Vegetable Grafting: Watermelon

WASHINGTON STATE UNIVERSITY EXTENSION FACT SHEET • FS100E

Introduction

Vegetable grafting is a centuries-old technique first used in Asia to improve plant production, reduce disease susceptibility, and increase plant vigor. Commercial production of and demand for grafted vegetable plants continues to increase across Asia and Europe, although it is relatively new in the U.S. Beginning in the 1990s, commercial growers and home gardeners in the U.S. have gradually become more aware of the advantages of using grafted vegetable plants.

This Extension fact sheet provides a summary of how to prepare watermelon seedlings for grafting, how to graft, how to heal grafted plants, and how to transplant and maintain grafted plants in the field. For grafting techniques that require high humidity, construct a healing chamber following the instructions provided in the *Washington State University Extension Publication* FS051E titled Vegetable Grafting: The Healing Chamber.

Grafting Preparation

Watermelon plants are grafted when they are 14–21 days old. In order for a successful graft union to form, the scion and rootstock plants must have similar stem diameters at the time of grafting so their vascular bundles can be aligned and in complete contact with one another. (See Figure 1 for an illustration of plant parts, including the vascular bundles in a watermelon stem.) The scion and rootstock seedlings may not germinate or grow at the same rates, so it is important to conduct a preliminary test to determine their growth rates in your growing environment. Seed more plants than necessary so you have a greater selection when matching stem diameters. Also, it is rare to get 100% graft survival, so graft at least 20% more plants than needed.

Water both rootstock and scion plants 12–24 hours before grafting. Do not water plants immediately before grafting, unless they are wilted. If reusing grafting clips, wash them in warm, soapy water, sterilize them by soaking for 1 minute in a 10% bleach solution, and rinse them under tap water. Allow the clips to air-dry before reuse. Use only clean, sharp razor blades for grafting, and wash your hands with antibacterial soap or hand gel, or use latex-type surgical gloves. While there are many tools that can be used for cutting

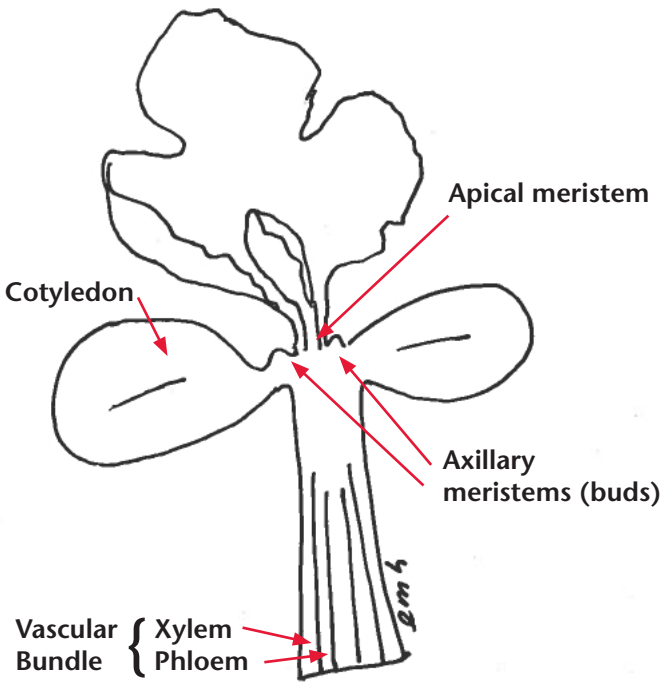

Figure 1. Botanical parts of a watermelon seedling.

vegetable grafts (Figure 2), the double-edged razor blade snapped in half is most commonly used. Fill a spray bottle with tap water in order to mist plants frequently during grafting. If you are using a healing chamber, spray the inner surfaces of the chamber with water a few hours before grafting to raise the relative humidity within the chamber.

Grafting Techniques Commonly Used for Watermelon

There are four methods commonly used to graft watermelon: 1) approach (tongue), 2) hole insertion, 3) one cotyledon (splice), and 4) side grafting.

1. Approach (Tongue) Grafting

Both rootstock and scion should have one or two true leaves. Cut a 45° downward slit halfway through the

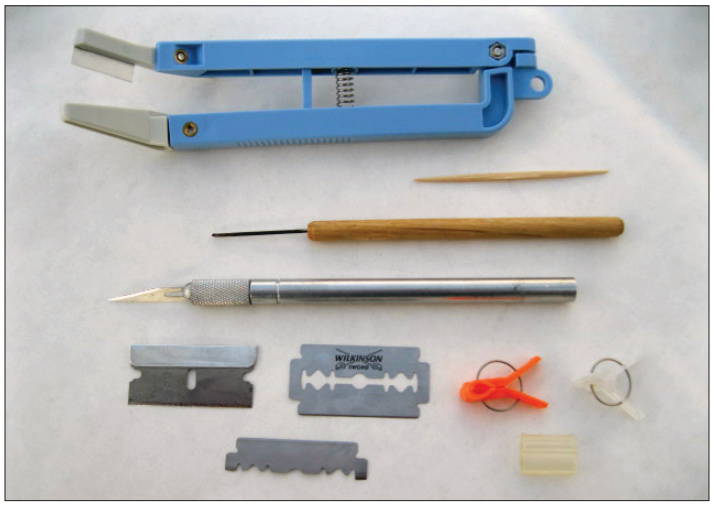

Figure 2. Supplies commonly used for grafting.

rootstock stem below the cotyledons, and cut an identically angled upward slit in the scion stem (Figures 3A and 3B). The angle and location of the cuts must be relatively precise so the scion can be placed on top of the rootstock. Bring the two cut stems together so they overlap (Figure 3C), then attach a clip or securely wrap the joined stems in plastic wrap, foil, or parafilm (Figure 3D). Figure 4 shows this grafting technique with actual plants. Place the joined plant in a transplant tray or small pot. Mist the plant with water and place it on a greenhouse bench. Water the plant as needed. Cut off the top of the rootstock 5 days after grafting. Wait 7 days, and then cut off the bottom portion of the scion.

Advantages:

- A relatively simple technique.
- A grafting clip is not essential.
- A high humidity and low light environment is not required for successful healing of the graft union; a normal greenhouse environment is sufficient.
- There is no shoot regrowth from the rootstock.

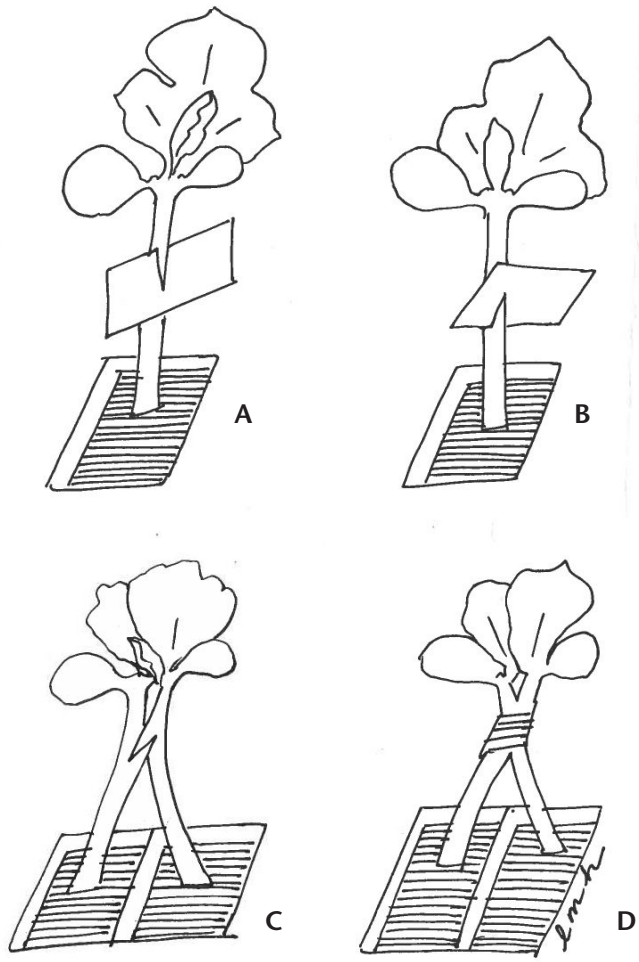

Figure 3. Approach grafting method.

Disadvantages:

- Requires severing of the rootstock top and the scion bottom after the graft union has healed.

Figure 4. Approach grafting method.

2. Hole Insertion Grafting

Rootstock seedlings should have one small true leaf, and scion seedlings should have one or two true leaves. With a pointed probe, remove the true leaf, the apical meristem (undifferentiated cells), and the axillary buds from the topmost growing point of the rootstock plant (refer back to Figure 1 for location of plant parts). It is important to remove all of the apical meristem and the axillary buds to prevent future shoot growth of the rootstock. Use the probe to create a hole in the top of the rootstock where the tissue was removed (Figure 5A). Cut the scion below the cotyledons at a 45° angle on two sides to form a wedge (Figure 5B) and insert it into the rootstock (Figure 5C). Figure 6 shows this grafting technique with actual plants. Mist with water and place in healing chamber.

Advantages:

- A grafting clip is not essential.
- There is no trimming of unwanted plant parts after healing of the graft union.
- Tends to have a high success rate.

Disadvantages:

- Requires slightly more skill than most other grafting techniques.
- Requires more time to graft than some of the other grafting techniques.
- Requires very careful control of humidity, light, and temperature after grafting.
- High losses may occur if the healing environment is not optimal.
- Regrowth of the rootstock will occur if not all the meristem tissue has been removed.

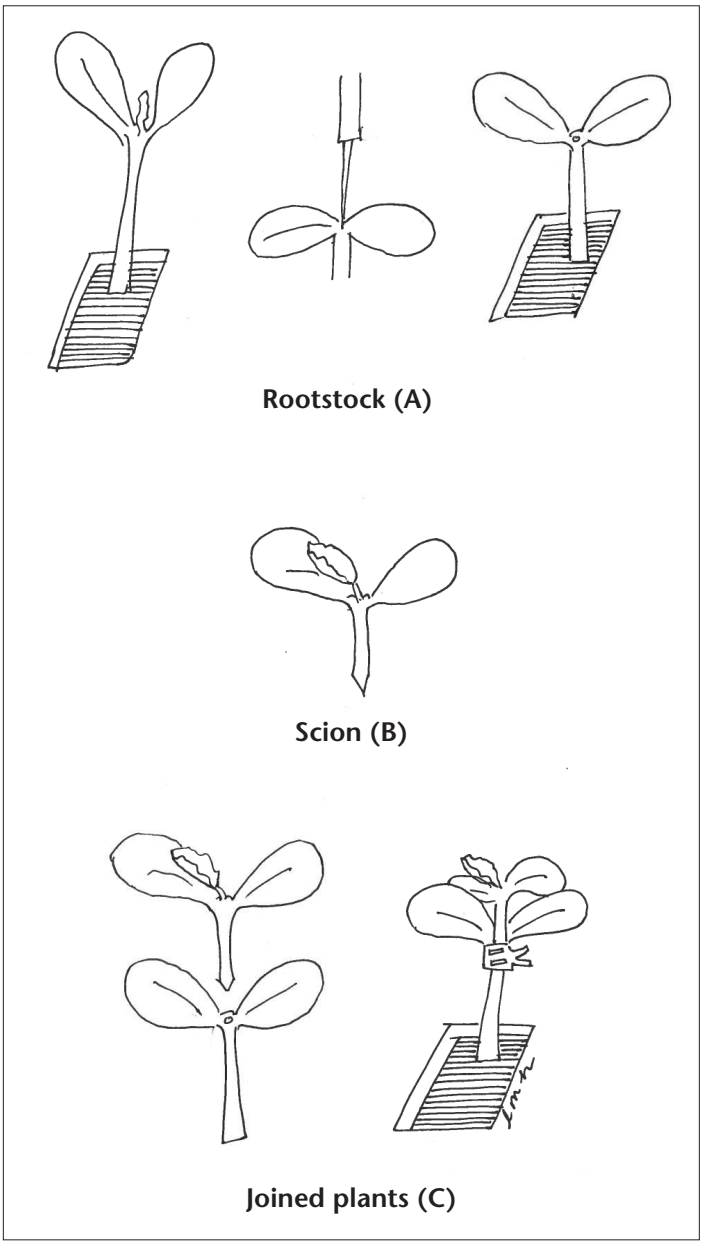

Figure 5. Hole insertion grafting method.

Figure 6. Hole insertion grafting method.

3. One Cotyledon Grafting

This method (also known as the splice graft) was originally developed by Japanese engineers for use with automated grafting. Due to the procedure's simplicity, it has become the most commonly used manual grafting method.

Rootstock seedlings should have at least one true leaf, and scion seedlings should have one or two true leaves. Cut the rootstock at a 45° angle so one cotyledon remains and one is removed (Figures 7A and 8A). Cut carefully so as to keep the remaining cotyledon firmly attached to the rootstock stem. The angled cut should also remove the apical meristem and both axillary buds (refer back to Figure 1 for location of plant parts). It is important to remove all of the apical meristem and the axillary buds to prevent future shoot growth of the rootstock. If all of the axillary bud tissue was not removed with the cut, use the probe to dig it out. Cut the scion at a 45° angle below the cotyledons (Figures 7B and 8B), where its diameter matches that of the rootstock. Bring the two cut stem surfaces together, and hold them in place with a grafting clip (Figures 7C, 8C and 8D). Mist with water and place in healing chamber.

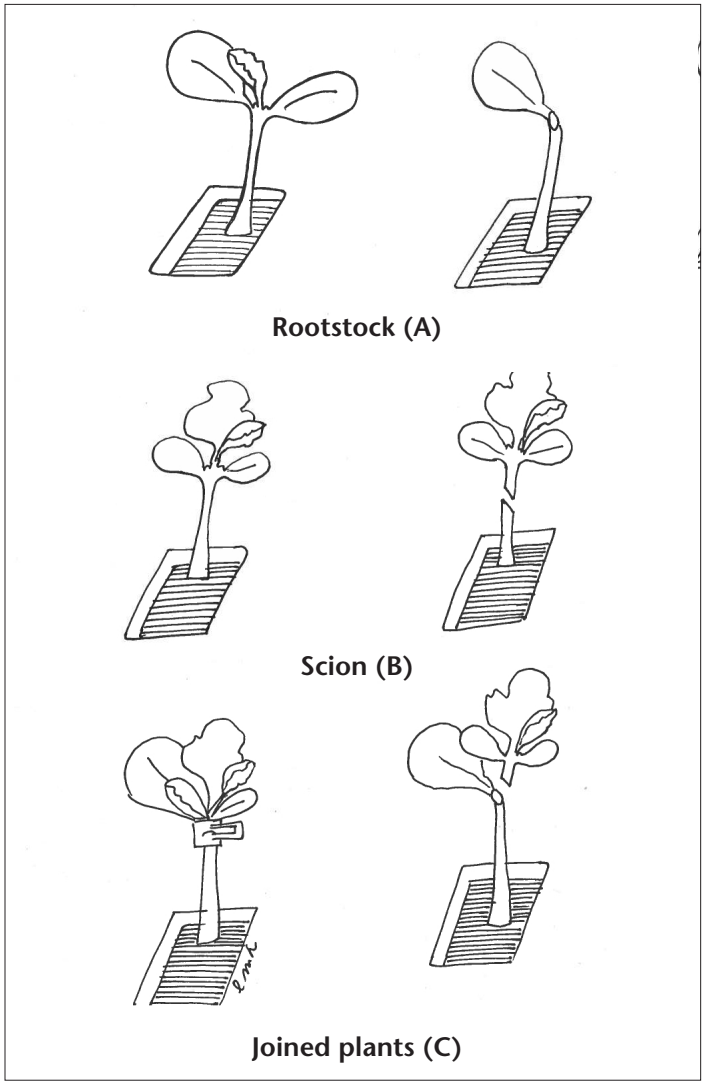

Figure 7. One cotyledon grafting method.

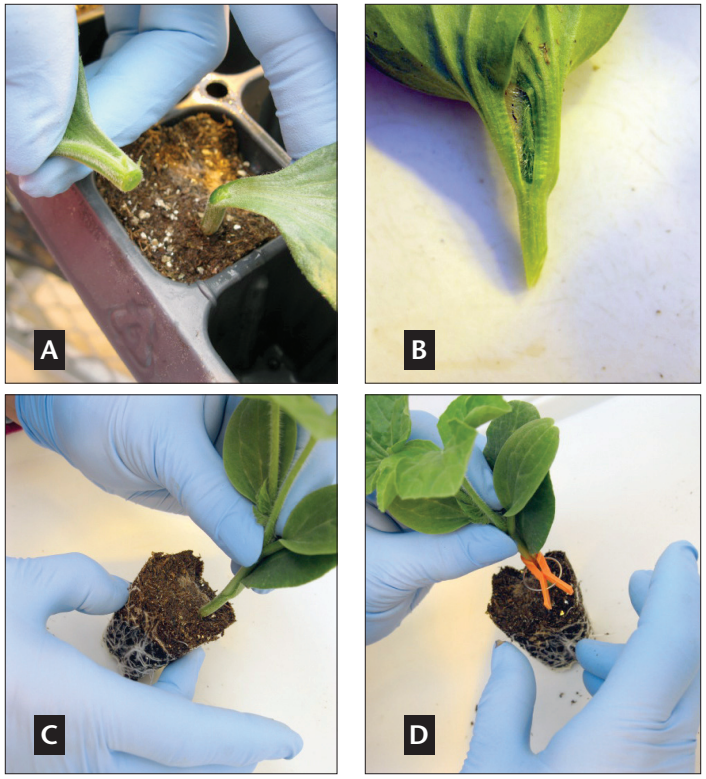

Figure 8. One cotyledon grafting.

Advantages:

- A simple technique that is relatively quick and easy to perform.
- The only task after grafting is to remove the clip. There is no trimming of unwanted plant parts after healing of the graft union.

Disadvantages:

- Requires careful control of humidity, light, and temperature after grafting.
- High losses may occur if the healing environment is not optimal.
- Regrowth of the rootstock will occur if all the meristem tissue has not been removed.

4. Side Grafting

This type of grafting requires rootstock seedlings with at least one true leaf and scion seedlings with one or two true leaves. It is suitable for rootstocks with wide stems. With a sharp knife or razor blade, cut a slit all the way through the stem of the rootstock below the cotyledons (Figure 9A). The slit should be just long enough to insert the scion. Insert a probe or toothpick into the slit to hold it open. Cut the scion below the cotyledons at a 45° angle on two sides to form a wedge (Figure 9B),and insert the scion into the slit of the rootstock (Figure 9C). Remove the probe or toothpick if one was used. Figure 10 shows this grafting technique with actual plants. Hold the scion in place with a grafting clip, mist with water, and place in healing chamber. Cut off the top portion of the rootstock 5 days after plants have been removed from the healing chamber.

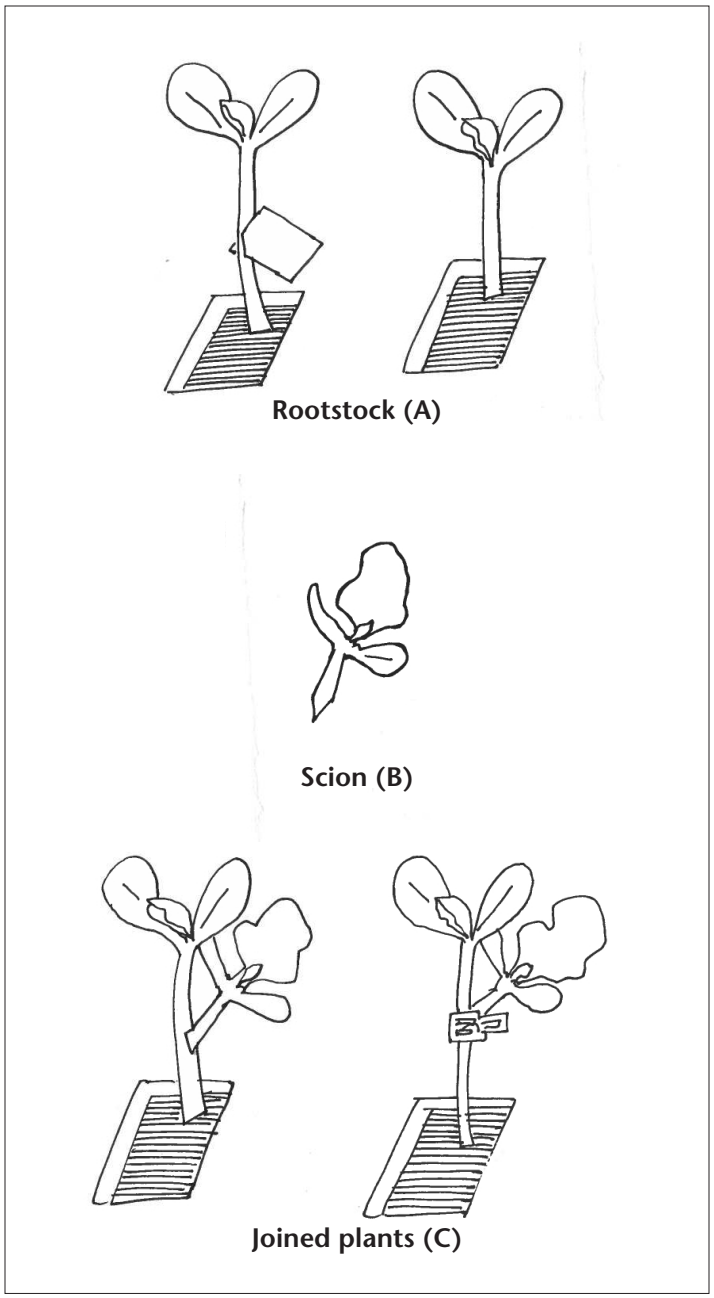

Figure 9. Side grafting method.

Figure 10. Side grafting method.

Advantages:

- A relatively simple technique.

Disadvantages:

- Requires careful control of humidity, light, and temperature after grafting.
- High losses may occur if the healing environment is not optimal.
- After the graft union is healed, the top portion of the rootstock must be removed.

Healing Chamber Regime

The following healing schedule is based on the greenhouse grafting environment at the Washington State University Mount Vernon Northwestern Washington Research and Extension Center, where the average temperature is 60/75˚F (night/day), and the relative humidity is 60%–80% in the late spring, when grafting usually occurs. Your greenhouse or grafting environment may be different (higher or lower temperature and humidity), and you may need to adjust the exposure times for grafted plants so they are not stressed when introducing them back into the greenhouse environment. The key is to slowly acclimatize the grafted plants without causing permanent wilting, which will lead to plant death.

Place grafted plants in a pre-misted humidity chamber (Figure 11). In the following schedule, Day 1 is the day of grafting.

- Day 1. Close plastic of healing chamber; cover chamber with black plastic.
- Day 2. Keep chamber closed and covered with black plastic.
- Day 3. Open the chamber and mist the inside (sides and top), close the chamber, and fold the black plastic up and away from the front of the chamber.
- Day 4. Leave the chamber closed, remove black plastic from all sides of the chamber, but leave it on the top.
- Day 5. Open the chamber for 30 minutes, then mist the inside of the chamber, mist the plants if any wilting occurs, and reclose the chamber. Remove the black plastic entirely.
- Day 6. Open the chamber for 1 hour, mist the inside of the chamber, mist the plants if any wilting occurs, and reclose the chamber.
- Day 7. Open the chamber for 3 hours, mist the inside of the chamber, mist the plants if any wilting occurs, and reclose the chamber.
- Day 8. Open the chamber for 6 hours, mist the inside of the chamber, mist the plants if any wilting occurs, and reclose the chamber.
- Day 9. Remove plants from the chamber.

Figure 11. A larger (top) and smaller (bottom) chamber used to heal grafted vegetables.

Preparation for Transplanting into the Field

Although vascular connection is established between scion and rootstock at approximately 7 days after grafting, it takes at least 14 days after grafting for the graft union to fully heal. After removing plants from the healing chamber, allow them to rest in the greenhouse for 5–10 days, and then move them outside for 3–5 days, so they can harden off before transplanting. Adjust this schedule as needed if plants appear stressed when they are introduced into each new environment.

You may remove the grafting clips (if used) before moving plants outside or leave them on until after transplanting. Clean and sterilize grafting clips before you use them again. You may also remove the clips before transplanting and wrap the graft union with parafilm or plastic wrap to provide extra support, especially in case of windy conditions. However, if possible, do not place grafted transplants into the field under windy conditions. Grafting clips and parafilm will usually drop off the stem as the stem increases in diameter, but plastic wrap may need to be removed from the plant.

Figure 12. Rootstock growth (squash-like leaves on the left) from grafted watermelon plant.

When transplanting, make sure the graft union remains above the soil line. If the graft union is buried, the scion will root into the soil and any advantages provided by the rootstock, such as resistance to soil-borne diseases, will be lost.

Field Maintenance of Grafted Plants

Remove any remaining grafting clips within 2–3 weeks of field transplanting. Check the plants at least once a week throughout the growing season to see if the rootstock has regrown (Figure 12), and remove rootstock shoots immediately. Many commercial rootstocks are extremely vigorous and will quickly overtake the scion variety if allowed to grow.

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