QUICK GUIDE TO ENVIRONMENTAL FACTORS IMPACTING AVOCADO, LYCHEE, LONGAN, AND MANGO IN FLORIDA

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The successful establishment and maintenance of tropical and subtropical fruit crops in Florida depend on the crop's tolerance to critical abiotic factors, including tolerance to flooded or waterlogged soil conditions, its ability to withstand high soil and irrigation water salinity, and high and low temperature ranges for growth, flowering, and production. This document aims to provide a quick guide to understanding the impacts of environmental factors on subtropical and tropical fruit crops in Florida.

<u>High and low temperature ranges for growth, flowering, and production</u>

Selection of a fruit crop for a specific area should consider the potential high and low extreme temperatures as well as the general mean temperatures of the area, along with the known ideal optimum temperatures and the tolerance for extreme high and low temperatures of the proposed fruit crop.

Temperatures for flowering. Fruit trees generally need a period of dormancy in order to flower and fruit successfully. Dormancy can be defined as a period of no active (visible) stem growth. Dormancy for many tropical and subtropical fruit crops occur in response to cool temperatures (above freezing but below species or cultivar specific thresholds). Technically, this dormancy is termed quiescence (i.e., environmentally imposed dormancy). The length of dormancy requirement varies between and within fruit crop species. For example, 'Keitt' and 'Tommy Atkins' mango trees require a longer period (2-4 months) of dormancy to flower well compared to 'Edwards' and 'Haden' cultivars (~1-2 months). Lychee in particular needs a long period of dormancy (2-5 months) to flower and fruit well and has the added requirement of exposure to cool temperatures (upper 40s to low 60s) just before or during panicle emergence. Because of the generally warmer climate as a result of global climate change, lychee now rarely flowers or fruits well in Miami-Dade County; trees repeatedly vegetatively flush because it is not suppressed by cool temperatures. In contrast, summer high temperatures greater than about 92°F may cause flower abortion in passionfruit. Therefore, careful study of the optimum temperatures for growth, flowering, and fruiting as well as tolerance to high and low temperature extremes should be investigated when selecting a fruit crop.

Chilling and cold tolerance. Historically, attempts to commercially produce (or at least trial) many tropical and subtropical fruit crops in north, central and south Florida have shown that successful tropical fruit production was limited to southeastern [Miami-Dade, Broward, Palm Beach, (southeastern end of Lake Okeechobee, eastern-to-central Palm Beach County], and southwestern [Lee County (Pine Island primarily)], and Manatee County (Bradenton area)] coastal areas of the state. There are other coastal counties where small plantings of tropical and subtropical fruit crops are grown (e.g., Martin, Indian River, and Brevard Counties). Periodic freezing temperatures have severely damaged or killed most tropical and subtropical fruit crops outside these areas. Even in these areas, periodic freezing events have caused severe damage or death to tropical and subtropical fruit crops. Indisputably the general climate has warmed throughout central and south Florida over the past twenty years and the frequency and/or duration of freeze events has decreased. This has led to new interest in expanding tropical and subtropical fruit production in Florida outside of its historic range. Currently, the acreage of cold-sensitive fruit crops such as guanabana (soursop), caimito, and sugar apple has expanded in Miami-Dade County. Production of these crops has been successful in the area, despite, brief cold (e.g., temperatures of 32-37°F) and chilling temperature (i.e., temperatures below ~55°F) events, which have caused some crop damage (e.g., caused defoliation, some dieback). In contrast, the acreage of three slightly less cold-sensitive fruit crops, guava, dragonfruit, and passionfruit, has recently expanded along coastal areas from Sarasota and Brevard Counties south.

Freezing temperatures. There are four components to freeze events: 1) the duration (how long is it at or below 32°F), 2) the frequency (how often do they occur), 3) the depth of the freezing temperatures (what is the lowest temperature experienced) and 4) when the freezing or chilling temperatures occur e.g., during bloom or dormancy. For example, chilling temperatures (i.e., above freezing but below ~45°F in 2022 in Homestead) occurred during the flowering period resulting in a drastically reduced fruit set and harvest. Despite the climate warming trend over the past twenty years, freeze events can and do still occur (even in Miami-Dade County). Most disconcerting is the lack of grower planning for potential freeze and/or frost events. Planning includes the establishment of appropriate irrigation infrastructure (e.g., high volume systems) or the establishment of a bedded planting with high-capacity pumps to move water between-tree rows (ditch) and to drain the water off quickly. For tropical and subtropical fruit crops, we have little experience with the use of microsprinkler systems with or without tree trunk covers for young tree freeze protection, and many new plantings only have microsprinkler systems with low pumping capacity that can only irrigate parts of the planting at one time. For a description of the irrigation systems used for tropical/subtropical fruit production see https://edis.ifas.ufl.edu/publication/HS1375. Prior to purchasing land and/or establishing an irrigation system, producers need to investigate the availability and quality of the water in their water management district. Use of high volumes of water are not permitted in some areas (i.e., water management districts), thus limiting the options for cold/freeze protection with water; this should be known and planned for before establishing a new grove.

Tolerance of flooded or waterlogged soils. Higher elevation areas are less prone to flooding than lower elevation areas. The potential frequency and duration of soil flooding or saturation increases in low lying areas or in areas with a hard-pan several inches to several feet down in the soil profile. Flatwoods areas are particularly vulnerable, and the citrus planted in these areas was on beds to elevate the tree roots above moderate flooding depths. Bedding, land contouring, and passive drainage systems should be considered prior to establishing a tropical or subtropical fruit grove in these areas. Also, sufficiently large pumps to move water onto and out of drainage ditches should be established prior to planting. Subtropical and tropical fruit crops vary in their tolerance to constantly saturated soil conditions and flooding. In general, flooding is more damaging when combined with high-temperature periods or if the tree has fruit. For example, guava and sapodilla are considered flood tolerant (i.e., they can survive several days to a few weeks) however, their growth and fruit production may be reduced, and root diseases may result in tree damage or death. Mango, lychee, longan, and carambola are moderately flood-tolerant but again growth and production may be reduced, and root disease may cause tree decline or death. In contrast, avocado, papaya, and passionfruit do not tolerate constantly wet or flooded soil conditions and may be severely damaged or die within 48-72 hours of overly wet soil conditions. One strategy to reduce avocado tree damage after flooded soil conditions is to prune trees (i.e., remove 1/3rd to ½ the canopy) immediately after the flooding event to reduce the canopy demand for water and nutrients. For more information on the flood tolerance of tropical and subtropical fruit crops, see https://edis.ifas.ufl.edu/publication/HS202.

Drought tolerance. Tropical fruit trees vary in their drought tolerance; however, the growth, production, and fruit quality of even drought tolerant species may be reduced. For example, mangoes and sapodillas reportedly tolerate several days to weeks of drought, but this may be affected by tree size and the extensiveness of their root system. In contrast, papaya and banana do not tolerate even short-term (i.e., survive a few days of drought but may result in leaf drop and yield reduction) drought conditions which may result in dramatic delays and reduced flowering. For more information on the drought tolerance of tropical and subtropical fruit crops see https://edis.ifas.ufl.edu/publication/HS202. To avoid drought conditions, optimally orchards should have an appropriately designed irrigation system managed so as avoid prolonged soil drought conditions, especially from flowering to the harvest period.

Saline soils and water. Very few fruit crops tolerate saline soils and/or water. For example, guava and dragonfruit are considered tolerant to saline soil and water conditions whereas avocado, mango, and passionfruit are not. For more information on the management of saline soil and/or water see https://edis.ifas.ufl.edu/publication/AE572. In some coastal areas (e.g., Pine Island) there is potential for saltwater intrusion into the aquifers and wells, and there are no economical or effective cultural practices to mitigate or prevent crop damage from saline irrigation water. Desalination of saline contaminated soils requires fresh water and desalination of brackish water for irrigation is expensive. In areas prone to storm surges (from tropical storms or sea level rise), bedding and passive and/or active drainage infrastructure should be established ahead of planting to help reduce the potential for soil contamination by saline water.

The tables below summarize important environmental factors that producers should consider prior to establishing tropical or subtropical fruit orchard.

Avocado (*Persea americana*) - West Indian (WI), Guatemalan (G), and Mexican (M) ecotypes and WI-G hybrids and G x M hybrids				
Crop	**Optimum growing temperature range (°F)**	**Freeze damage range (°F) mature trees**	**Heat damage range (°F)**	**Comments**
West Indian ecotypes	72-95	25-30	>100	Least cold hardy type grown in Florida.
Guatemalan ecotypes	55-75	21-25	>90	More cold hardy, only a few commercial cultivars.
Mexican ecotype	50-70	18-25	>90	Most cold hardy, only a few cultivars.
West Indian x Guatemalan hybrids	70-91	24-30	>90	Variable cold hardiness, most common type cultivars grown in Florida.
Guatemalan x Mexican hybrids	65-86	20-27	>90	In general, more cold hardy than WI x G but not much experience with most California hybrids.
Crop	**Flood tolerance**	**Plant and/or rootstock salinity tolerance**	**Drought tolerance**	**Comments**
West Indian ecotypes	Sensitive to intolerant	Most tolerant	Moderately tolerant	• Sensitivity to constant winds not reported for any of the ecotypes or hybrids. • Flood tolerance influenced by rootstock. • Drought tolerance by ecotype not compared. Irrigation is common practice.
Guatemalan ecotypes	Sensitive to intolerant	Intermediate tolerance	Moderately tolerant	
Mexican ecotype	Sensitive to intolerant	Least tolerant	Moderately tolerant	
West Indian x Guatemalan hybrids	Sensitive to intolerant	Varies	Moderately tolerant	

Guatemalan x Mexican hybrids	Sensitive to intolerant	Varies	Moderately tolerant	• Rootstock affects salinity tolerance (WI>G>M).

Longan (*Dimocarpus longan*)			
Crop	**Optimum growing temperature range °(F)**	**Freeze damage range (°F) for mature trees**	**Heat damage range (°F)**
Longan	>32-92	24-27	>95
Sensitivity to constant winds	**Flood tolerance**	**Plant and/or rootstock salinity tolerance**	**Drought tolerance**
Moderately tolerant	Moderately tolerant	Moderately tolerant	Moderately tolerant
Comments			
• Low RH and/or high temperatures may reduce fruit set and number of female flowers. • Fruit should be thinned when pea sized. Over production may lead to tree decline.			

Lychee (litchi) (*Litchi chinensis*)			
Crop	**Optimum growing temperature range (°F)**	**Freeze damage range (°F) for mature trees**	**Heat damage range (°F)**
Lychee	>32-92	21-28	>91
Sensitivity to constant winds	**Flood tolerance**	**Plant and/or rootstock salinity tolerance**	**Drought tolerance**
Moderately tolerant	Moderately tolerant	Intolerant	Tolerant
Comments			
• Requires dormant period and exposure to chilling temperatures (i.e., ≤59°F). Temperatures ≥68°F reduce chilling requirement. • Low RH and/or high temperatures may reduce fruit set and the number of female flowers. • Late season flowers may not set fruit and/or set fruit that develops properly.			

Mango (*Mangifera indica*)			
Crop	**Optimum growing temperature range (°F)**	**Freeze damage range (°F) for mature trees**	**Heat damage range (°F)**
Mango	75-86	25	>104
Sensitivity to constant winds	**Flood tolerance**	**Plant and/or rootstock salinity soil and/or water tolerance**	**Drought tolerance**
Moderately intolerant	Moderately tolerant to tolerant	Intolerant- moderately tolerant	Tolerant
Comments			
• Tolerance to salinity is affected by rootstock and typically those rootstocks are not used in Florida.			

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Avocado

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