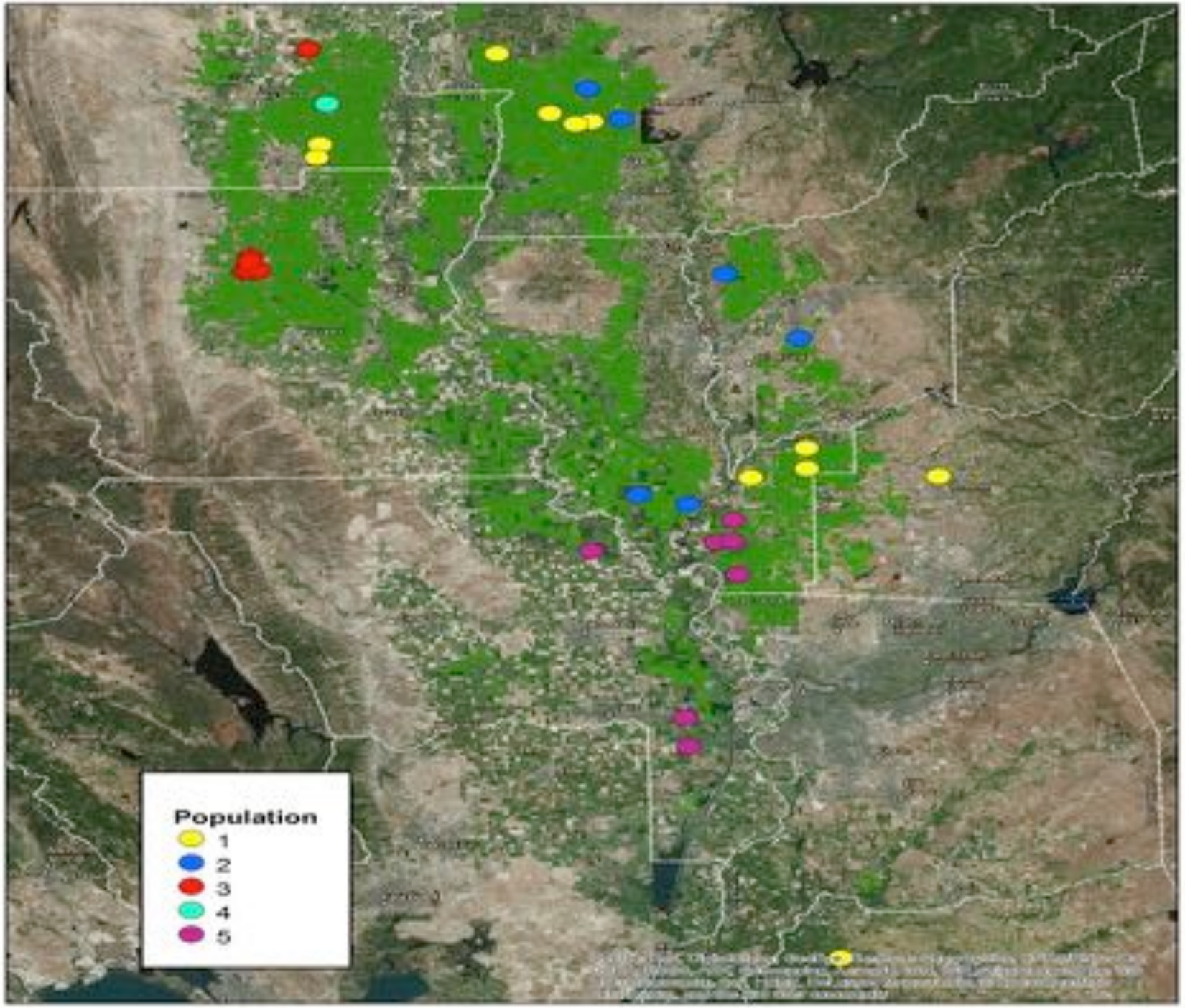
Weedy Rice Update

UCCE Winter Grower Meetings 2018

Whitney Brim-DeForest, Rice Advisor

Field Survey: 2016

- Over 10,000 acres
- 5 ecotypes
- Every major rice-growing county



Survey: Winter 2017

- 160 growers and PCA's were surveyed at 5 meetings in 4 counties (Butte, Glenn, Colusa, and Sutter):
  - 40% responded that they **had suspected a field was infested with weedy rice**
  - 49% stated that they had **seen it prior to 2016**
  - 57% **had not** reported the infestation to UCCE

- Approximately 25% of infestations likely not reported

Field Survey: 2017

By the end of the season, we had a total of:

- 53 samples submitted for testing
- Out of the 53, 22 confirmed to be weedy rice
- **About 42% of the samples!**

Eight seed fields were found to be infested with weedy rice and were rejected as seed fields:

- 3 were new medium grain seed fields
- 1 was an established medium grain seed field
- 4 were specialty variety seed fields

No new biotypes identified

Photos: Timothy Blank, CCIA

Sprangletop:

-Like rice (and weedy rice), it has a ligule, so it can be confusing (esp. before heading)

-Has a white stripe down the middle of the leaf (mid-vein)

Elongated Upper Internode (EUI):

-A genetic abnormality of common medium grain rice varieties

-Causes the part of the stem attached to the rice panicle to elongate

-The plant will look just like the variety planted in the field

Research Updates

Soil Seedbank Surveys: Fall 2016

- Sample 10 fields with known infestations
- 34 soil cores taken every 20 feet along transect
- Soil samples were washed in a saline (salt) solution to extract organic matter
- Rice seeds found in each core were subjected to a KOH (potassium hydroxide) test

Table 1. Weedy rice seed counts from soil samples collected in Fall 2016.

County	Ecotype	Seeds m^{-2}	Samples Present (%)
Butte	**1**	**31.3**	**41**
Sutter	1	2.3	6
San Joaquin	**1**	**23.2**	**32**
Glenn	1	4.6	9
Yuba	**2**	**29.0**	**21**
Sutter	2	4.6	12
Colusa	3	2.3	6
Colusa	3	7.0	18
Sutter	**5**	**39.5**	**42**
Yolo	Control	0.0	0

9500 seeds per acre

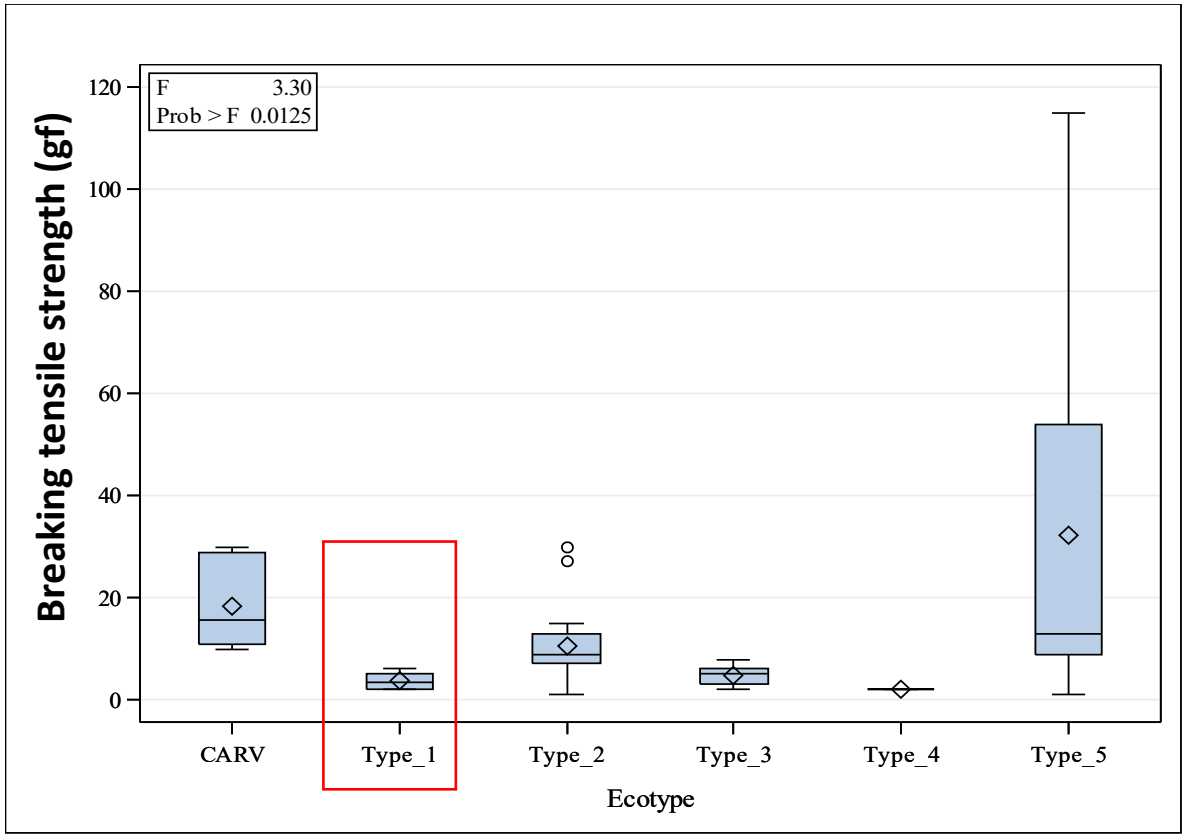
165,000 seeds per acre

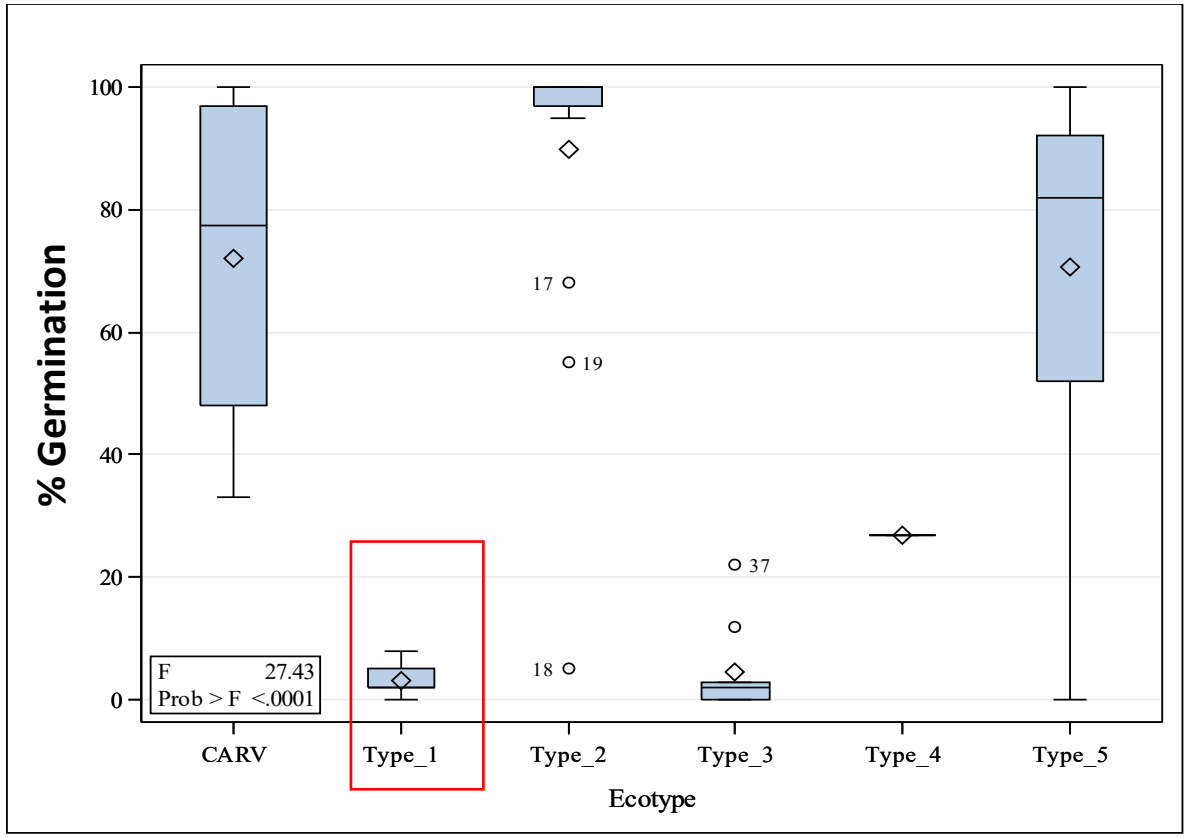
Research Updates

Weedy Rice Biotype Updates

- **All rice-growing counties (except for Colusa)**

- **Type 1:**
  - Awnless
  - Straw hull color
  - Tall stature
  - No color on nodes





Type 1:

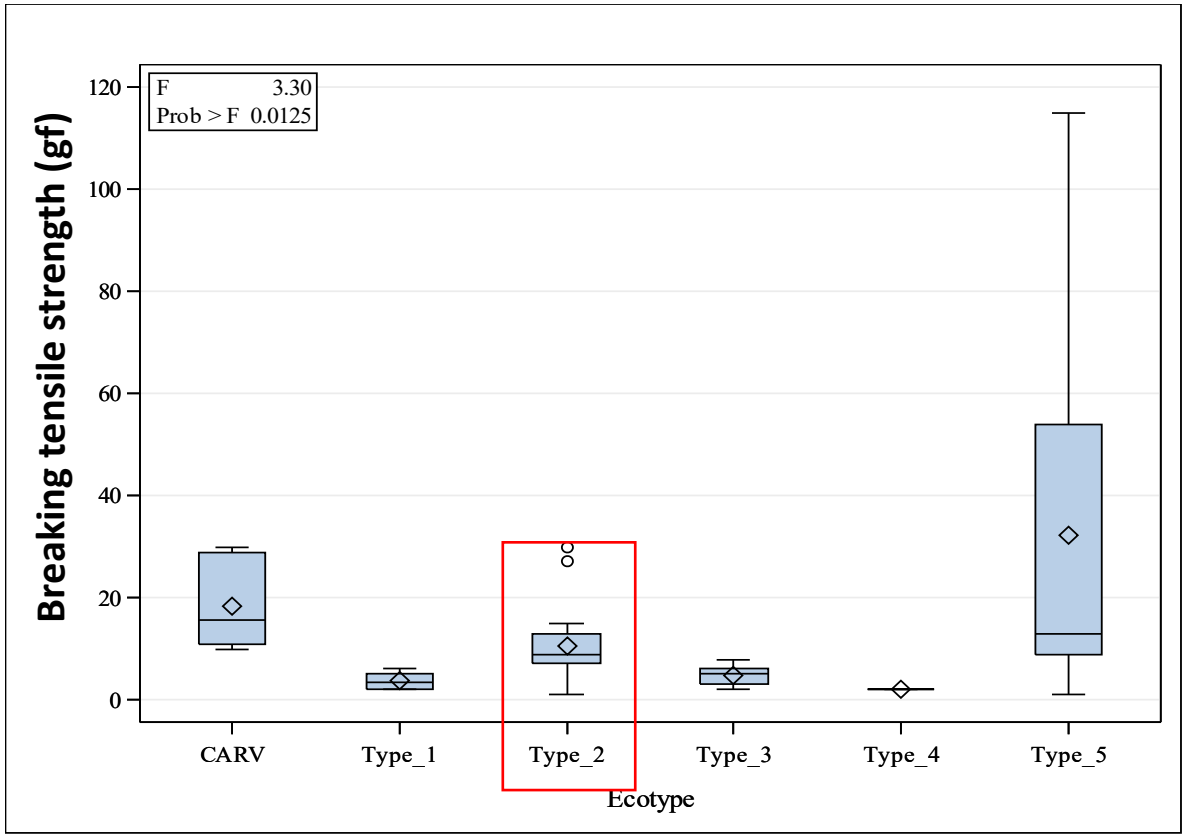
- High shattering
- High dormancy

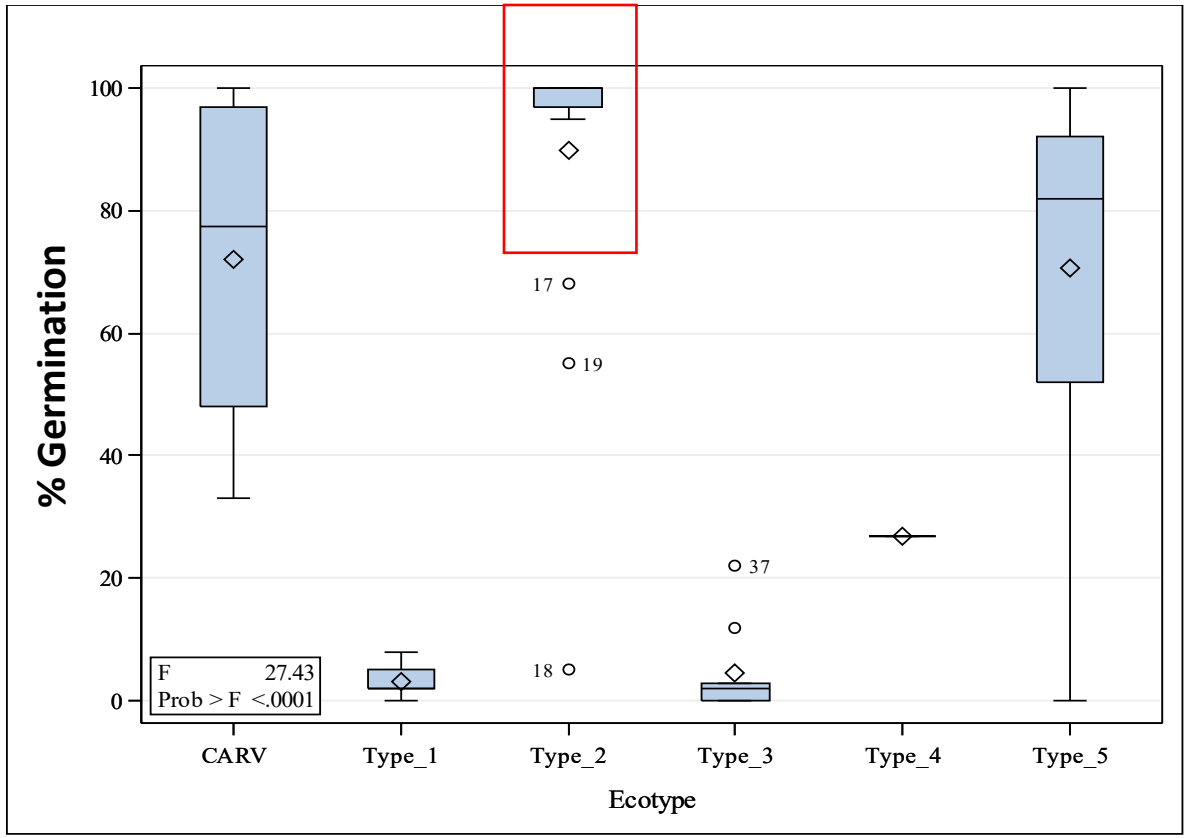
Implications for Management:

- High deposition into seedbank
- Length of time in soil: many years

- **Butte, Sutter and Yuba Counties**

- **Type 2:**
  - Awnless
  - ***Bronze hull color***
  - Tall stature
  - No color on nodes





Type 2:

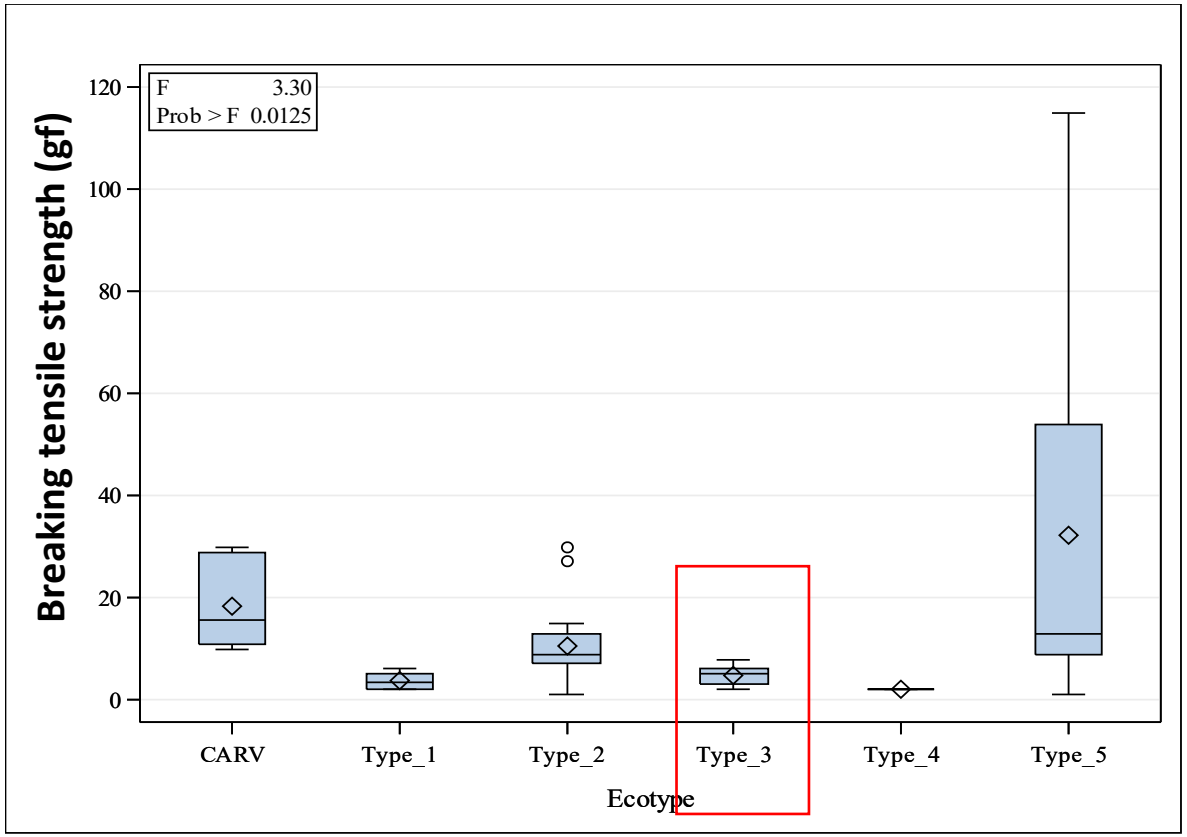
- High shattering
- Low dormancy

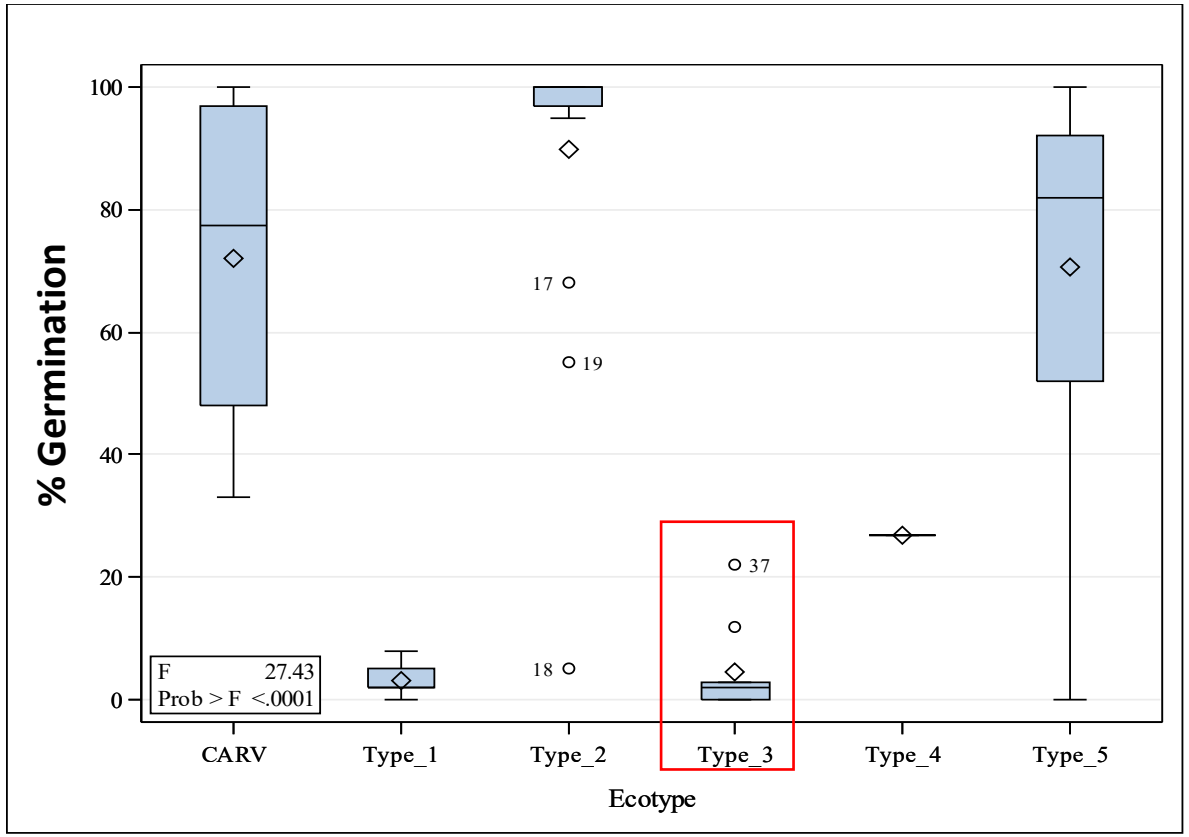
Implications for Management:

- High deposition into seedbank
- Length of time in soil: short!

- **Type 3:**
  - ***Awned***
  - Straw hull color
  - Tall stature
  - No color on nodes

- **Glenn and Colusa Counties**





Type 3:

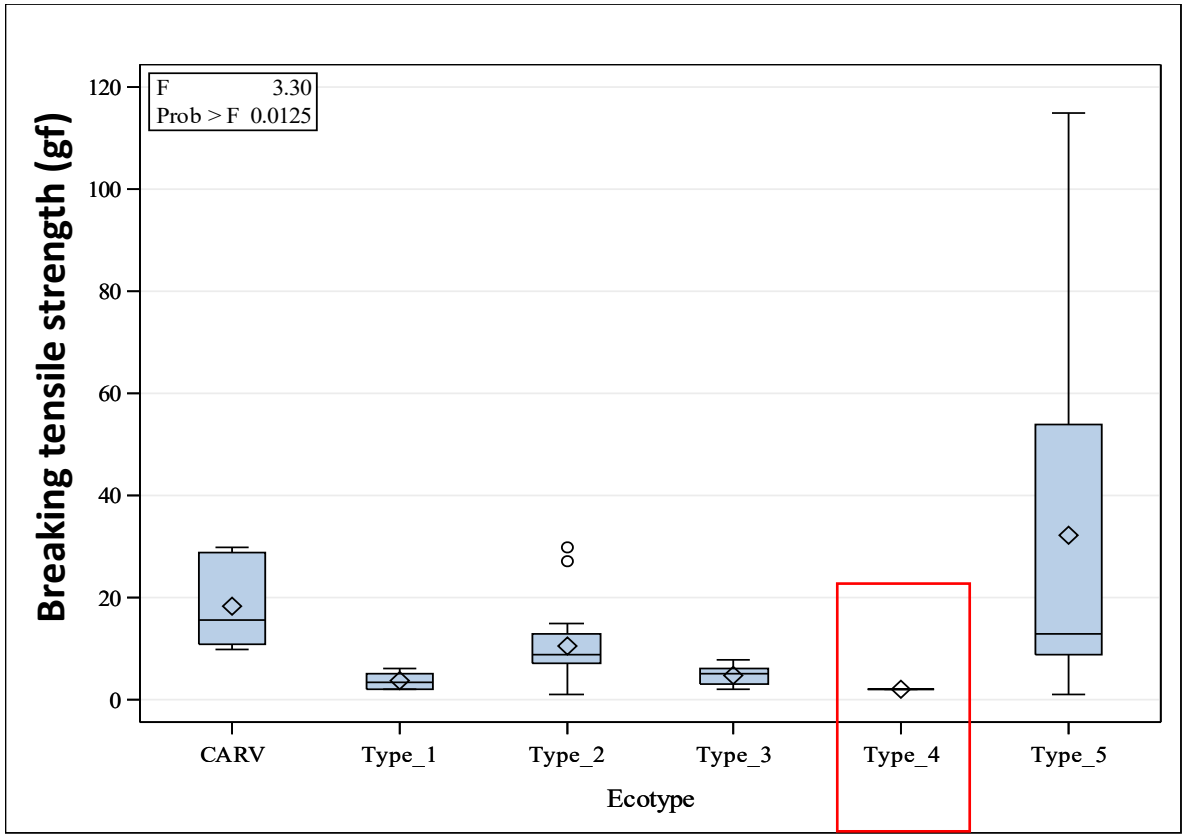
- High shattering
- High dormancy

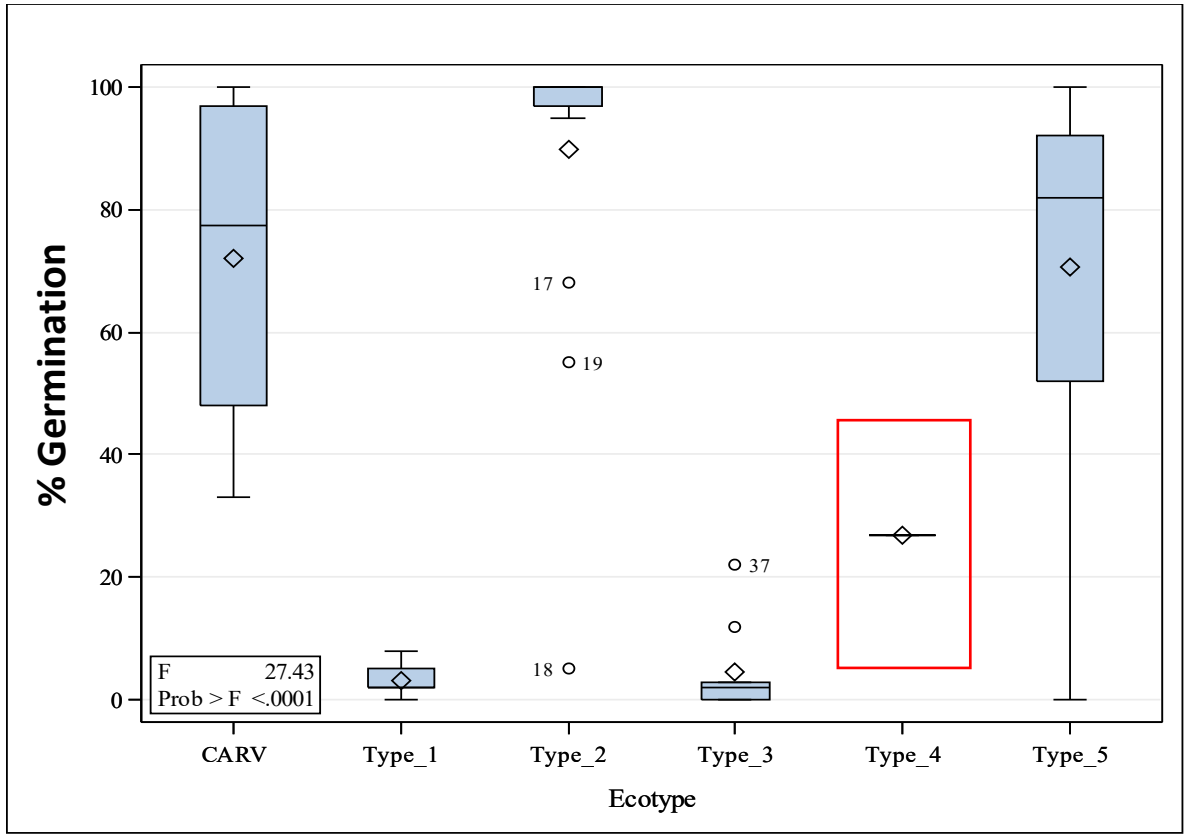
Implications for Management:

- High deposition into seedbank
- Length of time in soil: many years

- **Type 4:**
  - ***Awned***
  - ***Black hull color***
  - ***Short stature***
  - No color on nodes

- **Currently in one location, Glenn County**





Type 4:

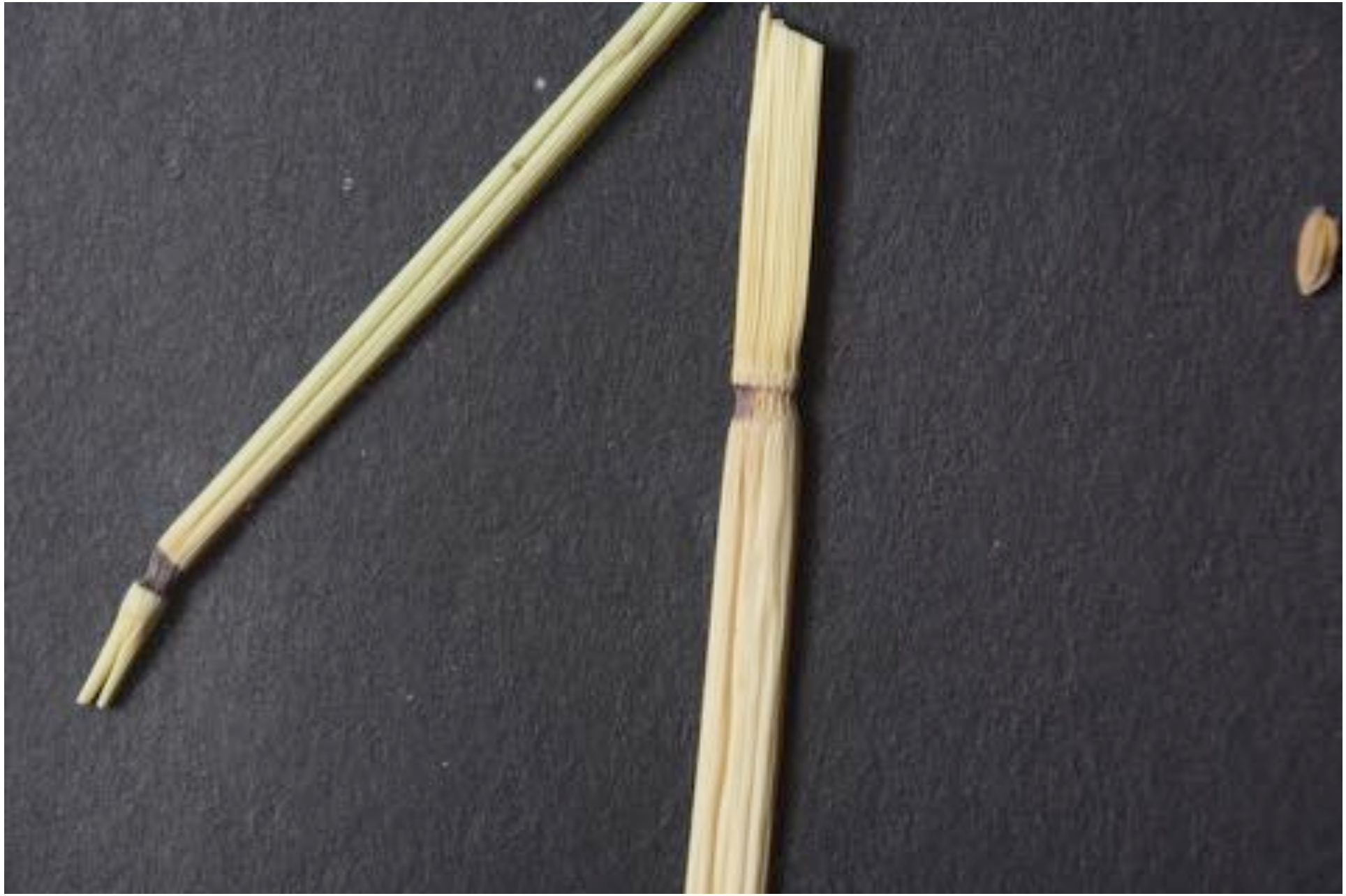
- High shattering
- High dormancy

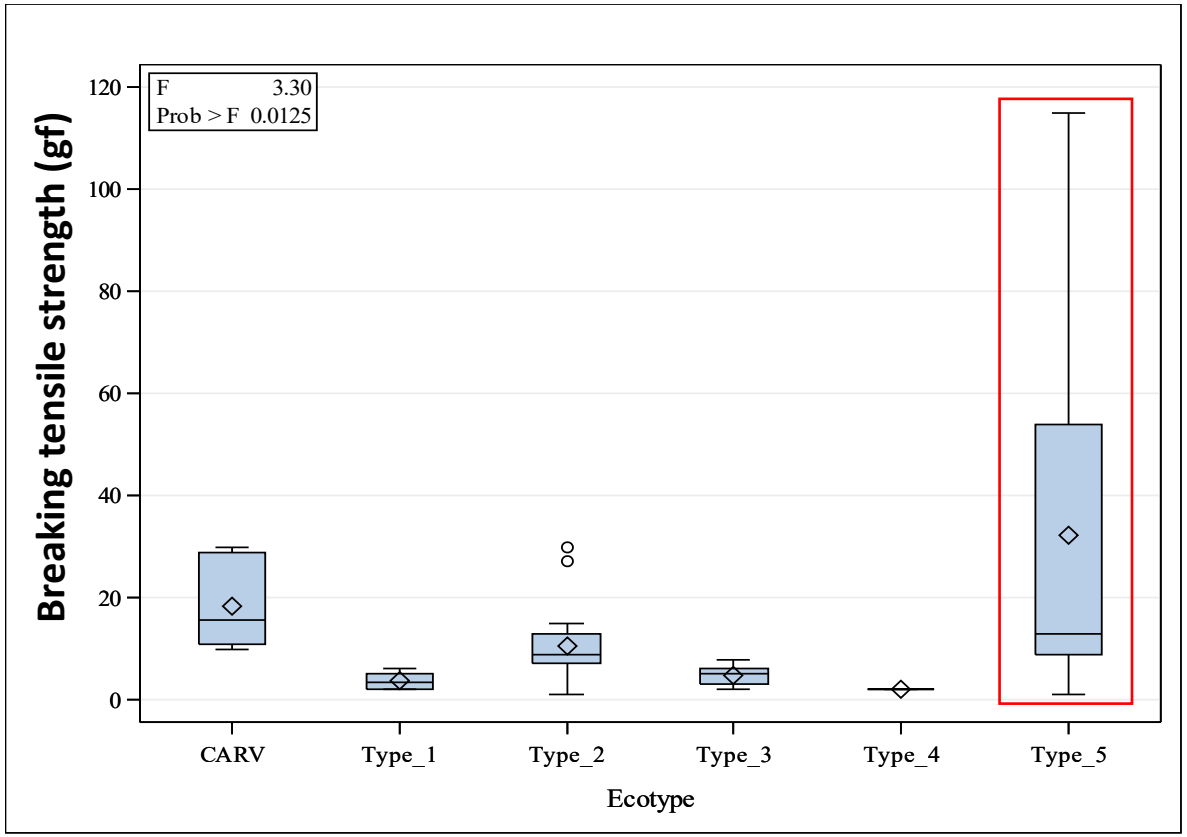
Implications for Management:

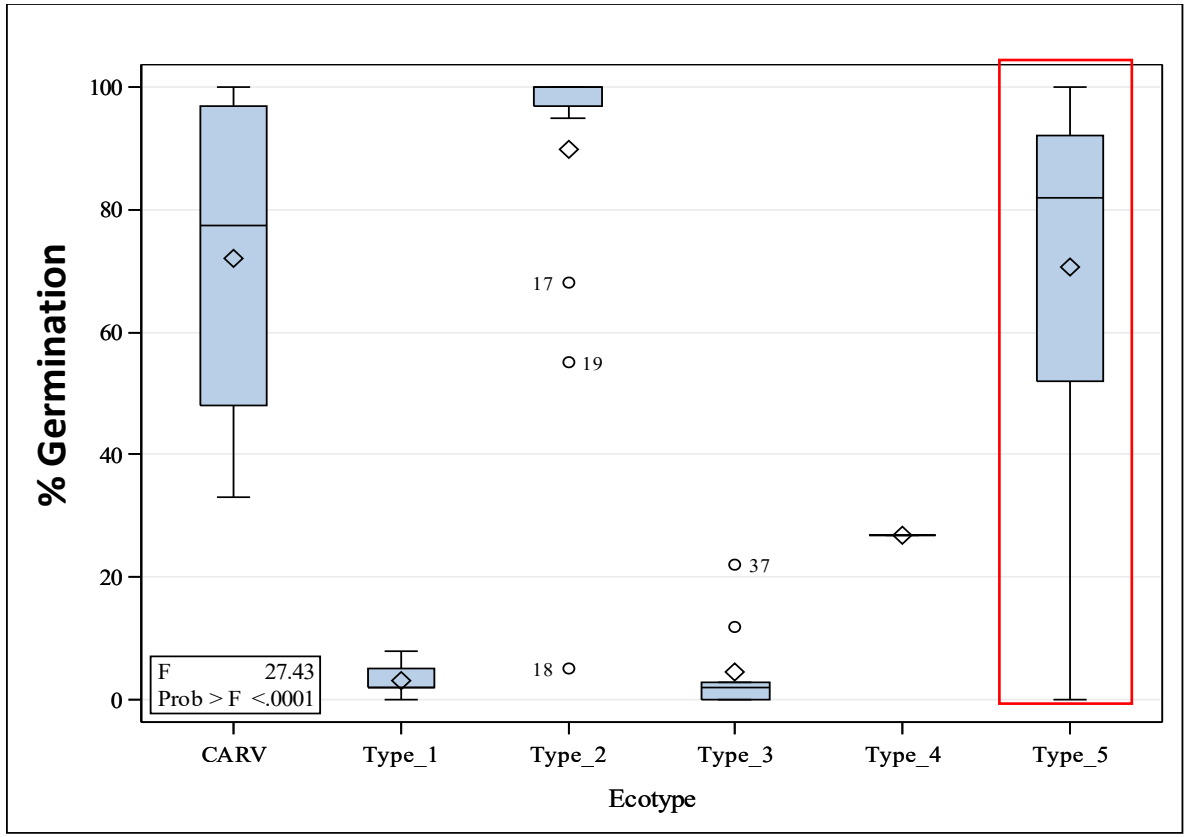
- High deposition into seedbank
- Length of time in soil: many years

- **Type 5:**
  - Awnless
  - Straw hull color
  - Tall stature
  - ***Purple-colored nodes***

- **Sutter, Yuba, and Yolo Counties**







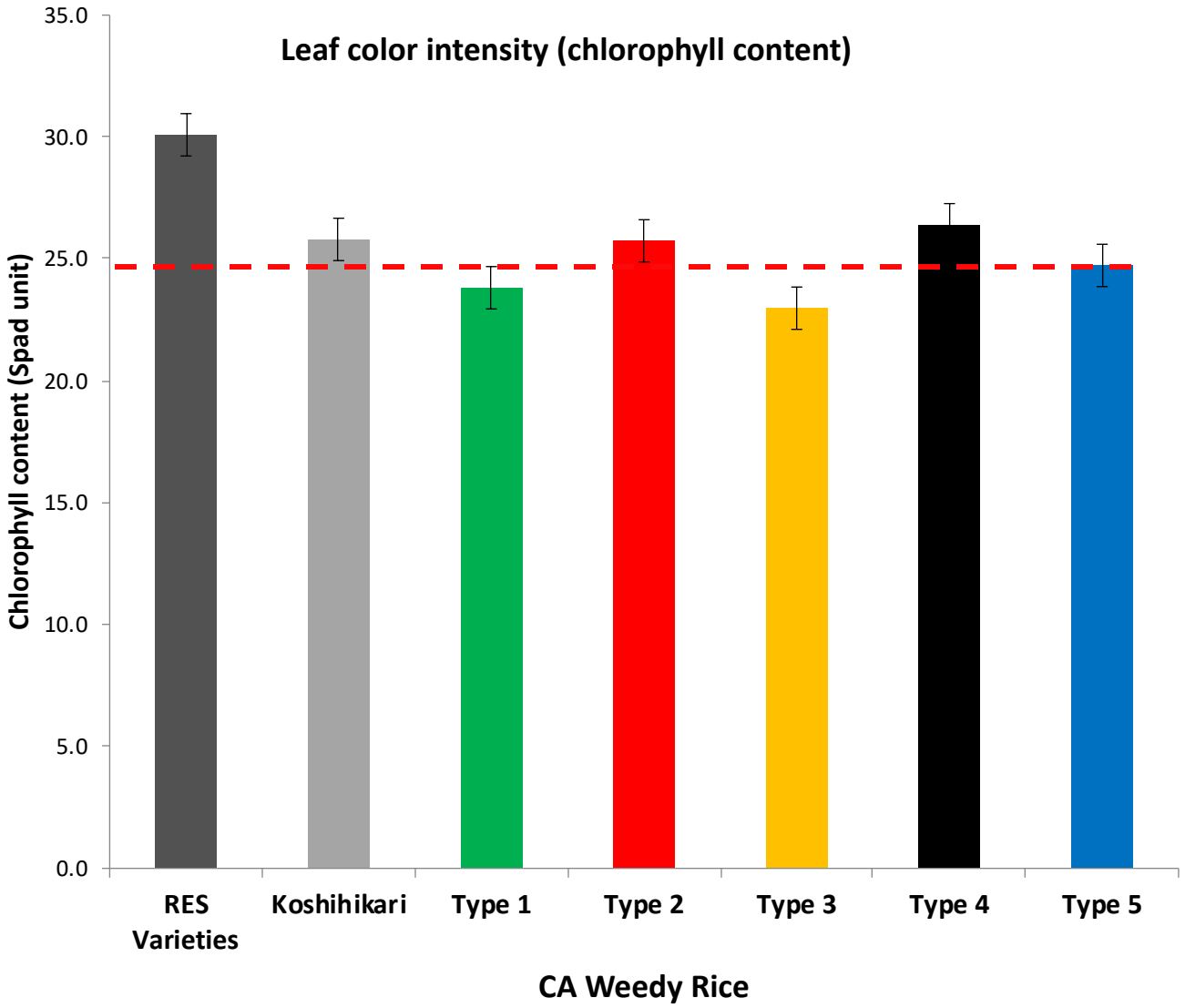
Type 5 (two groups):

- High shattering
- Low dormancy

Implications for Management:

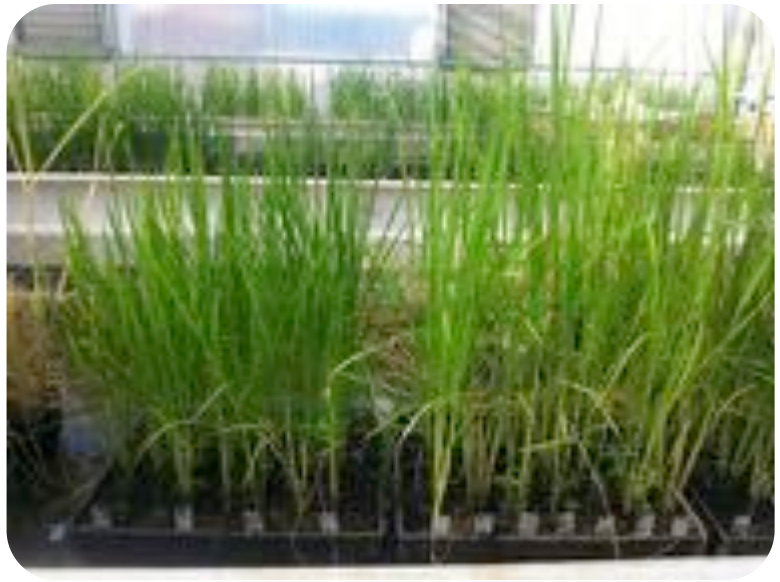
- High deposition into seedbank
- Length of time in soil: short!

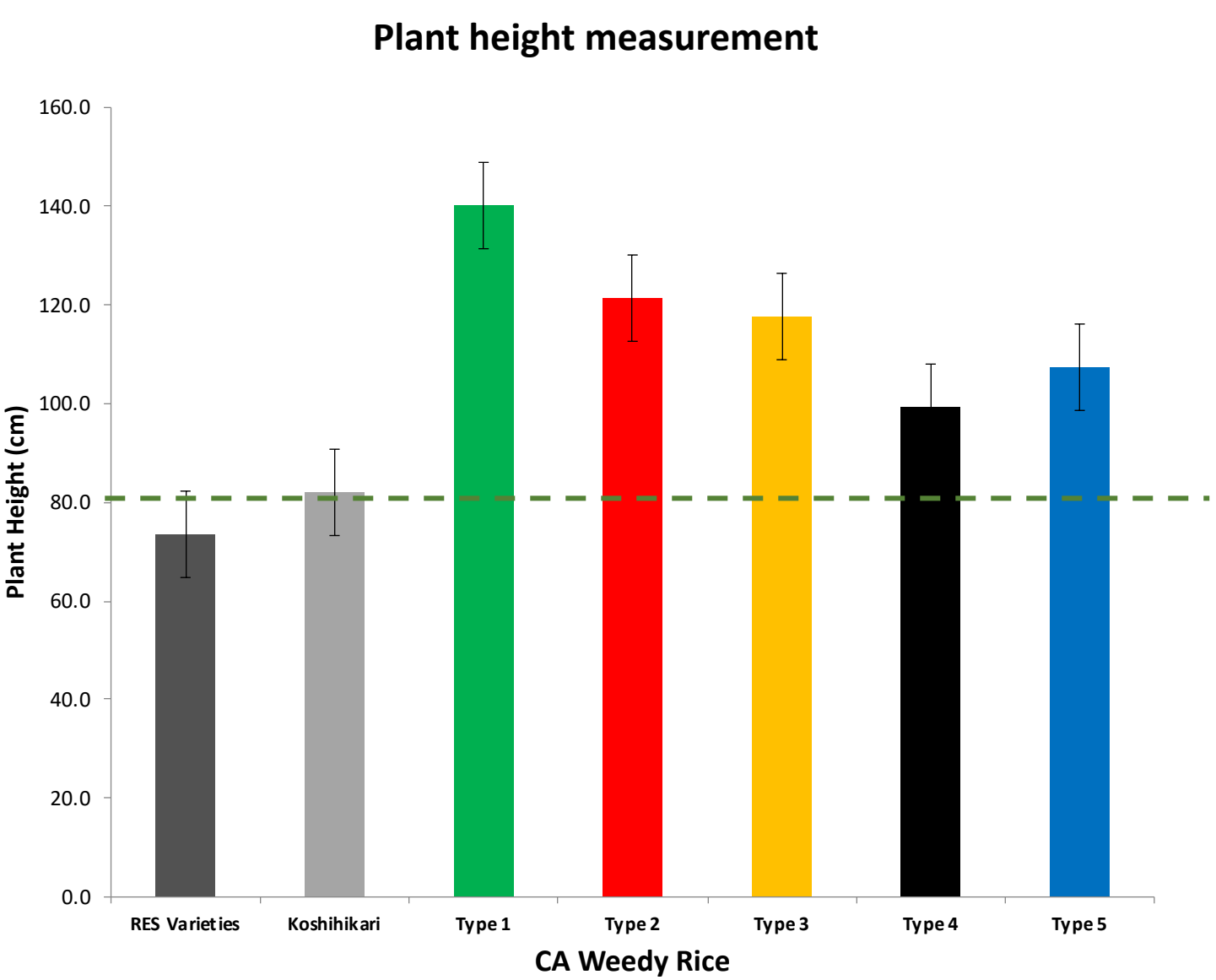
Phenotypic characterizations of weedy rice



RES rice varieties

CA weedy rice



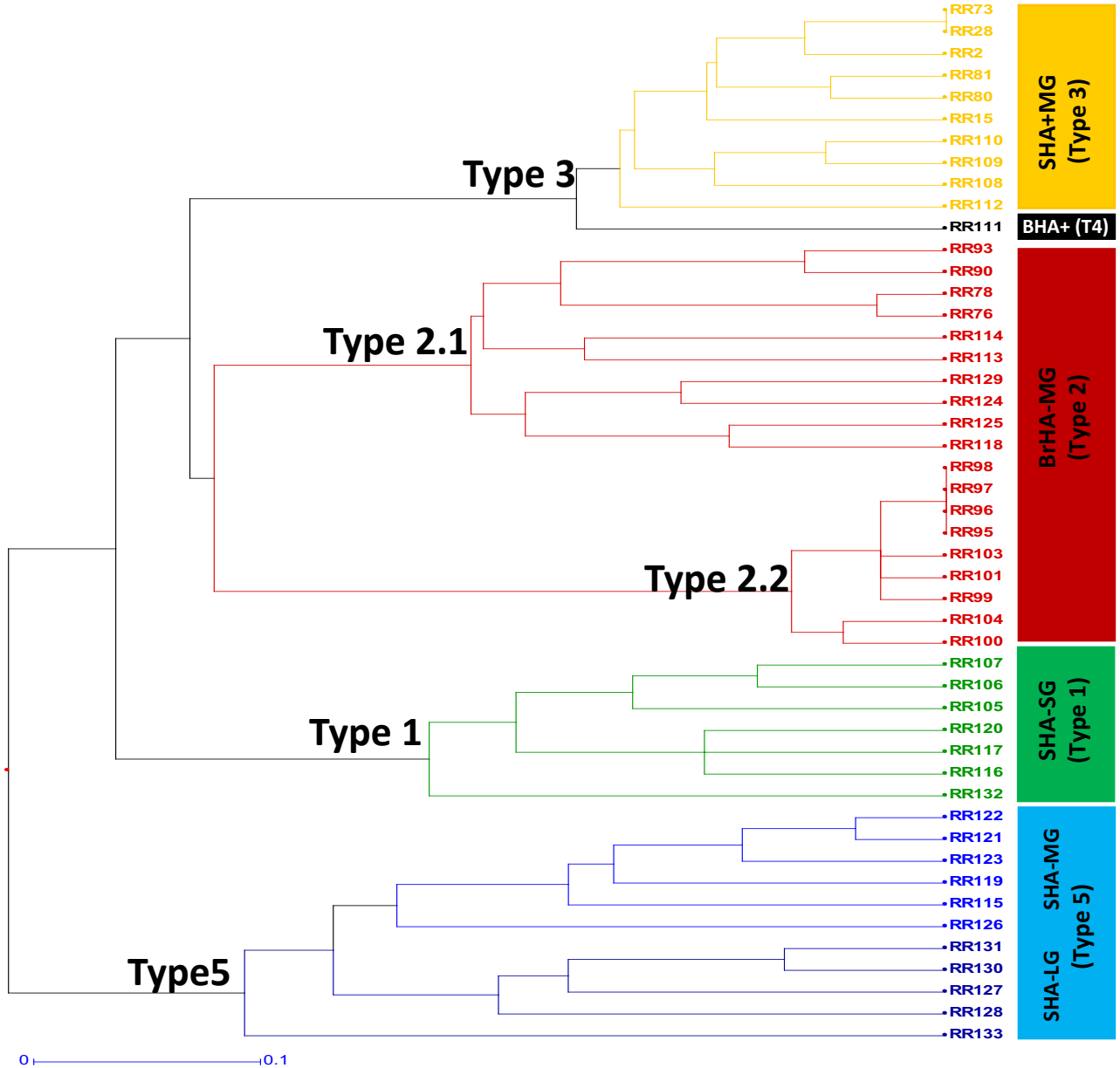

Plant height measurement
160.0
140.0
120.0
100.0
80.0
60.0
40.0
20.0
0.0
Plant Height (cm)
RES Varieties
Koshihikari
Type 1
Type 2
Type 3
Type 4
Type 5
CA Weedy Rice


RR116
RR111
RR133
M-205
144 cm
99 cm
74 cm
86 cm

Characteristics	Populations	Duration of time in soil
High dormancy, high shattering	Type 1, Type 3, Type 4	Long-term (may be 10 or more years)
Low dormancy, high shattering	Type 2, Type 5	Shorter (likely to be a few years, but only if more seed is not being put into the soil seedbank)

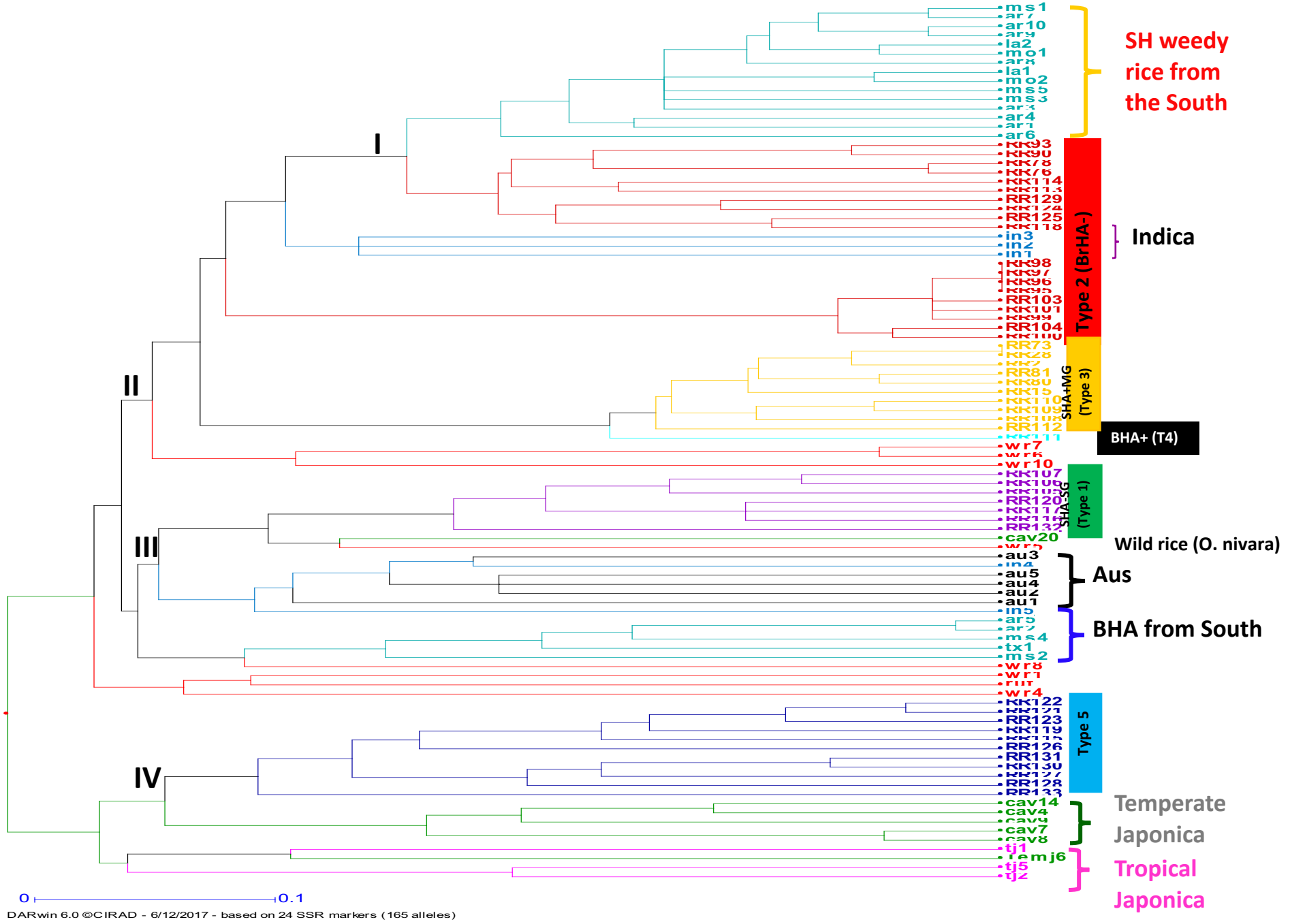
- **All populations are:** red-branned (red pericarp)
- **All populations are:** lighter green than Japonica varieties
- **All populations are:** taller than Calrose varieties

Genetic clustering of CA weedy rice ecotypes



Location	Leaf pubescent	Awn
Glenn	PART. PUB.	awned, long
Glenn	PART. PUB.	awned, long
Wells	PART. PUB.	awned, long
Colusa	PART. PUB.	awned, long
Colusa	PART. PUB.	awned, long
Wells	PART. PUB.	awned, long
Colusa	PART. PUB.	awned, long
Colusa	PART. PUB.	awned, long
Colusa	PART. PUB.	awned, long
Glenn	PART. PUB.	awned, long
Glenn	PART. PUB.	awned, long
Glenn	PUBESCENT	Part awned, short
Glenn	PUBESCENT	Part awned, short
Sutter	PUBESCENT	w/o awn
Sutter	PUBESCENT	w/o awn
Sutter	PART. PUB.	w/o awn
Glenn	PART. PUB.	w/o awn
Butte	PUBESCENT	
Yuba	PART. PUB.	w/o awn
Colusari	PART. PUB.	w/o awn
Sutter	PART. PUB.	w/o awn
Glenn	PUBESCENT	w/o awn
Glenn	PUBESCENT	w/o awn
Glenn	PUBESCENT	w/o awn
Glenn	PUBESCENT	w/o awn
Glenn	PUBESCENT	w/o awn
Glenn	PUBESCENT	w/o awn
Glenn	PUBESCENT	w/o awn
Butte	PART. PUB.	w/o awn
Glenn	PUBESCENT	Part awned, short
Butte	PUBESCENT	w/o awn
Butte	PUBESCENT	w/o awn
Butte	PUBESCENT	w/o awn
Sutter	PART. PUB.	w/o awn
Sutter	PART. PUB.	w/o awn
Sutter	PART. PUB.	w/o awn
--	PUBESCENT	
Sutter	PART. PUB.	Part awned, medium
Sutter	PART. PUB.	Part awned, medium
Yuba	PART. PUB.	Part wned, medium
Sutter	PART. PUB.	w/o awn
Sutter	PART. PUB.	Part awned, medium
Riz Rouge	PART. PUB.	w/o awn
Butte	PART. PUB.	Part awned, short
Butte	PART. PUB.	w/o awn
--	PUBESCENT	w/o awn
Sutter	PART. PUB.	Awned, long
--	PART. PUB.	w/o awn

Phylogenetic relationships of CA weedy rice with other rice groups



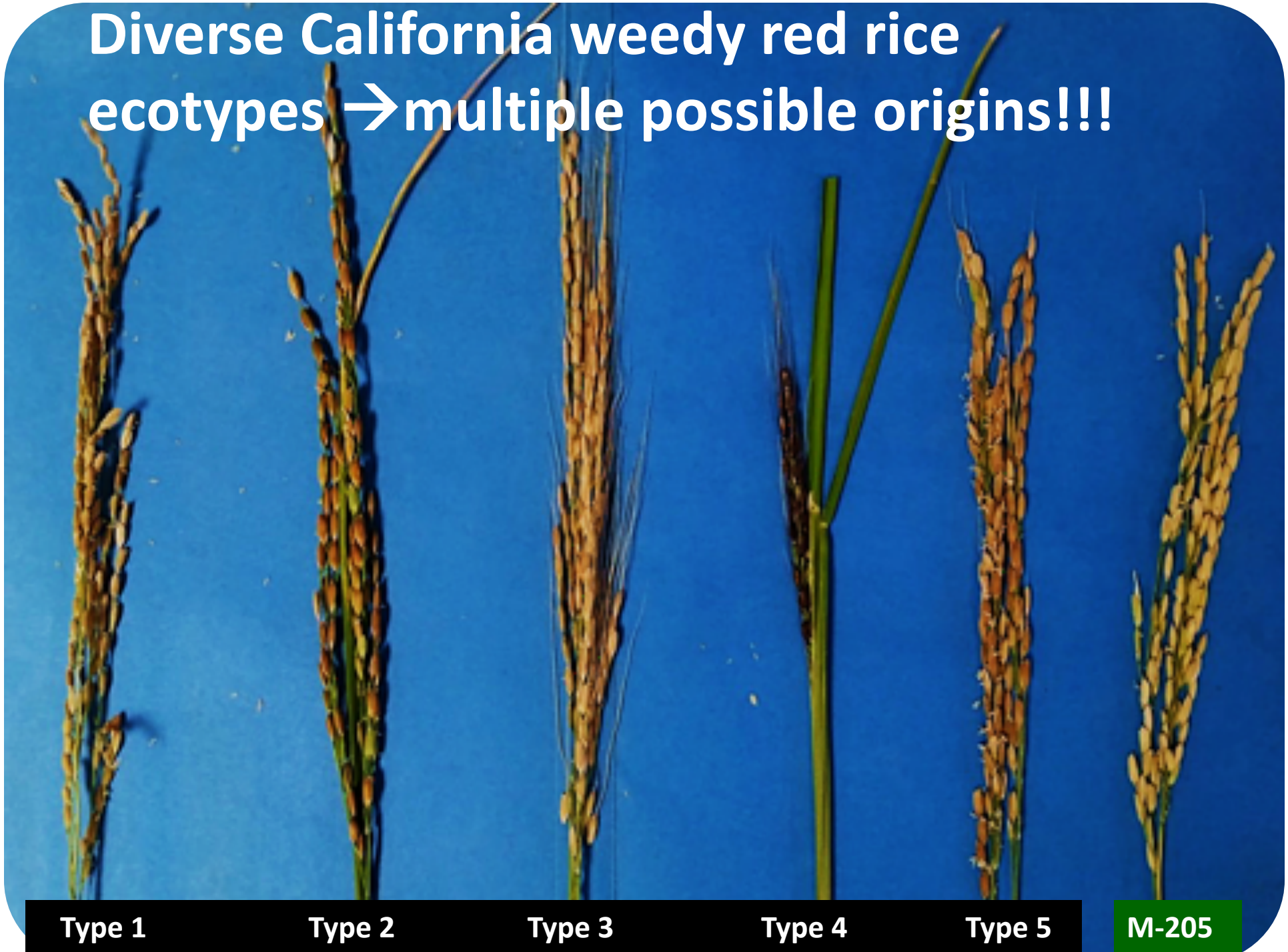
Summary of Preliminary Genetics

- **Five genetic groups, which align well with outward characteristics (phenotypes)**
- **Type 1:** Most closely related to black-hulled weedy rice from the southern US and Aus varieties
- **Type 2:** Most closely related to straw-hulled weedy rice from the southern US and Indica varieties
- **Type 3:** Most closely related to straw-hulled weedy rice from the southern US and Indica varieties
- **Type 4:** Most closely related to straw-hulled weedy rice from the southern US and Indica varieties
- **Type 5:** Most closely related to Japonica (both temperate and tropical varieties)

Types 2, 3 and 4 closely related to each other!

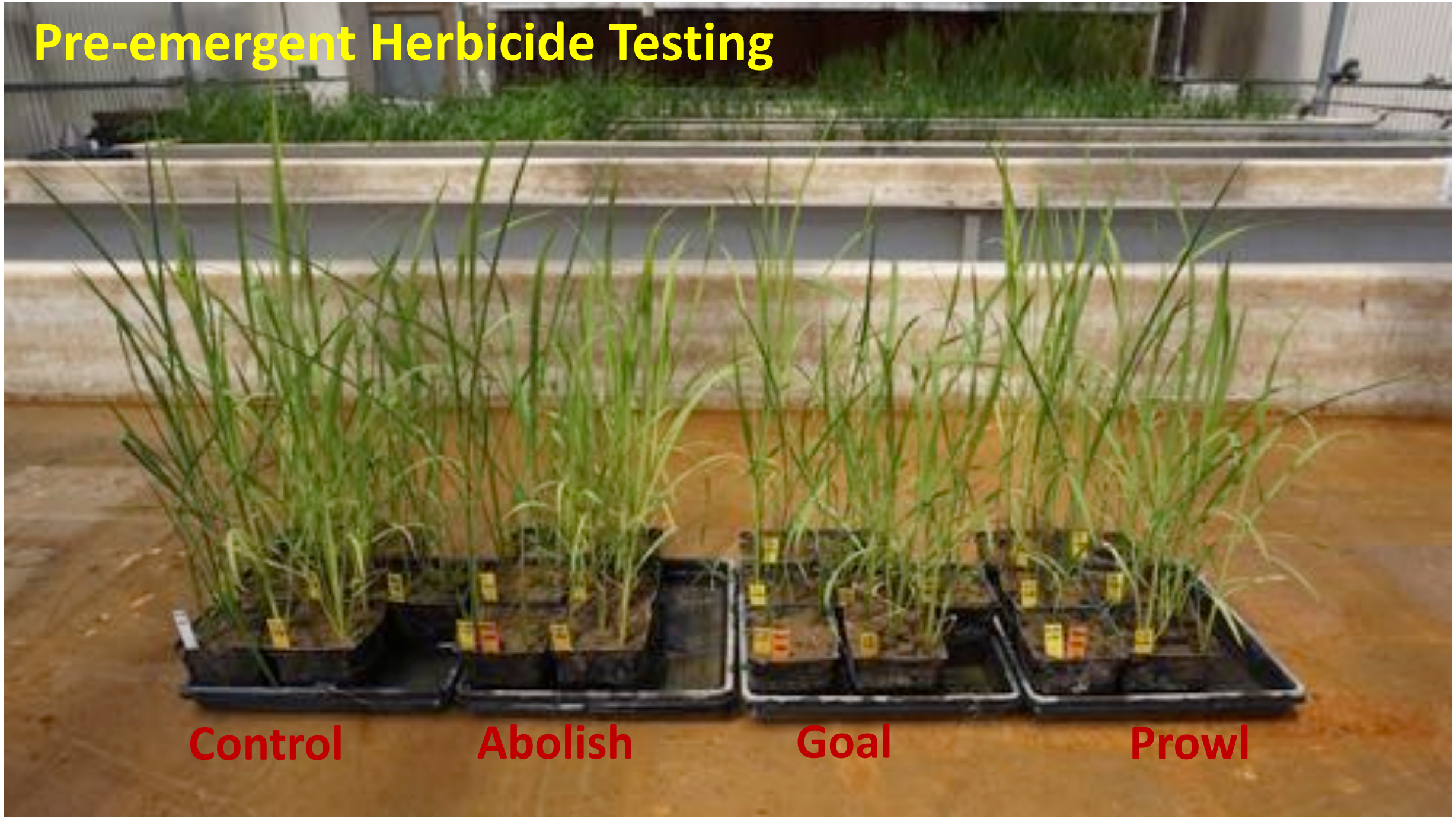
Types 3 and 4 are most closely related to each other!

Diverse California weedy red rice ecotypes →multiple possible origins!!!



Herbicide Screening

Pre-emergent Herbicide Testing



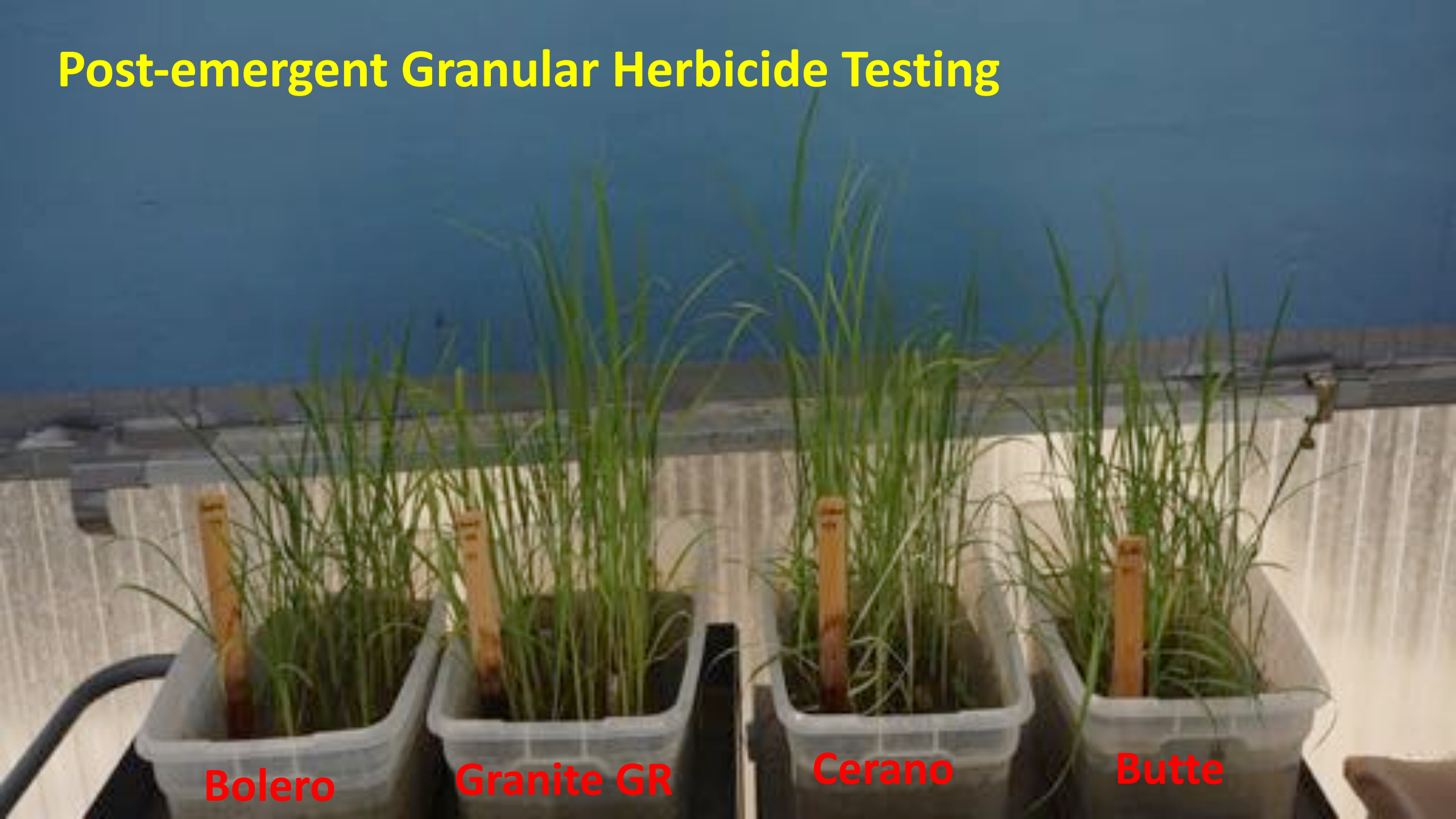
Treatments and Rates

- Herbicides were applied 1 day after planting the seeds to about 1 cm depth (simulate drill-seeded system)
- Pictures were taken 23 days after spraying

- Herbicides:
  - Prowl- 2 pts/A
  - Abolish- 2 qts/A
  - Goal 2X- 2 pts/A

No effect on any of the weedy rice biotypes

Post-emergent Granular Herbicide Testing



Treatments and Rates

- Herbicides were applied 10 days after planting (1-2 leaf stage of rice)
- Two days after (48 hrs) plants were placed at 4-inch water depth
- Pictures were taken two weeks after herbicide application

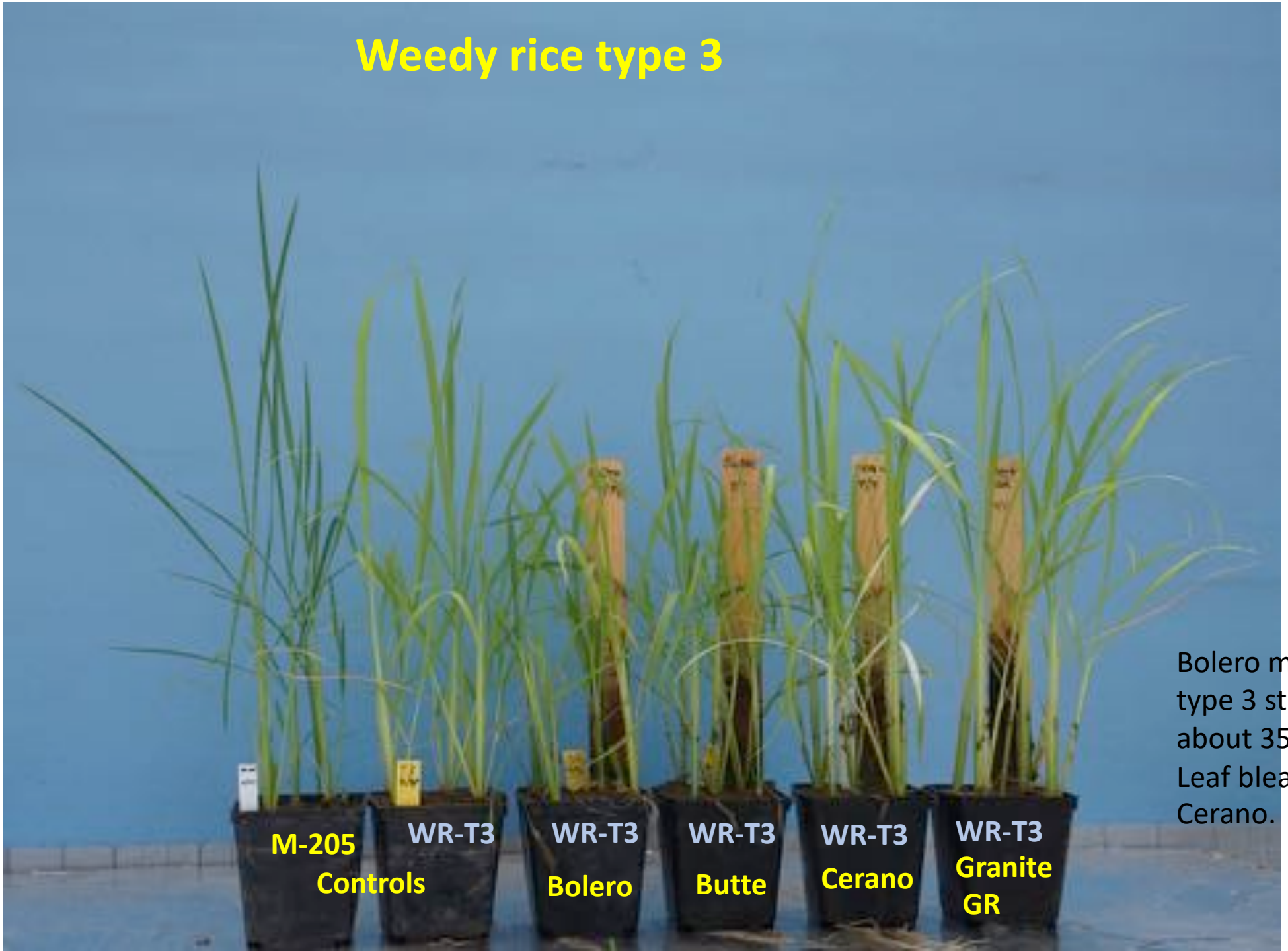
- Herbicides:
  - Bolero- 23.3 lbs/A
  - Cerano- 12 lbs/A
  - Butte - 7.5 lbs/A
  - Granite GR – 15 lbs/A

Leaf bleaching of M-205 by Cerano.

Stunting of WR type 1 by about 50% by Bolero.

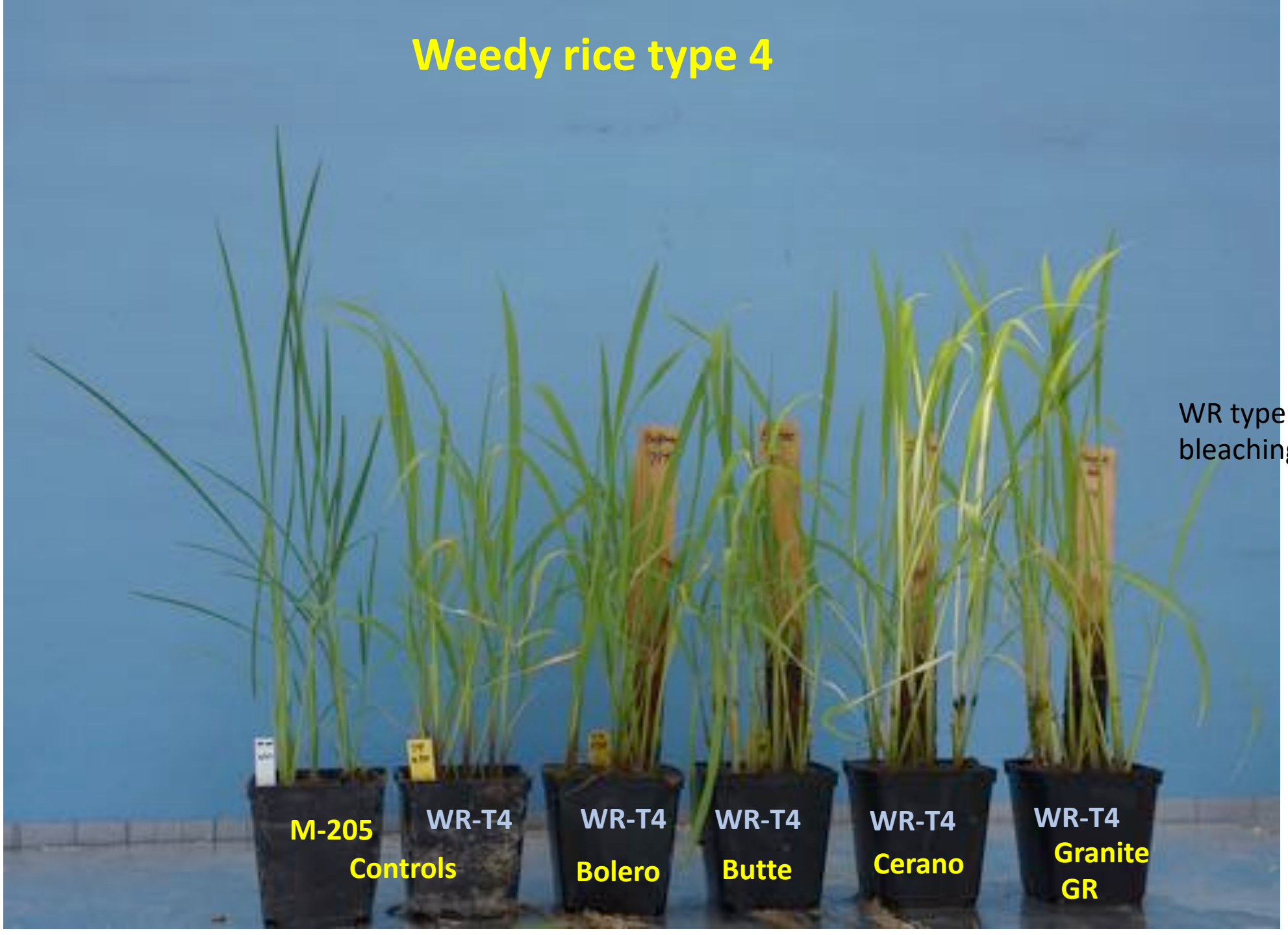
Stunting of WR type 2 by about 50% by Bolero.

Weedy rice type 3

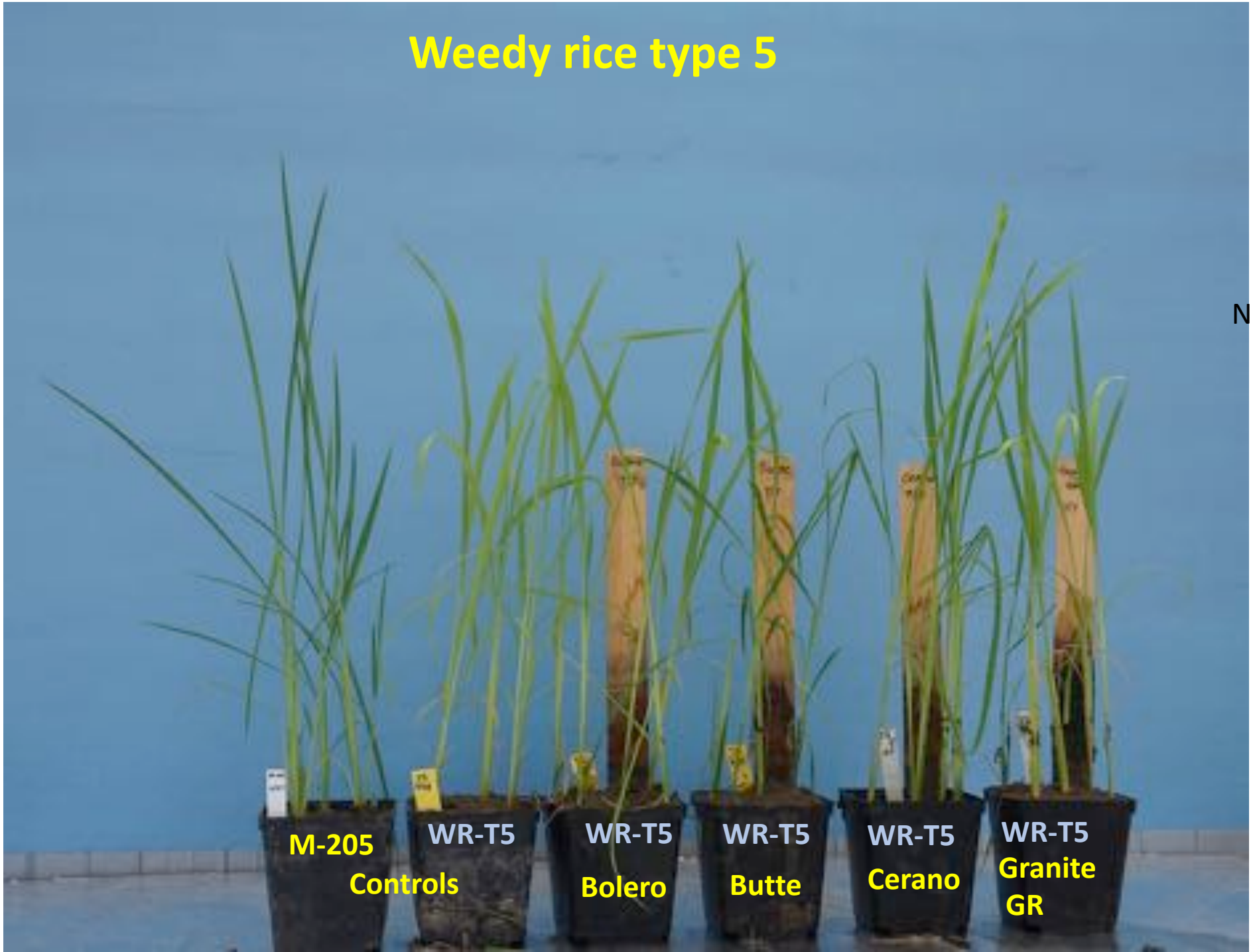


Bolero makes WR type 3 stunted by about 35%.
Leaf bleaching by Cerano.

Weedy rice type 4



WR type 4 leaves are bleaching by Cerano.



No effect on T5.

Granular Herbicide Screening Summary

- Some injury noted on **Types 1-4** from Bolero, but plants recovered
- **Type 5:** no injury from any herbicides

Post-Emergent Foliar Herbicide Testing

Treatments and Rates

- Herbicides were applied 14 days after planting (2 leaf stage of rice)
- Two days after (48 hrs) plants were placed at 4-inch water depth
- Pictures were taken four weeks after herbicide application

- Herbicides:
  - Goal 2X – 2 pints/A
  - Propanil- 8 lbs a.i. /A
  - Regiment- 0.8 oz/A


Control Plants
M206
Roxy
T1
T2
T3
T4
T5


Goal 2XL
M206
Roxy
T1
T2
T3
T4
T5


Propanil
M206
Roxy
T1
T2
T3
T4
T5

Regiment

Post-emergent Foliar Herbicide Screening Summary

- Propanil and Regiment: no effects
- Oxyfluorfen: controls Types 1-4, no effect on Type 5

Spot-Spraying Foliar Herbicide Testing

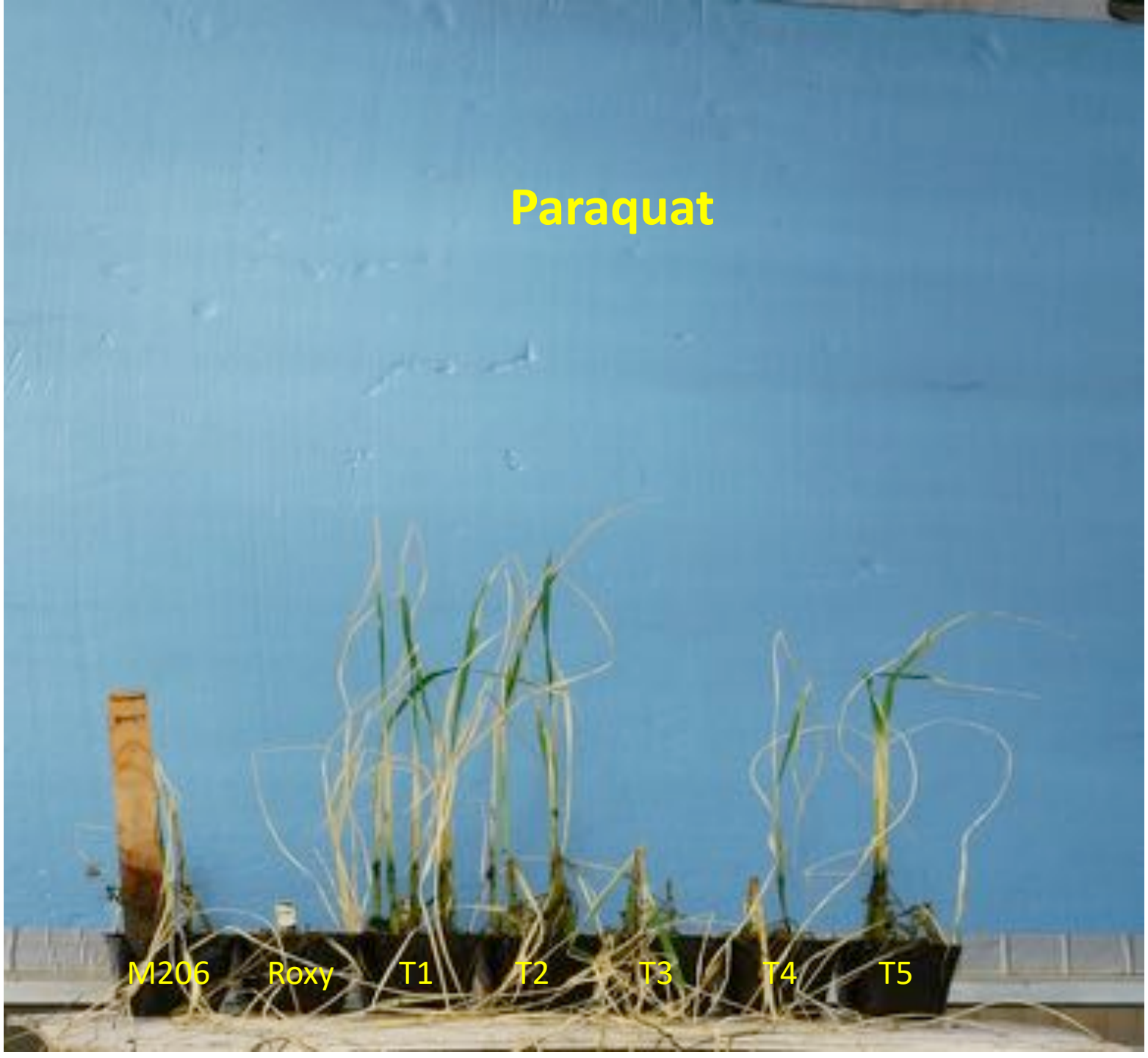
Treatments and Rates

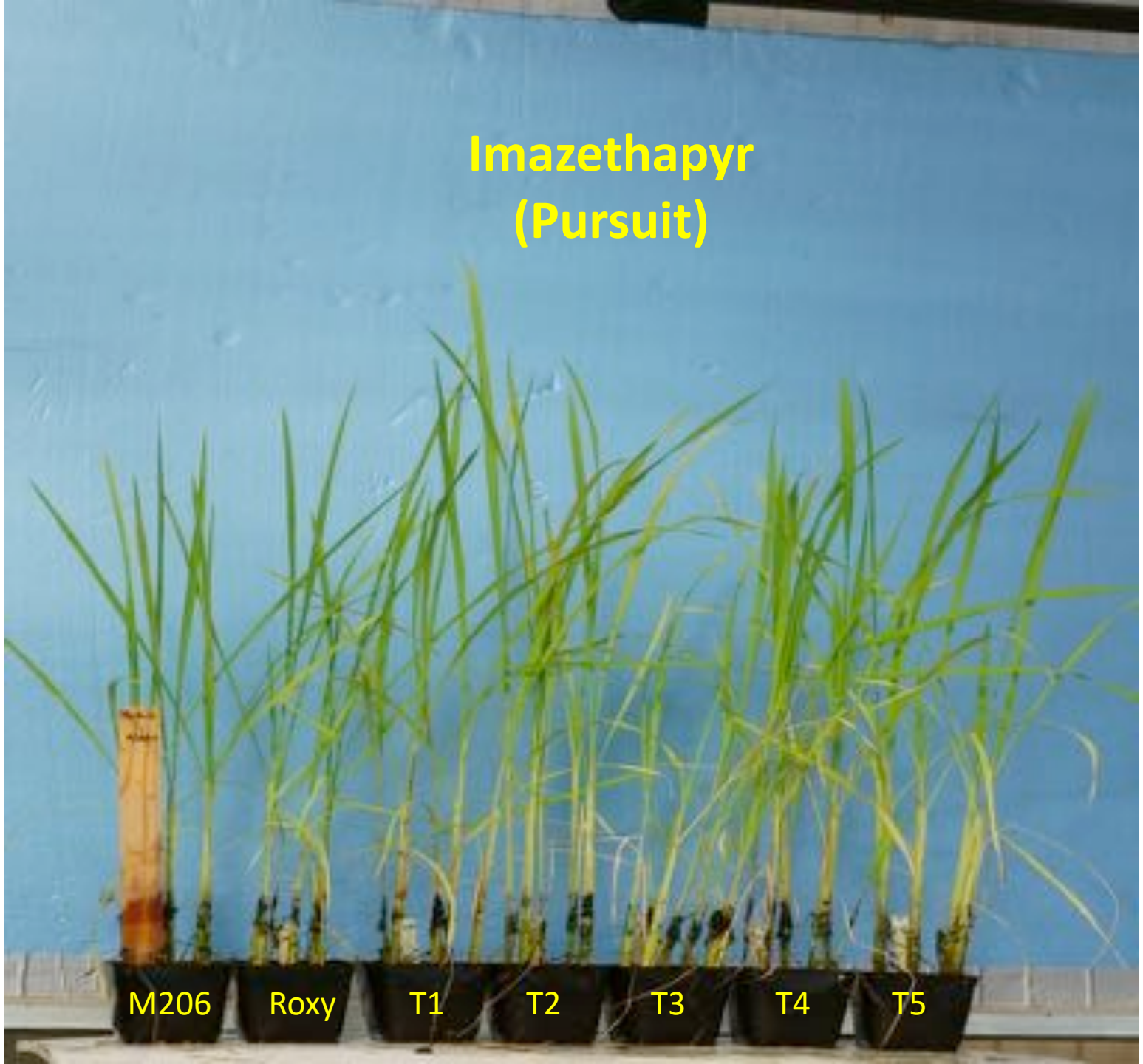
- Herbicides were applied 1 month after planting (tillering stage of rice)
- Two days after (48 hrs) plants were placed at 4-inch water depth
- Pictures were taken two weeks after herbicide application

- Herbicides:
  - Clethodim – 32 fl oz/A
  - Paraquat- 4 pts/A
  - Imazethapyr – 6 fl oz/A
  - Glufosinate – 82 fl oz/A
  - Glyphosate – 32 fl oz/A (Roundup PowerMax) = 525 g a.e. /A


Control Plants
M206
Roxy
T1
T2
T3
T4
T5


Clethodim
M206
Roxy
T1
T2
T3
T4
T5


Paraquat
M206
Roxy
T1
T2
T3
T4
T5


Imazethapyr
(Pursuit)
M206
Roxy
T1
T2
T3
T4
T5


Glufosinate
M206
Roxy
T1
T2
T3
T4
T5


Glyphosate
M206
Roxy
T1
T2
T3
T4
T5

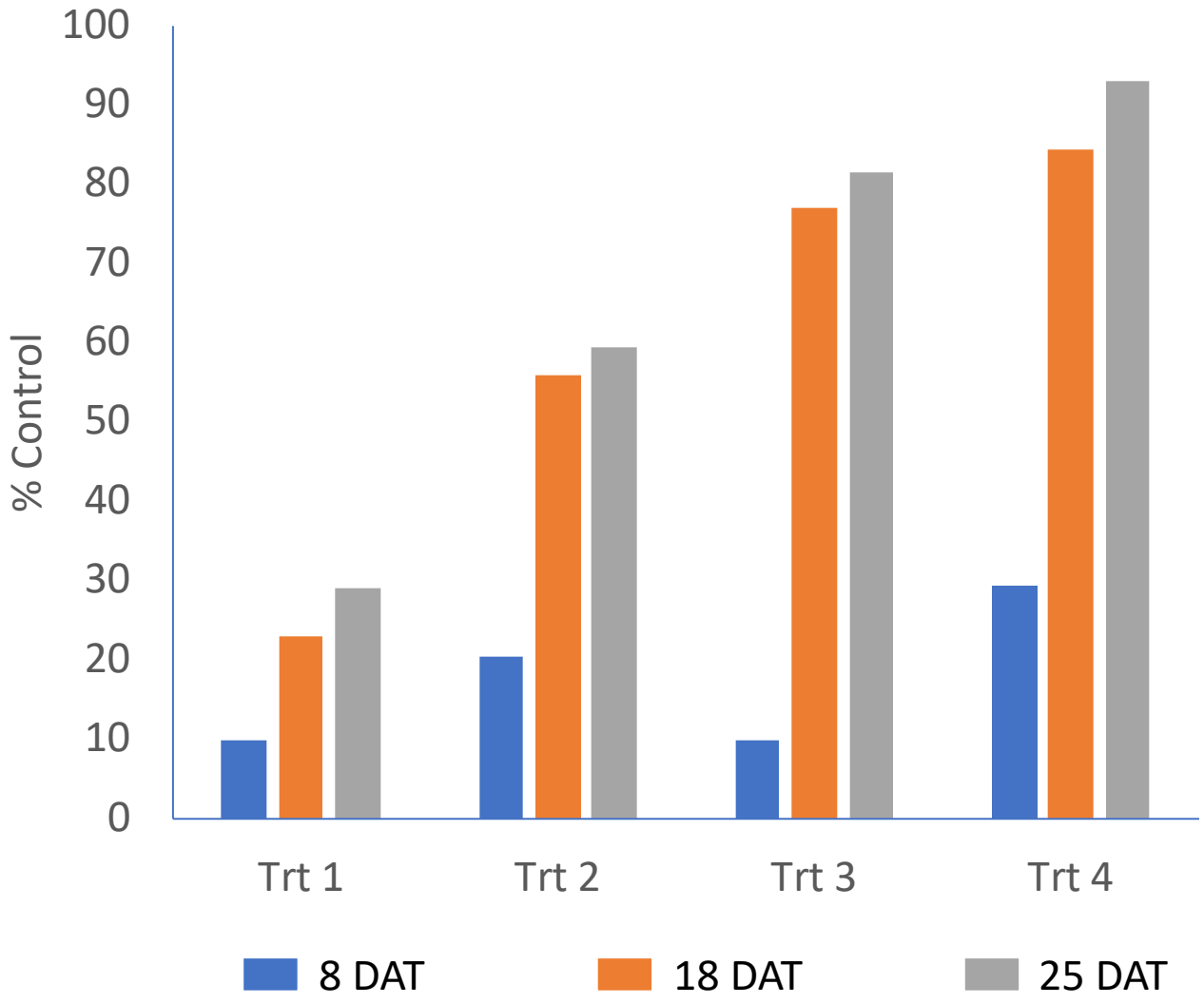
Spot-spray Herbicide Screening Summary

- Clethodim, Paraquat and Glufosinate show good control of all weedy rice types
- Glyphosate shows variable control (further investigation is necessary)
- Imazethapyr shows no weedy rice control when applied at rice tillering

Clethodim Spot-Spraying in the Field
Collaborator: Jim Cook

- Spot-sprayed tillering Type 3 weedy rice
- **Treatment 1:** 3 second duration spray of 2/3% V/V SelectMax + 0.25% V/V NIS
- **Treatment 2:** 5 second duration spray of 2/3% V/V SelectMax + 0.25% V/V NIS
- **Treatment 3:** 3 second duration spray of 2/3% V/V SelectMax + 1% V/V COC
- **Treatment 4:** 5 second duration spray of 2/3% V/V SelectMax + 1% V/V COC

- Damage to surrounding rice extended no more than 9.6 inches (for all treatments)
- Longer duration provided better control when using NIS (5 seconds)
- Treatments with COC as surfactant provided better control, regardless of duration (82% and 93%)



Herbicide Screening Summary

- Currently no registered rice herbicides that control or significantly injure weedy rice
- Several potential herbicides are available for spot treatment:
  - Clethodim
  - Paraquat
  - Glufosinate
- Oxyfluorfen may work on Types 1-4 as a post-emergent treatment, when used with the Roxy Rice variety