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HS1110

Rootstocks for Florida Stone Fruit[1]

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Rootstocks have been used in many tree fruit systems to provide growth advantages or pest or disease resistance without affecting productivity and fruit quality. In Florida, stone fruit are grown on rootstocks that specifically provide pest resistance to the peach root-knot nematode, *Meloidogyne floridensis* (Beckman, Chaparro, and Sherman 2008; Sherman, Lyrene, and Sharpe 1991). Although several root-knot nematode-resistant rootstocks are available for stone fruit grown in other locations and climates, 'Flordaguard' peach rootstock is currently recommended for stone fruit production in Florida.

Root-knot nematodes (*M. incognita* and *M. javanica*) have historically been the predominant species of root-knot nematodes, and 'Nemaguard', 'Nemared', and 'Okinawa' rootstocks are resistant to these species. However, in 1966 a new species of root-knot nematode was detected on 'Nemaguard' and 'Okinawa' peach rootstocks in Gainesville, Florida, and was identified as *M. floridensis* in 2004 (Handoo et al. 2004). This nematode reproduces abundantly on 'Nemaguard' and 'Nemared' peach rootstocks as well as on other crops (verbena, eggplant, squash, basil, impatiens, tomato, snapdragon, dill, and certain ornamental plants) (Table 1). Consequently, 'Nemaguard', 'Nemared', and 'Okinawa' peach rootstock are no longer recommended for peaches, nectarines, and plums in Florida. 'Nemaguard' and 'Nemared' rootstocks have been used in north Florida for many years, but continued use may increase nematode populations to damaging levels on these rootstocks.

'Flordaguard' rootstock has better resistance to *M. floridensis* than 'Nemaguard' rootstock. Field evaluation of peach rootstocks to different root-knot nematode species indicated that after 25 months, nematode egg production was greater on 'Nemaguard' than on 'Flordaguard' rootstock (Nyczepir, Beckman, and Reighard 2006). Longer-term observations in Florida also suggest that older trees on 'Nemaguard' rootstock do not perform well in soils infested with *M. floridensis*. Accordingly, 'Flordaguard' rootstock is the only commercial rootstock the University of Florida currently recommends. 'Sharpe', a plum rootstock (Beckman, Chaparro, and Sherman 2008), is only recommended for backyard fruit production because of its tendency to result in smaller fruit size when compared to fruit produced by trees budded onto 'Flordaguard' rootstock.

'Flordaguard' Characteristics

The University of Florida released 'Flordaguard', a red-leaved peach rootstock, in 1991 (Sherman, Lyrene, and Sharpe 1991). A copy of the original circular, S-376, can be found on the Florida stone fruit website at http://hos.ufl.edu/sites/default/files/faculty/maolmstead/documents/Circ%20S376_Flordaguard.pdf. It is the predominant

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rootstock found in orchards throughout the state and in areas where *M. floridensis* is found.

'Flordaguard' is recommended for low-chill peach, nectarine, and plum production in nonalkaline soils infested with peach root-knot nematodes as well as other types of nematodes. It has a chilling requirement of approximately 300 chill units (http://edis.ifas.ufl.edu/ae452) and usually blooms in early February in Gainesville, Florida. 'Flordaguard' trees grow and produce well as far south as Immokalee, Florida (100 chilling units), indicating it can also bloom and set fruit with fewer chilling units and warmer temperatures than observed in Gainesville.

'Flordaguard' trees are precocious, often fruiting the second year, and they produce many self-fertile flower buds. Trees have long, whippy growth (Fig. 1), and branches may need additional support to bear heavy crop loads. 'Flordaguard' rootstock's red-leaf trait allows for easy detection and removal of rootstock suckers (Fig. 2). Rootstock suckers should be cut carefully and flush with the stem to prevent regrowth and bark injury.

Figure 1. A 'Flordaguard' peach tree highlighted by red leaves and long, whippy branches
Credits: M. Olmstead

Like most peaches, 'Flordaguard' is self-fertile. Although peaches self-pollinate, pollen from different varieties can fertilize 'Flordaguard'. This is known as outcrossing. Outcrossing rates in peaches are typically around 5%. Outcrossed plants should be culled when seedlings are approximately 6 inches tall. Another 10% of plants may need to be culled because of small stature (runts). Peach trees budded onto 'Flordaguard' rootstock that do not exhibit dark red leaves in the new growth (Fig. 3) occur because of outcrossing (pollen from other peach trees) that results in trees not being "true-to-type" and, therefore, not resistant to the peach root-knot nematode (Fig. 4).

Figure 2. Budded peach tree with red-leaved 'Flordaguard' rootstock suckers
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Figure 3. An outcross of 'Flordaguard' rootstock exhibiting green leaves in the new growth (top), compared with a true 'Flordaguard' rootstock exhibiting red leaves in the new growth (bottom)
Credits: M. Olmstead

'Flordaguard' is susceptible to bark gummosis or gumming incited by the fungal pathogen *Botryosphaeria dothidea*, a physiological race specific to peach (Pusey 2005) (Fig. 5). Scion cultivars, or the fruiting portion of the tree, budded on 'Flordaguard' rootstock should be propagated as low as

Figure 4. Nematode galls on the root system of a 'Flordaguard' outcross that was not removed during the propagation process
Credits: M. Olmstead

Figure 5. Gummosis on 'Flordaguard' rootstock caused by *Botryosphaeria dothidia*
Credits: M. Olmstead

possible to reduce the amount of exposed, susceptible stem tissue. Trees budded onto 'Flordaguard' should be managed to reduce stress in the tree because fungal gummosis is exacerbated under such conditions. There is no effective control for fungal gummosis. 'Flordaguard' trees can be trained to an open vase system like other peach and nectarine trees, with three to four main fruiting limbs (scaffolds). Detail pruning can be done to remove dead or diseased limbs. Trees can set heavy crops, but fruit do not have to be thinned to produce viable seeds. Fruit harvesting, seed cleaning, and stratification (cold treatment) procedures are

Figure 6. Red-colored fruit of 'Flordaguard' rootstock trees. Seeds from the fruit are used to produce rootstock liners for propagating orchard trees.
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described in Table 2. Dull, red-colored fruit ripen in late June, about 130 days after bloom (Fig. 6).

'Flordaguard' is not recommended for use in alkaline soils. Iron deficiency symptoms commonly occur under alkaline conditions (a pH greater than 7.0) in calcareous soils (containing calcium and magnesium carbonates). This can result in yellowing of young leaves, called iron chlorosis.

Other Rootstocks for Florida Stone Fruit

Two other rootstocks are available for trial in both commercial and dooryards settings. 'Sharpe' rootstock, released in 2008 by the USDA-ARS and the University of Florida, is a plum hybrid rootstock compatible with multiple peach and nectarine varieties (Beckman, Chaparro, and Sherman 2008). Short-term tests of two standard plum varieties, 'Stanley' and 'Ozark Premier', indicate that the rootstock is compatible with these plum cultivars, but long-term monitoring is necessary to determine the longevity of scion/rootstock combinations. 'Sharpe' rootstock is recommended for peach, nectarine, and plum varieties that are planted on sites where Armillaria root rot (*Armillaria tabescens* [Scop.] Dennis et al.) is present. 'Sharpe' rootstock is not compatible with apricot. When compared to Guardian™ rootstock, it was found to be semi-dwarfing (~60% smaller than trees budded to Guardian™) (Beckman, Chaparro, and Sherman 2008). The lower vigor reduced annual yields when compared to Guardian™; however, higher densities of trees budded to 'Sharpe' rootstock are recommended to obtain yields typical of a standard-sized rootstock. For commercial growers considering 'Sharpe' rootstock, it is

only recommended for varieties that typically produce large fruit, like 'UFOne', 'UFSharp', and 'Flordabest'. 'Sharpe' rootstock is currently recommended for backyard and dooryard orchards.

The newest rootstock released for grower trial is an interspecific peach-plum hybrid, 'MP-29' (Beckman, Chaparro, and Sherman 2012). 'MP-29' is resistant to Armillaria root rot and has as good resistance to peach tree short life (PTSL) as Guardian™ rootstock (Nyczcepir, Beckman, and Reighard 2006). Peach scions that have been budded to 'MP-29' have displayed similar trunk cross-sectional areas as 'Sharpe' rootstock with higher yields of larger fruit, which increases yield efficiency. 'MP-29' has red leaves similar to 'Flordaguard'.

Rootstock Propagation

'Flordaguard' rootstock can be propagated by seed or by cuttings. Seed of 'Flordaguard' trees ripens typically around the first of July, and the fruit are very small with a moderate frequency of double seeds in the pit (Fig. 5). Fruit must be harvested before they fall off the tree because the embryo inside the pit (seed) is very sensitive to high temperatures, and prolonged exposure to heat can damage the seed. A full production schedule for 'Flordaguard' seed propagation is available in Table 2.

'Flordaguard' can also be produced by cuttings when seed supplies are short. Softwood cuttings taken in the spring or summer have performed better than hardwood cuttings taken during the winter season. Cuttings less than half an inch in diameter can be taken from a stem just woody enough to support itself. Cuttings are then placed under greenhouse mist systems for rooting. It is important that the medium is not kept too wet because fungal disease issues can quickly kill the cuttings. The rooting pattern of stem cuttings may be different from that of seedlings, but preliminary research has shown that 'Flordaguard' rooted cuttings perform as well as seedling rootstocks.

To ensure that cuttings are nematode resistant, stem cuttings should be taken from grafted 'Flordaguard' trees ('Flordaguard' trees grafted or budded onto 'Flordaguard' rootstock) rather than from 'Flordaguard' seedlings. Stem cuttings taken from 'Flordaguard' seedlings may have greater variability in terms of nematode resistance than stem cuttings taken from grafted 'Flordaguard' trees. Seedling trees can originate from the pollination of 'Flordaguard' blossoms from other cultivars, resulting in the loss of nematode resistance in these seedlings. Nurseries should, therefore, plant their grafted 'Flordaguard' trees from which seeds are taken in isolation from other peach trees to reduce outcrossing. If field-grown plants are to be sold or shipped, nursery site approval is required by the Division of Plant Industry to prevent spread of burrowing nematode.

Trees on 'Nemaguard' and 'Nemared' rootstocks, especially in central and south central Florida, can also be affected by "spring shock," a disorder characterized by delayed bud break and poor leaf development after bloom (Beckman and Lang 2003). This disorder has been associated with planting low-chill cultivars propagated on high-chill rootstocks in locations with low soil temperatures during bloom and leafing. Thus far, this disorder has not been found in Florida. It should be noted that trees budded to 'Nemaguard' and 'Nemared' rootstocks are not resistant to peach root-knot nematode (*M. floridensis*).

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Table 1. Chilling requirement, leaf color, and nematode resistance for rootstock cultivars

Cultivar	Chilling requirement (chilling units)	Leaf color	*Meloidogyne incognita*	*Meloidogyne javanica*	*Meloidogyne floridensis*
Flordaguard	300	Red	Resistant	Resistant	Resistant
Sharpe	500[z]	Green	Resistant	Resistant	Resistant
MP-29	750[z]	Red	Resistant	Resistant	Resistant
Nemaguard	825	Green	Resistant	Resistant	Susceptible
Nemared	650	Red	Resistant	Resistant	Susceptible
Okinawa	150	Green	Resistant	Resistant	Susceptible

[z]Based on bloom time relative to peach standards in middle Georgia

Table 2. Suggested schedule for peach nursery practices

Year 1	
June	*Propagation by seed:* Harvest 'Flordaguard' seeds from budded 'Flordaguard' trees. Remove fruit flesh and dry pits at room temperature for 3–4 days. Store pits under dry conditions in a paper bag at 45°F. Pits that have been dried and stored at 45°F (7.2°C) for 2.5 years have not shown a significant reduction in germination percentage. *Propagation by cuttings:* Take hardwood or semi-hardwood cuttings to propagate under mist for about 2 months. Transplant rooted cuttings to containers and grow until following May or June.
November	Remove pits from storage. Remove seeds from pits. Soak seeds in water for 5 days. It is ***very important*** to discard water and replace with clean water every day during that period. This treatment increases the seed germination percentage. Stratify seeds in moist peat or perlite with a soluble fungicide (e.g.Captan) at 45°F (7.2°C) for 40–60 days before planting. When the radicle has emerged from the seed coat, seeds are ready for planting in trays.
Year 2	
January–February	Seedlings that are 8"–12" tall should be transplanted into pots in a greenhouse environment.
February–June	Fertilize and irrigate trees. Remove seedlings that do not have red leaves.
May–June	Bud-graft 'Flordaguard' rootstock liners with desired scion cultivar. The bud should not contain xylem or woody fibers. Phony peach disease (*Xylella fastidiosa*) can be transmitted by bud-grafting budwood material that includes woody vascular (xylem) tissue.
June–January	Plant spring- or summer-budded trees in the field through the end of October. Be sure to irrigate newly established trees through dormancy. Bare-root trees can be planted during the winter season when trees are dormant. Irrigation helps to keep the roots moist and prevent freeze damage.