

ENHANCING WEED CONTROL IN CITRUS LATEST UPDATES FOR MATURE AND YOUNG GROVES

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UF/IFAS Southwest Florida Research and Education Center
Citrus Expo – August 17, 2023



Talk outline: Citrus weed control updates

A photograph of a citrus orchard with rows of trees and a dirt path. A vertical timeline is overlaid on the left side of the image, consisting of a brown line with circular endpoints and square markers. The text for each item is positioned to the right of the square markers.

■ Updates on citrus herbicides

■ Tree safety updates

■ New planting care

Talk outline: Citrus weed control updates



■ **Updates on citrus herbicides**

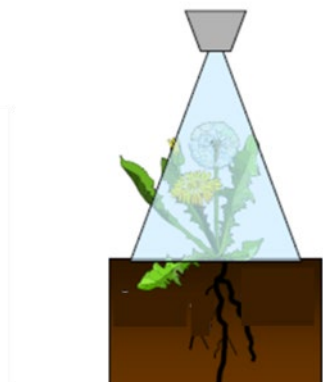
■ **Tree safety updates**

■ **New planting care**

Major POST-emergence herbicides used in FL citrus

- **Active ingredient** – E.g., Brand name(s)

Non-selective herbicides



POST
Foliar applied

- **Carfentrazone** – Aim EC
- **Paraquat** - Gramoxone
- **Glyphosate** – Roundup, Glystar etc.
- **Glyphosate + 2,4-D** - Landmaster
- **Glufosinate ammonium** – Scout, Rely 280

Availability Constraints

Consult **Florida Citrus Production Guide: Weed Chapter** for a complete listing of herbicides used in citrus and their rate suggestions

Major POST-emergence herbicides used in FL citrus

Selective herbicides



POST
Foliar applied

- Active ingredient – Brand name(s)

Broad-leaf weeds

- **Saflufenacil – Treevix**

- **2,4-D – Embed extra** (*24c local needs*)

Grasses

- **Fluazifop – Fusilade**

- **Sethoxydim – Poast plus**

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Selective
herbicides



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Foliar applied

- Active ingredient – Brand name(s)

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- See 'Florida Citrus Production Guide: Weed Chapter' for a complete listing of herbicides used in citrus
- Consult specific product label for rate suggestion and other usage restrictions

POST-emergence: What to Mix and What Not to Mix!



Glyphosate + 2,4-D (Embed Extra®)



clogged sprayer filter

Mixing issues - Dilution is the solution!

- Increase water application volumes (e.g., 20+ GPA)
- Only add glyphosate when the spray tank is full

POST-emergents: What to Mix and What Not to Mix!



Glyphosate + 2,4-D (Embed Extra®)



Survival of grass seedlings to glyphosate + 2,4-D mixture (right)

e.g., Johnson grass, Guinea grass, Barnyard grass etc.

POST-emergents: What to Mix and What Not to Mix!



These POST- herbicide mixes will NOT have favorable outcomes

- ❌ Fluazifop-butyl (Fusilade) + 2,4-D (Embed Extra[®])
- ❌ Glyphosate + Carfentrazone (Aim)
- ❌ Glyphosate + Glufosinate (Scout, Rely 280 etc.)

POST-emergence: Herbicide tolerance issues reported..

Parthenium weed..



POST-emergence: Herbicide tolerance issues reported..

Parthenium weed

- Ragweed parthenium, white-top etc.
- 25,000 seeds/plant
- Tolerance / poor efficacy
 - Glyphosate products
 - Glufosinate

Management strategies

- Saflufenacil (Treevix)
- 2,4-D (Embed extra; 24c label) + Glyphosate
- Effective pre-emergence herbicides
 - Pendimethalin (Prowl)
 - Flumioxazin (Chateau)
 - Indaziflam (Alion)



POST-emergence: Herbicide tolerance issues reported..

Spanish needles

- 3,000-6,000 highly viable seeds per plant
- Emerges throughout year
- Tolerance / poor efficacy
 - Glyphosate
 - Saflufenacil (Treevix)

Management strategies

- Rotate with 2,4-D (Embed extra) + Glyphosate
- Follow-up sprays
- Use a pre-emergence herbicide (e.g., Flumioxazin, Indaziflam etc.)



Herbicide tolerance issues

Spray when they are young

– *never let weeds to grow and adapt!*



Parthenium – young growth stage

Credits: Odeiro



Spanish needles – young plant

New problematic weeds in citrus

Clustered pellitory infestation in citrus rows

- Grows well in wet areas and under shade
- Spread quickly under citrus trees in the drip line areas

Management strategies

- Glyphosate products
- Glufosinate
- Saflufenacil (Treevix)



Improving herbicide application outcomes

Use optimum **rates**

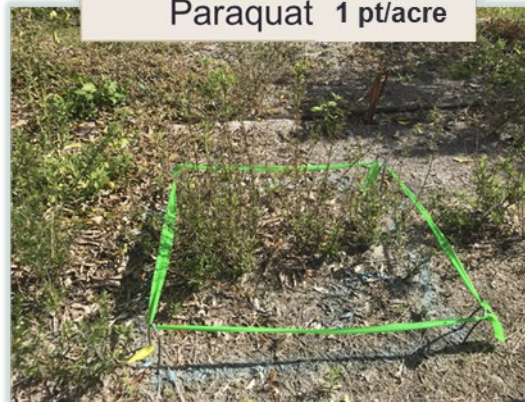
Use high labeled rates

- Heavy weed infestation
- Weeds in mature growth stage

Untreated Control



Paraquat 1 pt/acre



Paraquat 3 pt/acre



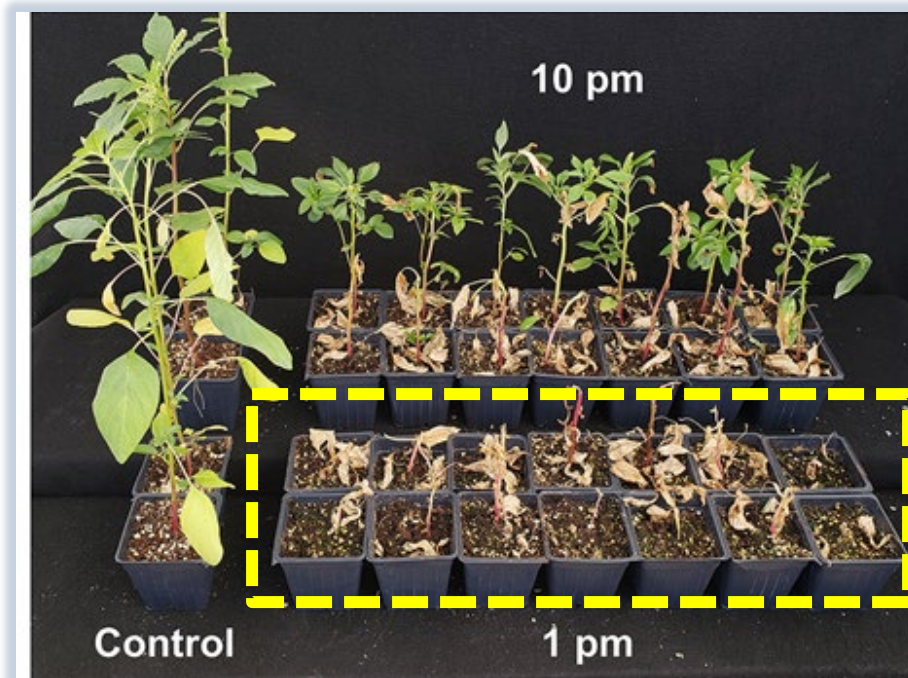
Effect of paraquat application rates on goatweed control

When to spray herbicides? – dawn, noon or dusk

Apply when there **is ample sunlight**

- **Mid-day applications** enhance effectiveness of *Glufosinate*
- Broad-leaf weeds tended to be more sensitive to the time-of-day effect than grasses

Impacts of 'application time' on glufosinate efficacy



Spraying during rainy season – *give at least 6 hrs. dry period*

Rainfast periods of burndown herbicides

- Time required between application and rain for the product to perform effectively
- Generally, rainfall within 6 hrs. after application may reduce effectiveness

E.g., of Rainfast ratings for citrus herbicides

Herbicide products	Hours until rainfast
Aim	1
Gramoxone SL	0.5
Roundup PowerMax	0.5
Roundup WeatherMax	0.5
Scout	4
Embed extra	6+
Poast	1
Fusilade DX	1
Treevix	1

Source: Product Labels

Spraying during hot weather— *apply during cooler part of the day*



Efficacy of these POST-emergent systemic herbicides reduces when temperatures are **above 95°F**

Glyphosate

2,4-D – Embed Extra

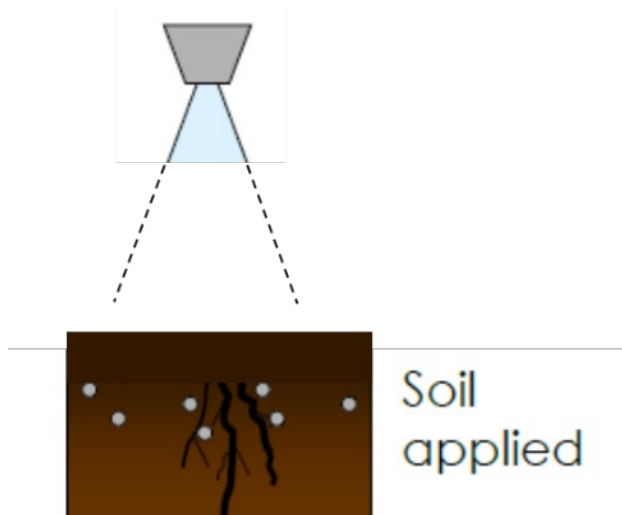
Sethoxydim - Poast

Injury potential to tree is also high

Major PRE-emergence herbicides used in FL citrus

- Active ingredient – E.g., Brand name(s)

PRE-emergent herbicides



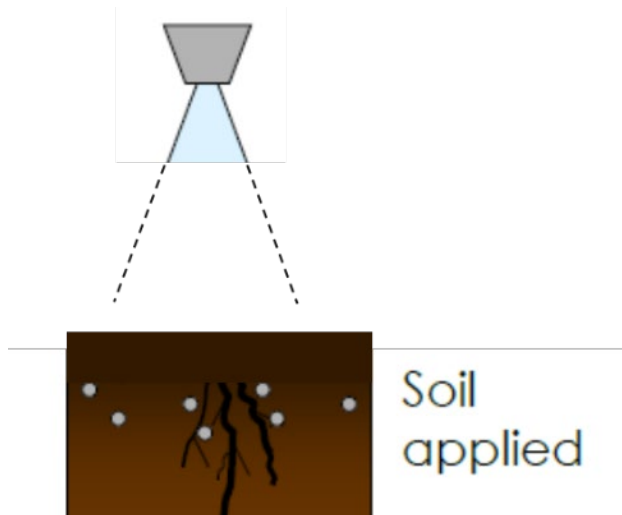
- **Simazine** – Princep, Caliber 90, etc.
- **Diuron** – Direx, Karmex, etc.
- **Norflurazon** - Solicam
- **Pendimethalin** - Prowl
- **Indaziflam** - Alion
- **Flumioxazin** – Chateau EZ

- See 'Florida Citrus Production Guide: Weed Chapter' for a complete listing of herbicides used in citrus
- Consult specific product label for rate suggestion and other usage restrictions

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PRE-emergent herbicides



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- **Indaziflam** - Alion
- **Flumioxazin** – Chateau EZ
- **Rimsulfuron** – Pruvion, Matrix
- **Flazasulfuron** – Mission (*5+ years old trees*)

- See 'Florida Citrus Production Guide: Weed Chapter' for a complete listing of herbicides used in citrus
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Tank mixing pre-emergence/residual herbicides helps cut-down the rates and manages herbicide tolerance issues



Evaluated PRE tank mixes

Active ingredient(s)	Herbicide product(s)	Product Rate (per acre)
Flumioxazin + Indaziflam	Chateau + Alion	6 oz 3 oz
Flumioxazin + Diuron	Chateau + Karmex	6 oz 4 lb
Flumioxazin + Norflurazon	Chateau + Solicam	8 oz 3 lbs.
Rimsulfuron + Indaziflam	Pruvin or Matrix + Alion	2 oz 3.5 oz

Resources

Proper *tank-mixing order* of crop protection products, including herbicides

PRECISION LABORATORIES
Results. Expect it!

HOME ONLINE APP FEATURES ABOUT US CONTACT US

Select Products

Herbicides (0/6) Select

Fungicides (0/4) Select

Insecticides (0/4) Select

Adjuvants (0/3) Select

Foliar Nutrition (0/2) Select

Get Mixing Order Clear Selection

Precision Laboratories is a leading provider of specialized chemistries applied to plants, seeds, soil and water to maximize resource and biological performance potential while stewarding the environment.

Always read and follow label directions. Conduct a compatibility test to ensure product compatibility.

<http://www.mixtankapp.com/onlineapp/index.php>

Challenges with Florida soils



Typical Crop
production soils



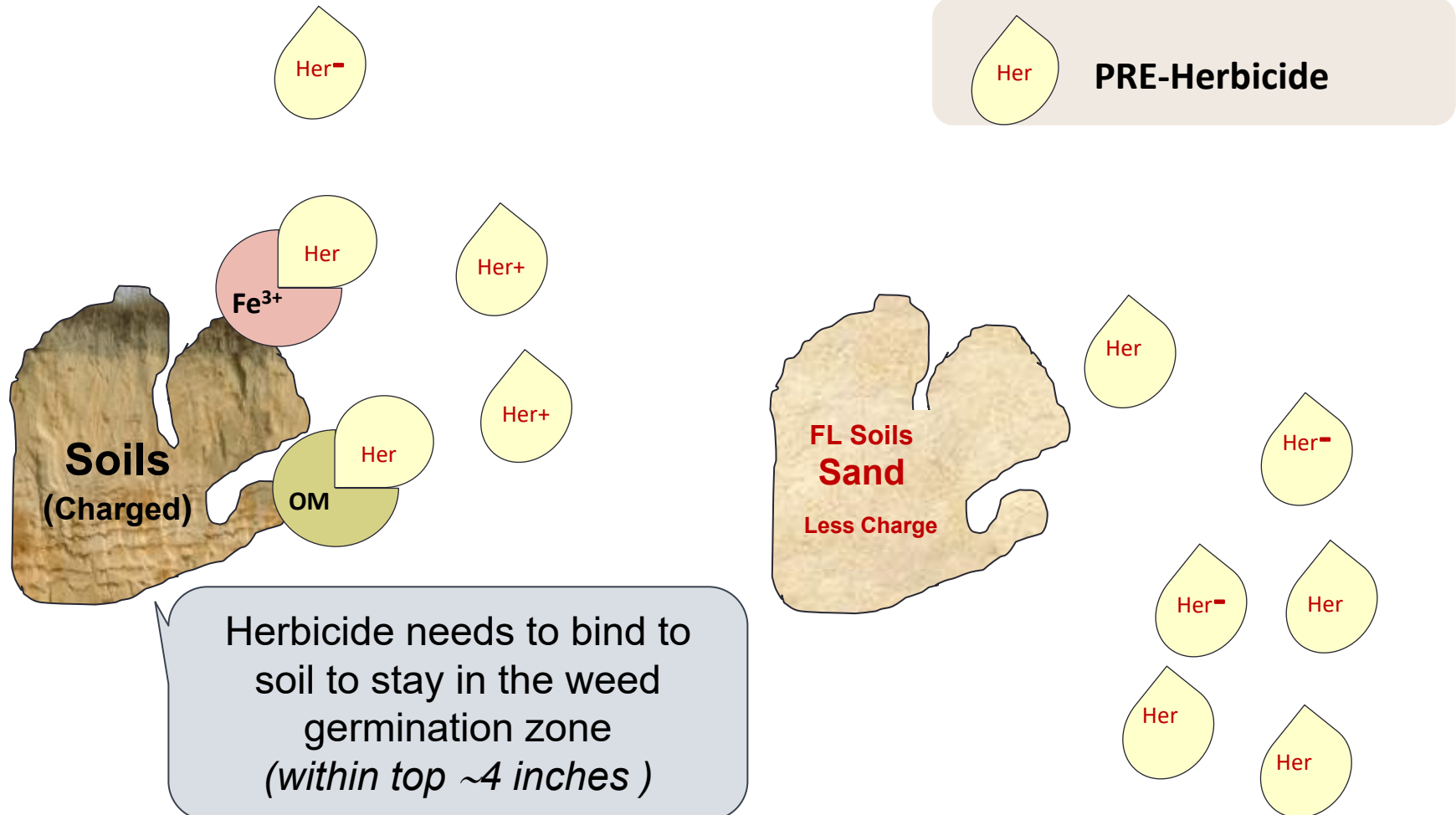
Florida
Citrus production soils

Sand >95%

Organic matter ≤1%

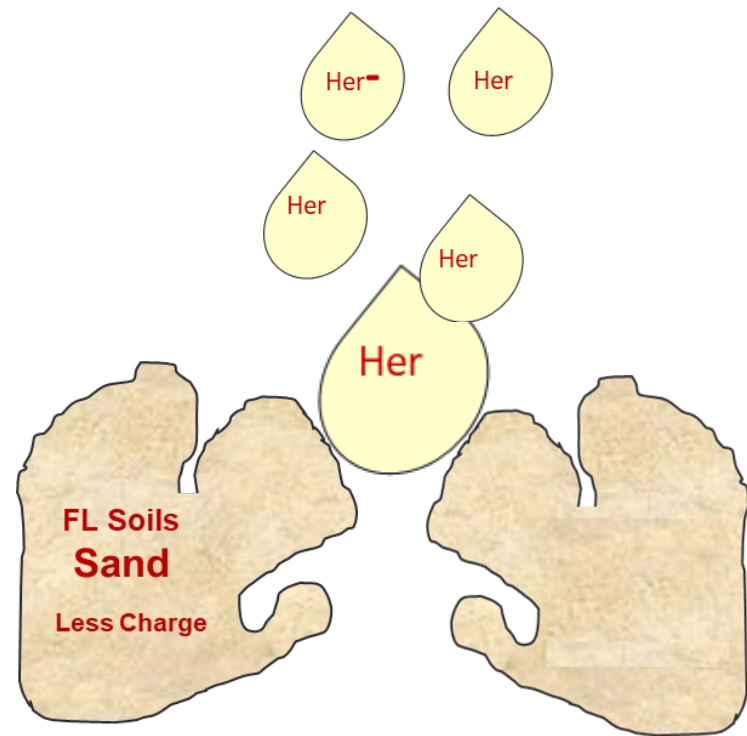
Basically, beach sand !

PRE-emergence herbicide retention in soil – *important for weed suppression*



Tank mixing adjuvants for improving the efficacy of **PRE-emergence** herbicides

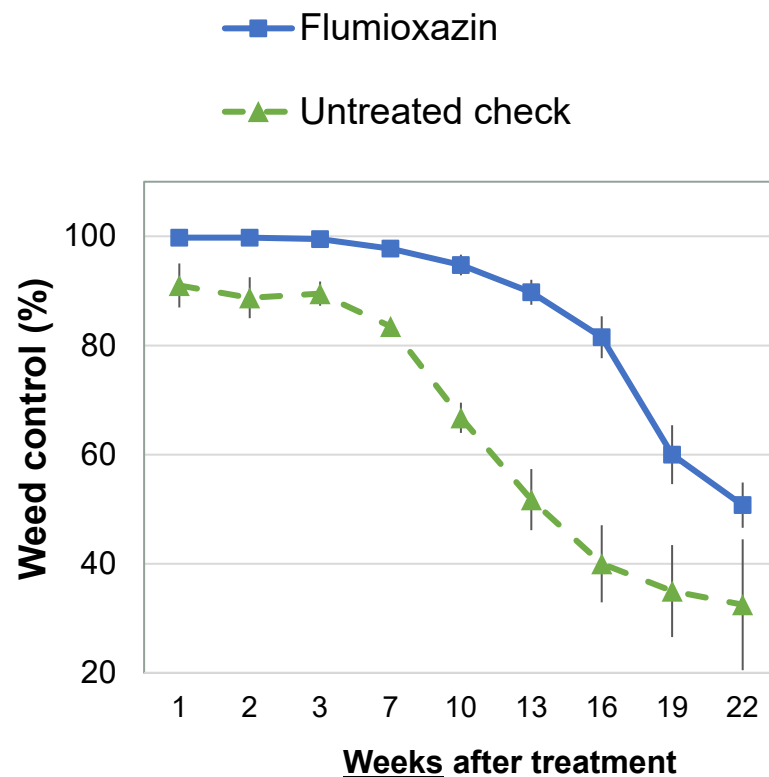
- Herbicide deposition agents – to improve soil retention of herbicides
- E.g., Polyvinyl polymers
- E.g trade names - Hydrovant *fA*®, Grounded® etc.
- Tank-mixed with PRE-emergence herbicides



Deposition agents increase the herbicide spray droplet size and restricts their movement through the soil pore spaces

Utilizing adjuvants for improving the efficacy of **PRE-emergence** herbicides

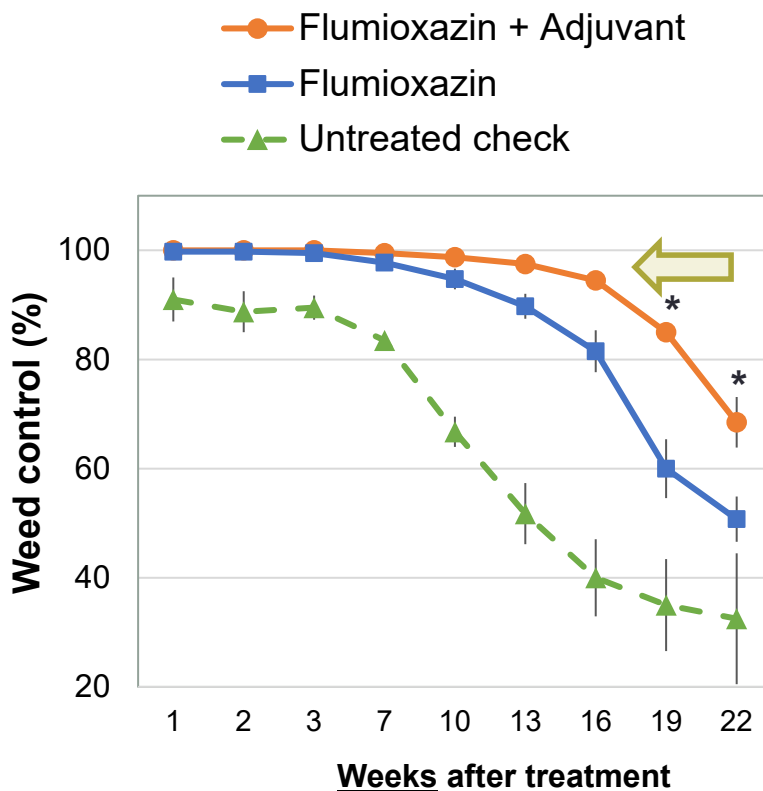
- Herbicide deposition agent or adsorption agent
- E.g., Polyvinyl polymers
- E.g trade name - Hydrovant *fA*®
- Tank-mixed with PRE-emergence herbicide **Flumioxazin** (Chateau)



- Replication (n) = 4
- Mean comparison: Tukey's HSD ($\alpha = 0.05$)
- * Significant difference ($p \leq 0.05$)

Utilizing adjuvants for improving the efficacy of **PRE-emergence** herbicides

- Herbicide deposition agent or adsorption agent
- E.g trade name, . Hydrovant fA[©]
- Tank-mixed with PRE-emergence herbicide **Flumioxazin** (Chateau)



Chateau 8 oz/acre + Hydrovant fA 0.1% v/v

- Replication (n) = 4
- Mean comparison: Tukey's HSD ($\alpha = 0.05$)
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Talk outline: Citrus weed control updates



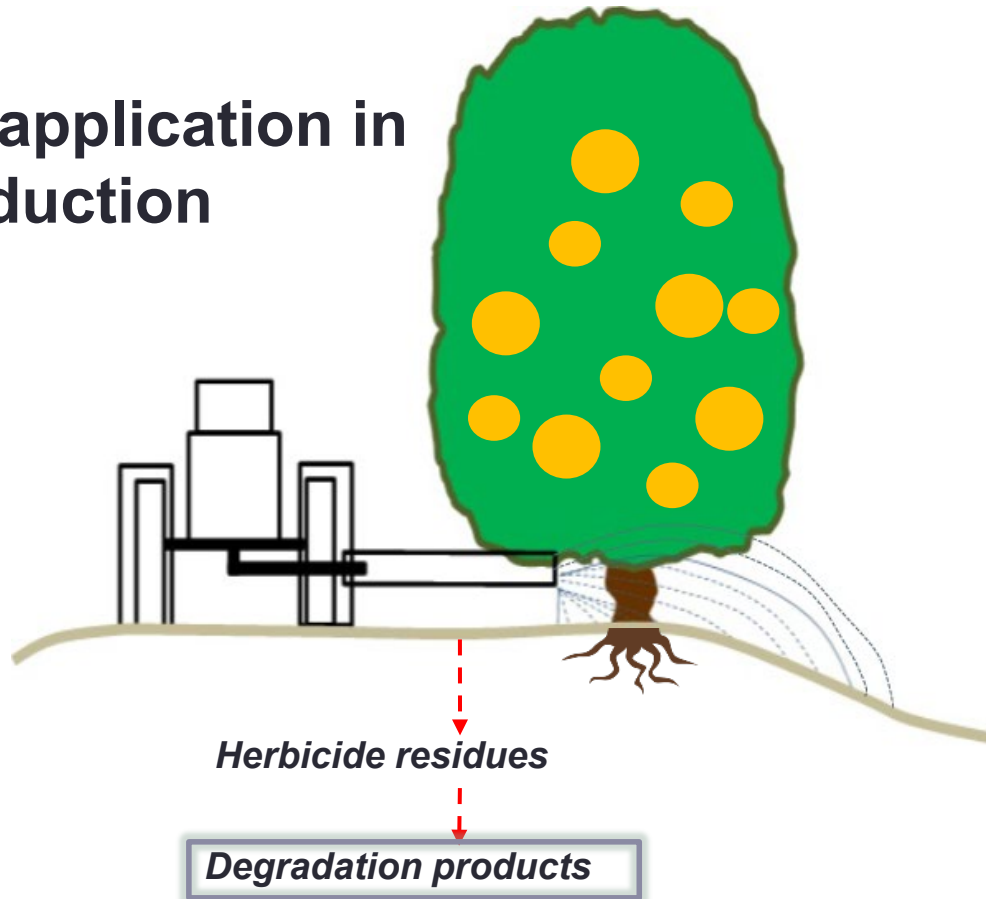
Updates on citrus herbicide options

Tree safety updates

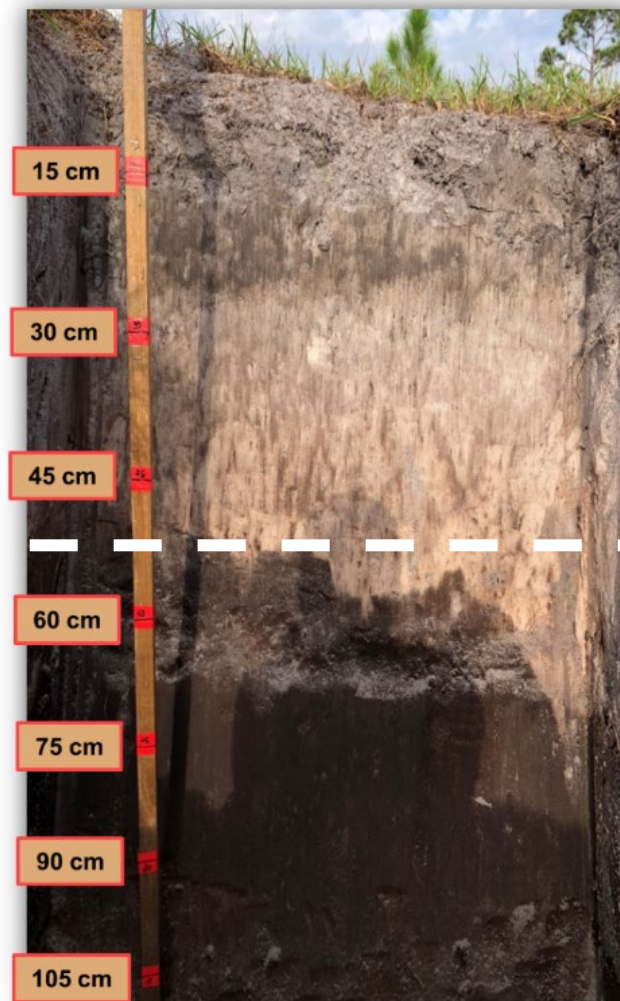
New planting care

Impacts of herbicides on citrus health and yield

-Herbicide application in citrus production



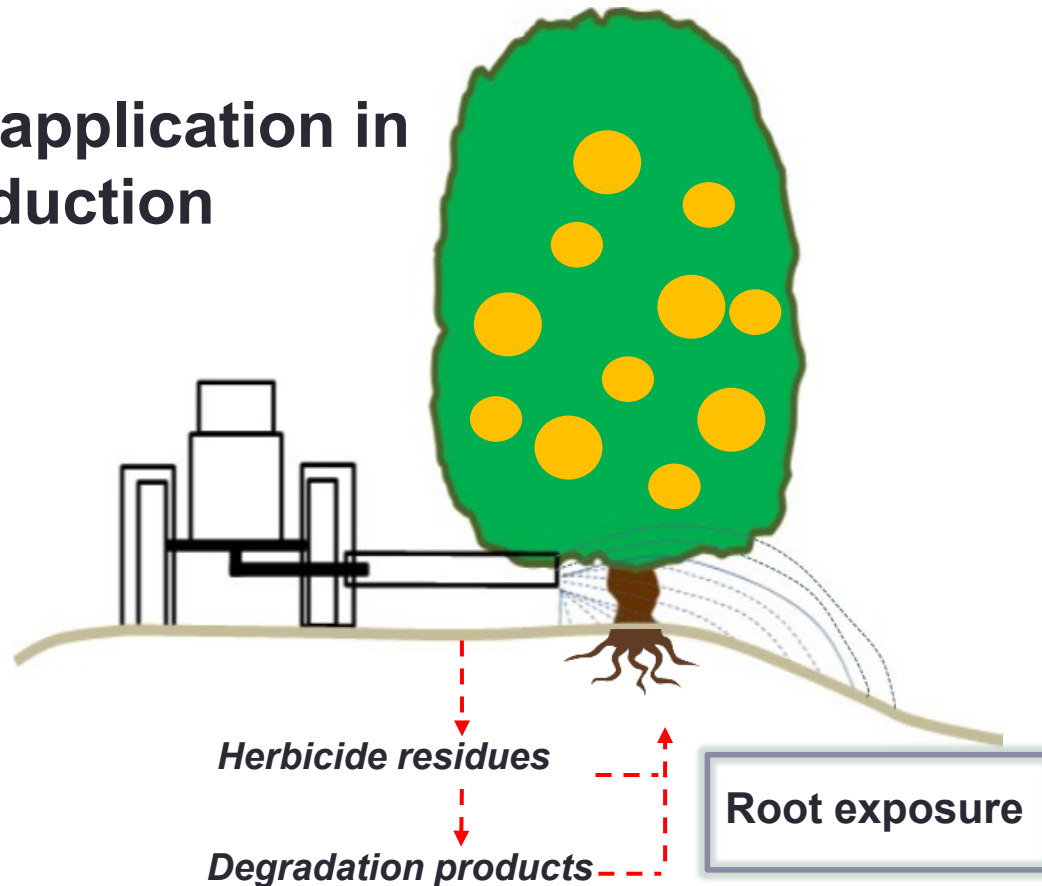
Herbicide movement in citrus soils



Soil profile in a Southwest Florida citrus grove
Immokalee, FL

Impacts of herbicides on citrus health and yield

-Herbicide application in citrus production



Citrus greening disease endemic

Do herbicides contribute to this stress??

Impacts of herbicides on citrus health and yield



Rhizotron studies to evaluate the impact of herbicide programs on root development in citrus

Tested pre-emergence herbicide programs did not significantly affected the roots

- Observation period of ~3-months

Hamlin orange

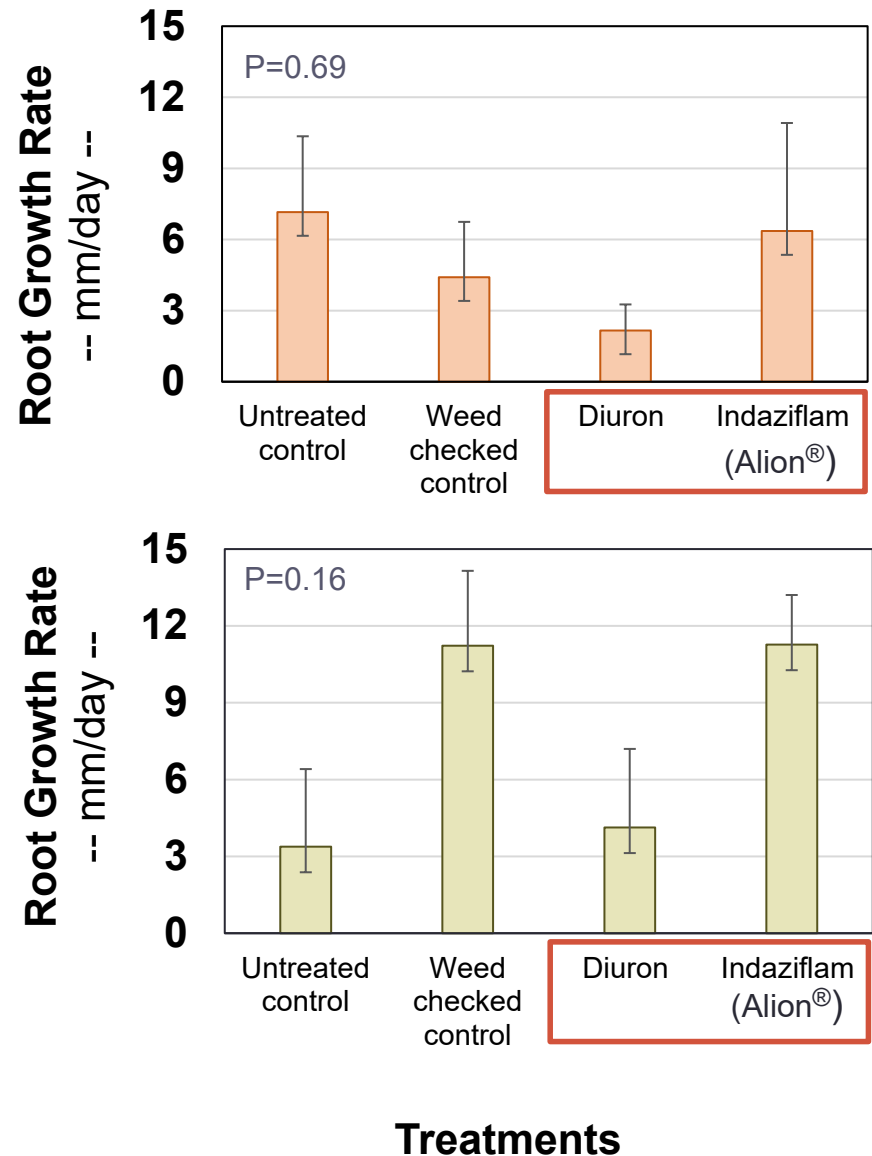


- No significant differences between the treatment means

Valencia orange



Number of reps: 4
Error bars: \pm SD
Tukey's HSD (α 0.05)

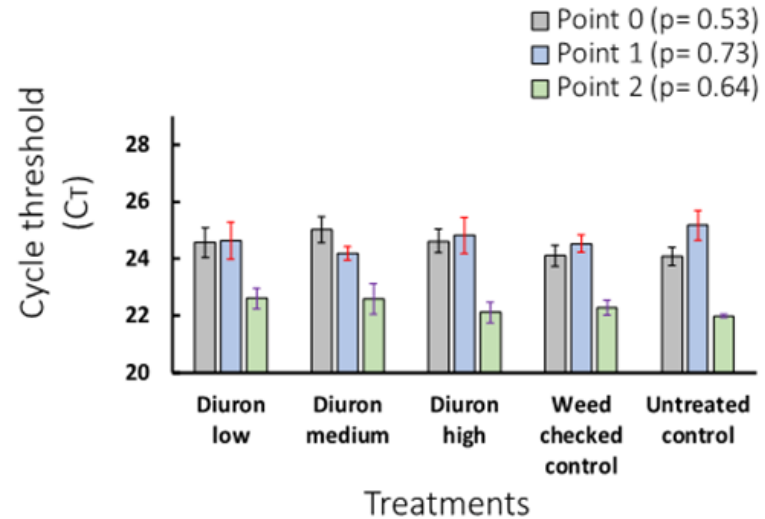


Tested pre-emergence herbicide programs did not significantly affected HLB disease severity

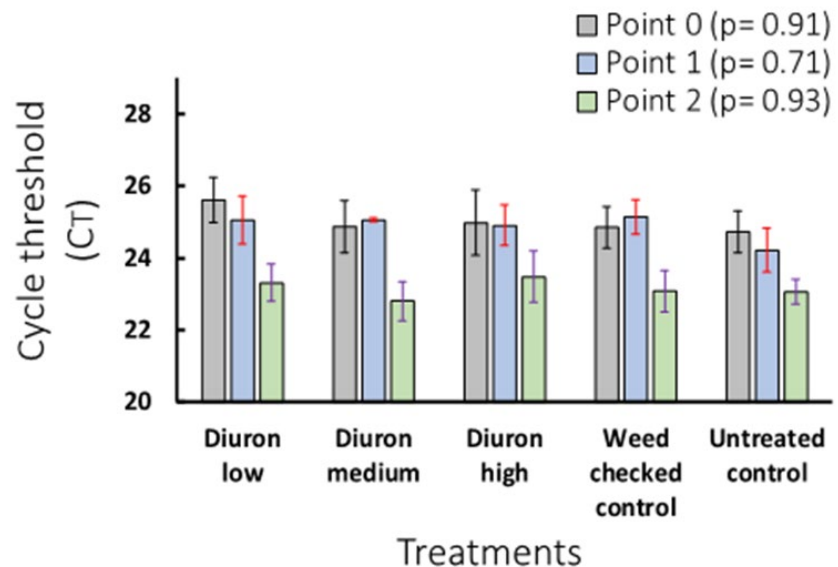
Hamlin orange



– No significant differences between the HLB severity



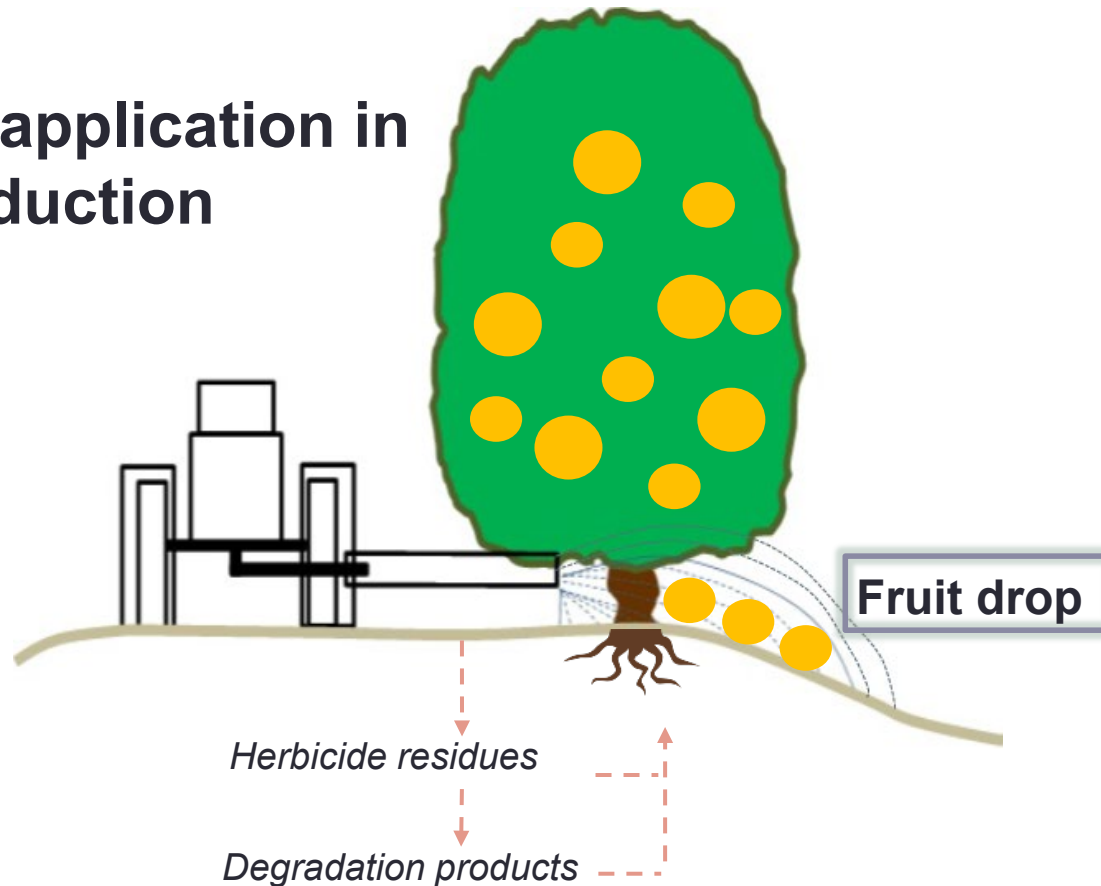
Valencia orange



Similar trend for Indaziflam observed !

Impacts of herbicides on citrus health and yield

-Herbicide application in citrus production



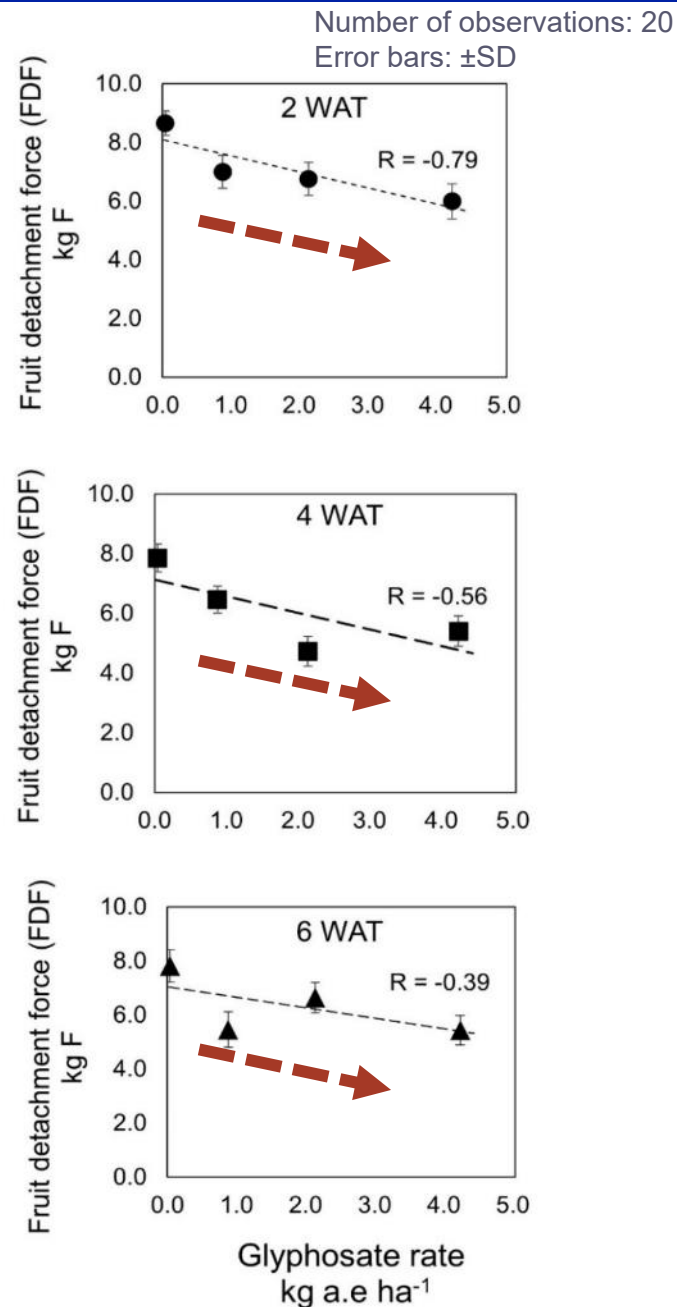
Crop-safety of glyphosate – in Florida Citrus

Image Credits: Citrus Industry magazine



Avoiding glyphosate sprays close to harvesting timeline in 'Valencia citrus' may be beneficial in improving the yield safety

Source: Gairhe et al. 2022 HortScience



Talk outline: Citrus weed control updates



Updates on citrus herbicide options

Tree safety updates

New planting care

Weed management in new plantings and young trees..

- Use contact herbicides for pre-planting burn-down, if possible
- If using glyphosate, provide enough pre-plant interval (3+ weeks)



Weed control prior to new tree establishment

Weed management in new plantings and young trees..

- Install protective wraps around the trunk of young citrus trees



Weed management in new plantings and young trees..

- Use lower end of the herbicide labeled rates in new plantings during the first year of planting
- E.g., of pre-emergence herbicides that could be applied during initial year of tree establishment
Norflurazon (Solicam DF)



Summary



■ Citrus herbicides

- *POST sprays (before flowering/seeding)*
- *Managing tolerance issues*
- *Weather considerations for POST*
- *PRE herbicides for preventing germination from soil seed bank*
- *Tank mixing PRE's*
- *Deposition agents for PRE*

■ Tree safety

- *PRE-emergence research updates*
- *Avoid glyphosate sprays near harvest*

■ New planting care

- *Use low herbicide rate during establishment*

My lab group

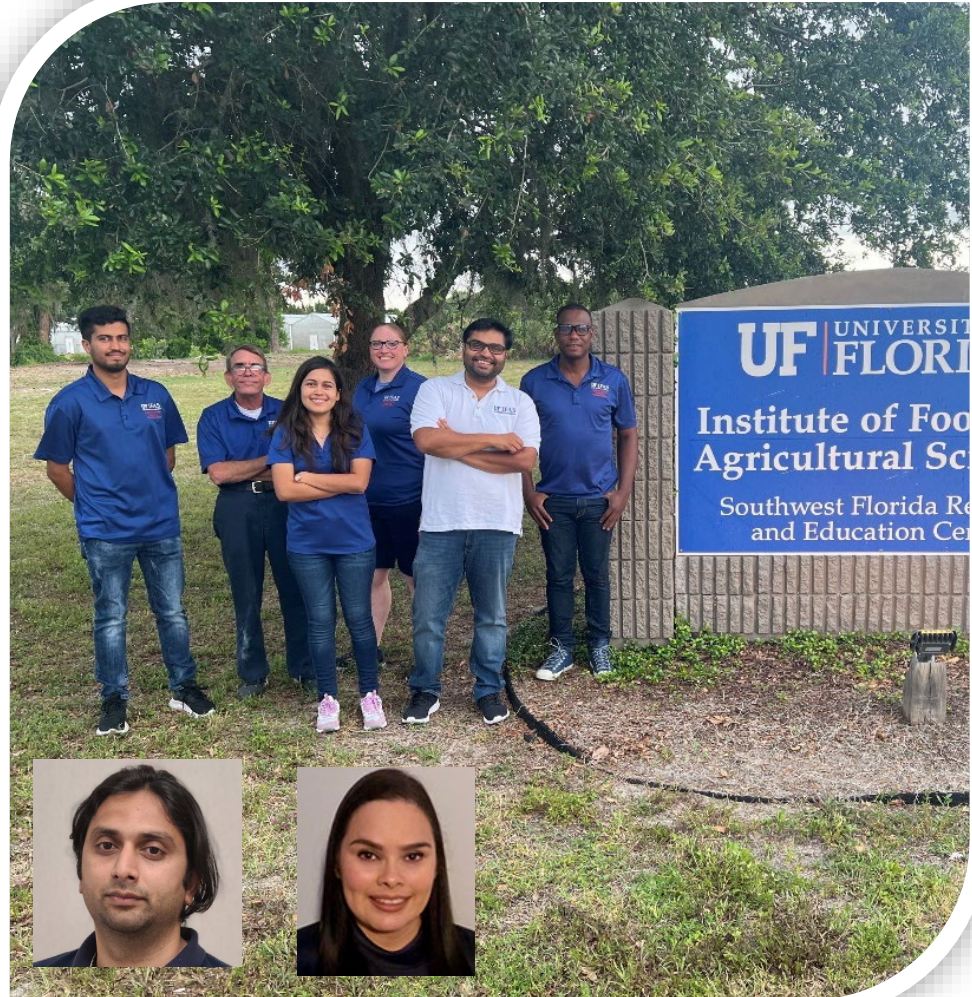
Acknowledgements



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Nirmal Timilsina



*From Left: Nirmal Timilsina, Robert Riefer, Ruby Tiwari, Shea Teems, Ramdas Kanissery, Diderot Saintilma
Inset: Mahesh Bashyal, Miurel Brewer
Not in picture: Rebecca McGill*

Thank you...

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Tom Zangrillo
and more..



United States Department of Agriculture
National Institute of Food and Agriculture

UF IFAS Extension UNIVERSITY of FLORIDA

Quick Reference Guide to Postemergence Herbicides for Citrus Weed Control
Products recommended in the Florida Citrus Production Guide and their effects on weed management.

HS1410
R. Kanissery, C. E. McAvoy, J. D. Burrow, S. H. Futch, B. A. Sellers, and S. S. Teems

Herbicide ^a	MOA ^b	REI ^c Hours	PHI ^d Day(s)	Weeds Controlled		Comments	Suggested Rate per Acre	
				Grasses	Broadleaf			
Nonselective Systemic Herbicides	Glyphosate -Undertow (9)	G	Varies ^e	1	X	X	Avoid contact with citrus fruit, foliage, and green bark. Rainfall within 1-6 hours after application may reduce effectiveness.	Annual weeds: 0.75-1.5 lb A.E. ^f Perennial weeds: 1.5-3.75 lb A.E. See product label for annual maximum rate.
	Glyphosate -Chemical weeding (9)	G	Varies	1	X	X	Do NOT mow within 1 week before or after treatment.	Rabigrass: 0.125 lb A.E. followed by 2nd application 45 days later Barnyardgrass: 0.125-0.37 lb A.E.
	Glyphosate -Spray (9)	G	Varies	1	X	X	Use sprays to remove tall growing and difficult weeds.	5% - 10% solution - careful spray 10% - 12.5% solution - careful spray
	Glyphosate -Soil treatment (9)	G	Varies	1	X	X	Avoid contact with citrus fruit, foliage, and green bark.	7% - 7% solution
	Glyphosate plus 2,4-D (Landsmaster II)	G, D	48	7	X	X	X	Apply with shielded and hooded nozzles to citrus midrib or under the tree. Do not mow trees. Use recommended rate in 30-40 GPA.
Nonselective Contact Herbicides	Carfentrazone-ethyl Am EC (14)						Requires registration in Florida. Avoid contact with green tissue or fruit. Finished spray volume of at least 20 GPA required.	Water per application: Max 2.0 fl oz Maximum rate/year: 79 fl oz Max appl./yr: 7 Min. time btwn. appli: 14 days
	Glufosinate-ammonium Rally 280 (10)	H	12	14	X	X	Warm temperatures, high humidity, and bright sunlight improve performance. Avoid contact with green bark, stems, or foliage. Spot treatment: 1.7 fl oz per gallon of water. Apply to undesirable vegetation foliage until wet but prior to runoff.	48-82 fl oz 246 fl oz (4.5 lb a.i.) 7 at max rate 14 days
	Paraquat Gramoxone SL 2.0 (22)	D	24	—	X	X	Addition of surfactant or crop oil concentrate is essential for maximum contact activity. Avoid contact with citrus fruit, foliage, and green bark. Per new labeling requirement, applicators must complete mandatory training program and be certified applicators of restricted-use pesticides.	2.5-4.0 pt 20 pt 5

<https://edis.ifas.ufl.edu/pdf/HS/HS141000.pdf>

Contact

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UF IFAS Extension UNIVERSITY of FLORIDA

2023-2024 Quick Reference Guide to Preemergence/Residual Herbicides for Citrus Weed Control¹
R. Kanissery, W. Liu, J. D. Burrow, S. H. Futch, B. A. Sellers, and S. S. Teems²

HS1438

Contact: Ramdas Kanissery (rkanissery@ufl.edu)

Products recommended in the Florida Citrus Production Guide and their effects on weed management.

This table lists registered pesticides that should be integrated with other pest management methods. Contact your local UF/IFAS Extension office for additional information (https://sfl.ifas.ufl.edu/find-your-local-office/).

Herbicide ^a	MOA ^b	REI ^c Hours	PHI ^d Day(s)	Weeds Controlled				Comments	Suggested Rate Per Acre
				Annual Grasses	Perennial Grasses	Annual Broadleaf	Perennial Broadleaf		
Indaziflam [®] Alion	L (29)	12	7	X		X		Do not apply Alion within 30 days prior to planting or within 30 days after planting citrus trees.	5-6.5 oz.
Bromacil Hyvar X BO WP	C1 (5)	12	—	X	X	X		Do not use on deep-sandy, ridge soil types.	Trees 4 years and older: 2-4 lb. Trees 1-3 years old: 2-3 lb.
Bromacil & Diuron Krovar 1 DF	C1, C2 (5, 5)	12		X	X	X		Do not use on deep-sandy, ridge soil types.	Trees 3 years and older: 4-6 lb. Trees 1-3 years old: 2-4 lb.
Diuron Diuron BODF	C2 (5)	12		X		X		Foliage contacted by diuron may develop a bleached or bronzed appearance.	2-4 lb.
Diuron Direx/Diuron 4L	C2 (5)	12	—	X		X		Trees 4 years and older: 80 days between sequential applications. Trees less than 4 years: 60 days between sequential applications.	1.6-3.2 qt.
Diuron Karmex BODF	C2 (5)	12	—	X		X		Trees 4 years and older: 80 days between sequential applications. Trees less than 4 years: 60 days between sequential applications.	2-4 lb.
Norflurazon Solicam BODF	F1 (12)	12	30	X	X	X		For best results apply prior to weed emergence.	2.5-5 lb.
Metolachlor	E1	12	30	X	X	X		Avoid ground or third instar contact during the application.	0.5-1.0 gal/acre (water spray) 10 gal/acre