THE MOTTLING DISEASE OF CANE AND THE SUGAR PRODUCTION OF PORTO RICO.

By C. A. Figueroa.

Since the year 1915 the cane growers of Porto Rico have been complaining that the sugar production of the Island has been diminishing with every succeeding crop. About the same time it was noticed that the fields were taking a yellowish color, the growth seemed to be handicapped, the stems were beginning to shrink and crack, and finally that the cane production per acre was getting to be less and less. To the disease presenting these symptoms was given the name of "matizado" or mottling disease.

A great many efforts have been made to control this disease, but so far they have proved to be of little value. To-day every cane-growing section of the Island is more or less infected.

About a year ago the students of the disease stated that the infection was "very general in the cane fields to the west of a line drawn from Bayamón on the north coast down to Guánica on the south coast." Only isolated cases were found to the east of this line. The progress of the disease since then is best shown by the following letter:

"My Dear Mr. Figueroa:

"In reply to yours of September 8, inquiring about the present extent of infection with *matizado* in the different cane-growing districts, I would say as follows:

"From Bayamón to Barceloneta on the north coast infection is as yet only partial, but the disease is sufficiently abundant to constitute a commercial factor of importance. Your investigation will probably show some effect of the disease in lessening production in this district. As a rule the hill lands are more heavily infested than the *vegas*.

"From Arecibo to Central Coloso on the west coast the per cent of infection is considerably heavier than in this first district, but it is not total in all the fields, especially near the coast. Back in the hills the infection is very severe and very many hill fields have been abandoned.

"From Rincón around the west coast to San Germán the infection may be considered as total. Many of the fields are actually 100 per cent infested and very many over 90 per cent infested. It is doubtful if any field can be found that is not more than 50 per cent infested.

"From San Germán to Peñuelas the infection is very general and is now spreading more rapidly than in any other part of the Island. It is not yet, however, as complete as in the western district.

"At Central Mercedita near Ponce and in the fields about Juana Díaz there is considerable infection, but in the remainder of the south coast from Ponce to Patillas while the infection occurs locally at many places there is as yet too little to be a commercial factor.

"The same can be said of the entire east coast, though local outbreaks have occurred at Naguabo and Fajardo.

"Cayey is heavily infested.

"The district from Caguas to Juncos is partially infested but not sufficiently as yet to affect total yields very seriously.

"There is also a local outbreak at Trujillo Alto which extends to the neighborhood of Carolina.

"The above data, in connection with the other statistics you have gathered, should show quite conclusively the actual losses due to the *matizado*. I shall be very much interested to see your conclusions.

"Yours truly,

"(Signed) F. S. EARLE,
"*Expert in Cane Diseases.*"

The statistics that Professor Earle alludes to may be found in table form on page 40.

It will be noticed that the cane-growing zone of the Island has been divided according to Professor Earle's letter. A glance at the statistics will show that where the infection is most intense the sugar production has diminished most heavily.

The first section, which Professor Earle calls partially infested, (first zone) increased its acreage by over 4,400 *cuerdas* in 1918, nevertheless its sugar production was diminished by 2,850.31 tons. This figure represents 4½ per cent of the 1917 crop for the zone. The following year the acreage was diminished by over 450 *cuerdas* and then the loss of sugar goes up to about 18.3 per cent of the 1917 crop. It will also be seen that there is no proportion between the fluctuations in acreage as compared with the sugar output.

In the section from Arecibo to San Sebastián the infection is still greater than in the preceding one. Of this section Dr. Blouin of Louisiana says the following:

"In the district between San Pedro and Mayagüez, particularly in the Arecibo district, the damage has been very extensive. I visited three or four plantations in that district and the damage amounted to 40 per cent of the crop." —(*La. Planter and Sugar Manufacturer*, Oct. 18, 1919.)

The statistics show that this section has seen its sugar production reduced by about 40 per cent in two years.

The section from Rincón to Lajas offers a conclusive proof of the extent to which this disease interferes with production. In one year the sugar output is cut down to 67.6 per cent of the normal

and the next year it goes further down to nearly 60 per cent. This clearly shows the rapid progress of the disease in one year.

This has been partly due to the fact that seed has been very scarce in that section and lots of diseased seed have been used. These could be bought at very low prices. The writer in his report on a trip throughout this section was informed of this fact:

"The fact that cane seed (cuttings) are being sold at a very low price in the San Germán valley induced me to look into the matter somewhat carefully. After some investigation I found healthy seed was exceedingly scarce in that section and this led many planters to use diseased seed which they can get at very low prices, thus helping to spread the disease in the most efficient manner. Lots of these diseased seed have been sold to the planters at Sabana Grande."

The section from Sabana Grande to Peñuelas has lost considerably. In this district, as in the first one here discussed, the infection has increased very rapidly and the losses in sugar have also increased accordingly.

In the south and east coasts of the Island the disease is only beginning to show. Losses here are greatly due to the lack of rainfall.

All students of this disease agree that its attacks are more severe in the hill plantings than in the lowlands of the coast. The Cayey and Adjuntas section prove this conclusively.

"The disease reduces the tonnage and therefore also reduces the production of sugar per acre." This statement was made by the director of the Insular Experiment Station in his Circular No. 14, and to back up his utterance he mentions the following experiences:

A Java experiment gave these results:

Healthy cane, 21.23 tons per acre, first crop.
Mottled cane, 18.20 tons per acre, first crop.

Results of a Hawaiian Experiment.

	Tonnage of 3 rows 80 feet long	Estimated tonnage per acre	No. of canes	Average weight per cane (lbs.)	Tons of sugar per acre
Healthy cane.....	2,786	101.13	835	9.27	14.98
Mottled cane.....	1.5495	56.24	623	8.01	8.43

OTHER CONDITIONS AFFECTING THE SUGAR PRODUCTION.

This work will not be complete if it does not contain a brief discussion of all factors that may have had some influence on the sugar production. The writer does not pretend to assume that every pound

of sugar lost has been due to this disease. Though he firmly believes that the bulk of the loss is the result of the *matizado,* there are other causes to be taken into consideration.

RAINFALL.

The rainfall records available are not complete and for this reason they do not appear in this work. However, it is a well-known fact that the severe drouths that have occurred in different sections of the Island, particularly in the south coast and in the Arecibo-Aguadilla section, have contributed to lower production. Furthermore, the scanty amount of rainfall in certain sections like the eastern coast have come just at the wrong time.

But even so, it is not reasonable to blame the lack of rainfall for the whole trouble. The precipitation records that are complete show that there is no uniform relation between production and rainfall.

MANURES.

The following table [1] shows the importation of commercial manures by the district of Porto Rico during the last three years:

Year.	Tons.	Value.
1915–16	39,702	$1,735,391
1916–17	45,769	2,827,796
1917–18	40,811	2,929,726

This table shows that in the year 1917–18 the imports were cut down by 5,000 tons. It also shows that the cost of commercial manures has gone beyond the reach of the small cane grower.

But if the small planter has not used as much commercial manure as before the war, he has used more stable manure, guano, etc. Moreover, the manure-mixing plants of the Island have increased their capacity to a considerable extent, and consequently lots of manurial ingredients have been imported. It is very probable that all of these ingredients have not been imported under the head "Manures" or "Fertilizers" but as "Chemical Products." The enormous increase of importations under this heading appears to confirm this belief.

On the other hand, these 5,000 tons that were not imported last year are largely potash. All commercial manure users have missed this ingredient in their manures. This has led them to believe that lack of potash is to be blamed for the deficit in the sugar production.

However, manurial experiments on record in Porto Rico as far

[1] Customs House records.

back as 1910 have failed to show the economic advantage of the use of potash as a fertilizer in cane cultivation. Professor Earle says in connection with the use of potash:

"Potash should not be taken into consideration for its need is not so essential. Experiments with cane in Porto Rico show that the use of potash in these soils is of no such a great need. The demand for potash as a manure is one of the things 'Made in Germany.' Its use has been extended by means of the active propaganda of the 'German Kali Works.' For a good many years previous to the war this firm has been paying specialists in almost every agricultural country, whose business it was to work in favor of the potash." (Circ. No. 17, Ins. Exp. Sta., Recomendaciones sobre el Cultivo de la Caña en Puerto Rico.)

TILLAGE AND CULTIVATION.

All those interested in agriculture in Porto Rico agree in that our methods of tillage and cultivation are rapidly and constantly improving. A trip through the cane section will convince anybody of this fact. Soils are better prepared; more attention is paid to manurial and cultivation problems; seed selection is beginning to be popular; the sight of implements such as the tractor, the harrow, the disc plow and others is familiar now-a-days; and in short, the sugar men are beginning to realize that sugar cannot be made in the factories if proper attention is not paid to the agricultural end of the sugar business.

Comparing the acreage with production for the last three years we have—[1]

Year	Cane acreage *Cuerdas*	Total sugar output *Tons*	Tons of sugar per acre	Per cent decrease
1917	295,106	503,081.18	2.41	.....
1918	256,431	453,975.55	1.77	9.7
1919	278,901	406,000 00	1.70	19 0

[1] From Bureau of Property Taxes and Report of the Treasurer.

This means that, taking the crop of 1917 as a basis for calculation, Porto Rico has lost 146,186.81 tons of sugar in two years. This is about equal to 30 per cent of its normal production for one season. The figure is large enough to command some attention.

COMPARATIVE STATISTICS OF THE CANE ACREAGE AND AMOUNT OF SUGAR MANUFACTURED IN PORTO RICO IN THE CROPS FROM 1917 TO 1919.[1]

Municipality		Acreage of cane			Central	Sugar produced (T. 2.000 lbs.)			Decrease—T. 2,000			Per cent decrease	
		1916-17	1917-18	1918-19		Crop of 17	Crop of 18	Crop of 19	Crop of 18	Crop of 19	Decrease total	1918	1919
First Zone	Bayamón	2,116	2,840	2,869	Juanita	6.520 00	7,510.00	7,092.50					
	Toa Baja	3,302	4,284	4.023	Constancia	7,759.55	8,573.75	6,913.25					
	Toa Alta	975	1,406	1,355									
	Dorado	2,224	3 024	2.950									
	Vega Alta	1,069	2,346	2.196	Carmen	11,024.00	10.059.88	8,400.00					
	Vega Baja	4.464	4,008	3,957	San Vicente	12,044.00	10.925.00	10,379.00					
	Manatí	3.587	3.847	3,719	Monserrate	7,171.00	6,612 63	5.276 00					
	Barceloneta	4.038	4.419	4,648	Plazuela	16,500.00	14,487.88	11,749.00					
	Totales	21,775	26,174	25,717		61,019.55	58,169.24	49.809.75	2,850 00	11,209.80	14,060.11	4.6	18.3
Second Zone	Arecibo	11,872	14,687	13,811	Cambalache	23.129.00	15.197.63	11,021.00					
					Caños	6,353 68	5,129.38	4.375.25					
	Hatillo	1,973	3,718	3,616	Bayaney	745.00	946.00	1,367.50					
	Camuy	2,788	3,972	3,956	Soller	1,010.00	769.00	458.00					
					Alianza	4,808.00	2,343.51	1.243.00					
	Quebradillas	1,384	2,090	1,970									
	Isabela	1,018	1,567	1,527									
	Aguadilla	3,362	3,786	3,609	Coloso	13.501.50	12,690 06	11.021.00					
	Aguada	3.459	2,988	4,226									
	San Sebastián	835	1,380	1.313	Plata	1,795.60	1.854.00	1,462.00					
	Totales	26,691	34,189	34,028		51,342.78	38,929.58	30.947.75	12,413.00	20,395.03	32,808.23	24.1	39.7
Third Zone	Rincón	1,526	1,672	1,952	Córsica	11,044 00	7,581.00	7.392 88					
	Añasco	5,033	4,809	4,890									
	Mayagüez	4,968	4,166	4,281	Rochelaise	7,284.00	5,200.00	4.744.00					
					Ana María	7,993.38	5,135 00	3,969.89					
	Hormigueros	3,438	3,834	3,863	Eureka	6,084.00	3,980.00	3,527.00					
	Cabo Rojo	6,878	7,563	7,626									
	San Germán	4,688	6 635	6,631									
	Lajas	8,073	6,353	6,339									
	Totales	34,604	35.033	35,587		32,405.38	21,896.00	19,633.77	10,609.38	12,771.61	23,380.99	32.4	39.4
Fourth Zone	Sabana Grande	1,466	1,881	2,054									
	Yauco	1,779	1,746	1,623									
	Guánica	3.193	4,281	4,317	Guánica	81.000.86	76.689 86	65,685.00					
	Guayanilla	1,890	1,857	1,904	Rufina	7,900.00	7,012.00	6.438.45					
					San Francisco	3,000.00	2,666.00	2.740.00					
	Peñuelas	1,609	1,848	1,991									
	Totales	9,937	11,613	11,889		91,900.86	86,367.86	74,863.45	5,533.00	17,037.41	22,670.41	6	17.4

Fifth Zone	Ponce	10,473	9,466	9,540	Mercedita	10,204.00	9,523.00	8,593.03					
					Constancia	2,206.00	4,508.73	1,590.00					
	Juana Díaz	8,113	8,117	8,195	Bocachica	14,925.00	16,231.00	13,180 00					
	Villalba		596	582									
	Santa Isabel	6,896	7,692	8,231	Cortada	10,780.00	11,173.00	8,932.00					
	Salinas	5,446	6,248	6,262	Aguirre	48,900.00	47,200.00	44,632.00					
	Guayama	8,580	7,447	7,237	Machete	10,557.00	10,237.00	9,845.00					
	Arroyo	2,622	2,775	2,766	Lafayette	8,685.00	7,826.00	13,093.75					
	Patillas	3,629	3,246	3,088	Providencia	5,200.00	4,765.00						
	Totales	45,759	45,587	45,907		111,457.00	111,463.73	99,365.78		11,081.22	11,074.49		10.8
Sixth Zone	Cayey	982	1,745	1,757	Cayey	5,221.00	2,778.00	2,636.00	2,443.00	2,585.00	5,028.00	46.7	50.0
Seventh Zone	Maunabo	2,865	2,151	2,142	Columbia	7,223.50	6,052.00	5,189.00					
	Yabucoa	4,980	8,900	7,205	Mercedita	17,285.00	13,724.24	12,447.65					
	Humacao	5,679	7,440	8,286	Ejemplo	6,276 00	6,074.00	5,152.00					
					Pasto Viejo	11,456.87	10,777.00	9,681.13					
	Las Piedras	2,192	3,054	1,773									
	Ceiba	3,057	3,816	3,429									
	Naguabo	4,601	5,840	6,149	Triunfo	1,276.25	3,203.00	3,254.88					
	Fajardo	3,978	6,336	4,516	Fajardo	29,343.82	35,818.00	31,193.00					
	Totales	27,352	37,537	33,500		72,871.44	75,648.37	66,917.66					
Eighth Zone	Caguas	2,909	5,440	5,424	Santa Juana	11,114.00	7,187.00	7,031.00					
	Gurabo	2,491	3,393	2,862									
	Juncos	1,625	3,064	2,374	Juncos	14,925.00	16,231.00	13,180.50					
	San Lorenzo	1,142	1,229	1,229									
	Totales	8,167	13,126	11,896		26,039.00	23,418.00	20,211.50	2,621.00	5,827.50	8,448.50	10	22.2
Ninth Zone	Río Piedras	3,280	4,467	4,584	Vannina	10,543.00	12,135.25	11,733.25					
	Guaynabo	1,197	3,379	2,600									
	Carolina	2,925	4,445	3,716	Progreso	6,335.00	5,704.63	5,485.39					
	Trujillo Alto	1,013	1,549	1,531									
	Loíza	3,388	5,464	3,556	Canóvanas	14,706.13	15,413 50	15,184.25					
	Río Grande	3,193	3,898	3,895									
	Luquillo	2,895	4,151	4,209									
	Totales	17,891	27,353	24,091		31,584.13	33,253.38	32,402.89					
Tenth Zone	Jayuya	36	334	425	Santa Bárbara	957.00	798.65	585.28					
	Adjuntas	477	444	426	Pellejas	373.00	235.00	284.00					
	Totales	513	778	851		1,330.00	1,033.65	869.28	296.35	460.72	757.07	22.2	34.0

[1] From Report of the Treasurer of Porto Rico, statements of the Bureau of Property Taxes and figures from the Sugar Producers' Association.