



A hurricane-damaged sweet orange tree (above) in Polk County exhibits dieback and chlorotic leaves. A closer view (right) of leaves on the same tree shows dieback, very advanced fruit and off-season bloom.



Stress factors and hurricane-damaged trees

By Syed Bilal Hussain, Rachel Gearhart, G. Zeng Michalzyk and Christopher Vincent

Hurricane Ian in 2022 caused significant damage to Florida citrus groves. Even groves that experienced only Category 1 winds have begun to decline as the weather has warmed.

Signs of canopy decline include branch dieback and leaf drop. Branches with new growth are also experiencing leaf drop. These observations suggest that the trees are under significant stress. Measures of photosynthetic efficiency also show declines in the health of the remaining leaves.

LEAF HEALTH

Measuring how efficiently a plant uses sunlight for photosynthesis is a good indicator of plant health. This method, called chlorophyll fluorescence, can be used in the field and tells how much of the chlorophyll in the leaf is able to contribute to photosynthesis, known as “Fv/Fm.” To keep the academic jargon low, in this article “leaf health” refers to Fv/Fm.

Leaf health has decreased in trees from January to March of this year, indicating that the leaves are stressed. This stress is growing as temperatures rise. Plants with a high chlorophyll fluorescence reading are healthy and growing because they are able to convert more sunlight into sugar.

Damage from Hurricane Ian is still affecting

tree health. Field observations show that the hurricane caused mechanical damage to plant limbs. This damage likely impacted the vascular system in the trees. The vascular system is responsible for transporting water from the soil to the leaves. Leaves get a low water supply without proper water transport from the soil to the leaves. This forces them to close their stomata to reduce water loss, which also reduces photosynthesis.

WARMING TEMPERATURES

Hurricane Ian's damage is further leveraged by warming temperatures, which will increase in the coming months. High temperatures cause stress to the leaves. As the weather warms, the production of reactive oxygen species in the photosynthetic system can increase, which damages the photosynthetic machinery of the plant and decreases leaf health.

High temperatures can also cause stomatal closure, which reduces carbon dioxide intake for photosynthesis. This leads to photoinhibition, in which the leaf is stressed because the incoming light is greater than what it can use for photosynthesis, releasing a lot of uncontrolled energy into the leaf. Photoinhibition intensifies when the weather warms up. All these factors can make growing plants in warm weather more difficult and can contribute to a decrease in leaf health if the leaves can't get enough



A small branch on an orange tree that died back from Hurricane Ian has new shoot growth lower down.

water. These factors are also especially harmful for plants that were damaged by Hurricane Ian.

LOW WATER SUPPLY

Low water supply contributes to declining leaf health. When leaves aren't getting enough water, photosynthesis decreases and affects leaf health. The electron transport chain in photosynthesis requires a constant supply of electrons from water. When water availability is limited, the supply of electrons is also limited, leading to a decrease in leaf health.

A low water supply can also cause a reduced transpiration rate. When plants aren't getting enough water there is less to transport from the soil to the leaves. This increases leaf temperature, which also decreases leaf health. Low water supply in the soil during dry weather also compounds damage from Hurricane Ian to create even more stress for the trees.

WAYS TO REDUCE STRESS

Reducing stress is an integrated approach to enhancing leaf health. If trees can reduce their temperatures and get more water, they will have less stress and better leaf health and growth.

Maintaining appropriate soil moisture is one approach to reducing stress.

One way to do this is more frequent irrigation. Keep irrigation volume the same but water the tree in frequent small doses. This ensures sufficient water availability to plants. This method of watering is best for the sandy soils where Florida citrus trees grow.

Another approach is to reduce leaf temperature and water loss. Kaolin particle films are one way to reduce leaf temperature. Kaolin is a natural clay that is sometimes sprayed as a crop protectant to reduce heat stress and sunburn on leaves and fruit. It reflects some of the sunlight, which helps cool the leaves and reduce photoinhibition by shading them. This allows leaves to utilize light energy efficiently, even when they have a low water supply. When leaves are not overheated, they can better use light energy for photosynthesis and avoid stress.

Kaolin clay can also help reduce water loss from leaves by shading and cooling them, reducing the temperature and light factors that reduce leaf health. Maintaining water can further improve the plant's ability to photosynthesize and maintain good leaf health.

SUMMARY

Trees in groves that were hit hard by Hurricane Ian are still exhibiting

signs of stress. Trees are showing poor leaf health, branch dieback and leaf drop. This is probably due to high temperatures and water loss.

High temperatures can cause photoinhibition, which means the plants aren't photosynthesizing efficiently. This pattern can be expected to continue into the summer. Low water supply is another factor that could be contributing to decreased leaf health.

Reducing stress in the plants is an approach that could increase leaf health. Kaolin particle film and frequent irrigation are valuable approaches to reducing stress and improving the recovery process. 🍊

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