Weedy Rice Biology, Ecology, and Genetics

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What is “weedy rice”?

- Same species as cultivated rice:
  - Cultivar: *Oryza sativa* L.
  - Weedy rice: *Oryza sativa* f. *spontaneae* or simply *Oryza sativa* spp.
- Considered one of the worst weeds of rice worldwide
- Can hybridize with cultivated rice
- Rice is considered to be a “selfing” crop (outcrossing of 1-2%)
- Weedy rice has an outcrossing rate approaching 10%
- Different populations present in each location
  - Different phenotypes, biotypes, etc.

Why is it important to control weedy rice?

It is rice, after all!

What makes one rice plant a weed, and the other a pest?

Field in Arkansas. Image from:
https://www.bio.umass.edu/biology/sites/imladris.bio.umass.edu.biology/files/gbi-images/weedyredricefield.jpg

Weedy Characteristics

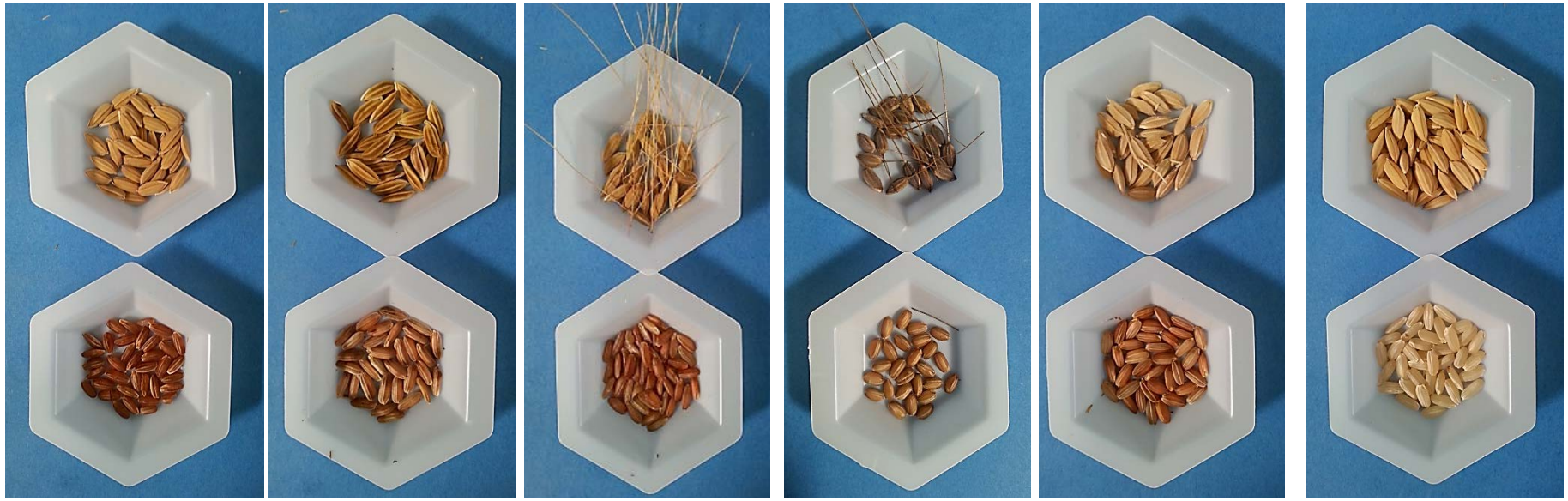
- **Domestication syndrome:**
  - Seed shattering
  - Seed dormancy (ability to remain viable in the soil)

Source: Siriwardana 2014, Photo: Timothy Blank, CCIA

Weedy Characteristics

M-206 =
Cultivar

Red pericarp = red bran



Weedy rices

Why is it important to control weedy rice?

Can impact quality

- In white rice, extra milling required
- In brown rice, has to be sorted out

Can affect yields

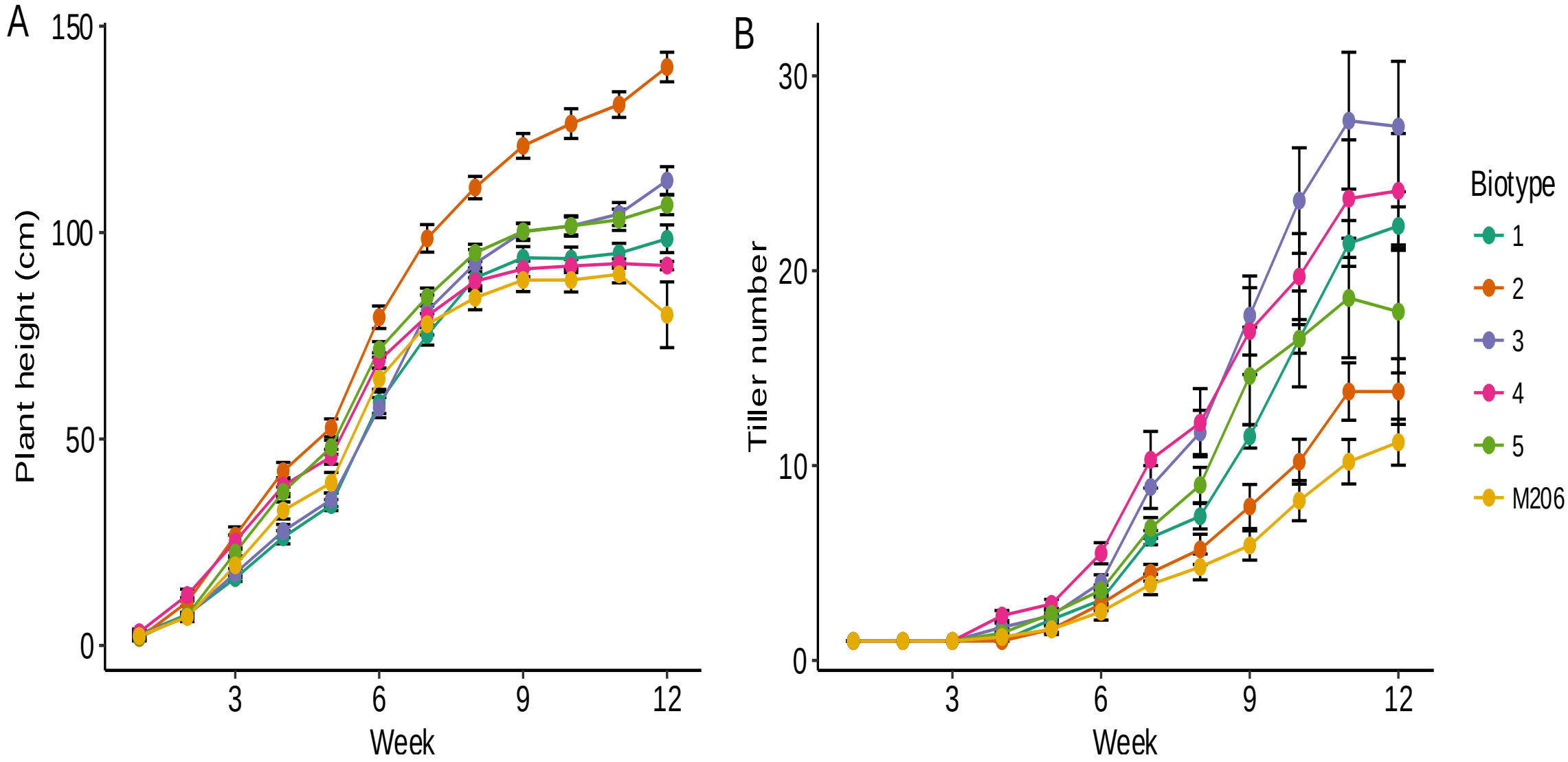
- Shatters
- If heavily infested, can reduce yields

Same species as rice!

- Herbicides ineffective
- Only one herbicide recently found for spot-spraying: SUPRESS
- Requires cultural management

Field in Arkansas. Image from: https://www.bio.umass.edu/biology/sites/imladris.bio.umass.edu.biology/files/gbi-images/weedyredricefield.jpg

Weekly early growth measurements of plant height (A) and number of tillers (B) for M-206 rice and weedy rice biotypes during the vegetative growth stage.



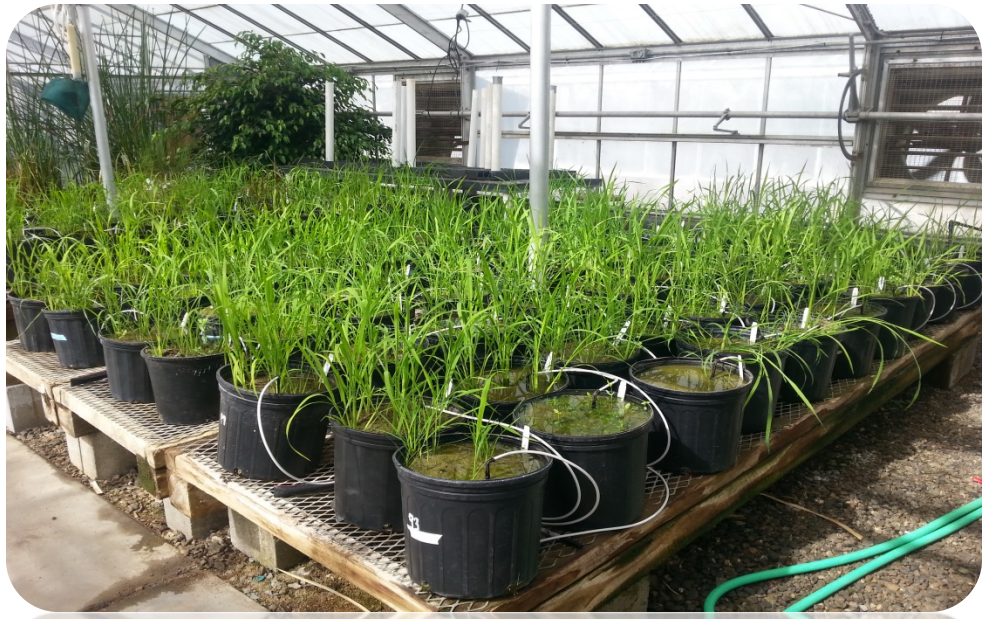
Where did it come from?

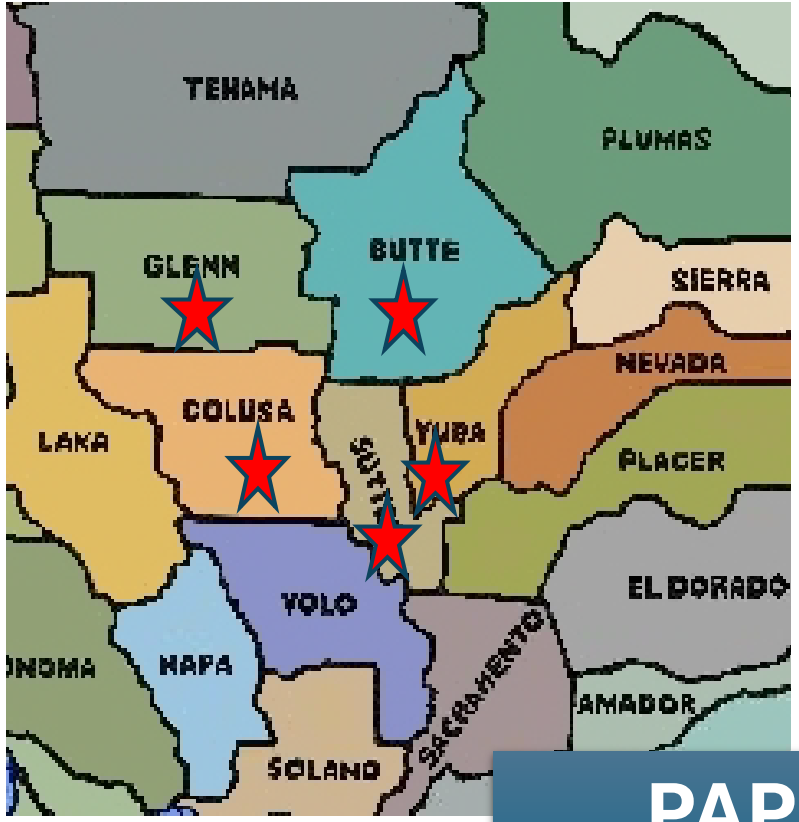
Several theories…

- De-evolved (lost its domestication)
- Outcrossing with wild rice types
- Imported and spread from rice-growing areas to other rice-growing areas

Materials & Methods

133 – CA Weedy Rice Collections
20 – Southern Weedy Rice (AR, LA, MS, MO, TX)
11- Wild rice (O. rufipogon, O. barthii, O. glumaepatula, O. nivara, O. officinalis, O. alta)
3 - Specialty Rice
21- Temperate Japonicas (CA rice varieties, 2 Jap variety)
5 – Tropical Japonicas (Southern USA rice)
5 – Indicas
5 - Aus





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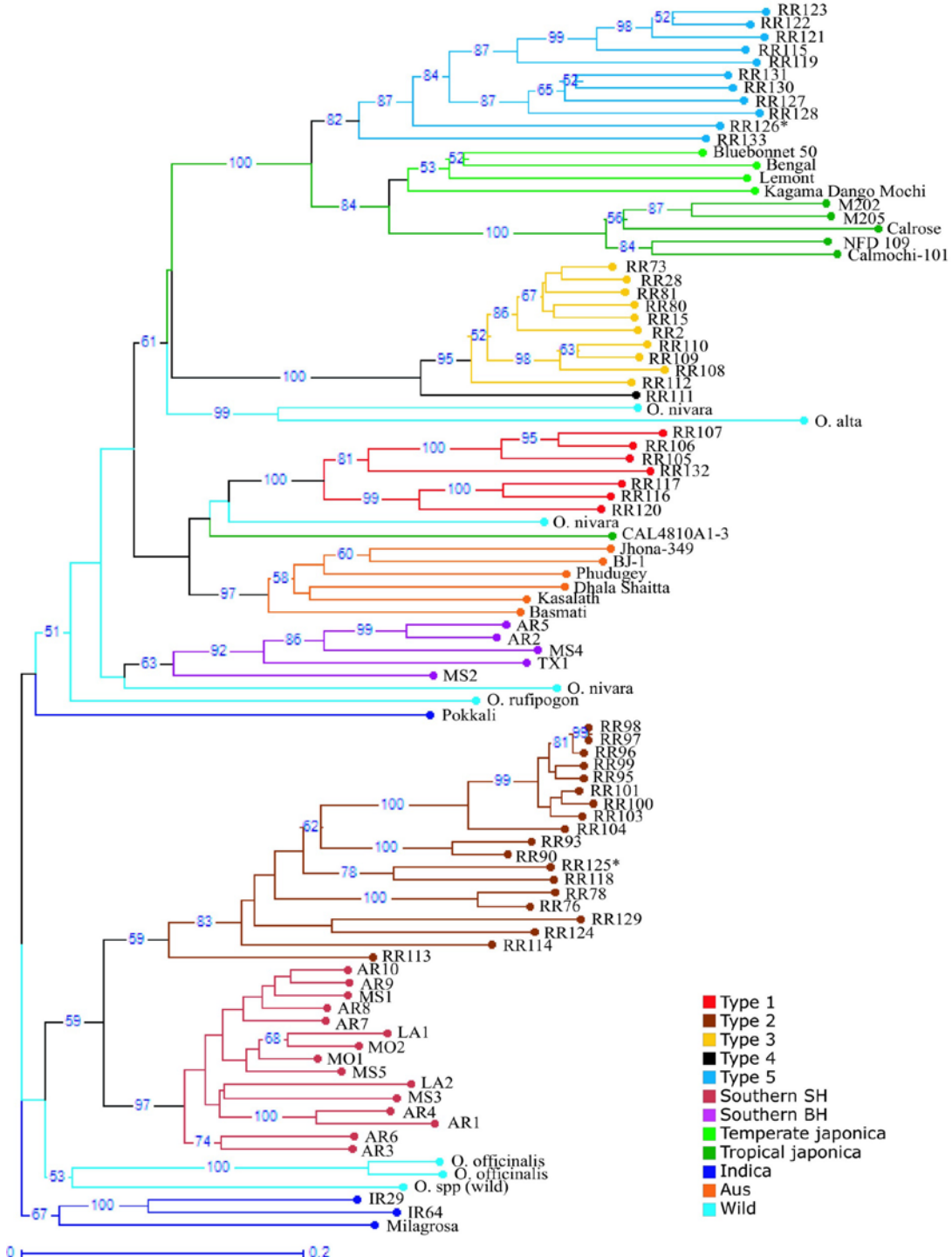
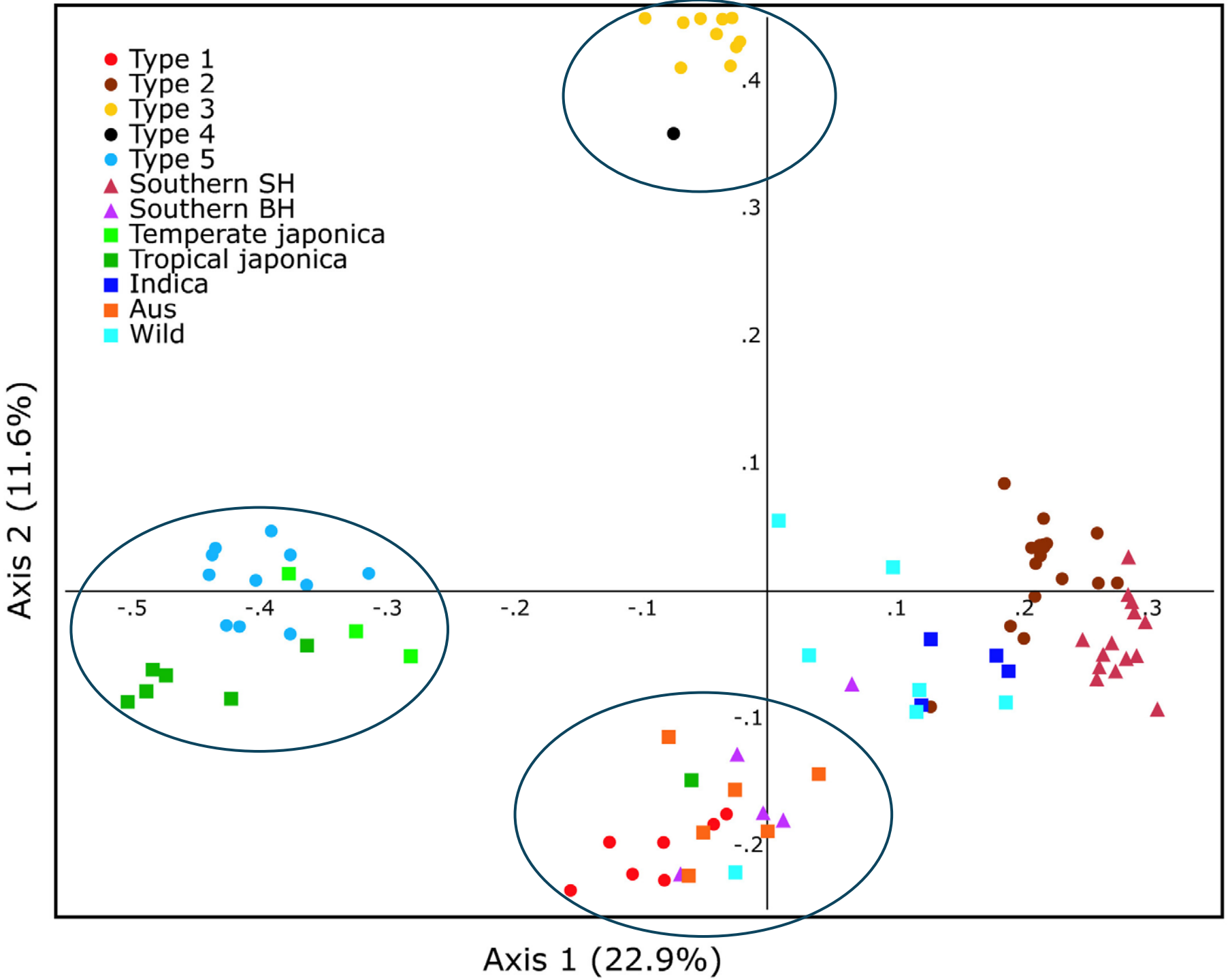
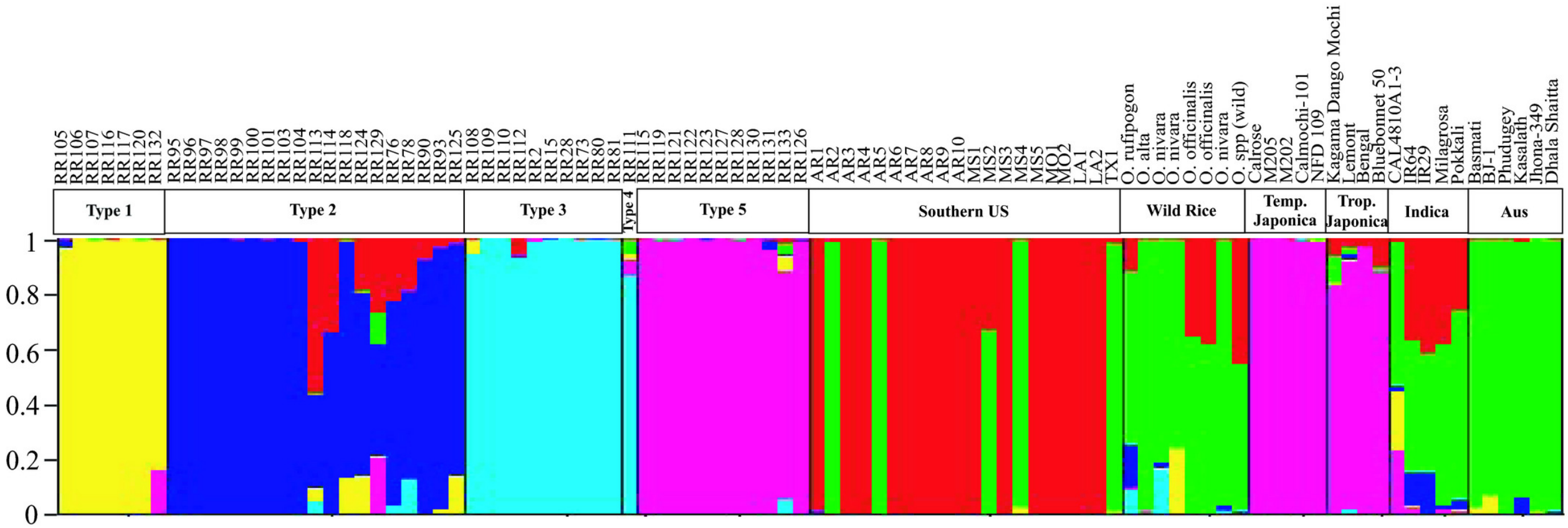
Phenotype
+
Genotype characterizations

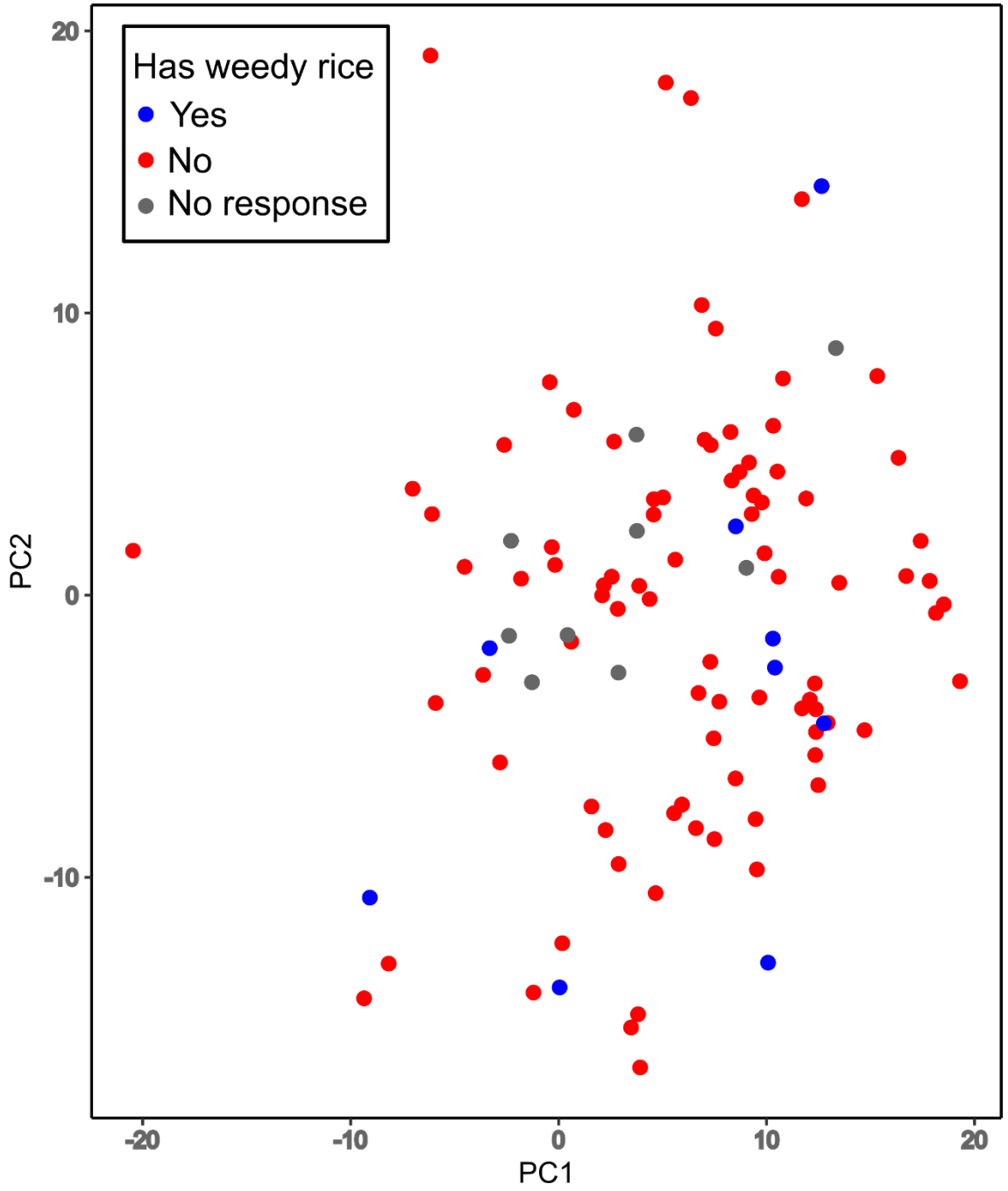


- Type 1: near an *O. nivara* individual and one temperate *japonica* variety as well as *aus* and Basmati rice
- Type 2: near southern SH weedy rice and some wild rice
- Type 3: grouped together with the Type 4 weedy rice. Most closely related to *O. nivara* and *O. alta* (wild rices)
- Type 5: near the *japonica* rice varieties Closely related to Type 3 and Type 4 weedy rice.
- Two noncertified introduced cultivated red-pericarped specialty rice varieties grown in California, (RR125 and RR126), clustered with California weedy rice.


Type 1
Type 2
Type 3
Type 4
Type 5
Southern SH
Southern BH
Temperate japonica
Tropical japonica
Indica
Aus
Wild
.4
.3
.2
.1
-.1
-.2
-.5
-.4
-.3
-.2
-.1
.1
.2
.3
Axis 2 (11.6%)
Axis 1 (22.9%)



- Type 1 cluster: genetic contributions from *O. nivara*, one *indica* rice variety, and some Type 2 weedy rice individuals.
- Type 2: individuals show admixture with strawhull weedy rice from the southern United States, *indica* rice, or wild rice species.
- Type 3 and Type 4 rice: minor contributions from wild rice
- Type 5 weedy rice: cluster genetically with both tropical and temperate *japonica* rice

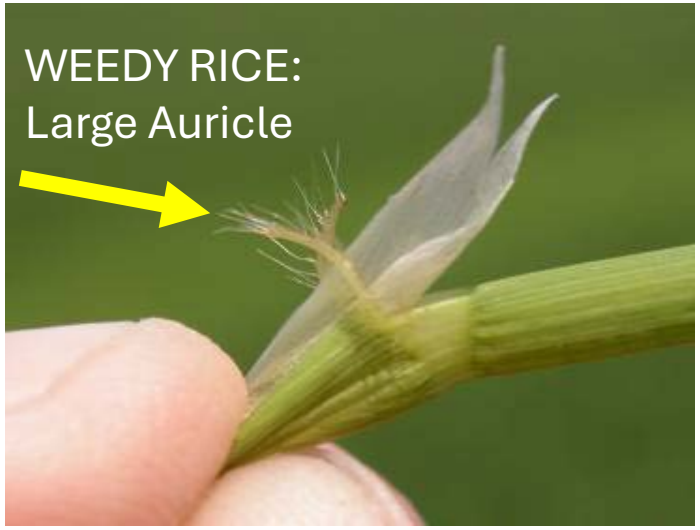


The included management practices and farm characteristics were:

- large (>1000 acres) vs. small (<1000 acres) farm size
- organic production
- production of medium grain rice
- production of specialty rice varieties
- purchasing certified seed
- saving seed
- obtaining seed from other growers
- use of preemergent herbicides
- use of post-emergent herbicides
- drill/dry seeding
- straw incorporation
- winter burning
- use of the stale seedbed method
- crop rotation

Points that are clustered closely together have similar overall management.

Identification at Panicle Initiation



Identification at Panicle Initiation

1. Once all herbicide applications have been made to control watergrass…
2. Watergrass-like plants still visible in the field
3. Check plants to see if there is a ligule
4. If ligule and auricle ABSENT, then it is a watergrass species
5. **If auricle or ligule PRESENT, time to call UCCE Advisors for help!**


• High shattering
• High dormancy
• Type 1:
• Awnless
• Straw hull color
• Tall stature
• No color on nodes

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

- **High shattering**
- **Low dormancy**

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

- **High shattering**
- **High dormancy**

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

- **High shattering**
- **High dormancy**

- **Currently in one location**

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

- **High shattering**
- **Low dormancy**

Type 6-7 and beyond

- Working on confirming weediness (shattering and dormancy levels)

  - **Type 6:**
    - Red Awns
    - Black hull color
    - Tall stature
    - ***Panicles come out of the boot***

New Weedy Rice Types

- All found in 1 location
- Except for the White pericarped type (found in 3 locations)

Type 6

- Black-hulled
- Long awns
- Awns reddish before maturity

Type 7

- Straw-hulled
- Long awns
- Awns reddish before maturity

WR-10

- Straw-hulled
- Medium length awns
- Seed is closer in size to a long-grain

WR-15

- Straw-hulled
- Variable awn length
- Variant of Type 3?
- Awns not exactly the same

WR-16

- Black-hulled
- Long awns
- Awns NOT reddish before maturity

White Pericarped

- Straw-hulled
- Long awns
- Awns reddish before maturity
- WHITE pericarped

Questions?