Successful Apple Grafting Techniques for New York

Stephen A. Hoying¹, Alison M. DeMarree² and Mario Miranda Sazo²
¹Dept. of Horticulture, Hudson Valley Lab, Cornell University, Highland, NY
²Cornell Cooperative Extension, Lake Ontario Fruit Program, Newark, NY

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-Working” also known as “Top-Grafting” has long been used to switch varieties (Mudge et al. 2009, Garner 1988) but has had associated risks and requirements 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. 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.

“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.”

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 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
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 spiraecola), 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 amylovora) are very serious diseases that must be managed. Be sure and maintain regular coverage to prevent insect and disease problems.

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.

---

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

<table>
<thead>
<tr>
<th>Costs</th>
<th>1-1.5</th>
<th>2</th>
<th>2.5</th>
<th>3-3.5</th>
<th>4</th>
<th>4.5</th>
<th>5-5.5</th>
<th>6.5</th>
</tr>
</thead>
<tbody>
<tr>
<td># Bud Sticks Required 2 3</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
<td>7</td>
<td>8</td>
<td>10</td>
</tr>
<tr>
<td>Cost/Tree</td>
<td>$1.39</td>
<td>$1.79</td>
<td>$2.19</td>
<td>$2.59</td>
<td>$2.99</td>
<td>$3.39</td>
<td>$3.79</td>
<td>$4.59</td>
</tr>
<tr>
<td>Cost/Acre 4</td>
<td>$1,250</td>
<td>$1,613</td>
<td>$1,976</td>
<td>$2,338</td>
<td>$2,701</td>
<td>$3,064</td>
<td>$3,427</td>
<td>$4,152</td>
</tr>
</tbody>
</table>

1 Diameter of trunk where bud sticks are inserted.
2 For Top Working only, additional sticks will be needed to graft additional scaffold limbs.
3 Bud sticks consist of 3-4 bud sections of shoots from appropriate scion wood.
4 Cost based on 4’X 12’ spacing and 907 trees/acre.

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

<table>
<thead>
<tr>
<th>Grafting wax, seal, and other supplies</th>
<th>Doc Farwell’s is available from Belle Terre Irrigation. 8142 Champlin Road, Sodus, NY 14551-9527 (315) 483-6155 email:<a href="mailto:dripsupply@hotmail.com">dripsupply@hotmail.com</a></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>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 <a href="mailto:info@oescoinc.com">info@oescoinc.com</a> as well as other retailers who sell horticultural supplies.</td>
</tr>
<tr>
<td></td>
<td>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: <a href="mailto:mail@wilsonirr.com">mail@wilsonirr.com</a> as well as other retailers who sell horticultural supplies.</td>
</tr>
</tbody>
</table>

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

Steve Hoying is a Senior Extension Associate stationed at Cornell’s Hudson Valley Lab. who specializes on apple and grape management. Alison DeMarree is an Extension Associate with Cornell Cooperative Extension, Lake Ontario Fruit Program in Newark NY who specializes in fruit farm economics. Mario Miranda Sazo is an Extension Associate with Cornell Cooperative Extension, Lake Ontario Fruit Program, Newark, NY who specializes in cultural practices for tree fruits and berries working.