

Managing Highly Feathered Apple Trees After Planting

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The Tall Spindle system utilizes the concepts of high tree densities (900-1,200 trees/acre) with highly branched (feathered) trees (10-15 feathers) and minimal pruning at planting to achieve high early and mature yields of high quality apples while reducing and simplifying pruning and other management costs. In trials at Geneva and on growers farms we have achieved yields of 300 bushels per acre in the second year and a total of 3000 bushels/acre over the first 5 years. This level of yield results in high profitability and a quick payback of the initial investment. An economic analysis of various orchard systems by Robinson and DeMarree (2007) indicated that 20 year profitability was greatest for the tall spindle compared to higher and lower planting densities. The improved yield and fruit quality of the Tall Spindle system can result in significant reductions in the costs per unit of production especially when coupled with partial mechanization of pruning, harvesting and tree training using platforms. We currently recommend that NY growers plant the Tall Spindle system for greater profitability and competitiveness and for lower management costs with the use of orchard platforms for pruning, thinning, tree training and harvest.

Over the years, our trials with the Tall Spindle have indicated several important principles of managing this system to optimize performance.

1. Highly feathered trees are essential for high early yield. An essential component of the Tall Spindle system is high branched (feathered) nursery trees. The tall spindle system depends on significant 2nd and 3rd year yield for the economic success of the system. If growers use whips or small caliper trees which do not produce significant quantities of fruit until year 4 or 5, often the carrying costs from the extremely high investment of the tall spindle orchard overwhelms the potential returns and negates the benefits of the high tree density on profitability. Generally, nurseries in North America have produced trees with 3-5 long feathers instead of 10 short feathers which are preferred. The tree with fewer long feathers requires more branch management than the tree with more short feathers.

Our earliest trial with the Tall Spindle system was planted in 1994 but when this trial was planted we could not obtain in the USA the highly feathered trees which are essential for the optimum performance of the Tall Spindle. Thus, its early yield performance was not up to the potential of more highly feathered trees. Each succeeding trial over the last 17 years has had trees with more feathers. In 2006, we planted two new trials of the Tall Spindle system in the Hudson Valley of NY State and in Wayne County, NY (western part of NY state) using Gala, Honeycrisp and Fuji trees with 10 feathers. Second year yield was 300 bushels/acre and a 5 year cumulative yield of 3000 bushels per acre with Gala and Fuji while with Honeycrisp we achieved a cumulative yield of 2,400 bushels/acre. This level of yield can completely pay off the initial investment in the first 5 year.

2. Minimal pruning at planting. A significant difference of the Tall Spindle and the traditional Slender Spindle is that neither the leader nor the feather are pruned at planting. Even if a whip is

planted, the leader is not pruned at planting. Without pruning of the leader or feathers at planting, the tall spindle tree can be growth to a height of 10 feet or more quickly and can be allowed to crop in the second year which contributes to a rapid payback of the initial investment. The lack of pruning on the feathers allows them to carry some crop in the second year and to be bent artificially or naturally to keep them weak while favoring leader extension.

3. Tying of feathers below horizontal at planting. With the Tall Spindle all of the feathers should be tied or weighted below the horizontal at planting to induce cropping and to prevent them from developing into large lower scaffolds. The pendant position results in a weak fruiting branch instead of a strong scaffold branch. This strategy is similar to that used in the Solaxe system and is in contrast with the Vertical Axis and Slender Spindle systems where the feathers were not tied down or were tied down a little above horizontal which allowed them to grow into large scaffolds over the first 5 years. A failure to tie feathers below horizontal soon after planting results in limbs in the lower part of the tree that are too strong for the close in-row spacings of the Tall Spindle which requires severe limb removal pruning at an early age which invigorates the tree and makes long term canopy containment problematic. This simple change in feather management allows for long-term cropping of many original feathers and little invasive pruning for the first 5-8 years at the very close spacing of the Tall Spindle system.



After the initial tying down of feathers at planting, new lateral branches that arise along the leader do not need to be tied down. In most climates, Tall Spindle trees which carry crops in years 2-5 have moderate tree vigor and lateral shoots arising along the leader often bend below horizontal with crop load in the third year. This creates a natural balance between vigor and cropping without additional limb positioning. However, in vigorous climates or where winter chilling is insufficient, often limbs become too large before they set sufficient crop loads to bend the branches down. In these climates, tying down of upper vigorous limbs must be done annually for the first 3-5 years until the tree settles down and begins to crop heavily. However, in most traditional apple growing areas, growers often invest too much money in limb tying which should be limited to only the initial feathers at planting. Thereafter, the precocity of the rootstock induces heavy cropping and a natural balance is established.

4. Irrigation and fertigation in years 1 and 2. Large, highly-feathered trees often have a low root:shoot ratio (small root system compared to the top). In many cases highly feathered trees undergo water stress shortly after planting despite adequate soil moisture levels in the bulk soil. This is due to the damaged and small root system of a transplanted tree which cannot adequately

support the large top without frequent irrigation. Large, highly-feathered trees produce much more leaf area shortly after planting than unfeathered trees which creates a high water demand before the root system can re-grow sufficiently to support the trees. In-addition, during some years, periods of dry weather following planting result in water stress of newly planted trees which can limit tree growth. Frequent and early trickle irrigation can help these trees produce good growth in the first year. In humid areas like NY State, many growers are unaccustomed to installing irrigation immediately after planting and delay its installation until mid summer. We recommend that growers install trickle irrigation soon after planting (within 4 weeks) when planting high density orchards that use feathered trees to prevent water stress and maximize first year tree growth. Once the trickle irrigation system is installed the new trees need only small but frequent doses of water.

The damaged root system of highly feathered trees has limited ability to take up nutrients from the soil. Often the new tree must generate all of its first years growth using reserve nutrients stored in the tree from the nursery. This illustrates the importance of nurseries applying 2 sprays of 3% foliar urea in the fall before leaf fall to give the trees a high level on Nitrogen reserves. After planting the uptake of N and tree growth can be improved with frequent low doses of nitrogen fertilizer delivered at least twice weekly through the trickle system (fertigation) for the first 12 weeks of the season. With fertigation, the nitrogen which is dissolved in the water, moves rapidly with the water to the root zone and is readily available to the tree as soon as it starts growing. Our trials show that fertigation can significantly improve tree growth during the first 2 years to speed development of the canopy. Ground fertilization with dry fertilizers is often ineffective since too much time lapses between applying the fertilizer and uptake by the tree.

The source of nitrogen which is most readily available during the first year is calcium nitrate but other formulations of nitrogen which are liquid (URAN's or CAN's) also are effective. An alternative we are exploring is the use of Ammonium polyphosphate which may improve root growth more than nitrogen alone.

After the first two-three years, low nitrogen fertilization is desirable to keep the trees calm with a balance between fruiting and cropping. Many mature high density orchards receive excessive nitrogen fertilizer which cause severe canopy management problems. "Soil strength" or fertility must be considered when calculating the amount of nitrogen to apply to mature high density orchards especially with vigorous and poor coloring varieties. Many soils in New York produce 30-60 lbs/acre of nitrogen annually through nitrification. This is often close to the amount needed by mature high density orchards. Excess fertility often results in excessive vegetative growth, delayed cropping and soft and poorly colored fruit.

5. Strict crop load management in the first 5 years. With precocious dwarfing rootstocks, young Tall Spindle apple trees with 10 pendant feathers and no pruning at planting can often overset in the 2nd or 3rd year resulting inadequate growth to fill the allotted space and in biennial bearing as early as the 4th year. This then results in increased vigor in the 4th year just when the trees have filled their allotted space and when reduced vigor is needed. Varieties differ in their biennial bearing tendency and this must be incorporated into the crop loads allowed on young trees. Based on tree growth data under different crop loads (Robinson, 2008), we recommend for annual cropping varieties like 'Gala' a crop load of 5 fruits/cm² trunk cross-sectional area (TCA) for the first 5 years. This results in 15-20 apples/tree in the second year, 50-60 apples/tree in the third year, and 100 apples/tree in the fourth year. For slow growing and biennial bearing varieties like 'Honeycrisp' crop loads should 3-4 fruits/cm² TCA.