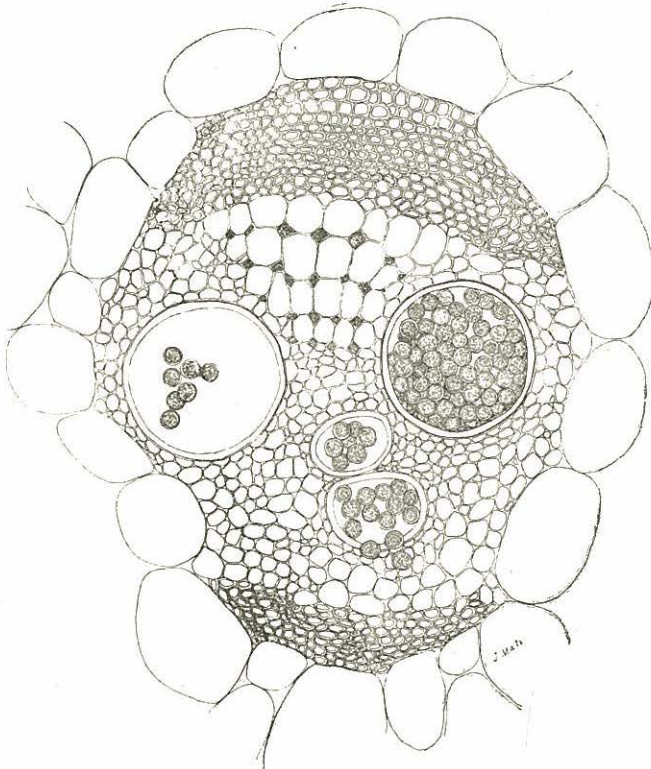


FIG. 9.—Camera lucida drawing of a cane bundle, showing the distribution of the organism in the vessels. $\times 133$.

it was observed that it occurred in cane which showed symptoms of stunting and the tops of which were either partially or totally dry, effects which are commonly attributed to root disease.

THE RELATION OF THE ORGANISM TO THE GROWTH OF CANE.

From the mode of occurrence of the organism in cane, and the manner of its plugging the conducting vessels in the vascular system

of cane it is quite natural that an interference with growth should result. At first an attempt was made to germinate the spores of the organism in water, in sugar water, in cane juice, in fermented but sterilized cane juice, and in several agars but no germination was observed to have taken place. Spores were kept in moist cells for over six months and no germination was observed to have taken place. Portions of cane stalks which contained bundles filled with the organism in its several stages were cut and placed in moist chambers together with healthy seed pieces of Rayada cane, and after five months it was found that the roots of the Rayada cane contained many of the spherical spores of the organism. Apparently a transfer of the organism from its original seat into the healthy cane had taken place. Inoculations with bits of infested bundles into six healthy canes were made at the basal regions of the latter. The six cane stools thus inoculated show marked stunting in contrast with other uninoculated canes growing along side of the former. The important fact is that the organism is able to plug the free passage of the fibro-vascular system in cane, as it is found in that condition in the field. (Fig. 9.)

There seems to be no mention of such a phenomenon in sugar cane in literature on the subject of cane diseases. It is apparently an organism hitherto undescribed.

No mycelium of any kind has been observed to be directly connected with any of the spore forms of the organism. The spores are free in the vessels of the host plant, and the plasmodium is limited by walls of the vessels of the host. Therefore it agrees with the characters of the family *Plasmodiophoraceæ*. It differs from *P. brassicæ* in that it does not form galls and that it inhabits the vascular system of its host. The spores of *P. brassicæ* are smaller than in the organism of sugar cane.

NAME OF THE ORGANISM.

Plasmodiophora vascularum, n. sp.

Description.—The spores in their advanced stage in the interior of the vessels of fibro-vascular bundles are spherical with smooth, somewhat thick hyaline walls, evenly granulated or sometimes coarsely granulated in the interior; orange, yellow, sometimes slightly brown in color, measuring .014—.016 millimeters in diameter. Spores are

embedded in a yellowish hyaline, at length hard matrix. Plasma is composed of a mass of granular cytoplasm, later developing into individuals composed of clear, cytoplasmic variable bodies having a dense, darker, granular center.

Habitat.—Mayagüez, Río Piedras and other localities, in cane fields, Porto Rico. In vascular system of sugar cane, *Saccharum officinarum* Linn.

PUBLICATIONS OF THE YEAR (1919-1920).

(Published or in Press.)

1. Annual Report of the Insular Experiment Station of the Department of Agriculture and Labor (1918-1919) of Porto Rico.
2. Journal of the Department of Agriculture, Vol. III, No. 3, The Mottling or Yellow Stripe Disease of Sugar Cane, by John A. Stevenson.
3. Bulletin No. 19. The Resistance of Cane Varieties to Yellow Stripe or the Mosaic Disease, by F. S. Earle.
4. Boletín No. 20. Insecticidas y Fungicidas, por I. A. Colón.
5. Circular No. 17. Recomendaciones Sobre el Cultivo de la Caña de Azúcar en Puerto Rico, por F. S. Earle.
6. Circular No. 18. El Exterminio de la Garrapata, por J. Bagué.
7. Boletín No. 21. Abonos (1918-1919), por F. A. López Domínguez.
8. Bulletin No. 22. Eradication as a Means of Control in Sugar Cane Mosaic or Yellow Stripe. The Year's Experience with this Method, by F. S. Earle.
9. Circular No. 19. La Preparación de Abonos Mezclados por el Agricultor, por F. A. López Domínguez.
10. Boletín No. 19. (Edición Española.) La Resistencia de las Variedades de Caña a la Enfermedad de las Rayas Amarillas o del Mosaico, por F. S. Earle.
11. Boletín No. 22. (Edición Española.) La Extirpación del Mosaico de la Caña como Medio de Represión, por F. S. Earle.
12. The Journal of the Department of Agriculture, Vol. IIII, No. IV. Yellow Strips Investigations, (Progress Report).
13. Circular No. 20. La Gomosis de la Caña, por J. Matz.
14. Circular No. 21. El Cólera del Cerdo, por Dr. Jaime Bagué.
15. Circular No. 22. El Mosaico de la Caña o Matizado, por F. S. Earle.
16. Circular No. 23. Variedades de Caña, por F. S. Earle.
17. Circular No. 24. La Preparación de la Disolución Arsenical para el Exterminio de la Garrapata, por F. A. López Domínguez,
18. Circular No. 25. El Mal del Guineo, por J. Matz.