

Grapevine Propagation with an Emphasis on Grafting

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You have probably heard people say that you can just stick a piece of grapevine in the ground and it will root and start growing. Well, after many years of grafting grapevines I tried it and it worked. I never doubted it. The fact is that plants in the genus *Vitis* readily lend themselves to all types of propagation techniques. Methods include seed, tissue culture, dormant cuttings, green cuttings, dormant bench grafts, green grafts, chip budding, T-budding, layering, and many more.

DORMANT CUTTINGS

Hardwood dormant cuttings have many uses such as producing grapevines that do not need to be grafted and rootstocks that are planted in the vineyard for a season and then chip budded. Wood for the cuttings is harvested in the winter, usually from December to February, and stored at 36°F until ready for use. The cuttings are processed into 14-inch long pieces, with a minimum of ¼ inches in diameter. The 14-inch cutting is to facilitate deep planting in the field.

The first step in rooting grape hardwood cuttings is to disbud. Leaving the top bud alone, remove all other buds using clippers, being careful not to disbud too deep. After disbudding recut stem ¼ inch below bottom node. A 1500 ppm (0.15%) IBA rooting hormone is applied using a 5-sec dip. Once the cuttings are prepared they are normally placed horizontally in a rooting bed covered with moist peat moss, at a temperature of 78°F. The cuttings are layered on top of each other to a depth of approximately 10 inches and monitored daily for temperature and moisture levels. Root growth should be sufficient for transplanting in 21 days.

Some grape cultivars are more difficult to root than others and the top bud will start to grow before the roots are initiated. An alternative method to root these varieties can be used. This method consists of the same cutting preparation as mentioned before, but instead of covering the cuttings with soil in the rooting bed, they are placed upright with roughly ⅓ of the cutting stuck in a peat and perlite (1 : 1, v/v) mix. Flats, pots, or beds can be used on top of a bottom heat source. Air temperature must be kept cool, between 50 and 55°F to prevent the top bud from growing while the base of the cutting is kept at 75°F to promote root development. Once roots are present the air temperature is increased to 75°F to let the bud break.

GREEN CUTTINGS

Green cutting propagation of grapevine is another easy method that is used to increase new varieties or for production of nongrafted grapevines. Green cuttings can be made year-round from greenhouse-grown stock plants or during the growing season from the field. Cuttings are made using a single node, so many can be made from one plant. These single node cuttings are cut leaving 1 inch of stem above the node and 2 inches below, with the leaf attached, sometimes called a “leaf and eye”.

Green cuttings can be rooted from very soft tips all the way to lignified material, but best results come from recently hardened-off green stems.

Because grape leaves generally grow very large, the leaves should be reduced in size by at least half before placement in the rooting medium. Cuttings should receive a 5-sec dip in 1500 ppm IBA prior to sticking. Bottom heat should be kept between 75 and 85°F and the propagation soil is a peat and perlite (1 : 1, v/v) mix. Intermittent mist or fogging intervals depend on individual greenhouse conditions. Leaves should just be starting to dry off when they are re-wetted. Green grape cuttings can have ¼-inch roots as early as 7 days and it is very important to start backing off the mist when roots appear. One hundred percent rooting is not unusual especially when stock plants are started from tissue culture. Propagation houses should have 70% shade, high humidity, and a constant temperature of 80 to 85°F.

DORMANT BENCH GRAFTS

Dormant grafting is the most common method of grafting grapevines. It is sometimes referred to as bench grafting because it is normally done by a person sitting at a grafting machine, as opposed to field grafting. When grafting small numbers, it is not difficult to have a 90% to 95% graft success. With the larger nurseries who graft millions of vines of many different varieties and combinations, graft takes can range anywhere between 40% to 90%. Each year is different. The last 10 years have seen widespread vineyard expansion due to demand for wine grapes and extensive replanting due to the need for new rootstock that are resistant to the soil dwelling insect *Phylloxera*. Most grapevine nurseries old and new are constantly adjusting the following procedures in the quest for the elusive 100% graft success.

Scion budwood and rootstock cuttings are field harvested the months of December through February. Rootstocks are processed to 12 to 14 inches long and 5/16 to 1/2 inches in diameter at the top of the cutting. Scion budwood sticks are also 12 to 14 inches long, 1/4 to 1/2 inches in diameter and contain a minimum of five buds. Long rootstocks are essential to prevent the formation of scion roots in the vineyard. After harvest, cuttings are soaked for 3 h in water, dipped in fungicide or disinfected, and stored at 36°F.

For 1 week before grafting, wood is pre-warmed to 70°F with 85% humidity to increase cell activity. During this time the cuttings must be monitored for temperature and moisture. The day before grafting, the rootstock must be disbudded and then soaked for 12 h in water. Just prior to grafting, budwood sticks are cut into one node cuttings, and rootstock is recut at the top. There are a wide variety of grafting machines and different types of graft cuts, but the goal is to have good cambium contact between the scion and rootstock. Most high volume nurseries use either the saw cut or the Omega grafting machines, which do not require any wrap around the graft union. These types of cuts are beveled so that when put together by the grafting machine the fit is tight and holds together on its own. When grafting by hand the whip and tongue, V-notch, or wedge grafts are used. These grafts require some type of rubber or elastic wrap to force cambium contact.

After grafting, the new grafts are immediately placed in callusing boxes. Callus box media consist of a peat moss and perlite mix (4 : 1, v/v). This must be moist, but not overly so. Grafts are layered horizontally in the callus box, with peat moss between grafts. Temperature should be maintained at 78°F for 21 days, which by this time 95% of grafts should have callus tissue formed completely around the graft

union and some root initials showing. The grafts are then carefully removed from the callus box. Vines that are machine grafted and use a saw or Omega cut need their unions painted with wax. Another method to quickly dip the union and scion in cheesecote-type wax that is heated to 150°F. This wax coating prevents desiccation. Graft unions that have been wrapped to hold the union together do not need to be waxed.

New grafts are planted in paper tubes or 4-inch × 5-inch deep pots and moved to a greenhouse for acclimation. The acclimation greenhouse should be 70-70-70, that is; 70% shade, 70% humidity and kept at 70°F. Once established the grafts are moved to a shade house or to full sun. The grafts in planting tubes are field planted in nursery rows, allowed to grow for a season and then harvested bare-root dormant. The grafts in 4-inch pots are either delivered to the customer soon after acclimation *to full sun or grown for a season in the pot and delivered the next year dormant.*

GREEN GRAFTING

Green grafting grapes is a technique that has been used to a limited degree for at least 50 years in Europe, New Zealand, and the United States. Green grafting is used in grape, citrus, and rose production but has potential to be used in other fruit crops and ornamentals. Green grafting grapes has many advantages. It allows introduction of large numbers of newly grafted varieties within the first year the new material is received. With traditional dormant bench grafting it takes several years to build up sufficient stock plants to graft in quantity. Green grafting can be done year round. Stock plants are grown in the greenhouse thus allowing for greater control of pests. The potential for producing disease-free vines is very high due to three factors. The first is that the stock plants are isolated from disease vectors. The second is that it would be very difficult for a diseased plant to survive the callusing and rooting process of green grafting. And third, diseased stock plants can be eliminated and replaced very quickly. The most important condition for successful green grafting is healthy rootstocks and scions with which to start. This is true for all plant propagation, but cannot be emphasized enough for green grafting. Green scion and rootstocks must be free of disease, have semihardened tissue, be in a vigorous state of growth and nutrient levels should be optimum. During the fall and winter, day and night temperatures must be kept at 70°F or above and lights used to provide long days. Greenhouse-grown stock plants must be rotated in and out of the greenhouse to allow dormancy and new stock plants started on a continual basis. A stock plant that has not been allowed to go dormant after several crops will yield very poor grafting material.

Harvesting stock in the greenhouse is very quick and easy compared to field harvesting, with very little damage or breakage. Stock plants are trellised 8 to 10 ft on string and kept free of lateral branches during growth. Plants are harvested early in the morning and no later than 10 AM. Once cut, the material is kept in a cool and moist environment.

Preparing the rootstock for grafting consists of cutting the rootstock into 12-inch sections, and disbudding all buds leaving one leaf attached. This leaf is trimmed down in size by two-thirds. The one bud scion piece is about 3 inches long with 1 inch above the bud and 2 inches below. The scion must also retain its leaf and it is also trimmed by two-thirds. The diameter of the rootstock and scion should be a minimum of ¼ inch. When preparing stock for grafting it is important to rogue out

all cuttings that are too soft, thin, and/or damaged. If any material is questionable, it should be discarded immediately. Grafting time and greenhouse space are too valuable to waste on grafts that only have a slight chance of surviving.

For hand grafting, the wedge graft used for green grafting of grapes works quite well. The cut on the rootstock is a simple split down the middle of the stem that is $\frac{3}{4}$ inches deep. The scion cut, which takes quite a bit of skill, is a 20° angle cut on two sides of the scion. As with all grafting, matching the caliper of both scion and rootstock for good cambium contact is the number one goal of the grafter. Once the graft is made, the union must be held together tightly. Many different materials can be used for this purpose, from rubber budding strips to elastic or shrink-wrap-type materials. It is important not to cover the union completely, as this practice is believed to encourage decay. Leaving an opening also allows the union to be inspected for callus formation. Contrary to this, the top cut on the scion is sealed with liquid plastic graft seal, as water tends to collect on this horizontal cut in the propagation tent. Once the graft union is secured, the basal end of the rootstock is dipped in 1500 ppm IBA for 5 sec.

After grafting, the vines are planted and placed in a propagation tent. The soil that green grafts are planted in is a very porous mix of perlite and peat moss (4 : 1, v/v). The propagation flat is a 38 plug tray with $1\frac{3}{4}$ -inch \times 5-inch deep cells. After grafting and before planting, cuttings must be frequently syringed with water. The propagation greenhouse is covered with 70% shade cloth and equipped with both a fog system and mist system. The propagation tents are hoops covered with polyethylene plastic running the length of the benches. A hot water bottom heat system is used on top of the bench.

The goal during the callusing and rooting stage is to provide the grafts with a very constant hot and humid environment. The greenhouse itself must have this same environment but the propagation tents inside the greenhouse provide even more protection and less fluctuation in temperature and humidity. The temperature inside the tent should be kept at between 85 and 90°F. The humidity should be between 95 and 100°F. Grafts are kept in a closed tent for 10 to 14 days, rooting and callusing occur almost simultaneously. If the stock is not healthy and in peak condition when grafted it will become evident in the propagation tent in the form of disease and decay and these plants should be removed immediately. Grafts are checked several times daily for moisture and misted when needed. Any wilting or other stress during the first couple of weeks is almost certain graft failure. Once the grafts have visible callus around the graft union and roots are $\frac{1}{2}$ inches long, the tent is opened. The grafts are gradually acclimated over a period of a week, using either fog or mist. A 200 ppm 20N-10P-20K fertilizer is also applied at this time. Once acclimated from high humidity, grafts are moved to a heated greenhouse with 55% shade and are potted to their final container. The final step is to move the grafts outside to full sun. This grafting process can take as little as 8 weeks.