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Pomegranate in Florida for Commercial Enterprises and Homeowners

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The pomegranate is being explored as a species for commercial and homeowner uses in Florida. A collection of ≈75 accessions has been assembled. From those selections ≈3500 plants have been propagated in a commercial nursery and are being distributed to grower–cooperators and nurseries for evaluation. Two foundation trials have been established in central Florida, one at the University of Florida, IFAS, Citrus Research and Education Center (CREC), Lake Alfred and another at Water Conserv II, Winter Garden. The initial effort showed that all the pomegranate selections were easy to propagate and in the field, nursery plants in 1-gal containers grown on a citrus-based irrigation and nutritional program reached heights of 4 to 5 ft in 1 year with a healthy appearance. The plants at Water Conserv fruited after 1 year with many selections producing 15 to 35 fruit. Cercospora leaf spot caused some leaf drop and other unknown pests and/or diseases affected fruit development. An herbicide study using containerized 'Parfyanka' plants grown in sand soil showed unacceptable phytotoxicity to label rate applications of indaziflam, diuron, and norflurazon, but the injury from pendimethalin and simazine was ≤10%.

The pomegranate has a certain natural appeal because it is such an unusual fruit, one that is quite different from common fruits such as bananas and apples consumed in the U.S. Part of its appeal may relate to its long history of cultivation. The pomegranate is an edible fruit of antiquity that ranks right along with the date, fig, and olive. Also, there is considerable current consumer interest in pomegranate because of its enhanced reputation in recent years as a healthy fruit and juice.

The major producers of pomegranate are India, Iran, Turkey, and Spain, and in the U.S., California is the major grower. The reputation of pomegranate has benefitted considerably from the aggressive marketing effort of a California company and its product, POM Wonderful®, which is derived from the 'Wonderful' cultivar. Their efforts have greatly raised the awareness of pomegranate.

The pomegranate is native to regions of the Middle East (Persia, e.g., Iran), and Southeast Asia (e.g., Turkmenistan and Afghanistan), areas with relatively cold winters and arid, but hot summers. The species is not generally considered to be suitable for climates such as those of the southeastern U.S. where the winters can be cold, but the weather is humid during the warmer months of the year (Holland et al., 2009) Nevertheless, pomegranates have been a dooryard plant in southern Georgia and Florida for decades (Maclean et al., 2011). We have discovered plants in the Florida panhandle area near Marianna and Perry that are about 100 and 80 years old, respectively. However, the origin of many dooryard plants is unknown. Furthermore, as we have visited nurseries to add plants to our collection, it became clear that it would be helpful to establish a collection of known cultivars and begin a systematic evaluation of their potential in Florida. Also, citrus growers have an interest in alternate crops as options to help them deal with the debilitating effects of canker and Huanglongbing diseases. Determining the commercial potential of pomegranate in Florida has never been attempted. Therefore, we initiated a pomegranate project with these objectives:

- Collect pomegranate selections and cultivars and establish mother blocks.
- Propagate from the collection and provide plants to interested growers.
- Establish cooperative projects and evaluate the selections.

We chose these objectives because, while it is already apparent that pomegranate plants will grow in at least central Florida and northward into southern Georgia, it is not known whether the plants will produce acceptable quantities of good quality fruit especially for commercial purposes. We see these options:

1. Fresh fruit grown conventionally or organically. Particularly intriguing would be to grow the fruit as a small farm enterprise and market it locally.
2. Fruit grown by either method for juice, which might alter the cultural program toward less use of pesticides. Particularly appealing with this option is to grow fruit for juicing in a small retail outlet and possibly blending with other juices such as blueberry or peach. Equipment for countertop operations to produce single glasses of juice or small quantities for bottling is readily available via the internet.
3. Pomegranates grown as an ornamental for the homeowner and the "Edible Landscape" (Worden and Brown, 2010).
4. Produce fruit for extracting and marketing of the arils. A brief search of the internet will reveal the variety of commercial equipment available for juicing the fruit and extracting and packaging arils.

Our purpose herein is to provide some general information about pomegranate botany, cultivars, and production practices, but not to provide an in-depth, comprehensive review. Such de-

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tails are available in the literature cited. The status of our Florida project is also described.

Botany. The Punicaceae family has only two members, one of which is *Punica granatum*, the pomegranate of commerce. The Punicaceae family belongs to the Order Myrtales, which includes *Corymbia torelliana* (a plant being used as a windbreak around citrus in Florida), eucalyptus, melaleuca, jaboticaba, and guava. The pomegranate is a naturally bushy, multi-stemmed plant that tends to maintain its bushiness because of suckers routinely arising from the base. Plants grow to heights of ≈10–12 ft and commercially are often trained to a single trunk or sometimes three stems (Fig. 1). The plant is normally deciduous. New spring shoots tend to be thin and weepy with thorns. The leaves are shiny and dark green. The plant is essentially monoecious with two types of showy flowers produced on new growth each spring. Flowering may occur over several months with some flowers still being produced into late summer/early fall, but the major bloom period is the spring. A flower is either male or hermaphroditic. The latter flower type is bell-shaped and self-fertile (Maclean et al., 2011). Hermaphroditic flowers produce fruit. Male flowers are more trumpet-shaped and do not set fruit. Flower color for many cultivars is orange-red to brilliant red and there are some, especially ornamental types, with "double" flowers (i.e., with extra petals) or some that are pink, white, or some combination of those colors and red (Fig. 2). Pollination primarily by insects (bees) leads to fruit set and the development of the inferior ovary.

Fig. 1. A 17-year-old 'Wonderful' pomegranate plant growing in California and trained to a single trunk with three main branches similar to the open vase form used for peach trees.

The mature pomegranate fruit is large, usually 3 inches in diameter and sometimes as large as 4 to 5 inches. Fruit generally mature in 5 to 8 months and often change from round to a slightly squared-out shape. The fruit of different cultivars are quite diverse in their color, taste, and certain other traits. Peel color ranges from a light yellow to "black" or very dark red/purple. The fruit is distinctive because it retains the calyx (petals + sepals) at one end of the fruit giving the fruit the appearance at maturity of having a small crown attached to it. Internally, the fruit consists of a series of chambers (locules) separated by a membranous septum. Inside each chamber are the seeds, which each have a fleshy outgrowth (aril) that contains the edible juice. The seeds range in hardness from very hard (not edible) to soft (easily consumed). The color of the arils also ranges from a light, virtually white, color to very dark red or purple. The flavor of the juice can be inedibly tart to bland to sweet or sweet/tart depending on acidity. Typical soluble solids values for fruit grown in California are 15% to 18%.

Fig. 2. Ornamental pomegranate cultivars: 'Dotch Legrelley' (**upper left and right**) and 'Ki Zakuro' (**lower left and right**). Photographs taken at the National Clonal Germplasm Repository, Davis CA, and provided by Jeff Moersfelder.

The terms "seed" and "aril" are often used interchangeably as if they defined the same structure, which is not true. Technically speaking, the "seed" has two parts: the crunchy interior structure that is the part that contains the embryo and is sometimes eaten if it is not perceived to be too hard, and the juicy, fleshy part or the aril (Fig. 3). The aril provides the color of the juice.

Culture. Anyone interested in growing pomegranates is likely to discover that, while it is an ancient crop, it has not been widely studied in a systematic manner, an assessment that applies to cultural practices. A search of the literature reveals only a few articles on subjects such as the growing of pomegranates in different types of soils and tolerance to salinity (Okhovatian-Ardakani et al., 2010). Furthermore, it is obvious that the scarcity of original information and research has led to repeating the same information across a large number of publications. The following is a summary of cultural information where there appears to be a reasonable and consistent foundation for the information.

Culture: climate, soils, water quality, irrigation. The pomegranate plant is adaptive to a wide range of environmental and soil conditions, but is usually described as requiring a long, hot, dry season to crop properly (Holland et al., 2009). There are mixed reviews about its tolerance to salinity and calcareous soils, indicating the need for further investigation. The plant is very cold hardy, but is not tolerant of wet conditions. It is responsive to irrigation as a recommended practice, perhaps with water not containing more than 2,000 ppm salt (Holland et al., 2009). However, plants in Israel have been irrigated with 4,000 to 6,000 ppm saline water with effects on vegetative growth, but without significant injury to the plant (Holland et al., 2009).

Culture: fertilization. There are few reports on formal fertilization studies, but supplying the usual essential elements apparently improves commercial performance. In Israel, Spain, India, and other regions, pomegranates are fertigated while in other places the plants are supplied with dry fertilizers. Some attempts have been made to establish leaf nutrient standards through research (Gimenez et al., undated) and some data have been developed privately (e.g., in California). Some evidence suggests that careful attention to certain nutrients can affect aril weight and fruit size without altering juice quality (Prasad and Mali, 2003).

Culture: propagation, orchard design, tree training. Pomegranates are readily propagated from stem cuttings of various size and age. They root easily with application of commercial hormone products and placement in a mist bed. They can also root when placed directly into orchard soil. Pomegranates can be propagated from seed. They have a relatively short juvenile period and can begin flowering in one year, but more typically after 2 or 3 years.

Good light interception is considered essential for cropping and fruit development. Thus, plants are usually widely spaced, ≈10–12 × 20 ft and trained to a form that minimizes the willowy young branches that bend under the weight of fruit. The plants are often trained to one to three trunks with an open vase canopy. In some instances, a single trunk is formed and three main branches diverge 1 or 2 ft from the ground to form the open vase.

Culture: pests and diseases. Reviews of pomegranate culture have long lists of pests and diseases that include various insects, fungi, and bacteria (Holland et al., 2009). Among the insects, aphids appear to be common to most regions where pomegranates are grown especially among young plants at the propagation stage. Other insect pests are some of those common to citrus in Florida like mealy bugs, thrips, and various mites, but pomegranates are not listed as a significant host for Med fly (Thomas et al., 2010). Less information appears to be known about the Caribfly, which has been found in much of peninsular Florida infesting guava and other soft fruits and occasionally citrus. In one study conducted only in the Miami area without any observation on seasonality of infestation, pomegranate was listed as a host of this pest (Swanson and Baranowski, 1972). Root knot nematode, *Meloidogyne incognita*, has been reported to be a serious pest (Luc et al., 2005).

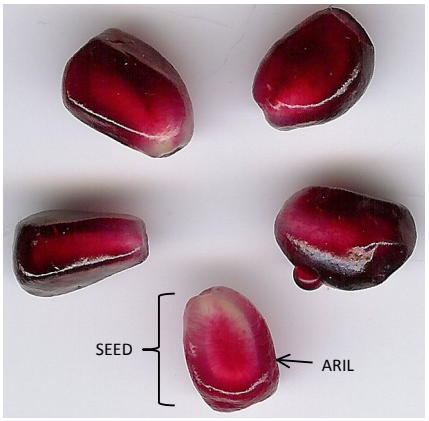

Fig 3. Pomegranate seeds. In the marked seed, the white embryo inside the structure is visible along with the fleshy outer seedcoat or aril.

The more serious problems are diseases caused by fungi and bacteria. Among these are leaf spotting, which can lead to leaf drop, caused by *Cercospora punicae* (Alfieri, 1978), fruit blemishes also caused by *Cercospora* sp., and fruit decay that renders fruit inedible. The bacterial genera *Botrysphaeria* and *Alternaria* along with others are implicated as sources of fruit rot problems.

Postharvest. Two frequently asked questions are how to determine when a pomegranate fruit is mature and when is the season of maturity. A common answer to the first question is when the fruit changes from perfectly round to a slight pentagonal shape presumably because of internal pressure exerted by the arils as they fill with juice. As to the season of maturity, most cultivars are harvested, regardless of where they are grown, between late summer and mid-fall. The 'Wonderful' cultivar grown in California is typically harvested during the month of October. For details regarding physiological disorders such as fruit splitting and postharvest handling, see Holland et al. (2009) and Kader (2006).

Status of UF/IFAS/CREC Project

The project began in 2009 for the purpose of evaluating the potential of pomegranate as an alternative for citrus growers. However, interest has grown remarkably and the project was opened to homeowners and hobbyists in 2010. We have established a series of plantings with cooperators and are in the first stages of learning how to grow pomegranates and, most important, to see if fruit can be reliably produced at the dooryard level and to support a commercial enterprise. The latest information about the project is always available at our website: www.crec.ifas.ufl.edu/extension/pomegranates/.

Resources. We have assembled nearly 75 accessions from the U.S. National Clonal Germplasm Repository (NCGR), Davis, CA (http://afrsweb.usda.gov/Main/docs.htm?docid=12170), two collections in Georgia, and local nurseries and homeowners (Table 1). One surprise in the project was to discover important

Table 1. Pomegranate accessions at the CREC, Lake Alfred.

Name	Source	Use	Seed
Afganski	NCGR	C D	Medium
Alk Pust Ghermez Saveh	USDA, Byron, GA	C D	
Al-sirin-nar	NCGR	C D	Very hard
Angel Red	Willis Orchard Co., Moultrie, GA	C D	
Apseronski	USDA, Byron, GA	C D	
Apseronski Krasnyj	USDA, Byron, GA	C D	
Ariana	NCGR	Ornamental	Soft
Azadi	NCGR	C D	
Bala Miursal	USDA, Byron, GA	C D	
Big Yellow	Ponn Nursery, Palm City, FL	C D	
Chandyr	NCGR	C D	
Christina	Just Fruit and Exotics, Crawfordville, FL	C D	
Cloud	UGA, Ponder Farm, Tifton	C D	
Comb's Sweet	UGA, Ponder Farm, Tifton	C D	
Crab	UGA, Ponder Farm, Tifton	C D	
Cranberry	Just Fruit and Exotics, Crawfordville, FL	C D	
Desertnyi	NCGR	C D	Soft
Don Somner North	UGA, Ponder Farm, Tifton	C D	
Don Somner South	UGA, Ponder Farm, Tifton	C D	
Dotch Legrelley	NCGR	Ornamental	
Double Red #2	NCGR	C D	
Double Red/White	NCGR	Ornamental	
Dwarf [C]	Chestnut Hill Tree Farm, Alachua, FL	C D	
Dwarf [H]	Hopkins Tropical Fruit Nursery, Immokalee, FL	C D	
Dwarf [J]	Just Fruit and Exotics, Crawfordville, FL	C D	
EG	Hopkins Tropical Fruit Nursery, Immokalee, FL	C D	
Entekhabi Saveh	USDA, Byron, GA	C D	
Eve(H)	Hopkins Tropical Fruit Nursery, Immokalee, FL	C D	
Eversweet	Hopkins Tropical Fruit Nursery, Immokalee, FL	C D	
Fleischman (Fleshman)	Chestnut Hill Tree Farm, Alachua, FL	C D	
Gainey Sweet	Just Fruit and Exotics, Crawfordville, FL	C D	
Garnet Sash	Hopkins Tropical Fruit Nursery, Immokalee, FL	C D	
Girkanets	NCGR	C D	
Gissarskii Rozovyi	NCGR	C D	Very soft
Grenada	Willis Orchard, Moultrie, GA	C D	
Hak-Botan	Just Fruit and Exotics, Crawfordville, FL	Ornamental	
Hydranar × Kirmizy Kabuh©	NCGR	Ornamental	
Kaim-anor	USDA, Byron, GA	C D	Hard
Kaj-acik-anor	Just Fruit and Exotics, Crawfordville, FL	C D	
Kara balamiursal	USDA, Byron, GA	C D	Medium
Kasmir Blend	Hopkins Tropical Fruit Nursery, Immokalee, FL	C D	Normal
Kazake	NCGR	C D	Large
Ki Zakuro	NCGR	Ornamental	
King	UGA, Ponder Farm	C D	
Kunduzski	NCGR	C D	
Larkin (Marianna)	Just Fruit and Exotics, Crawfordville, FL	C D	
Mack Glass	Mariana, FL.	C D	
Mae	UGA, Ponder Farm, Tifton	C D	
Mae II	UGA, Ponder Farm, Tifton	C D	
Medovyi Vahsha	NCGR	C D	Soft
Mejhos	Just Fruit and Exotics, Crawfordville, FL	C D	
Mejhos 6269	USDA, Byron, GA	C D	
Molla Nepes	NCGR	C D	Very soft
Myagkosemyannyi Rosovyi	NCGR	Ornamental	
Nikitskiranni	USDA, Byron, GA	C D	
Nikitskiranni	Just Fruit and Exotics, Crawfordville, FL	C D	
Nochi Shibori	NCGR	Ornamental	
Padgett	Perry, FL	C D	

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Table 1. Continued from previous page.

Name	Source	Use	Seed
Parfianka	NCGR	C D	Soft
Parfyanka	NCGR	C D	Very soft
Pink	UGA, Ponder Farm, Tifton	C D	
Purple Heart	NCGR	Ornamental	Medium
Red Silk	Hopkins Tropical Fruit Nursery, Immokalee, FL	C D	
Rose	UGA, Ponder Farm, Tifton	C D	
Russian #8 (Salavatski)	Just Fruit and Exotics, Crawfordville, FL	C D	
Saartuzski (Yalta)	USDA, Byron, GA	C D	
Sakerdze	NCGR	C D	Medium hard
Salavatski	NCGR	C D	Medium hard
Shari's	Just Fruit and Exotics, Crawfordville, FL	C D	
Shirin Pust Ghermez Saveh	USDA, Byron, GA	C D	
Shirin Zigar	NCGR	C D	
Sin Pepe	NCGR	C D	Very soft
Sirenevyi	NCGR	C D	Very soft
Surh-anor	NCGR	C D	
Sweet	Willis Orchard Co., Moultrie, GA	C D	
Sweet	UGA, Ponder Farm, Tifton	C D	
Tabestanimalas Birandensaveh	USDA, Byron, GA	C D	
Thomson	UGA, Ponder Farm, Tifton	C D	
Toryu-shibori	IRREC via NCGR	Ornamental	
Treehouse Vietnam	Treehouse Nursery, Pine Island, FL	C D	Hard
Vkusnyi	NCGR	C D	Very small
WEO 42	NCGR	Ornamental	
Wonderful	NCGR	C D	Medium
Zubejda (Denau)	Just Fruit and Exotics, Crawfordville, FL	?	

[z]NCGR = U.S. National Clonal Germplasm Repository, Davis, CA; USDA, Bryon = S.E. Fruit and Nut Research Lab; UGA = University of Georgia; IRREC = University of Florida Indian River Research and Education Center, Fort Pierce.

[y]Preferred or best uses have not been determined in Florida. It is likely that most selections have commercial (C) and dooryard (D) potential, but some selections are considered best suited for ornamental uses because of their exceptional flowers and small, non-commercial-sized fruit.

[x]Seed hardness is important because it determines whether seeds are easily eaten. Medium hardness is the dividing line in that some cosumers find medium-hard seeds to be edible; others do not. Soft seeds are easily consumed as part of the eating experience.

collections at the USDA Southeastern Fruit and Nut Research Lab in Byron and the University of Georgia at Tifton. Our collection consists of the 'Wonderful' cultivar, other common selections, many ornamental types with exceptional flowers, dwarf types, a selection from Vietnam that produces yellow fruit and might be promising for our climate, soft- and hard-seeded types and cold hardy ones. Duplicate mother blocks of these accessions have been planted at the CREC, Lake Alfred, and at Water Conserv II near Winter Garden and will be amended as new accessions are acquired. They serve as the plants for observation and as a source of cuttings. Planting of the mother blocks will be largely completed in 2011. Some published descriptions of the cultivars as grown elsewhere are available (see the NCGR website; Ashton, 2006; Stover and Mercure, 2007).

Propagation. We have been working with a commercial propagator, AgriStarts, Inc. of Apopka, to root cuttings. We have supplied semi-hardwood and hardwood cuttings of all sizes from ≈1/4 to 1/16 inches in diameter. The cuttings have been supplied without regard to the time of year. They are treated with a commercial rooting hormone, placed in a peat mix and rooted in ≈16 weeks with percentages >75% (Table 2). The rooted cuttings are grown off in a greenhouse or shadehouse in 1-gal containers where they are now trained to a single stem with no branching for a length of ≈12 to 18 inches. Our results confirm that pomegranates are easy to propagate, but it may require 3 to 4 months to achieve maximum rooting percentages.

Test locations. Pomegranates can presently be found in dooryards from southern Georgia to south-central Florida indicating that they can be grown in a range of climatic conditions and soils. Our young plants and older ones already in dooryards became dormant, shed their leaves and withstood the prolonged cold weather in the winter of 2009–2010. They survived Fahrenheit temperatures in the low 20s during the winter of 2010–2011. Thus, we rated ≈6- to 24-month-old plants growing in central to north-central Florida for shoot development in mid-Feb. 2011 as a measure of a possible physiological response to the winter temperatures. The plants of some cultivars had yet to begin bud swell while others were nearly completely re-foliated (Table 3).

We have cooperative plantings in the coastal flatwoods of Florida as well as in the deep sandy soils of central Florida. Our observations show that chronic wet conditions or flooding events are not favorable for growing pomegranates and can lead to plant death. More vigorous growth and earlier cropping have occurred with plants growing in the central Ridge region.

Cultivar selection, orchard design, plant training. What should I plant is a frequently asked question without an answer. We are encouraging cooperators to try any of the cultivars available until we have enough cultural data to answer the question. One of our first plantings was set out at Water Conserv II in May 2009. In 2010, those 38 plants (2–4 plants each of 10 cultivars) flowered after about 12 months in the field and produced 0 to 50 fruit/plant depending on the cultivar.

Table 2. Percent rooting of pomegranate cuttings at 16 weeks.[z]

Cultivar	%
Afganski	89
Al-Sirin-Nar	86
Angel Red	86
Azadi	84
Chandyr	67
Desertnyi	72
Double Red #2	95
Girkanets	81
Gissarskii Rozovyi	95
Grenada	93
Kazake	90
Kunduzski	63
Medovyi Vahsha	92
Parfyanka	96
Sakerdze	75
Salavatski	90
Shirin Zigar	87
Sin-Pepe	73
Sirenevyi	93
Surh-Anor	95
Sweet	97
Toryu-Shibori	97
Vkusnyi	100
Wonderful	80

[z]Cuttings ranged in size and age.

Table 3. Pomegranate shoot development rating, Feb. 2011.[z]

Selection	Rating	No. plants
Surh-Anor	0.7	16
Kunduzski	0.7	10
Afganski	0.8	19
Shirin Zigar	0.9	7
Sweet	0.9	10
Salavatski	0.9	15
Desertnyi	0.9	19
Double Red #2	1.0	7
Sirenevyi	1.0	8
Sin-Pepe	1.1	18
Toryu-Shibori	1.1	10
Gissarskii Rozovyi	1.1	15
Grenada	1.1	14
Angel Red	1.2	14
Kazake	1.3	7
Sakerdze	1.4	21
Parfyanka	1.5	18
Azadi	1.6	19
Girkanets	1.6	13
Medovyi Vahsha	1.8	19
Chandyr	2.3	3
Vkusnyi	2.3	9
Al-Sirin-Nar	2.4	10
Wonderful	2.4	17

[z]Ratings are the means of five locations ranging from Fellsmere to Water Garden; 0 = no shoots emerging; 1 = bud swell; 2 = some shoots apparent; 3 = many shoots.

The growth of our earliest planted pomegranates along with observation of older plants in dooryards and nurseries suggest that a spacing of 12 × 20 ft should be adequate for commercial plantings. A wider spacing of 14, 16, or 18 × 18 ft, has been recommended in Georgia depending on geographic location, cultivar, and anticipated canopy training program (MacLean et al., 2011). There are mature plants at the University of Georgia Ponder Farm, Tifton, and their size would seem to justify the wider spacing. However, spacing may depend on the type of training practiced. Plants trained as bushes may develop broader canopies and require more space. Plants trained to a single trunk with the vase-shaped canopy may need less space in the row. Neither training method has been evaluated in Florida although the single trunk provides a means to attach a wrap like those on citrus trees to shield against damage from pesticide applications. Preliminary evidence does not indicate that a wrap helps prevent suckers, which need to be removed each year, generally when the plants are dormant. The suckers do not necessarily need to be discarded as they are a source of cuttings for propagation. Limited evidence also indicates that wraps may be harmful for the same reasons sometimes observed with citrus. Ants build nests inside the wrap, which can lead to damage, and we have noticed other damage of unknown cause to the trunks of developing pomegranate plants.

Nutrition and irrigation practices. The literature does not suggest that pomegranate requires any special irrigation management other than to avoid overwatering and chronically wet conditions. Most authors report that relatively little is known about fertilization practices (Holland et al., 2009). We have not yet developed any practical experience in Florida. Therefore, until further information is obtained, we suggest that pomegranate plants be treated as if they were orange trees regarding irrigation and nutrition. Plant tissue analyses obtained from a California lab support that recommendation. We have learned, however, that pomegranates are very responsive to fertilization and can change from yellow to green virtually overnight after receiving a modest application, by citrus standards, of fertilizer.

Pest, disease and weed management. Pomegranate is a minor crop in the U.S. even though in California, where most pomegranates are grown, there are an industry-estimated 35,000 acres. As a result, there are few materials registered for use on pomegranates.

Pomegranate pests are numerous (Holland et al., 2009), but few have been encountered so far at the propagation and nursery stages or in our cooperator trials. The primary pest has been aphids. The more troublesome issue is diseases. We have encountered the leaf spotting caused by *Cercospora punicae,* which is easily controlled with copper. Our observations suggest that there may be differences among selections in susceptibility to this fungus. We have also learned that *Cercospora* infections, if left uncontrolled, lead to premature leaf loss. However, the most serious problems manifest in the fruit and lead to drop or infections that render the fruit unappealing if not unusable (Gangawane and Khilare, 2008; Maclean et al., 2011). Some of the genera thought to be involved are *Xanthomonas, Cercospora,* and *Botryosphaeria*. Species of *Aspergillus* and *Colletotrichum* have also been isolated from infected fruit. Investigations into pest and disease identification and management in pomegranates are needed. Because of a humid climate and rainfall in the summer months when the fruit are developing, the results of those studies are likely to be the foundation for successful pomegranate culture in the southeastern U.S.

A number of products have been approved for use in California to control pests (Carroll et al., 2010). Web data (http://www.pesticideinfo.org/DS.jsp?sk=6015) show that sulfur, several herbicides and imidacloprid are among the most commonly used. A

long list of products that are registered for use in Florida, but not necessarily on pomegranates, can be obtained from the Pesticide Registration Office, Florida Dept. of Agriculture and Consumer Services. Very few of them are fungicides. You must read the label to determine on what crops the various products may be used. Remember, registration of a product in Florida does not mean it can be used on pomegranates in Florida unless that is explicitly stated on the label because "The label is the law."

If a good starting point for culturing pomegranates in Florida is to treat them as if they were an orange tree, then that approach may also apply to weed management. To see their response to commonly used citrus herbicides, we conducted a greenhouse evaluation of 8.5-month-old 'Parfyanka' cuttings in 1-gal containers filled with typical Central Ridge sand soil. The plants were treated with five compounds at label rates with an untreated check (Table 4). Herbicide treatments were applied as a soil drench. There were four, single-plant replications arranged in a randomized complete-block design. Visual injury was rated weekly using a 0–100 rating scale with 0 being no injury and 100 being complete death of plants. The rating system is based on the comparison of the overall appearance of the plants treated with a given herbicide to the untreated ones. The data were analyzed using ANOVA and treatment means were compared using Fisher's protected LSD at the 5% level of significance.

Phytotoxicity symptoms appeared within 21 d after treatment. Damage included leaf burning followed by drop and, in some instances, leaf death. Higher levels of phytotoxicity were observed in the plants treated with indaziflam, diuron and norflurazon (Fig. 4). The injury level from indaziflam was 14% at 21 d after treatment and progressed to plant death at 48 d (Table 5). Diuron and norflurazon had a high initial injury at 21 d (66 and 63%, respectively) and increased further at 31 d. At 48 d, recovery from injury was observed in diuron- and pendimethalin-treated plants athough injury was still ≥50%. Pendimethalin and simazine were less harmful than the other herbicides and after 48 days, no injury was observed and plants had recovered with new growth occurring.

Indaziflam is a new preemergence herbicide that is pending registration for a variety of crops including citrus. Diuron, norflurazon, pendimethalin, and simazine are older herbicide chemistries and are commonly used in perennial fruit production in the U.S. Results from this study indicated that the pomegranate cultivar Parfyanka responded differentially to the preemergence herbicides. Indaziflam, diuron, and norflurazon were not safe for use due to their high phytotoxicity while the other herbicides, such as pendimethalin and simazine, were less harmful with the phytotoxicity being ≤10%.

Fruit maturity. Our one experience to date suggests that fruit mature as they do elsewhere, i.e., late summer into October. Fruit sizes were typical and all aspects of fruit development seemed normal, although no juice quality or flavor data have been obtained. However, 20 cultivars were evaluated in Tifton, GA, for yield, exterior color, fruit size, total soluble sugars and titratable acids, taste, and juice color along with observations on various fruit disorders.

The Future

A broad range of pomegranate selections have been assembled for testing, but there are several important unknown factors yet to be resolved in order for pomegranates to have a commercial future in Florida and an expanded future as a dooryard species.

Table 4. Herbicide treatments by chemical name, commercial name, and rates used in the study.

Treatment	Chemical name	Commercial name	Rates
1	Untreated		
2	Indaziflam	Alion	5 oz/acre
3	Diuron	Karmex	2 lb/acre
4	Norflurazon	Solicam	2 lb/acre
5	Pendimethalin	Prowl H	2 lb/acre
6	Simazine	Princep	4 lb/acre

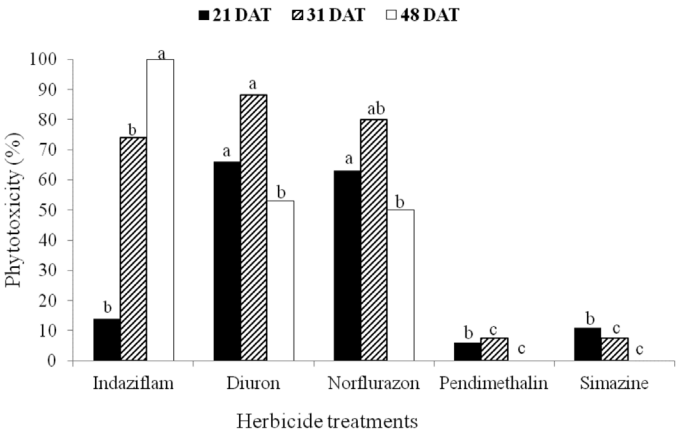

Fig. 4. Phytotoxicity of 'Parfyanka' pomegranate to preemergence herbicides.

Table 5. Shoot injury on 'Parfyanka' pomegranate plants treated with five preemergence herbicides.[z]

	Days after treatment		
Herbicide	21	31	48
Indaziflam	14 b	74 b	100 a
Diuron	66 a	88 a	53 b
Norflurazon	63 a	80 ab	50 b
Pendimethalin	6 b	8 c	0 c
Simazine	11 b	8 c	0 c

[z]Plants rated 0 (no injury) to 100 (plant death). Means within a column followed by the same letters are significantly different at $\alpha = 5\%$.

Especially important among those factors are those related to pest and disease management. Anyone interested in evaluating pomegranates should also be aware that there is considerable grower interest in Georgia that may merit connecting with the Georgia Pomegranate Association and University of Georgia researchers.

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