

Citrus weed control

- current options & new additions

Ramdas Kanissery

Southwest Florida Res. & Education Center
University of Florida



Talk outline: Citrus Weed Control

Current options

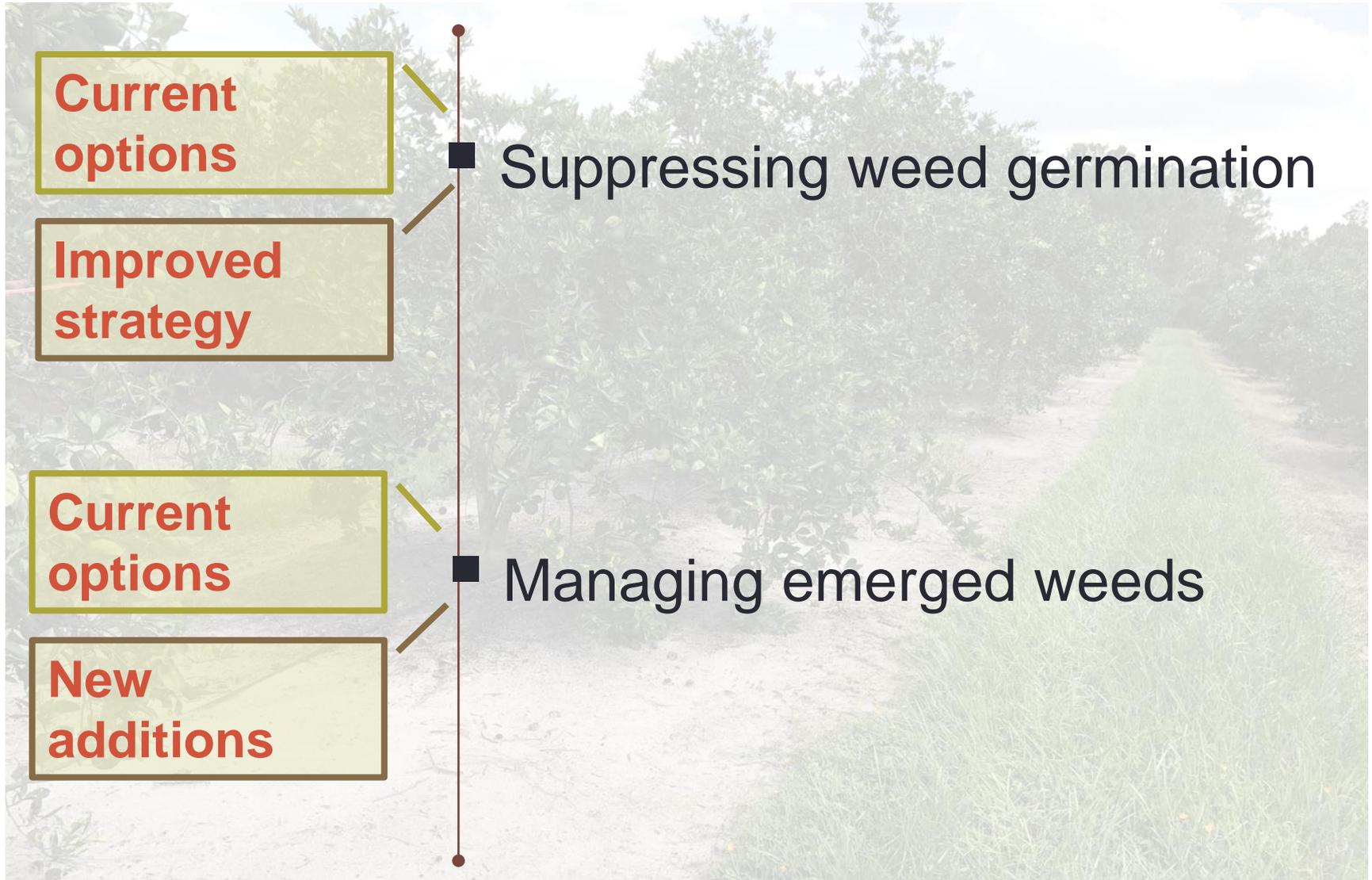
Improved strategy

Current options

New additions

■ Suppressing weed germination

■ Managing emerged weeds



Citrus weed control – Why does it matter?

Keeping weeds in check ...

- Help reduce trees' competition for resources
- Improve yield and productivity
- Potentially help pest and disease management

Citrus weed control – Why does it matter?

Keeping weeds in check ...

- Help reduce trees' competition for resources
- Improve yield and productivity
- Potentially help pest and disease management

“Weed control may help psyllid management”

Spanish needle

Dog fennel

Primrose



Psyllids (ACP) can use some citrus weeds as a ‘way station’ for their survival

Weed management strategies in citrus production

*Weed control
'tool-box' for citrus*



■ Prevention

- Mulching

■ Mechanical

- Mowing

■ Cultural

- Cover-crops

Weed management strategies in citrus production

*Weed control
'tool-box' for citrus*



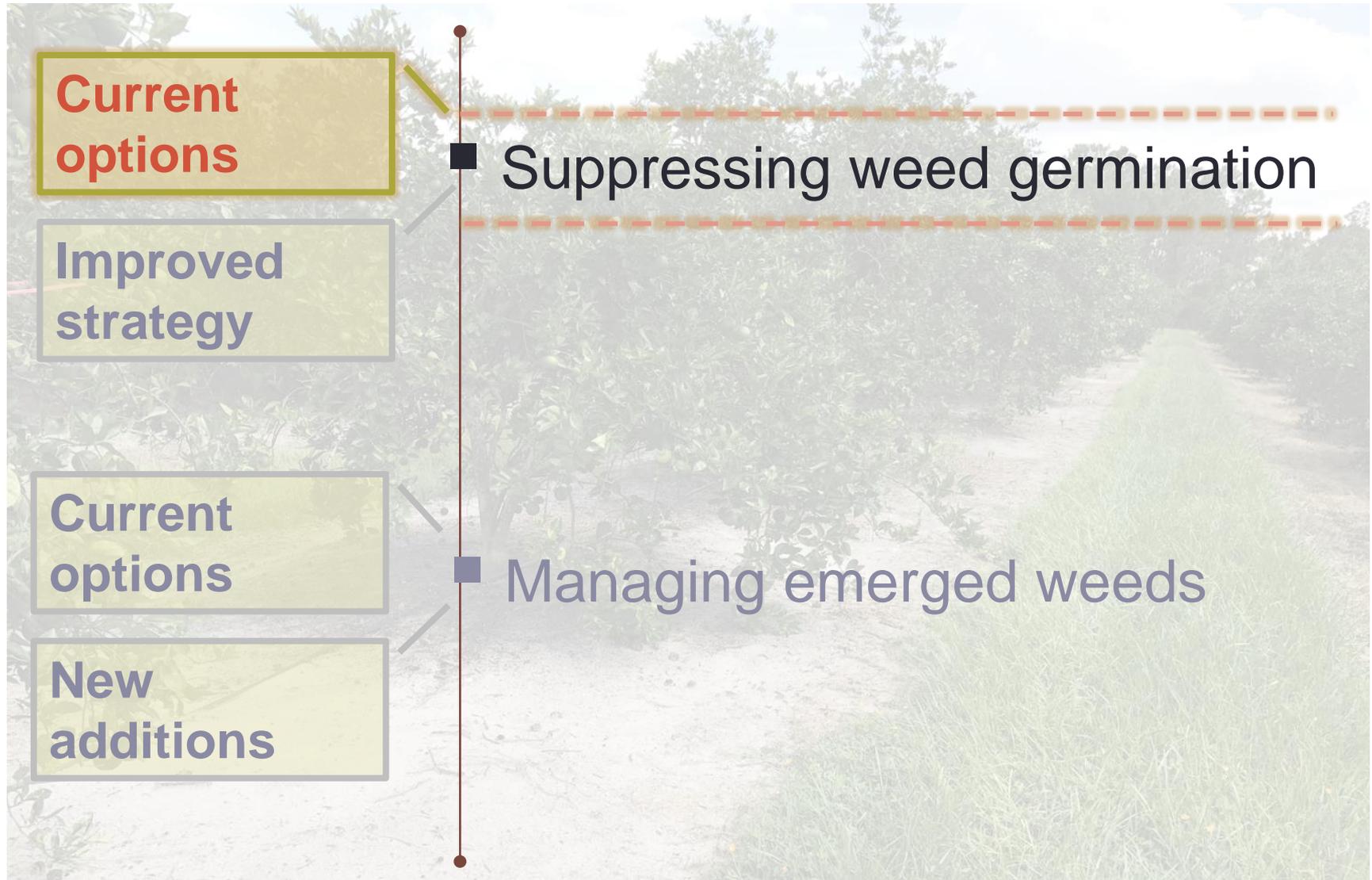
- Prevention

- Mechanical

- Cultural

- Chemical *(Most popular)*
 - **Herbicides**

Talk outline: Citrus Weed Control



Suppressing weed germination – *prevention is better than cure*

- *Preventing the weed germination from soil seed bank*
- *Key strategy for long-term citrus weed control*
- *Achieved by PRE-emergent herbicide programs*

Quick weed emergence
in citrus tree rows

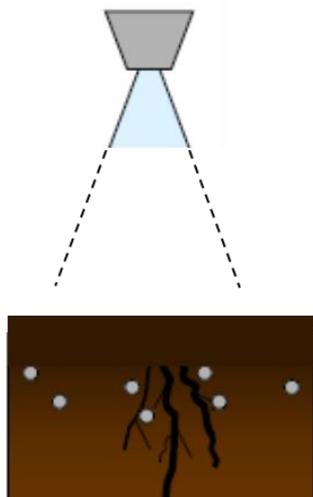


After 30 days



Major PRE-emergent herbicides used in FL citrus

PRE-emergent herbicides



Soil
applied

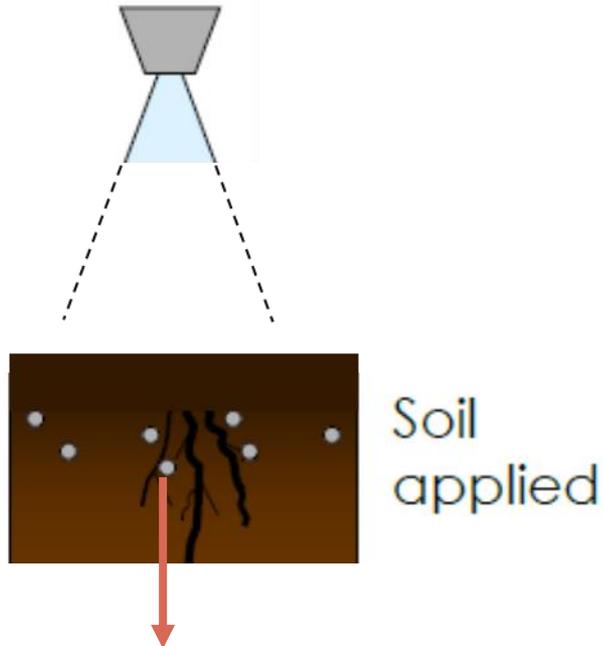
- Active ingredient – E.g., Brand name(s)
 - **Simazine** – Princep, Caliber 90, etc.
 - **Diuron** – Direx, Karmex, etc.
 - **Norflurazon** - Solicam
 - **Pendimethalin** - Prowl
 - **Indaziflam** - Alion
 - **Flumioxazin** - Chateau

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

Getting the best out of PRE-emergents

—tips for improving efficacy

PRE-emergent OR
Residual herbicides



*Suppress weed seeds
in soil*

- Apply to bare soil or minimum 'existent weed coverage' to ensure max soil incorporation
 - Include a compatible post-emergent tank-mix partner if there is an existing weed growth
- Irrigation will help activate most residual herbicides

Talk outline: Citrus Weed Control

Current options

Improved strategy

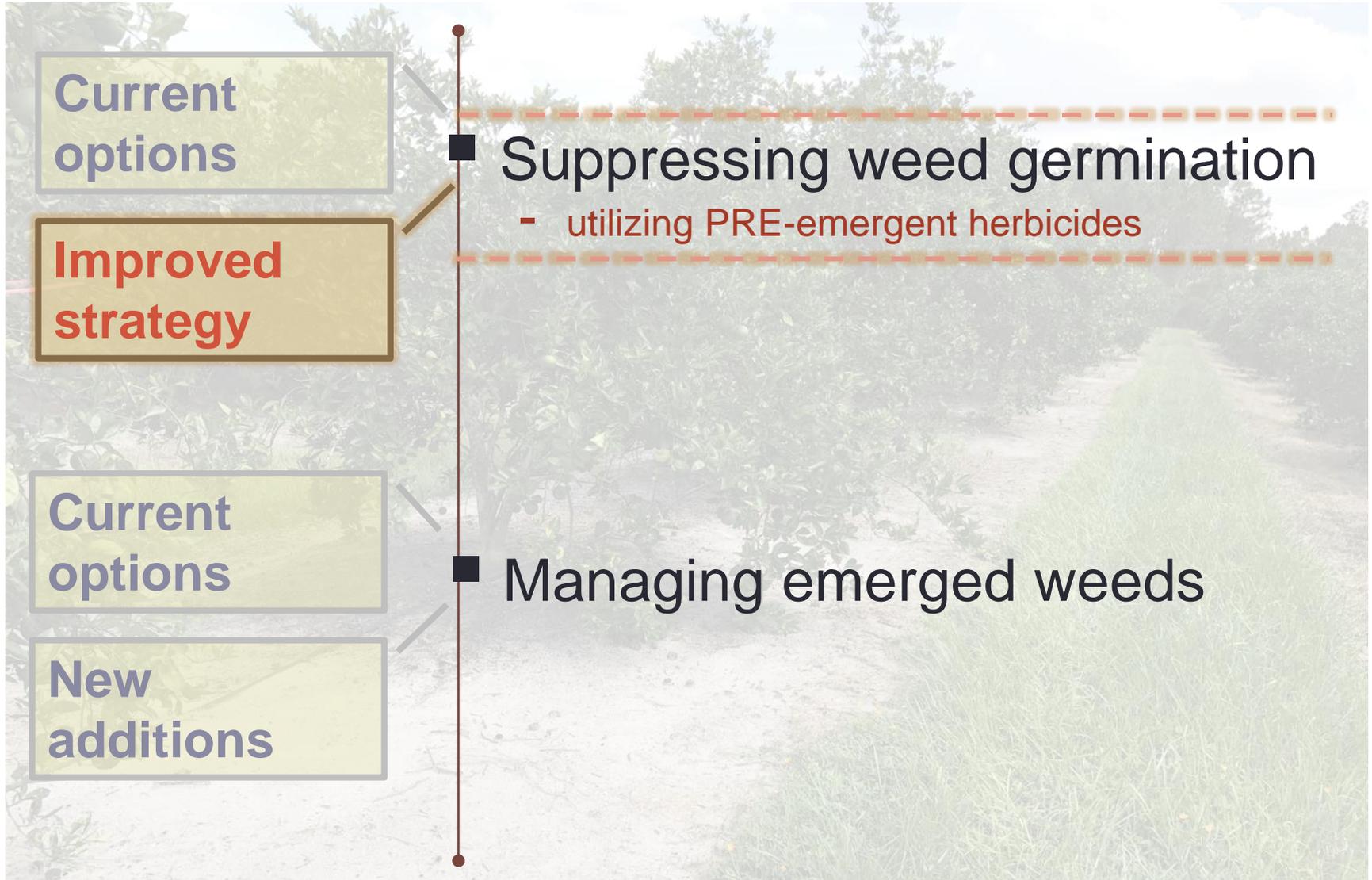
Current options

New additions

■ Suppressing weed germination

- utilizing PRE-emergent herbicides

■ Managing emerged weeds



Herbicide synergy

– Tank-mixing pre-emergent herbicides with different modes of action

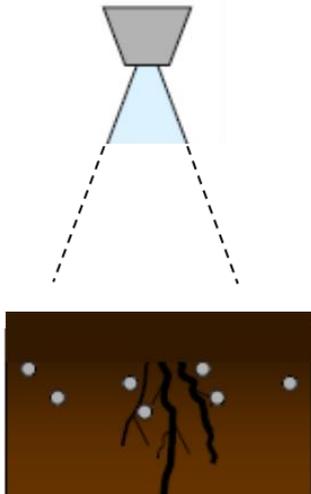


- Increase the spectrum of weed control
- Reduce tolerance/resistance issues
- **Need to ensure:**
 - Mixing compatibility
 - Absence of any antagonistic effects

Herbicide synergy – ‘Tank Mixing’ pre-emergent herbicides

- Active ingredient – Brand name(s)

Pre-emergent herbicides



Soil
applied

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

Herbicide synergy — Mixing pre-emergent herbicides

<i>Active Ingredient(s)</i>	<i>Products</i>	<i>Product Rate (per acre)</i>
Flumioxazin	Chateau	6 oz.
Flumioxazin	Chateau	8 oz.
Indaziflam	Alion	3 oz.
Indaziflam	Alion	5 oz.
Flumioxazin + Indaziflam	Chateau + Alion	6 oz. + 3 oz.
Flumioxazin + Indaziflam	Chateau + Alion	8 oz. + 5 oz.
Control	--	--



Trial location: Immokalee, FL

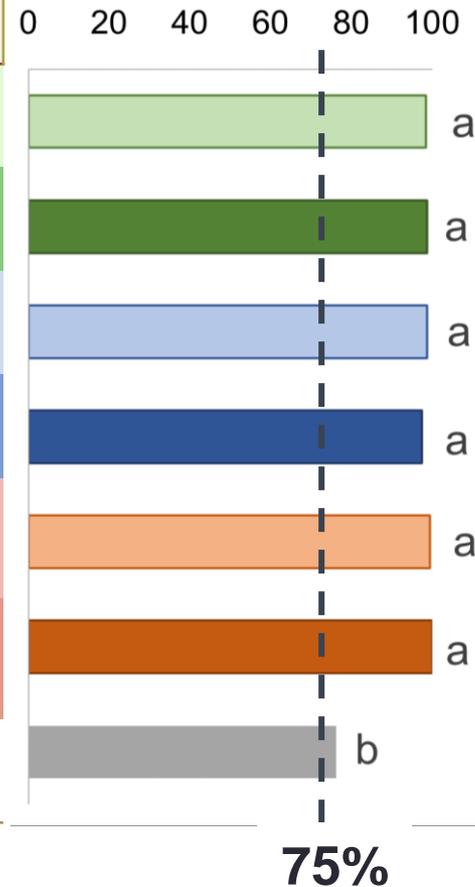
- RCBD (4 reps)
- All treatments included glyphosate (Roundup Custom) at 88oz product per acre & adjuvants, Quest (0.25%v/v) and Induce (0.5% v/v) in the tank mix

Herbicide synergy – Results

1 Month

<i>Active Ingredient(s)</i>	<i>Products</i>	<i>Product Rate (per acre)</i>
Flumioxazin	Chateau	6 oz.
Flumioxazin	Chateau	8 oz.
Indaziflam	Alion	3 oz.
Indaziflam	Alion	5 oz.
Flumioxazin + Indaziflam	Chateau + Alion	6 oz. + 3 oz.
Flumioxazin + Indaziflam	Chateau + Alion	8 oz. + 5 oz.
Control	--	--

Weed control efficacy (%)



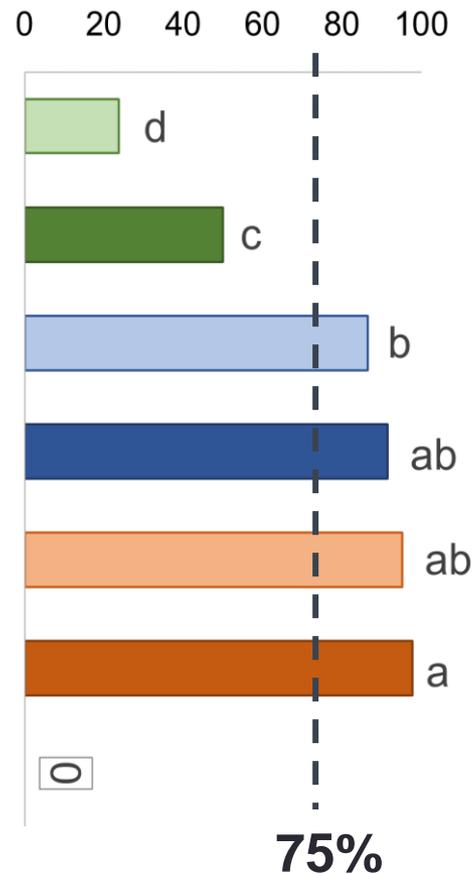
- Replication (n) = 4
- Mean comparison: Fisher's LSD ($\alpha = 0.05$)
- $p \leq 0.0001$

Herbicide synergy – Results

3 Months

<i>Active Ingredient(s)</i>	<i>Products</i>	<i>Product Rate (per acre)</i>
Flumioxazin	Chateau	6 oz.
Flumioxazin	Chateau	8 oz.
Indaziflam	Alion	3 oz.
Indaziflam	Alion	5 oz.
Flumioxazin + Indaziflam	Chateau + Alion	6 oz. + 3 oz.
Flumioxazin + Indaziflam	Chateau + Alion	8 oz. + 5 oz.
Control	--	--

Weed control efficacy (%)



- Replication (n) = 4
- Mean comparison: Fisher's LSD ($\alpha = 0.05$)
- $p \leq 0.0001$

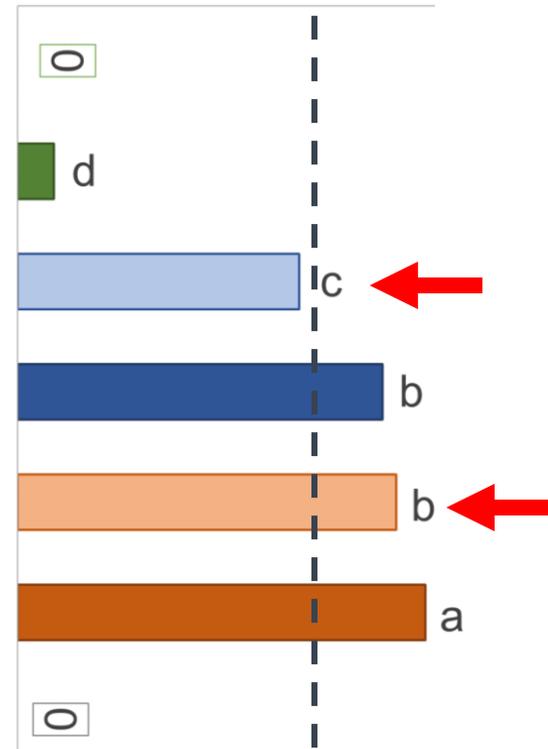
Herbicide synergy – Results

5+ Months

Active Ingredient(s)	Products	Product Rate (per acre)
Flumioxazin	Chateau	6 oz.
Flumioxazin	Chateau	8 oz.
Indaziflam	Alion	3 oz.
Indaziflam	Alion	5 oz.
Flumioxazin + Indaziflam	Chateau + Alion	6 oz. + 3 oz.
Flumioxazin + Indaziflam	Chateau + Alion	8 oz. + 5 oz.
Control	--	--

Weed control efficacy (%)

0 20 40 60 80 100



75%

- Replication (n) = 4
- Mean comparison: Fisher's LSD ($\alpha = 0.05$)
- $p \leq 0.0001$



Control

2 Months

Indaziflam + Flumioxazin

2 Months

Indaziflam + Flumioxazin
5 months after application



Study location: Immokalee

Talk outline: Citrus Weed Control

Current options

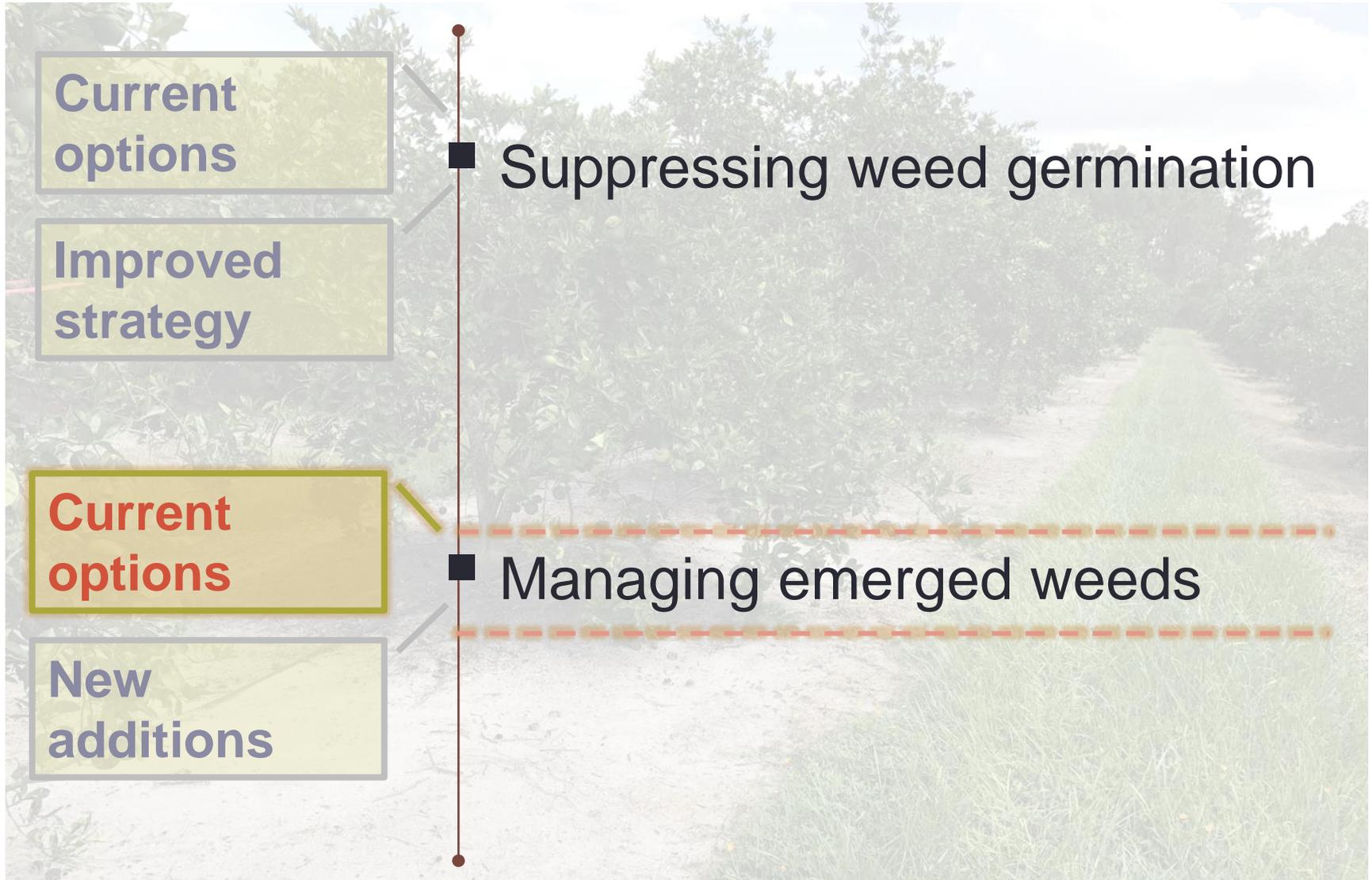
Improved strategy

Current options

New additions

■ Suppressing weed germination

■ Managing emerged weeds



Managing emerged weeds in citrus — *Better late than never*



Spanish needle



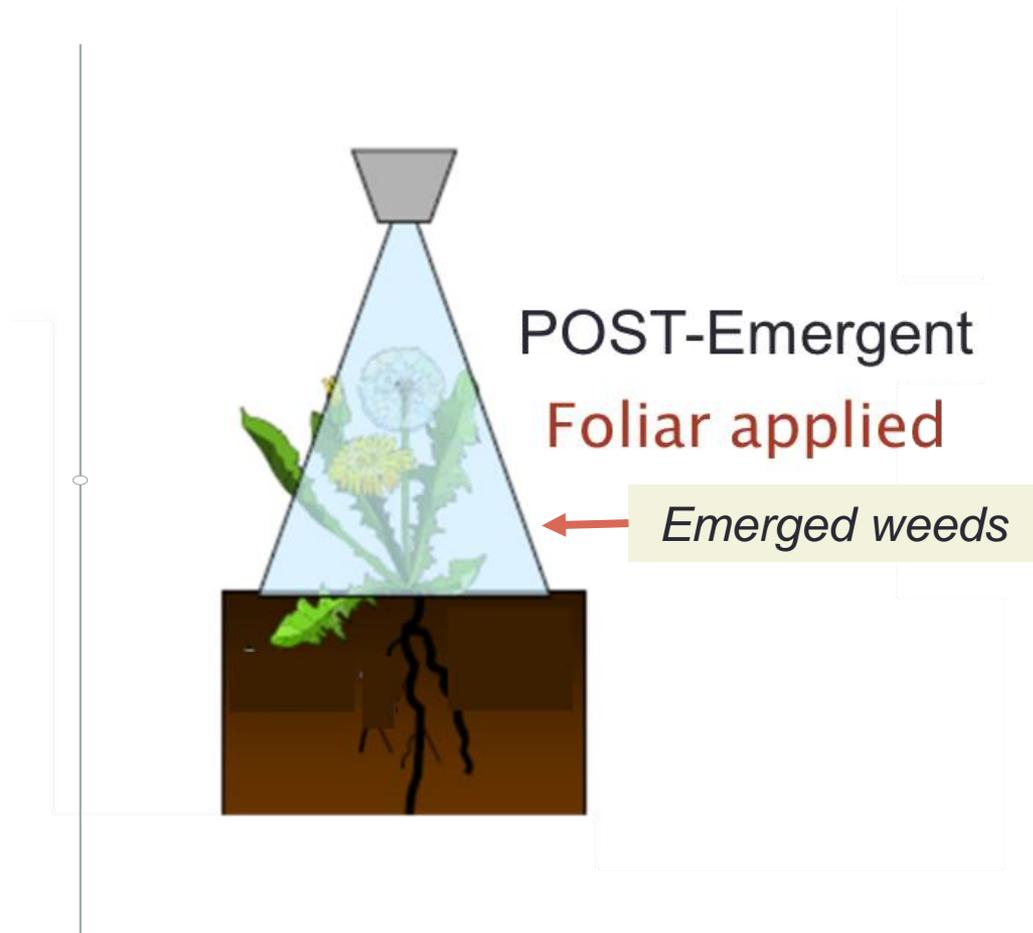
Cutleaf evening-primrose



**Pennsylvania cudweed
in citrus tree rows**

Timely control of emerged weeds is important to prevent future weed problems!

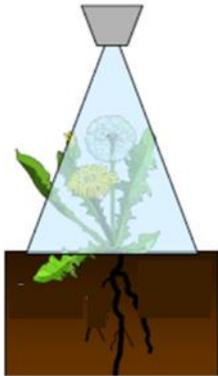
POST-emergent herbicides in citrus



Major POST-emergent herbicides used in FL citrus

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

Non-selective
herbicides



POST
Foliar applied

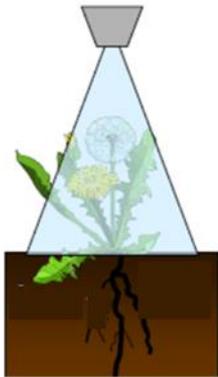
- **Carfentrazone** – Aim EC
- **Paraquat** - Gramoxone
- **Glyphosate** – Roundup, Glystar etc.
- **Glyphosate + 2,4-D** - Landmaster

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

Major POST-emergent herbicides used in FL citrus

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

Non-selective
herbicides



POST
Foliar applied

• Carfentrazone – Aim EC

• **Paraquat - Gramoxone**

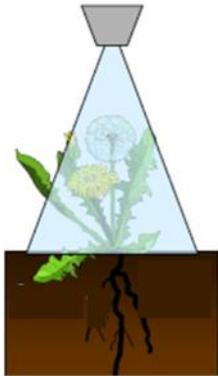
• Glyphosate – Roundup, Glystar etc.

• Glyphosate + 2,4-D - Landmaster

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

Major POST-emergent herbicides used in FL citrus

Non-selective herbicides



POST
Foliar applied

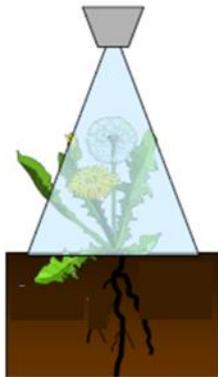
- **Active ingredient** – E.g., Brand name(s)
- **Paraquat - Gramoxone**

Changes to paraquat use requirements

- *Only certified pesticide applicator*
- *Non-certified workers under supervision can NO LONGER use paraquat*
- *Additional paraquat training from EPA is now required to certified applicator*
- *Training and info <https://npsec.us/paraquat>*

Major POST-emergent herbicides used in FL citrus

Selective
herbicides



POST
Foliar applied

- Active ingredient – Brand name(s)

Broad-leaf weeds

- **Saflufenacil – Treevix**

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

Saflufenacil is an effective management option for most annual/perennial broad-leaf weeds



Spanish Needle



Pusley



Common Ragweed

Examples of
Broad-leaf
weeds
in FL citrus



Ragweed Parthenium

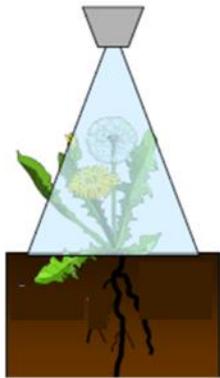


Goatweed



Nightshade

Selective
herbicides



*POST
Foliar applied*

- Active ingredient – Brand name(s)

Broad-leaf weeds

• **Saflufenacil – Treevix**

Grasses

• **Fluazifop – Fusilade**

• **Sethoxydim – Poast plus**

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

Selective grass killers are effective to manage grass weeds

Grass
weeds



Guinea grass



Bermuda grass



Johnson grass

Guinea grass

- **Fluazifop** – Fusilade
- **Sethoxydim** – Poast plus

Spot treatment

- 1.5 – 2.25% v/v solution
- Read label for directions



Guinea grass growing near the citrus tree

Strategies for getting the best out of POST-emergents

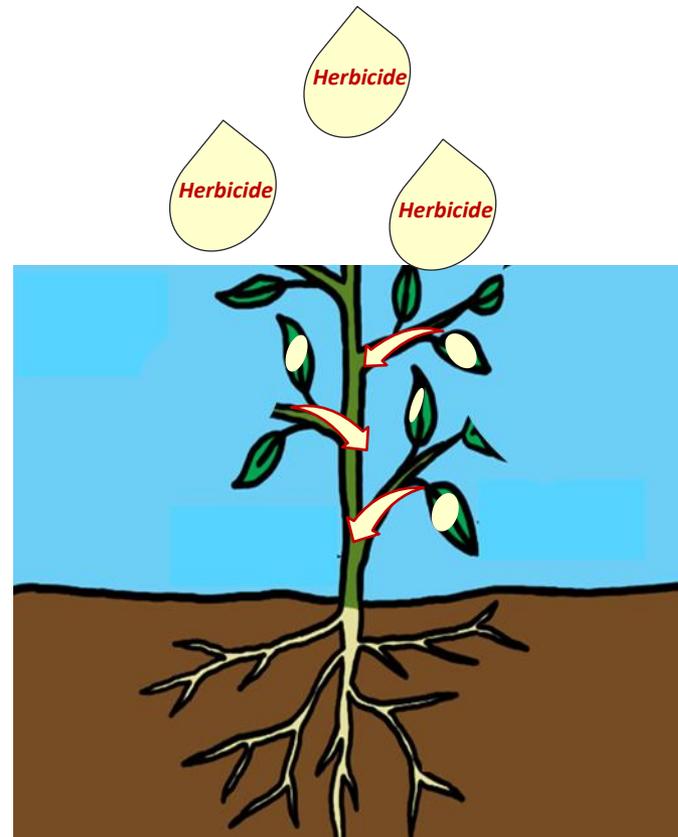
—tips for improving efficacy

Good spray coverage

- Contact herbicide – Paraquat
- Limited translocation in the weed

Optimum spray volume

E.g., 20-40 gallons/acre



Strategies for getting the best out of POST-emergents

—tips for improving efficacy

Use of surfactants

- Helps improve the herbicide retention, coverage and efficacy

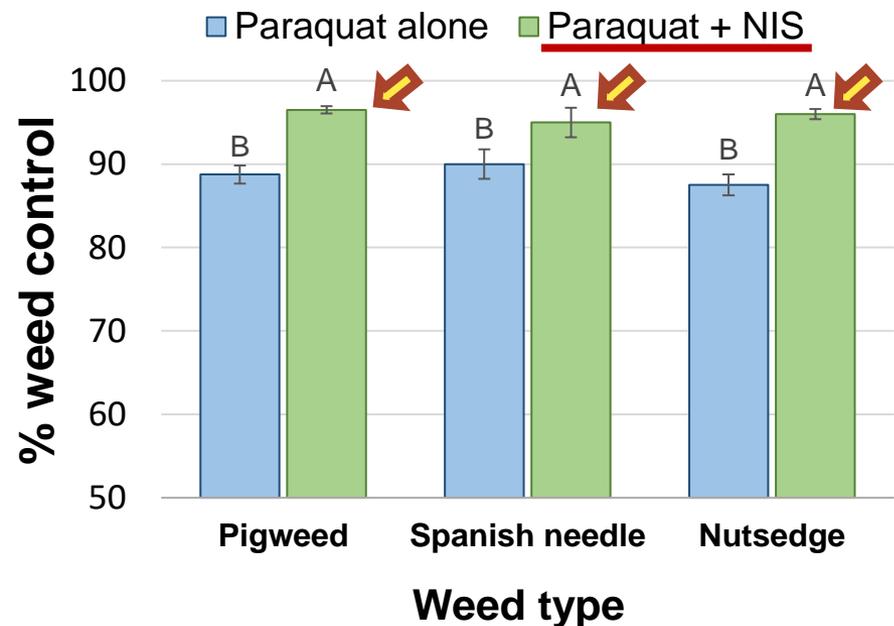
(Read specific product label for requirement)

Use of adjuvants

- AMS, Buffers etc.
- Most herbicides works best when the pH of mixing water is 4-6

(Read specific product label for requirement)

Effect of non-ionic surfactant (NIS) on efficacy of paraquat



- Replication (n) = 4
- Mean comparison: Fisher's LSD ($\alpha=0.05$)

Strategies for getting the best out of POST-emergents

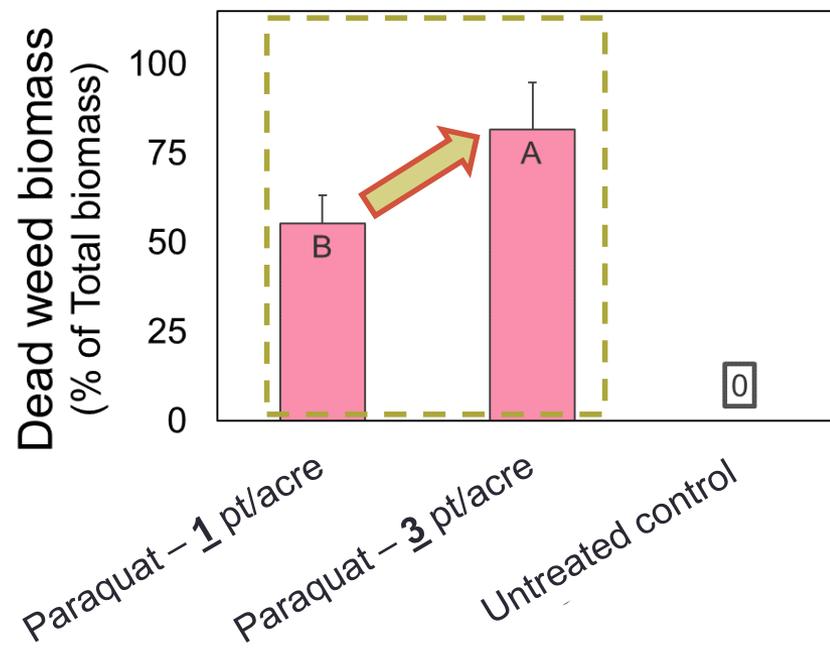
–tips for improving efficacy

Use high labeled rates

- Heavy weed infestation
- Weeds in mature growth stage

Effect of paraquat application rates on weed re-growth

Goatweed control
(30 Days after treatment)



- Replication (n) = 4
- Mean comparison: Fisher's LSD ($\alpha=0.05$)

Talk outline: Citrus Weed Control

Current options

Improved strategy

Current options

New additions

■ Suppressing weed germination

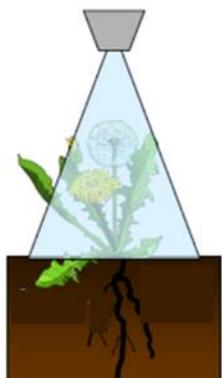
■ Managing emerged weeds

- utilizing POST-emergent herbicides

Major POST-emergent 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** – Rely 280, Scout

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

Rotating herbicides with different mode of action is the key in managing resistant/tolerant weeds



Non-Selective herbicides

Active Ingredient	Example Product(s)	<u>Mode of action grouping</u>
Glyphosate ←	Roundup, Glystar, etc.	9 (G)
Paraquat ↻	Gramoxone	22 (D)
Carfentrazone-ethyl ↻	Aim	14 (E)
Glufosinate-ammonium ←	Rely-280, Scout, etc.	10 (H)

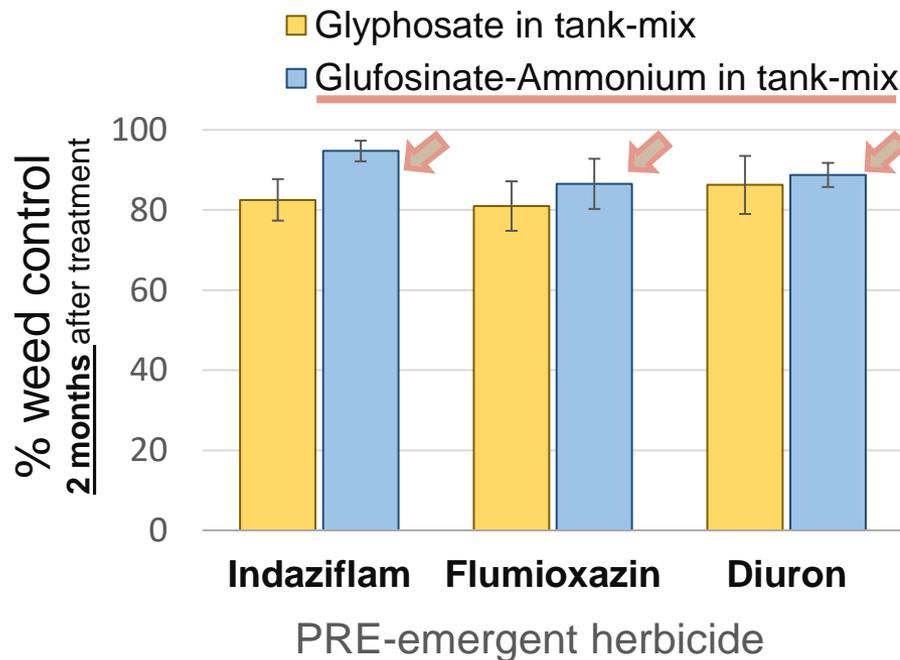
Glufosinate-ammonium in citrus weed control

–tank mixing with pre-emergent herbicides

Glufosinate tank-mixing with
PRE-emergent herbicides

Mix-well with herbicides like

- Indaziflam (Alion)
- Flumioxazin (Chateau)
- Diuron (Karmex, etc.)



Potential alternative to glyphosate

POST-emergent weed control

- Surfactant/AMS addition
- Optimum spray volume
- Good spray coverage

Apply

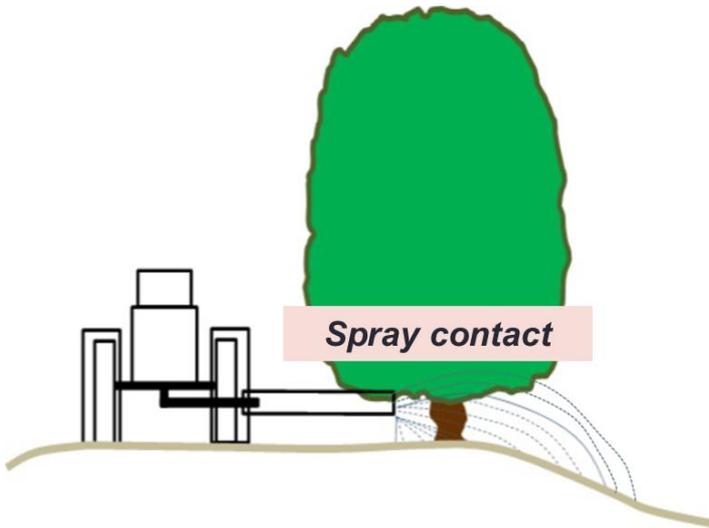
- Ample sunlight
- Low wind



- Non-stressed weeds
- Actively growing
- Young growth stage

- Effective POST-emergent weed control

Chemical weed control – *tree-safety matters*



- **Maintain proper spray boom height**
- **Deliver the herbicide to the target**
- **Avoid tree foliage, and fruit contact**

Herbicide related phytotoxicity in citrus

Glyphosate

- spray contact with fruit



Herbicide related phytotoxicity in citrus

Paraquat

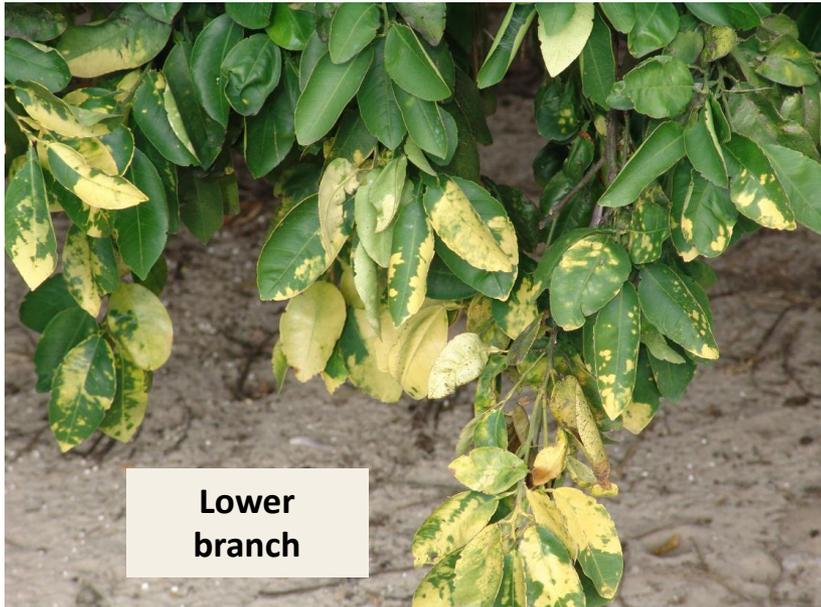
- 'Contact' injury on foliage & fruits



Herbicide related phytotoxicity in citrus

Diuron

- Certain grapefruit varieties are sensitive
- 'Flame' grapefruit

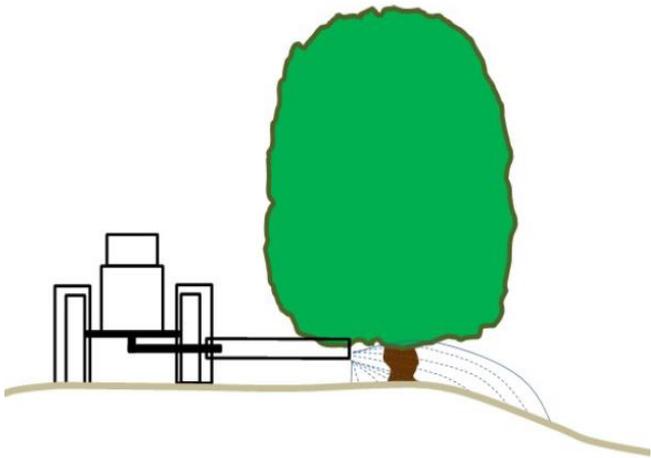


Spray Contact injury



Root uptake injury

Chemical weed control – *considerations*



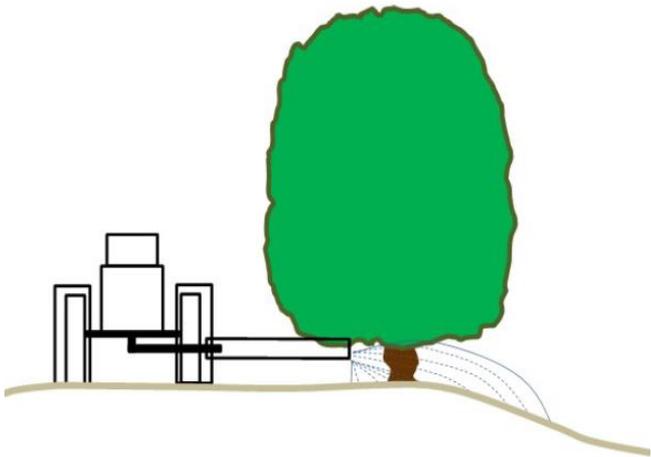
- **Maintain proper spray boom height**
- **Deliver the herbicide to the target**
- **Avoid tree foliage, and fruit contact**
- **Special care for new plantings**
 - Use lower range of labeled rates
 - Install protective wraps around the trunk of young citrus trees

Prevent herbicide injury to young trees..

- Install protective wraps around the trunk of young citrus trees



Chemical weed control – *considerations*



- **Maintain proper spray boom height**
- **Deliver the herbicide to the target**
- **Avoid tree foliage, and fruit contact**
- **Special care for new plantings**
 - Use lower range of labeled rates
 - Install protective wraps around the trunk of young citrus trees

ALWAYS READ PRODUCT LABELS !!

Summary

■ Suppressing weed germination

- *PRE herbicides for preventing germination from soil seed bank*
- *Herbicide synergy – improved strategy*

■ Managing emerged weeds

- *Timely POST sprays (before flowering/seeding)*
- *Coverage - Spray volume ; surfactants*
- *Glufosinate ammonium - new option*

■ Minimizing effects of herbicide on citrus

- *Accurate and safe application*
- *Read herbicide label*

Thank you...

SWFREC weed science team



Acknowledgements

Collaborators..

From left: Shea Teems, Biwek Gairhe, Robert Riefer, Ramdas Kanissery

Not in picture: Miurel Brewer, Nirmal Timilsina, Ruby Tiwari



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	REF Hours	pH ^d Day(s)	Weeds Controlled		Comments	Suggested Rate per Acre		
					Grasses	Broadleaf				
Nonselective Systemic Herbicides	Glyphosate -Underside	G (9)	Varies ^e	1	X	X	Avoid contact with citrus fruit, foliage, and green bark. Rainfall within 1-4 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	G (9)	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 -Striping	G (9)	Varies	1	X	X	Use wipers to remove tall growing and difficult weeds.	5%-10% solution—carpet wiper 50%-100% solution—panel wiper		
	Glyphosate -Spot treatment	G (9)	Varies	1	X	X	Avoid contact with citrus fruit, foliage, and green bark.	7%-2% solution		
	Glyphosate plus 2,4-D -Landmaster II	G,O	48	7	X	X	Apply with shielded and hooded sprayers on citrus middles or under the trees. Use must have.	Use recommended rate in 30-40 CPA		
Nonselective Contact Herbicides	Carfentrazone-ethyl -Am EC	(14)					Avoid contact with green tissue or fruit. Finished spray volume of at least 20 CPA required.	Water per application Max 2.0 fl oz	Maximum rate/year 79 fl oz	Min. time btwn. appl. 14 days
	Glufofenoxate-ammonium -Ruly 280	H (10)	12	14	X	X	Warm temperatures, high humidity, and bright sunlight improve performance. Avoid contact or spray drift 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.)	3 at max rate 14 days
	Paraquat -Gramoxone SL 2.0	D (22)	24	—	X	X	Addition of surfactant or crop of 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/files/HS/HS141000.pdf>

Contact

Ramdas Kanissery

UF/IFAS SWFREC
2685 State Road N
Immokalee, FL

Phone: (239) 658-3455
rkanissery@ufl.edu