

Quick Reference Guide

for Plant Growth Regulators (PGR) in Florida Citrus Production

T. Vashisth and
J.D. Burrow

PGR AS DEFINED BY FLORIDA DEPARTMENT OF AGRICULTURE CONSUMER SERVICES (FDACS)

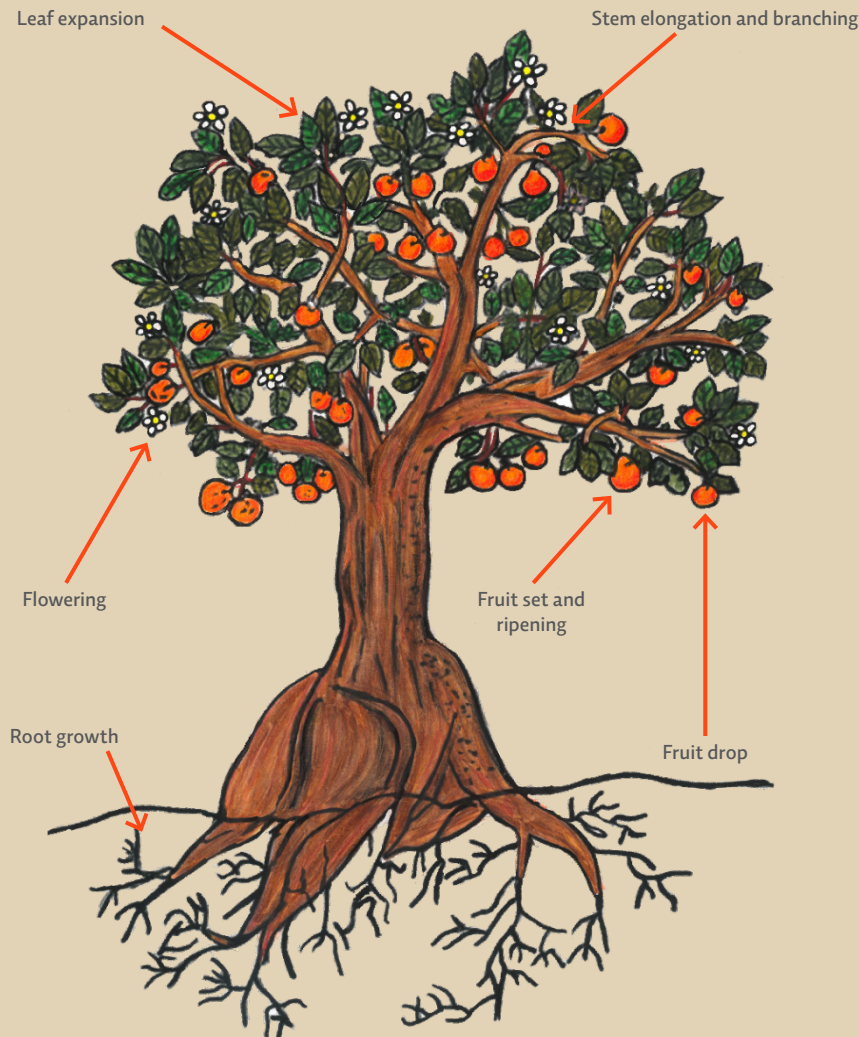
- Any substance or mixture of substances intended, through physiological action, for accelerating or retarding the rate of growth or maturation or for otherwise altering the behavior of ornamental or crop plants or the produce thereof, but not including substances intended as plant nutrients, trace elements, nutritional chemicals, plant inoculants, or soil amendments.
- Regulated as a pesticide
- Must follow pesticide laws when applying PGRs

PGR FACTS

- Known as growth regulators or plant hormones
- Chemicals used to alter the growth of a plant or plant part
- Can be growth inhibitors, promoters or retardants
- Play major role in abscission, dormancy, fruit ripening, fruit set, leaf expansion, stem elongation, root growth, germination, etc.
- Efficacy and effect of PGRs depends on rate, spray volume, and the developmental stage of plant or fruit
- Can work at very low concentration
- If applying two or more PGRs at a time, ratio of PGRs is very critical for efficacy

APPLICATION OF PGRs

- Must be absorbed by the plant tissue
- Uniform spray coverage must be ensured
- Absorption is often affected by weather conditions; warm and humid is favorable for absorption
- A surfactant helps in absorption of PGRs



Plant growth regulators impact multiple components of citrus tree growth.

PGRs can have multiple effects on plant depending on the developmental stage and time of application. For example, auxins can cause chemical thinning of fruit, reduce preharvest fruit drop, and promote next season bloom; therefore, careful consideration is needed when applying PGRs.

COMMONLY USED PGRs IN CITRUS

- In citrus, 2,4-dichlorophenoxyacetic acid (2,4-D) and gibberellins (gibberellic acid; GA) can reduce premature and preharvest fruit drop in healthy trees
- GA has been shown effective in reducing flowering when applied in the fall
- Naphthalenacetic acid (NAA) can be used for fruit thinning in mandarin varieties

CURRENT RESEARCH PROGRESS

- PGRs have been found effective in reducing preharvest fruit drop in other fruit crops such as apple, pear, and peach
- PGRs were considered to be a beneficial tool to decrease preharvest fruit drop related to Huanglongbing (HLB; citrus greening)
- Current research suggests that 2,4-D and GA are not effective in reducing HLB induced preharvest fruit drop. Further research is needed.



When applying PGRs, full spray coverage is necessary. Follow the label for proper PPE (personal protective equipment) when applying by hand.

RESOURCES

Albrigo, Leo G., and Ed W. Stover. 2015. "Effect of Plant Growth Regulators and Fungicides on Huanglongbing-related Preharvest Fruit Drop of Citrus." *HortTechnology* 25(6): 785–90. Web.
Fishel, Frederick M. 2015. Plant Growth Regulators. PI-102. Gainesville: Institute of Food and Agricultural Sciences. <http://edis.ifas.ufl.edu/pi139>

Tree Drawing: Naweena Thapa, UF/IFAS CREC
Tree Coloration: Katherine Snyder, UF/IFAS CREC
Photo Credit: Taylor Livingston and Travis Bergdoll, UF/IFAS CREC

MAJOR PLANT GROWTH REGULATOR CLASS, ASSOCIATED FUNCTION(S), AND PRACTICAL USES IN AGRICULTURE

CLASS	ASSOCIATED FUNCTION(S)	PRACTICAL USES
Auxins	Shoot elongation	Fruitlet thinning, increase rooting and flower formation
Gibberellins	Stimulate cell division and elongation	Increase shoot length, fruit size, and fruit set
Cytokinins	Stimulate cell division	Prolong storage life of flowers and vegetables and stimulate bud initiation and root growth
Ethylene	Ripening, abscission, and senescence	Induce ripening and loosens fruit
Abscisic acid	Seed maturation	Regulate plant stress
Jasmonates	Plant defense	Wound response
Salicylic acid	Systemic Acquired Response (SAR)	Defense against pathogenic invaders
Brassinosteroids	Developmental processes	Regulates germination and other developmental processes
Strigolactones	Suppresses branching and promotes rhizosphere interaction	Suppresses branching, promotes secondary growth, and promotes root hair growth

ACTIVE INGREDIENTS ON CHEMICAL LABEL

Auxins

1-naphthaleneacetic acid (NAA)
2,4-Dichlorophenoxyacetic acid (2,4-D)
3-indoleacetaldehyde acid (IAld)
3-indoleacetic (IAA)
3-indolepyruvic (IPA)
indolebutanoic acid (IBA)

Gibberellins

GA₄GA₇
GA₃

Cytokinins

CPPU
Kinetin

Ethylene

Ethephon
Ethylene

Jasmonates

Methyl jasmonate (MeJA)
Linolenic acid (LA)

Salicylic acid

Methyl salicylate

SAMPLE PGR LABELS SHOWING ACTIVE INGREDIENT

ACTIVE INGREDIENT:
1-Naphthaleneacetic Acid, Potassium Salt* 6.25%
INERT INGREDIENTS: 93.75%
Total 100.00%

ACTIVE INGREDIENTS: By Wt
3-Indolebutyric acid (IBA) 0.85%
Cytokinin, as Kinetin 0.15%
OTHER INGREDIENTS: 99.00%
TOTAL 100.00%

Active Ingredient: Gibberellic Acid (A₃) 20%
Other Ingredients: 80%
Total: 100%

ACTIVE INGREDIENTS
*Cytokinin, as Kinetin 0.090%
*Gibberellic Acid 0.030%
*Indole Butyric Acid 0.045%
OTHER INGREDIENTS 99.835%
TOTAL 100.000%

FOLLOW ALL LABEL PRECAUTIONS.

ACTIVE INGREDIENT:
Isopropyl Ester of 2,4-Dichlorophenoxyacetic Acid* 45.0%
INERT INGREDIENTS: 55.0%
TOTAL: 100.0%
*2,4-Dichlorophenoxyacetic Acid Equivalent 38% 3.36 lbs. 2,4-D acid equivalent per gallon.
Contains petroleum distillates

USE PRECAUTIONS

- ALCO CITRUS FIX is a plant growth regulator for use on citrus only. Do not use as a herbicide.
- Do not use on citrus trees less than 6 years old.
- Do not apply during a flush of leaf growth.
- Do not apply within 7 days of harvest.
- Do not allow drift to susceptible plants, which include but are not limited to: cotton, grapes, roses, beans, peas, alfalfa, lettuce, ornamentals and broadleaf plants. This product may injure cotton, beans, peas, grapes, ornamentals, etc. (coarse sprays are less likely to drift).
- Do not use equipment that has been used to spray ALCO CITRUS FIX to spray 2,4-D sensitive plants. Always use caution in disposing of spray solutions as they can cause extreme injury or kill sensitive plants. (See Storage and Disposal section.)
- Before using spray equipment for any other purpose, thoroughly clean same with hot soap suds followed by soaking and washing with ammonia or baking soda.

Disclaimer: The listing in this publication does not indicate general or specific endorsement or exclusion of a product, nor does it indicate approval by the University of Florida, the Institute of Food and Agricultural Sciences, or the Florida Cooperative Extension Service.

ACTIVE INGREDIENT	PRODUCT NAMES
Cytokinin	Ascend®; Ascend® SL; Ascend® WSG; Cytokinin® Bioregulator Concentrate; Cytoplex HMS®; Plant Pro Maximizer; Simplex Crop Biostimulant; Stimulate™ Fruit Thinner; Stimulate Power; Stimulate Yield Enhancer; Validate®; X-Cyte™
Gibberellic Acid	Falgro® 20SP; Falgro® 4L; GibGro® 20% Powder; GibGro® 4LS; N-Large™; ProGibb® LV PLUS; ProGibb® 4%; ProGibb® 40%
Auxin	Citrus Fix™; Hivol™-44; KickStand®; K-SaltFruit Fix 200™; PGR IV®; Radiate®; Receptor™

THE LABEL IS THE LAW!

Refer to label for specific crop use requirements. This guide does not supersede the label.