

The shredded chewing tobaccos to which sweetening is added appeared to be free from the virus and probably are put through a sterilizing process in manufacture. The granulated smoking tobaccos and cigarettes tested appear to be viruliferous, as positive results were obtained from all of them. Chesterfield cigarettes were used in a plant pathology student laboratory exercise and as a result of carefully controlled inoculations three plants became infected.

Of a total of 45 commercial brands of tobacco tested, infections were obtained from the following 16 brands:

Plug	Granulated Smoking	Cigarettes
Reynolds' Natural Leaf	Old Loyalty	Chesterfield
Apple Suncured	Five Brothers	Lucky Strike
Brown's Mule	Stud	Camel
Climax	Bull Durham	Herbert Tareyton
	Duke's Mixture	Piedmont
		Fatima
		Melachrino

SUMMARY

The results reported indicate that, in regions where cured tobacco is commonly chewed by tobacco growers, it may be an important source of mosaic infection, especially at weeding and pulling time. Commercial chewing tobaccos probably are not so important a source of mosaic infection, as far as tobacco is concerned, as the natural leaf, the results, except for four brands of plugs, being negative. Cigarettes and granulated smoking tobaccos also probably play a very minor part in the mosaic problem in commercial planting of tobacco. They are likely to be of importance, however, in connection with more limited plantings of susceptible plants such as tomatoes grown under glass or intensive culture in the field. Under these conditions the plants are handled from time to time in setting, pruning, training, and harvesting. Infection of a single plant under such conditions may lead to the spread of the disease through the house or field. Although it has not yet been conclusively demonstrated, it might be expected that the fingers of an inveterate cigarette smoker would become contaminated with the mosaic virus and thus transfer it to plants which were handled. Cigarettes are also an important consideration for the investigator who smokes cigarettes and works with susceptible plants. It is not at all improbable that many cases of sporadic mosaic infection occurring in cultures of tomatoes and tobacco in mosaic-free houses may have originated from fingers which have become contaminated while smoking cigarettes.

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THE EFFECT OF A STRAIN OF TOBACCO MOSAIC ON THE YIELD AND QUALITY OF BURLEY TOBACCO¹

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In a test carried on the past season to determine the effect of mosaic on quality and yield of Burley tobacco, such striking results were obtained that they are being published, although they cover but a single season, in the hope that they may stimulate further investigation. Growers in Kentucky pay very little attention to mosaic when it appears in the fields in the usual amounts of a trace to 10 or 12 per cent after setting, taking it to be an abnormal condition of the plant beyond their control. Occasionally, when most of the plants are affected, it causes considerable concern. If the plants grow fairly normally, many growers believe the cured tobacco is not injured, as no sign of the mosaic pattern remains after curing. The question as to whether later infections, such as those occurring at topping or suckering stages, cause injury to the cured tobacco has hardly been given consideration. In this connection, Chapman (p. 81)² states: "The amount of damage done by late mild attacks when the plants are maturing, or appearing on the sucker growth after topping, is practically negligible and, so far as can be learned, does not in any way injure the commercial leaf."

Two distinct types of mosaic are commonly found in tobacco fields in Kentucky. One of these causes severe stunting, distortion and, in the field, burning of the leaves, together with a distinct mottling; the other type causes only a slight retardation of growth, the leaves are rarely distorted or rugose, and the mosaic pattern is not conspicuous. The first causes marked reduction in yield and quality if inoculations are made soon after setting. The other, the mild type, does not cause marked injury. The mild type of mosaic was used in the following experiment:

Thirteen rows of standup White Burley tobacco (strain 36-12) were set with a setter, June 9, 1926. The odd rows were left as buffer rows in an attempt to prevent, as much as possible, the spread of mosaic from row to row. The second and eighth rows were inoculated at setting time, or as soon as growth commenced if the first attempt was not successful. The fourth and tenth rows were inoculated at topping time, and the sixth and twelfth rows were not inoculated. The disease spread some during the summer, but care was used in selecting plants for final harvest, in the rows

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² CHAPMAN, G. H., Mosaic diseases of tobacco. Mass. Agr. Exp. Sta. Bul. 175. 1917.

TABLE 1.—Effect of mild mosaic on the yield and quality of Burley tobacco at Lexington, Kentucky, in 1926

Grade	Healthy uninoculated			Inoculated at topping			Inoculated at setting			Advance per acre, yield 671 lbs.*
	Actual yield, 50 plants, gms.	Per cent	Advance per 1,000 lbs.	Actual yield, 50 plants, gms.	Per cent	Advance per 1,000 lbs.	Actual yield, 50 plants, gms.	Per cent	Advance per 1,000 lbs.	
Flyings	533	13	\$ 9.02	189	4	\$ 3.00	439	16	\$10.83	\$ 7.37
Second trash	773	19	24.30	561	14	17.71	.....	.....	.....	.....
do	.....	.....	.....	279	7	6.09	.....	.....	.....	.....
do	.....	.....	.....	313	8	3.80	755	27	13.61	9.13
do	598	14	14.46	515	12	12.50	.....	.....	.....	.....
Lugs	.....	.....	.....	340	8	7.43	333	12	7.21	4.84
do	727	18	15.83	850	20	4.03	.....	.....	.....	.....
Leaf, green cast	.....	.....	.....	703	17	6.83	.....	.....	.....	.....
DMI	1,250	30	21.16	398	10	3.86	.....	.....	.....	.....
Red	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
do	254	6	2.46	.....	.....	.....	.....	.....	.....	.....
Tips heavy	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
F 5	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Total	4,135	100	\$87.23	4,119	100	\$63.31	2,773	100	\$49.77	\$33.39
Per cent decrease in crop-value due to mosaic	.....	0	.....	.....	25.1	.....	.....	43.1	.....	61.7

* Assuming an acre yield of 1,000 pounds for the "healthy" and for the "inoculated at topping" plants, the yield per acre of the "inoculated at setting" plants would be 671 pounds.

inoculated at topping time, which appeared healthy up to the time of topping (August 11, 1926). The hands were washed in soap and water before topping the healthy rows. As a further precaution, these plants were examined nine days before cutting and only the plants with mosaic-free suckers were suckered, thus marking them for harvest. All plants in the other rows were suckered at the same time. Fifty plants were harvested from each of the three pairs of rows twenty-eight days after topping. The tobacco was all cured together, was stripped and sorted into hands, and was then taken to the Burley Cooperative Association warehouse where it was graded by the head grader of the Association and his assistant. The grade, advance paid by the Association, the actual yield in grams of each grade, the percentage of the total yield represented by each grade, and the advance for each grade on an acre basis, figuring the yield at 1,000 pounds per acre, are given in table 1.

The yield was reduced 33 per cent by infection at setting time, although not appreciably reduced by infection at topping time. The leaves of plants inoculated at setting time averaged about three or four inches shorter than the leaves of the other two lots, and were of lower quality. The leaves of plants inoculated at topping time fell into nine grades; whereas those from healthy plants fell into only six grades. This is an important factor, as it increases the difficulty of grading or, if the grading is not carefully done, reduces the value of the better grades because of admixtures of lower grades. The effect of mosaic seems to be evident even in the lower leaves (second trash and flyings) but is probably most marked in the quality of the leaves which expanded following inoculation.

In the leaves which expanded (grades D to F) there was a marked effect on color, 20.15 per cent of the crop falling into DMI which is "leaf" with a green cast. The E grade or red was greatly reduced in weight, and was of a lower grade than in the healthy plants, a portion of it evidently having fallen into the DMI grade. It seems certain that mosaic infection, even though not occurring until topping time, has a marked effect on the color of cured tobacco, causing it to be dark or to have a green cast.

The advance paid for the various grades of tobacco by the cooperative association, although not an accurate measure of its total value, may be used for comparison. A reduction of 33 per cent in yield due to inoculation at setting time resulted in a reduction of 43.1 per cent in value of a given weight of tobacco and 61.7 per cent reduction in value on an acre basis. Inoculation at topping time, although resulting in no appreciable reduction in yield, caused a reduction of 25.1 per cent in the value of the crop. This difference could hardly have been predicted from the appearance of the plants at cutting time. The result emphasizes the necessity of developing

cultural practices which will not only eliminate initial mosaic infection but will reduce the spread of the disease throughout the entire growth period of the plants.

It has been recognized for years that late inoculation, even in the upper portion of the plant, would result in the entire plant becoming viruliferous in a comparatively short time. That the presence of the virus in well-developed, apparently normal leaves has any effect upon them either while alive or during the curing process has not been generally recognized even by tobacco specialists, it being commonly believed that the chief loss caused by mosaic is due to stunting of the plant and to loss of quality in the mottled leaves.

Miss Eckerson² gives a possible basis for an understanding of the results reported in the present paper. After inoculation of a single leaf on a tomato plant, she found small flagellate organisms penetrating the chloroplasts of other leaves and partially destroying them, noting that later some cells were completely disorganized. If similar effects are found to be produced in mature tobacco leaves, it might be expected that during the curing process many of the partially disorganized chloroplasts, which have not lost their color completely, might not break down normally, but remain as they were, thus accounting for a darker color in some leaves and the distinctly green cast in others. The partial or complete destruction of other cell constituents following inoculation may also have some effect on the color of the cured product.

SUMMARY

1. Two types of mosaic occur commonly in the tobacco fields of Kentucky. One type produces severe stunting accompanied by distortion and a distinct mottling, together with a "burning" of the leaves; the other type causes only a slight retardation of growth, without an apparent quantitative or qualitative injury.

2. A study was made of the effect of the mild type of mosaic on the yield and quality of Burley tobacco, grown in the field in 1926.

3. There was no appreciable reduction in yield when the plants were inoculated at topping time; but infection at setting time resulted in a one-third yield reduction as compared with the check.

4. The leaves of plants inoculated at setting time averaged about three to four inches shorter and were of lower quality than the leaves of either the check or those inoculated at topping time, resulting in a reduction of 43.1 per cent in value of a given weight of tobacco and 61.7 per cent reduction on an acre basis.

²Eckerson, Sophia H. On organism of tomato mosaic. *Bot. Gaz.* 81: 204-209. 1926.

5. The leaves of plants inoculated at topping time fell into nine grades; whereas those from healthy plants fell into only six grades, thereby increasing the difficulty of grading.

6. Inoculation at topping time, although not reducing the yield, nevertheless resulted in a reduction of 25.1 per cent in the value of the crop, which difference could hardly have been predicted from the appearance of the plants at cutting time.

7. Possible disorganization of chloroplasts during the curing process, and the partial or complete destruction of other cell constituents following inoculations, may be responsible for the color of the cured product.

8. There is a real necessity for developing cultural practices which will not only prevent initial mosaic infection, but will reduce the spread of the disease throughout the entire growth period of the plants.

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