

Tropical Fruit Tree Recovery from the 2005 Hurricane Season

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The tropical/subtropical fruit tree recovery rate from the devastating effects of hurricanes is influenced by the wind intensity and direction of the storm, rainfall amounts and flooding duration (if that occurred in your grove), time of year of the storm and subsequent weather conditions following the storm. Unfortunately southeast Florida had the unique experience of two indirect and two direct hurricanes in one year [Hurricanes Dennis (July 9/10; cat.1-2) and Rita (Sept., 20/21; cat. 2) and Hurricanes Katrina (Aug., 25/26; cat 1) and Wilma (Oct., 24; cat. 3), respectively]. Most recent hurricanes that affected southeast Florida have occurred during the summer months (July to August mostly). Warm weather conditions subsequent to these storms were beneficial to tree recovery. Unfortunately, the recovery time between the damage caused by Hurricane Rita and Wilma was short and the occurrence of Hurricane Wilma late in the season (fall) meant that subsequent weather conditions would be cooler and potentially quite cold during a period when tropical/subtropical fruit trees were recovering. In general, the temperature of fruit trees are a few degrees above or below ambient temperatures and physiological processes such as growth rate and nutrient and water uptake are dependent on temperatures. So while temperatures since October have been on average above the minimum required for growth they have not been in the range of optimum temperatures for optimum growth during December and January (Table 1 and Table 2). Furthermore, the data does not show that day/night temperature fluctuations mean generally only a few hours of temperature are warm enough for plant growth to occur during any 24 hour period. We also know that water and nutrient uptake for many tropical/subtropical fruit crops is slowed or inhibited during cool weather and soil conditions; thus making tree growth less vigorous and potentially less healthy.

We are all too familiar with the immediate effect of hurricane damage to tropical fruit trees: uprooting, tree toppling, wind-throw (complete uprooting), trunk and/or limb twisting, limb and shoot damage, fruit drop, fruit scarring, and leaf tattering, desiccation, and/or drop. We are also familiar with the secondary damage which may include overheating (commonly called sunburning) of sun exposed limbs and trunk, further root damage as trees are reset, and nutrient stress, i.e., draining of carbohydrate reserves and elemental nutrients from woody tissues, as trees regrow.

Other factors which impact the success of tree recovery and cultural practices necessary for storm recovery include the intensity of the hurricane force winds, whether flooding occurred along with the storm, the number of storm events, and the time between storm events. In general, the mechanical process of resetting toppled trees with pruning and propping, and repairing irrigation capability are tasks that can be managed and provides some satisfaction that perhaps the grove will come back to life and production in the future. The more subtle but very important cultural practices post-storm include fertilizer and irrigation management.

Post-storm defoliated (or partially defoliated/leaf damaged) and mechanically damaged and repaired trees begin to re-grow. We do not completely understand whether root or shoot growth begins first or simultaneously. We do know that the lost leaves, wood, and roots represent not just lost tree-parts but lost carbohydrate and nutrient reserves. We do know that the trees are in a state of vegetative regrowth and that in order to do this quickly and successfully careful attention to fertilizer and irrigation frequency and timing become critical. Finally, we know that in many cases preventing nutrient deficiency is less costly in materials, time, and labor than trying to overcome nutrient deficiencies.

This brings me to the main subject, namely, recommendations for recovery from the late season Hurricane Wilma also realizing trees were damaged to some extent by 3 previous hurricanes during 2005. Tropical and subtropical fruit trees are recovering from storm events in which nutrient reserves were lost and the reserves remaining in the trees were and are being used to regrow. However, due to the cool temperatures during fall, winter, and early spring, regrowth is more difficult because uptake of water and nutrients is typically repressed during this time of year.

Conventional recommendations for avocado, mango, lychee, and longan are to withhold nitrogen and micronutrient applications during the fall and winter because: 1) nitrogen applications during this time may stimulate vegetative growth and reduce the potential for spring flowering and; 2) micronutrient applications are generally not efficiently taken up by plants during cool weather. Conventional recommendations for carambola, papaya, and banana is to continue to apply frequent light applications (less than those applied during the warm part of the year) of NPK and micronutrients during the fall and winter in an effort to take advantage of any warm weather and maintain trees in an active state of growth. Nutrient applications are suspended for atemoya and sugar apple because they generally defoliate during the late fall and winter in response to cool dry weather. Passion fruit nutrient applications during the fall and winter are generally limited or suspended because of the inefficiency of uptake during cool weather. In contrast, sapodilla and mamey sapote trees generally are entering their season for production and flowering, respectively, during the fall, winter, early spring and light applications of nutrients are recommended. However, conventional recommendations do not necessarily apply to trees in recovery from environmental stress, i.e., hurricanes.

We do want to state that we are fully aware that having lost the year's income and/or potential near-term future income due to fruit loss makes the economics of providing inputs for tree recovery more financially difficult. Growers need to assess their economic and future situation and decide whether to spend now in the hopes of a successful fruit production and income in the future. However, one thing is for sure, if the trees are not cared for during the winter and early spring, subsequent tree recovery during the summer will be slower and more difficult.

In general, fertilizer rates for trees with limb loss should be reduced in proportion to the amount of canopy lost. In contrast, trees that lost mainly only foliage should receive slightly more fertilizer (over a period of time) to assist in re-establishing their canopy. In both cases, light, frequent applications may ensure a steady supply of major (nitrogen, phosphorous, potassium, magnesium) and micronutrients (iron, manganese, and zinc, iron) during any time temperatures allow active growth during the winter and early spring months. Lastly, all fruit growers should be monitoring the new growth for insect pests as pest damage will further slow tree recovery during these cool months.

Avocado. There were basically two types of avocado trees during Hurricane Wilma, those that had already been harvested or lost their fruit to the previous hurricanes and those to be harvested. Those that had been harvested or had already lost fruit were in a state of building or rebuilding their carbohydrate and nutrient reserves. Those that had fruit during Hurricane Wilma generally had more limb damage due to the effect of fruit weight on limb strength. The outlook for this year's crop is 30-40% of normal, why? Partly because avocado fruit set is heavily dependent upon stored carbohydrate reserves, which have been depleted, and partly because the new growth (new shoots or relatively new growth) generally do not bloom. Recommendations: On those cultivars that are in an active state of vegetative new growth, light, frequent nitrogen, and micronutrient applications throughout the winter and early spring. On those cultivars that have retained their leaves and have mature stems (that is are "dormant"), emphasize frequent micronutrient applications and fertilize with a low amount of nitrogen from flowering and/or fruit set. Trees in an active state of growth should be irrigated throughout dry periods.

Mango. Most mango groves lost fruit from the previous hurricanes and were in a state of vegetative and nutrient recovery when Hurricane Wilma struck. Trees appeared to be not too badly defoliated. Recommendations: On those trees with a major new growth occurring, very light, frequent applications of nitrogen and micronutrients should be made throughout the rest of the winter and early spring. This will increase the potential that the new vegetative growth will be healthy but not stimulate excessive new growth. On trees with minimal or no new vegetative growth (that is "dormant") emphasize micronutrient applications from flowering until fruit set then apply a moderate amount of nitrogen. Mature mango trees in our area do not require frequent irrigation and so irrigation just before and just after soil applied nutrient applications should be considered. This will move the dry fertilizer into the root zone for uptake.

Lychee. Many lychee groves are in a state of regrowth after Hurricane Wilma and/or after being topped and hedged subsequent to the storm. Some lychee trees retained most of their leaves post Hurricane Wilma; others were defoliated for the most part. Little to no bloom and successful fruit set should be expected from trees that were defoliated or severely damaged. Despite bloom inductive temperatures during December and January, those trees basically defoliated due to Hurricane Wilma or subsequently topped and hedged have a preponderance of immature shoots and/or current active growth; bloom will be minimal and for those shoots that do bloom, fruit set may be fair to poor. Recommendation: for those trees basically defoliated and with active new growth emphasize (or recent growth within the last two months) frequent micronutrient applications and very light nitrogen applications to enhance healthy new leaf and shoot recovery. These trees should be irrigated during dry periods. Those trees that do not have recent shoot and/or leaf growth (i.e., retained their foliage for the most part and are "dormant") emphasize frequent micronutrient applications and apply a light NPK application during bloom or fruit set. These trees should be irrigated infrequently until bloom, then regularly during flowering and fruit set.

Longan. Many longan trees appeared to maintain some or a majority of their foliage; some did basically defoliate. Little to no bloom and/or fruit set should be expected from those trees with immature (recent new shoots and leaves) shoots or in a state of active new growth. Recommendation: for trees that basically defoliated or were severely damaged or have a lot of new active or recent shoot/leaf growth emphasize frequent micronutrient applications and very light nitrogen applications to enhance healthy new leaf and shoot recovery. On trees that basically maintained their foliage and are not for the most part in a state of active growth (“dormant”), the normal strategy of with-holding or limiting irrigation during the winter until bloom occurs with the subsequent resumption of irrigation and fertilizer applications during bloom and fruit set is recommended. The use of potassium chlorate should be limited to only those trees that did not defoliate and have had little new active regrowth during the past several months. Potassium chlorate use could be an option after trees have recovered and have a mature flush later in the 2006 year. We do not recommend treating trees that toppled over with potassium chlorate during 2006.

Mamey sapote. Fruit loss on mamey sapote ranged from light to heavy and leaf loss from slight to moderate. Mamey sapote trees are blooming now, however, for those trees in an active state of vegetative regrowth, how much fruit set will occur is questionable. For those trees with the mature leaves, the potential fruit set is increased if trees are properly cared for. Recommendations: for trees with active or recent new vegetative growth, emphasize light, frequent nitrogen and micronutrient applications. Trees that retained their foliage emphasize frequent micronutrient applications with a very light nitrogen application toward the end of the flowering period. Periodic irrigation during dry periods is recommended for trees with new growth and for those that retained their foliage and are blooming. Note, fruits that have lost the scurfy surface on the south or west side of the fruit may begin to crack and fall during the next 3 to 6 months.

Carambola. Fruit loss and defoliation were massive after Hurricane Wilma. Unfortunately, soil and/or ambient temperatures below 68°F have not been conducive to healthy new shoot and leaf growth. Some carambola trees are flowering in response to their defoliation however without a healthy canopy, fruit set and any fruit production will be reduced and of poor quality. Recommendations: frequent light applications of NPK and micronutrients. Soil application with chelated iron, manganese, and zinc is recommended for those trees with little foliage. Once foliage is re-established, foliar manganese and zinc micronutrient applications may resume. Carambola trees should be irrigated during dry periods and 6 to 8 inches of mulch will assist in maintaining soil temperatures conducive to vegetative recovery.

Guava. Some plant toppling or tree leaning occurred due to Hurricane Wilma. However, most guava trees had a lot of fruit and leaf loss. Post-storm temperatures have not been conducive to regrowth. Typically guava trees respond to defoliation by blooming and producing fruit, however, due to cool temperatures and its effect on plant growth, this may not lead to a successful “off-season” crop. Recommendations: frequent light NPK and micronutrient applications and moderately frequent irrigation during dry periods. If practical, trees will benefit from 2 to 6 inches of mulch.

Banana. Plant toppling, fruit loss, and leaf damage were severe after Hurricane Wilma and subsequent temperatures have been fairly conducive for plant regrowth. Recommendations include thinning to 3 the number of pseudostems per mat, mulching heavily, and frequent light applications of NPK and periodic applications of micronutrients. Banana plants should be irrigated frequently during dry periods.

Papaya. Plant toppling and defoliation were common and during short periods of time temperatures have been fairly conducive for plant regrowth. Recommendations include removing all fruit; why? Fruit are a large sink (plant organ) for water and nutrients and their presence will severely slow new leaf growth. In addition, fruit quality is poor from papaya trees with few leaves and a small canopy. The emphasis should be on re-establishing a vigorous, healthy new canopy of leaves that will allow the plant to resume fruit production as temperatures warm in the spring and summer. Recommendations include frequent applications of NPK, micronutrients, and irrigation to take advantage of any warm weather during the winter.

Sapodilla. Hurricane Wilma resulted in a major fruit loss and some leaf damage but trees appeared to retain most of their foliage. Subsequent to the storm some new vegetative growth has occurred but the effect on off season flowering remains to be seen. Recommendations include periodic light applications of NPK and micronutrients and periodic irrigation during dry prolonged periods.

Passion fruit. Late storm damage included defoliation, leaf damage to remaining leaves and vine structural damage. Vines have been in a state of slow but active growth. Recommendations include frequent light applications of NPK and micronutrients and frequent irrigation during dry periods to take advantage of any warm periods during the winter. Mulching may be of benefit in modifying soil temperatures conducive to growth.

Pitaya. Pitaya vines sustained some structural damage due to this year's hurricanes and subsequent regrowth has generally been satisfactory. Recommendations: continue frequent light applications of NPK and micronutrients to aid in regrowth during the winter. For those vines of sufficient size to carry a crop, irrigation should be withheld or reduced during the spring to induce subsequent blooming. Monitor for disease development along scarred or damaged sections of the plant and treat accordingly. Once fruit are set resume irrigation during dry periods.

Atemoya and sugar apple. Atemoya and sugar apple trees were toppled or left leaning and defoliated after Hurricane Wilma. Some but not all fruit had been dropped or previously harvested. Trees have been and are in a state of vegetative regrowth. Unfortunately due to tree damage and cool soil and ambient temperatures regrowth has been weak. Recommendations: frequent light applications of NPK and micronutrients and irrigation during dry periods to take advantage of any warm periods during the winter. In addition, mulching may be of benefit in modifying soil temperatures conducive to growth.

Table 1. Mean minimum, maximum, and average ambient temperatures in Homestead area.

Homestead area ^z	Ambient temperatures (°F)	
	Range	Average
September	68-93	81
October	70-91	77
November	46-84	71
December	41-79	67
January	55-76	65
February	55-77	66
March	59-80	70
April	62-84	73
May	67-87	77

z, Data from July-Dec., FAWN, Homestead, and the Southeast Regional Data Center, NWS; 30 year averages.

Table 2. Minimum temperatures for growth and optimum temperatures for growth of selected tropical fruits.

Crop	Range in temperatures (°F) for	
	any growth	optimum growth
Atemoya	55	72-90
Avocado	55	65-82
Banana	65	78-86
Carambola	65	68-95
Guava	60	73-82
Longan	65	70-95
Lychee	52	68-86
Mamey sapote ^z	65	72-90
Mango	55	75-91
Papaya	65	70-90
Passion fruit ^y	60	65-86
Pitaya	60	65-77
Sapodilla ^z	55	70-86
Sugar apple	60	73-94

z, educated estimate.

y, purple types.