

# Kiwifruit Production Guide

The kiwifruit is in the genus *Actinidia*, which contains over 50 species. There are only about three species, however, that are of popular interest for fruit production cultivation. The kiwifruit is a large, woody, deciduous vine native to China. Geographically, various species are distributed from Siberia to Southeast Asia through China and Japan. Seeds from China were taken to New Zealand and planted in 1906. Commercial planting began in California in the late 1960s.

The old name for this fruit was Chinese gooseberry. In order to promote its sale, it was renamed kiwifruit by a United States importer because of its brownish color and hairy appearance resembling the flightless kiwi bird from New Zealand. The shortened version of “kiwi” has also been used, but in 1974 the name kiwifruit became the internationally accepted name.

## Fuzzy Kiwifruit

The most commercially important species is *Actinidia deliciosa*, the fuzzy kiwifruit. Since kiwifruit is a dioecious plant (produces male and female flowers on separate vines), a male and a female vine are required for fruit production. Plants (varieties) of both sexes are essential for fruit production, and they must flower at the same time to ensure pollination. Male vines are usually spaced throughout the vineyard in a number of designs in which the male-female ratio varies from 1:6 to 1:10. In a commercial kiwifruit vineyard, one male vine is generally planted to serve as a pollenizer for eight female vines.

Kiwifruit are wind- and insect-pollinated. Commercial kiwifruit growers place three to five beehives per acre in their vineyards during flowering to ensure good fruit set. Female kiwifruit flowers are not attractive to bees due to their lack of nectaries. Fortunately, however, in their search for pollen from the male flowers, the bees inadvertently enter and pollinate the female flowers. The ultimate size of a fruit depends both on good growing conditions and on the number of seeds that have been fertilized.

The fuzzy kiwifruit is really a subtropical plant and will not tolerate temperatures much lower than 10 degrees F. The long growing season required for fruit to mature can also limit production. A frost-free period of at least 225 days is required for adequate ripening. Winter damage most commonly occurs on the trunks, so protective insulating wraps may be useful for cold protection. Additionally, in warm climates, this species requires around 600 hours of winter chilling (below 45 degrees F) for sufficient bud break and 850 to 1,100 hours of chilling for maximum flowering.

There are a number of commercially available female (fruit-producing) varieties, of which ‘Hayward’ has dominated the industry for many years. The most commonly named male varieties are ‘Matua’ and ‘Tomuri.’

Kiwifruit are very similar to grapevines in their general growth and fruiting habit as well as their training and trellising requirements. It takes anywhere from 2 to 8 years before kiwifruit vines will produce flower buds. Fruit of this species require about 25 weeks from flowering to ripen. Fruit typically range in size from 40 to 90 grams (1.5 to 3.2 ounces) and can be picked shortly after the first fall frost, kept in cool storage, and allowed to ripen naturally over time. Fuzzy kiwifruit will not ripen on the vine but will slowly ripen in a refrigerator in about 4 weeks. Fruit can be stored from 4 to 6 months at 32 degrees F if protected from dehydration at 90 to 95 percent relative humidity. Fruit will ripen at room temperature when removed from cold storage. Ripening can be hastened by ethylene treatment. This can be accomplished at home by placing kiwifruit in a plastic bag with an apple for at least 2 or 3 days. Check the fruit periodically, and begin using them as they ripen.

# Cold Hardy Kiwifruit

*Actinidia arguta* and *Actinidia kolomikta* are both under the broad category of cold hardy kiwifruit. *A. arguta* tolerates temperatures to 25 degrees F, and *A. kolomikta* to 40 degrees F. Both species perform well in partial shade and may actually prefer 20 to 50 percent shade. Yield per plant varies with species and variety. 'Hayward' (*A. deliciosa*) yields from 25 to 200 pounds per plant; *A. arguta* yields from 50 to 100 pounds per plant.

Cold hardy kiwifruit are also distinguished from the fuzzy type by their smooth skins and much smaller fruit. *A. arguta* fruit size is in the range of 5 to 18 grams (90 to 25 fruit per pound), and fruit of *A. kolomikta* are even smaller. Once again, there are a good number of varieties available. Probably the most popular is 'Ananasnaya,' which is commonly called 'Anna.' With *A. kolomikta*, there is less acceptance of a winner for most popular variety, but the name 'Arctic Beauty' appears quite frequently. As with the *A. deliciosa*, all of these need a male plant to provide pollen. The one exception is the self-fertile variety 'Issai,' which tends to have small fruit (approximately 5 grams) and relatively low vine vigor.

## Site Selection and Establishment

Kiwifruit vines will grow on a wide range of soils, from a sandy loam to a clay loam, as long as drainage is good. Although vines grow in soil with pH between 6.0 and 8.0, they do best in a deep, well-drained silt loam with a neutral pH (about 7.0). Plants will not tolerate heavy, poorly drained soils. When grown in sandy soils, they are susceptible to root-knot nematodes.

When selecting a site for planting kiwifruit vines, consider air drainage, wind, and water, minimum winter temperatures, and number of hours of chilling expected. As with other fruit crops, it is best to avoid low-lying frost pockets. Plants are particularly susceptible to winter injury during their first 3 years. Trunk wraps of foam pipe insulation or fiberglass attic insulation wrapped with plastic can be used to keep vines dry to prevent trunk injury.

High winds can break canes, particularly when they are tender and growing vigorously in the spring. Wind also causes scarring of fruit where they rub against the canes. In New Zealand, virtually all kiwifruit vineyards are planted with windbreaks. In windy regions, plant a windbreak, or plant on the side of a building or fence where the vines will be protected from wind.

Plant kiwifruit vines as you would fruit trees. However, since the kiwifruit's root system is smaller, decrease the planting hole depth to keep the soil line at the same level as it was in the nursery. Where possible, the home gardener would benefit from purchasing containerized plants.

Protect newly planted kiwifruit vines from desiccation by wind or very hot sun by providing shade. Kiwifruit vines should be considered tender and drought-sensitive until they are well established.

## Irrigation

Kiwifruit vines require a great deal of water. In hot summer weather, the vines' large leaves transpire water rapidly. In summer, newly planted vines in average soils should be watered deeply about once a week. Overhead sprinklers are often used in commercial kiwifruit vineyards for frost protection as well as irrigation (sprinkler heads should be about 3 feet above the training wire). Drip irrigation, however, makes more efficient use of water.

## Fertilization

Nitrogen is the nutrient most commonly deficient in soils. However, do not use any fertilizers at planting time. After vines have several inches of new growth, feed them with chemical fertilizers or well-decomposed manures. If chemical fertilizers are used, use 2 ounces of actual nitrogen per plant in January, April, and June of the second year (1 year after planting). In the third year, apply 4 to 8 ounces of actual nitrogen per plant during the same months. If manures are used, apply them once a year in early spring. Whether manures or chemical fertilizers are used, gradually increase the amounts applied each year until at maturity 1 to 1½ pounds of actual nitrogen per vine per year is applied (10 pounds of 15-0-0 fertilizer supplies 1½ pounds of actual nitrogen). To avoid vigorous late summer growth and to allow the plants to acclimate for maximum winter hardiness, do not fertilize young plants after July.

## Insects and Diseases

Compared to other fruit types, kiwifruit has few insect pests. European red mite can build up in late summer in hot, dry areas. Scale insects and leaf rollers can also be pests. Leaf diseases may affect plants some years, and fungicide sprays may be useful in eliminating them.

Kiwifruit vines are susceptible to oak root fungus, crown gall, and crown and root rots (*Phytophthora sp.*). Although crown and root rots can be discouraged by careful watering (by allowing no standing water in vineyards), the best way to deal with oak root fungus is to not plant kiwifruit vines in infested soil. Root-knot nematode is a serious pest of kiwifruit; therefore, fumigate infested soils before planting.

## Trellis Systems

Under cultivation, a kiwifruit vine is incapable of supporting the weight of itself and its fruit. It must, therefore, be supplied with some form of structural support. Either a T-bar or hitching post trellis is recommended because each supplies a large fruiting area, provides easy access to the fruit, and requires a minimum investment in materials.

The T-bar usually consists of an 8- to 10-foot wooden post (4- by 4-inch minimum thickness and pressure-treated with preservatives), firmly set (at least 2½ feet deep) in the ground or concrete, with a 6-foot-long, 2- by 4-inch cross bar about 6 feet from the ground. A third wooden piece is often added as a brace between T-bars, which are spaced 15 feet apart. Pulled, 8- to 10-gauge galvanized wires are strung between T-bars and are pulled taut. Attach the wires to a very sturdy end post or anchor them firmly to the ground or a building. Place T-bars no closer than 2 feet from the vines. The center wire will support the main cordons, and the outer wires will support the fruiting laterals as described below. The following illustrations show a kiwifruit vine being trained to a T-bar trellis.

A hitching post is basically the same as a T-bar except that a greater structural support is provided by a post at either end of the cross bar instead of a single post in the middle. A T-bar or hitching post system can be converted to a pergola system, in which the vines are trained to a solid, overhead layer covering the entire vineyard (see Figure 5). To make this conversion, string additional wires, spaced about 30 inches apart, perpendicular to the wires of the existing T-bar or hitching post system.

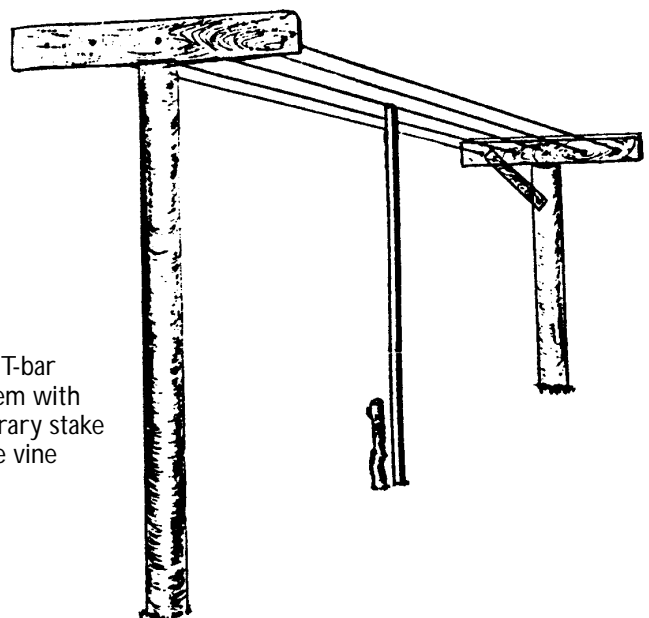
## Training

The first step in establishing any kiwifruit vine pruning system is to develop a framework of permanent cordons. The number and location of these cordons will vary with the training and pruning system to be used. Training kiwifruit vines to a T-bar or hitching post and pruning them using the fruiting lateral method are recommended. Cordon training on a T-bar trellis is illustrated in Figures 1 through 4.

Once permanent cordons are established, allow temporary fruiting laterals to develop every 24 to 30 inches along these cordons. This training system can be maintained and productive for 60 years or more if the vines are pruned to provide a constant turnover of fruiting laterals. The fruiting lateral system of pruning is illustrated in Figures 6 through 8.

Male kiwifruit vines can be trained and pruned in the same manner as female vines; however, since they produce no fruit, male vines are often pruned more severely than female vines are so that they will occupy less space. Male vines also receive their major pruning after bloom rather than in the dormant season. This delayed pruning allows male vines to retain maximum flowering wood for spring pollination. During the dormant season, prune only dead or declining wood from the male vines. Shortly after bloom, head back the cordons to about 4 to 6 feet on either side of the main trunk, and thin out one-third to one-half of the flowering laterals. This will promote growth of abundant new laterals for next year's bloom.

At planting time, place a temporary stake that is as high as the wire next to the vine (Figure 1). As the vine grows, tie it loosely to the stake, and check it often during the first year to see that it doesn't wind around the stake.



**Figure 1.** T-bar trellis system with the temporary stake next to the vine

During the first growing season, allow a single trunk to grow straight up (Figure 2). After the trunk is a few inches above the wire to which cordons will be trained, cut it to 3 to 6 inches below the wire. Cutting below the wire allows cordons to grow from the cut to the wire at a 45-degree angle. The resulting Y-shaped crotch is structurally stronger than the 90-degree angles that would result from cutting the trunk level with the wire. Now, and during all subsequent growing seasons, remove all side growth below the cordons in order to direct the vine's energy into the trunk and cordons. While the vine is young, particularly in very hot regions, some of this side growth can be only nipped back and left to provide shade and nourishment for the vine during the growing season. These shoots should be removed, however, by the following dormant pruning.

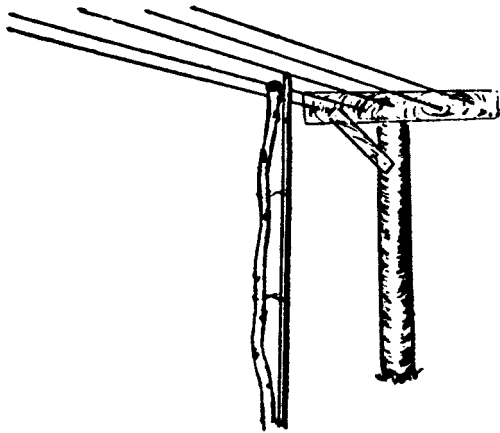


Figure 2. Single trunk in first growing season

After the kiwifruit vine is pinched, allow two cordons to grow to and along the training wire for the remainder of the first growing season. Drape each cordon over the wire once (only once to avoid girdling the cordon) for support (Figure 3).

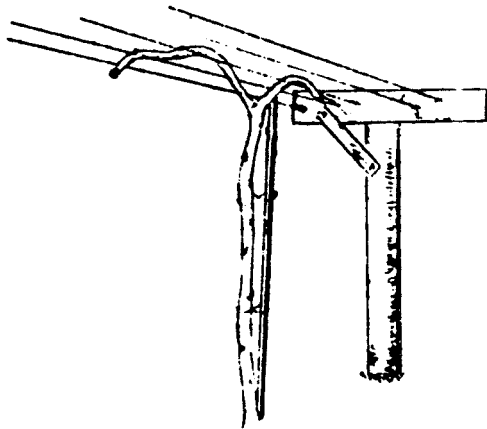


Figure 3. Cordons draped over the training wire

During the first dormant season, head the cordons back to about 3 feet from the trunk. (Cut the cordons to an upward-facing bud for vigorous cordon extension growth during the next growing season.) Heading the cordons, like pinching a houseplant to make it bushy, will force laterals to grow during the upcoming growing season.

If the main trunk doesn't grow to the wire in the first growing season, it is recommended to cut the trunk back to 4 to 8 buds from the ground during the first dormant season. Although this will set training back a season, the more vigorous growth from such a shortened vine will ultimately form a stronger cordon system.

During the second growing season, temporary lateral branches, which will bear fruit for 2 to 3 years, will grow vigorously from the cordons. These laterals should be spaced every 24 to 30 inches along the cordons and draped over the outer wires (Figure 4). If they grow very vigorously during spring, these laterals may be lightly headed back during the summer. Remove any growth, other than fruiting laterals, that sprouts on the cordons, particularly strong upright canes that will compete with the fruiting laterals. However, to extend the cordons, allow one cane at the end of each cordon to grow along the middle wire. During the second winter pruning, head the cordons, leaving about 2½ feet of the growth they made in the preceding growing season (to a total length of about 5 feet from the trunk). Wrap the cordons over the center wire again. (These two wraps around the middle wire should be sufficient to support the cordons permanently.) Ultimately, the cordons will extend to about 8 feet from the trunk (which is one-half of the distance between vines in a typical planting). After this length is reached, usually by the third dormant season, training is complete and plant energy is then directed into fruit production, renewal of the fruiting laterals, and thickening of the trunk and cordons.

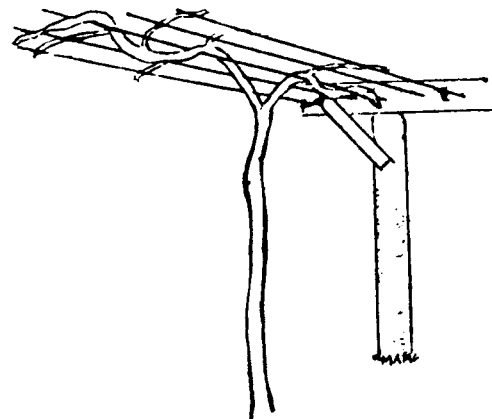


Figure 4. Lateral branches draped over the outer wires

After permanent cordons are trained as shown in Figures 1 through 4, kiwifruit vines can be further trained to a pergola system (Figure 5). Permanent cordons can be trained in a single direction to cover a patio or in other configurations to suit different structures. However, for best fruit production and quality in any pergola system, maintain a single layer of fruit-bearing wood and limit the area to be covered by a single vine to approximately 250 square feet (about 16 by 16 feet).

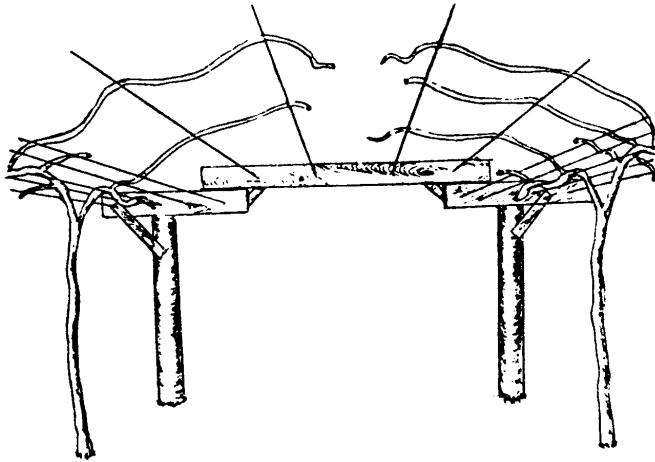


Figure 5. Pergola system

To start a pergola system, select strong fruiting laterals during winter pruning, and train them over the pergola. These will become permanent secondary cordons and should be spaced about 3 feet apart. Depending on the pruning system you use, either fruiting laterals or spurs will be allowed to develop along the secondary cordons. Fruiting laterals in the pergola system are pruned as shown in Figures 6 through 8. Due to the greater number of cordons in the pergola system, fewer fruiting laterals should be left than in a trellis system, and they should be pruned more heavily in summer.

## Pruning

Once permanent cordons are established, a kiwifruit vine must be pruned throughout its lifetime in order to maintain its form, contain its size, and, most importantly, maximize its fruit production. Before any fruit-pruning system can be mastered, the fruiting habit of the plant must be understood. Kiwifruit vines produce all their fruit on the current season's growth that arises from 1-year-old wood. (The large, bulbous fruit buds can be easily distinguished from the flat, inconspicuous vegetative buds). With this fruiting habit in mind, the goal of both the fruiting lateral and the spur pruning systems is to maximize such new and fruitful wood.

The fruiting lateral method of pruning shown in Figures 6 through 8 is the method recommended. Not only is it easier to master than spur pruning, but, for a vigorous vine like 'Hayward' (which doesn't produce spurs until the vine is very large), it is the only method that will result in reliable fruit production from trellis-trained vines.

To the untrained eye, a mature kiwifruit vine may appear hopelessly tangled and overgrown. Take hope—it isn't. First, remove all "winders" (canes that have wound around the trellis and other canes), crossed branches, and other branches such as suckers that obviously should be removed. With the structure of the vine now easier to discern, remove 3-year-old fruiting laterals of spurs. In a well-trained vine, one-third of the fruiting laterals or spurs should be removed at every dormant pruning. Try to distribute the remaining laterals or spurs evenly along the cordons, maintaining a single layer of fruit-bearing vines. Prune kiwifruit vines in later winter or early spring; they may bleed if pruning is delayed until the early growing season.

With the fruiting lateral pruning system, there is a constant turnover of fruiting laterals. Each fruiting lateral is left to fruit for two seasons (or three if it is still very vigorous after it has fruited twice), and then it is removed.

During the first summer of a fruiting lateral's growth, it will grow to about 4 to 6 feet from the cordon. Drape the lateral over the outer wire of the trellis support as it grows (Figure 6). A very vigorous lateral can be headed back to about 4 feet in midsummer. Because the ends of these laterals usually wind around other laterals and wires, this heading back simplifies dormant-season pruning. During the lateral's first dormant season, cut it to 8 to 10 buds (to just beyond the outer wire).

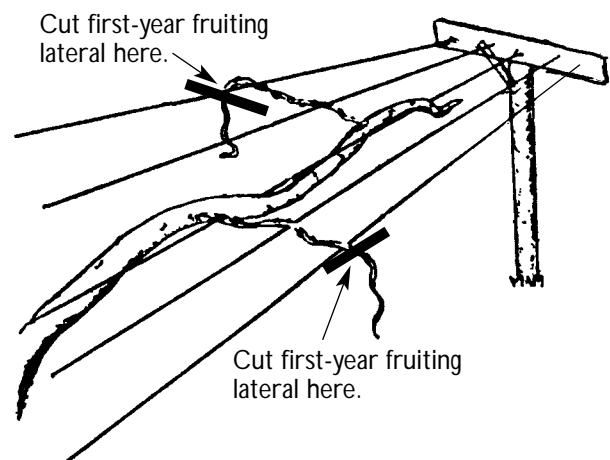
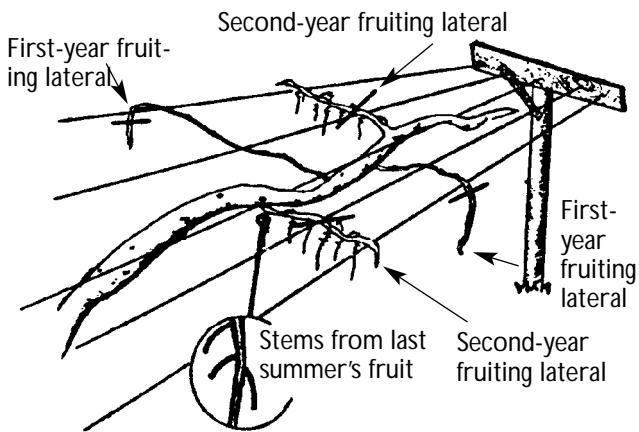


Figure 6. Cut first-year fruiting laterals to just beyond the outer wire during the first dormant season.

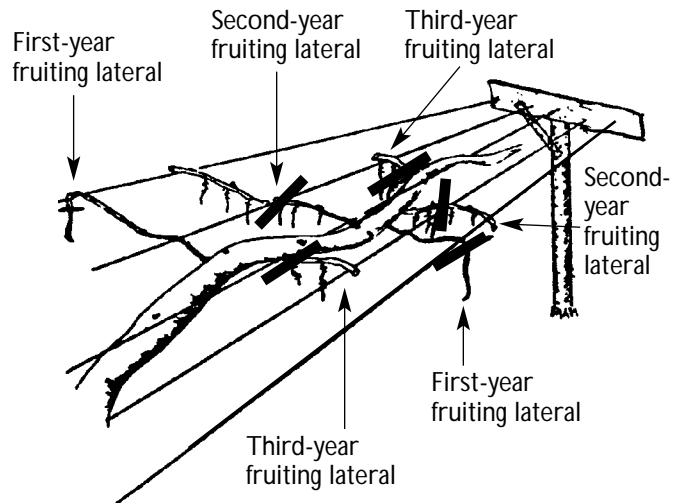
During the second summer, canes growing from the fruiting laterals will produce fruit at their bases. During the growing season, in May or June, cut the ends of these canes back to 6 to 10 buds beyond the last flower (18 to 24 inches from the fruiting lateral) (Figure 7). This diverts energy into the fruit, prevents excessive shading of the fruit and vine, and simplifies the next dormant pruning. Very vigorous canes may need a second heading back later in the growing season. Remove most new laterals as they arise from the cordons, especially those laterals with strong, upright growth. Leave a sufficient number of laterals, however, to replace old fruiting canes that will be removed as their production declines. These replacement laterals should be selected early in the growing season, at least by Memorial Day. Laterals that develop later in the season will not be sufficiently mature to produce fruit during the next growing season. During the second winter, cut back the main stalk of the fruiting lateral, leaving only two to three of the canes that fruited in the preceding season. These canes will grow new fruiting wood in the next growing season.



**Figure 7.** Cut first- and second-year laterals to just beyond the last flower during the growing season.

In the third growing season, the two to three canes left on each lateral that bore fruit last year will bear fruit again on the new growth (Figure 8). Again, these canes should be headed back in summer as shown in Figure 7.

The fruiting lateral, having produced fruit for two growing seasons, should be completely removed during the third dormant season. If it is still very vigorous after it has fruiting twice, however, the fruiting lateral may be left to fruit a third time before it is removed.



**Figure 8.** Head back the canes left on each lateral in the third growing season.

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# Kiwifruit Nurseries

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