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ORCHARD STUDIES: HOW AREAS OCCUPIED BY
APPLE TREE HEADS INCREASE WITH AGE
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In the experimental orchard at the Fruit Breeding Farm records were made from time to time of the increase in tree head areas, or the area covered by spread of the trees. These areas were recorded for Haralsons at 12, 15, 16, 19 and 21 years of age. Wealthy trees were measured at 16, 19 and 21 years. Northwestern trees were measured only at 16 years of age just before they were removed. These records are shown in Table 1. In Figure 1 the increase of head areas is shown graphically. Performance of the trees included in this study can be considered fairly typical of the three varieties used. Growth of the young trees was checked somewhat during the drouth years of 1934 and 1936, and some trees were lost during the severe winters of 1935-36 and 1947-48.

The records shown in Table 1 and Figure 1, beginning when the trees were 12 years old, show how rapidly the allotted space in the Filler Block was occupied. When 12 years old the Haralson trees in that block began to show crowding of the tops as tips of the branches were nearly touching along and across the rows. When 15 years old, branch tips were touching, and when 16 years old, just before the filler trees were removed, the trees interlaced an average of two feet. At that time 96.5 percent of the allotted space was covered by the tree heads. There was only 3.5 percent of the orchard area not completely covered by the trees. Individual trees interlaced as much as four feet at this time so that operations such as spraying and hauling the crop were impeded. Spray rig and trucks brushed against and damaged branches on almost every tree. All the records show that the Haralson filler trees were left in place in this orchard about four years too long. There was the same extent of crowding among the Wealthy trees when 16 years old. After the filler trees were removed in 1947 the Wealthy trees spread out a little faster than Haralson trees so that when 21 years old they occupied 30.5 percent of the Permanent area (35 x 35 ft.) compared to 28.3 percent for Haralson trees.

Northwestern trees that grow more rapidly and make larger trees than either Haralson or Wealthy, interlaced their branches about five feet beyond the limits of allotted space, so occupied 131.6 percent of that space when 16 years old. These trees occupied one third more space in their 16th year than Wealthy or Haralson trees of the same age, and at that age were 4.6 percent larger than Haralson trees 21 years old. Although Northwestern trees bear relatively early their rapid spread makes them unsuitable for use as fillers at the spacing used in this orchard. In the original plan for the orchard the Northwestern trees were to be permanent and the Haralsons were to be fillers. The arrangement had to be changed because the severe winter of 1935-36 killed or severely injured more than 80 percent of the four year old Northwestern trees. The change was made easily by designating the Haralson trees opposite to the Northwestern in adjoining rows as permanent and calling the Northwestern filler trees.

The areas occupied by Haralson and Wealthy trees when 21 years old are shown in Figure 1 in relation to filler spacing for comparison, although the filler trees had been removed four years earlier. Table 1 and Figure 1 show that Haralson and Wealthy trees occupied the same areas, 295.6 sq. ft., or 96.8 percent of the allotted space, when 16 years old. In the five years following removal of the fillers the Wealthy trees grew a little faster than Haralson trees and occupied 30.5 percent of the space allotted to permanent trees compared to 28.3 percent for Haralson permanents when 21 years old.

Some idea of the areas occupied by permanent trees when 21 years old can be gained from the lower part of Figure 1. If a second Haralson tree was shown instead of the Northwestern tree there would be a space of 14 feet between them. At the Semi-Permanent spacing of approximately 25 feet the branch tips would be only about four feet apart at that age. As the roots crowd before the tops touch it is apparent that to avoid the effects of crowding the Semi-Permanent tree should be removed at about the 20th year at the planting distances used in this orchard.

The permanent spacing of 35 x 35 feet allowed more room than Haralson trees seem to require as there was about 14 feet between tips of the branches when these trees

were 21 years old, and when the head diameters averaged 21 feet. Probably permanent Haralson trees would have enough room at 32 x 32 foot spacing providing no fillers were used. This spacing would leave about 11 feet between the tree heads at 21 years of age. This would be enough room for all orchard operations without injury to branches.

Comparisons also were made between the permanent Haralson trees in the Filler spacing of 17.5 x 17.5 feet and the permanent trees in the wider spacing of 35 x 35 feet. There had been somewhat more soil erosion in the wider spaced area before the trees were planted, and some of the practices planned for sod-mulch management were not always followed. Also, the young trees in the Permanent Block were damaged more by Buffalo tree Hoppers than those in the Filler Block. The same head measurements were used in this comparison as for those shown in Table 1, but the 24 permanent trees in the Filler Block and the 18 trees in the Permanent Block were considered separately.

Table 2 shows that head areas in the two blocks were about equal in 1943 when the trees were 12 years old, and before the depressive effects of crowding were evidence in the Filler Block. In the late fall of 1947 all filler trees then 16 years old were removed, but the Semi-Permanent trees were left in place. One of the effects of crowding can be seen in the figures shown in Table 2. The head areas of permanent trees in the Filler Block when 19 years old in 1950 were about equal to those in the Permanent Block when 16 years old. Again, when trees in the Filler Block were 21 years old their head areas were about equal to those in the Permanent Block when 19 years old. These are important differences in size as it is well known that for a given variety the largest trees usually produce the largest yields.

The records show that head areas in the two blocks were again about equal in 1952 when 21 years old. Trees in the Permanent Block had produced somewhat larger crops in that five year period. Also head areas of half the trees in the Permanent Block had been decreased slightly as spreading branches were pulled down by heavy crops, or had been pruned back to permit working beneath the trees. In addition, spacing in the Filler Block was upset by severe injury or killing of several trees during the severe winter of 1947-48, thus providing more room for remaining trees.

These records and comparisons of the areas occupied by tree heads should be useful guides for those who are increasing their plantings, or those who have included filler trees in their orchards. The records suggest caution relative to the spacing between permanent trees. It always should be kept in mind that apple tree roots extend several feet beyond the tips of the branches. This important item of growth habit needs to be considered when orchard plans are made, and as the trees increase in size. Production of 1200 bushels per acre in the Filler Block compared to 260 bushels in the Permanent Block in 1943, when the trees were 12 years old, shows how filler trees increase yields during the early years in an orchard. But to keep filler trees beyond that age may cause serious shading, check growth, reduce color and yields, interfere with orchard operations, and increase the cost of removal.

Table 1. Increase of Head Areas With Age,
and Percent of Allotted Space Occupied.

Year	Age in Years	Trees No.	Average Diameter Feet	Average area Sq. Ft.	Allotted Space Occupied		
					Filler	Semi-Perm. ²	Permanent ³
<u>HARALSON</u>							
1943	12	68	16.0	201.1	65.7	32.8	16.4
1946	15	68	17.5	243.3	79.4	39.8	19.9
1947	16	66	19.4	295.6	96.5	48.2	24.1
1950	19	60	20.2	320.4	—	52.4	26.2
1952	21	58	21.0	346.4	—	56.6	28.3
<u>WEALTHY</u>							
1947	16	61	19.4	295.6	96.5	48.2	24.1
1950	19	39	20.6	333.3	—	54.4	27.2
1952	21	37	21.9	373.3	—	60.9	30.5
<u>NORTHWESTERN</u>							
1947	16	11	22.6	402.6	131.6	65.8	32.9

1. Fillers 17.5 x 17.5 ft. = 306.25 Sq Ft. Allotted Space. 142 trees per acre.
2. Semi-Permanent 24.7 x 24.7 ft = 612.5 Sq. Ft. Allotted Space. 71 trees per acre.
3. Permanent Spacing 35 x 35 ft = 1225 Sq. Ft. Allotted Space. 35.5 trees per acre.

Table 2. Head Areas of Haralson Trees
in Filler and Permanent Blocks.

Year	Age in Years	Trees = No.	Average Diameter Feet	Average Area Sq. Ft.
Permanent Trees - Filler Block				
1943	12	24	15.8	195.1
1946	15	24	17.4	234.5
1947 ^{1.}	16	24	18.9	284.3
1950	19	19	19.3 ^{2.}	293.2 ^{2.}
1952	21	19	20.4	326.9
Permanent Trees - Permanent Block				
1943	12	18	15.8	195.1
1946	15	18	17.8	248.8
1947	16	18	19.4	295.6
1950	19	18	20.6	333.3
1952	21	18 ^{3.}	20.8	339.8

1. Filler trees removed November 1, 1947.
2. About equal to trees in Permanent Block at 16 years.
3. Nine of these trees had diameters decreased by heavy crops and by pruning treatment.

FIGURE 1. RELATION OF HEAD AREAS TO ALLOTTED SPACE

Shown for Filler Spacing 17.5 x 17.5 Feet.

