

Performance of Mosaic-Resistant Strains of Filler Tobacco¹

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INTRODUCTION

Common mosaic is at present the most harmful tobacco disease in Puerto Rico. It affects not only the yield, but also the grading of the marketable product, thus reducing considerably the income of farmers. All commercial varieties grown in the Island are susceptible to the mosaic. The virus causing the disease is spread by farmworkers during such cultural practices as pulling, transplanting, weeding, topping, suckering, and priming. Unfortunately, the recommended preventive methods have been rather inefficient in controlling the disease. Obviously, the most effective measure consists in developing mosaic-resistant varieties. In view of these considerations, a tobacco-breeding program was undertaken in 1953-54 to develop mosaic-resistant varieties and, at the same time, select for superior agronomic characters.

An important factor in breeding for common mosaic resistance, was the discovery in 1933 of the Ambalema type of resistance (4)³. Although extensive work was done in different tobacco areas of the world, no important commercial varieties could be developed from this source of resistance since it was associated with undesirable leaf characters. Later on, Holmes (1) transferred mosaic resistance to tobacco from Clausen's fertile glutinosa x tabacum allopolyploid (2). This resistance was simple-inherited and determined by a single dominant pair of factors. This source of resistance has been used widely over the world, proving to be very effective in attaining practical control of the common mosaic of tobacco.

MATERIALS AND METHODS

Using the glutinosa type of resistance, a breeding program was started by López-Matos in 1953-54 (3) at the Gurabo Substation⁴. Mosaic-resistant varieties were introduced from Continental U.S. and crossed to local commercial varieties, so as to incorporate the mosaic resistance. How-

¹ Contribution from the Gurabo Substation.

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³ *Italic numbers in parentheses refer to Literature Cited, p. 53.*

⁴ This tobacco-breeding program was initiated by L. López-Matos, who continued the work until 1958. From 1958 to 1961 the breeding was in charge of the authors.

ever, the introduced varieties were susceptible to black shank disease (*Phytophthora parasitica* var. *Nicotiana*), this also being of a great economic importance in the Island. Although the local commercial varieties used were resistant to black shank, the hybrid strains obtained from the crosses between local and introduced varieties showed high susceptibility, hence it was necessary to select also for black shank resistance. Numerous hybrid strains were backcrossed for three or four generations using local varieties as recurrent parents. Selection of superior types followed by selfing was practiced during the following six generations. Careful consideration was given to the selection for plant type and height, number of leaves, leaf characteristics, yield, curing qualities, and grading.

During the first segregating generations seedlings were inoculated under field conditions with a common mosaic-virus extract, discarding all the susceptible plants. Selected strains were inoculated during three or four successive generations until they were homozygous resistant. The experimental area where the strains were grown was infected with the black shank fungus, so as to facilitate the selections for resistant types. Selection for agronomic characters was made simultaneously with selection for disease resistance.

During 1959-60 advanced-generation strains were harvested and leaves were cured in a conventional curing shed. Cured tobacco was graded according to USDA standards. Strains producing tobacco of inferior grades were discarded. Selected strains were compared next year at the Gurabo Substation. A total of 59 strains and 5 commercial varieties used as checks, were tested and compared for disease resistance, yield, and grading.

Simultaneously four preliminary regional tests were conducted at Comerío, Aguas Buenas, Cayey, and Barranquitas, so as to evaluate the performance of 27 promising strains in different areas of the Tobacco Region of the Island. The standard commercial varieties of each particular area were used as checks. To secure healthy, uniform seedlings for these experiments, seedbeds were grown in clay pots filled with a 1:1 sterilized soil mixture of loam and cured filter-press cake. Three weeks after the seed were sown, the young seedlings were transferred to vita-bands on metal flats. As soon as they attained the proper size they were transferred to the experimental fields.

Cultural practices such as soil preparation, planting distance, fertilizer level, and insect control followed Station recommendations. Plants were topped as soon as the inflorescence emerged, suckering was practiced once every week, and priming of mature leaves was done every 8 days. Curing was conducted in conventional curing sheds. Once the leaves were cured, they were classified according to the Federal standards. Data on disease incidence, yield, and grading were recorded.

Meanwhile, as shown in table 1, a new group of hybrid strains from different generations was grown and screened for disease resistance and for desirable agronomic characters. Final selections from advanced generations of this material will supply new promising strains to be used in future regional tests.

RESULTS

A frequency distribution of black shank resistance of the strains tested at the Gurabo Substation indicates that 30 out of 59 mosaic-resistant strains showed more than 86-percent resistance to black shank. The remaining strains fluctuated from moderately resistant to highly susceptible. Obviously, this disease was a limiting factor in the yield, as susceptible strains performed poorly. The results obtained in the same location indicate that 16 strains yielded over 1,400 pounds per acre (table 2). These strains surpassed the yield of the commercial varieties used as checks, the mean yield of which fluctuated between 1,100 and 1,300 pounds per acre.

In Aguas Buenas, eight strains produced higher yields than Selección Olor, the best yielder among the commercial varieties used as checks. Three of the tested strains were black shank-susceptible and were discarded. The trial conducted at Cayey was severely affected by a drought, resulting in reduced yields. Nevertheless, 13 of the strains tested produced higher yields than the checks. The yields of the strains fluctuated from 1,000 to 1,200 pounds per acre, while in the commercial varieties yields fluctuated from 700 to 900 pounds.

Dry weather conditions prevailed also at Comerío where the yields obtained were the lowest among all tests. In spite of the adverse conditions, most of the strains tested showed a superior performance as compared to checks. A similar pattern was observed in Barranquitas where most of the strains tested were superior to the commercial varieties. In this trial irriga-

TABLE 1.—*Selection of new tobacco strains underway in the breeding program of the Gurabo Substation*

Number of strains	Generation	Mosaic resistance ¹
46	BC ₂ S ₆	NN
88	BC ₃ S ₄	NN
75	BC ₄ S ₃	NN
34	BC ₄ S ₃	Nn
51	BC ₃ S ₄	Nn
30	F ₁	Nn

¹ NN stands for homozygous-resistant; Nn for heterozygous

TABLE 2.—*Frequency distribution for yield of tobacco strains in preliminary regional tests in Puerto Rico*

Location	Yield, 100 pounds per acre, of strain and check																
	6	7	8	9	10	11	12	13	14	15	16	17	n	X	S.D.	C.V.	
Barranquitas	—	—	—	1	6	11	4	2	—	—	—	—	24	11.58	1.06	9.19	
	—	—	1	1	1	—	—	—	—	—	—	—	3	9.58	1.30	13.61	
Comerio	2	5	4	7	4	1	1	—	—	—	—	—	24	9.07	1.55	17.13	
	—	3	—	—	—	—	—	—	—	—	—	—	3	7.29	.35	4.79	
Aguas Buenas	—	—	—	—	2	—	1	7	6	5	3	—	24	14.28	1.22	8.55	
	—	—	—	—	1	—	—	1	1	—	—	—	3	12.32	2.50	20.3	
Cayey	—	2	4	5	3	9	1	—	—	—	—	—	24	10.14	1.43	14.15	
	—	1	—	2	—	—	—	—	—	—	—	—	3	8.77	.73	8.34	
Gurabo	—	—	—	—	—	—	3	5	9	6	—	1	24	14.46	1.02	7.07	
	—	—	—	—	—	1	2	2	—	—	—	—	5	12.73	1.33	10.4	

tion was used during the preliminary stages, which could account for the higher yields as compared to those obtained at Cayey and Comerío where no irrigation was used.

Obviously the results obtained in these trials were affected by the climatic conditions prevailing at each location. The higher values for the coefficient of variability (see table 1) obtained at Cayey and Comerío, 14.15 and 17.13 percent, respectively, suggest an interaction between strains and location.

Environmental conditions prevailing in both locations affected the behavior of the strains, indicating a wide difference in adaptation among them. A lower variability was observed in the other trials, indicating a more uniform performance of the strains under the environmental factors at those locations. Nevertheless, considerable differences in yield were obtained among strains within and between the different locations. In all the tests performed, the mean yields of the strains surpassed those of the commercial varieties used as checks.

Higher yields were obtained from the experiments at Gurabo and Aguas Buenas (fig. 1), followed by Barranquitas, while Cayey and Comerío had the lowest yields. Preliminary data about performance of mosaic-resistant strains tested in five locations of the Tobacco Region indicate that there are some promising strains among those tested, not only because of their disease resistance but also because of their higher yielding ability. It is well to point out that further investigations are underway to verify the results

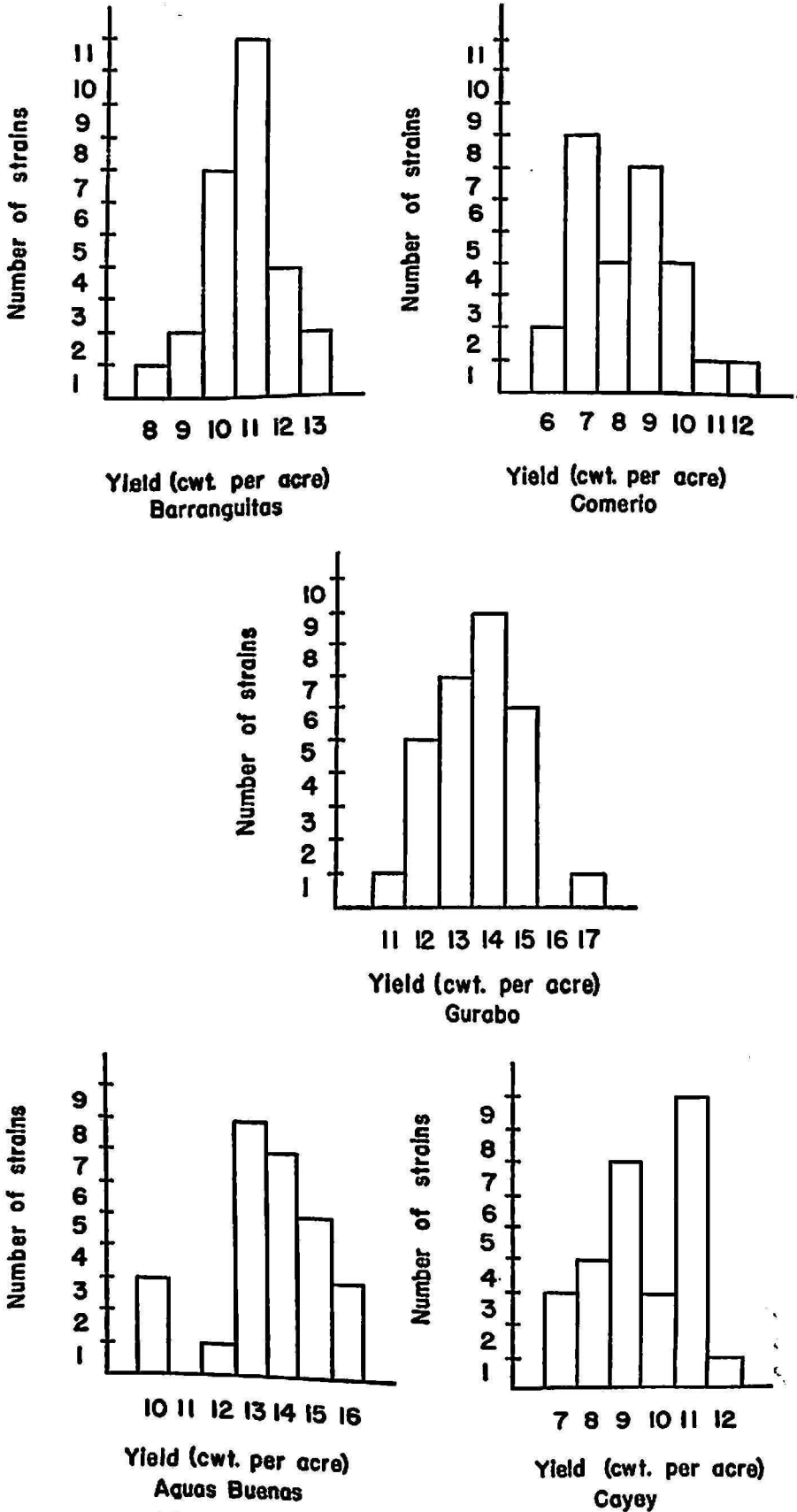


FIG. 1.—Frequency histograms of the average yield of mosaic-resistant tobacco strains obtained in preliminary regional tests at 5 locations in Puerto Rico.

obtained. Additional regional tests will be necessary in other locations so as to have a more complete picture of the performance of the strains in the different locations where tobacco is grown.

DISCUSSION

Black shank resistance has been one of the major problems in this breeding program. As was pointed out previously, because hybrid strains obtained from the crosses of imported and local varieties were susceptible to black shank, it was necessary to backcross these strains three or four times to local resistant varieties used as recurrent parents and then to self and select during the following five or six generations. Different patterns of resistance have been observed at different stages of plant growth that should be given due consideration. The agent causing this disease can attack plants at any stage of growth, even after flowering or seeding, which might be a handicap in the selection techniques.

Data on black shank-resistance percentage obtained at the Gurabo Substation with 59 strains and 5 commercial varieties indicate that 26 out of 59 strains tested have less than 50-percent resistance after selection during 6 or 7 generations. This seems uncommon, but might be explained because of the handicaps in the selection techniques.

It was possible to improve the desired black shank resistance in many other strains. Resistance shown by the checks fluctuated between 88 and 100 percent. The highest resistance among checks occurred in Selección Olor, and Beinhart 1000, a variety recently introduced from the USDA. At present, these two varieties may be considered the best sources of resistance to black shank grown in the Island, so they can be used extensively as germ plasm in future black shank resistance breeding programs.

SUMMARY

1. Some filler-tobacco strains resistant to both common mosaic and black shank, the two most important tobacco diseases of the Island, have been developed in a breeding program conducted at the Gurabo Substation.

2. The performance of some of the new strains tested at different locations indicates superior agronomic characters and yielding ability as compared with commercial varieties grown at present in the Island.

3. Pronounced differences were observed in the coefficient of variability among the different locations at Comerío, Aguas Buenas, Cayey, and Barranquitas, indicating an interaction between strains and locations. High coefficients of variability seem to be associated with the poor performance trials.

4. Selected strains exhibited good agronomic characters. Careful attention was given to such characters as plant type and size, leaf characters, curing qualities, and grading.

5. Additional research is underway in order to verify the performance of these new developed strains.

RESUMEN

En pruebas preliminares con varias líneas de tabaco resistentes al mosaico común y a la pata prieta, realizadas en cinco localidades de la zona tabacalera, se obtuvieron los siguientes resultados:

1. En su mayoría, las nuevas líneas probadas demostraron ser resistentes al mosaico común y a la pata prieta.

2. Varias de las líneas comparadas produjeron mayores rendimientos que las variedades comerciales usadas como testigos.

3. Se observó la gran superioridad de ciertos caracteres agronómicos en varias de las líneas al compararse con las variedades comerciales; las que además se comportaron bien durante la cura. Esto resultó en una clasificación comercial del producto final que comparó favorablemente con los testigos.

4. Sin duda alguna, los factores ambientales imperantes en las localidades donde se condujeron dichos experimentos afectaron el comportamiento de las líneas, según se puede observar por las diferencias obtenidas en los coeficientes de variabilidad de las distintas localidades.

5. Se continúan las investigaciones de estas líneas a fin de corroborar su comportamiento a través de toda la zona tabacalera de la Isla.

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