High Density Peach Production in Ontario

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Peach culture in Ontario is thriving partly due to the protected climate between Lake Erie and Lake Ontario. Growers have moved to higher density peach orchards trained as central leader trees. An even higher density system called 'Fusetto' is being tried, and early results are encouraging. Fusetto trees planted at a density of 770 trees/ acre are trained as upright and narrow cone shaped trees with leaves and fruit exposed to good sunlight.

The Niagara Region, the area of Ontario between Lake Ontario and Lake Erie, in Ontario, Canada, produces more than 85 percent of Canada's peaches and nectarines. Other primary production areas include the extreme southwestern section of Ontario (along the northwestern shore of Lake Erie and southwest of Detroit, Michigan) and in British Columbia. In the Niagara region, peach and nectarine production is limited to a narrow strip of land (2 to 10 km wide and 60 km long) between the south shore of Lake Ontario and the Niagara escarpment (a bluff rising 100 to 200 meters above the lake).

The unique microclimate formed between the lake and the escarpment is suitable for the production of "tender fruits" such as peaches, nectarines, sweet and sour cherries, pears, plums and apricots, and grapes. Flower and vegetable greenhouses, nurseries, and poultry farms also flourish in this microclimate. To compete with these crops for the limited land base and to produce the domestic supply for fresh and processing fruit, peaches and nectarines must be productive and profitable.

The Ontario peach and nectarine industry is on the northern frontier for commercial production. The Niagara tender fruit belt climate is characterized by harsh winters (lowest recorded minimum was -16° F), short growing seasons (182 frost free days), and cool summers (average temperature for June, July, and August is 68° F). Under these conditions, tree growth and vigor are limited. Fruit production is consistent year after year (1981 and 1994 were the only years in recent history when yields were significantly lower than average); however, productivity in a given year is less than desirable (5.5 tons/ acre provincial average).

Central Leader Trees Provide Improved Production Efficiency

The standard training systems in Ontario have been the open center and modified leader. To improve the productivity and efficiency of Ontario orchards, many growers have been replacing the standard open center and the modified leader training systems with central leader training technology. In previous research, it was determined that better productivity could be obtained from trellis trained central leader trees (1,2). This technology was modified to freestanding central leader trees to eliminate trellis costs.

The primary advantage of central leader trees over the previous systems used is the reduction of labor. More than two-thirds of the fruit is produced on the four major scaffolds that are oriented close to the ground. Because tasks such as pruning, thinning, and harvesting can be done without ladders, fewer labor inputs are required. Orchard workers can easily learn the concepts of training and pruning cen-

Eighty-five percent of Canada's peaches are produced in the Niagara Region of Ontario.

tral leader peach trees. Other advantages include improved light distribution within the canopy and better spray distribution within the canopy.

The central leader peach tree used in Ontario orchards is similar to the central leader training system commonly used in apple orchards. The properly trained tree has four distinctive parts: (Fig. 1) a strong central trunk, a vigorous apical bud, four major scaffolds arising from the lower portion of the trunk, and numerous small branches along the upper portion of the trunk (Fig. 1).

Establishing a central leader orchard starts with initial training at planting time and continues semi-annually with spring pruning (bloom period) and summer pruning (coinciding with pit hardening). In the first few years, four strong scaffold branches are established in the four compass directions and spaced vertically four to six inches apart along the lower trunk. The lowest branch should be directed into the prevailing wind and originate 20-30 inches above the soil. Pruning cuts direct the growth outwardly and encourage re-branching and stiffening of the scaffold. A strong and vertical central trunk that terminates at a vigorous apical bud is encouraged at each pruning. Numerous small branches are encouraged to grow along the upper portion of the central leader. These branches are restricted by heading them back. This prevents overgrowth of the top of the tree and allows excellent light penetration into the lower canopy.

Well-feathered nursery trees are best for establishing the central leader orchard (Fig. 3). After planting, remove low and undesirable branches, top the tree at 48 inches (just above a healthy bud oriented into the prevailing wind) and stub as many as eight well spaced, healthy branches to two buds. Summer pruning is done six to eight weeks later, after growth has initiated and shoots have begun to elongate. Rub off undesirable growth below the lowest scaffold and upright shoots from the scaffolds. The leader is singled out and growth from the scaffolds is directed outward. Use caution to remove as few shoots as possible to avoid removing too much leaf surface.

The important cuts to make when pruning the following spring, year two (Fig. 4), are heading back the leader to a strong bud, removing branches competing with the leader and spacing the scaffolds properly along the lower trunk. Additional cuts may be necessary to direct the growth of the scaffolds outwards. It is important to summer prune as in the previous year.

The three-year-old tree (Fig. 5) is ready to produce its first major crop. Training cuts are needed for structural purposes but also to set up good conditions for development of the crop. In addition to the types of cuts made the previous year, it is necessary to select fruiting laterals in the upper portion of the trunk. At this stage, it is important to direct terminal growth of the scaffolds laterally. Again, summer pruning is necessary to direct growth from the scaffolds laterally and to remove unwanted upright and vigorous growth.

By the fourth year, the structure of the tree should be established, and there is a large enough potential canopy to support nearly a full crop (Fig. 6). As in other years, it is necessary to maintain the upright growth of the leader, remove branches competing with the leader, restrict the growth of the branches on the upper trunk and, most importantly, direct the growth of the scaffolds outward. Be sure to eliminate competing scaffolds. Summer pruning will continue to be useful to remove vigorous competing growth that shades the 'working leaves' on the fruiting wood.

Pruning the mature tree follows the same principles. A careful balance is required to restrict growth from the upper portion of the tree without serious reduction of the vigor of the central trunk. Heading back cuts may be necessary to maintain the tractor aisle and restrict overlapping of the trees. Care should be used when summer pruning so that tree vigor is not reduced excessively.

Improving the Production Efficiency of Central Leader Orchards

Cooperatively with three growers and one nurseryman, we are developing management procedures to improve the productivity of central leader trained peach and nectarine trees. Spacing and nitrogen fertilizer rates are being compared. The varieties included were Vinegold, Virgil, and Babygold 5 processing peaches and Harblaze and Fantasia nectarines. All were propagated on Bailey rootstock. The experimental plots were one acre in size.

Trees were spaced at either 4.5, 7.5, or 11.5 feet apart in the rows, which are spaced 18 feet apart (538, 323, and 210 trees/acre, respectively). The trees spaced 7.5 and 11.5 feet apart were pruned as four-scaffold central leader trees as described previously. Trees at the closest spacing were pruned as two-scaffold trees (Fig. 2). The concept of pruning is the same, but only two scaffolds were permitted on the mature trees, both oriented into the aisle between the rows.

The central leader peach tree can be pruned, trained, thinned, and picked from the ground reducing labor costs.

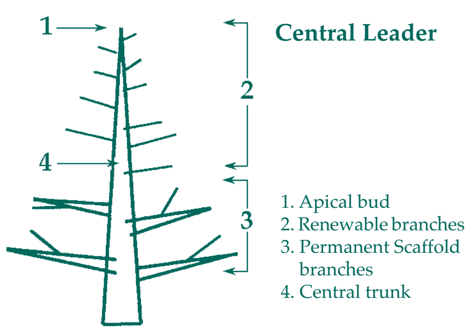

Figure 1. Diagrammatic sketch of the 4-scaffold central leader trained peach tree.

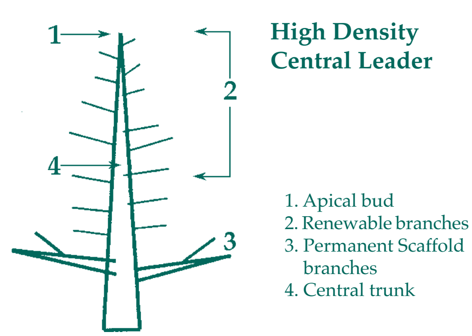

Figure 2. Diagrammatic sketch of the 2-scaffold central leader trained peach tree.

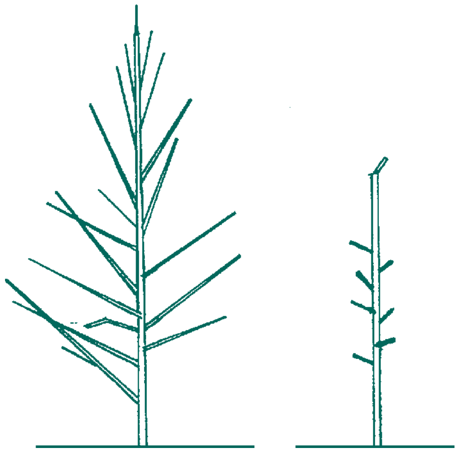

Figure 3. A well feathered nursery tree to be used to develop a central leader peach tree (left, before pruning; right, after pruning.

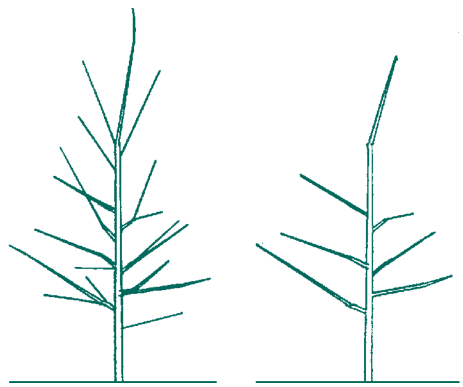

Figure 4. The central leader tree one year after planting, after the first dormancy (left, before pruning; right, after pruning.

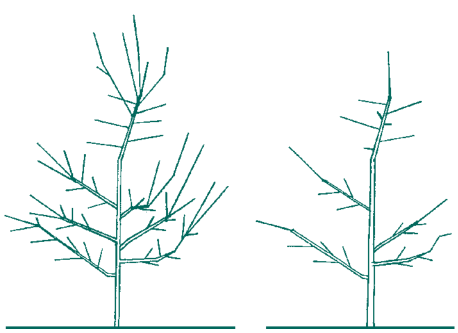

Figure 5. The central leader tree two years after planting, after the second dormancy (left, before pruning; right, after pruning.

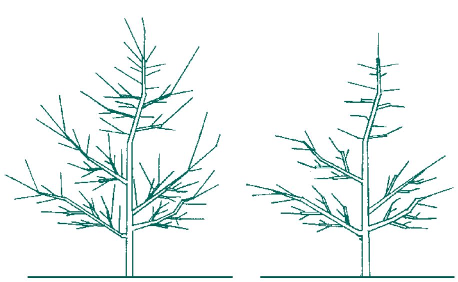

Figure 6. The central leader tree three years after planting, after the third dormancy (left, before pruning; right, after pruning.

Nitrogen fertilizer application rates were 100, 50, and 25 percent of the amount recommended for commercial peach production in Ontario (3). It was applied at bud break as a granular fertilizer (ammonium nitrate) to the soil surface at the drip line of the trees in 1997 and 1998. No fertilizer was applied during the planting year, 1996. Recommended amounts of potassium fertilizer were applied in the same manner. Other orchard management and Integrated Pest Management procedures were standard for commercial orchards in the area.

The trees were planted in the spring of 1996, and records of growth and fruiting have been maintained. Information presented is for only one variety, Vinegold, and at one cooperator's orchard (Smith's). It is representative of data from other varieties and at other orchard locations.

Tree growth in all varieties and orchards has been vigorous. The average height of the Vinegold trees at the Smith orchard at the end of the third growing season, 1998, was 11 feet and the spread was 10 feet (data not included). Trunk cross-sectional area (TCSA) after the third growing season was affected minimally by rates of fertilizer application (Fig. 7). The sandy loam soils of the orchard site supported strong tree growth during the early development of the orchard with minimal rates of nitrogen fertilizer. No nitrogen was applied during the planting year. The TCSA of the more widely spaced trees, 11.5 feet, tended to be larger than the TCSA of the closer spaced trees, 4.5 feet. These differences in tree sizes occurred mainly during 1998 when competition among trees was greatest at the closer spacing (Fig. 8). Also, trees at the closer spacing were trained with only two scaffolds, which required the removal of more wood during pruning.

Accumulated yields per tree through the third growing season, 1998, were not affected by the rates of application of nitrogen fertilizer (Fig. 9). However, trees spaced at 11.5 feet produced slightly more fruit than those trees planted at 4.5 feet apart. This difference occurred during the third growing season (Fig. 10). Pounds of fruit per tree were positively correlated to tree size (Figs. 7, 8). Tree spacing had little effect on yield per tree during the tree development phase of the orchards. As the trees become older, spacing is expected to cause differences in tree size.

Yield per acre through the third growing season was affected by tree density more than by nitrogen fertilizer application rates (Fig. 11). Per acre yield from trees spaced 4.5 feet apart was double the yield of trees spaced 11.5 feet apart. Per acre yields increased dramatically from 1997 to 1998, as would be expected from a young orchard (Fig. 12). However impressive these data are, it is important to consider that the orchard remains in the growth stage and long term production, especially as the trees mature, will be important. It will be necessary to continue to observe the growth and fruiting over the life of the orchard and to assess the economic feasibility to ascertain any real benefit for increasing tree density. Figure 13 shows the expected yields from central leader orchards and the actual yields that have been obtained.

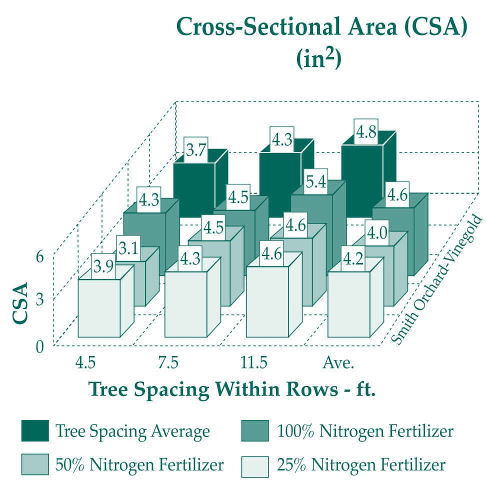

Figure 7. The cross-sectional area of the trunks of central leader trained Vinegold peach trees after the third growing season as affected by tree spacing within the row and rates of application of nitrogen fertilizer.

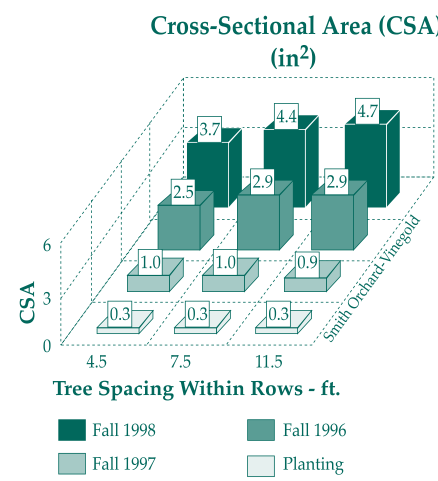

Figure 8. The cross-sectional area of the trunks of central leader trained Vinegold peach trees at planting and after each succeeding growing season as affected by tree spacing.

High Density Fusetto Orchards

We also are attempting to develop procedures for management of high density peach orchards of vertically trained fusetto trees. Several commercial orchard trials of fusetto were planted in 1996 with a spacing of four feet apart in rows 14 feet apart, or 777 trees per acre. The varieties we compared were, Veecling, Babygold 5, and Babygold 7. All are non-melting clingstone peaches for processing. Factors studied include variety, rootstock, trellis support systems, ground covers, and pruning techniques. The experimental orchards range in size between one and five acres. The orchards were established in 1996 and, except for the factors being compared, they have been maintained under cultural and Integrated Pest Management practices that are standard for the area.

The training system used was an adaptation of the fusetto system that is similar to the spindle system used for apples. Tall, narrow cone-shaped trees were developed with an upright central trunk terminating with an apical bud (Fig. 14). There were numerous and small scaffold branches spiraled along the dominant upright trunk.

At planting, the nursery trees were pruned the same as the central leader tree described above. During the first growing season, it was important to obtain a maximum leaf surface early. A minimal number of summer pruning cuts were needed to single out the leader and eliminate undesirable growth such as upright shoots. The following years, both late dormant and summer pruning were used again to single out the leader and to select and direct the scaffolds outwardly at regular intervals along the trunk. Scaffolds selected were: (1) less than a third of the diameter of the central trunk, (2) oriented somewhat horizontally, and (3) of medium vigor. They were encouraged to develop lateral secondary scaffolds and branches. Vigor was reduced by eliminating more upright growth in favor of lateral growth. Branches in the upper part of the canopy were shorter than those in the lower canopy to provide strong light conditions that encourage more vigor in the lower branches.

Pruning was always done in two stages. During the spring pruning, problem branches were eliminated. During the summer pruning, fine cuts assured proper spacing of the fruiting branches and directed the growth properly. These cuts restricted the tree growth and encouraged secondary growth from the scaffolds.

Our trees developed rapidly and were quick to establish a large enough canopy to support a crop (Fig. 15). Trees were taller than six feet high at the end of the first growing season and, by the end of the third growing season, they were greater than 11 feet high with a maximum width of 7.5 feet (data not included). As a result, accumulated yields through the third leaf were 12 tons/acre in one orchard (Fig. 16)

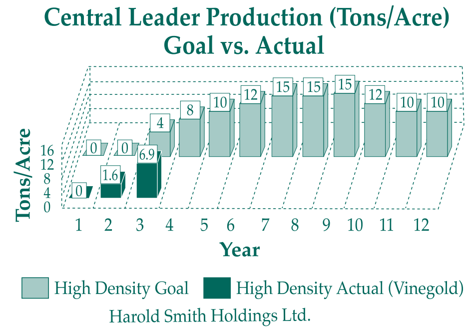

Figure 13. Expected goal for production in tons/A from central leader trained peach orchards over the 12-year life of the orchard vs. actual production obtained in years One to three.

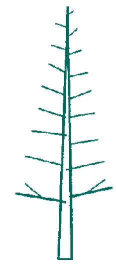

Figure 14. Diagrammatic sketch of the fusetto trained peach tree.

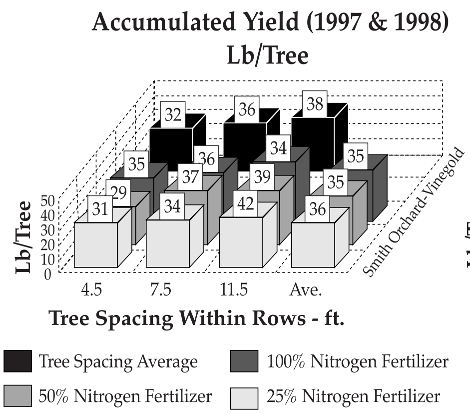

Figure 9. Accumulated yields (lbs/tree) through the third growing season from central leader trained Vinegold peach trees as affected by tree spacing within the row and rates of application of nitrogen fertilizer.

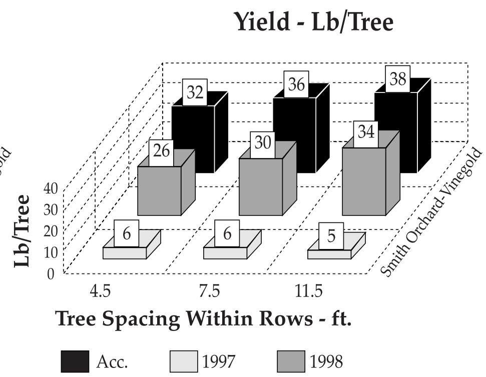

Figure 10. Annual and accumulated yields (lbs/tree) through the third growing season from central leader trained Vinegold peach trees as affected by tree spacing within the row.

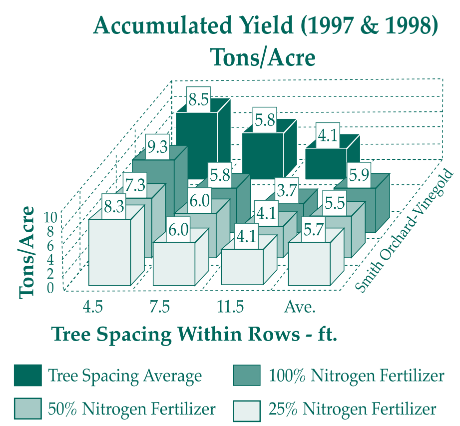

Figure 11. Accumulated yields (tons/A) through the third growing season from central leader trained Vinegold peach trees as affected by tree spacing within the row and rates of application of nitrogen fertilizer.

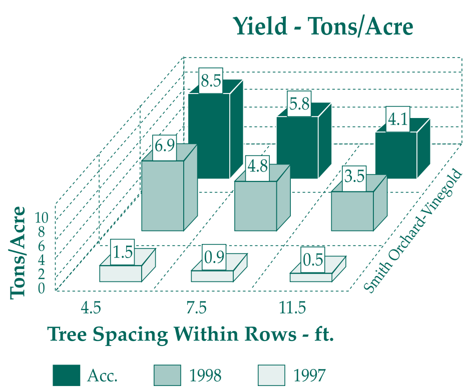

Figure 12. Annual and accumulated yields (tons/A) through the third growing season from central leader trained Vinegold peach trees as affected by tree spacing within the row.

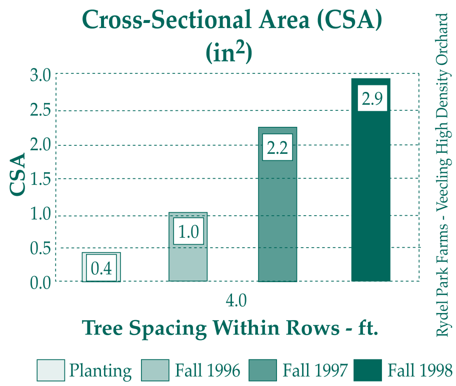

Figure 15. The cross-sectional area of the trunks of fusetto trained Veecling peach trees at planting and after each succeeding growing season.

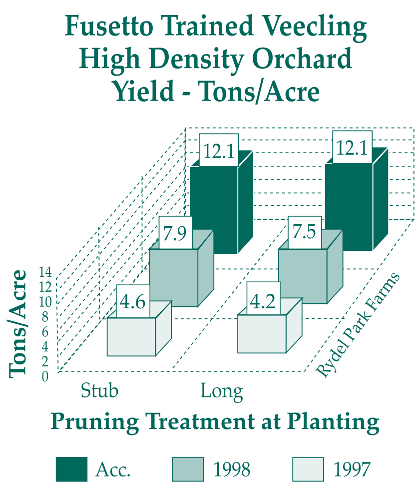

Figure 16. Annual accumulated yields (tons/A) through the third growing season from fusetto trained Veecling peach trees as affected by training procedures at the time of planting.

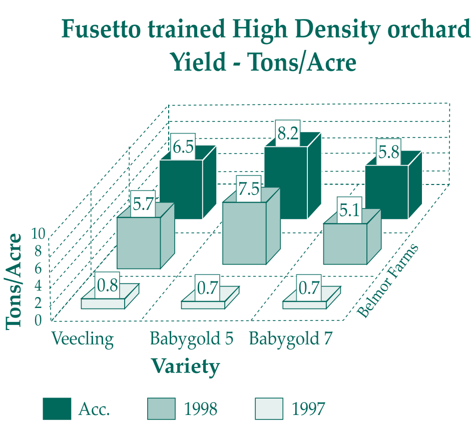

Figure 17. Annual and accumulated yields (tons/A) through the third growing season from three varieties of fusetto trained peach trees.

and six to eight tons/acre in the second (Fig. 17). Babygold 5 trees were more productive than either Veecling or Babygold 7 trees (Fig. 18), and production also was affected by rootstock. Veecling and Babygold 5 were more productive on the standard Bailey rootstock while Babygold 7 was most productive on CLT rootstock. The data are from non-replicated plots so variations in growth and production could be related to site variability.

Figure 19 compares the actual yield to the goals established for the experiment. During the first three years, production was near the goal for the experiment. Fruit size, color, and quality seemed to be normal for these varieties and quite acceptable for processing standards.

Today, after the third leaf, the tree canopy appears to be well enough established to support a larger crop next year. Training procedures used have created the desirable upright tree canopy that exposes leaves and fruit to optimal sunlight conditions.

These high-density orchards of fusetto trees have provided encouraging results through the developmental stage of the orchard. There remain serious concerns whether the trees can be maintained within the allotted space yet continue to be productive throughout the life of the orchard. However, the outlook is encouraging.

Conclusion

Ontario peach orchardists have a strong need to develop and adopt training procedures that will promote better production efficiency. They have been encouraged by the benefits of central leader trained trees, primarily reduced labor costs. The central leader has changed the shape of Ontario orchards. Now, over two-thirds of the canopy remains close enough to the ground so that hand labor can be accomplished without the use of ladders. Attempts to improve the system likely will lead to orchards with closer spaced trees within the rows.

The fusetto high-density orchard, if shown to be an improvement, will reshape Ontario orchards once again. The orchards of the future would contain upright and narrow cone shaped trees with leaves and fruit exposed to good sunlight. New procedures and redesigned orchard equipment will be necessary for managing the orchards and harvesting the fruit. The preliminary results from the high-density fusetto orchards are encouraging.

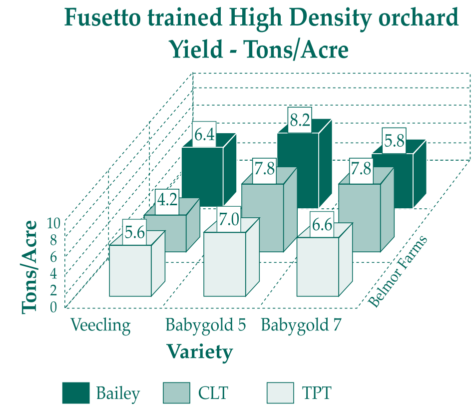

Figure 18. Accumulated yields (tons/A) through the third growing season from three varieties of fusetto trained peach trees as affected by rootstock.

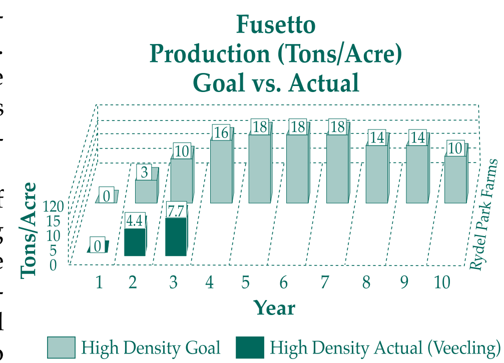

Figure 19. Expected goal for production in tons/A from fusetto trained peach orchards vs. actual production obtained in years one to three.

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