

Scab-resistant Cultivars (Varieties)

Susan Brown and Kevin Maloney
Department of Horticultural Sciences, NYSAES, Cornell University
Geneva, NY

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Scab-resistant apples are an important component in organic apple production, but organic apple production, especially in the northeast, is a challenging, high-risk endeavor due to the need for adequate (higher) profit margins, high costs to transition from traditional to organic culture and a more diverse set of pests and diseases to protect against. Apple scab is not the largest challenge in organic orcharding, but the use of resistant cultivars eliminates one of the production problems.

“Breeding for scab resistance has accelerated around the world in recent years. A number of new varieties have been introduced to the marketplace. Some of these varieties are now available to NY growers and others will be introduced in the US as club varieties. These new varieties have ever improving quality and can be the center piece of organic apple production in NY State.”

powdery mildew (*Podosphaera leucotricha*) is one of the important attributes of a resistant cultivar. In the eastern US, resistance to cedar apple rust (*Gymnosporangium virginiana*) and quince rust are also important. With the reduction or elimination of fungicide sprays, new concerns emerge, such as the summer fungal diseases (sooty blotch and fly speck). Resistance to the bacterial disease fire blight (*Erwinia amylovora*) is desirable as is resistance to postharvest diseases and disorders.

Breeding for scab-resistant cultivars

In the United States, the PRI cooperative among three apple breeding programs (Purdue University in Indiana, Rutgers University in New Jersey and the University of Illinois) has had a long history of developing scab-resistant varieties (Crosby et al., 1992) and www.hort.purdue.edu/newcrop/pri/. At Cornell University, the scab-resistant cultivars ‘Liberty’ and ‘Freedom’ were named (Lamb et al., 1978, 1983) and crosses continue to be made to develop scab-resistant cultivars. Some advanced selections are available for growers to test under a non-distribution agreement.

Breeding for scab resistance has accelerated in Europe and other regions of the world, with new releases in France, Italy, Germany and the Czech Republic. It is likely that some of these varieties will be available in the US for production, as several have been granted US patents. Marketing for scab-resistant cultivars, such as ‘Modi’, stresses “environmentally friendly production” and state that this red apple is “green” (www.modiapple.com). A

club or a managed variety approach to growing and marketing is also occurring with scab-resistant varieties in Europe and include ‘Ariane’, ‘Juliet’ and ‘Modi’.

Europe has also been engaged in large-scale testing of cultivars and production systems for organic apple production, more so than any other part of the world (Weibel et al., 2003). Weibel et al. (2007) provides an excellent overview of some of the challenges and limiting factors beyond resistance, such as thinning, weed control and marketing.

Scab resistance breeding is starting to yield cultivars approaching commercial competitiveness, but we are still lacking a strong contender, with all the desirable attributes. To conserve resistance, pyramiding of genes will be necessary and will affect quality. Growers interested in growing scab-resistant cultivars are urged to start small and then expand. Attention to management is key. There are many sources of information on the web (included below), yet organic fruit product remains challenging and higher prices are needed for organic apples to be profitable.

Scab-resistant cultivars currently available for testing in the US

There are many more scab-resistant cultivars available in the US than listed here, and others from Canadian programs. We have only listed a few cultivars that have had better success in limited testing. Growers are cautioned to test extensively before planting.

‘CrimsonCrisp’™ (Co-op 39): This eighteenth release from the PRI cooperative was tested in the NE183 trials (Janick et al., 2006). ‘CrimsonCrisp’™ is resistant to scab but susceptible to cedar apple rust (CAR) and to fire blight. Ripens mid-September.

‘Enterprise’: While some growers have had good experiences with ‘Enterprise’, the quality is poor and it has objectionably thick skin, perhaps limiting it to juice production or other processing.

‘Galarina’ (x4982): This breeding selection from France, a hybrid of ‘Florina’ x ‘Gala’, was released jointly by Agriculture and Agri-Food Canada and INRA in France (Khanizadeh et al., 2003). Fruits ripen about with ‘Cortland’. Some years at Geneva the fruits have had raised russet resembling acorn caps at the top of the fruit and these fruits were considered unmarketable.

‘Goldrush’ (Co-op 38): A very acid, green/gold-skinned cultivar that has excellent firmness, crispness, storage and storage life. ‘Goldrush’ is very susceptible to powdery mildew and is also susceptible to cedar apple rust. This apple has excellent quality after storage, but its late maturing restricts its adaptation to sites with a long growing season. Surprisingly, this very acid cultivar (in the US) is classified as a mild to sweet cultivar when tested in Switzerland (Weibel et al., 2003).

‘Juliet’™ (Co-op 43): The latest release from the PRI program

(Korban et al., 2003) this variety ripens two to three weeks after 'Delicious'. 'Juliet' is susceptible to cedar apple rust (CAR). Grown in France under organic production and licensed as an exclusive to Benoit ESCANDE (www.juliet.eu).

'Liberty': One of the best known of the scab-resistant apples, 'Liberty' must not be picked too early or acidity and astringency will be prominent. Ripens with 'Empire' and fruit quality improves with storage. Adequate thinning is essential. Trees are productive and winter hardy.

'Pixie Crunch'[™] (Co-op 33): Named for its small to moderate fruit size and its crisp texture (Janick et al., 2004). The open calyx at the base of the fruit is a concern for the development of moldy core. Suggested for home gardeners or for U-pick operations but not as a commercial variety to place in cold storage due to its relative short storage life. 'Pixie Crunch' ripens in mid-September but has the ability to hang on the tree.

'Pristine' (Co-op 32): This clean yellow apple is also from PRI (Janick et al., 1995) Tested in the NE183 trials. Ripens in mid-August, this variety may be site selective, with some sites unable to produce enough sugar in the fruit to balance its high acidity. Fire blight has been observed in some test sites and 'Pristine' is known to be susceptible to cedar apple rust.

'Redfree' (Co-op 13): A very sweet August ripening apple that has been successful as a niche variety in WI. Tree habit is weepy and prone to bare wood. 'Redfree' is highly susceptible to rosy apple aphid infection and to fire blight (Minarro and Dapena, 2007).

'Scarlet O'Hara' (Co-op 25): (Janick et al., 2000). This cultivar has excellent firmness and storage life, but its susceptibility to fire blight and to moldy core have limited its commercialization.

'Sundance'[™] (Co-op 29): A yellow skinned variety that occasionally is faintly blushed (Janick et al., 2004). This variety ripens in mid-October in Indiana. Fruits of 'Sundance' are prone to russet in the stem cavity and this russet can extend over the side of the fruit. Prone to biennial bearing, fruit clustering and bare wood.

'Topaz': This hybrid of 'Rubin' x 'Vanda' was developed and named by the Czech Republic. It ripens in the middle of October and has good fruit quality. Fruits are prone to bitter pit and have a short storage life. Trees also prone to collar rot and are very susceptible to fire blight (noted in the US and Europe). It has been trialed fairly extensively in Europe as one of the better quality scab-resistant cultivars. However in a trial in The Netherlands, 'Topaz' produced 75-79% class 1 fruits for three years, but then dropped to 25% class one fruits due to stem bowl russetting (Van der Maas, 2007).

Varieties from Europe that may become available in the US

'Ariane': This apple was derived from a cross of two selections, one a hybrid of 'Florina' x 'Prima' and the pollen parent an open pollinated selection from 'Golden Delicious' (Laurens et al., 2005). By 2005, about 95,000 trees of 'Ariane' already had been planted in France. The quality of the fruit is excellent as is the storage life, but thinning must be aggressive to obtain good fruit size. 'Ariane' is also said to have good resistance to powdery mildew and to fire blight.

'Ariwa': This scab-resistant apple from the Swiss breeding program also has good resistance to powdery mildew in European trials.

'Ecolette': A hybrid of 'Elstar' by 'Prima' that was developed in the Netherlands. Fruit size and yield are moderate; fruits are tart with good firmness and keeping quality. Low susceptibility to mildew.

'Goldstar': This apple was developed in the Czech Republic, has 'Golden Delicious' and 'Lord Lambourne' in its pedigree, and has looked promising in some tests. It was rated as worth a trial by Lind et al. (2003)

'Modi' (CIVG 198): This hybrid of 'Gala' x 'Liberty' is a solid red apple that ripens with 'Golden Delicious' is said to taste like 'Gala' and stores well. Rights to this variety are with the Consorzio Italiano Vivaisti in Italy (www.modiapple.com/eng/numbers.html).

'Otava': This is a product of a breeding program in the Czech Republic. This 'Sampion' x 'Jolana' hybrid was rated as worth a trial by Lind et al. (2003). 'Otava' has a good growth habit, yield, and multiple resistances. Concerns included susceptibility to sooty blotch and acidic taste that might be too acidic given its resemblance to 'Golden Delicious' (Weibel and Häseli, 2003).

'Santana': This hybrid of 'Elstar' x 'Priscilla' was developed in the Netherlands. This variety produces good-sized fruits with good color and a sweet, yet sharp flavor. Trees are productive annual producers. 'Santana' is susceptible to powdery mildew and may defoliate (Lind, 2003). 'Santana' has also been determined to be low in apple allergens.

The "RE" series from Dresden-Pillnitz in Germany

These are available in the US as the "ReZista" series. Cultivars in the Re group include: 'Reanda', 'Regine', 'Reglindis', 'Relinda', 'Remo', 'Resi', 'Resista' and 'Retina'. Lind et al. (2003) suggested that 'Resi' was worth a trial, that 'Reanda' and 'Reglindis' would be suitable for processing and 'Relinda' and 'Remo' were prospects for cider. While the "Re" cultivars have multiple resistances and represent an advance in resistance breeding, its developers admit that incorporating both resistance and commercial qualities is a challenge (Fischer and Fischer, 2008).

Availability

The availability of scab-resistant apples in the US is limited currently, but future introductions should be occurring. Managed varieties are also possible, as they have been targeted in Europe.

Future concerns

As plantings of scab-resistant apples increase the likelihood of some break-down in resistance appears likely. This has occurred in Europe, with the discovery of two new races of scab that are able to infect the V_f source of resistance (the gene in 90% of resistant apples). Erosion of the V_f gene for scab resistance is widespread in Belgium.

Several researchers have outlined management strategies for organic production. Suggestions target the reduction of inoculum and include: 1) Do not plant V_f scab-resistant varieties together with susceptible varieties, and 2) keep a distance from susceptible varieties, 3) treat with fungicides on major primary infection and 4) practice sanitation in winter to reduce inoculum –such as urea sprays or removal of leaf litter (Trapman, 2006). Others recommend the use of at least one early fungicide spray when needed to reduce inoculum and also treat for powdery mildew infections; this will reduce the likelihood of problems (Kellerhals et al., 2003).

Summary

Scab-resistant cultivars can be grown without the need for scab sprays, but growers must assess whether or not the quality is sufficient for their markets. Small test plantings are suggested to gain experience on their performance.

Books

Phillips (1998) *The Apple Grower: A Guide for the Organic Orchardist*.

Edwards, L. (1999) *Organic Tree Fruit Management*

Lind et al. (2003) *Organic Fruit Growing*.

Swezey (2000) *Organic Apple Production Manual*.

Web sites with additional information

Details on an organic apple production system experiment conducted in New York are available at. www.nysipm.cornell.edu/grantspgm/projects/proj02/fruit/robinson.asp

Also at Cornell is the report by Peck (2004) Orchard productivity and apple fruit quality of organic, conventional and integrated farm management systems. (<http://hdl.handle.net/1813/2720>).

Midwest Organic Tree Fruit Growers Network (www.mosesorganic.org) has a newsletter and a listing of resources available to those interested in organic fruit production.

The Northeast Organic Farming Association of New York - NOFANY (www.nofany.org) also has links to federal programs and regulations.

ATTRA is the National Sustainable Agriculture Information Service (attra.ncat.org/). The web site has documents available for downloading, including the following publications related to apples: Organic and low-spray apple production, Tree fruits: Organic production overview and Considerations in organic apple production.

OrganicA—a resource for organic apple production is based in the Northeast (www.uvm.edu/~organica/OrganicAProject/welcome.html).

Michigan State has a site on Organic spray program at www.canr.msu.edu/vanburen/organasp.htm.

Ohio State reviews Disease Management guidelines for organic apple production in Ohio at www.caf.wvu.edu/Kearneysville/organic-apple.html/

Washington State sites include: www.organic.tfrec.wsu.edu/OrganicIFP/Home/. It is important to note that organic production is easier under the less humid conditions out west.

In Europe there is an “International conference on Cultivation Technique and Phytopathological Problems in Organic Fruit Growing” available at www.ecofruit.net.

Conferences on sustainable apple production have also been held in the US and in Nova Scotia, Canada and abstract and papers from these meetings may be available on-line or through a database search.

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Susan Brown is a Professor in the Department of Horticultural Sciences, Geneva Campus who leads the apple breeding program at Cornell University. Kevin Maloney is a Research Support Specialist who works with Dr. Brown in the apple breeding program.