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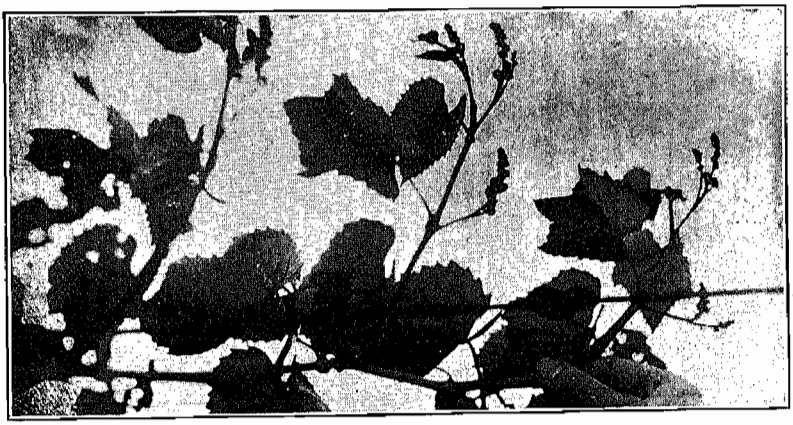

PROMISE OF A GOOD CROP

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THE FRUITING HABIT OF THE GRAPE

BY

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The Agricultural Experiment Station

OF THE UNIVERSITY OF TENNESSEE

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THE FRUITING HABIT OF THE GRAPE

During the past year an investigation has been made into the fruiting habit of four commercial varieties of the grape—Concord, Niagara, Delaware, and Brighton—in the Station vineyard.

In 1905 a late freeze (April 23-4) destroyed the new growth, which at the time was 4 to 8 inches long. The second growth which followed this injury produced less than half a crop of fruit, but the vines made very strong wood, which matured perfectly. The growth was the stronger, of course, because of the light fruit crop, and it is fair to assume that the heavy yield of grapes this year was in some measure due to the very light crop preceding.

The vineyard exemplifies six systems of training: Munson, Kniffin, Double Kniffin, Renewal, Long-arm-short-spur, and Cordon-horizontal. As ordinarily practiced, in the last two of these systems the new wood is cut back to 2 or 3 buds; in all the others new growth is left from 6 to 12 or more buds long, depending on the system of training employed and the strength of the vine.

For the purposes of this investigation a wide range of variation from the usual pruning was adopted, and for every variety at least one cane was left unpruned. Thus not only the natural fruiting habit of the vine could be observed, but the effect of pruning and training.

The grape is a continuous grower until late in the season. Its terminal bud is poorly developed when growth ceases, as compared with the lateral buds. As in other woody plants the first bud formed in the spring is less well developed than the following buds. In appearance the buds from the second to near the end of a cane resemble each other closely, though where a lateral branch is permitted to grow unchecked the bud at its base will always be less well developed than where laterals do not appear or are pinched during the summer. Toward the end of the season the growth becomes weaker, and the buds are not so well developed as those formed earlier in the summer.

UNPRUNED CANES

The unpruned canes on which observations were made formed from 44 nodes (joints, each surmounted by a bud) in Concord to 72 nodes in Delaware. The canes of Concord and Niagara resemble each other and are thicker in proportion to their length than those of Brighton, and much thicker than those of Delaware. The latter vine is usually a comparatively weak grower, but it produces strong canes in our soil.

The grape fruits on new shoots, which spring from the wood that grew the previous year. So in grape pruning the object is to leave as many

buds of the last season's growth as the vine can well carry, so placed that the shoots from these buds will have ample light and room for their development.

In some unpruned canes the new wood will throw out laterals from the base of most of the buds as the cane grows, and the buds on these laterals will produce fruiting shoots the following year. The total number of buds, their location, and fruitage on unpruned canes that were included in this study, are as follows:

TABLE I—*Fruiting of unpruned canes*

Variety	No. buds on main cane	No. buds on laterals	Total fruit from main cane buds	Total fruit from lateral buds	Average weight of main cane bunches	Average weight of lateral bunches
			Ounces	Ounces	Ounces	Ounces
Concord.....	40	7	91.50	4*	2.6	.....
Niagara	43	all dead	217.25	.....	3.8	.....
Delaware.....	53	139	49.50	153	.9	1.1
Brighton	55	75	280.25	211	6.0	2.0

*From one bud; others destroyed.

Unfortunately for purposes of comparison no canes of Concord or Niagara produced laterals that developed fruit worthy of mention. Twenty vines of these varieties were under observation, but only 4 canes were allowed to remain 40 nodes or more long. It may be assumed that these sorts do not throw out laterals as freely as Delaware and Brighton. It will be observed that in Delaware the average weight of the bunches on the laterals was slightly greater than on the main cane, whereas in Brighton the bunches produced on the main cane were three times as heavy as on the laterals. In another vine of Delaware on a cane 72 nodes long all the laterals were pruned off, 28 buds in the cane failed to grow, and the remaining 44 buds produced 127 bunches, weighing 179 ounces (11 lbs., 3 oz.), an average of 1.4 oz. per bunch.

The largest weight of fruit produced from the best 3 buds on the same cane in the four varieties, on unpruned canes, was as follows:

Concord: 28th bud, 10 oz.; 31st bud, 10 oz.; 32d bud, 10.25 oz.

Niagara: 13th bud, 16.25 oz.; 19th bud, 17.5 oz.; 26th bud, 16 oz.

Delaware (with laterals): 6th node, 5th lateral bud, 6 oz.; 9th node, 1st lateral bud, 6.25 oz.; 10th node, 1st lateral bud, 6 oz.

Delaware (laterals pruned off): 40th bud, 8.75 oz.; 41st bud, 8.5 oz.; 51st bud, 8.25 oz.

Brighton (with laterals): 28th bud, 17.75 oz.; 6th node, 6th lateral bud, 16.5 oz.; 9th node, 4th lateral bud, 16.25 oz.

Compare these weights with the best yield from buds on pruned canes:

Concord (Double Kniffin): 4th bud, 21.25 oz.; 5th bud, 17.75 oz.; 6th bud, 17 oz.

Niagara (Munson): 4th bud, 22.75 oz.; 6th bud, 26.75 oz.; 7th bud, 20 oz.

Delaware (Double Kniffin): 8th bud, 12.5 oz.; 7th bud, 9.75 oz.; 3d bud, 7.75 oz.

Brighton (Double Kniffin): 7th bud, 29.5 oz.; 5th bud, 29.75 oz.; 3d bud, 25.5 oz.

As regards total weight of fruit from pruned and unpruned canes, in only one variety—Concord—did a pruned cane surpass the unpruned cane; but for market it is of the utmost importance that the bunches shall be of good size, and the average weight of the bunches on the pruned canes is in all cases very much greater than on the unpruned. This is shown in the following table:

TABLE II—*Best yield from a single cane*

Variety	Unpruned			Pruned		
	No. buds	Total	Average per bud	No. buds	Total	Average per bud
		Ounces	Ounces		Ounces	Ounces
Concord.....	47	95.50	2.03	10	107.00	10.70
Niagara.....	43	217.25	5.05	14	201.00	14.35
Delaware.....	192	202.50	1.05	14	69.00	5.00
Brighton.....	130	491.25	3.78	15	185.75	12.38

The accompanying pictures will illustrate better than description can, the effect of care upon the subsequent crop. Not only are the bunches of fruit on the pruned vines heavier, and hence more marketable, but the

FIG. 1.—UNPRUNED DELAWARE

neglect to prune weakens a cane so much that it makes a poor growth the following season. In an unpruned Delaware the crop exhausted the cane so much that all the fruiting laterals died, and the growth from the buds

on the main cane was very weak, many buds failing to push (Fig. 1). This will result in the crop of the present year being small, and, owing to the great length of the cane, badly placed on the vine.

A single cane of Brighton that was pruned at the 44th node last year (practically unpruned) bore 130 bunches of grapes, which weighed a little more than 25 pounds. This great burden so weakened the cane that much of the fruiting wood died after maturing the crop, and (April 13) the same cane has set only 70 fruit clusters this season. The crop last year was produced from 123 buds, on main cane and laterals; this spring there were 130 live buds on the cane, and Fig. 2 shows how poorly the fruiting shoots are placed—a long stretch of cane without fruiting wood.

Contrast this picture with Fig. 3, a Brighton grape pruned to 34 buds last year (when it yielded 22.6 pounds of fruit) and 30 buds this year.

FIG. 2.—UNPRUNED BRIGHTON

Last year 76 clusters of fruit were formed on this vine, and this year 75 clusters have appeared. The picture on the title page shows how strong these clusters are. At this date (April 13) the clusters have not yet blossomed, but the vigor of the young shoots, and the size of the bud-clusters, as compared with those in Fig. 2, show clearly the beneficial effects of pruning.

Fig. 4 represents a Concord vine which was unpruned in 1906; it was 40 nodes long. The picture shows the vine as pruned for the season of 1907. The main cane was cut off at the 16th node, a length of over 6 feet, and only 5 new canes survived the heavy crop produced by the unpruned cane the year before. Not only is the growth weak, but the clusters are small; the cane will produce a light crop of small bunches this

year. Compare this vine with Fig. 5, a Concord vine pruned to short spurs in 1906, with practically the same pruning in 1907. In 1906 the vine produced 90 bunches from 49 buds, and this year 37 buds give 82 clusters. Pruning has resulted in practically the same setting of fruit in the two seasons.

Niagara shows the same effects of pruning.

It may be definitely concluded, therefore, that it is entirely unprofitable to leave table grapes unpruned even for a single year. The immediate crop is less salable, though heavier, and the strength of the vine is greatly depleted by overbearing.

PRUNED VINES

There are several training systems practiced for the grape, and they may all be comprised in two pruning methods. In the one case, short spurs of not exceeding 3 buds each, are variously disposed along 2 or more main arms, which are retained year after year. In the other the

FIG. 3.—BRIGHTON, PRUNED TO LONG ARM (KNIFFIN SYSTEM) TWO YEARS IN SUCCESSION

new canes are left from 6 to 16 or more buds long, but their number rarely exceeds 4, all other canes being cut out entirely. The long-arm-short-spur training system was the most commonly used in large vineyards for many years, and it is still a favorite in many localities. The Cordon-horizontal is a modification of this system especially adapted to small gardens. The Thummery system is a very elaborate modification, seldom seen in the South or West. Of the long-spur systems the most popular is the Kniffin, in which the main stem of the plant is carried without branches to a height of about 6 feet, where it forms 2 short arms, from each of which a single cane of new wood is trained to a horizontal wire. The cane is pruned 8 to 16 buds long, or even longer, depending on the vigor of the vine. In the Double Kniffin system there are 2 stems, one stopping 3 or 4 feet from the ground, and its 2 canes are pruned shorter than the tall stem. The Renewal system, as the name suggests, is an effort to grow new canes

(usually 4) every year from as near the ground as possible, which are to take the place of similar fruiting canes, the latter being cut back to the renewal canes in the winter pruning. The young canes are pruned at the 10th to 16th bud—longer or shorter according to the vigor of the vine. In the Munson system the pruning is the same as in the Kniffin system, but the trellis consists of 2 supporting wires parallel to the main wire to which the canes are tied.

It need hardly be added that one may make modifications of any of these systems, all of which have the same purpose in view—restricting the number of buds so as to prevent overbearing, and placing the buds in a good position with reference to light and an equitable division of the food gathered by the roots and elaborated in the leaves.

FIG. 4.—CONCORD, UNPRUNED IN 1906; PRUNED TO SHORT SPURS IN 1907

In an effort to determine the weight of fruit produced by each bud, from the base of the cane outward, the number and location of all bunches of fruit on 37 vines were recorded when the berries first formed, and when the fruit was ripe this record was verified, and each bunch of fruit was weighed and recorded separately, so as to show the total number of bunches from each bud. Barren shoots, and buds which did not grow, were also noted.

It will seldom happen in any system of training, with the possible exception of the Renewal, that more than 12 nodes will be left on any cane in pruning, no matter how vigorous the growth. Counting all canes included in this study, the following table gives the number of buds with their position and the average weight of fruit produced by each:

TABLE III—*Record of fruitfulness in pruned canes*

Bud	Concord		Niagara		Delaware		Brighton	
	No.	Av. Wt.	No.	Av. Wt.	No.	Av. Wt.	No.	Av. Wt.
		Ounces		Ounces		Ounces		Ounces
1	95	2.33	41	.44	71	.69	50	2.15
2	94	4.41	39	1.81	68	1.52	50	3.37
3	51	5.38	28	4.03	48	2.48	32	4.28
4	29	6.30	22	3.04	28	2.80	27	5.23
5	23	5.90	19	4.05	22	2.94	27	7.91
6	17	6.40	20	5.75	21	2.32	27	7.69
7	16	5.63	19	7.34	21	2.73	24	11.14
8	12	4.37	19	7.70	20	3.27	21	11.13
9	12	4.43	18	4.96	19	2.56	19	8.56
10	10	4.85	17	7.40	18	2.66	18	12.04
11	8	2.90	15	7.02	18	2.61	14	6.78
12	7	4.29	11	4.45	15	2.56	14	6.84
Total buds	374		268		369		323	

It must be remembered that the bunches of grapes do not grow direct from the winter buds, like apples and pears, but are borne on the shoots which these buds push; hence, a grape bud may produced from 1 to 4

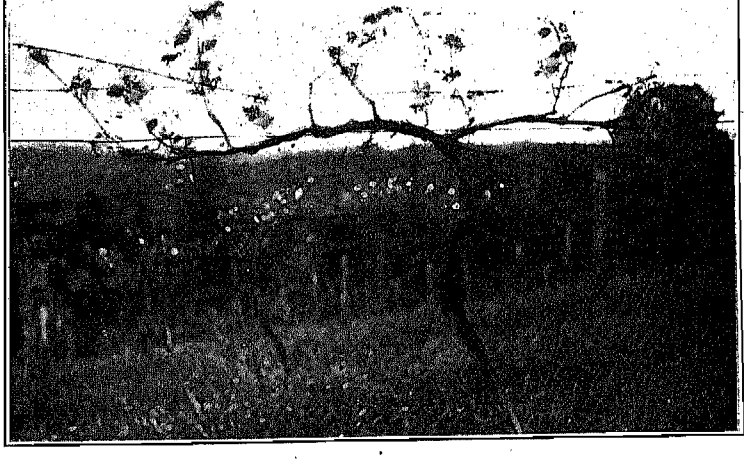

FIG. 5.—CONCORD, PRUNED TO SHORT SPURS TWO YEARS IN SUCCESSION

bunches. When as many as 4 bunches are produced the outermost is usually small and poorly formed; but it is not unusual for 3 large bunches to be borne from a single winter bud. In this table the average weight of fruit is the total product of the bud, including all bunches formed from it.

It will be observed that the four varieties agree in giving the smallest yield from the base bud, and in an increase in the average weight of the fruit up to and including the 4th bud, except Niagara, in which the 3d bud gives a greater yield than the 4th. This variety in general, however, adheres to the same law of progression as the others, as will be seen by an examination of Table III. Concord reaches the maximum average weight per bud at the 6th bud, Niagara at the 8th, Delaware at the 8th, and Brighton at the 10th.

In Concord the average weight of fruit from the first 3 buds is three-hundredths of an ounce heavier than that from the fourth 3, but in all the other varieties the fruit from buds 10, 11, and 12 is much heavier than that from buds 1, 2, and 3. But this comparison is not strictly correct, for the number of buds considered in making the average for the fourth 3 buds of Concord was but 25, as against 43, 46, and 51 for the other varieties.

This comparison is made because in short-spur pruning it is usual to leave not more than 3 buds to the spur. In long-spur pruning the cane is left with from 6 to 12 buds—seldom more than 12.

The following tabulation admits of more direct comparison between the varieties, and divides the weight of fruit per bud for the four successive groups:

TABLE IV—*Average weight of fruit per bud on main canes*

Bud—from base	1	2	3	4	5	6	7	8	9	10	11	12
	Oz.	Oz.	Oz.	Oz.	Oz.	Oz.	Oz.	Oz.	Oz.	Oz.	Oz.	Oz.
Concord	2.33	4.41	5.38	6.30	5.90	6.40	5.63	4.37	4.43	4.85	2.90	4.29
Niagara	.44	1.70	4.03	3.04	4.05	5.75	7.34	7.70	4.96	7.40	7.20	4.45
Delaware	.69	1.52	2.48	2.80	2.94	2.32	2.73	3.27	2.56	2.66	2.61	2.56
Brighton	2.15	3.37	4.28	5.23	7.91	7.69	11.14	11.13	8 50	12.04	6.78	6.84

Concord	Av. 4.04	Av. 6.20	Av. 4.81	Av. 4.01
Niagara	" 2.06	" 4.28	" 6.67	" 6.35
Delaware	" 1.56	" 2.69	" 2.85	" 2.61
Brighton	" 3.27	" 6.94	" 10.27	" 8.55
For all	" 2.73	" 5.03	" 6 15	" 5.88

It should be kept constantly in mind that these data are for a single crop, and it may be that a series of crops would change the results materially. It is believed, however, that the figures are of sufficient interest to warrant their publication at this time. From them it is evident that, as is shown in the unpruned canes, in no case do the first equal the later-formed buds in fruitfulness, and for at least three varieties the difference is sufficient to show a decided preference for long canes over short spurs.

Among the training systems in which long canes are used, the Renewal system seems distinctly inferior to either Munson, Kniffin, or Double Kniffin, because the upward direction of the canes on the trellis gives a decided advantage to the outermost buds, resulting in the failure of the lower buds to grow. In all the other systems named the canes are

trained horizontally, and while the outermost bud is apt to push a little ahead of the others the difference is nothing like so great, and with the exception of the first bud there is an almost uniform development of all the buds along the cane. On 31 canes trained on the Renewal system 118 buds, from the base upward, either failed to grow or were barren, while on 35 canes of other long-spur systems, trained horizontally, only 52 buds, from the base upward, failed.

The short-spur pruning resulted in fewer failures of buds to push. In all the vines under observation there were 175 short spurs, on which 76 base buds failed to grow, and 66 long spurs, on which 170 base buds failed to grow. By base buds is meant here those from nearest the base of the stem outward. In one of the Renewal vines the first 12 buds on a cane failed to grow. These are included among base buds in this comparison. The short spurs have here a manifest advantage.

SUMMARY

1. Unpruned grape canes give a heavier total yield of fruit the first season they are thus neglected than the pruned canes, but the average weight per bunch is much less, and as the result of overbearing much of the new growth will die, thus greatly reducing the next crop.

2. The base bud in Concord, Niagara, Delaware, and Brighton grapes gives the lightest weight of fruit. In Niagara and Delaware the average yield from the 2d bud was over twice as much as from the 1st bud, while in Concord and Brighton it was more than half again as much. In all four varieties the yield from the 3d bud was greater than from the 2d.

3. Considering the first 12 buds (grape canes are seldom left longer than 12 nodes at pruning), the greatest yield is reached in Concord at the 6th bud, in Niagara at the 8th bud, in Delaware at the 8th bud, and in Brighton at the 10th bud.

4. Arranging the buds in groups of three, Concord gives the best yield from buds 4-6, Niagara from buds 7-9, Delaware from buds 7-9, and Brighton from buds 7-9.

The relative order of yield for the four groups is as follows:

Concord	group 2, 3, 1, 4
Niagara	group 3, 4, 2, 1
Delaware	group 3, 2, 4, 1
Brighton	group 3, 4, 2, 1

5. Comparing the average yield of the first 6 buds with that of the second 6, the result is:

	Buds 1-6	Buds 7-12
Concord	30.72 oz.	26.47 oz.
Niagara	19.01 oz.	39.05 oz.
Delaware	12.75 oz.	16.39 oz.
Brighton	30.63 oz.	56.49 oz.

6. Concord is better adapted to short-spur systems of pruning and training than the other varieties named; in this variety it would probably be more profitable to reduce the number of spurs per vine and increase the length of the spur to 6 buds.

7. Niagara and Brighton would seem to be most profitably pruned at the 10th to 12th bud. While there is less difference between the yields of buds 1-6 and 7-12 in Delaware, the indications favor the longer cane.

8. In long-cane systems, horizontal training is preferable to upright or diagonal training, as the lower buds of the cane are better nourished in the horizontal systems.

9. The observations and conclusions herein indicated, being based on one crop, are not to be regarded as conclusive, but rather as a preliminary report.