



A quarterly online magazine published for Master Gardeners in support of the educational mission of UF/IFAS Extension Service.

Fruits, Roots, and Shoots: A Gardener's Introduction to Plant Hormones

By Shane Palmer, Master Gardener

What are hormones?

Have you ever wondered why trimming off the growing tips of a plant stems often causes more compact, bushy growth? Perhaps you've heard of commercial fruit producers using a gas called ethylene to make fruits ripen more quickly. Both of these cases are examples of plant hormones at work. Hormones are naturally occurring small molecules that organisms produce which serve as chemical messengers inside their bodies. Plants and animals both use hormones to deliver "messages" to their cells and control their growth and development.

A plant's hormones tell it how to behave. They determine the plant's shape. They determine which cells develop into roots, stems, or leaf tissues. They tell the plant when to flower and set fruit and when to die. They also provide information on how to respond to changes in its environment. Knowing more about the science behind these processes helps gardeners and horticulturalists better control the propagation and growth of plants. In some cases, herbicides incorporate synthetic hormones or substances that alter hormone function to disrupt the growth and development of weeds.

How plant hormones work

Cells throughout a plant's body produce various hormones. Some hormones affect the same cell that

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produced them; some diffuse a short distance to nearby cells; others are transported to other regions of the plant through its xylem (conducting water and minerals) or phloem (conducting sugars and nutrients) vascular system.

When a hormone molecule reaches a target cell, it can either bind to a special receptor molecule on the cell's surface (like a key fitting into a lock), triggering a chain reaction inside the cell, or it might be absorbed directly into the cell. In either case, the cell changes its growth or behavior in response to this chemical reaction. Different cells and tissues can respond differently to the same hormone.

Examples of plant hormones in action

Take the example of pruning and shoot growth. The growing buds and stems of many plants produce a hormone called auxin (derived from the Greek word *auxein*, 'to grow') that encourages shoot elongation while also suppressing the growth of side buds (called lateral or axillary buds). A higher concentration of auxin at the growing tip (shoot apical meristem) suppresses axillary growth, known as apical dominance. A lower concentration of auxin farther down the stem allows some side shoots to grow. Many conifers such as the Norfolk Island Pine (*Araucaria heterophylla*) have a distinct pyramidal shape caused by apical dominance.



This Norfolk Island Pine exhibits apical dominance. Photo credit: Flickr user nautical2k. Source: <http://edis.ifas.ufl.edu/pdf/files/fr/fr00300.pdf>.

What happens when the dominant stem of a plant is pruned or killed? The concentration of auxin in the surrounding tissues drops, allowing the axillary buds to sprout and grow into larger shoots. Repeated pruning allows more and more side shoots to branch out, resulting in a denser, bushier plant.

Auxin also results in other important things in plants. It stimulates plant tissues to bend in response to light and gravity. In addition, auxin stimulates the formation of roots on cut stems. Its use in commercially available "rooting hormone" powders helps propagate cuttings.



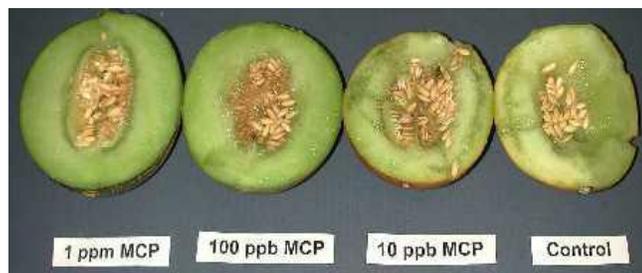
Plantlet in auxin rooting hormone powder. Photo credit: Kim Kruse (some rights reserved).

Source: http://gardeningsolutions.ifas.ufl.edu/images/care/planting/rooting_hormone.jpg

Another major plant hormone is cytokinin. It promotes cell division. Unlike auxin, which suppresses axillary bud growth, cytokinin encourages it. It also helps slow the aging process of cells. Commercial products to increase the shelf life of cut flowers use cytokinin.

Gibberellin is another growth and cell division promoter. Mutant plants deficient in gibberellin have dwarfed forms with short internode spaces between their stems, and may be desirable as ornamental cultivars.

Ethylene is a gas that diffuses through plant tissues and is especially prevalent in ripening fruit. If you've ever put avocados or a pineapple in a paper bag with a slice of cut apple to make them ripen faster, you've used ethylene.



Honeydew melons treated with varying concentrations of an "ethylene antagonist" substance that prevents ethylene buildup in their tissues. Fruits on the left had higher concentrations of the ethylene antagonist and did not continue ripening after cutting. Fruits on the right had little or none of the ethylene antagonist and continued to ripen. Source: <http://hos.ufl.edu/sites/default/files/public/images/honeydew-mcp.jpg>

The table below provides additional information on these and other plant hormones, including their functions and examples of their applications in horticulture.

Class	Function(s)	Practical uses
Auxins	Shoot elongation	Thin tree fruit, increase rooting and flower formation
Gibberellins	Stimulate cell division and elongation	Increase stalk length, increase flower and fruit size
Cytokinins	Stimulate cell division	Prolong storage life of flowers and vegetables and stimulate bud initiation and root growth
Ethylene generators	Ripening	Induce uniform ripening in fruit and vegetables
Growth inhibitors	Stops growth	Promote flower production by shortening internodes
Growth retardants	Slows growth	Retard tobacco sucker growth

For further reading on plant hormones, refer to these publications:

Plant growth regulators <http://edis.ifas.ufl.edu/pi139>

Hormones are messengers <http://hos.ufl.edu/sites/default/files/faculty/gamooore/Full%20Hormones.doc>

Plant propagation <http://gardeningolutions.ifas.ufl.edu/care/planting/propagation.html>

Auxins could help crops beat heat and high salinity, UF study suggests

<https://news.ifas.ufl.edu/2013/05/auxins-could-help-crops-beat-heat-and-high-salinity-uf-study-suggests/>

Research on ethylene and fruit ripening: <http://hos.ufl.edu/faculty/djhuber/current-research>

How herbicides work: why they kill plants and not people

<https://conference.ifas.ufl.edu/aw12/PDFs%20of%20Onsite%20PPTs/Tuesday/General%20Session/1500%20MacDonald.pdf>

Butterfly Saviors by Lois Weber, Master Gardener



Photo Credit: Lois Weber

Thank you to everyone who planted even one or two Milkweed plants to help the Monarch butterflies. For over 20 years, I've been passionate about Monarch butterflies. Since 1990, there has been a 90% decline in the Monarch population and I've been urging everyone to plant more milkweed plants. In January 2015, I had 200 caterpillars in my cages. In April 2016, I counted 333! The planting everyone is doing is making a difference.

I garden every day to be sure I have milkweed for our plant sales at the Palm Harbor Garden Club (October 10 and December 3), the Palm Harbor Y (held this year on September 24), and the Tarpon Springs Garden Club in the spring. I always have plants at home, not only milkweed but also other host and larval plants.

It's important to give the Monarchs a way station to stop, eat, and lay eggs. When I find baby caterpillars, I bring them inside the house to raise them because they have so many predators outside. While a Monarch might lay 100 eggs, if only one survives it is a lucky thing. I've been teaching children about these important butterflies for years, going into elementary schools and welcoming them, along with teachers and other adults to my home. You are always welcome. Just call and catch me home. My number is 727.938.2947.

Pollinators Critical to Our Survival

By Jane Morse, Commercial Horticulture, UF/IFAS Extension Pinellas County

Can you imagine a day without coffee, chocolate, apples, or honey? Did you know that nearly 90% of all wild flowering plants depend at least to some extent on animal pollination, and of the 1,400 crop plants grown around the world 75% require pollination by animals? Pollinators provide an essential ecological function. Without them, the human race and all of our land-based ecosystems would perish.

Now that you know how important they are, what exactly are pollinators? Pollinators include butterflies, flies, moths, wasps, beetles, birds, bats, midges and many other animals. There are over 20,000 species of wild bees. Most of us are familiar only with the European honeybees that provide plant pollination. Pollinators enable plants to reproduce and this reproduction produces many things we use, such as fruits, vegetables, beans and oils.

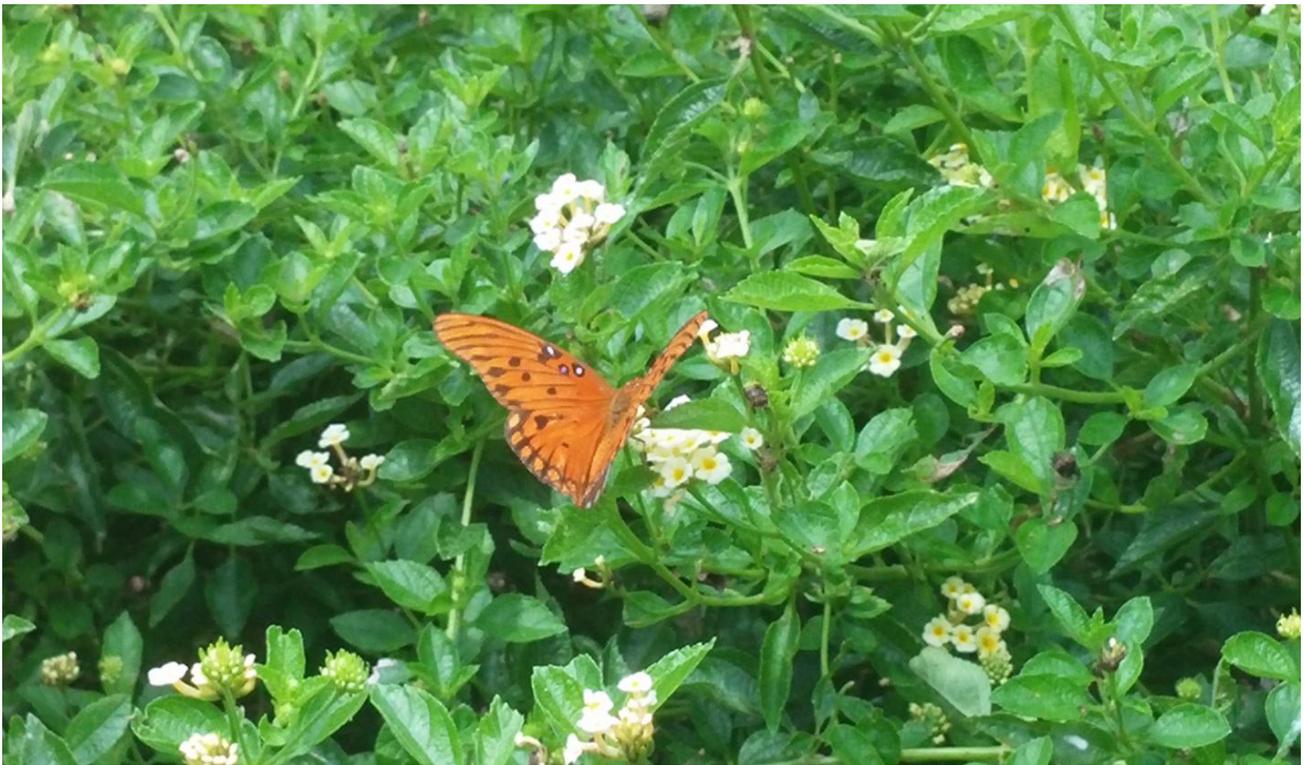


Photo Credit: UF/IFAS

Because of their important ecological function, our survival and well-being depends on these pollinators staying healthy. According to the Food and Agriculture Organization of the United Nations, more than 40% of invertebrate pollinator species, especially bees and butterflies, are facing extinction. This is an alarming trend! We need to address it.

According to the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services: Wild pollinators in certain regions, especially bees and butterflies, are being threatened by a variety of factors. Their decline is mainly due to changes in land use, intensive agricultural practices and pesticide use, alien invasive species, diseases and pests, and climate change.

These declines are occurring in both Northwestern Europe and in North America. The *Thematic Assessment of Pollinators, Pollination and Food Production* found that pesticides, including neonicotinoid insecticides, threaten pollinators worldwide. While we don't know everything about pollinators, we have more than enough evidence to know we need to act.

Since we can't live without pollinators, we need to protect them and begin helping them survive and prosper. To do so, do as many of the following things as you can.

- **Plant a wide variety of plants that bloom at different times of the year.** Plant them in clumps so the pollinators can find them. Use native plants. Native plants are adapted to our local climate, soil and native pollinators. Night blooming flowers will help support moths and bats.
- **Avoid using hybrid flowers, especially “doubled” flowers.** Pollinators avoid these structures. Pollen, nectar and fragrance are much more important. Give up that double flower for the benefit of the pollinators. If you are using native plants, you won't have to worry about this.
- **Eliminate pesticides whenever possible, which is most of the time.** If a plant requires frequent pesticides, it is the wrong plant for your location. Remove it. If you have to use a pesticide occasionally, use the least-toxic material possible. Insecticidal soaps and horticultural oils will kill most soft-bodied pests such as aphids, mealy bugs, scale and whitefly. Because they are not residual, they are less harmful to our pollinators. Many pesticides are especially harmful to bees, even insecticidal soap. Spray pesticides in the late evening after bees have returned to their hive.
- **Plant butterfly host plants in your landscape.** Because caterpillars eat the host plants, you may want to keep these host plants out of view, as they may be “messy” at times. Many people consider host plants to be weeds. They need to grow rampantly because caterpillars voraciously munch them. Search the web using the keywords, “Butterfly Gardening IFAS” to find out which butterflies are in your area and which plants are their host plants.

- **Provide a puddling pond or damp salt lick for butterflies and bees.** Mix soil with water to make mud and then add a bit of sea salt or wood ashes into the mud. You could also try putting a sponge in a dish of lightly salted water and see who comes to investigate.
- **Leave some animal droppings or rotting fruits.** Some butterflies are attracted to them. Toss that overripe banana or other fruit outside behind a bush. Leave a couple of Fido's droppings, too.
- **Leave dead tree snags, or at least an occasional dead limb to provide essential nesting sites for native bees.** Make sure these are not safety hazards. If this isn't possible you can make a bee house by drilling holes of varying diameters 3 to 5 inches deep into the cut side of a log or into a piece of scrap lumber mounted to a post. A bundle of stems tied together is another type of bee house. Even a stack of logs will work.
- **Provide nectar sources for hummingbirds.** Many plants with red tubular flowers are their favorites such as firebush, coral honeysuckle, and salvia. You can use hummingbird feeders but you must clean them at least twice a week to keep them mold free. Fill them with sugar water and use only real sugar. A good mixture is one part sugar to four parts water. Sugar water does not provide all the other good things found in true flower nectar.
- **Add many layers to your garden.** Provide ground covers, wild flowers, shrubs of differing heights and trees. Concentrate on native plants where possible. Make sure to have a source of water, such as a birdbath or pond.

If you do these things, your garden will teem with beneficial life. Enjoy all the life you bring to your garden, including insects. Many insects are pollinators as well as a food source for birds and other creatures. They are beneficial to us, keeping us fed and alive as well.

Resources:

The Xerces Society for Invertebrate Conservation

<http://www.xerces.org/wp-content/uploads/2013/12/EstablishingPollinatorMeadows.pdf>

<http://www.xerces.org/bringbackthepollinators/>

References:

Food and Agriculture Organization of the United Nations

<http://www.fao.org/news/story/en/item/384726/icode/>

United States Department of Agriculture Forest Service

<http://www.fs.fed.us/wildflowers/pollinators/importance.shtml>

<http://www.fs.fed.us/wildflowers/pollinators/gardening.shtml>



Photo Credit: UF/IFAS

Preserving Florida Yesterday, Today, Tomorrow

By Barb Stauffer, Master Gardener

On June 15, I attended the FFGC/UF Short Course in Gainesville, "Preserving Florida, Yesterday, Today, Tomorrow." Not only were the lectures clear and informative, but the fellowship of both Master Gardeners and Garden Club members was inspiring.

The opening reception Monday night was an inviting welcome to the two days of activities and provided an overview of what to expect. Tours on Tuesday included Sweetwater Wetlands, Paynes Prairie & Island Grove Winery, and lunch at the Straughn. Afternoon sessions included "A History of Florida Blueberries" by Dr. Paul Lyrene and "Old Gardening Practices of Florida" by Dr. Jim Stephens. The evening program, held at the Gainesville Garden Club, included a program on floral design by Claudia Bates, along with dinner.



Florida "Emerald" Blueberry. Photo
Credit: James W. Olmstead, UF/IFAS

The four sessions I attended on Wednesday, graciously hosted at the beautiful Gainesville Garden Club, included Dr. Patti Anderson, our State Botanist, presenting "The Endangered and Rare Plants of Florida". She focused on the history of The Endangered Species Act of 1973 and explained how Florida maintains a list of plants that fall into the categories of endangered, threatened, or commercially exploited ([Rule 5B-40](#)).

Dr. Carrie Harmon, a Plant Pathologist, presented "Make a Sick Plant Talk! Plant Disease Strategies". Beginning with a vocabulary review, she went on to discuss diseases, preventions, recommended treatments and the importance of knowing normal growth patterns. The Diagnostic Center is available for submitting samples:

<http://plantpath.ifas.ufl.edu/extension/plant-diagnostic-center/>

Erin Alvarez, a Plant Science Lecturer for the Agronomy Department at UF/IFAS, presented "Landscaping with Florida Natives". She explained the benefits of native plants, the importance of maintenance, and the "Right Plant, Right Place" principle. The right plant in the right place means the homeowner can use less water and pesticides. More information about native plants is at the Florida Native Plant Society's website: <http://www.fnps.org/plants>

As a butterfly enthusiast, I was delighted to hear Dr. Jaret Daniels present "Monarchs and Milkweed: What You Need to Know". Dr. Daniels is Assistant Professor and Curator at the McGuire Center for Lepidoptera & Biodiversity at the Florida Museum of Natural History. His focus is endangered butterflies and native insect pollinator conservation. He has published a reference book, the *Butterflies of Florida Field Guide*.

Dr. Daniels referred to the monarch butterfly, common in Florida, as a "gateway bug" to all Lepidoptera. Monarchs migrate throughout our state; many winter in the southern counties.

Unfortunately, beginning in 1995, there has been a steady decline in the monarch population. Fall landscapes are critical for feeding and refueling. Monarchs feed primarily on milkweed plants, both native and non-native. However, planting non-native milkweed can result in the Monarch butterfly becoming more vulnerable to such deadly parasites as *Ophryocystis elektroscirrha* (OE). Native milkweed provides a safe and healthy food source. He spoke about the many opportunities for us to become "Nature Aware" citizens and help the monarch. These include becoming a "Citizen Scientist", collecting data, tagging, creating Monarch way stations, planting window boxes, and participating in such national incentives as the "Million Pollinator Garden Challenge". Restoring the Monarch population will take a "cluster of people", but it is possible! The references section below includes some of his suggested websites.

Leaving the course, I found myself thinking more about conservation and the ways I could personally make a difference by being a nature aware citizen and gardener.

References:

<http://www.floridanativenurseries.org/info/News/fann-launches-new-program-to-expand-availability-of-native-asclepias/>

<http://www.MonarchWatch.org>

<https://www.flmnh.ufl.edu/science-stories/2008/09/01/volunteers-contribute-to-florida-butterfly-networks-conservation-plan/>

<http://www.monarchnet.org/sites/default/files/MonarchNet%20News%20July%202016%20final.pdf>

<http://www.monarchnet.org/florida-butterfly-monitoring-network>

<https://www.learner.org/jnorth/monarch/index.html>

Important Rules (and some plant advice) for Cats

By Barbara Strickland



Photo Credit: Barbara Strickland

A few weeks ago, my indoor cat, Keebler, after chewing on one of my indoor plants, calmly watched me clean up the mess after he regurgitated it near where I was studying. When I resumed my studying, he continued to sit, staring at me as though he was trying to tell me something.

Next morning, after I came downstairs, I discovered he had "marked" my study papers that I had left on the coffee table. This was unusual behavior. In addition, he was lethargic, not his usual feisty self. Since he will be 16 years old in October, despite his protests, I hauled him to the vet. I was worried that perhaps the plant had made him sick. After paying over \$300 for the exam and lab tests, they pronounced him in fantastic health. I realized then that what he had been trying to tell me the night before was the most important indoor cat rule—"don't ignore me, Mom. Your studying is not more important than me!"

However, the experience did cause me to think about the plants that he happily chews when he encounters them. I realized that our indoor plants belong to both of us. I decided to start an herb garden we could both enjoy.

Here is a list of what I started with:

- Thyme
- Basil
- Catnip
- Dill
- Oregano
- Rosemary
- Lavender
- Cilantro
- Mint (all varieties)
- Parsley
- Sage
- Wheat, lemon, and oat grasses

In addition to the herbs, Parlor Palms are not toxic to cats and the frond makes a great interactive toy!



Photo Credit:
Barbara Strickland

However, many plants are toxic to cats. These include primrose, lilies, garlic, azaleas, pothos, English ivy, kalanchoe, diffenbachia, peace lily, oleander, and sago palms. The ASPCA maintains a complete list of toxic & nontoxic plants for both cats and dogs at <http://www.asPCA.org>

My cat, Keebler, is a nuisance at times, but he's my 18.5 pound protector against all who enter my home, my beloved companion, and the only male I know who thinks I'm wonderful to look at first thing in the morning. We need to be sure our beloved pets are not in danger from the plants around them.



Photo Credit: Barbara Strickland

Report on the 2016 South Central District Master Gardener Conference By Theresa Badurek, Urban Horticulture Extension Agent and Master Gardener

The 2016 South Central Regional Master Gardener Conference started on a wet and stormy morning the day before Hurricane Hermine made landfall to our north. Despite the terrible weather, 193 Master Gardeners came to learn, share, and celebrate at the Bradenton Conference Center. The silent auction was a huge success, resulting in over \$1,300 for Master Gardener recognition awards and future conference expenses. Plant vendors lined the entry and the hall selling plants, irrigation supplies, and more. Even lunch was a delicious treat!

In addition to all that fun, the core of the conference was the educational offerings (6 CEUS for only \$40). They were excellent. The agenda overflowed with workshops—pest scouting, weed control strategies, plant diagnostics, plant identification, info on the UF/IFAS partnership with Bok Tower, and a fabulously funny Florida-Friendly Yard recognition program. MGs spent time doing hands-on puzzles, peering at pests under microscopes, and laughing at the FFL hi-jinx.

Thank you to all who attended despite the challenging weather—Pinellas County had a very good showing in attendance. You all are awesome!



Photo Credits: Theresa Badurak

A Few Pictures from the Geneva, Switzerland Botanical Garden, September 2016
By Dianne L. Fecteau

In early September, I visited the Botanical Garden in Geneva, Switzerland. The garden has over 16,000 species of plants, trees, and shrubs. It includes garden habitats from around the world, a garden of smell and touch, a rose garden, and a path of evolution. Sculpture is on display throughout.

Here are a few pictures.



Left: Swiss Alps Garden. Right: Their natural lawn mowing system. The lamb looked up soon after I took this photo and, realizing how far it was from the adults, scampered to get near them. Photo Credits: Dianne L. Fecteau



Bob Verschueren is a Belgian artist who creates his sculptures from natural materials in the landscape. Photo credit: Dianne L. Fecteau

Send your Articles and Photos

The next Issue of *The Dirt* is January 2017. The Deadline for articles is December 18. Share your passion for gardening with your fellow Master Gardeners by writing an article for *The Dirt*. Include images where possible. However, if you include images they must fall under one of the following guidelines:

- your own
- UF/IFAS image
- open access image, as in wiki-commons, where all rights are open and the photographer is credited
- used with the express permission of the photographer

When you do send images, please do not embed them within the article. Include them separately.

I would like to start a photographer's gallery within the newsletter so if you take photographs of plants or trees, send them in with a description, even without an accompanying article, and I'll publish them with the description as well as a credit to you, the photographer.

Send your articles, images, and your photos to Dianne Fecteau at dianne@kendiacorp.com. My phone number is 727.366.1392.

All articles are subject to editing. In addition, Theresa Badurek, Urban Horticulture Extension Agent and Master Gardener Coordinator, reviews and approves all articles prior to publication.

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