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Grafting Tomatoes for Arkansas Growers

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Introduction

From a plant disease perspective, growing grafted tomatoes is an excellent management tool for both the home gardener and commercial grower in Arkansas. For field-grown tomatoes, grafting is used primarily to increase their resistance capability to soil-borne diseases such as verticillium wilt (*Verticillium albo-atrum, V. dahliae*), fusarium wilt (*Fusarium oxysporum* f. sp. *lycopersici*) and root-knot nematode (*Meloidogyne* sp.). Grafting of greenhouse tomatoes can be used to decrease susceptibility to these plant disease organisms and to increase fruit production and quality by increased plant vigor. Historically, these diseases are common in many areas in Arkansas where tomatoes have been grown on a seasonal basis for a number of years. They tend to be more prevalent during warm weather conditions and in sandy soils.

Verticillium wilt is often confused with fusarium wilt and bacterial wilt. Initially, fusarium-infected plants often wilt in the hottest part of the day and recover at night. A reddish brown discoloration is seen just under the bark in the lower stem area of the plant when split lengthwise. The pith remains green or whitish. The disease is favored by cool weather and soils with a high soil pH. Root-knot nematode pressure can increase the disease by providing wounds to the root system.

Fusarium wilt is perhaps the most important of the wilt-type diseases of tomato. It is favored by hot weather and sandy, acid soils. The fungus can survive in the soil for years and can be spread by anything that moves the soil or infected plant material. Leaves tend to initially wilt on one side of the plant. Eventually the entire plant collapses and dies.

Root-knot nematodes are common in sandy soils where tomatoes and other susceptible row crops and non-row crops have been grown long term. These microscopic roundworms build up during the summer months and can feed on roots of many other agriculturally important plants. Small swellings or knots develop on the roots. Severely infected plants may become chlorotic and wilted.

Methods

The technique of tomato grafting involves splicing the fruit-producing scion (above-ground portion) of a desirable variety such as “purple celebrity” or heirloom type onto the rootstock (below-ground portion) of another variety that possesses resistance to a particular disease or group of root-related diseases that are of concern to the grower. Basically, the above-ground portion (scion) of a seedling of the heirloom variety is secured to the root system (rootstock) of a disease-resistant seedling by some device, usually a plastic clip that holds the two portions together while they grow together (heal). The entire process should be treated like a surgical process in which sanitation is essential in every step. After a suitable “curing” period in which both scion and rootstock achieve a good connection and are acclimated to sunlight, plants are ready to be transplanted to the field or garden.

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The scion portion could be a cutting from any tomato variety the propagator is trying to produce. In many cases, this will be from an heirloom variety with superior taste and quality.

Rootstock selection is a key factor in successful grafting. The rootstock can either be from commercial tomato rootstock cultivars (Table 1) or any tomato variety that has the desired resistance. There are many combinations of resistance available utilizing commercial hybrid tomato varieties. Refer to seed catalogs to determine which variety has the resistance you require. In Arkansas, root-knot nematodes and the soil-borne disease fusarium wilt can be serious problems for heirloom tomato producers. Grafters could select one of the many commercially available hybrid tomato varieties that are resistant to those disorders, such as the hybrid tomato varieties 'Amelia' and 'Crista.' Both of these varieties are resistant to fusarium wilt races 1, 2 and 3 and three of the root-knot nematodes: Ma, Mi and Mj. These two rootstocks have been successfully evaluated under Arkansas conditions.

Keep in mind that there may be some degree of incompatibility between rootstock and scion. Finding the right combination may be by trial and error.

The three most common techniques used for grafting are what are referred to as a tongue approach, cleft and tube grafting. When performing both cleft and tube grafting, it is important that the diameter of the cut ends of the scion and rootstock be the same. This will help ensure a good cambium connection between the scion and rootstock. To help increase the success rate, grafting should be done during the late evening or night. Also, prune or cut off all of the limbs and leaves except the top leaf to reduce moisture loss due to transpiration. This reduces water and nutrient stress. It is critical that neither the scion nor rootstock portions be allowed to dry out until the graft union has healed. The cleft graft is perhaps the most common and simplest type to perform. For the greatest level of success, the stem diameter of the scion and rootstock should match precisely for the cambiums of the respective portions to match. For cleft grafting, it is recommended that the seeds for the rootstock be seeded five to seven days before the seeds for the scion plant. For tube grafting, seeds should be sown one to two days prior to seeds for the scion. With the tongue grafting technique, the scion donor-plant remains on its own rootstock until the graft heals.

After the grafting process, the plants will need to heal. Newly grafted plants should be kept in total darkness for four to six days at 85°F and 95% humidity. The high relative humidity can be maintained by using a plastic tent, plastic bag or even a box as an enclosure. After healing, plants should be acclimated to full sun over a period of three to four days. The entire process from sowing seed to transplanting may take up to five weeks.

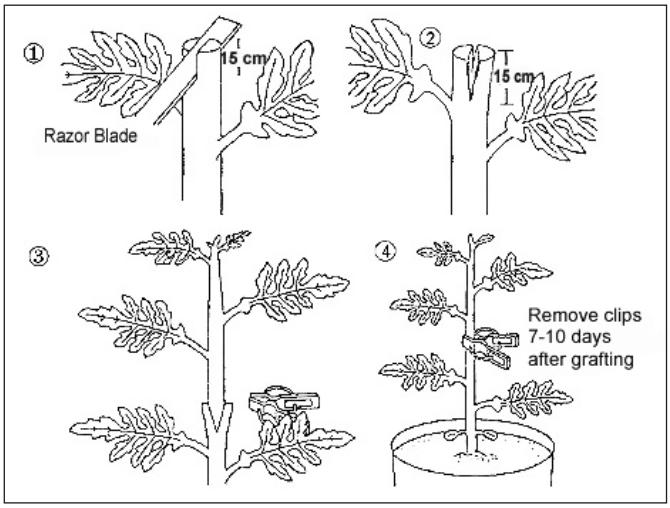

Figure 1. Schematic diagram of cleft graft technique *(courtesy Masayuka Oda).*

Table 1. Disease resistance and vigor of commercial tomato rootstock cultivars (ratings are based on seed supplier information; vigor is measured on a scale of 1 to 5, where 1 represents poor and 5 represents excellent).

Seed Supplier/ Rootstock	Disease Resistance							Vigor
	Tomato Mosaic Virus	Corky Root	Fusarium Wilt		Verticillium Wilt	Bacterial Wilt	Nematodes	
			Race 1	Race 2	Race 1			
deRuiter Seeds								
Maxifort	High	High	Moderate	High	High	Susceptible	High	5
Beaufort	High	High	Moderate	High	High	Susceptible	High	3
Takii Seeds								
Anchor-T	High	Suspectible	High	High	High	Moderate	High	5
Survivor	High	Suspectible	High	High	High	Moderate	High	5
Aegis	High	Moderate	High	High	High	Moderate	High	4
Bruinsma Seeds								
Body	High	High	Susceptible	High	High	Susceptible	High	5
Robusta	High	High	Susceptible	High	High	Susceptible	Susceptible	3

(From "Grafting for Disease Resistance in Heirloom Tomatoes," 2006, by Cary Rivard, graduate research assistant, and Frank Louws, Ph.D., associate professor, Department of Plant Pathology, NCSU)

Figure 2. Preparing the rootstock with vertical cut.

To see various types of tomato grafting techniques demonstrated by The Ohio State University, visit http://www.youtube.com/watch?v=tHnOYcI6B44.

When transplanting into the garden or field, it is very important to keep the graft union above the soil line to prevent adventitious roots or suckers from developing from the grafted scion. Shallow planting can help avoid these adventitious roots. If the scion is allowed to root into the soil, the plant may become susceptible to any soil-borne diseases that are present.

Figure 3. Preparing the scion.

Figure 4. Alignment and clipping the completed graft *(courtesy M. Traynor).*

Figure 5. Healing the graft union.

Advantages

Grafting can be very effective against a variety of soil-borne fungal, bacterial, viral and nematode diseases. It can also be an alternative technique to using methyl bromide, a chemical fumigant. Grafting tomatoes is often used to manage another serious disease called bacterial wilt which is caused by the bacterium *Ralstonia solanacearum*. Resistant varieties that were previously available were not of an appreciable size and marketability. Grafting has allowed not only for the production of a high-quality fruit but also for resistance to many infectious diseases. Rootstocks used in grafting can also provide a stronger and more cold-hardy or heat-resistant root system. They can also increase fruit size, yield and quality of the tomato.

The most efficient and cost-effective management practice for these infectious diseases is to select and grow resistant varieties. Cultural practices such as crop rotation, weed management and pH adjustments can complement disease management.

Disadvantages

Cost is perhaps the biggest disadvantage. Grafted plants have an added cost associated with labor and materials. If growers are interested in grafting, they will need grafting and growing supplies, plant materials and an appropriate facility to grow and "heal" the newly grafted plants. Another disadvantage is time. After the grafting process, the grafted plant will require additional growing time before transplanting into the garden.

Since grafting involves making a wound on the plant, growers should be aware that wounds can provide entry sites for various disease organisms on the plant. Good sanitation should be practiced at all times when performing grafts. If the graft union is not strong enough or does not maintain good contact, stems may be disfigured and unable to support the leaves and roots.

Figure 6. Tray of healing plants.

Additional Information

An effective disease management program begins with an accurate diagnosis. A microscopic laboratory exam in conjunction with background information about the disease situation may be required for an accurate diagnosis. For further information about growing and caring for tomatoes, contact your local county Extension office or the Arkansas Plant Health Clinic at ssmith@uada.edu.

Additional fact sheets are available at http://www.uaex.uada.edu.

Unless indicated otherwise, all photos courtesy John Gavin.

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