e-GRO Edible Alert

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How to Grow Grafted Watermelon Transplants

Vegetable grafting combines two plants for better plant growth and productivity. In this article we present a brief introduction to grafted watermelon transplants and highlight some important considerations for those interested in their production.

Grafting is a propagation strategy that combines the shoot system (scion) of one plant with the root system (rootstock) of another to receive the benefits of both. Since the early 1900's, watermelon grafting has been widely adopted in countries with intensive use of protected cultivation. While adoption in the U.S. has been comparatively slow, we have observed a steady increase of interest and adoption among producers. The need for grafting will likely increase further in watermelon growing regions of the U.S. due to growing issues with *Fusarium* wilt race 2 to which all commercial watermelon cultivars are susceptible. In this article we describe considerations including cultivar selection, sanitation, growing, grafting, and healing for those interested in producing grafted watermelon transplants.

Cultivar selection:

Cultivar pairing is critical in the production of grafted plants as the two cultivars (one for the scion and one for the rootstock) must perform well together. Certain scion x rootstock combinations are more productive, and the effect of a rootstock may not hold true for all scions. In extreme cases, it is possible that a combination will be incompatible and fail to form a successful graft union. Cultivar pairing is also important as some rootstocks like squash can alter flavor or other fruit quality traits. However, results on this topic are often contradictory and are likely influenced by the environment and maturity of fruit at harvest. Common commercial watermelon rootstock species include squash hybrids (*Cucurbita maxima* x *C. moschata*), bottle gourd (*Lagenaria siceraria*), and wild watermelon (*Citrullus amarus*). Scions are

chosen to fit consumer market preferences while a suitable rootstock is selected based on grower need (resistance to specific pathogens, enhanced vigor, cold tolerance...). A list of cucurbit rootstocks including their reported disease resistance packages and U.S. availability is maintained at the vegetable grafting website.

Crop planning and pre grafting growth:
Successful grafting requires scion and rootstocks are ready to graft at the same time. This requires testing by propagators to determine how long each cultivar takes to reach appropriate size under their specific environmental conditions so that seeding dates can be properly coordinated. Generally, watermelon scions are planted 7-14 days before the faster growing rootstocks to ensure similar stem diameters. In our greenhouse (average daily temperatures 73.5-75.0 °F), we plant triploid (seedless) watermelon scions 21 days before grafting (DBG), wild watermelon rootstocks 14-15 DBG, bottle gourd rootstocks 12-13 DBG, and squash rootstocks 8 DBG (Figure 1). Watermelon scions are ready to graft when they have 1-2 true leaves, while squash, wild watermelon and bottle gourd rootstocks are often ready to graft between the time when the first true leaf can be clearly distinguished (unopened) and the time it reaches 1 inch. If rootstocks are too large, it is difficult to match scion diameter and avoid exposing hollow stems when grafting. In addition to stem diameter, rootstock height is important for plant quality. Rootstocks should be tall enough (>1.5 inches) to ensure that the graft union is above the soil after transplanting. However, excessively stretched rootstocks are delicate and difficult to handle. Rootstock height can be effectively controlled by adjusting

Figure 1 . From left to right, triploid watermelon scions, wild watermelon, bottle gourd, and squash rootstocks. Seeds were sown 21,15,13, and 8 days before grafting, respectively

temperature and lighting. While cultivars may differ, lower temperatures and higher daily light integrals (DLI) result in shorter plants while higher temperatures and lower DLI promote stretching. The number of seeds required must also be determined through testing. There is often a significant overseeding requirement for both scion and rootstock to ensure that there are enough properly sized plants at grafting and account for any losses during/post grafting. Overseeding rates are often especially high for seedless watermelon due to lower vigor and uniformity.

Grafting method (Figures 2 & 3):
Unlike other grafted crops like tomato, cucurbits require that at least one cotyledon be left intact on the rootstock to serve as an energy source during graft healing. While other methods exist, most commercially grafted watermelon in the U.S. is grafted using single cotyledon grafting (SCG). The process is similar for all rootstocks with the exception that squash is typically cut at the

Figure 2. Basic single cotyledon grafting process for watermelon grafted to squash. Links to detailed guides can be found under the section of "useful resources" at the end of this article.

substrate, grafted, and re-rooted during healing while the existing root system is kept intact with other rootstocks. Rootstock preparation can be difficult for beginning grafters but can be picked up quickly. The cut length on both scion and rootstock should be sufficiently long (0.25-0.30 inches) to maximize contact and should be flat and clean. Another critical aspect during rootstock preparation is the complete removal of the meristem (tiny growing point; figure 3A) at the base of the kept cotyledon. Failure to completely remove this meristem can allow rootstock regrowth making plants unmarketable (figure 3B). During rootstock preparation, care needs to be taken to avoid cutting too deep into the rootstock exposing the hollow stem which reduces scion-rootstock contact. Similarly, the remaining cotyledon must not be damaged during meristem removal. Scion preparation is generally easier than the rootstocks, requiring only a single cut (matching the rootstock) starting roughly 0.25 inches below the cotyledons. For seedless watermelon, the cut should be made so that the wide (flat) side of the stem contacts the rootstock. Regularly changing blades such as a disposable razor will ensure clean, accurate cuts. Once scion and rootstock are prepared, they must be held together with a clip and stabilized with a stake.

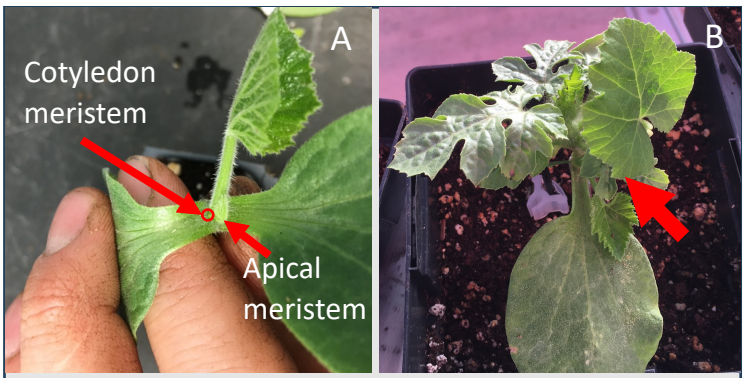

Figure 3. Squash rootstock with cotyledonary and apical meristems highlighted. Failure to completely remove the cotyledonary meristem results in the rootstock regrowth (B).

Healing:
Healing is critical in grafted plant production. Improper healing can lead to graft failure or poor-quality plants. Healing processes used in commercial operations vary greatly. However, the general process and principles are the same. Because vascular reconnection between scion and rootstock does not occur for several days, newly made grafts must be quickly moved to and kept in a high humidity environment initially to prevent desiccation and gradually acclimated to lower humidity conditions. This high humidity can be achieved with additional plastic coverings inside a greenhouse. In our standard protocols, we maintain close to 100% relative humidity for the first 4 days followed by 3 days of humidity reduction before exposing plants to ambient greenhouse conditions. Warm temperatures encourage fast growth and healing, while light is also necessary to prevent plant stretching. In our research projects we regularly achieve over 97% success rates in watermelon with precise control of temperature and light using a growth chamber. Specifically, we apply no light for the first 24 hours followed by continuous (24-hour photoperiod) low intensity (100 µmol m^{-2} s^{-1} PAR) lighting and a constant temperature of 81-82 °F inside the healing container. Post healing, transplants can be grown further in the greenhouse and hardened off for outdoor production. Compared to standard plants, grafts require additional quality control checks to ensure properly formed graft unions and that there is no rootstock regrowth.

Sanitation:
Because grafted plants are intensively handled, cut with the same blade, and healed in high humidity there is an increased risk of spreading pathogens to large numbers of plants if proper precautions are not taken. Of primary importance is starting with disease free scions and rootstocks. Visually unhealthy plants as well as those around them should be avoided as pathogens in those plants could be easily spread on contaminated blades. During grafting, blades should be regularly disinfected and replaced. Frequently cleaning the working space (remove plant fragments and sanitize between trays) also reduces risk of pathogen transmission.

Figure 4. Example benchtop healing setup in a greenhouse. Plastic covering maintains high humidity. Dark coverings used to exclude light can be seen on benches in B. Shade screens (overhead) are deployed to maintain relatively low light levels.

Useful resouces:
- Grafting Manual: http://www.vegetablegrafting.org/resources/grafting-manual/.
- Table of cucurbit rootstocks: http://www.vegetablegrafting.org/resources/rootstock-tables/.
- Growing wild watermelon and squash rootstocks: https://www.youtube.com/watch?v=N_Y3pysE7u8.
- Video of single cotyledon grafting: https://www.youtube.com/watch?v=SxTvFcVYhBI.

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