



Down to Earth: Reports from the field

Innovative Small Farmers' Outreach Program (ISFOP): West Central Region

Vegetable Grafting: An Introduction by Dr. Sanjun Gu

Grafting is an old practice with tree fruit. It is the act of joining two plants together. The upper part of the graft, the *scion*, becomes the top of the plant; the lower portion, the rootstock, becomes the root system or part of the trunk. Vegetable grafting (Fig. 1) came in much later. It first appeared in an ancient Chinese book when an experienced farmer was recorded to use more than six gourd plants (rootstocks) to support one gourd vine (scion) and harvested extra large gourds (birdhouse). Commercial grafting of vegetable plants began in Korea and Japan in the late 1920s when watermelon plants were grafted onto squash rootstocks for Fusarium wilt resistance. Eggplant was grafted onto scarlet eggplant (*Solanum integrifolium* Poir) in the 1950s. Since then, grafting has been adopted in Asia and Europe for various protected production systems including greenhouse and high tunnels. Currently, more than 95 percent of cucumbers and watermelons, and more than 54 percent of tomatoes grown in South Korea or Japan are grafted. In China, almost all cucumber and most tomato, watermelon and eggplant plants, are grafted for winter production in unheated solar plastic greenhouses or low-tunnels. In the Mediterranean region, grafting has been a major component of integrated management on soilborne diseases and increasing crop productivity. The number of grafted tomato plants was over 45 million in Spain and over 20 million in Morocco in 2004. In North America, there are about 40 million grafted hydroponic tomatoes in the British Columbia area and over 1250 acres of grafted tomatoes in Mexico.

In the United States, however, vegetable grafting has been an emerging technique but has become popular among small-scale farmers, especially with those who have high tunnels or a greenhouse. So far, research and demonstrations have been conducted at University of Florida, North Carolina State University, The Ohio State University, University of Arizona and Lincoln University of Missouri. Although only a few Missouri farmers have included grafting in (*cont'd on page 2*)



Figure 1. Grafted tomato plants using the tube grafting method.

Saskatoons! By Jim Peirce

If you are considering beginning a fruit orchard or adding a fruit crop to your farm plan, there is a crop emerging for the Midwest called saskatoons. There are many names for the saskatoon such as June berry, service berry and Amelanchier. This deep blue to purple fruit is gaining consumer acceptance and offers a potentially profitable option for small scale producers. The blueberry looking fruit is very healthy and high fiber. It also has a high antioxidant value and is highly nutritious. The value added producer will find that the berry lends itself to value

added products such as jams.

The Fruit: It is commonly referred to as a berry while technically it is a pome fruit related to apples, plums and cherries. The fruit is similar in size to blueberries. The fruit grows in clusters and ripens evenly for a once-over picking by machine or hand. The berries are an excellent source of vitamin C, manganese, magnesium, iron and a good source of calcium, potassium, copper and carotene. Because the small edible seeds are consumed, the berries are also higher in protein, fat and fiber.

The Plant: The Latin for Saskatoons is *Amelanchier alnifolia*. They are hardy perennials and grow as woody shrubs rather than trees. Saskatoons have been found to tolerate winter temperatures of -50 to -60°F and are considered very hardy. They are also drought resistant. Saskatoons are considered self-pollinated because they don't need pollinators to produce a crop. Pollination may actually increase the seediness of fruit. Flower buds are formed on wood in year one and fruit set occurs the following spring forming clusters. Height varies from (*cont'd on page 2*)

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their vegetable production, Fahrmeier Farms in Lexington, Missouri began tomato grafting about 10 years ago with excellent results. This technique has been well accepted among Missouri extension horticulturists, thanks to a professional development program grant awarded to Lincoln University from the USDA Sustainable Agriculture Research and Education (SARE).

The benefits of vegetable grafting are prominent with intensive cropping systems such as in greenhouses and high tunnels. By carefully choosing appropriate rootstock

varieties, grafted vegetable plants will have a more hardy root system that provides resistance to disease and cold weather, and enhances water and the ability to absorb minerals. The increased efficiency of nutrient and water absorption has been observed on most grafted vegetables and reduced fertilizer inputs have been reported on grafted cucurbits, a plant from the gourd family. Grafting can also be an alternative, in terms of soil-borne diseases, to methyl bromide which had been used extensively for soil fumigation but was banned com-

pletely in 2005. Grafting could be instrumental for organic and sustainable production of heirloom tomatoes. Grafting disease-susceptible heirloom tomatoes to resistant rootstocks is recommended for organic cultivation by researchers at North Carolina State University. For cucumber, watermelon and melon grafting, Fusarium wilt disease resistance has been a target in production. For tomatoes, grafting targets multiple diseases as detailed in Table 1. Grafting vegetable seedlings involves extra investment in materials (rootstock seeds, grafting tools, healing chamber etc.) and labor. (cont'd on page 4)

Table 1. Rootstock and Disease Resistance in Tomatoes

Rootstock	TMV	Corky Root	Fusarium Wilt (Race 1&2)	Verticillium Wilt	Root-knot Nematode	Bacterial Wilt	Southern Blight
Beaufort	R	R	R	R	MR	S	HR
Maxifort	R	R	R	R	MR	S	HR
TMZQ702	R	S	R	R	MR	HR	?
RST-04-105	R	S	R	R	MR	HR	MR
Big Power	R	R	R	R	MR	S	HR

TMV: Tobacco Mosaic Virus; R: Resistance; HR: High Resistance; MR: Moderate Resistance; S: Susceptible

Saskatoons . . .(continued from page 1)

1-18 feet depending on variety and pruning management. Saskatoon tolerates a wide range of soil types. The ideal pH range is 5-8. Today one can find it grown commercially in Canada, while in the United States it is grown on limited acreage in the north



Berries of the Saskatoon bush growing in Missouri. Photo by Jim Pierce.

and northwest states. When buying plants, choose those produced from cuttings, division or tissue culture. Plants could stay productive for up to 50 years. Planting should ideally occur in early spring.

Production: Saskatoons are considered wild and there is little literature on production settings. They do tolerate a wide range of conditions and practices. They will do better on a well drained site. This means a

soil that does not hold water for an extended time or a soil that has been amended and hilled before planting. A site that has a gentle slope of 1-3 degrees will also facilitate air drainage which will help avoid late frost damage.

Like any crop, enhancing the site where they grow will result in higher yields. Fall application of fertilizer is not recommended as it will promote vegetative growth that will not survive the winter. Therefore, it is recommended to fertilize preplant and early in every spring. When considering the economics of applying fertilizer remember higher yields don't necessarily equal more profit. A close evaluation of production costs and resulting income needs to be done when considering applying inputs such as fertilizer.

Pruning is kept to a minimum. Remove dead and diseased branches in early spring. Thinning the middle to facilitate air movement through the bush will help in preventing diseases that start in the leaves. You can plant around 880 per acre with rows at least 10 feet apart and, depending on farm equipment, 3-5 feet in row spacing. Reducing competition from weeds that affect marketable yields. Some mulch choices to consider are plastic, woven weed barrier, organic-such as straw and wood chips. Some me-

chanical methods for weed control are mowing or cultivating. As a last resort some herbicides are labeled for Amelanchier.

Plants begin bearing in their third year with significant yields beginning in the fifth year. Average yields of 3,000-5,000 pounds per acre with well managed orchards reaching 28,000. Fruit is commonly sold for around \$2 a pound.

Northline, Smoky and Honeywood are the predominant varieties that can be found from orchard stock. Honeywood will produce large fruit while Smoky is commonly suggested for medium sized fruit in a commercial orchard.

Demand/Marketing: According to the USDA, a diet diverse in fresh fruit and vegetable consumption leads to better health. In the US there is a growing awareness of eating locally grown fresh produce for good health and consumers are demanding fresh, local fruits and vegetables. The versatile Saskatoon can be used for fresh consumption or processed adding value in the form of jams, jellies, pies, syrups, muffins and wine.

The opportunity exists to market this fruit as high fiber, antioxidant and vitamin C. The Potential market channels are U-pick, farmer's markets, wholesale, or processed into a value added product.

More information can be found at: <http://www.prairie-elements.ca/saskatoon/14.3-quality.pdf>

Keeping it Sharp! By Jeff Yearington

How sharp you make your tools is a matter of personal choice. I like my shovels to be sharp enough to cut through minor roots, but with my rocky soil, I won't repair an edge to razor sharpness every five minutes. On the other hand, when I'm trimming back my lilacs, a razor-edged pair of pruning shears makes the job quick and easy. Sharpening tools is a slightly more complicated procedure than removing rust. Some tools like shovels, axes, hoes, and trowels are best sharpened with a hand file, while other tools like pruning shears and knives call for a honing stone. Depending on how dull an edge is, some tools may require the use of a high-speed grinder.

A good guideline to use when sharpening is to follow the bevel already on the tool's blade. Recommended sharpening angles range from 10 to 45 degrees depending on the tool and its use. In general, the angle of sharpness determines the length of the blade's beveled edge, so use the angle of the blade as a guideline when sharpening.

For example, blades sharpened at low angles have relatively wide bevels. Knives and pruning shears,

tools that need finer edges for cutting, should be sharpened to between a 10- to 25-degree angle. Tools used for heavy-duty chores that dull the blades quickly, like hoes, shovels, and mattocks, only need to be sharpened to a 30- to 35-degree angle. The bevel on these blades is relatively short. Understanding this relationship is the key to successful sharpening.

The tools needed for basic sharpening are neither expensive nor complicated. The most basic sharpening tool is an 8 or 10-inch-long mill file with a bastard cut which you can purchase at your favorite hardware store for about \$8 to \$12. When sharpening a tool with a mill file, work by drawing the cutting teeth in one direction over the edge being sharpened. For best results, hold the tool steady in a vise, or other bracing system, keeping the file at an angle from the plane of the tool's working surface as you push it along the edge you are sharpening. And since sharpening edges with a mill file requires two hands, get one that has a handle on one end. This makes it easier to maneuver and get a good edge. Remove the hoe from the vise (if applicable) and test it in the



Sharpening the head of a hoe with a file

Photo by Jeff Yearington.

soil. You should notice a measurable difference in the sharpness as it cultivates the soil. Once you complete your sharpening work use a rag with some vegetable oil and wipe it on the tool to help prevent rust.

IPM CORNER: Importance of Pollination and Pollinator Insects

By Dr. Jaime Piñero, LUCE State Extension Specialist-Integrated Pest Management

Close to seventy-five percent of the flowering plants on earth rely to some degree on pollinators in order to set seed or fruit. Therefore, understanding, providing, enhancing, and managing habitat for pollinating insects is a very important component of food production. We are well into the fall so the following information will become useful for next spring.

What is pollination and why is it important? Pollination is the transfer of pollen within a flower or between flowers and is needed for many plants to produce fruits. For the vegetables we grow for leaves (lettuce, spinach, cabbage) and roots (beets, carrots, radishes), pollination is not important. But the vegetables we grow for fruit, or seeds (melons, corn), pollination is almost always needed. The pollination process in all beans, peas, and tomatoes is called self-pollination because the transfer of pollen takes place within the individual flowers without the aid of insects or wind. However, many crops such as cucurbits (e.g., squash, pumpkins, melons, cucumbers) have the male and female organs in separate flowers on the same plant and therefore insects are needed to transfer pollen from male flowers to female flowers while going from flower to flower, collecting nectar and pollen. In

general, the more bee visits per flower, the greater the number of seeds per fruit, the larger the size of the fruit, and the smaller the number of irregularly shaped fruit. Poorly shaped fruit (cucumbers, watermelons, tomatoes) may result from incomplete pollination but also from temperature extremes and poor plant nutrition status. Also, many insects that visit flowers as adults also provide pest control for crop plants.

What are the most common pollinating insects?

Bees (honey bees, native bees, bumble bees, sweat bees) are the most important group of pollinators. Flies are important pollinators of strawberries, and for onion and carrot seed, whose flowers are not a favorite of managed bees. Wasps, butterflies, and moths can also aid in pollination, but to a lesser degree.

How can I enhance pollination in my garden? Since pollinating insects are so important in the garden, it is important to consider them when choosing and applying insecticides. Choose insecticides that are least toxic to bees, and apply them late in the day when bees are not actively working in the

garden. A patch of suitable flowers quickly becomes a magnet for butterflies, bees, flies, and beetles that aid in pollination of adjacent plants. The following advice comes from the Xerces Society (<http://www.xerces.org>), an international non-profit organization that protects wildlife through the conservation of invertebrates and their habitat:

Use local native plants. Research suggests native plants are four times more attractive to native bees than exotic flowers. In gardens, heirloom varieties of herbs and perennials can also provide good foraging.

Choose several colors of flowers. Flower colors that particularly attract native bees are blue, purple, violet, white, and yellow.

Plant flowers in clumps. Flowers clustered into clumps of one species will attract more pollinators than individual plants scattered through the habitat patch. Where space allows, make the clumps four feet or more in diameter.

Include flowers of different shapes. Bees are all different sizes, have different tongue lengths, and will feed (cont'd on page 4)

Native plants should be your first choice to help our native bees!

ISFOP

If you are a small farmer and need information, please contact an ISFOP Farm Outreach Worker (FOW). FOWs live and work in your community. They can provide information on ways to better manage your resources, reduce expense and increase income. They can also provide information on other programs and resources that may increase your income and the overall quality of life for you and your family.

You are eligible to participate if:

- ☑ Your family lives on a farm, rural or urban.
- ☑ Farm products or income from the farm are necessary for you to live where you do.
- ☑ Your family provides the management and most of the labor for your farm.
- ☑ Your total annual family income is less than \$50,000.

How to Contact

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IPM Corner...

(continued from page 4)

on different shaped flowers. Consequently, providing a range of flower shapes means more bees can benefit.

Have a diversity of plants flowering all season. By having several plant species flowering at once, and a sequence of plants flowering through spring, summer, and fall, you can support a range of bee species that fly at different times of the season.

Where can I buy seeds? Information on where to get seeds, and for the types of native plant seeds that are available and suitable for Missouri can be provided by Dr. Nadia Navarrete-Tindal (Navarrete-TindalN@LincolnU.edu), State Extension Specialist—Native Plants.

Vegetable Grafting... (continued from page 2)

Grafted tomato transplants cost 40 to 50 cents more per plant. The labor input is not as high as one would imagine. About 24 percent of the total cost for farmers without any experience in grafting (Fig. 2) will be reduced to about 15-17 percent after some practice. These additional costs will be easily compensated by the profit increase associated with increased yield and quality. Yield of grafted tomatoes could be increased by 9.4 tons (or 752 more boxes) per acre or a \$9,014 profit increase (assuming \$12 per box). This translates to a profit increase of \$1.88 per plant. In the case

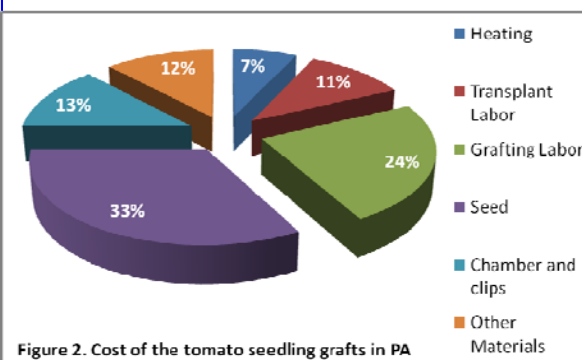


Figure 2. Cost of the tomato seedling grafts in PA

of watermelon, a grafted transplant costs about 50 cents more than an ungrafted one which translates to a \$700 additional cost per acre. The return, however, would be at least 12.6 percent more than the ungrafted if Fusarium wilt is a problem.

Please note that grafting is not for all vegetables. It is more applicable to fruiting vegetables and some vining vegetables such as tomato, watermelon, melon and cucumber.

Grafting vegetables is not a complicated technique. Look for future articles on specific grafting methods for tomato, cucumber, melon, watermelon, pepper and eggplant.

Upcoming Events

- **Great Plains Growers Conference:** January 5-7, 2012, St. Joseph, MO www.greatplainsgrowers.org
- **Governor's Ag Conference:** January 19-21, 2012 Kansas City, MO www.mda.mo.gov/events.php
- **Missouri Organic Association Conference:** February 2-4, 2012 St. Louis, MO www.missouriorganic.org
- **Goat Workshop:** February 28, 2012, 10 a.m. to 3 p.m., Pleasant Hill, MO. Contact Jeff Yearington (FOW), details above.