

# Lessons Learned about Tree Support from the 1998 Labor Day Storm

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On the morning of September 7, 1998 (Labor Day), a massive storm roared through the western New York apple industry with winds in excess of 80 miles per hour and hail. It ruined an estimated four million boxes of apples and uprooted or broke off many acres of trees. A similar storm with winds in excess of 100 mph hit the Grand Rapids, Michigan, area on May 31, 1998, also destroying many fruit trees. Extension agents from Michigan report that a severe fire blight epidemic resulted from the damage caused by the storm, resulting in additional loss of hundreds of acres of dwarf apple trees.

Following the 1998 storms in western New York and following earlier storms from remnants of hurricanes in eastern New York and Connecticut, we have reevaluated our recommendations for tree support systems used in dwarf orchards to determine if improvements can be made. Our observations are:

1. All tree support systems will fail if the winds are strong enough, but some systems performed much better than others when winds were in excess of 80 mph.
2. Trees supported by a single 1/2" or 3/4" (1.25 or 1.9 cm) steel tube (conduit) fared the worst. Although the "conduit stake" will generally support the tree when it is young and will give some support to the cropping leader of young trees, the steel tube cannot support the tree during high winds especially when carrying a crop. We learned this

15 years ago after hurricane winds came up the East Coast and broke many trees that were supported by a conduit pole. The storm of 1998 gave the same result. This support system is most commonly used on central leader trees with interstems and M.26, which are semi-free-standing. When carrying a heavy crop even these trees need better support than a single conduit pole when winds exceed 40 mph.

3. Trees that are supported by a small diameter wood pole (2" [5 cm] diameter) also fared poorly. Square 2" x 2" wood poles are the worst. They often snap off at a knot in the wood. Round 2" diameter wood poles are slightly better with clear differences in performance depending on the quality of the pole. "Peeler cores," which are the remnant of trees that are peeled for plywood, are no better than the 2" x 2" square poles. This is because they are made from the softer wood at the center of a log. Other whole tree 2" diameter wood poles did slightly better but still broke in large numbers since the forces of the wind exceeded the breaking strength of the poles of that diameter. This support system is commonly used with trees with M.9 trained as slender spindles and is the most common support system in Holland. Although these small diameter wooden poles can normally support both the tree and heavy crops, they are inadequate for

*The most durable support system was the "single high wire and conduit stake" trellis system.*

the kinds of winds experienced in New York and Michigan in 1998.

4. Trees supported by 3" diameter or larger wood poles fared well. This support system has been used for slender spindle trees in the past, but the cost of the poles and installation has reduced its popularity.
5. Trees supported by a 1/2" or 3/4" conduit steel stake tied to a single-wire trellis generally survived better than other systems. Support systems using a two-wire trellis and a conduit stake (one wire at the height of the lower scaffold branches and the other at the top of the poles) were even better, especially with brittle varieties like Gala which can snap off at the graft union on M.9 or M.26. Systems using bamboo instead of conduit also survived well but not as well as steel conduit. Nevertheless there are cases in western New York where even this sys-

FIGURE 1

Tree support system for Vertical Axis and Slender Spindle using the single high wire and 1/2" steel stakes with a driven post as the anchor.

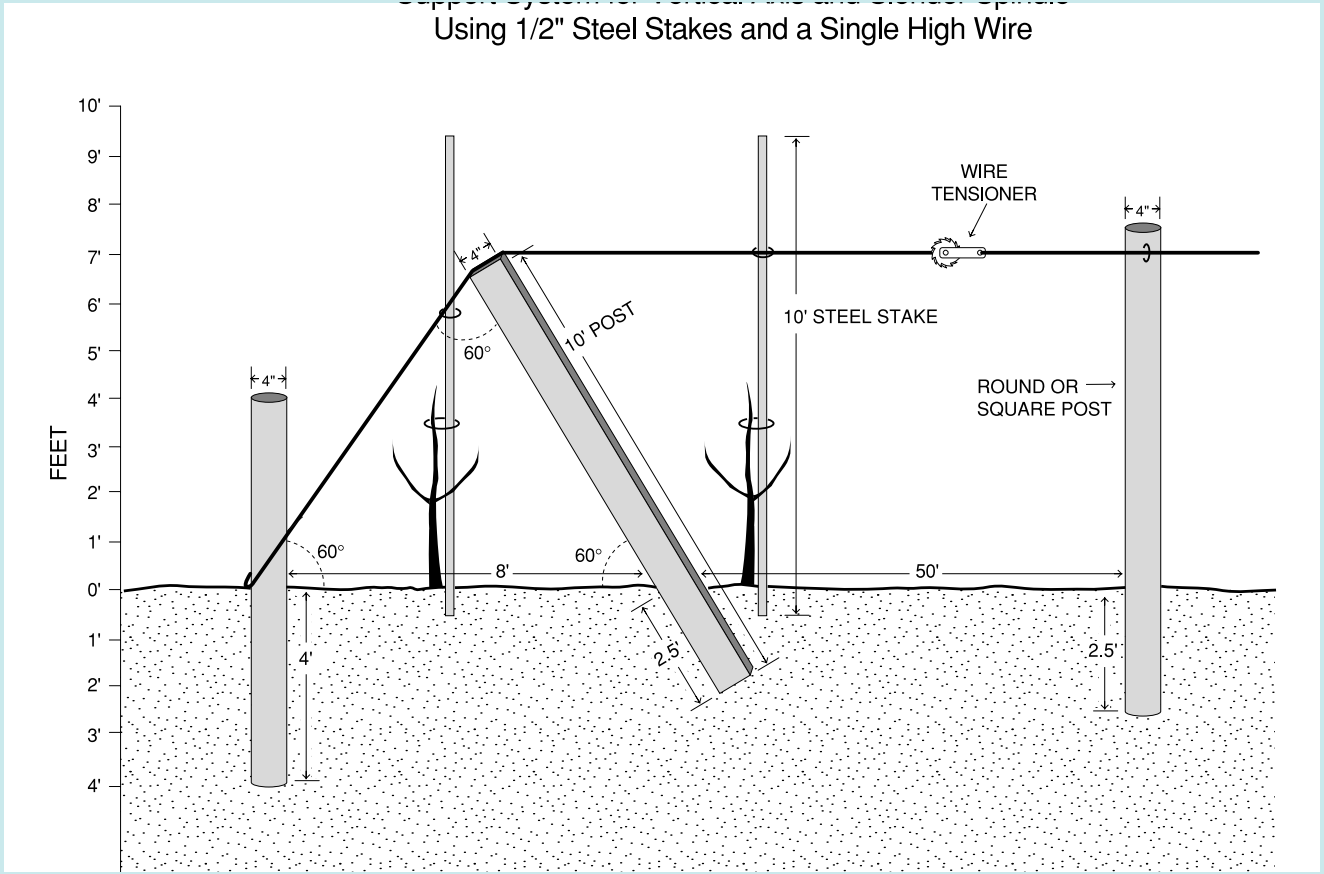
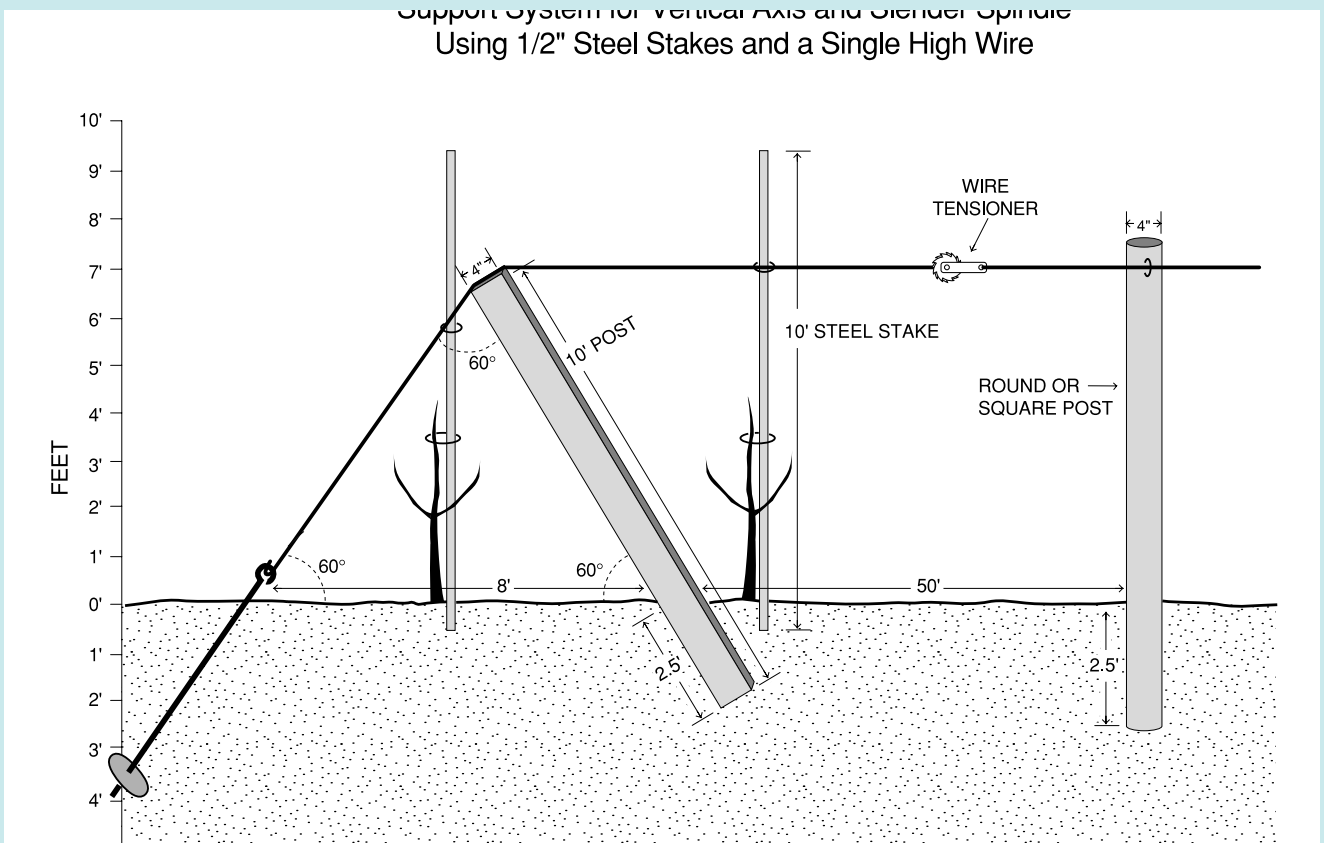


FIGURE 2

Tree support system for Vertical Axis and Slender Spindle using the single high wire and 1/2" steel stakes with a screw type anchor.



tem failed. One notable example occurred when a trellis was supported by cement poles and the hurricane force winds broke off the cement poles, bent the conduit, broke off the trees, and then piled them all up together in the hedgerow. The success of the “single high wire and conduit stake” system depends on how well the steel stakes are attached to the wire, the distance between in-line poles, the strength of the anchoring system, and the tension of the wire.

Over the last 15 years we have studied tree support systems and have benefited from the knowledge of John Wall of Kiwi Fence Company and of Fred Smith of Innovative Fence Company. We have learned from trial and error many of the important points of good tree support systems. Based on our experience and our assessment of the successes and failures following the 1998 storms we suggest fruit growers consider the following points when designing support systems for new dwarf apple orchards.

1. A tree support system must be designed for the worst case scenario growers are likely to encounter during the lifetime of the orchard. The infrequency of storms like the one

we had in 1998 has led many to gamble and install minimal support systems. These storms proved that “conduit” pipe, bamboo, or 2” diameter wood stakes alone are not adequate for tree support and we no longer recommend them except for training purposes. The need for stronger support systems than these was very evident in 1998, but growers rightfully must still consider the cost of stronger systems and should not invest unnecessarily in support systems.

2. The “single high wire and conduit stake” system is a good compromise between cost and excellent tree support. This support system survived the storms of 1998 better than other systems and is what we recommend for dwarf orchards. Figures 1 and 2 show the basics of the system. For brittle varieties like Gala, a two-wire and conduit trellis system should be used (Fig. 3). The lower wire is placed at the height of the lowest tier of scaffold branches. These lower scaffolds are then attached to the wire to prevent a twisting motion of the tree in high winds that can break brittle graft unions with M.9 or M.26 rootstocks. The

strength of this system lies in 1) the anchoring system at the end of each row, 2) the use of high tensile wire, 3) the use of 4” (10 cm) diameter in-line wood poles spaced no further than 50 ft (15 m) apart and 4) in the attachment of the steel poles to the wire. These four key factors that resulted in this system surviving better than other systems the 1998 storms are discussed below.

### THE ANCHORING SYSTEM

We prefer a system based on an equilateral triangle formed by angling the first in-line pole back toward the anchor to a 60° angle with the ground. The pole forms one side of the triangle. The other two sides are the wire, which comes down over the top of the pole and is attached to the anchor near the ground and the ground from the base of the anchor pole to the base of the first in-line pole. By having the first in-line pole angled back toward the anchor, the pull of the wire on the anchor is more evenly transferred to the anchor. If the first in-line pole is vertical, it acts as a lever and the force on the anchor from the wire tension is increased. The anchor itself can be any immovable object. Growers have successfully used buried objects

FIGURE 3

Tree support system for Vertical Axis and Slender Spindle using the two wires and 1/2” steel stakes. This system is recommended for Gala and other brittle varieties.

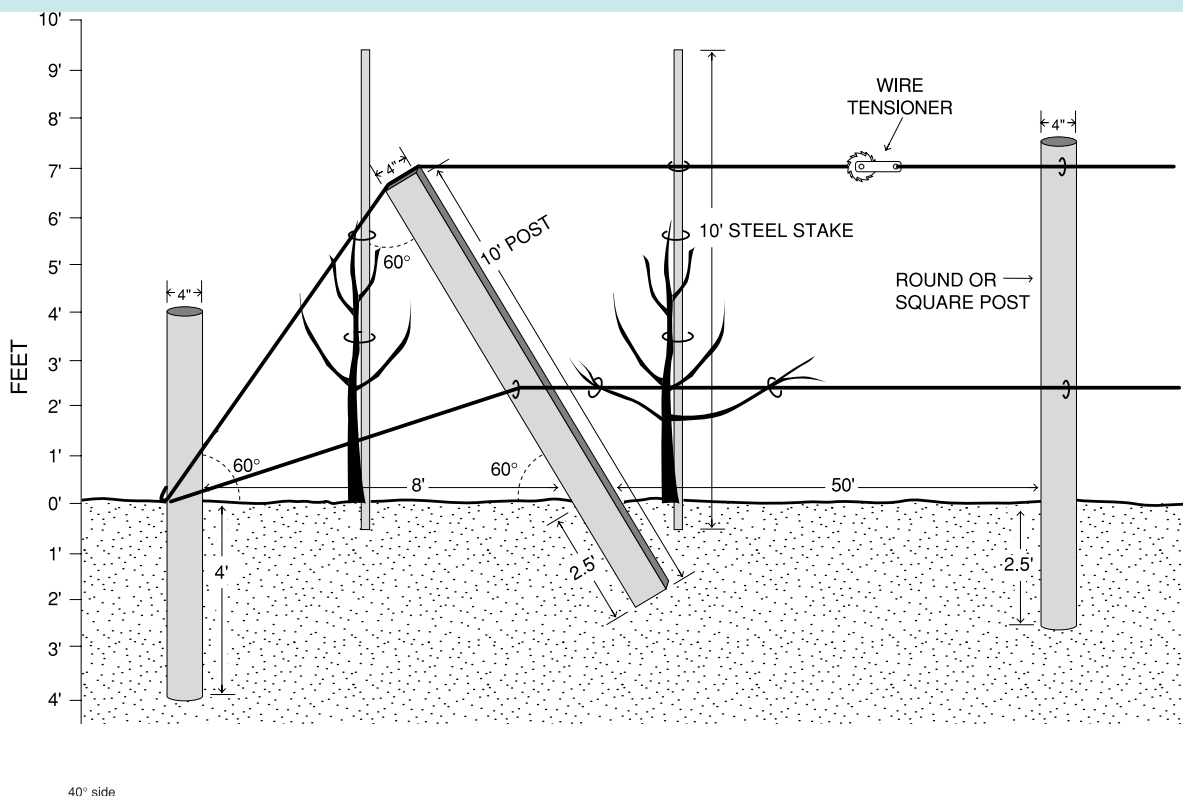


FIGURE 4

Tree support system for V-Slender Spindle using a variation of the single high wire and conduit tree support system.

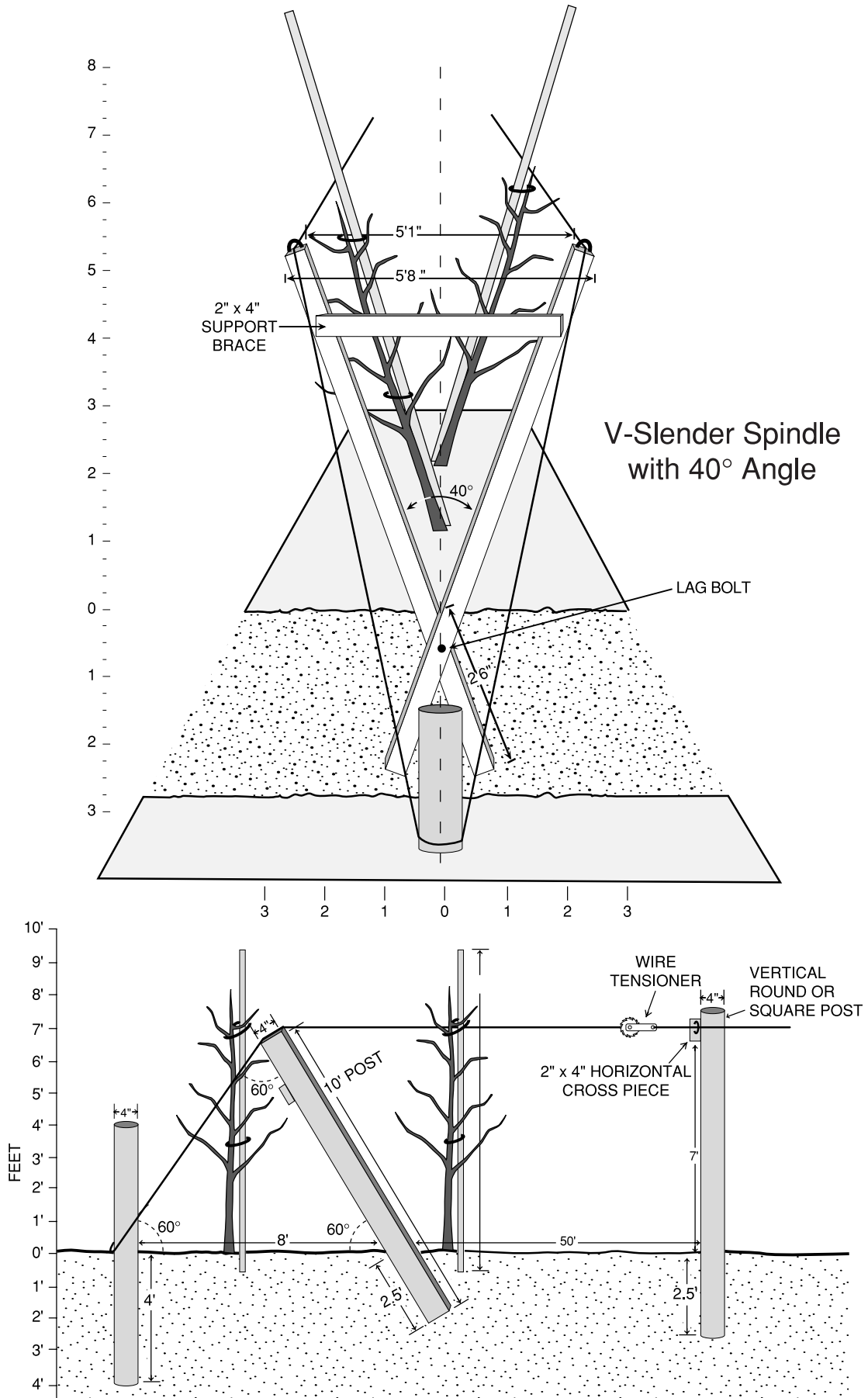
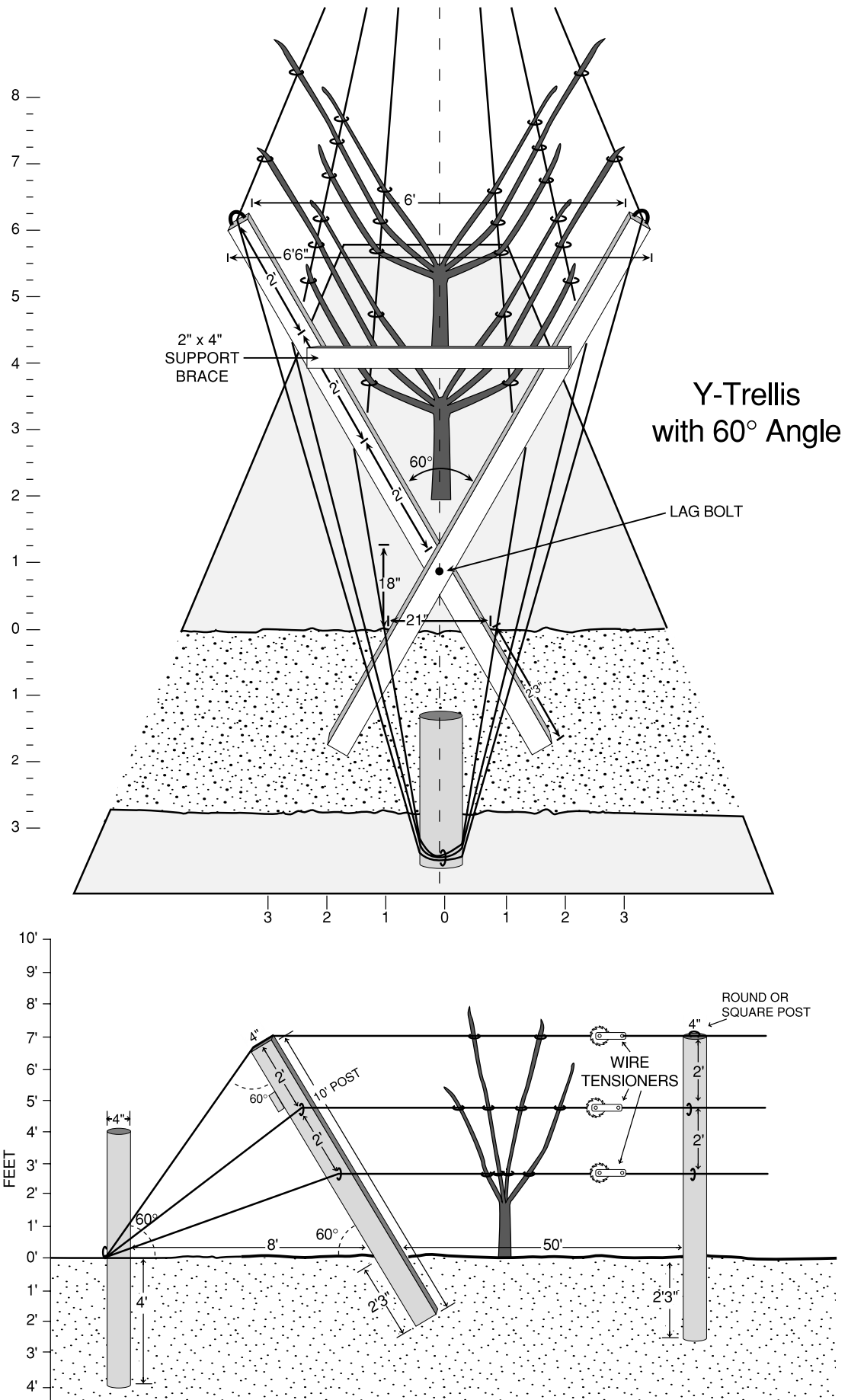


FIGURE 5

Tree support system for V-Slender Spindle using six wires and the equilateral triangle anchor system.



(deadmen), screw type anchors (Fig. 2) or driven posts (Fig. 1). We like driven posts, since in many soils the screw anchors do not hold. The driven anchor post should be vertical and should be 4 ft (1.2 m) in the ground. If this post is angled back, the wire tension will cause it to knife through the soil, resulting in a loss of wire tension and the failure of the system. The strongest position relative to the angle of pull by the wire coming down to the ground at 60° is for the post to be vertical. If anchor posts are installed by auguring a hole and then tamping in the post, their failure rate is very high. Anchor posts must be driven.

Variations of the single high wire system using the same equilateral triangle anchoring system have been successfully used with other trellis systems including V-systems. For V- or Y-systems, the first in-line pair of V-posts is also angled back toward the anchor post forming the equilateral triangle (Figs. 4 and 5).

### HIGH TENSILE STRENGTH WIRE

Our preferred wire is a galvanized high tensile 12.5 gauge wire. The type of galvanizing, or the weight of zinc coating deposited on the wire, can greatly affect its useful life. If the coating is too thin, corrosion will shorten the life for the wire. We recommend type III galvanizing, which has a life expectancy of up to 50 years. The wire must have enough tensile strength to withstand the initial tension of 150 ft lb and also the increased tension resulting from low-temperature contraction of the wire or from the fruit weight near harvest.

The wire should be attached to the posts with 1.75" (4.4 cm) long galvanized fence staples. Staples should not be driven all the way home into the wood to allow uniform tension when the wire is tightened (Fig. 3). To prevent staple pull-out, several stapling techniques have been developed for dips and rises in the land over which the trellis passes (Figs. 6-8). The wire should be stapled to the top of the last in-line pole (angled pole) using the method detailed in Fig. 6. With the wire on top of the pole, the wire tension will help hold the pole in the ground.

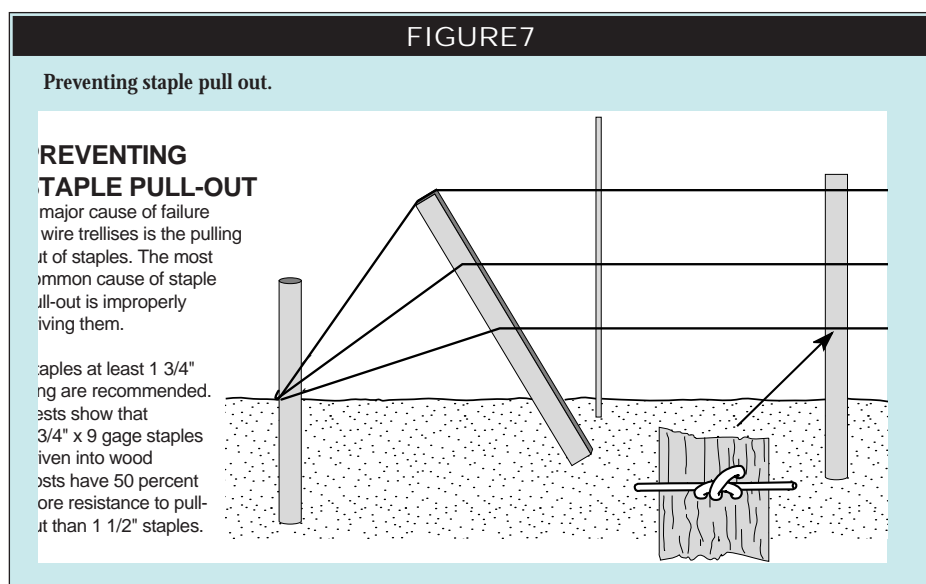
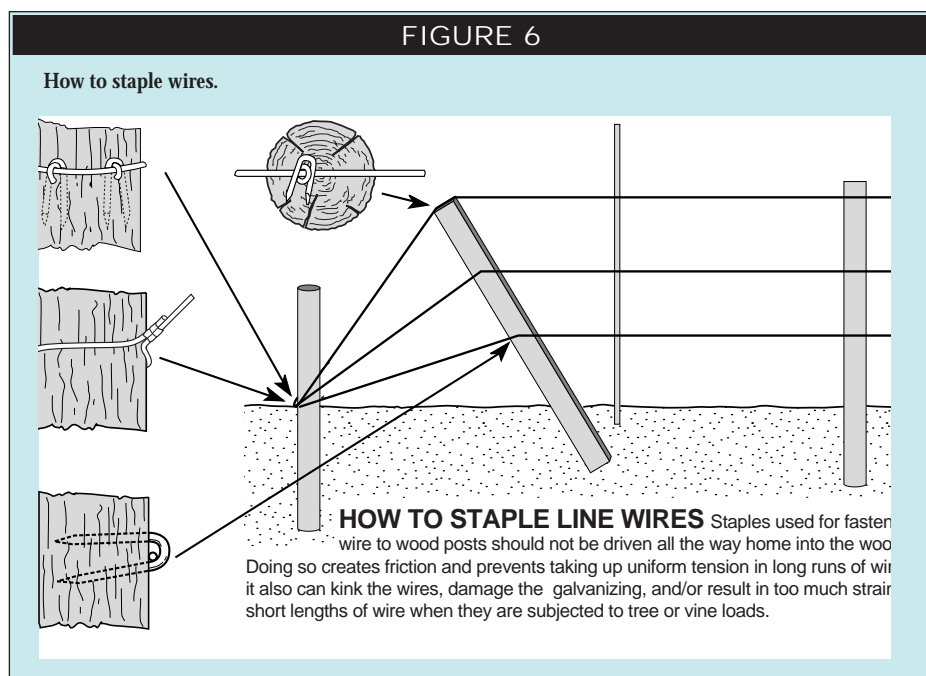
### WOOD POSTS

Our preferred size of post is a 4" (10 cm) diameter, 10 ft (3 m) long pole. It should have a blunt end and should be driven into the ground 2.5 ft (.75 m), thus leaving 7.5 ft (2.25 m) out of the ground.

Over the years we have tried smaller wood posts but after the results of the 1998 storms we recommend the 4" poles. The strongest poles are round and made from lodgepole and southern yellow pine. We have also used dimensional 4" x 4" wood poles, but these are not as strong as round poles. Red pine poles are also common but are less desirable since that species has tiers of branches that originate at one point on the tree, giving a series of knots at that level which is a weak point in the pole. The distance between in-line posts is an important factor in the structural strength of the system. Over the years we have used distances from 48 ft (15 m) up to 80 ft (24 m) between poles. The storms of 1998 made it clear that to withstand 100 mph winds the distance between poles should not exceed 50 ft (15.2 m) (Fig. 1).

### ATTACHMENT OF THE STEEL POLE TO THE WIRE

We learned from the East Coast hurricane of 15 years ago that if the conduit steel tubes were attached loosely to the wire then the poles would slide down the wire during high winds. This resulted in the tree breaking off and then the entire pole and tree being stacked down the row at the next wood support post. The pole must be attached rigidly to the wire so it cannot slide up or down the row. Our preferred method for attaching the poles to the wire is to use a 16 gauge galvanized "potato bag wire tie." The tie is looped around the pole, then around the wire and back around the pole and then tightened down with a twist of the wire ends (Fig. 9).



## SUMMARY

The investment in a good support system is essential for dwarf apple orchards. The support system will not only protect the tree during infrequent wind storms such as experienced in 1998 in New York and Michigan but will also allow the young tree to carry heavy crops. The value of dwarf, high density apple trees is directly related to their increased production during the early years and the ease of management and fruit quality as the trees age. The economic success of the dwarf orchard depends on the trees surviving for 15 to 20 years. A good support system that will last for 20 years and require little maintenance will help ensure fruit growers' success. The single wire and conduit stake tree support system, if installed properly, is a very strong but economical support system. It survived the Labor Day storm of 1998 better than other economical systems.

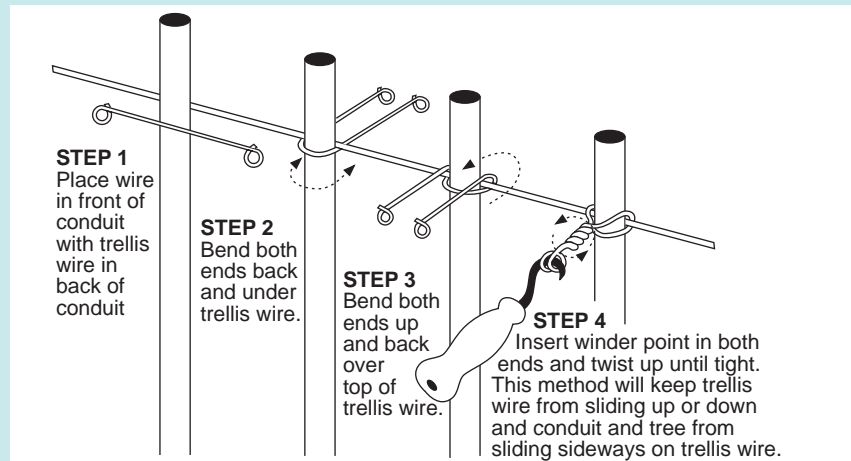
## ACKNOWLEDGEMENT

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pany, Marion, NY. He provided Figures 6-9. This work was funded in part by the New York Apple Research and Development Program.

### FIGURE 9

Method of attaching steel stakes to wire using wire ties.



### FIGURE 8

Double stapling line posts.

## DOUBLE STAPLING LINE POSTS

When stapling wire on line posts for heavy weight bearing loads, we recommend double stapling. We have found it reduces costly maintenance for years to come.

If your posts are driven properly, we highly recommend installing wire on top of the post for lower maintenance.

