Guidelines for Pomegranate Nutrient Management in Florida[1]

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Introduction

Pomegranate (*Punica granatum*) is a fruit-bearing deciduous shrub or tree in the family Lythraceae, originating in the region from Iran to northern India. It was cultivated in ancient Egypt, Babylon, India, Iran, and the Mediterranean region. Pomegranate was introduced into the United States probably by early Spanish settlers to their colony at St. Augustine, Florida. Today, California produces more than 90 percent of pomegranates in the United States.

A pomegranate fruit is 3 to 5 inches in diameter with a tough leathery rind enclosing hundreds of juicy arils. In turn, small white seeds are enclosed within the arils and can be soft or hard, depending on the cultivar. Arils and seeds comprise the edible portion of pomegranate fruits. Arils of common pomegranate cultivars in the United States are dark red, although arils of other cultivars can appear red, light red, pink, light pink, yellow, or clear (Fernandes et al. 2017). The most common rind color is red, but it can also be yellow, orange, green, or black. The taste of pomegranate juice ranges from very acidic to very sweet. Pomegranate juice is a good source of folate, potassium (K), and vitamin K, and it is extremely rich in antioxidants (Gil et al. 2000). Pomegranate arils are also rich in fiber.

In recent years, pomegranate aril and juice consumption has increased rapidly because of consumers' growing interest in healthy foods and antioxidants (Faria and Calhau 2011). According to the Census of Agriculture published by the United States Department of Agriculture (USDA), the pomegranate production acreage in the United States increased from 24,517 acres in 2007 to 31,472 acres in 2017 (USDA 2014, USDA 2019).

Pomegranate Production and Phenology in Florida

Many Florida growers are interested in the potential of pomegranate as an alternative fruit crop. It is estimated that pomegranate is currently grown on about 100 acres in Florida. In the subtropical climate of north and central Florida, pomegranate trees generally go into dormancy in December and develop new spring foliage in March. Climatic conditions have a great impact on the timing of flowering. Pomegranate trees flower almost year-round in south Florida, whereas flowering generally occurs from April to June in north and central Florida. In young trees grown in north and central Florida, flowering may continue throughout the summer. The first flush of flowers produces the best quality fruit. The fruit development period varies among cultivars from 100 to 160 days.

Fertilizer Recommendations

Before planting or new leaf growth each spring, soil testing is strongly recommended to determine soil pH and basic nutrient needs. Soil pH should be adjusted to between 6.0 and 7.0. Fertilizer recommendations should take into

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account the age of trees, planting density, desired canopy structure, and soil nutrient levels. The traditional plant spacing is 18 ft × 18 ft (134 trees/acre) (LaRue 1977, Westerfield et al. 2017), although high-density planting has been recently used in some production areas (Ashton et al. 2006, Haneef et al. 2014). Table 1 shows recommended amounts of nitrogen (N), phosphorus (P), and K calculated per plant or per acre. These rates were calculated for an orchard with a traditional plant spacing of 18 ft × 18 ft. Nutrient requirements increase as trees mature. Like other fruit-bearing crops, pomegranate requires more K than N, particularly during fruit development stages. For this reason, the recommended N:K_2O_5 ratio is 1:1.25. In California, the recommended amount of N for mature pomegranate trees is 0.5–1 lb/tree/year (LaRue 1977), but higher rates are used for sandy soils (Ashton et al. 2006).

Table 2 shows fertilization schedules recommended for slow-release and liquid fertilizers. Optimum fertilization is important to improve your crop productivity and profitability. Insufficient fertilization can limit not only fruit yield but also fruit quality, whereas overfertilization can result in salinity damage and leaching of excess nutrients. Fertilization programs should be adjusted based on the results of leaf nutrient analysis (Table 3).

Leaf Sampling and Nutrient Analysis

Plant nutrient analysis is a useful tool to determine the plant nutrient status and to evaluate your current fertilization program. Plant mineral concentration and composition depend on the plant part that is tested. Leaves are commonly used for nutrient analysis because they can be sampled easily and because their nutrient level is more sensitive to the availability of soil nutrients compared to other plant parts.

For pomegranate, it is recommended to perform leaf nutrient analysis monthly from April to August. Each set of leaf samples should represent a block of your orchard with a single cultivar, the same age of trees, and similar growing conditions.

Walk diagonally through each orchard block and collect 75 to 100 of the youngest fully matured leaves (several leaves from each tree) from nonfruiting branches to make one composite sample (Figure 1). Select average-sized, undamaged leaves from healthy trees. Avoid immature leaves, because their nutrient status is not stable and the result will be misleading. If one area of the orchard is displaying less vigorous growth than other areas or nutrient deficiency symptoms, collect a separate sample to investigate potential nutrient disorders. Place the leaves in a paper sample bag provided by a commercial or university testing lab. Send samples to the lab as soon as possible to obtain accurate results.

Figure 1. Pomegranate leaves sampled for tissue nutrient analysis. The white highlighted area shows where leaves were sampled.
Credits: Shinsuke Agehara, UF/IFAS GCREC

Deficient, optimum, and excessive nutrient ranges for pomegranate leaves are listed in Table 3. If test results do not fall within the optimum range, fertilizers or fertilization amounts should be changed.

Seasonal Leaf Nutrient Variation

Figure 2 shows the seasonal variation in pomegranate leaf nutrients. The data represent the average values of three pomegranate orchards in central Florida, where the recommended fertigation program was used. In general, N and iron (Fe) show a declining trend from April to July followed by a recovery, whereas other nutrients remain relatively consistent throughout the growing season.

Common Nutrient Disorders

Nitrogen Deficiency

Among mineral nutrients, N exists at the highest concentration in pomegranate leaves (Table 3). Because pomegranate trees require a large amount of N to support healthy foliage growth and soil nitrate is susceptible to leaching, N deficiency can occur when fertilization amounts or scheduling are not managed properly. Nitrogen deficiency is typically expressed by uniform chlorosis (yellowing) on old matured leaves. Nitrogen deficiency limits photosynthesis, leaf growth, resistance to diseases and pests, and eventually overall plant growth and fruit production.

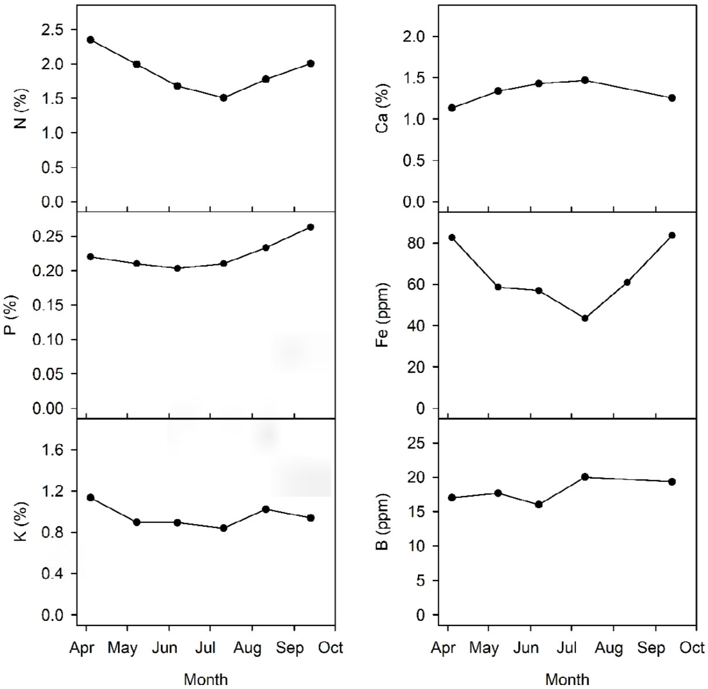

Figure 2. Seasonal variations in leaf nutrient concentrations of pomegranate trees grown in central Florida.

Potassium Deficiency

Adequate K fertilization is important to maintain high fruit quality. One common K deficiency symptom on pomegranate fruit is the discoloration of arils (Figure 3).

Figure 3. Potassium deficiency symptoms on a pomegranate fruit. Potassium deficiency is characterized by discoloration of arils (left).
Credits: Ali Yavari and Ali Sarkhosh, UF/IFAS

Iron Deficiency

Iron deficiency is one of the most common micronutrient deficiencies observed on pomegranate trees grown in Florida. Because Fe is not readily mobile in plant tissues, its deficiency symptoms appear on younger leaves (Figure 4). In mild cases, interveinal areas show chlorosis. When the deficiency is severe, both interveinal areas and leaf veins become increasingly yellow, eventually turning ivory to white. Leaves that are deficient in Fe cannot maintain normal leaf expansion, so new leaves may remain small. Severe Fe deficiency can also cause defoliation of new leaves and branch dieback.

Figure 4. Iron deficiency symptoms on pomegranate seedlings. Iron deficiency is characterized by chlorosis on young leaves, inhibition of leaf expansion, and branch dieback.
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Sun Scald (Sunburn)

Sun scald is a common nonpathogenic defect of pomegranate fruits. Sun scald will appear on the sun-exposed side of the affected fruit as brown or bronze discoloration (Figure 5). Pomegranate fruits with sun scald are not marketable for fresh market. To prevent sun scald, it is important to promote adequate canopy development by proper fertilization. Although N is a major component of leaf chlorophyll (green pigment), other macronutrients and micronutrients are also very important for pomegranate canopy development.

Figure 5. Sunburn symptoms negatively affecting pomegranate fruit appearance and quality.
Credits: Ali Yavari and Ali Sarkhosh, UF/IFAS

Fruit Cracking and Splitting

Fruit cracking and splitting can be caused by abiotic stresses, including water stress and nutrient deficiency, especially in boron (B), calcium (Ca) and K (Chandra et al. 2011). In general, Ca deficiency and soil moisture fluctuation before and during harvesting are the main causes of fruit cracking and splitting (Figure 6). High temperature and drought make the fruit skin hard and less elastic. If heavy rain events or improper irrigation follow subsequently, the expansion of the internal tissue will cause fruit cracking, or fruit splitting in extreme cases. Open wounds by fruit cracking and splitting result in water loss and shriveling of arils, making the affected fruits completely unmarketable. Optimum irrigation and fertilization can minimize these fruit disorders in pomegranate.

Figure 6. Pomegranate fruits with cracking (left) and splitting (right).
Credits: Ali Yavari and Ali Sarkhosh, UF/IFAS

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Table 1. Fertilizer recommendation rates for different ages of pomegranate trees.

Age	N		P_2O_5		K_2O	
(year)	(lb/tree)	(lb/acre)	(lb/tree)	(lb/acre)	(lb/tree)	(lb/acre)
1–2	0.40–0.60	54–80	0.20–0.30	27–40	0.50–0.75	67–101
3	0.60–0.80	80–107	0.30–0.40	40–67	0.75–1.00	101–134
4	0.80–1.00	107–134	0.40–0.50	54–67	1.00–1.25	134–168
5+	1.00–1.20	134–161	0.50–0.60	67–80	1.25–1.50	168–201

N = nitrogen, P_2O_5 = phosphate, K_2O = potash.

Table 2. Recommended pomegranate fertilization schedules.

Month	Slow-release dry fertilizers*	Fertigation (liquid fertilizers)
March	50%	10%
April		20%
May		20%
June	50%	20%
July		20%
August		10%

*3–6 month release.

Table 3. Leaf nutrient analysis standards for mature, nonfruiting pomegranate branches.[1]

Element	Deficient	Optimum	Excessive
N (%)	<1.20	1.50–2.00	>3.00
P (%)	<0.10	0.10–0.30	>0.50
K (%)	<0.60	0.80–1.80	>2.00
Ca (%)	<0.60	0.80–2.00	>2.50
Mg (%)	<0.12	0.15–0.60	>1.00
S (%)	<0.10	0.15–0.30	>0.50
Na (%)	--	≤0.04	>0.10
Fe (ppm)	<45	60–120	>300
Mn (ppm)	<20	20–70	>400
Zn (ppm)	<20	20–70	>150
B (ppm)	<10	10–50	>100
Cu (ppm)	<5	5–20	>50
Al (ppm)	--	≤300	>500

[1] The leaf nutrient standards were developed based on the standards used by a commercial analytical lab (personal communication) and tissue nutrient test results conducted for pomegranate orchards in Florida.