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THE EFFECT
OF
TOPPING AND SUCKERING
ON
HAVANA SEED TOBACCO

BEING A REPORT
OF THE
TOBACCO SUB-STATION
AT
WINDSOR

NOTE TO LIBRARIANS

The separate series, "Tobacco Station Bulletins" has been discontinued, No. 10 being the last. Hereafter, reports of the Tobacco Substation will be included in the regular Station series, this bulletin, No. 297 being the first to so appear.

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Topping and Suckering Practices As Related to the Yield and Quality of Havana Seed Tobacco

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The maturity of a tobacco leaf probably determines quality to a greater extent than any other single factor. The accepted practice among tobacco growers is to go through the crop some time during the blossoming period and break off the tops. The purpose of this operation is to hasten the development of the leaves by retarding or preventing the formation of seeds. Since rapid and important changes are occurring in all plants during the blossoming period, it would seem that the grower had a powerful means of either retarding or accelerating these chemical changes by topping. Similar results (1) have been found to hold true for such plants as alfalfa, timothy, bluegrass and redtop. Important effects (2) also have been obtained by removal of young fruits from the tomato, and much work on the effects of pruning fruit trees have been reported indicating similar trends. All of these experiments indicate that pruning has an important influence on plant growth. Topping and suckering of tobacco is in fact a pruning operation and therefore should exert a marked influence on the metabolic changes occuring in the plant during the period of ripening.

Among tobacco growers there is considerable variation in the time when topping is done and the size of the portion removed from the plant. The time of topping varies from the bud to the full bloom stages. Also, the number of leaves allowed to remain on the plant varies from twelve to eighteen. In view of the results obtained on other plants this operation, as well as the frequency of suckering, should be standardized to such a time and manner so as to permit the most profitable production of leaf by the plant.

Considerably greater difficulty is encountered in determining the most favorable degree of ripeness with the stalkcut than with those varieties which are primed. The primed leaves are picked when the grower judges they are ripe; but the stalk cut varieties, such as Havana seed and Broadleaf, are harvested when the plant as a whole represents the best quality. Therefore, although rules may be laid down as to when certain operation are to be done, the grower must exercise good judgment to obtain best results.

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Review of Literature

In reviewing the work of other investigators on topping and suckering of tobacco, one is impressed with the apparent disagreement in conclusions reached. For instance, Olson (3) of Pennsylvania, obtained increased yields from high topping as compared with low topping. Johnson (4) of Wisconsin, found that high topping did not necessarily increase the yield. Low topping is advocated by some workers as the most satisfactory; others maintain that low topping produces coarse, low-quality tobacco. In regard to suckering, Olson (3) finds that two suckerings improved the quality of Pennsylvania tobacco, whereas Kentucky workers (5) (6) find that a lighter, thinner leaf is produced with less suckering. In the Pennsylvania experiments covering a period of ten years. the results on height of topping were measured in terms of yield only, nothing specific being stated regarding the effect on quality. In their suckering experiments, however, during 1912 and 1913 the best yield and also the best quality was obtained on the plots suckered twice. The plots suckered once not only gave inferior quality but the yields averaged over 300 pounds less per acre.

These illustrations are typical of the diversity of results on experiments in this country relative to the effects of topping and suckering on the yield and quality of tobacco. Experimental workers are more or less agreed that low topping reduces the variability in the size of the leaves and tends to hasten maturity. The evidence also indicates that a thick, heavy-bodied leaf, better adapted for use as a filler or a cheap binder is produced by frequent suckering.

Plan of Experiments.

Purpose.—An attempt was made to determine the relation between common practices of topping and suckering and the subsequent yield and quality of the crop. Experiments were begun at the Connecticut Tobacco Substation in 1925 and continued for three years.

Stages of topping.—Four stages of plant growth were selected, namely: bud, early bloom, full bloom and seed pod. The *bud stage* was when the top of the plant had elongated to a considerable extent, but the upper stem portion was still succulent. This somewhat immature stage was about three or four days before blossoming commenced. The *early bloom* stage was when the first blossom opened. The upper stem was more rigid than it was in the bud stage but was still somewhat succulent and could be broken easily. The *full bloom* stage was represented by an advanced maturity of three or four days when fifteen to twenty blossoms were open. At this stage the stem had become somewhat stiff and woody. The *seed pod* stage was not topped, nor suckered, until the day of

harvest. This stage represents the normal growth and development of the plant. This stage was used as a standard, any deviations from which indicate the extent to which the plant can be changed.

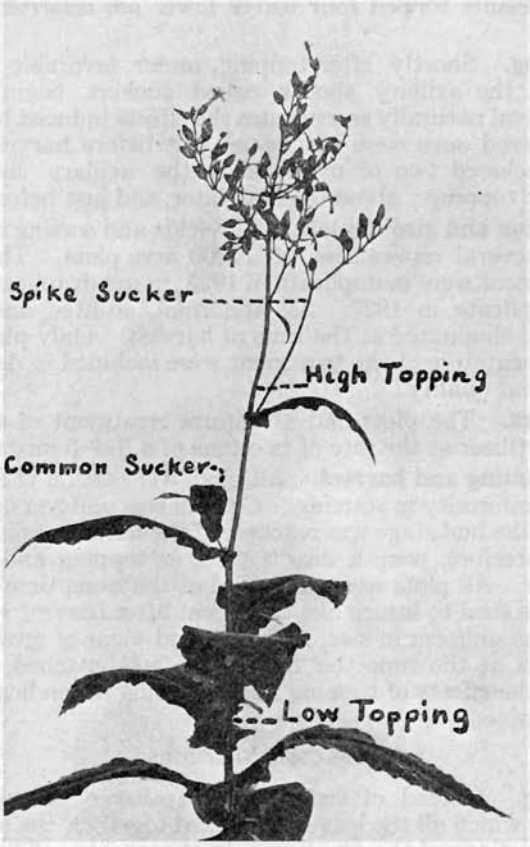

FIGURE 1.

Top portion of a tobacco plant showing the bare, leafless, spikelike stem of the lowest "spike" sucker. This is sometimes called the "bald" sucker. The ordinary or common suckers growing lower on the stalk have two or more leaves. *High topping*, as used in the text, refers to plants topped at the internode immediately above the "spike" sucker; *low topping* is four leaves below this.

Height of topping. All references to *high topping* as used in this work refer to plants at such a height that approximately eighteen leaves were allowed to remain on the plant after topping. The

point selected was the internode above the so-called "spike" sucker, sometimes called the lowest "bald" sucker. (See Figure 1.) The "spike" sucker is the lowest sucker having a bare, leafless, spike-like stem. All suckers below this have two or more leaves. Topping in the above manner is referred to in this study as *high topping*. Plants topped four leaves lower are referred to as *low topping*.

Suckering. Shortly after topping, under favorable conditions of growth, the axillary shoots, called suckers, begin to grow. Their removal naturally accentuates the effects induced by topping. Plots suckered once were so treated just before harvesting. On tobacco suckered two or more times, the axillary shoots were removed at topping ; about ten days later, and just before harvest.

Replication and size of plots. All yields and sorting records are based on several replications of 1/200 acre plots. The plots of each treatment were in duplicate in 1925; in quadruplicate in 1926; and in triplicate in 1927. All abnormal, stunted and diseased plants were eliminated at the time of harvest. Only plants which were representative of the treatment were included in determining the yield and quality.

Fertilizers. The plots had a uniform treatment of a standard tobacco fertilizer at the rate of two tons of a 5–4–5 mixture.

Transplanting and harvest. All plots were set on the same day to insure uniformity in starting. Growth was uniform on all of the plots until the bud stage was reached. The differences in yield and quality, therefore, were a direct effect of topping and suckering treatments. All plots were harvested at the same time and cured in the same shed to insure like treatment after harvest. Since the tobacco was uniform in size, maturity and vigor of growth, on all of the plots at the time the bud stage was reached, important trends on the effects of topping and suckering are indicated in the results obtained.

Special Methods.

Stripping. Instead of stripping the tobacco in the ordinary manner by which all the leaves are mixed together, the leaves from different portions of the plant were kept separate. The upper six leaves in high topping and the upper two leaves in low topping were called "*tops*". The next four leaves were called "*upper leaves*"; the next four were designated as "*middle leaves*"; and the remaining leaves at the bottom of the plant (three to five leaves) constituted the "*lower leaves.*" In using this method the effects of the different topping treatments could be traced to specific portions of the plant.

Sorting. The tobacco from these several treatments and plant regions was carefully sorted into the various commercial grades, which were immediately weighed and the results computed on a percentage basis. Also, from the total weight of tobacco from each plot the acre yields were determined.

Experimental Results.

STAGE OF TOPPING.

Yield. As previously mentioned, the treatments were in duplicate, quadruplicate, and triplicate for the years 1925, 1926, and 1927, respectively. These results are presented in Table 1.

Table 1. Yields of Plots Topped at Different Stages of Growth, 1925-1927.

Stage of topping	Average of yield per acre of cured leaf. 1925	1926	1927	3 year average
Bud	1638	1398	1148	1395
Early bloom	1800	1478	1192	1490
Full bloom	1710	1476	1182	1456
Seed pod	1512	1322	900	1245

These results indicate that the early bloom period is the best time to top Havana seed tobacco. The results are particularly pronounced in a favorable year. When the season is exceptionally dry (as in 1926) or exceptionally wet (as in 1927) the difference between early bloom and full bloom is not significant. Abnormal years like these tend to smooth out quantity of growth differences, due to treatment, because the seasonal conditions are the limiting factors. In general, it may be said that an early blossom stage of topping gives better yields than when this is done at too immature or succulent stage or at too woody or ripe stage. If topping is done when the plant is too young growth is checked to such an extent that its adverse effect is reflected in the yield. If topped too late, after seed production has progressed to a considerable degree, topping will have less effect in activating the plant to further vegetative growth. One should not top the plant when it is too immature and succulent, not wait until it becomes old and woody

Quality. The effects of stage of topping on the quality as determined by sorting records is computed to a single figure called the *grade index* and presented in Table 2. The grade index is a single

Table 2. Grade Index of Tobacco Topped at Different Stages, 1925-1927.

Year	Average grade index of tobacco topped at different stages. Bud	Early bloom	Full bloom	Seed pod
1925	.393	.451	.409	.326
1926	.483	.489	.469	.437
1927	.471	.459	.432	.226
3 year average	.449	.466	.437	.330

number, expressing the quality of a particular lot of tobacco. It is based on the percentage of carefully assorted grades and the relative price values. Although market prices for grades vary

from year to year the relative ratio of prices remains fairly constant. The price relationship as used in these experiments is as follows: Light wrappers, 1.00; mediums .75; seconds .50; darks .30; fillers and brokes .10. The grade index is obtained by multiplying the percentage of each grade by the prices indicated above and adding the products.

These results show that the early blossom stage is the best time to top Havana seed tobacco when quality is desired. It is decidedly better than topping at more mature stages.

There are other substantial reasons for topping the tobacco at an early bloom stage. It is desirable to do so early in order to reduce the hazard of winds blowing the crop down. Winds may do serious damage at this time. However, if the plants are topped before the tops become too large they are less liable to be damaged. Also, at this early stage the tops are easily broken because the stems are still succulent. If topped earlier the tops do not develop sufficiently to indicate the proper place to top. Hence, for these additional reasons, it seems better to top tobacco when it begins to blossom rather than at the bud or full bloom stages.

HEIGHT OF TOPPING

Yield. The height of topping does not have as much influence on the yields as one might anticipate. The results in 1925 did not give any decrease in yield due to low topping, but on the contrary an increase. The low topping yielded 1,850 pounds; high topping 1,810 pounds per acre.

The average results for 1926 and 1927 are given in Table 3.

TABLE 3. EFFECTS OF HEIGHT OF TOPPING AT VARIOUS STAGES ON THE YIELDS, 1926-1927.

		Yield per acre (lbs.) at different topping stages.		
Height of topping	Year	Bud	Early bloom	Full bloom
Low	1926	1412	1467	1462
	1927	1145	1172	1192
	Average	1278	1319	1327
High	1926	1385	1490	1462
	1927	1148	1192	1182
	Average	1266	1341	1322

Within the limits of these experiments, the height of topping did not affect the yields. When the tobacco was topped low the remaining leaves increased in size and weight to counterbalance the loss incurred at topping. It is conceivable, however, that still lower topping might reduce the yield. Four leaves below the spike sucker apparently is as low as a plant can be topped without causing a loss in yield.

Quality. Low topping had a marked beneficial effect on the quality. The effect of height of topping on the percentage of lights, mediums and darks is given in Table 4.

TABLE 4. SHOWING THE EFFECTS OF HEIGHT OF TOPPING IN EARLY BLOOM ON THE PERCENTAGE OF DARKS, MEDIUMS AND LIGHTS FOR THREE YEARS, 1925-1927.

Height of topping	% Light				% Mediums				% Darks			
	1925	1926	1927	Ave.	1925	1926	1927	Ave.	1925	1926	1927	Ave.
Seed pod (high)...	0	4	0	1	0	0	1	0	37	28	32	32
High.....	15	15	9	13	13	11	4	9	39	26	31	32
Low.....	23	31	20	25	16	18	11	15	32	18	28	26

Nearly twice as high a percentage of lights and mediums was produced by low topping as by high topping. The tobacco when allowed to go to seed without topping, until the day of harvest, resulted in very poor quality. Chemical conditions within the plant brought about by seed formation are not correlated with high quality leaf. High topping does not counteract this as effectively as low topping. The percentages of lights and mediums is practically midway between those of low topping and those resulting from the normal development of the plant. Severe pruning, i.e., low topping, in an early bloom stage produces high quality tobacco.

Grade index. The simplest way of indicating the relative qualities is probably by expressing it in terms of the grade index. These averages are presented in Table 5.

TABLE 5. SHOWING EFFECTS OF HEIGHT AND STAGE OF TOPPING ON THE QUALITY AS REPRESENTED BY THE GRADE INDEX, 1926-1927.

Stage of topping	Year	Average grade index in relation to height and stage of topping: Low	High	Not topped
Bud.....	1926	.524	.442	.437
	1927	.514	.439	.276
	Average	.517	.440	.331
Early bloom.....	1926	.523	.455	.437
	1927	.524	.395	.276
	Average	.523	.425	.331
Full bloom.....	1926	.491	.447	.437
	1927	.497	.368	.276
	Average	.494	.407	.331
General average.....		.512	.426	.331

The best quality tobacco was produced by low topping in the early bloom stage. This tobacco averaged 8.6 cents more a pound than high topped tobacco for the two years, 1925 and 1926. In every instance the tobacco excelled the corresponding plots topped high. The evidence is conclusive that low topping of Havana seed tobacco results in better quality than high topping.

Regional distribution of grades. Since the quality is improved to such an extent by low topping, it is of interest to note the particular portions of the plant affected. In table 6, the percentage of lights, mediums and darks, produced at different levels on the plant is given.

TABLE 6. SHOWING THE EFFECTS OF HEIGHT OF TOPPING ON THE PERCENTAGE OF DARKS, MEDIUMS AND LIGHTS AT DIFFERENT LEVELS OF THE PLANT, 1925-1927.

Grade	Year	Tops		Upper leaves		Middle leaves		Lower leaves	
		Low	High	Low	High	Low	High	Low	High
		%	%	%	%	%	%	%	%
Darks	1925	84	93	10	23	0	0	0	0
	1926	66	82	11	5	0	0	0	0
	1927	100	100	55	51	0	0	0	0
Average		83	92	25	26	0	0	0	0
Mediums	1925	16	7	3	31	0	5	0	0
	1926	27	8	38	13	0	38	0	0
	1927	0	0	27	12	4	0	0	0
Average		14	5	23	18	1	14	0	0
Lights	1925	0	0	36	25	54	40	5	4
	1926	3	4	42	36	60	16	17	5
	1927	0	0	7	5	51	14	12	0
Average		1	1	28	22	55	23	11	3

There seem to be two opposing tendencies in the plant: first, a decreasing tendency to produce darks extending from the top of the plant toward the base; second, an increasing tendency to produce lights as the lower leaves are approached. There is evidently a point along the stalk where the tendency to produce darks is equal to that of producing lights. This point is higher up on plants that are topped low. Accordingly, the tendency to produce the less desirable darks does not extend as low down on the plant when the plant is topped low. This is indicated by the lower percentage of mediums found in middle leaves under low topping, 1% compared with 14%. The difference between the percentage of darks and lights in the different regions under the two methods is consistently in favor of the lower topping. The tendency to produce inferior quality is consistently associated with high topping, particularly in the middle portion of the plant.

Grade index. To further illustrate the effects of topping on the quality of tobacco in different regions of the plant, comparisons of the grade index are given for two years 1926 and 1927. These results are given in Table 7.

TABLE 7. SHOWING EFFECTS OF HEIGHT OF TOPPING ON THE GRADE INDEX IN DIFFERENT REGIONS OF THE PLANT WHEN TOBACCO IS TOPPED AT DIFFERENT STAGES OF GROWTH.

Stage of topping	Height of topping	Grade index in different plant regions (1926-1927) Upper 1926	Upper 1927	Upper Ave.	Middle 1926	Middle 1927	Middle Ave.	Lower 1926	Lower 1927	Lower Ave.
Bud	Low	.651	.487	.569	.829	.806	.817	.498	.333	.415
	High	.664	.463	.564	.672	.646	.659	.408	.290	.349
Early bloom	Low	.717	.508	.613	.900	.756	.828	.546	.382	.464
	High	.659	.479	.569	.672	.614	.643	.418	.305	.362
Full bloom	Low	.753	.455	.604	.776	.740	.758	.494	.351	.423
	High	.801	.507	.654	.649	.547	.598	.453	.218	.336
Seed pod		.587	.421	.502	.630	.437	.534	.450	.221	.336
Average	Low	..	..	.595	..	...	801	...	..	.434
Average*	High	...	...	.596	...	...	.633	...	...	.349
Average not topped		...	...	.501	...	...	534	...	...	.336

*Not including seed pod plots.

Tobacco topped later than the early bloom stage rapidly deteriorates in quality. The middle and lower leaves are affected to a greater extent than any other portion of the plant. This undesirable effect is characterized by an overripe condition of these leaves which is associated with yellow, variegated, and mottled colors, when the tobacco is cured

It will be noted in Table 8 that the quality of the middle and lower leaves of the plant is improved the most by low topping. It has been observed that this is the region immediatetly below the maximum sucker development.

TABLE 8. AVERAGE RELATIVE QUALITY ON BASIS OF 100 IN DIFFERENT PLANT REGIONS AS EFFECTED BY TOPPING.

Topping treatment	Relative quality, index in different portions of the plant (1926-1927) Upper leaves	Middle leaves	Lower leaves
Seed pods†	100.0	100.0	100.0
High topping	118.7	118.5	100.4
Low topping	118.7	150.0	129.1

†Not topped until harvest.

High and low topping improved the upper leaves 18.7%, but the middle leaves were improved 50%, by low topping and only 18.5% by high topping. The lower leaves were improved 29.1% by low topping. High topping had practically no effect, only .4%, on the bottom leaves.

Burn tests. The fire holding capacity of the unfermented leaves as affected by the height of topping, was tested by counting the number of seconds a leaf continued to glow after it had been

ignited by an electric match. To facilitate this work a metronome was standardized so that there were exactly sixty beats a minute. Each figure recorded was the average of a burn test on each side of at least twenty leaves taken at random from the grades represented. These burn tests indicated that low topping improved burn. The average burn of darks was 6.2 seconds for high and 9.0 seconds for low topping. The medium averaged 10.7 seconds for high topping and 11.7 for low topping. This difference between the lights was not great. Low topping averaged 13.9 and high 13.4 seconds. There also was a consistent relationship between the duration of burn and the portion of the plant from which the leaves were taken. The tobacco became progressively poorer in burn as the top of the plant was approached. The top, upper, and middle leaves averaged 7.5, 11.5, 13.2 seconds respectively.

These figures indicate that the burn of tobacco is intimately associated with the chemical transformations taking place in the plant after the plant is topped. It also shows the farmer has some degree of control over these changes by the manner of topping.

Low topping of Havana seed not only increases the percentage of desirable grades but also results in an improved burn.

DEGREE OF SUCKERING

Yield. The degree of suckering exerts a marked influence on yield. These results for 1925 are given in Table 9. The plots suckered once were so treated the day before harvest. Those plots suckered twice had an earlier suckering two weeks before harvest.

TABLE 9. YIELDS OF TOBACCO AS AFFECTED BY NUMBER OF TIMES CROP WAS SUCKERED, 1925.

Stage of topping	Yields per acre (lbs.) Suckered once	Suckered twice	% increase from two suckerings
Budded*	1377	1674	21.6
Bud	1530	1746	13.5
Early bloom	1746	1854	6.2
Full Bloom	1674	1746	.3
Average	1582	1755	41.4

*Topped to desired height ten days after the buds were removed.

In 1926, three suckerings in early bloom averaged 1592 pounds per acre as compared with 1,412 pounds when suckered only once.

In all of these trials two or more suckerings consistently yield higher than a single suckering. The average increase per acre was 173 pounds in 1925 and 180 pounds in 1926. These differences are more striking when tobacco is topped in the immature bud stage. This relation is made clear by comparing the percentage increase of the yields resulting from more than one suckering. The average

increase for the bud stages was 17.5% while the more mature blossom stages averaged only 5.2%.

Quality. As previously noted, the yields of the three earliest topping stages were affected more by the number of suckerings than the later stages. These three stages are used to show comparative effects on quality. The percentage of assorted grades from these treatments is given in Table 10.

TABLE 10. PERCENTAGE OF DARKS, MEDIUMS, LIGHTS AND SECONDS ON PLOTS SUCKERED TWICE AS COMPARED WITH THOSE SUCKERED ONCE, 1925.

Number times suckered	Stage of topping	Percentage of indicated grades. Darks	Mediums	Lights	Seconds
Once	Budded	25	3	5	39
	Bud	25	4	4	35
	E. bloom	32	10	15	37
	Average	27.3	5.7	8.0	37.0
Twice	Budded	37	7	7	27
	Bud	37	8	11	26
	E. bloom	38	10	9	26
	Average	37.3	8.3	9.0	26.3

These data indicate that if the sucker growths on tobacco are removed too diligently, there is a resultant tendency to produce high percentages of heavy dark tobacco. The growth of suckers appear to be a desirable characteristic in the production of light colored, free burning tobacco. These actively growing suckers are instrumental in drawing from the leaf materials which are detrimental to quality. These translocation phenomena are intimately associated with the removal of nitrogenous compounds, whose presence in the leaf is associated with dark colors and poor burn. Considering the tobacco taken from any particular plant, high quality is always correlated with a reduction in the amount of these nitrogenous constituents. These changes are most active during the ripening period between early topping and harvest.

SUMMARY

With a given fertilizer treatment, the quality of leaf for any particular season is largely determined by the extent of the changes occurring in the plant between the bud and the harvest stages. The grower can control these changes by judicious topping and suckering.

The best topping stage for Havana seed tobacco is when it begins to blossom. If it is topped at too mature a period of growth the quality deteriorates as evidenced by increased percentages of mottled, yellow-spotted and variegated colors. This over-maturity effect may be avoided by earlier harvest.

Low topping does not necessarily reduce the yield. The remaining leaves grow larger.

High topping increases the percentage of short, low-priced darks. Furthermore, it promotes the production of dark tobacco in regions nearer the base of the plant than is the case with low topping.

Low topping (three to four leaves below the "spike" sucker) consistently gives better quality than high topping (at "spike" sucker).

Low topping stimulates the growth of the lower nine to eleven leaves.

Low topping has a marked beneficial effect on the burn.

There is a regional distribution of grades. The tendency of the plant is to produce darks and mediums in the upper leaves, and lights and seconds in the lower portion of the plant. The lower nine to eleven leaves usually include the bulk of high quality tobacco.

Several suckerings tend toward higher yields but a heavier, darker leaf.

Abundant growth of suckers suggests the removal from the leaf of substances deleterious to quality.

Topping retards the process of seed formation and activates the plant to vegetative growth.

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