Fruiting Espaliers: A Fusion of Art and Science

Lee Reich

An espalier is a plant, usually a fruit plant, trained to an orderly two-dimensional form. The word may derive from the Old French *aspau*, meaning a prop, and in fact, most espaliers must be propped up with stakes or wires. (Another possible origin of the word is the Italian *spalliera*, referring to a support for a shoulder or back.) Espalier had its formal beginnings in Europe in the sixteenth century, when fruit trees were trained on walls to take advantage of their extra warmth. Strictly speaking, an espalier grown on a trellis in open ground—that is, away from any wall—is termed a *contre-espalier* or an *espalier-aere*. But no need to be a stickler for words, the definition of espalier is as lax as the plant is formal. The British reserve the term for a specific two-dimensional form; and some fanciful, yet well-ordered shapes that are called "espalier" by some gardeners are, in fact, three-dimensional.

One structure (a contre-espalier) serves to support two apple trees in horizontal palmette form growing back to back at Colonial Williamsburg, Virginia.

Why go to all the trouble of erecting a trellis and then frequently having to pinch and snip a plant to keep it in shape? Because a well-grown espalier represents a happy commingling of art and science, resulting in a plant that pleases not only the eye, but also the palate. This science is applied artfully (or the art scientifically) by pulling exuberant stems downward to slow their growth and increase their fruitfulness; by cutting notches just above buds to awaken them where a stem threatens to remain bare, and by pruning back stems in summer to keep growth neat and fruitful. Every stem on a well-grown espalier is furnished throughout its length with fruits, and these fruits, bathed in abundant sunlight and air, are luscious, large, and fully colored.

The physiological bases of plant responses to the branch bending and pruning needed to maintain an espalier are known to some extent. Pruning response depends on time of year, growth stage of stem, degree of cutting, species, and, in some cases, even cultivar. Perhaps the most significant (or best understood) responses involve the hormones auxin and ethylene. Auxin is produced at the tips and most elevated portions of stems; among the effects of this hormone is that of suppressing bud growth farther down a stem so that growth of the apical bud or buds dominates. Ethylene is a hormone produced in response to wounding or branch bending, and one of its effects is fruit bud formation, which helps explain how branch bending promotes fruiting. Other hormones are also involved

As pear spurs age, they must be thinned to stimulate and make room for younger spurs. The spurs on this branch are well spaced and still vigorous. They will not need thinning for a few years.

in shoot growth and fruit bud formation; the effects of all of them vary with concentrations and ratios.

Despite the constant attention espaliers demand, caring for them is not burdensome. Repeated pruning keeps trees small enough to be conveniently clipped, thinned, and harvested from the ground. And while pruning must be frequent, the cuts are small and quickly executed, in many cases requiring nothing more than a thumbnail.

Note that espalier is not restricted to plants bearing edible fruits. A strictly ornamental espalier is in keeping with a formal setting. (But so is an edible-fruited espalier.) Maintenance of a purely ornamental espalier, especially when the plant does not bear even ornamental fruit, entails nothing more than repeated clipping of wayward stems.

When fruit, especially edible fruit, is a goal, however, you must carefully consider the response of the plant before you cut back shoots. Are there enough leaves to adequately nourish each fruit? (Each apple fruit, for example, needs about 40 leaves for best quality.) Will a new shoot grow to defiantly replace the one you just cut off? Will your pruning restrict growth and keep stems furnished with fruit buds along their entire length?

Forms for an Espalier

An espalier consists of main stems, called leaders, from which grow branches which, in some cases, become arms or ribs. Arms and ribs are permanent; all other branches are temporary and the trick is to minimize branch growth while maximizing fruiting.

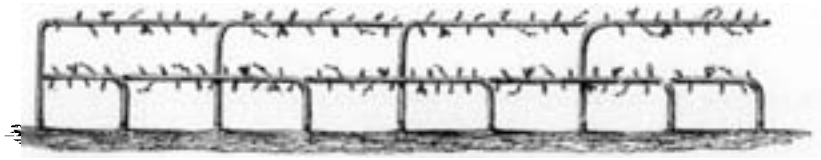
The simplest form for an espalier is a single stem, a cordon (which some people choose to call an "espalier"). Vertical cordons can be set a mere eighteen inches apart in a row, so are useful, for example, for growing many varieties of apple in a small space. Or, a cordon can be trained horizontally to border a path or create a living edge to a garden.

The cordon is best suited to plants that bear fruit on spurs—stubby, long-lived stems that elongate only a fraction of an inch per year—thus avoiding a cordon that looks more like a porcupine than a cordon. Among common fruits, apples and pears and, to a lesser extent, plums make good cordons. To counteract the tendency towards topheavy growth (due to apical dominance of a vertical stem), single cordons are commonly planted and grown at an angle. This practice encourages uniform budbreak and growth up and down the length of the cordon.

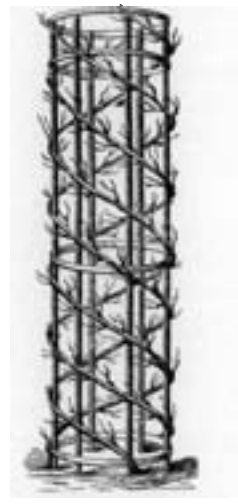
Now suppose you were to terminate that single stem of a vertical cordon near ground level and split it into two leaders that turn away from each other before growing vertically again. You now have a "U palmette." Split those two vertical leaders again and you have a "double-U palmette," increasing the spread and yield from a single plant—and also changing the design, of course.

There exist many variations on this theme. The central stem could have two side branches grow into a wide U, then continue upwards with another two side branches growing into a less wide U, and so on with increasing height. Or, the central stem could grow to the full height, along the way sending out tiers of horizontal leaders growing off to left and right. (This latter form is what the British choose to call an "espalier"; others call it a "horizontal palmette" or, if the side arms angle upwards, an "oblique

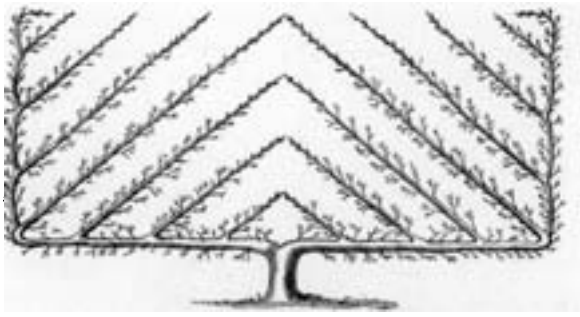
The horizontal palmette, opposite, is from J & A Hardy, Traité de la taille des arbres fruitiers (Treatise on Pruning Fruit Trees), *1900. All other drawings on pages 19 and 20 are from Dr. Ed Lucas,* Die Lehre vom Baumschnitt für die deutschen Gartenbearbeitet (Dwarf Fruit Trees), *1899. Library of the Arnold Arboretum.*



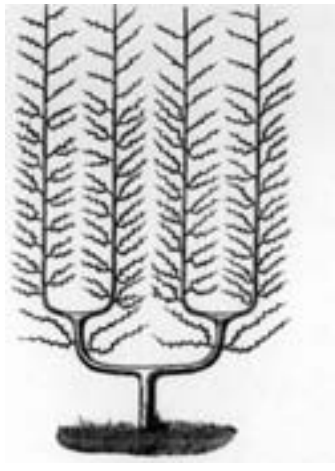
Horizontal cordons



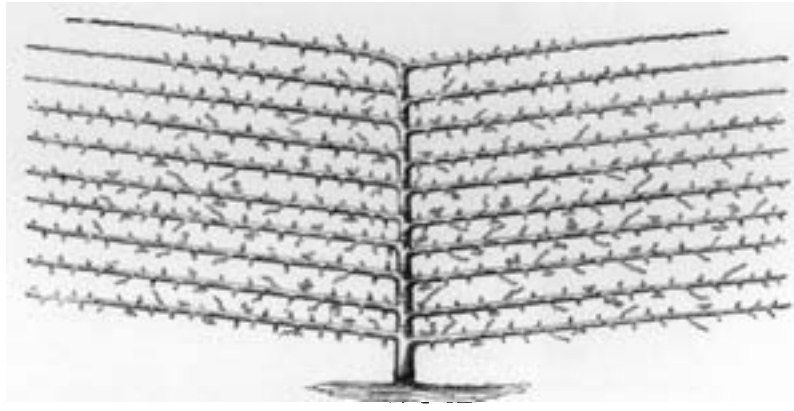
Three spiraling cordons



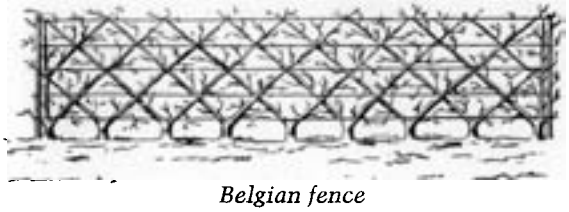
Candelabra palmette with oblique arms.



Double U palmette, a form of candelabra palmette



Horizontal palmette



Belgian fence

Fan palmette

palmette.") In yet another variation, the central stem could split into a broad U with horizontal tiers of leaders growing outwardly from each upright of the U.

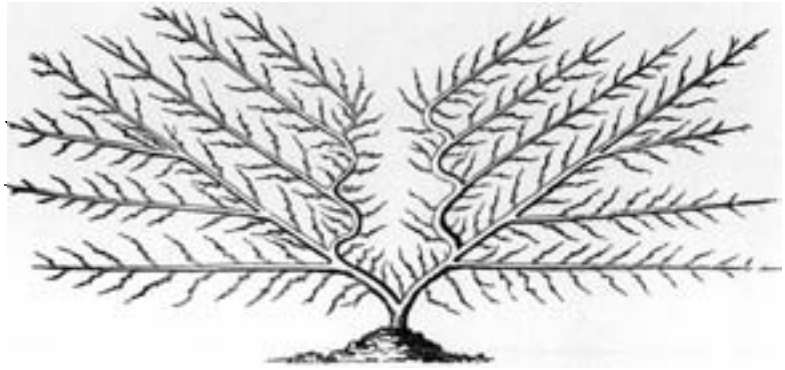
All these forms are prey to the problem of excess growth near the tops of the plant. Auxin produced at the tips of those upright leaders inclines them to grow vigorously, mostly from their tips, and prevents fruit buds from forming farther down. Although the hormone auxin was not isolated until the twentieth century, its effects had long been observed. To quote M. Gressent (*Arboriculture Fruitière,* 1869), a vertical growth "throws trouble into the whole economy of the tree and paralyzes its production and compromises the very existence of the horizontal branches."

To counteract the hazards of apical dominance, other shapes have been devised. One popular form is the "fan," in which the central stem terminates low in the plant, dividing into two leaders that angle upwards and outwards. Off each of these leaders, above and below, grow permanent ribs, with fruiting spurs or temporary fruiting branches growing from them. The number of ribs, and just how vertically they are allowed to grow, depends on the inherent vigor of the plant. Building up the lower and outside parts of the fan first keeps the potentially most vigorous part—the highest and most central—from overtaking the rest. In other designs, the central leader is purposely weakened by being bent around in a decorative curve, rather than allowed to grow straight upward.

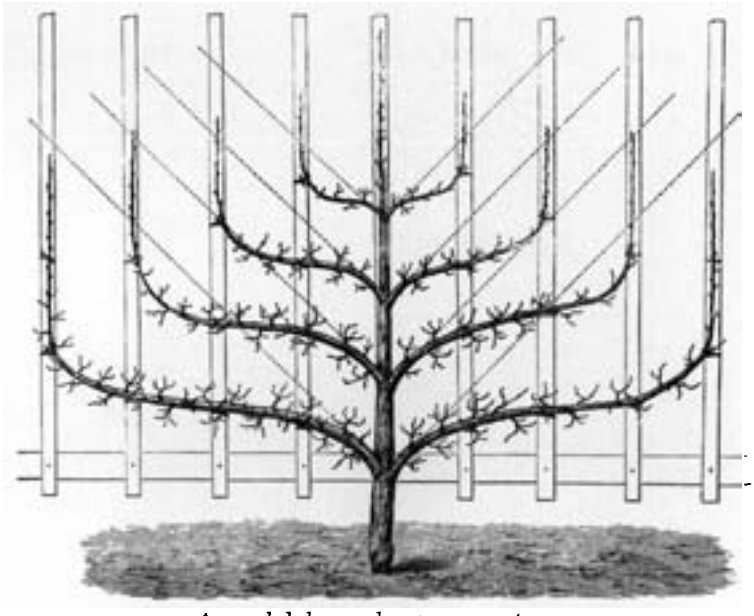
Mention should also be made of espaliers that create an effect *en masse* from plants lined up and overlapping in a row. Among the most popular of such designs is the Belgian fence, a living latticework of branches. In some designs, adjacent branches actually graft together so that the espalier eventually becomes self-supporting.

Training

Training an espalier is just like training any other plant. "Heading" cuts—that is, shortening of stems—release buds lower down the stem from the inhibiting effects of auxins produced at the stem tips, thus causing growth from the lower buds. "Thinning" cuts—totally removing stems at their origins—get rid of unwanted growths (which include stems growing perpendicular to the plane of the espalier) without inducing new growth at that point.



The two central leaders of this double palmette have been trained to curve, an effective method of thwarting apical dominance.



A candelabra palmette in training.

Differences between training a conventional fruit plant and an espalier lie in the goals: With an espalier, the ideal is to develop branches with near perfect symmetry and active, fruitful buds throughout their length. No matter what the design, sufficient space (about twelve inches) must be allowed between leaders. Wherever one leader is to divide into a Y or a U, the ideal is to have the resulting two leaders growing as nearly as possible directly opposite each other. Suitably positioned shoots might already exist; if not, they can be induced with heading cuts just above the desired point of bifurcation. Of course, in plants with alternate leaves (which originate some distance apart along the stem), heading back a dormant shoot never results in leaders exactly opposite each other.

For the connoisseur who demands nearly perfect symmetry even in alternate-leaved plants, there are ways to position those leaders more directly across from each other. One way is to graft a shoot opposite an existing shoot, or a bud opposite an existing bud, where arms are wanted. Another way is to cut the stem back to desired points while the plant is dormant. Typically, a vigorous, vertical shoot grows from the top of that cut stem out of a whorl of tightly packed buds. If, when that vertical shoot is about a foot long, it is cut back to the whorl (leaving about a quarter of an inch of new growth), two new shoots should originate from buds within that whorl—at almost exactly the same level. Aesthetics aside, leaders that originate at the same level are more likely to keep in step as they grow.

As a young espalier develops, its leader or leaders are shortened each year, typically while the plant is dormant. Reducing a leader's length by about a quarter of the previous year's growth—even more on weak shoots, to channel energy into fewer buds—keeps buds along the stem active. Upon reaching full length, the leaders are annually cut back to within an inch or so of the previous season's growth.

The thumbnail is a useful tool for pinching tips of growing shoots during training; it can hold back a shoot trying to outgrow others. Pinching back the tips of developing leaders every foot or so also keeps buds lower on the shoot active, avoiding "blind" wood and reducing or even eliminating the need for dormant heading of the leader(s).

Typically, leading shoots are tied to bamboo canes that, in turn, are tied to the wooden or wire framework that supports the plant. By tying a leader to the cane rather than directly to the framework, the shoot can be kept ramrod straight even as the angle of the supporting cane is adjusted to make best use of that old bugbear, apical dominance. For example, if an espalier is to have two horizontal arms, these arms could initially be held at an upward angle to keep growth moving along—the more upward pointing, the faster the growth. As the arms approach full length, they could gradually be lowered to slow growth and increase the development of side branches and fruit buds. All that needs to be done is to untie the cane from the framework and, with the branch still firmly lashed to it, retie it at the desired angle.

Another way is to simply lash all but the ends of the developing shoots to horizontal supports. The free ends of the shoots then do what they are naturally inclined to do, turn upwards, and

Oblique cordons slow growth and promote fruiting.

that upward orientation keeps the growing tips vigorous. As the shoot elongates, older portions are tied to the horizontal support.

Maintaining an Espalier

Even before an espalier is fully trained, the older parts of the plant require strict pruning to control branch growth in order to maintain a neat shape—all the while avoiding sacrifice of fruit yield or quality. How pruning can help depends on the plant's fruiting habit. For example, peach and Oriental plum fruit freely on one-year-old wood. Apple and pear, on the other hand, generally fruit on spurs. (A popular misconception is that shortening any apple or pear stem to spur length converts it to a fruiting spur. Not so. A spur is a physiologically unique entity.) No matter what the plant, any shoots growing perpendicular to the plane of an espalier are kept in check by thinning or pinching. Overcrowded branches also must be thinned. Stems of the perfect espalier are solidly clothed with fruit, and if this goal is realized, developing fruits will need to be thinned. And with plants that fruit on long-lived spurs, old or overcrowded spurs eventually need pruning.

The specifics of maintaining an espalier vary with kind of fruit plant, the cultivar, possibly even geographical region. Success might also depend on the predictability of the climate and its vagaries; in my opinion it is those vagaries that are responsible for espaliers that become nothing more than fruitless and flowerless stems bent in fanciful shapes. Consistent response with apple and pear, for example, demands more consistent weather patterns than is experienced over much of the United States.

Pruning the Lorette way: a half-woody shoot is cut back to the whorl of leaves at its base.

The Apple Espalier

Variable response to espalier pruning is well illustrated by the apple, a tree extensively espaliered in Europe. Spur fruiting enables apple trees to assume many different shapes. No doubt that accounts for the many different systems devised for apple espaliers.

One of the most elegant of them was devised at the end of the nineteenth century by Louis Lorette, curator and professor of the Practical School of Agriculture at Wagonville, France, north of Paris, near the Belgian border. In the Lorette system, which can produce spectacularly beautiful and fecund results, trees are pruned only during the growing season. When branches are about two inches long (late April in Wagonville), the extension growth of leaders is shortened according to their vigor—the less vigorous are shortened more to strengthen growth in the bud just behind the cut—and according to whether further extension is desired.

Pruning of branches themselves begins as soon as any are pencil-thick, about a foot long, and becoming woody at their bases (in Wagonville, the middle of June). Such branches are cut back to the whorl of leaves at their bases, leaving stubs about a quarter of an inch long. Branches that have not yet reached the proper growth maturity are left untouched.

Properly mature branches are cut back at monthly intervals throughout the summer. Regrowth that follows pruning is also cut back, but only if it is at the stage of maturity described for the first cut. At the last pruning, in late summer, any immature branches are cut back to three buds. This description covers no more than the bare bones of Lorette pruning; for more detail, see *The Lorette System of Pruning*, 1946.

Research has shown that Lorette pruning does, in fact, increase ethylene production in stubs that remain and that could lead to flower bud formation. It has also been suggested that repeated cutting removes young leaves and so decreases formation of another hormone, gibberellic acid, which can inhibit flower bud formation. Where the Lorette system works, buds

at the bases of pruned side shoots eventually become fruit buds hugging the leaders. But here's the rub: Lorette pruning is not effective everywhere. It seems to work where the climate is equable year-round with a long period of warmish weather in autumn. This describes the maritime climate of northern France, but not very much of North America. My experiences with Lorette pruning in the continental climate of the northern United States concur with those of many others who have tried it. Variable summer rainfall, hot summers, and cold winters result too often either in rampant regrowth that is susceptible to winter injury—or in nothing more than dead stubs.

Across the English Channel, the British devised their own system of pruning apple espaliers: the "three-bud" system. The essence of this system is the cutting back of young branches, in winter, to three buds. Older branches are trimmed to a single stem and/or shortened to three buds beyond any fruit buds. Pruning continues throughout the growing season: tips of side shoots are pinched when they have grown three leaves beyond the whorl of leaves at the base of the shoot. Shoots may also develop from older, fruiting branches and the time to pinch these depends on the vigor and activity of the lower buds. Pinched too early, the lower buds are jarred awake and grow out into shoots. But pinched at just the right time, they plump up into fat fruit buds. Close observation and the ability to predict the weather improve results.

Soon after becoming familiar with the elegance of the Lorette system, the British modified it to their conditions and inclinations. "Modified Lorette" pruning requires that trees be pruned only twice a year. The timing of the first branch cut corresponds with M. Lorette's, except that half-woody shoots are shortened to the second leaf (not counting the basal cluster of leaves), perhaps to the third leaf if growth is very strong.

In winter, regrowth from summer cuts is shortened. If one stem grew from a two-bud stub, it is shortened to two buds. If new stems grew from both those buds, the farthest one is shortened to one bud, and the lower one to two buds. Notice, either way, that the branch

This pear tree pruned according to the Lorette system approaches perfection: it is spectacularly beautiful and fully clothed with fruit.

A full-grown, vase-trained "Lorette" apple tree.

Redcurrant espaliers require only twice yearly maintenance.

is left with a total of the signature three buds. The following summer, half-woody shoots are pruned to leave a total of three buds on any of these branches.

Other pruning methods also have been devised for the apple. Pinching the tips of branches when they are half woody and about a foot long, then shortening them to an inch two weeks later, has quelled growth and set up fruit buds in New Zealand. In northeastern United States, a similar result has been achieved by shortening any branches longer than a foot back to a quarter of an inch in the middle of August. This latter pruning is supplemented by winter pruning that cuts back regrowth and all vertical sprouts. Of course, an espalier that spends the bulk of the summer spiked with relatively long branches growing from the leaders is not particularly neat.

In Australia, a technique called "twice-heading" is used to make fruiting spurs from vigorous branches. A branch is shortened early in the season and then, when the resulting regrowth of two or three shoots is three or four inches long, a second cut is made just below this regrowth.

The Redcurrant Espalier

Redcurrant represents the other extreme in espalier. It is very easy and responds predictably and well over a wide range of locations and climates. A redcurrant can be trained as a fan, cordon, or U-palmette.*

It requires twice yearly maintenance pruning. For the mature plant, summer pruning entails nothing more than cutting back all shoots growing off leaders to five inches in early July, when the fruits are beginning to color. Each winter, those branches are again shortened, this time to an inch or two in length. This program works as well on this side of the Atlantic as on the other side.

Redcurrant bears fruit laterally on one-year-old stems and on spurs on older wood, so it is easy to see why this program can keep a redcurrant espalier neat and fruitful at the same time. On the other hand, why don't the shortened shoots resprout after summer pruning? What would be the effect of earlier pruning, which would keep the plant even neater between spring and early summer? Those are the questions are that make experimenting with any espalier interesting, even as the plant provides gustatory and aesthetic pleasure.

Further Reading

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Lee Reich, PhD, is the author of *Uncommon Fruits Worthy of Attention* (Addison-Wesley, 1991), *A Northeast Gardener's Year* (Addison-Wesley, 1992), and *Growing Fruit in Your Backyard* (MacMillan, 1996) Much of the information in this article was derived from his latest book, *The Pruning Book* (Taunton Press, 1997).

* But bear in mind that because the black currant is an alternate host to white pine blister, all currants are prohibited in many towns and counties in the Northeast.