A Blast from the Past -- 50 years ago.

FRUIT NOTES

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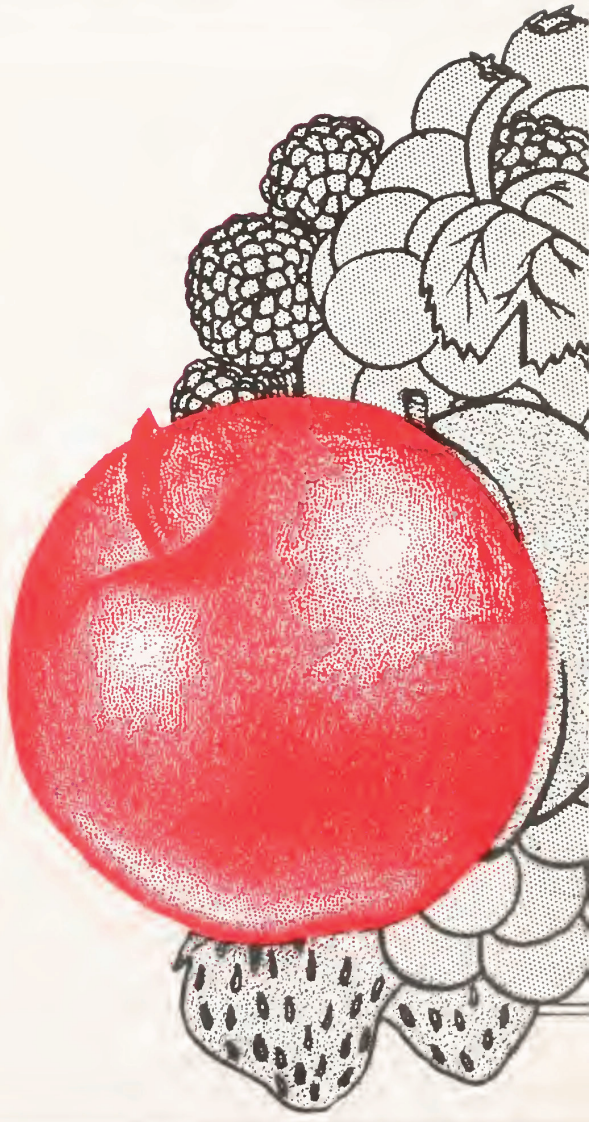

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INCREASING APPLE ORCHARD OUTPUT

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Dr. John C. Cain of the New York State Agricultural Experiment Station, Geneva, New York, recently published a report entitled "Tree Spacing in Relation to Orchard Production Efficiency," (N.Y. Agr. Res. Circular No. 15).

In this report, the efficiency benefits of close spacings for apple trees are discussed. Efficiency was defined simply as OUTPUT/INPUT. The output factors were resolved into bushels per tree and trees per acre, while the input factors included planting, production and harvest costs.

In spite of technological advances, efficiency increases have barely kept pace with inflation and higher living standards. Yields per tree have improved considerably, but according to Dr. Cain, too little attention has been given to a study of tree spacing in relation to land-use efficiency and its effect on production per acre. Using some of the information presented by Cain as well as other data and ideas, the writer has attempted below to analyze our Massachusetts orchards and visualize how production efficiency can be increased.

Many of our older orchards are spaced 40' x 40' and as pointed out by Dr. Cain, at maturity the trees may actually cover no more than 50-60% of the land. Furthermore, at least 25 years are required for these trees with 40' x 40' spacing to reach maximum production. If production were approximate linear function of the land area covered by the trees, the lifetime production efficiency in terms of land usage in a 40' x 40' planting could be no more than 30-35%. However, as it will be pointed out later, yield per square foot of space occupied by the tree is greater for the smaller tree.

What can be done to improve land utilization and production per acre for trees on seedling roots? First, Cain suggests the elimination of cross alleys. With air blast sprayers and chemical control of weeds in the tree row, the necessity for spraying and mowing or cultivation in both directions is eliminated. Therefore, input is reduced and efficiency is increased. Second, the minimum alley width required for orchard travel needs to be determined and used. Grower opinion regarding travel space needed, appears to vary between 7 to 10 feet. If it is assumed that an 8-foot alley is needed, trees on seedling roots can be planted 32' x 40' instead of 40' x 40'. Tree number per acre is increased 26% (27 to 34 trees) and an equal gain in production is possible with no more miles of rows to travel. The space requirement of trees will vary with variety and soil, however, and the maintenance of trees on seedling roots at planting distances of less than 32' x 40' is possible. Furthermore, tree size can and is being controlled by restrictive pruning and filler trees in many blocks are not being removed which makes higher yields per acre possible.

Now let's look at our plantings on size-controlling stocks, most of which are on EM VII rootstock, in terms of efficient land utilization. In the past, we recommended a 20' x 30' spacing for McIntosh on EM VII rootstock. Three possibilities exist in these plantings regarding space: (a) the trees may not fully utilize the space alloted; (b) it may take an excessive number of years to fill the alloted area; or (c) the spacing is too close.

Dr. Cain cited a report of National Fruit Trials in England which indicated that the average spread of 89 varieties on EM VII rootstock was about 10 feet at 10 years of age and that they can conveniently be held to this size by minimum peripheral pruning. However, variations due to variety, soil, nutrition and climate may cause wide differences from this figure. In 1963, the branch spread on 19-year-old McIntosh on EM VII in the University of Massachusetts orchard in Amherst, averaged 29 feet, with a range of 27 to 31 feet. No attempt had been made to confine the spread of these trees by pruning. Since 1963, the height (12' to 14') and the spread has been restricted.

Data shown below (Table 1) for branch spread and yield of a young McIntosh orchard on EM VII in Shelburne, Mass., planted 20' x 30', 72 trees per acre, also indicate the vigor of this variety on EM VII. It would appear that McIntosh on EM VII in Massachusetts is much more vigorous than trees on similar stock in England, and that we can assume that trees here will fill the 20' x 30' spacing alloted this variety in the past. When these trees eventually obtain a spread of 20 feet, they will fill about 66% of the land area if a 10 foot alley is maintained.

Table 1. Spread and yields of young bearing 'McIntosh' trees in Shelburne, Mass. 1965-1968.

Yield	Tree age	Tree spread	Yield (boxes/tree)	Yield (boxes/acre)
1965	4	8.0	0.23	17
1966	5	9.8	0.88	63
1967	6	12.3	3.30	238
1968	7	14.3	3.10	223

[1]Measurements made by taking 2 measurements at right angles to each other. Measurements were made from the tip of the outermost branch on one side of the tree to the outermost tip on the opposite side.

Dr. Cain stressed the importance of filling the land area quickly with bearing surface and cited the beneficial effect of close tree spacings on the lifetime production of the orchard. At 8' x 16' spacing with an 8 foot alley, the trees will occupy 50% of the land in 8 years and will be near maximum production. On

the basis of equal production per unit of land area utilized, the total lifetime production of the 8' x 16' planting will be about 50% greater than a 15' x 30' planting at 30 years of age. Therefore, he concluded that if we can accurately estimate the spacing at which trees can be economically maintained by pruning, and can maintain high yield per square foot of tree-spread for a reasonable lifetime of the tree, great gains in production can be achieved by choosing the proper spacing at planting.

With a constant alley width, land utilization favors the larger tree. For example, with a constant alley of 8', an 8' x 16' planting of trees will eventually occupy 50% of the land, whereas a 32' x 40' planting will occupy 80% of the land at full spread.

If one assumes equal yield per square foot of space occupied, the larger tree may eventually surpass the smaller trees in production. However, Cain showed that small trees produce higher yields per foot of space occupied by the trees. When he applied the factor for yield in lbs/ft^2 of tree-spread to the calculation of space occupied at different tree spacings, he concluded that with a constant alley-way of 8 feet, the smaller tree properly spaced produces more bushels per acre and reaches maximum production at an earlier age, thereby eliminating the possibility of the larger tree ever exceeding the smaller tree in lifetime production.

Dr. Cain estimated the efficiency and net return for life-time-average bushels per acre for a 40-year-old orchard at various spacings. Tentative cost values were assigned for the various input factors and these costs were converted to bushels of apples so that input and output could be expressed in the same units. His calculations showed the following. "The total input per acre per year is much greater for the smaller trees, but is largely accounted for by the cost of harvesting greater yields. Efficiency (output/input) is only about 25 per cent greater for the 12' x 20' planting than for the 32' x 40' planting. However, the net gain (output-input) for the smaller tree is over 2.5 times that of the large tree. The maximum efficiency and net gain for life-time production appears to be obtained from a tree about 12 feet wide, but variations in orchard lifetime; weather conditions, and other variables of estimate could not justify distinction between tree sizes of 8 to 15 feet. However, there does not appear to be any good reason to plant trees whose final spread is expected to exceed 20 feet."

With the information quoted above in mind, let's re-examine our older recommendation of 20' x 30' spacing and our newer suggestion of 15' x 25' spacing for McIntosh on EM VII. Some persons are talking about the possibility of restricting tree spread of McIntosh on EM VII to 6 feet. The question is: Would it have been possible to restrict spread to 6 feet in the University of Massachusetts orchard mentioned above without forcing excessive vegetative growth and without reducing yields? Furthermore, Dr. Cain's calculations indicated no distinct differences between 8 feet and

15 feet tree-spread regarding efficiency. It would appear, therefore, that our current recommendations of 15' x 25' spacing for McIntosh on a good orchard soil is reasonable from the standpoint of maximum efficiency and a high lifetime production of the orchard. (Dr. Cain is suggesting 13 feet for McIntosh on EM VII, plus or minus 2 feet depending on soil capability.) With the 15' x 25' spacing, a 10-foot alley was considered necessary for bulk boxes and space to drive past the boxes. As previously mentioned, however, grower opinion regarding travel space needed appears to vary between 7 and 10 feet.

Growers who have established close spacings--6' x 14', 10' x 18' and so forth--have in mind the development of tree walls and the possible use of a harvesting aid. Restricting tree size and maintaining productivity at these spacings will challenge the horticultural ability of the grower. Since the ultimate answer as to the planting distance, height and spread of our trees is not known, it would appear based on the data presented by Dr. Cain, that the more conservative spacings of 15' x 22' to 15' x 25' should enable the grower to obtain high lifetime yields without encountering problems that may arise with closer tree spacings.

SUMMARY

The inflationary spiral must be counteracted by similar increases in orcharding efficiency for the industry to remain profitable in the future. Fortunately, significant increases in lifetime yields per acre are possible through better utilization of land. Spacings of 40' x 40' or greater are no longer needed for trees on seedling roots. New production techniques--herbicides, restrictive pruning with hand tools, air blast sprayers, and mechanical pruning have eliminated the need for the cross-alley and filler tree removal in many instances. The alley for the movement of orchard equipment can be kept to the absolute minimum to reduce tree spacing between rows.

Small trees on size-controlled rootstock, properly spaced, produce more bushels per acre and reach maximum production at an earlier age than larger trees. Hopefully, within a few years we will be able to predict, with reasonable accuracy, the size at which we can hold the tree with a minimum cost of pruning and a size at which high yields per square foot of tree spread can be maintained for the lifetime of the tree.

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