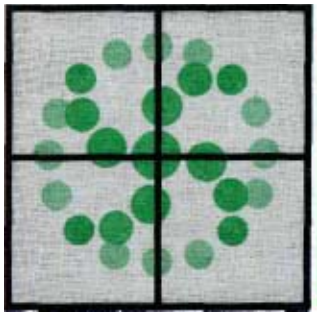

PLANT SCIENCES

POMOLOGY AND VITICULTURE (GENEVA) • 22

NEW YORK STATE AGRICULTURAL EXPERIMENT STATION, GENEVA, A DIVISION OF THE NEW YORK STATE COLLEGE OF AGRICULTURE AND LIFE SCIENCES, A STATUTORY COLLEGE OF THE STATE UNIVERSITY, CORNELL UNIVERSITY, ITHACA

McIntosh Apple Crop Prediction Grower Sampling Instructions

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Apple fruits grow at a relatively uniform rate during much of the season. While many factors influence the rate of fruit growth, such as weather, tree vigor, crop load, etc., the interacting effects of these factors are fairly well established 2-3 months after bloom. Throughout the remainder of the season, the growth rate follows a predictable pattern. As a result, the harvest size of McIntosh apples can be accurately predicted from fruit size measurements on August 1.

The yield of an apple tree is a function of two factors—the number of fruits on the tree and the size of those fruits. Combining estimates of fruit size at harvest with fruit set counts provides an estimate of the crop at harvest. These two factors have been integrated into a single statistic called crop load (weight of fruit per centimeter of branch circumference), and the relative crop can be accurately estimated by comparing crop load (on August 1) with crop load from previous years. The data required for the calculation of crop load also permits an estimate of fruit size at harvest.

This approach has several advantages as follows:

1. It can be used by individual growers to provide information about the crop on their own farms.
2. It is based on specific measurements and data rather than on observation and "guesstimates".
3. It provides reliable information on fruit size that is not available in other crop estimates.

An accurate assessment of total crop and fruit size as early as August 1 provides valuable guidance for progressive fruit growers in several areas:

1. Determining the number of pickers needed.
2. Ordering supplies such as bulk bins and packing materials.
3. Estimating storage space needs.
4. Planning the order in which different blocks will be harvested.
5. Determining which fruit would be most desirable for storage.
6. Deciding which fruit should be marketed first.
7. Establishing the price for fruit sold.

EQUIPMENT NEEDED

The sampling procedure is fairly rapid and simple and requires only three items:

1. Marking or tagging material to identify trees and branches to be sampled. Bright-colored plastic flagging tape is excellent for this purpose.
2. A measuring tape to determine branch circumference. This should be calibrated in centimeters, but a table for conversion of inches to centimeters is included for the convenience of those who might not have a centimeter tape.
3. An accurate scale, with a capacity of approximately 10 lbs. that can be used in the field. As with the diameter measurements, it would be advantageous to determine weight in metric units. A table for converting pounds to grams is included.

SELECTING TREES AND BRANCHES

The trees that are to be sampled must be representative of the orchard. Sampling the trees nearest the storage, or only the best trees, will not provide meaningful data. Selection of the trees to be sampled is made in full bloom. This is necessary to avoid bias because most people are unconsciously influenced by crop and the selection must be made before visible fruits develop. Selection should be limited to trees with bloom that is representative of the block. Four trees are sampled in each block. A good approach is to roughly divide a block into quarters and select a tree of average bloom near the center of each quarter. Mark the trunks of these trees so that they are easily located. Two branches are then selected on each tree. These branches should be about shoulder height, *well exposed to light,* and on opposite sides of the tree. Accuracy is significantly influenced by branch size; therefore, *only branches 10-15 centimeters in circumference (about 1 1/4 inches in diameter) should be used.* It is not necessary to sample the entire branch all the way to the trunk. The sample can be collected from a segment of a larger branch as long as the largest part of the sample segment is within the range of 10-15 cm in circumference. Mark the branch at the point that satisfies the circumference requirements. The branch will be easier to locate later if it is also conspicuously marked at the tip. In branch selection, *avoid branches that have been heavily pruned.* Where this program is followed for several years, use the same trees and the same branches (as long as they are not severely pruned) each year.

SAMPLING

The trees are sampled on August 1. Since there is a measurable increase in fruit size each day, and the predicted harvest size is based on a definite interval from sampling to harvest, earlier or later sampling will result in significant errors. In sampling, *all* of the fruits are harvested from the point at which circumference is determined on the branch. The fruits are picked, counted, and weighed (combined weight of all fruits on a branch) and the circumference of the branch is accurately determined. The data for each branch are recorded separately.

INTERPRETATION

If the measurements were not made in metric units, they must be converted, as illustrated in Tables 1 and 2.

Interpretation can be illustrated by a typical sample from 1975 data:

	Branch circ. - cm.	Number fruits	Weight of fruits - gm.
Tree 1, Branch 1	11.8	64	3459
Tree 1, Branch 2	13.6	57	2853
Tree 2, Branch 1	12.7	56	3203
Tree 2, Branch 2	14.6	70	4110
Tree 3, Branch 1	13.5	61	4167
Tree 3, Branch 2	13.0	54	3350
Tree 4, Branch 1	11.8	51	3062
Tree 4, Branch 2	11.6	63	3742
TOTAL	102.6	467	27,946

$$\text{Crop load} = \frac{27{,}946 \text{ gm}}{102.6 \text{ cm}} = 272.38 \text{ gm/cm of branch circumference}$$

$$\text{Average fruit size} = \frac{27{,}946 \text{ gm}}{467 \text{ fruits}} = 58.7 \text{ gm}$$

Once a regular program is established, yield is estimated by comparing crop load with that of previous years. In the initial year, there are no past data for comparison and the crop estimate must be based on theoretical optimum values. Fruit size at harvest is estimated from tables prepared from several years of fruit growth studies. Evaluation of the above data would be as follows:

	Av. fruit size—gm.	Crop load—gm/cm of branch circumference
1974*	50.5	263.15
1975*	55.5	311.11
1976*	59.8	202.68
Optimum range	57.0-63.0	260.00-290.00

*Crop prediction study averages for the Northeast.

The values for fruit size (58.7) and crop load (272.38) from the above example fall within the optimum range and an average crop is indicated. A crop load of less than 260.00 (as in 1976) is indicative of a light crop and a crop load of more than 290.00 (as in 1975) is indicative of a heavy crop. In the absence of specific data from previous years, no further interpretation's possible. Where crop load data from the previous year are available, the crop is estimated as a per cent of the previous crop. Using crop load values from two markedly different years (1975 and 1976), the crop estimate from the above example would be calculated as follows:

1. $\frac{272.38}{311.11} \times 100 = 87.5\%$

2. $\frac{272.38}{202.68} \times 100 = 134.4\%$

In Example 1, the estimated crop would be 87.5 per cent of the previous year's crop. In Example 2, the estimated crop would be 34.4 per cent greater than the previous year's crop. Where accurate yield records are kept, these percentages can be converted to bushels.

Fruit size distribution is estimated from Table 3. Since the fruits continue to grow as long as they remain on the tree, the interval between the August 1 estimate and harvest will affect the accuracy of the prediction. In Table 3, it is possible to estimate the effects of different harvest dates. In the above example, the average fruit size of 58.7 gm falls between the table values of 55 and 60 and the exact value must be determined by interpolation. For a September 20 harvest date, this would be calculated as follows:

Fruit size: 60.0 - 55.0 = 5.0
58.7 - 55.0 = 3.7
3.7/5.0 = 74%

% Less than 2½ in: 29 - 22 = 7
7 x 74% = 5.2
29 - 5.2 = 23.8

An average fruit size of 58.7 gm on August 1 would indicate that 23.8% of the crop would be less than 2½ in. on September 20. If the fruit were harvested on September 10, as might be the case with Ethrel-treated fruit, the per cent less than 2½ in. would be 30.8. Conversely, if harvest were delayed until September 30 only 17.8% would be less than 2½ in.

Table 1.—Conversion of inches to centimeters.

3 in = 7.62 cm	1/16 in = 0.16 cm
4 in = 10.16 cm	1/8 in = .32 cm
5 in = 12.70 cm	3/16 in = .48 cm
6 in = 15.24 cm	1/4 in = .64 cm
7 in = 17.78 cm	5/16 in = .79 cm
	3/8 in = .95 cm
	7/16 in = 1.11 cm
	1/2 in = 1.27 cm
	9/16 in = 1.43 cm
	5/8 in = 1.59 cm
	11/16 in = 1.75 cm
	3/4 in = 1.91 cm
	13/16 in = 2.06 cm
	7/8 in = 2.22 cm
	15/16 in = 2.38 cm

Example: Branch Circumference 4 5/8 in

4 in = 10.16 cm
5/8 in = 1.59 cm
4 5/8 in = 11.75 cm

Table 2.—Conversion of pounds to grams.

1 lb = 453.6 gm	1 oz = 28.3 gm
2 lb = 907.2 gm	2 oz = 56.7 gm
3 lb = 1360.8 gm	3 oz = 85.0 gm
4 lb = 1814.4 gm	4 oz = 113.4 gm
5 lb = 2268.0 gm	5 oz = 141.7 gm
6 lb = 2721.6 gm	6 oz = 170.1 gm
7 lb = 3175.1 gm	7 oz = 198.4 gm
8 lb = 3628.7 gm	8 oz = 226.8 gm
9 lb = 4082.3 gm	9 oz = 255.1 gm
10 lb = 4535.9 gm	10 oz = 283.5 gm
	11 oz = 311.8 gm
	12 oz = 340.2 gm
	13 oz = 368.5 gm
	14 oz = 396.9 gm
	15 oz = 425.2 gm

Example: Fruit Weight 7 lb 10 oz

7 lb = 3175.1 gm
10 oz = 283.5 gm
7 lb 10 oz = 3458.6 gm

Table 3.—McIntosh apple fruit size on August 1 and estimated fruit size distribution on different harvest dates.

Av. Fruit Size on Aug. 1— wt in gm	% Less than 2½ inches if harvested on:		
	Sept. 10	Sept. 20	Sept. 30
35	94±13	81±12	67±10
40	76±11	64±9	50±7
45	60±9	49±7	38±5
50	46±7	37±5	30±4
55	36±5	29±4	23±3
60	29±4	22±3	16±2
65	23±3	16±2	11±2
70	18±3	11±2	7±1
75	14±2	7±1	3±1

Table 4.—McIntosh fruit size at harvest and estimated fruit size distribution.

Av. Fruit Size wt in gm	% less than 2½ inches
80	74±11
85	67±10
90	60±9
95	52±7
100	45±6
105	38±5
110	32±5
115	26±4
120	21±3
125	15±2
130	9±1
135	3±1