PLANTS

Transplants & Grafting

AUTHORS & INSTITUTIONS

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SECTIONS

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SECTION 1

Vegetable Grafting

Do you have a seemingly unbeatable soil problem, such as nematodes and plant pathogens? New growers usually do not, unless they've bought a farm with a long history of vegetable production. However, if you did and do, then grafting vegetables may be worth the added hassle and expense. This advanced technique does not add much value to vegetables grown in a stress-free environment. In fact, they can yield less in certain high-nutrient environments.

In grafting, a variety is chosen as the "top" or "scion", and another is chosen as the "rootstock". Both are grown, and then combined.

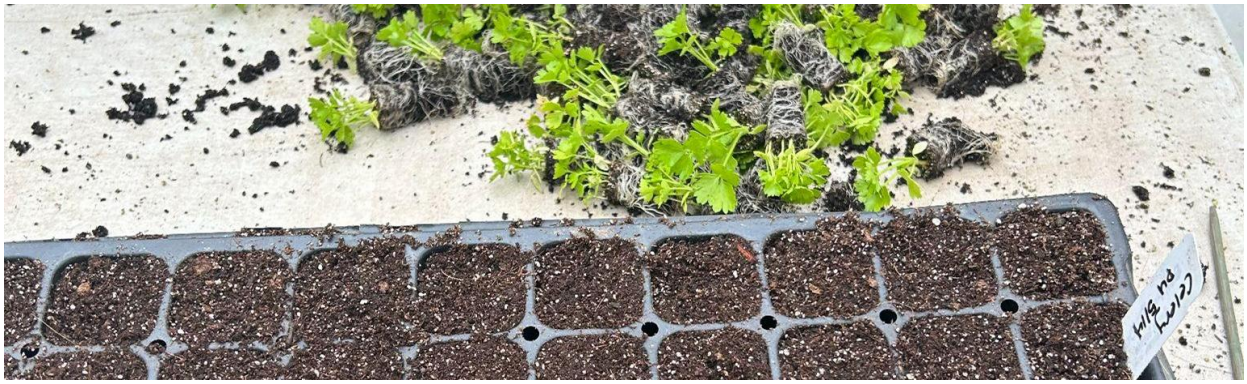
Three vegetables that can be grafted interchangeably are **tomatoes, eggplants,** and **peppers**. Any standard or wild variety of these three species can serve as a rootstock for any other variety, with a wide range of effects, including increased thriftiness with water and nutrients, resistance to diseases, increased vegetative growth, and sometimes dwarfing. However, rootstocks should be chosen carefully to address your specific problem. The quality of the fruit is generally unaffected.

Watermelons and cucumbers can also be grafted onto a rootstock made from a special breed of gourd, but a bad combination of scion and rootstock can affect the flavor of the watermelon. It is much more important to choose compatible varieties for this case. The primary interest in grafting cucumbers is to make the scions more cold-resistant.

How to Get Started

Identify your problem. For example, Verticillium wilt in eggplant, or nematodes in hoophouse tomatoes, or Fusarium in field-planted watermelon.

Browse catalogs for varieties that are known to be resistant to the stressor. Sometimes there are specific sections for rootstocks. In the case of tomato, eggplant, and tomato, a standard variety that is resistant to the issue might work. For example, most tomatoes are naturally resistant to Verticillium and can be grafted to eggplant as a rootstock. For tomatoes, peppers, or eggplants, it doesn't necessarily need to be a special rootstock variety. With all the combinations available, it is often best to have grafted plants made for you by a greenhouse operation with experience in these matters.



Primary Considerations

SPACE

If you graft your own vegetables you will need twice the amount of space to grow both the rootstock and scions. You will also need a special dark or shaded space to heal the grafted plants with 95% humidity for about two weeks.

TIME

You will need to figure out whether or not you need to start your rootstock and scion seeds at the same time, or stagger them due to the tendencies of each variety. True rootstock varieties often germinate and grow faster and so are started after scions. It helps to have colder and warmer areas in the greenhouse to slow down or speed up growth. As for your transplanting schedule, you will also need to factor in the extra two weeks of healing where the plants basically don't grow.

SIZE

When scions and rootstocks have stems about 2 mm thick, it's time to graft. If there is a size difference it is better to have thicker rootstocks than to have thicker scions.

EFFICIENCY

It helps to have a team of people to graft, and to work such that you don't end up with a bottleneck in the process that leaves ungrafted plants to wilt for too long.

SUPPLIES

Grafting clips are a must! The most versatile clips look like two clear soft plastic tubes mated together; one tube is complete, and one tube has a slit in it. When you squeeze the complete tube, it opens the other tube to clip onto the graft union. Then, the complete tube serves as a guide for a coffee stirrer stuck through into the potting media to hold the plant upright.

Process for getting started

- Start small. Just do enough for one row of tomatoes, or about 25 plants.
- Seed both sets of plants appropriately so that they will have 2 mm thick stems at about the same time.
- Gather your team to set up a good flow for the work. One person to cut and throw away rootstock tops, one person to cut and collect scion tops, and two people actively grafting the scion tops to the rootstock bottoms. The cuts on both the rootstocks and scions should be a 45 degree angle.
- After the grafts are made, they need to be moved to a dark and very humid space so that their tissues heal together. Since the vascular systems of both the rootstock and the scion are severed, they will lose moisture. The solution for this is to reduce their cues to grow by blocking light, and reduce their moisture loss with high humidity (>/=95%).

Disclaimer: For a specific list of resources in the above description, view the Necessary Resources area of this section.

SECTION 2

Fruit Grafting

Do you ever wonder why apple trees in modern orchards look different from the apple tree you might have climbed as a kid? In modern agriculture, most fruit trees are grown as dwarf-sized, which is made possible by grafting our preferred varieties onto roots that control the size of the tree.

In grafting, a variety is chosen as the "**top**" or "**scion**", and another is chosen as the "**rootstock**". Both are grown, and then combined.

Apples, pears, peaches, plums, cherries: rootstock is primarily used for size/vigor control with secondary use for disease control.

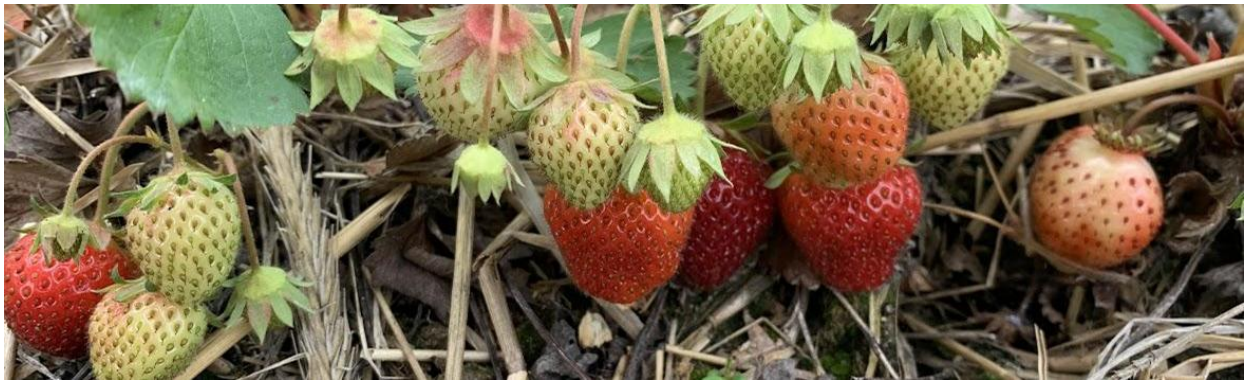
In **grapes**, rootstock is primarily used for Phylloxera control in V. vinifera grapes, with secondary use for size/vigor control. Hybrid wine grapes and many table grapes are grown on their own roots.

Blueberries, strawberries, and brambles: grafting is uncommon, though possible.

How to Get Started

Almost all commercially producing fruit trees are grafted. Those interested in purchasing new trees should browse catalogs for rootstock varieties that are known to be resistant to the stressor that also fit your size requirements. If you're buying a common variety (e.g. Honeycrisp apples, Bartlett pears, Montmorency cherries) buy them already grafted from a reputable nursery. Specialty trees, including cider apples, may be less available to purchase pre-grafted. In that case you will need to collect budwood of the specialty trees and purchase rootstock and graft the trees yourself or by commissioning a professional. Some nurseries will take special orders, but it may take a few years before the trees are ready.

Some pitfalls associated with grafting fruit trees include viruses, incompatibility (sometimes this can take a few years to show), and high failure rate of grafting for beginners.



Primary Considerations

SPACE

Different size rootstocks will determine your spacing.

TIME

For tree fruit grafting is usually done in April, budwood is collected in March.

SIZE

For tree fruit and grapes the branches are usually pencil thick. If there is a size difference it is better to have thicker rootstocks than to have thicker scions.

EFFICIENCY

It helps to have a team of people to graft, and to work such that you don't end up with a bottleneck in the process that leaves ungrafted plants to wilt for too long.

SUPPLIES

Grafting knives, parafilm, wax, omega grafter for bench grafting.

Process for getting started

- Practice. Just do a few trees, try a few different methods.
- Gather your team to set up a good flow for the work. One person to cut and throw away rootstock tops, one person to cut and collect scion tops, and two people actively grafting the scion tops to the rootstock bottoms. The cuts on both the rootstocks and scions should be a 45 degree angle.
- After the grafts are made, they need to be moved to a dark and very humid space so that their tissues heal together. Since the vascular systems of both the rootstock and the scion are severed, they will lose moisture. The solution for this is to reduce their cues to grow by blocking light, and reduce their moisture loss with high humidity (>/=95%).

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TRANSPLANTS & GRAFTING

COMMON QUESTIONS

01 Should I graft?

VEGETABLE GRAFTING

The situations where grafting works best are in hoophouses where tomatoes have been grown continuously for more than four years, and in fields where watermelons have been grown for more than three times in eight years. Also, nearly any field where eggplants are grown more than once in any span of time. These scenarios represent crops that suffer from a buildup of pathogens. Early hoophouse cucumbers can also benefit from grafting for cold tolerance.

FRUIT GRAFTING

Most growers purchase trees that have already been grafted, and for common varieties that is the easiest method. Growers who want to grow specialty varieties may have to propagate them on their own to get the trees they want.

02 How do I choose a rootstock?

There are more and more seed companies selling rootstocks, and they report pertinent information about their qualities that can help you decide if they are right for you. There are several “standards” that appear to have multiple-functions to cover a lot of different situations and with catchy names that make them easy to remember, such as ‘Maxifort’ tomato, ‘Carolina Strongback’ squash, and ‘Foundation’ pepper.

03 Why did my grafted plants die?

Grafting takes time to learn. The most common problems the new grafters encounter are uneven stem diameters and uneven cut angles that cause a poor graft union, and poor healing conditions that further stress them. One other common mistake grafters make is to water rootstocks and scions heavily before grafting. This actually makes them ooze water and form a thin layer of liquid that prevents the two surfaces from mating together well. It is common to experience 50-75% loss rates in the first year of learning.

04 Do grafted plants grow differently than non-grafted plants?

True rootstock varieties are especially vigorous and thrifty. They don't need as much pampering with irrigation and nutrients. In a stress-free environment they can become quite gluttonous and create rampant vegetative growth with less fruit production. Growers have had to dial back their fertility in particular. Rootstocks can also sometimes form stems from below the graft that bully their way past the scion's growth. These need to be pruned off. In some early experiments, certain bell peppers caused a dwarfing effect when used as rootstocks. Poor rootstock pairings with watermelon can create off flavors in the final product.

05 Can I sell the fruit of rootstock plants?

Rootstocks can sometimes send up a shoot from below the graft. The fruit of true rootstock varieties are typically not desirable in appearance or flavor, which makes them easy to sort out.

NECESSARY RESOURCES

VEGETABLE GRAFTING

- http://www.vegetablegrafting.org/ includes a detailed manual and pictures, as well as a rootstock reference resource
- How to Splice Graft Cucumber Plants by Wenjing Guan at Purdue Extension - includes detailed instructions, pictures, and a companion video
- Techniques for Tomato Grafting by Wenjing Guan and Steve Hallett at Purdue Extension - includes detailed instructions, pictures, and a companion video

FRUIT GRAFTING

- Dwarfed fruit trees, Tukey
- The Bench Grafter's Handbook: Principles & Practice; Humphrey