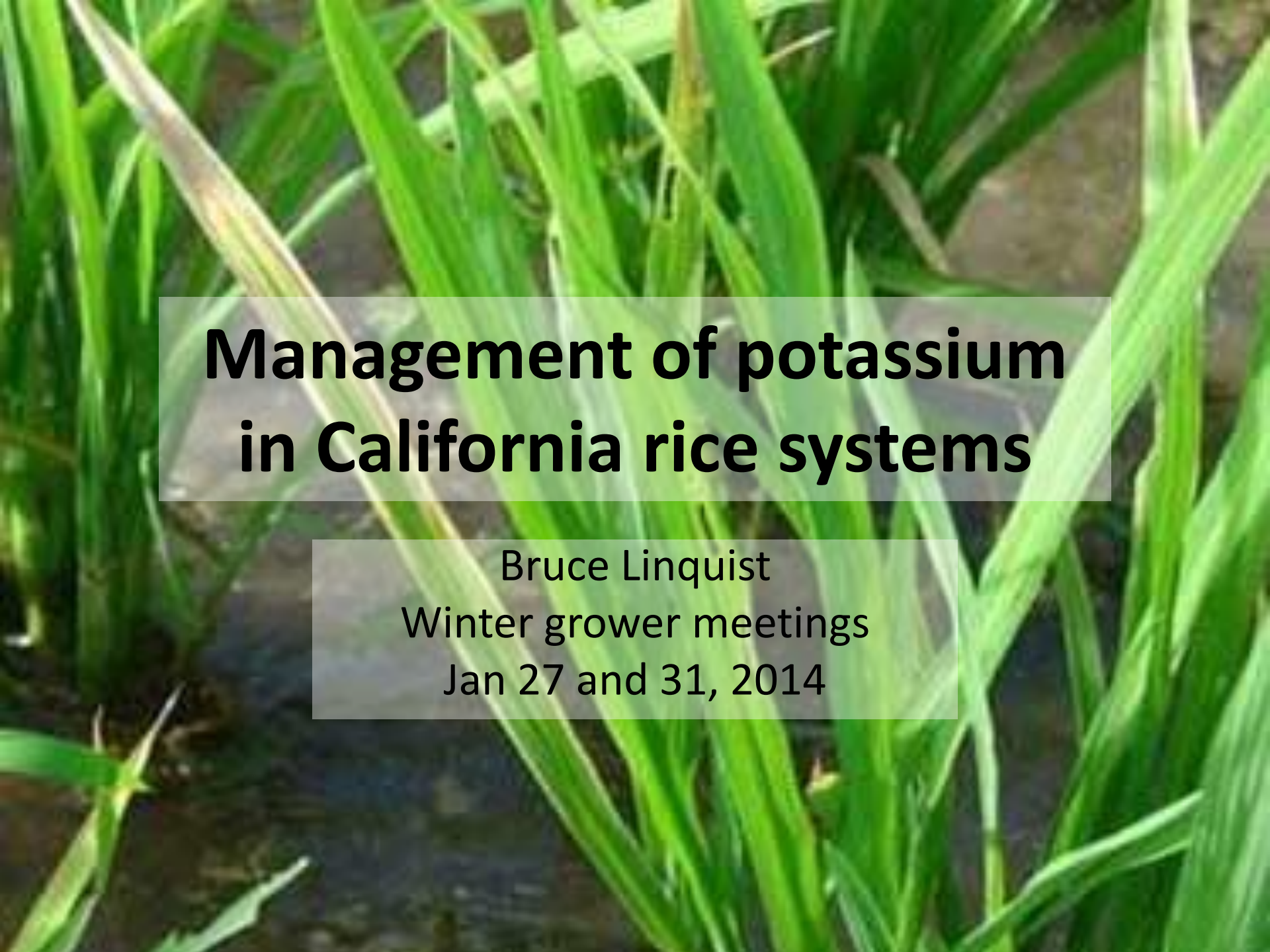


Management of potassium in California rice systems

Bruce Linquist

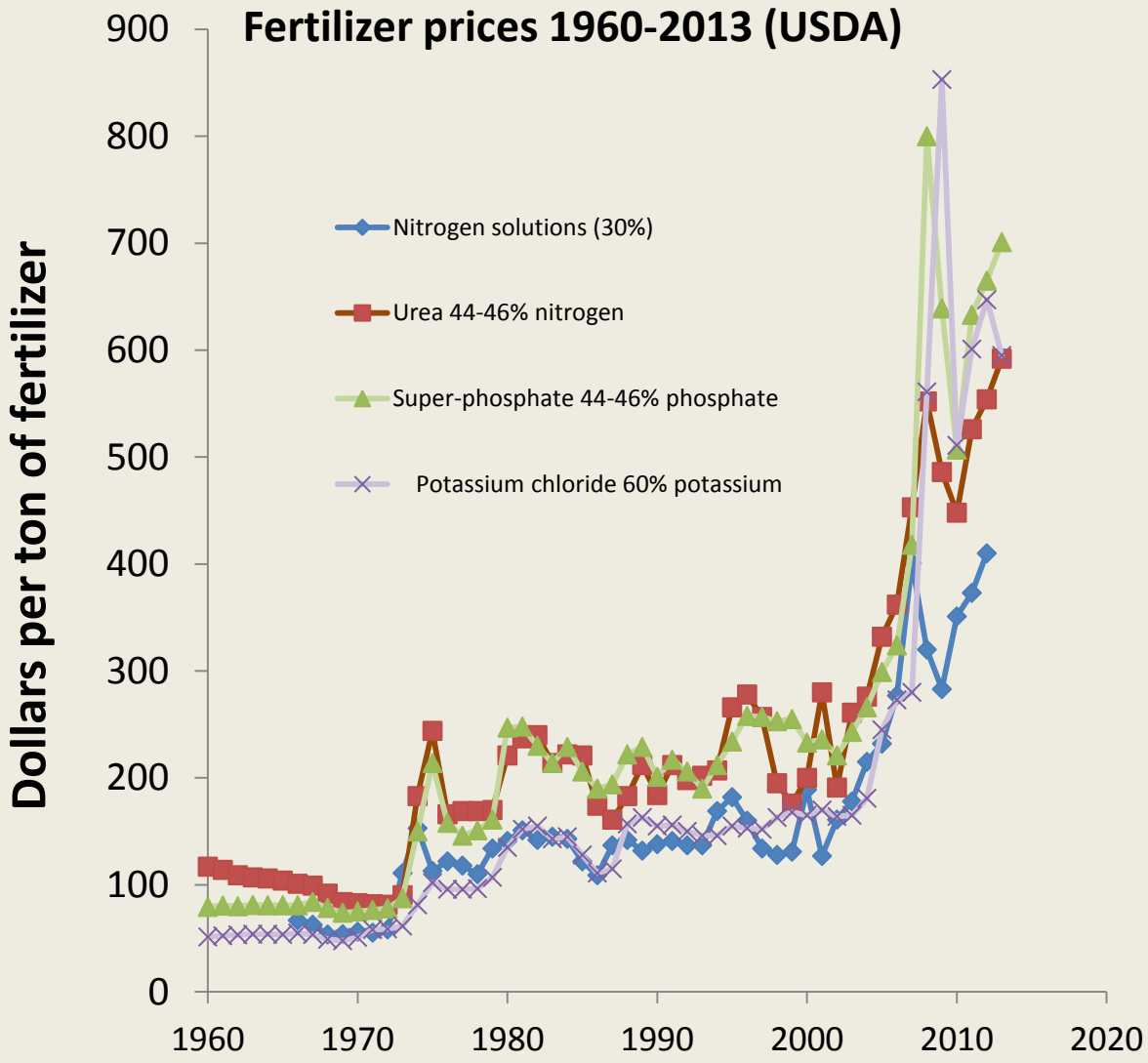
Winter grower meetings

Jan 27 and 31, 2014

Outline

- Cost of K fertilizer
- Why plant needs K
- Deficiency symptoms
- Plant demand for K
- K inputs and losses
- Results of 2012 study: K status of CA rice soils

Changes in fertilizer prices

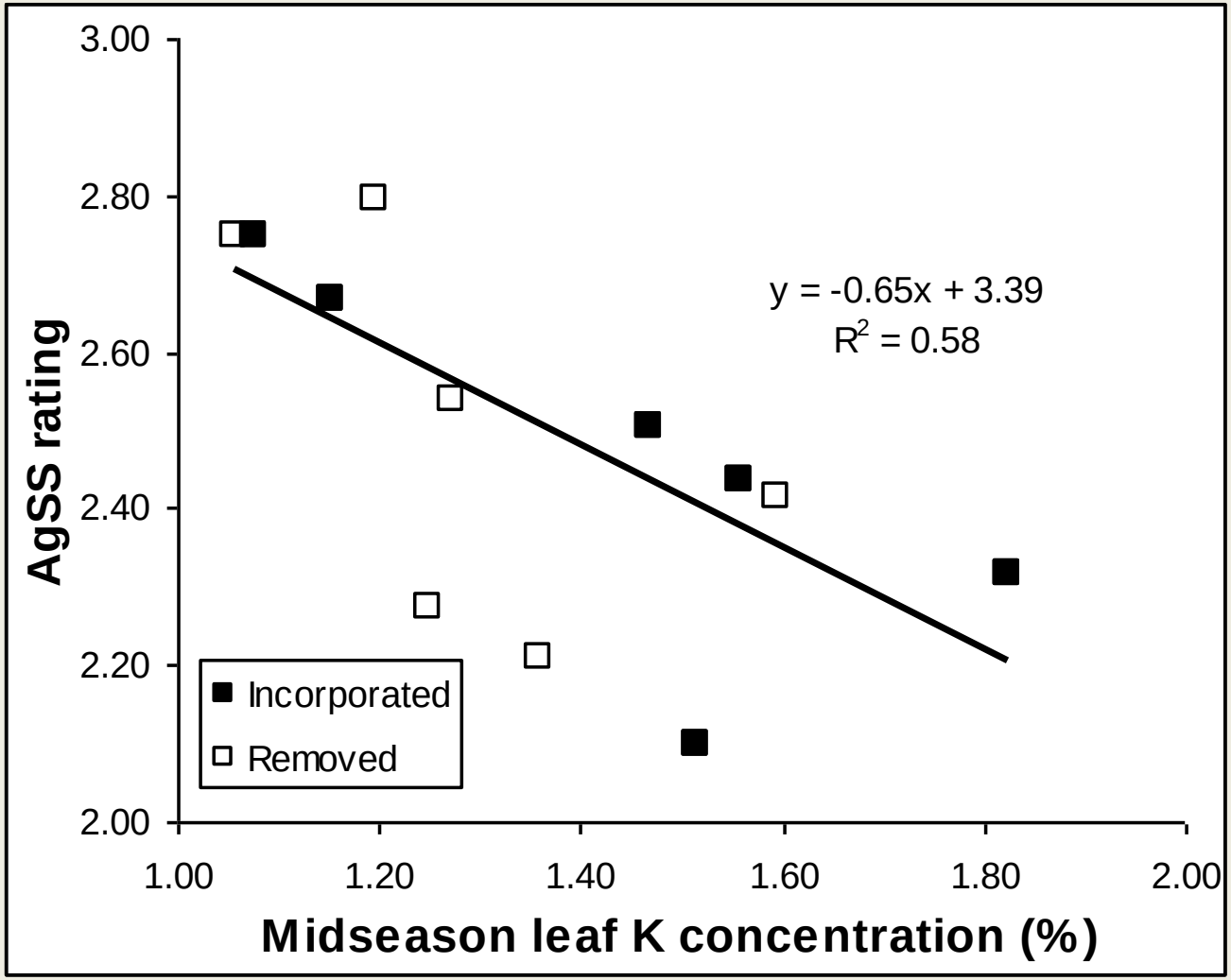


Price increase since 2000 (%)	
N solutions	213
Urea	196
Phosphate (P)	201
Potassium (K)	261

Potassium deficiency symptoms

- Older leaf tips are yellowish brown
- Younger leaves can be short and droopy
- Rusty brown spots appear on tips of older leaves and then spreads to entire leaf.
- Symptoms tend to appear during later growth stages.

Aggregate Sheath Spot (AgSS) and plant K status



Linquist et al., (2008)

How much K does a plant take up?

- K concentration at harvest
  - Grain: 0.27%
  - Straw: 1.39%
- Plant uptake (assume a yield of 85 sacks)
  - Grain: 23 lb K/ac (28 lb K2O/ac)
  - Straw: 118 (142)
  - **Total: 141 (169)**

Inputs and Losses of K in rice systems

- Inputs
  - Fertilizer
  - Irrigation water
- Losses
  - Grain harvest
  - Straw removal (28/33 lb K/K2O per ton of straw)
  - Surface water runoff

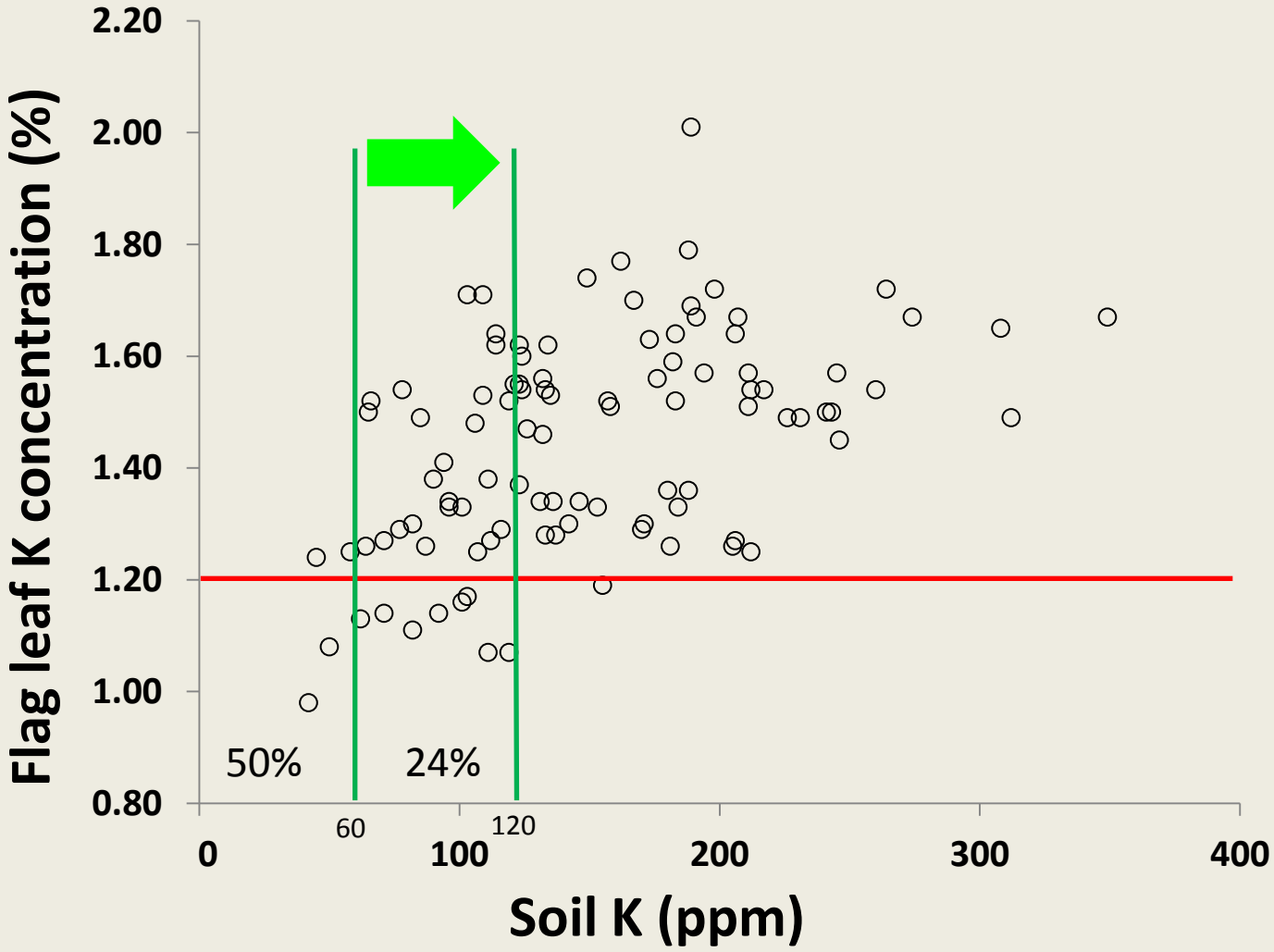
2012/13 Field study

- Objective: Determine status of K in CA rice soils
- Study
  - 55 rice fields
  - Analyzed 3 checks in each (top, middle, bottom)
    - Soil K analysis
    - Leaf tissue K at heading
  - Inlet water analysis (two times)
  - Grower field history
    - Yields, K inputs, winter straw mgmt.
    - Develop a soil K budget

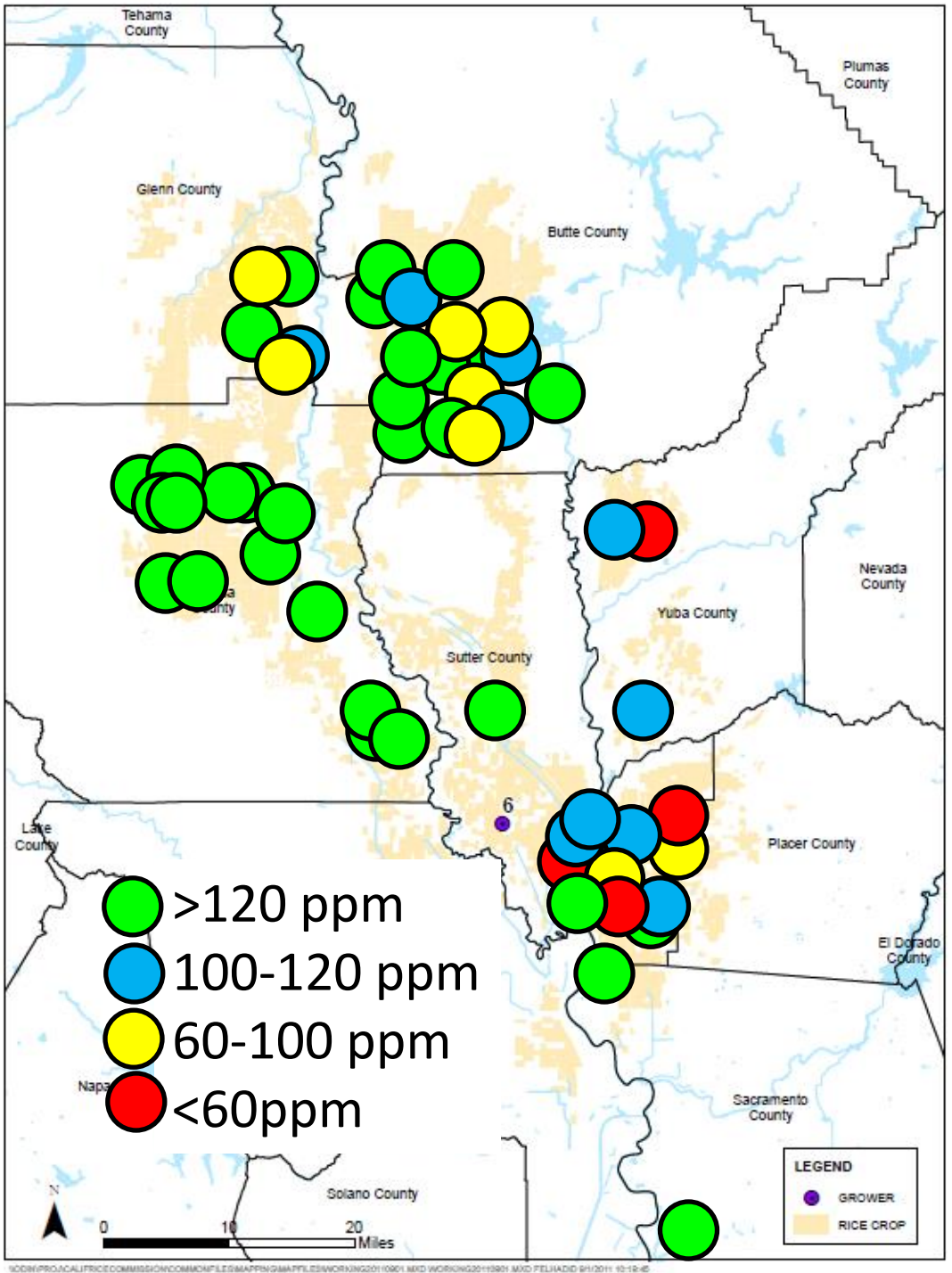
Summary information

- 36% of growers in study applied K fertilizer
  - Low number reflects selection criteria
  - Average application rate was 33 lb/ac
- Soil K: 35 to 350 ppm (60 ppm - critical)
- Flag leaf K: 0.98 to 2.01% (1.2% - critical)
- Water K: 0.28 to 4.65%

Flag leaf K vs. soil K
(fields w/o K fertilizer application)

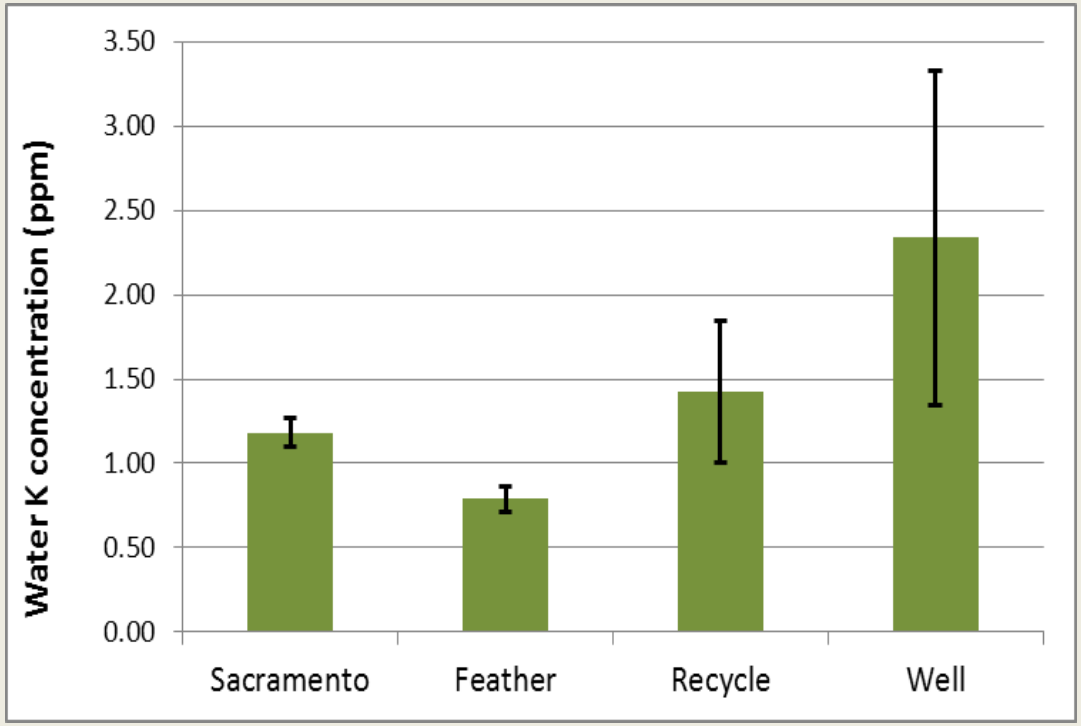


Soil K by location

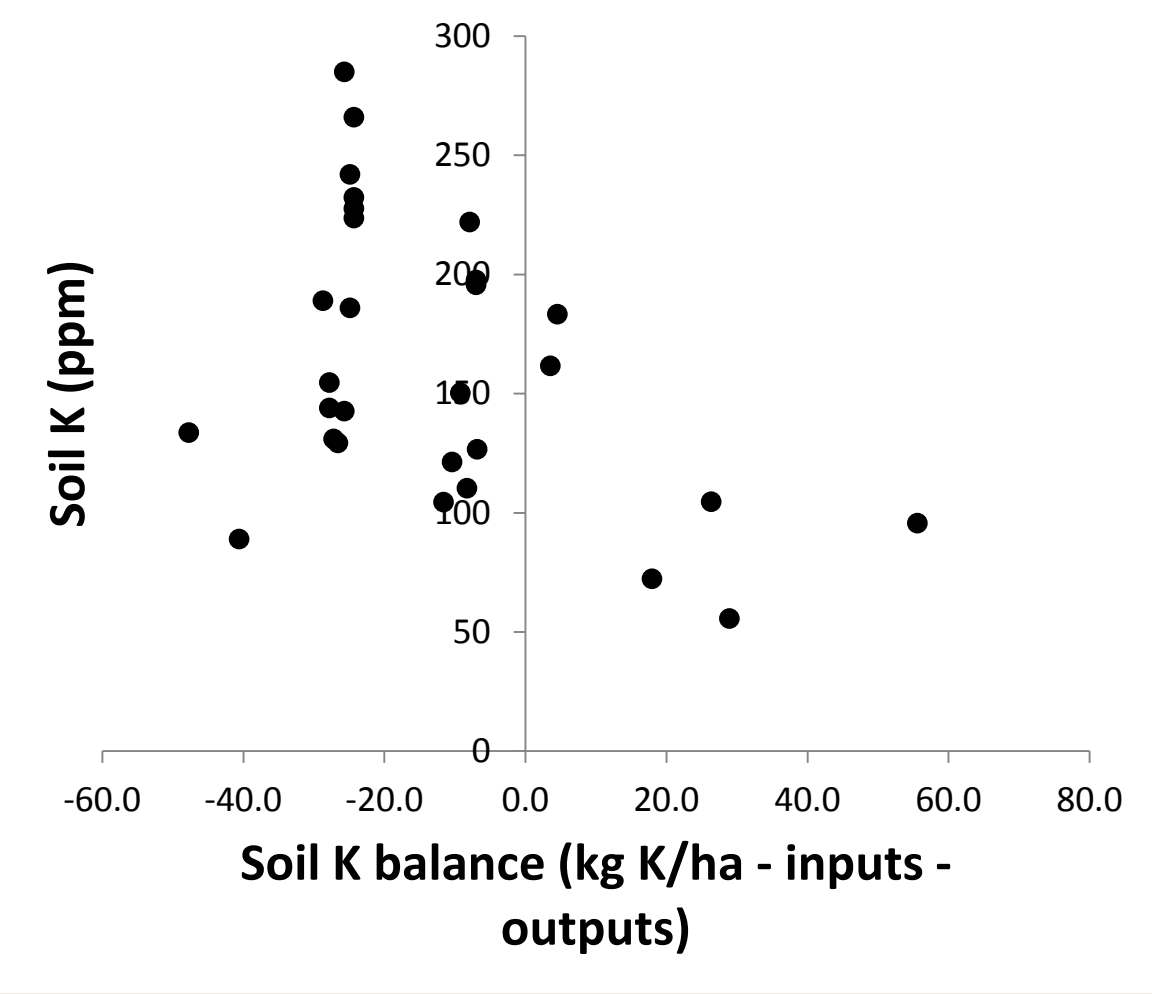


Water K inputs

- Water sources vary in K input
- Assuming only ET water (40”)
  - Sac R = 13 lb K_2O/ac
  - Feather R and Sierra rivers = 8 lb K_2O/ac
  - Others are variable

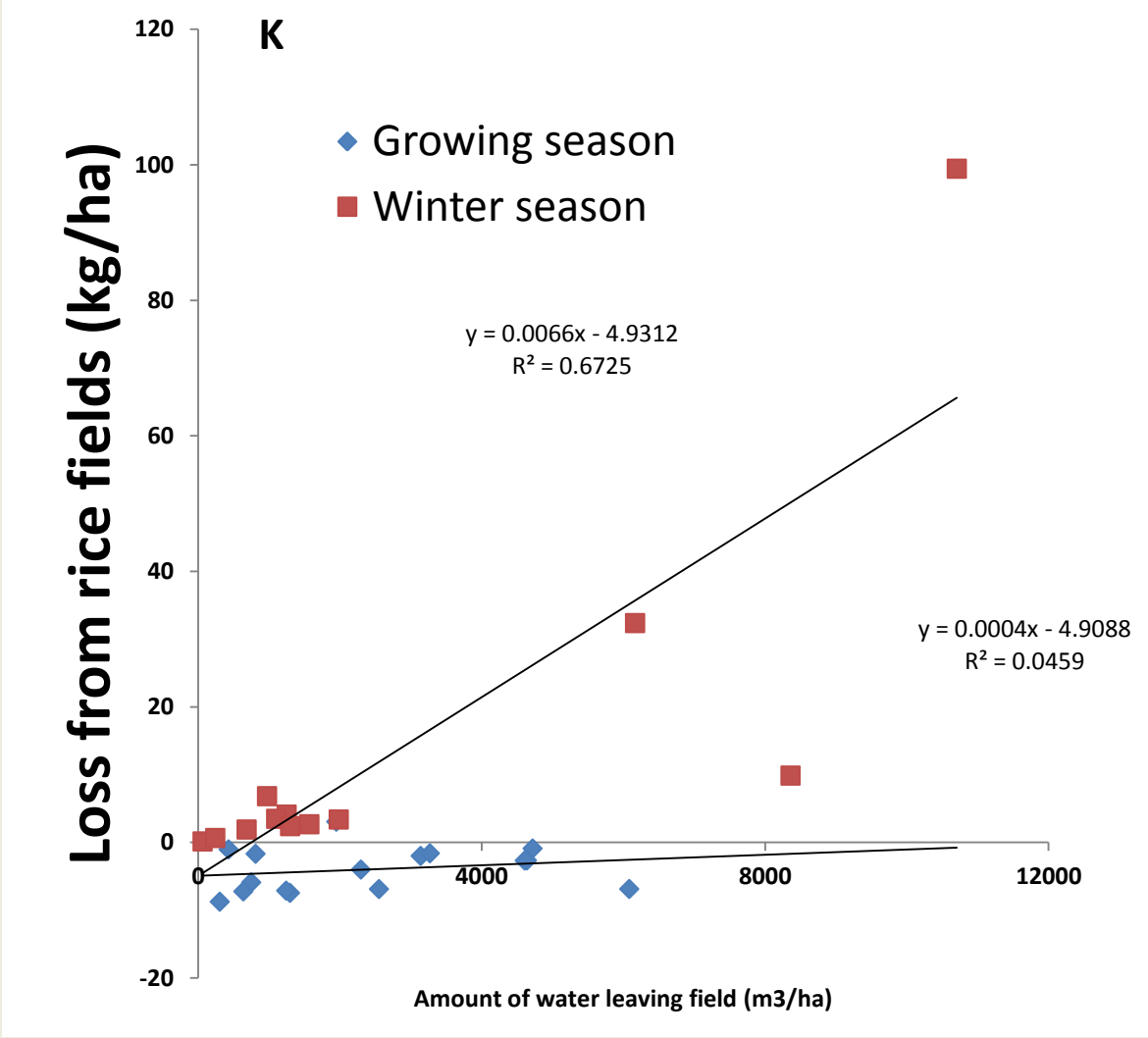


Soil K vs. water and K balance



- No relationship between K balance and soil K.
- Suggests that K is not built up in the system

Growing vs. winter season: K retention in rice fields



Summary

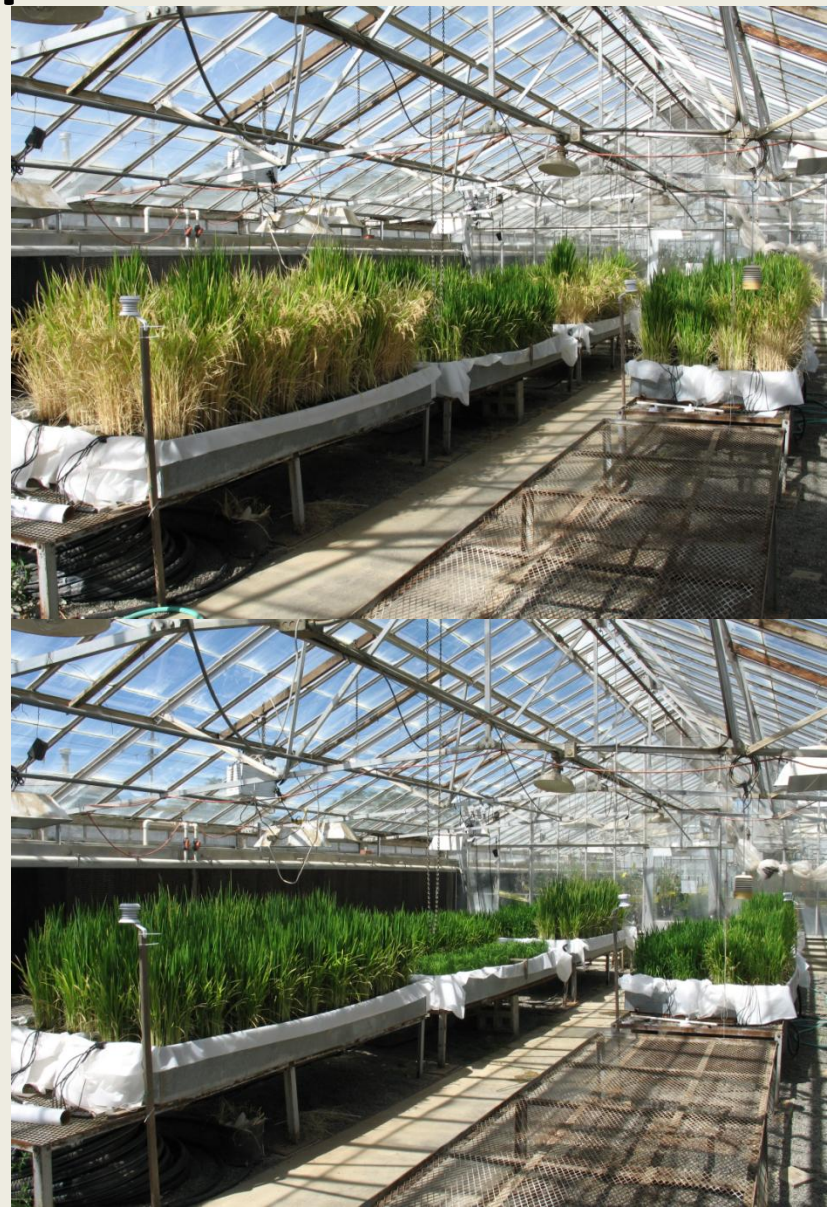
- East side of valley has greater the potential for K deficiency
  - Related to soil type and irrigation source.
- No observed effect of previous fertilizer history on soil K
  - Possibly due to effects of winter flood mgmt.
  - Should not attempt to “build-up” soil K
- Applications should be made based on soil test
- Straw removal has a large effect on K fertility management decisions

Deciding on need for K fertilizer

- Considerations to maintain soil K
  - Considerations
    - Soil K
      - Critical value is 60 ppm
      - Most CA soils above this value
      - Consider applying at least maintenance levels if soil K is below 120 ppm
  - Crop K removal (assuming 85 sacks)
    - Grain: 28 lb K_2O/ac
    - Straw 70 lb K_2O/ac
  - Water source
  - Winter water management
  - Scenarios
    - Scenario 1
      - No straw removal, no winter flood (or burn or no winter tail water
      - 15 -20 lb K_2O/ac
    - Scenario 2
      - No straw removal, but winter flood with tail water at low flow rates
      - 20 to 30 lb K_2O/ac
    - Scenario 3
      - Remove ½ of straw
      - 100 lb K_2O/ac

Crop development

- Develop tools to accurately predict critical developmental times for major varieties.



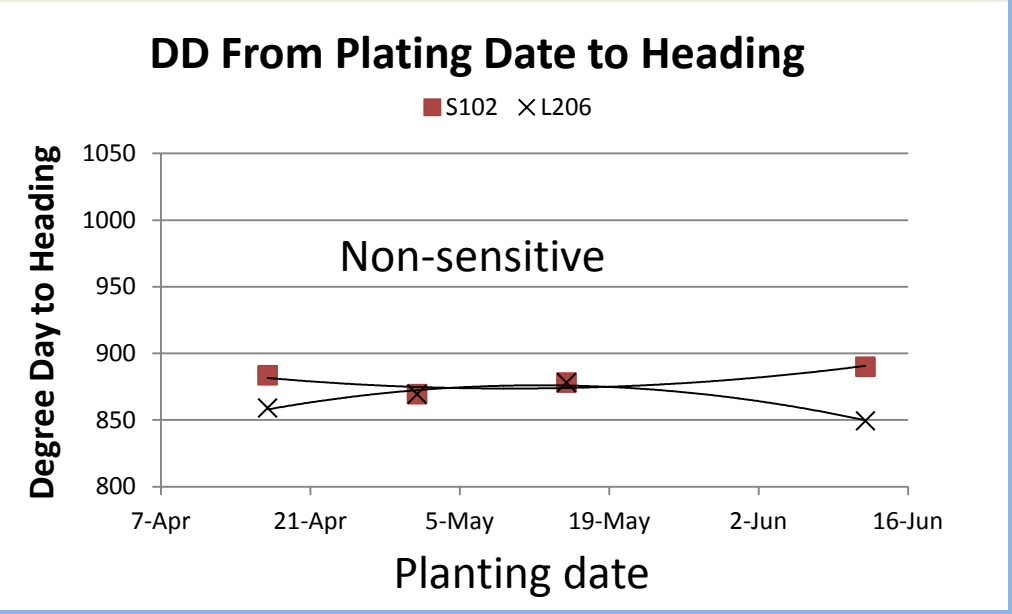
Methods

- Statewide variety trails and greenhouse
- Greenhouse
  - Planting every 2 weeks from April 1 to June15
- Varieties
  - M104, M105, S102, CM101, M202, M205, M206, L206, M401

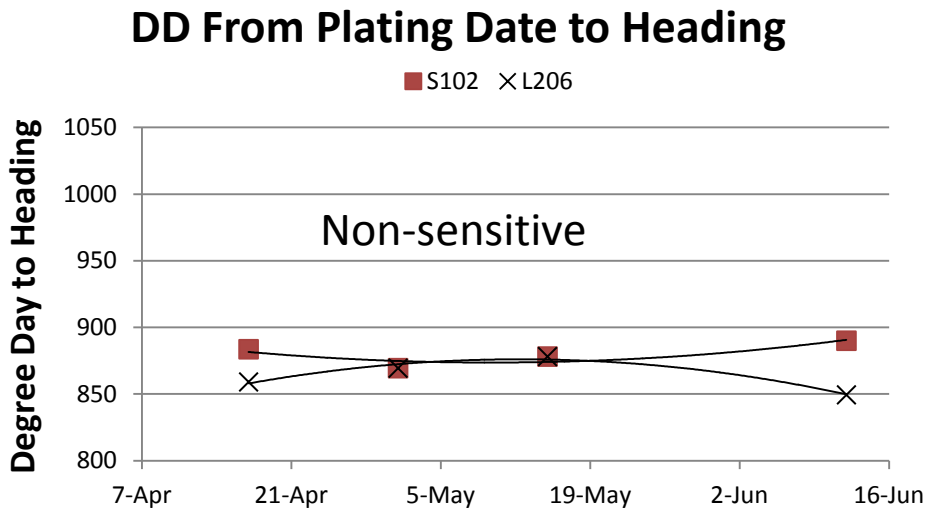
Results summary
(average across planting times and varieties)

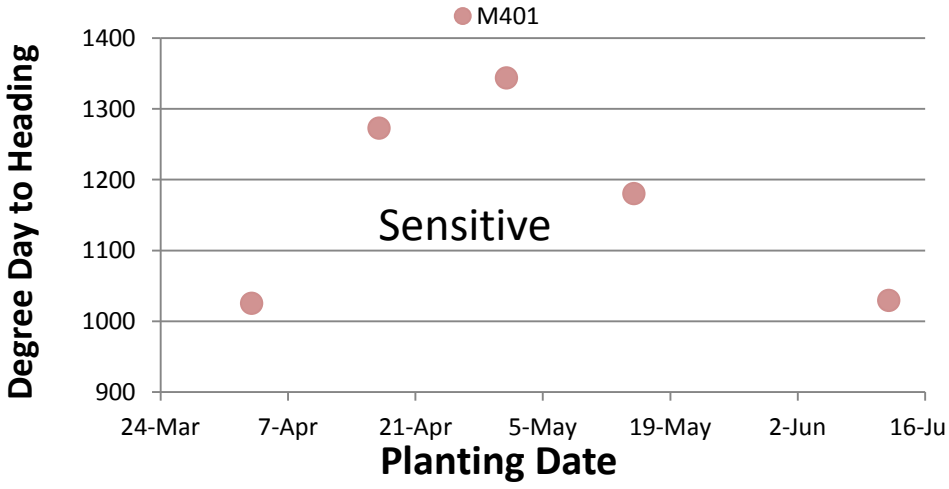
- Field studies
  - Degree days (10 DD ≈ 1 day):
    - Planting to Heading: 815-1350 DD
    - Planting to PI: 500-600 DD
    - PI to Heading: 275-730 DD

Degree days from planting to heading

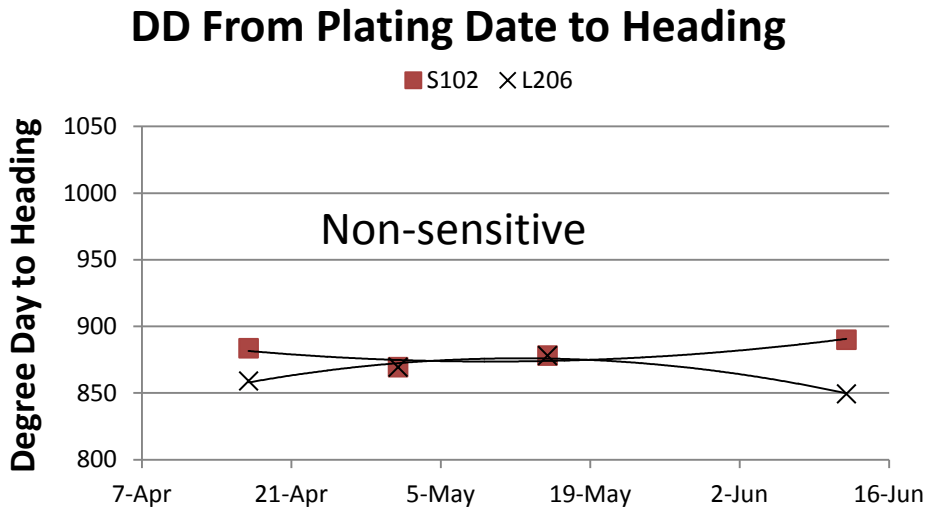


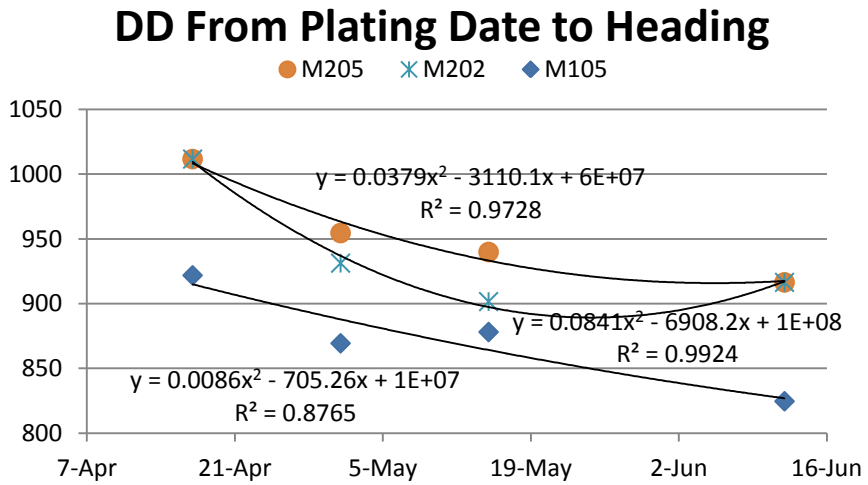
Degree days from planting to heading



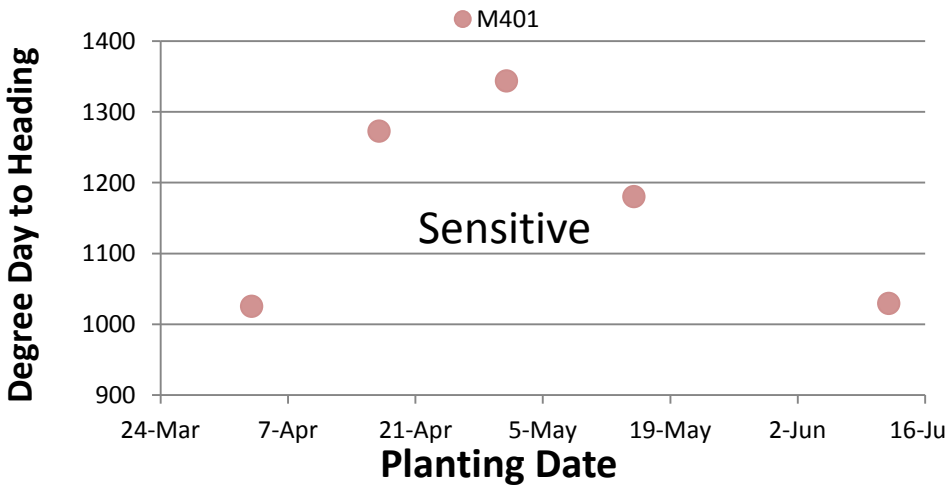


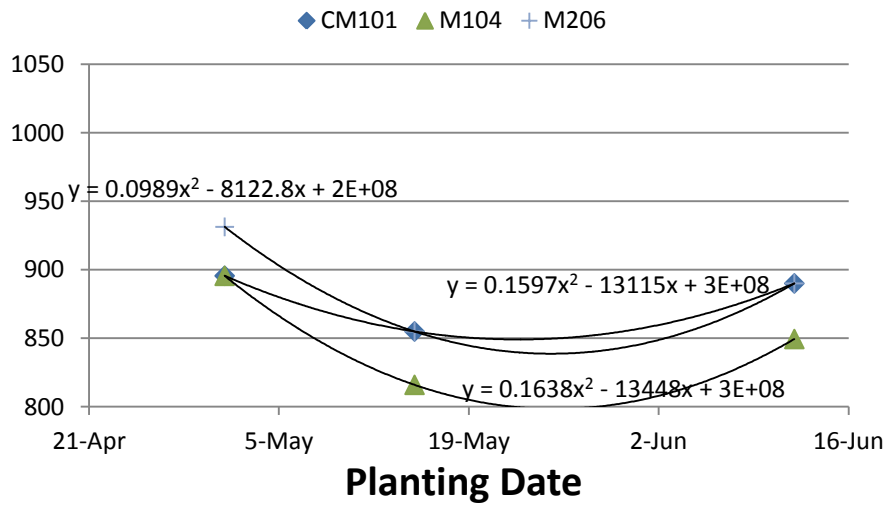
Degree days from planting to heading



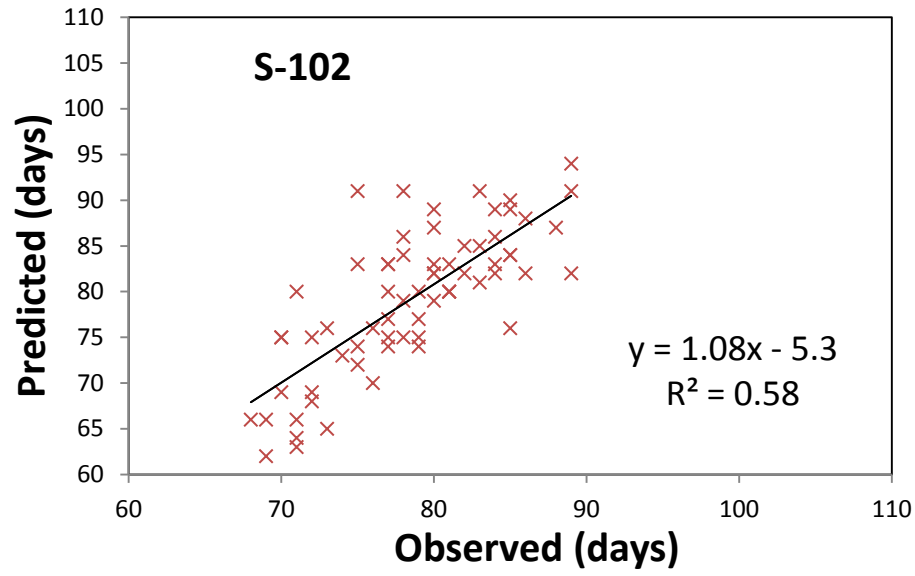


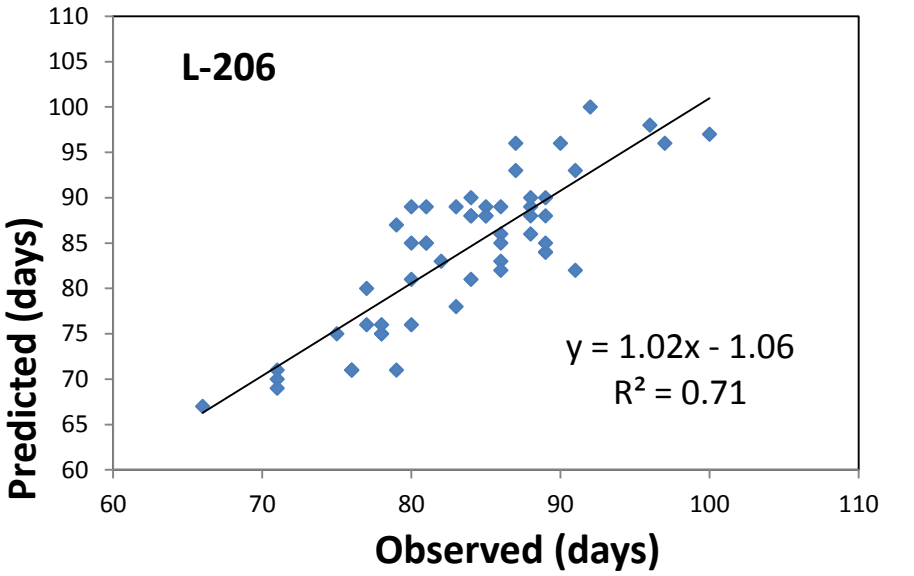
Moderately sensitive

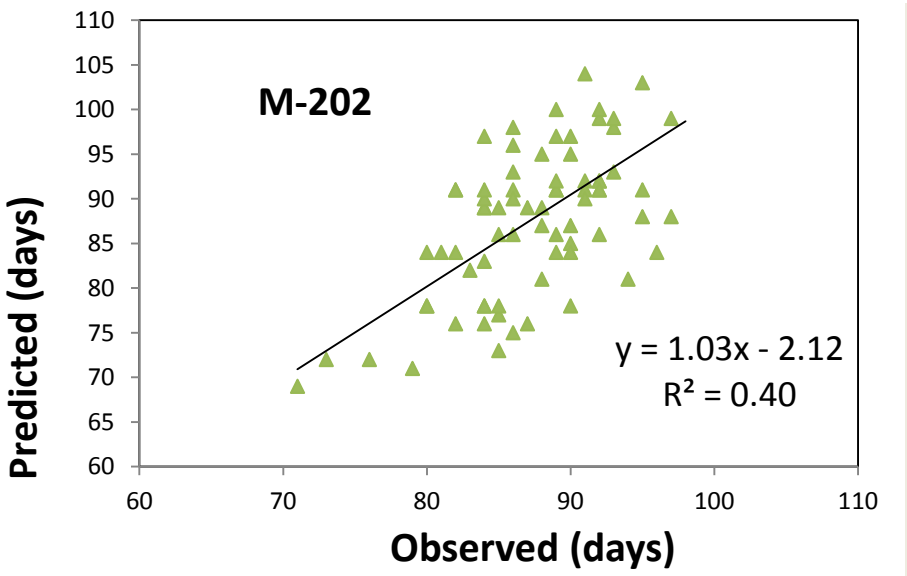




Thermal model (degree day) results showing predicted time to heading.

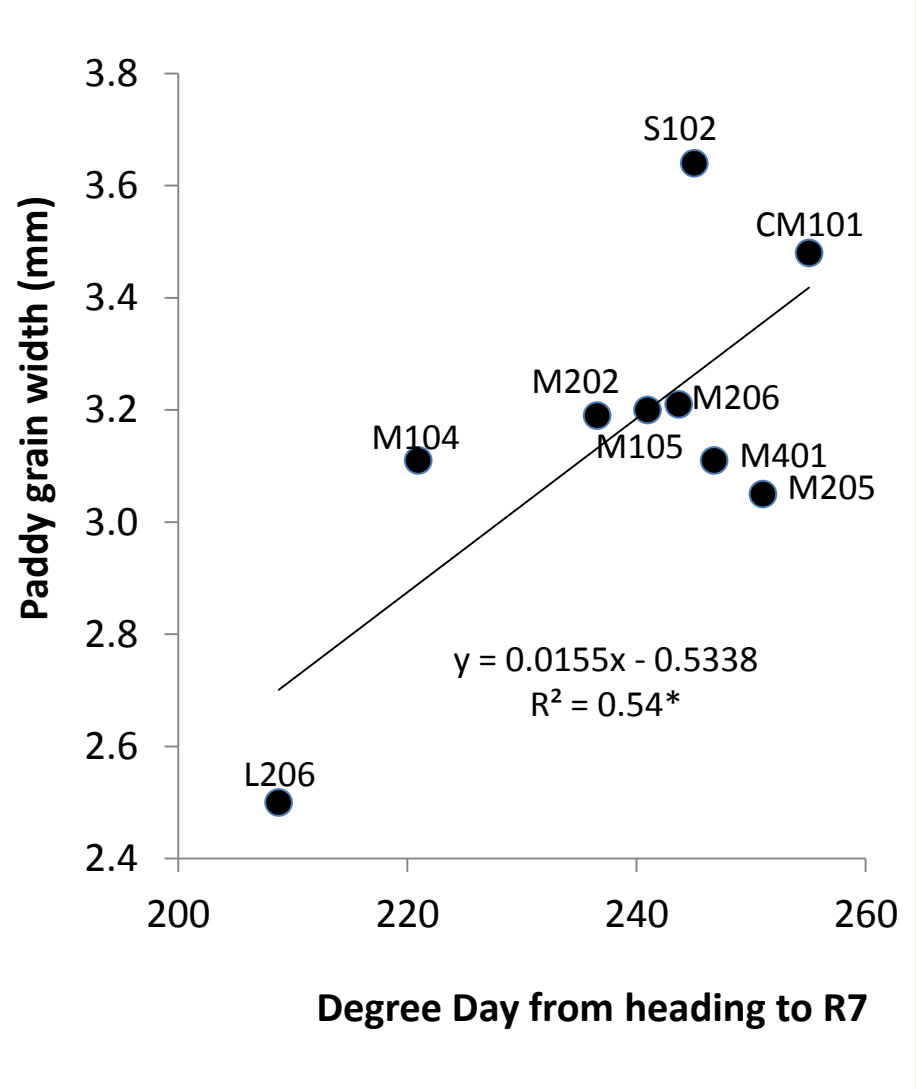






Effect of grain width on time from heading to maturity (ave across planting dates)

- Crop duration needs to consider time to maturity not just heading.

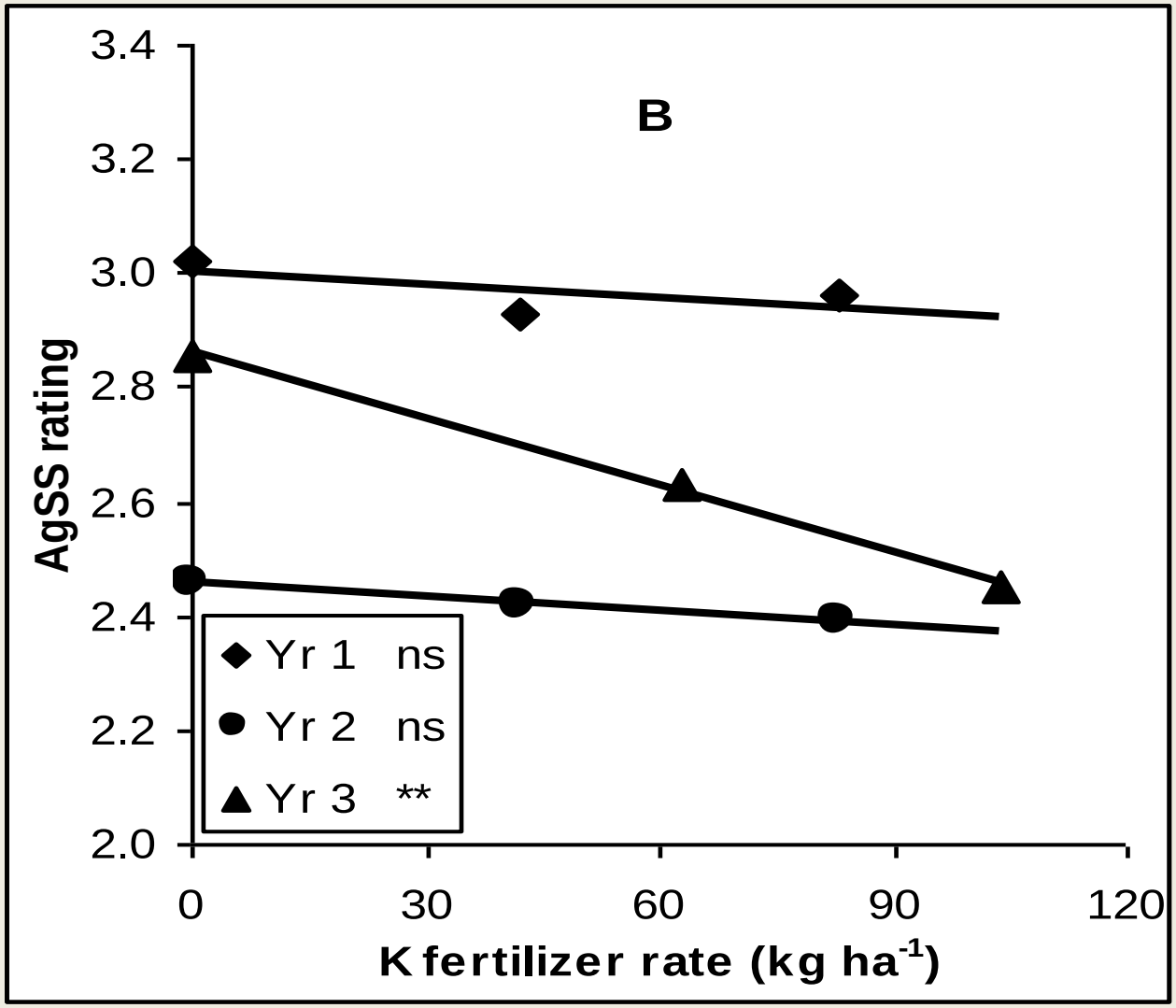


Thank you

K deficiency

- Inadequate K results in:
  - An accumulation of sugars and amino acids that are suitable food sources for leaf diseases
- Adequate K improves a plants ability to tolerate adverse climatic conditions, lodging, insects, and diseases.
- Deficiency symptoms first occur in older leaves because K is a mobile nutrient.

Aggregate Sheath Spot (AgSS) and K management



Linquist et al., (2008)

Why does rice need K?

- Plant regulation
  - Osmoregulation
  - Enzyme activation
  - Regulation of cell pH
  - Cellular cation-anion balance
  - Regulation of transpiration
  - Regulation of assimilate transport
- Whole plant level
  - K increases leaf area and chlorophyll content
  - Delays senescence
  - Increases #spikelet/panicle, % filled grains, and grain weight
    - Does not affect tillering