

# Successful Apple Grafting Techniques for New York

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Today, the ability to quickly establish an orchard and begin cropping a new and exciting apple varieties is important to farm profitability. Productive varieties, precocious rootstocks, and higher and higher densities can all be used to bring orchards into early production. “Top-Grafting” also known as “Top-Working” has long been used to switch varieties (Mudge et al. 2009, Garner 1988) but has had associated risks and requirements

**“Top grafting an orchard to a new more profitable variety has had erratic success in NY State. However, adding a few modifications to the well-known “Bark Grafting” technique has proven to be almost 100% successful in our trials in NY. If tree density and rootstock of the old orchard are acceptable for a modern orchard then top grafting can allow rapid conversion of an old unprofitable variety to a new profitable variety.”**

that has limited its use by all but a few skillful fruit growers. This is particularly true in the Northeast where weather conditions have made this method even more risky.

Historically, erratic success in New York has been due to severe and unpredictable weather conditions combined with technical flaws in the procedure. Not only has success been erratic between orchards but also among blocks from year to year using apparently similar techniques. Adding a few modifications to the well-known “Bark Grafting” technique has proven to be almost 100% successful in our trials in NY. Grafting needs to be nearly completely successful to be profitable since the additional cost of regrafting and the reduced early yields can significantly reduce the profitability of this procedure.

We prefer “Bark Grafting” over the more common “Cleft Grafting” (Lewis and Alexander, 2008) for pome fruit since it can be used on almost any tree size, it maximizes the cambial contact which increases the chances of success, and requires a lower skill level than cleft grafting. The bark must easily separate from the wood for “Bark Grafting” but not for “Cleft Grafting”. Recently, experienced crews traveling from Washington State using these modifications have successfully converted many acres in New York from less profitable to more profitable varieties and to varieties that better fit the individual farm businesses needs.

In addition, growers now have existing orchards with less profitable varieties that need to be renewed despite tree age and productivity and at tree densities of 600-1000 trees/acre which would be very expensive to renew by replanting. This makes top-working a more appealing option since replanting will take a minimum of 2-3 years to prepare the ground and plant and then another 2-3 years to return to partial production. Since there is less site preparation and lower materials costs, a top-worked orchard can be producing marketable crops by the 3<sup>rd</sup> leaf. Vig-

orous re-growth and rapid loss of juvenility of the scion wood contributes to this rapid early production. Another advantage is that wood that is suitable for grafting and is known to produce quality fruit is often available from a local source. Proper licensing and acquisition fees must be paid for patented varieties.

Most top working is done using a combination of a skilled hired crew that specializes in top working and on-farm labor for the less skilled tasks. Costs increase with tree age and size and as the number of bud sticks needed increases (Table 1). A typical rate for a commercial crew (2009 cost) is \$0.40 per inserted bud stick plus materials. A farm crew could top work an orchard for this rate but the risk of failure and taking labor away from other important tasks make hired crews a more attractive option.

Materials needed for “Bark Grafting” include suitable scion wood (about 3-4 buds per inserted stick), common electrical tape to hold the grafts in place, 1” wide poly grafting tape to seal out air and stabilize scion inserts, a pliable grafting wax such as Gashell or Wilson to plug gaps between the bark and the wood and scion stick, and finally a grafting sealer such as Doc Farwell’s to seal all cut surfaces from air (See Table 1). On-farm labor adds additional cost with the majority of the cost in applying the graft sealer and pruning the trees and removing brush in preparation for top-working.

## Important Steps:

**Scion wood collection** – only wood produced during the immediate past season is suitable for grafting. Select moderately vigorous shoots rather than vigorous upright sucker wood. Collect wood when buds are completely dormant and as late in the dormant season as possible to minimize the length of storage. Be sure wood is not winter injured and is pest free. Collect wood from trees with known fruit quality. Color, size, sweetness, and firmness are all influenced by this wood. Collect from as few trees as possible to restrict variation. Buds at the tip and base of collected shoots are not suitable for grafting and should be discarded at collection.

**Scion wood storage** – scion wood must remain completely dormant, moist and healthy through out storage. Large quantities of scion wood can be bundled and stored in bins of well rotted sawdust in cold storages dedicated to nursery stock. Exposure of scion wood to very low levels of ethylene can kill the wood. Smaller quantities of scion wood can be bundled, wrapped in moist newspaper, and put in plastic bags and stored in a 32-34°F refrigerator. Use a dedicated refrigerator for storage to avoid exposure to ethylene from stored fruit and check wood regularly for moistness and mold which can negatively affect scion wood. Plastic bags must be completely sealed if stored in frost-free refrigerator since wood will quickly dry out. Temperatures must be kept very close to freezing. Wood kept too close above 40°F may start to “wake up” and grow prematurely resulting in graft failure.

**Preparing to graft** – purchase all the materials needed to graft ahead of time so that you have them available when you are ready to graft. Tree tops can be removed anytime during the dormant season before spring grafting. This is best done in a two-stage process with a majority of the top removed first so that the large quantity of brush generated can be removed. A fresh cut is made the day of grafting to create a smooth fresh cambial interface. Cuts should be as low as possible on the tree trunk but 2-3 inches immediately above a “nurse” limb that will support early growth and absorb excess vigor (Figure 1).

The most successful grafting takes place when temperatures become consistently warm. I prefer to wait until after bloom in New York since there is very little chance of extended cool periods, frost, or freezes and bark easily separates from the wood. Callus formation is rapid and complete when there are no weather-related interruptions.

**Grafting procedures**

–where scion sticks will be inserted, make a fresh clean cut on the trunk with a fine bladed saw being careful not to separate the bark and expose cambium. Then, using a sharp grafting knife make a single cut through the bark to the solid wood beneath perpendicular to the ground (Figure 2). This cut should be approximately 1.5 inches in length. Loosen the bark on only one side of the cut by carefully rotating the knife blade in the direction of the side where the stick will be inserted. As soon as the bark starts to separate from the wood, stop rotating and withdraw the knife. Only a small separation is needed to insert a sharpened scion stick. Make additional cuts, every 2 inches along the circumference of the stock repeating the above procedure for each cut (Figure 3).

Prepare the scion stick by making a single long sloping cut on each side of the stick approximately 1 inch in length Figure 4). This cut should be very smooth to ensure good cambial contact. When



**Figure 1. This tree has been prepared for top working by removing unnecessary top, limbs and branches during the dormant. Tree is being cut to final size where grafts will be inserted.**



**Figure 2. A 1 1/2 inch cut is made through the bark just to the wood.**



**Figure 3. Bark is slightly separated from the wood at the cut on one side so that scion sticks can be inserted at 2 inch intervals around the circumference of the stock.**

done properly, there should be a thicker side and a thin edge. The thick side should be approximately the same thickness as the bark of the tree being grafted.

Insert the scion stick so that the thicker edge is toward the unloosened bark. Carefully push the scion stick into the gap until all of the sloping cuts made to the scion stick is completely covered by bark on the stock. The scion stick should be seated firmly in place with good cambial contact between the scion and the stock.

Make a single wrap of electrical tape around the top of the stock to temporarily hold scion sticks firmly in place (Figure 6). Then use small pieces of grafting wax to fill any existing gaps between the stock and the inserted scion and exposed cuts on the stock (Figure 7).

The next step is to wrap the stock with poly grafting tape from the edge of the cut surface to just below where cuts were made on the stock to insert scion wood. Loop the grafting tape under a previous wrap to fix in place (Figure 8).

Finally, liberally cover the top of the stock, grafting tape, and ends of the scion sticks with grafting seal to hold it all in place and prevent any exposure to the air (Figure 9,10,&11). The stock/scion stick interface must be completely airtight, so be sure the seal is applied heavily. Repaint each scion/stock again at the end of each grafting day.

**Aftercare:** Watch for buds to swell and begin to push. Don't be too anxious and abandon your grafting project too soon. Sometimes adventitious buds need to form and it may take a while to do so. If it is evident that grafts have not taken, trees can be re-grafted provided good dormant wood is still available. The most common causes of graft failure are bad scion wood and incomplete air seals around the scion sticks. Re-cut stock slightly below the unsuccessful graft and repeat the grafting procedures above.

Depending on the



**Figure 4. A 1 1/2 inch smooth, sloping cuts are made on opposite sides of the scion sticks. This exposes the maximum amount of cambial tissue.**



**Figure 5. Sticks are inserted into the stock with the wider portion of the scion stick against the un-separated bark.**



**Figure 6. A single wrap of electrical tape helps hold the scion sticks in place.**



**Figure 7. Grafting wax plugs all gaps between the scion stick and the stock.**



**Figure 8.** Grafting tape is wrapped around the stock holding scion sticks in place and sealing out air.



**Figure 9, 10, 11.** The entire graft area is sealed with paintable grafting seal including the top of the stock, the grafting tape, and the ends of the scion sticks.

weather (which now should be consistently warm) new shoots should grow from 2-4 inches per week, more slowly at first then rapidly picking up steam. New shoots will also form along the existing stock. These should be regularly removed as they appear through the growing season (Figure 12).

It is important to protect the new grafts from secondary pests and diseases. Potato leaf hopper (*Empoasca fabae*), white apple leaf hopper (*Typhlocyba pomara*), rose leaf hopper (*Edwardsiana rosae*), green apple aphid (*Aphis pomi*) spirea aphid (*Aphis spiraeicola*), tarnished plant bug (*Lygus lineolaris*) various tortricid leafrollers, and japanese beetle (*Popillia japonica*) are all potentially serious problems. Powdery mildew (*Podosphaera leucotricha*) and fireblight (*Erwinia amylovera*) are very serious diseases that must be managed. Be sure and maintain regular coverage to prevent insect and disease problems.



**Figure 12.** This successful graft is growing rapidly 6 weeks after stick insertion. Note that a “nurse limb” is immediately below the graft. The ‘nurse limb’ will be removed during the dormant period. New shoot growth on the stock should be rubbed off at this stage.



**Figure 13.** A single cut across the tapes made in August allows callusing to grow unrestricted.

**Table 2. Sources of grafting wax and grafting seal.**

<b>Grafting wax, seal, and other supplies</b>	Doc Farwell's is available from Belle Terre Irrigation. 8142 Champlin Road, Sodus, NY 14551-9527 (315) 483-6155 email:dripsupply@hotmail.com
<b>Grafting wax</b>	Gashell Grafting Wax is available from OESCO, Inc.- P.O. Box 540, Route 116 - Conway, MA 01341 800-634-5557 413-369-4335 Fax 413-369-4431 info@oescoinc.com as well as other retailers who sell horticultural supplies.
<b>Grafting wax</b>	Wilson Grafting Wax is available from Wilson Irrigation. 1104 E. Mead, Yakima, WA 98903 Phone: (509) 453-9983, Fax:(509) 453-1258, Out of State: 1-800-232-1174 email: mail@wilsonirr.com as well as other retailers who sell horticultural supplies.

As grafts become firmly established later in the first season, make a single cut across the grafting tape to allow for scion stick growth and callus expansion. This will prevent potential girdling by the electrical and grafting tape (Figure 13).

As grafts grow, they become more susceptible to breaking out caused by birds or high winds. This can be prevented by attaching the new shoots to an existing trellis or plant stake stapled to the existing trunk. A simple tie around all shoots or braiding new growth can also protect grafts from breaking off the stock (Figure 14).

Do not do any shoot thinning during the first season. Competition among shoots helps to limit their growth which can be excessive.

Paint tree trunk with a low-grade water-based white paint to prevent sunburn and fluctuating temperatures which may cause winter injury.

The “Nurse Limb” should be removed during the next dormant pruning.



**Figure 14.** A support stake, tie, or braided shoots will prevent breakout of grafts by wind or birds.

**Table 1. Costs of top working various tree sizes.**

Costs	Tree Diameter (inches) <sup>1</sup>							
	1-1.5	2	2.5	3-3.5	4	4.5	5-5.5	6.5
# Bud Sticks Required <sup>2 3</sup>	2	3	4	5	6	7	8	10
Cost/Tree	\$1.39	\$1.79	\$2.19	\$2.59	\$2.99	\$3.39	\$3.79	\$4.59
Cost/Acre <sup>4</sup>	\$1,250	\$1,613	\$1,976	\$2,338	\$2,701	\$3,064	\$3,427	\$4,152

<sup>1</sup>Diameter of trunk where bud sticks are inserted.

<sup>2</sup>For Top Working only, additional sticks will be needed to graft additional scaffold limbs.

<sup>3</sup>Bud sticks consist of 3-4 bud sections of shoots from appropriate scion wood.

<sup>4</sup>Cost based on 4' X 12' spacing and 907 trees/acre.

## Summary

“Bark Grafting” can be used to change the variety in an orchard much more quickly, cheaply, and easily than replanting if tree planting density is high and rootstock of the old orchard is acceptable for a modern orchard. Under these conditions top grafting can allow rapid conversion of an old unprofitable variety to a new profitable variety. It is best used where higher tree densities allow orchards to get to maximum production quickly. Modifications made to the traditional method have improved success in New York. These modifications include: a) grafting later in the season than traditionally done. The ideal “Bark Grafting” timing is within 30 days after bloom, b) sealing crevices between the scion stick and the stock wood with grafting wax. This prevents grafting seal from coating the cambial layers of stock and scion stick that can prevent callusing, and c) the use of a paintable more pliable, stretchable and flexible graft seal. Less flexible seals are harder to use and often crack and expose grafts to air resulting in unpredictable graft failure.

## Literature Cited

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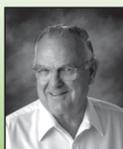


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