Management of potassium in California rice systems

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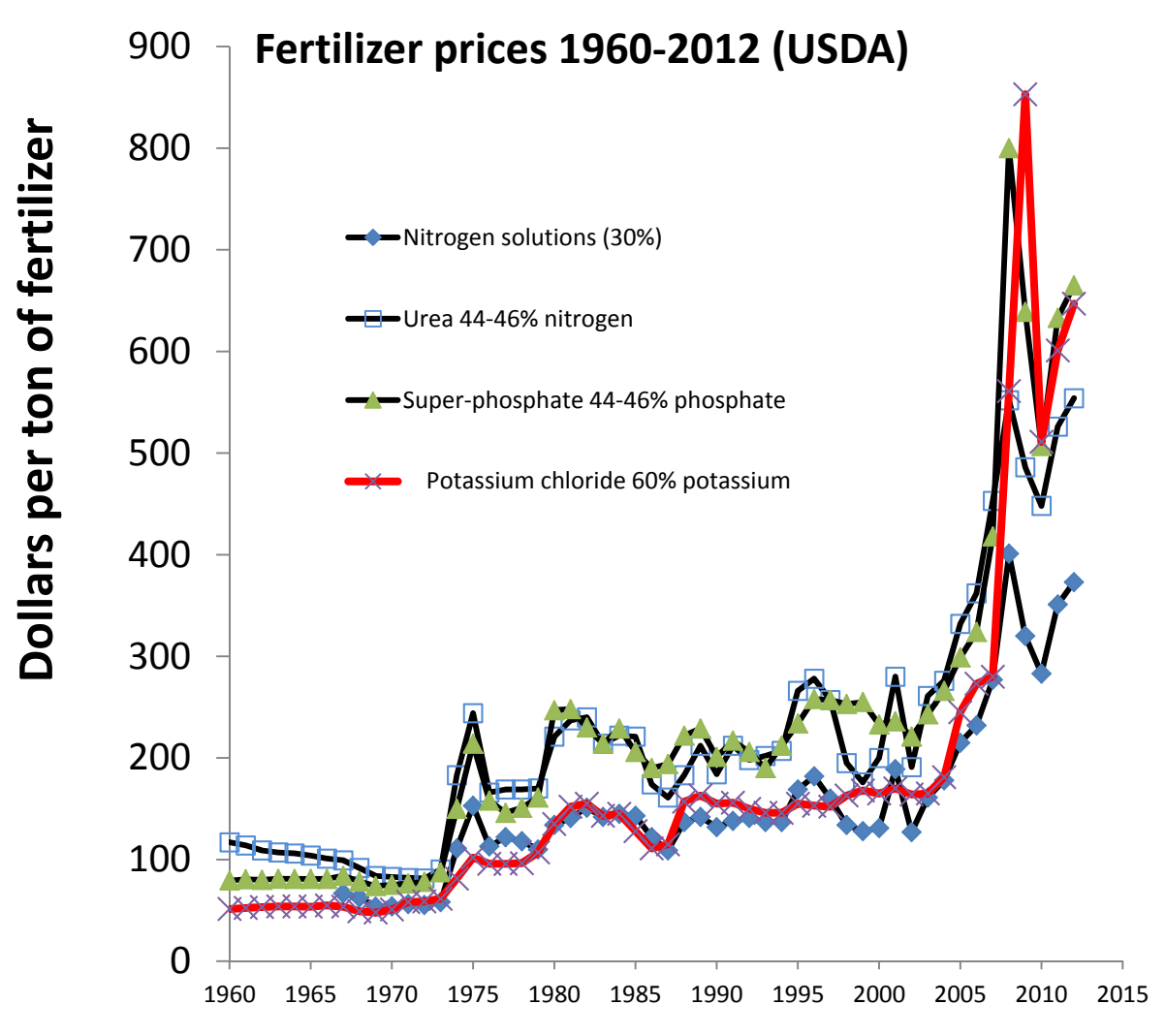
Winter grower meetings

Jan 28 and Feb 5, 2013

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	185
Urea	177
Phosphate (P)	185
Potassium (K)	292

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

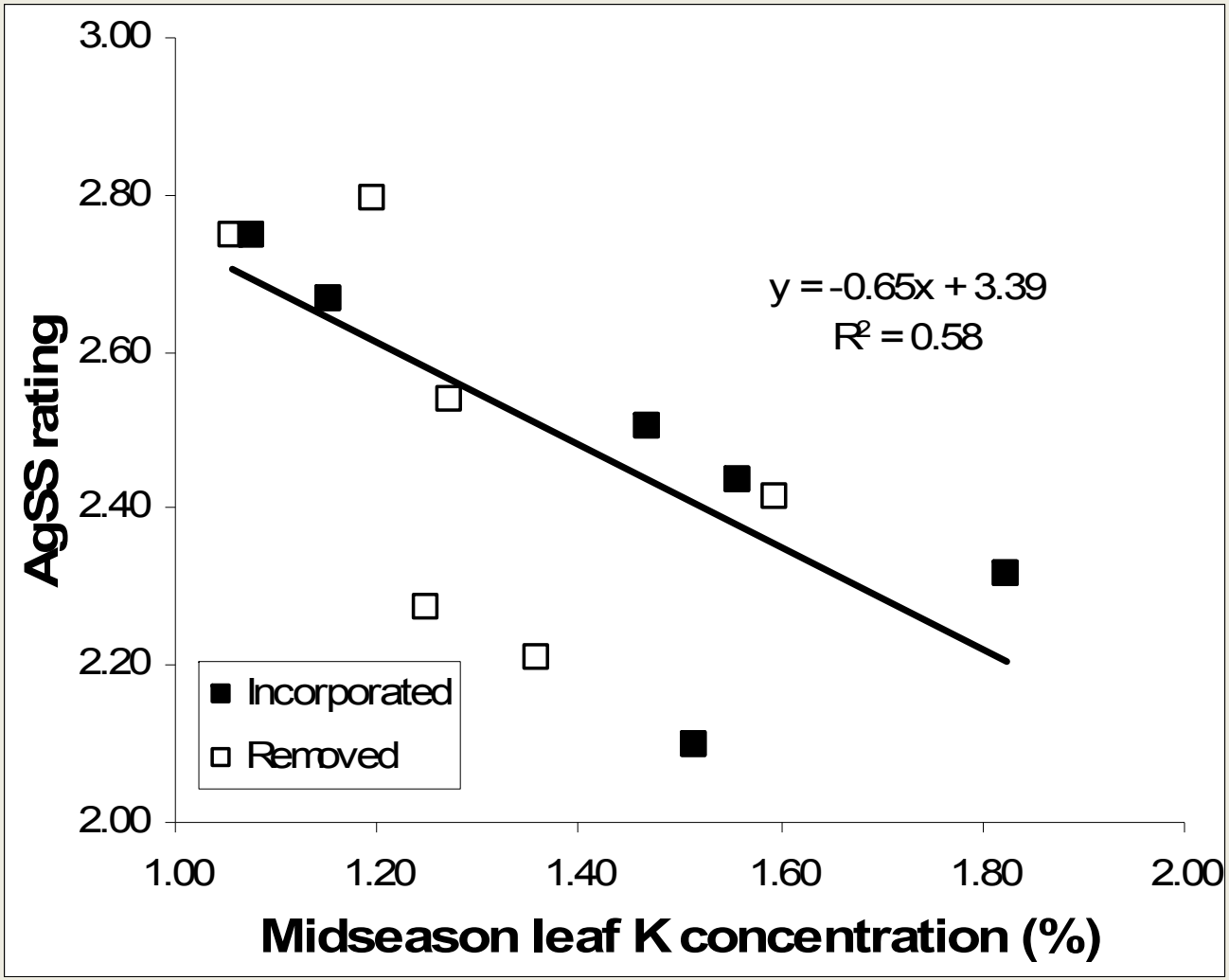
K deficiency

- 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.

Potassium deficiency symptoms

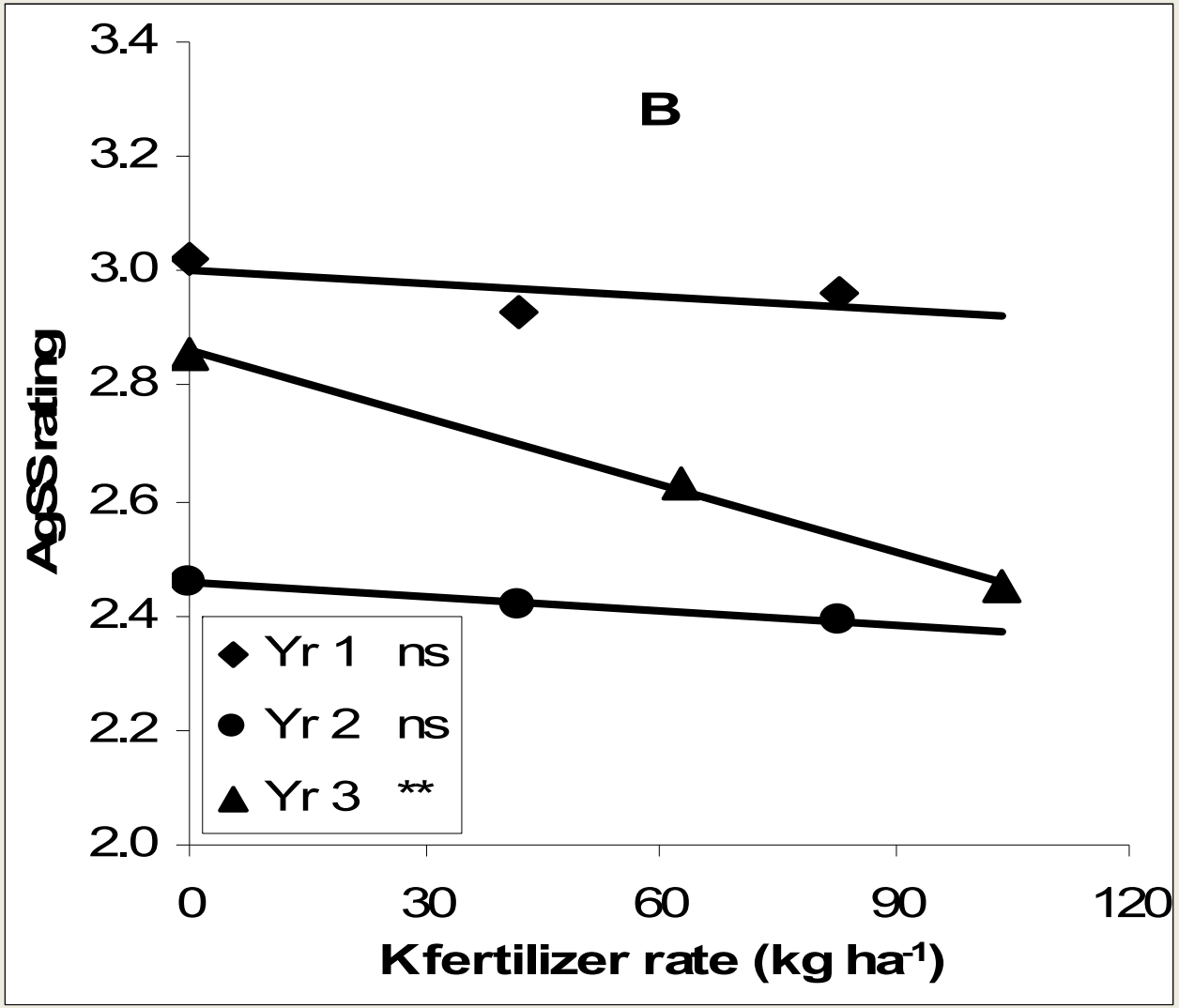
- Older leaf tips are yellowish brown
- Younger leaves can be short and droopy
- Rusty brown spots appear on tips of older leaves and then spreads to entire leaf.
- Symptoms tend to appear during later growth stages.

Aggregate Sheath Spot (AgSS) and plant K status



Linquist et al., (2008)

Aggregate Sheath Spot (AgSS) and K management



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 K_2O/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

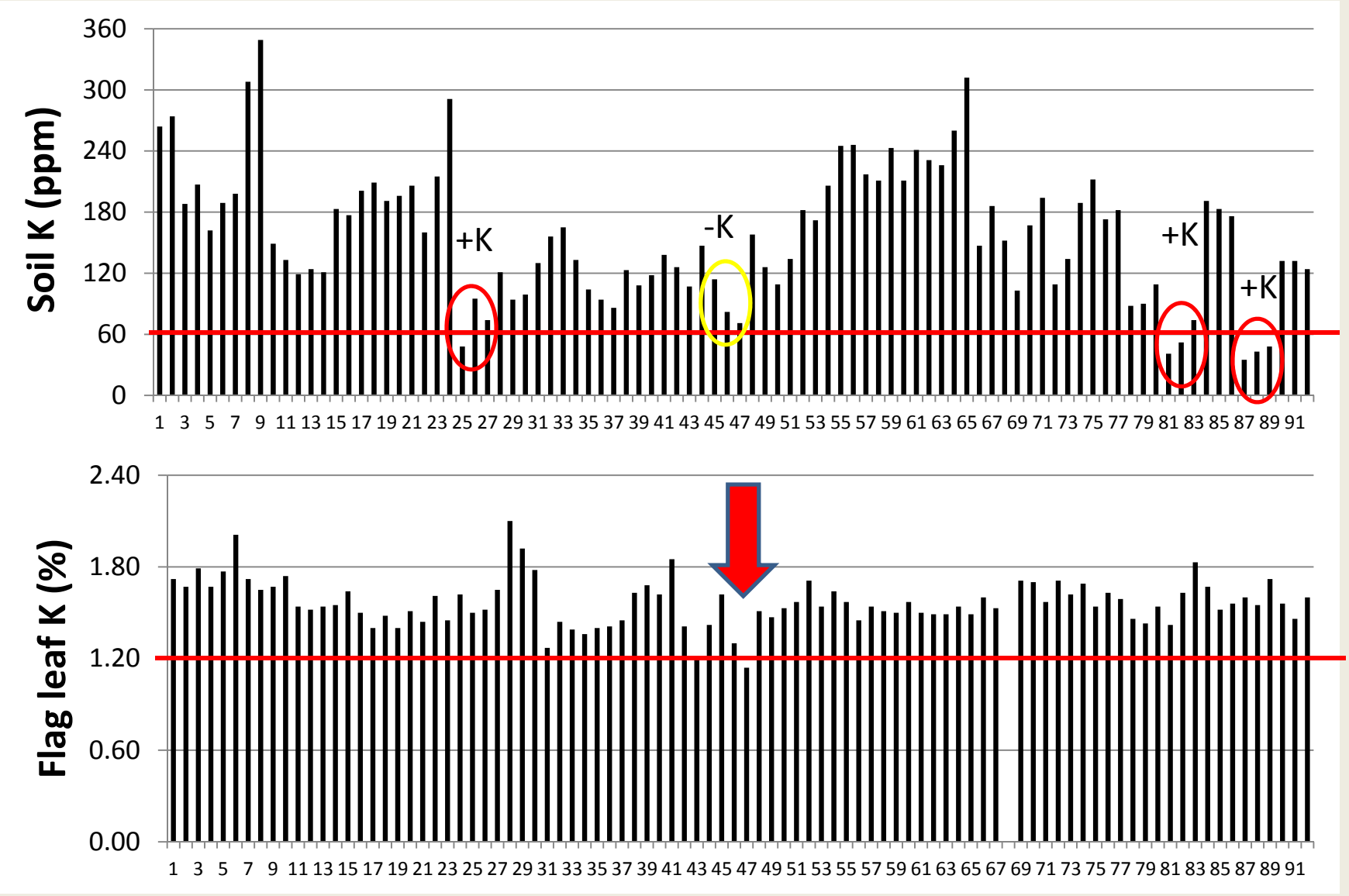
2012 Field study

- Objective: Determine status of K in CA rice soils
- Study
  - 31 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

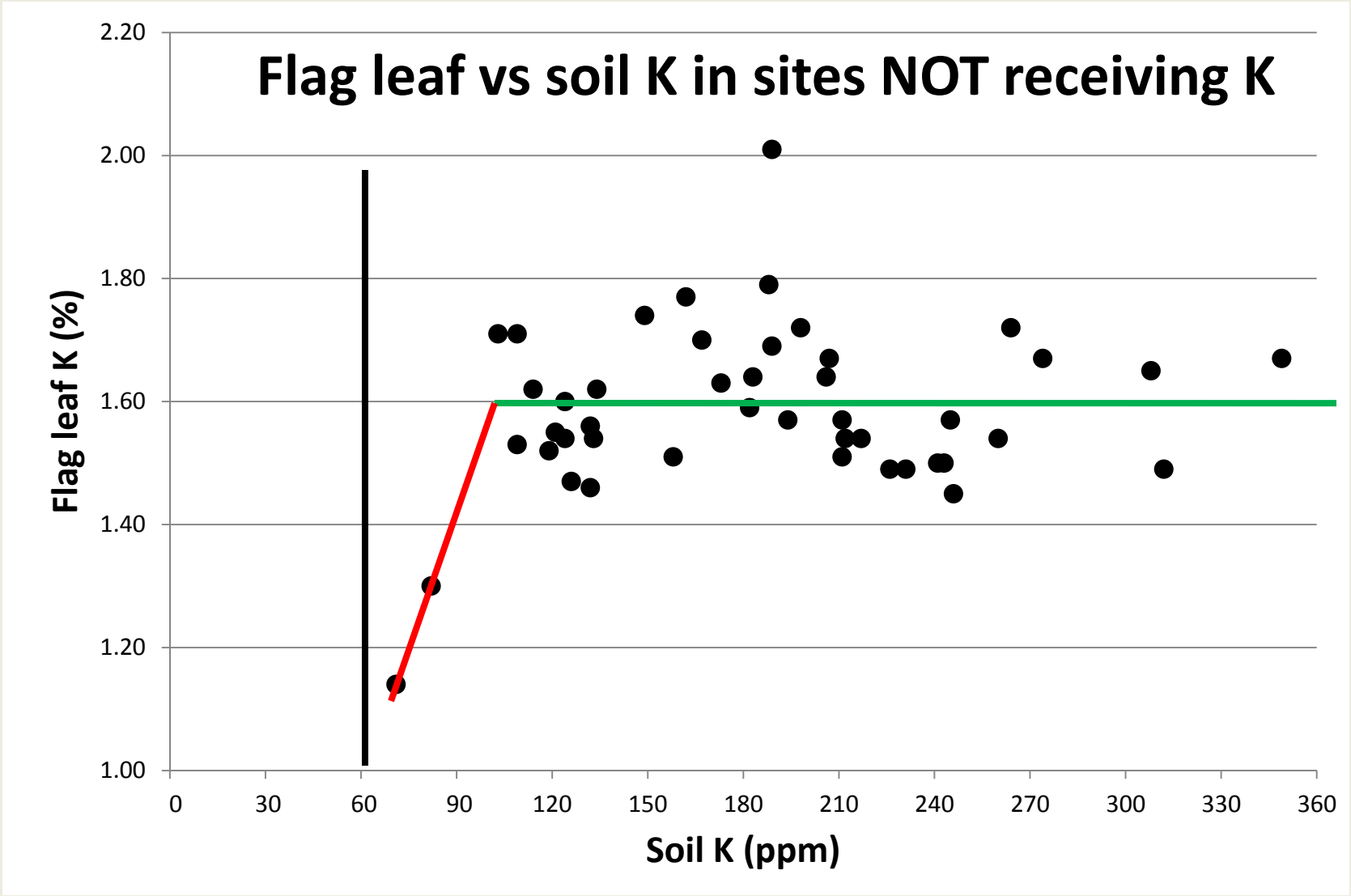
Summary information

- 14/31 fields had applied K fertilizer
  - Those that applied - 30 kg K_2O/ha (27 lb/ac)
- No fields had straw removed regularly
- Variability between checks - not consistent
- Soil K
  - <100 ppm K: 8 fields all on east side of valley
- No relationship between soil K and K fertilizer input/output
- 4 groups of fields (adequate=100 ppm)
  1. (14) Adequate soil K – No K addition
  2. **(9) Adequate soil K – K addition**
  3. **(1) Inadequate soil K – No K addition**
  4. (6) Inadequate soil K – K addition

Soil and flag-leaf K values



Flag leaf K vs. soil K



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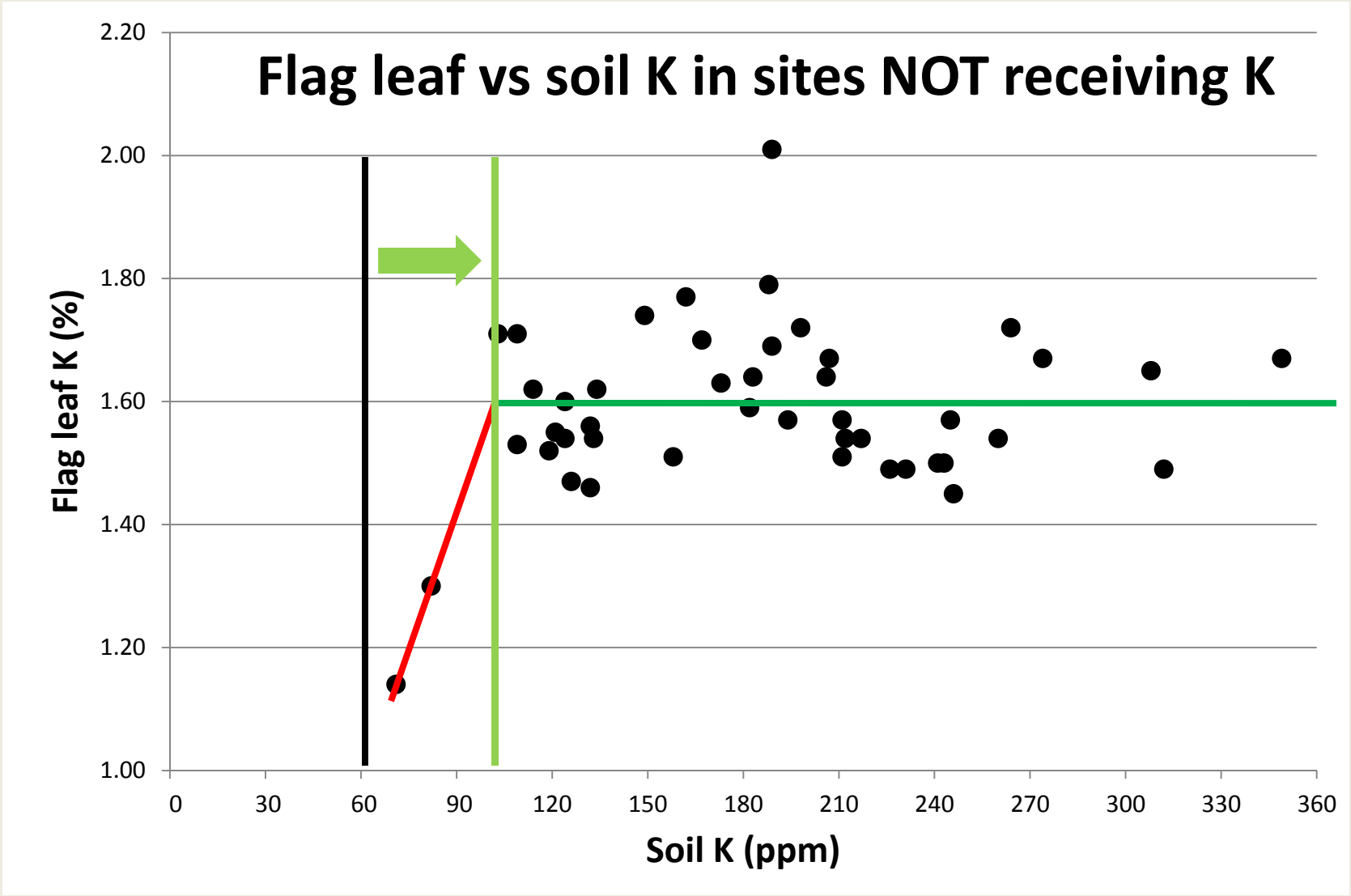
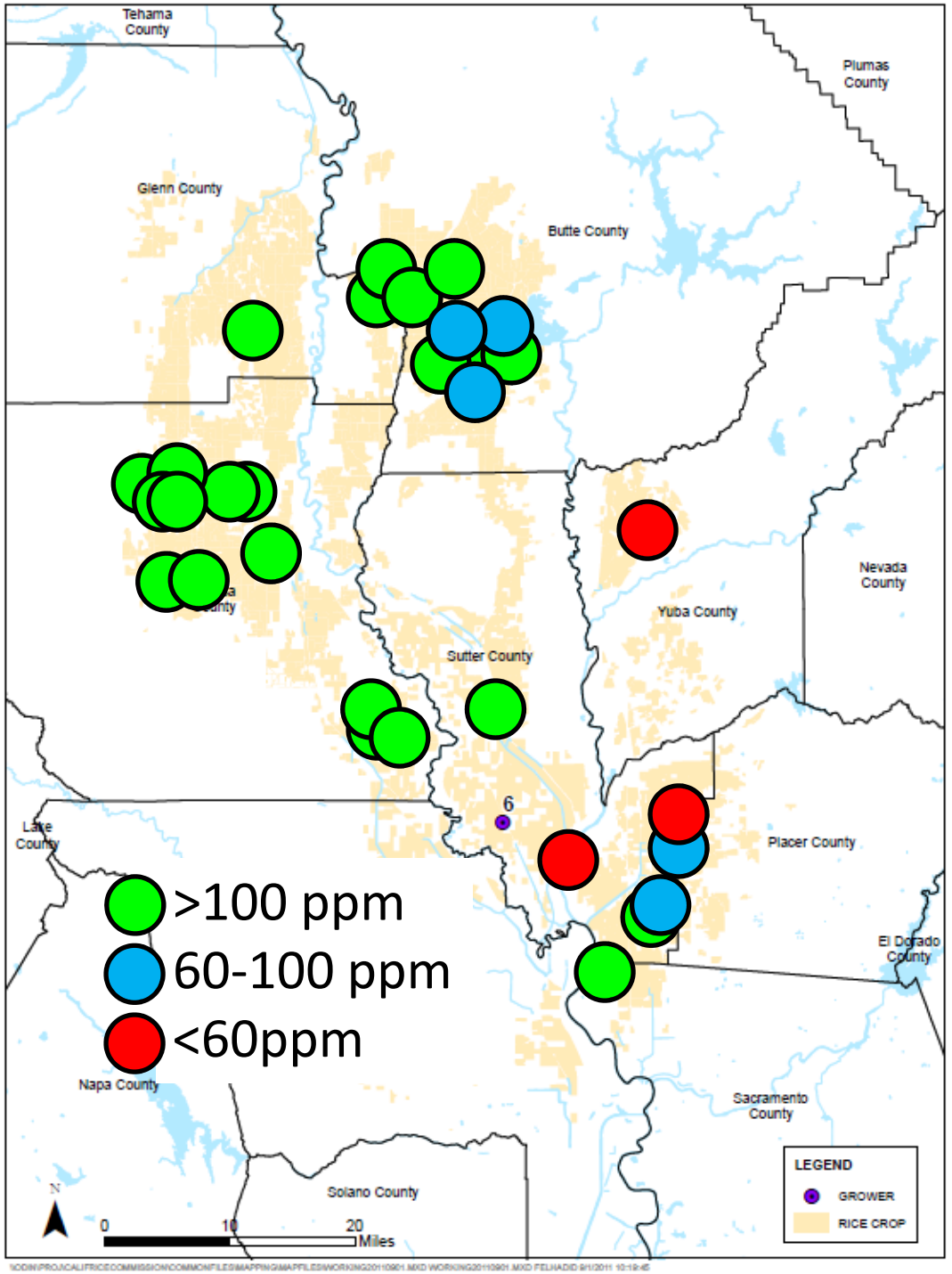
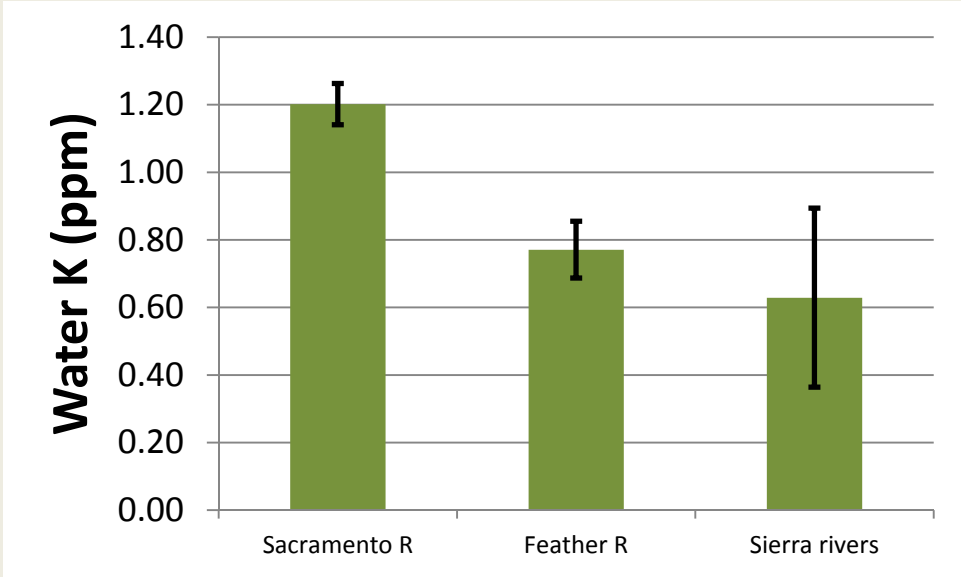


Soil K by location

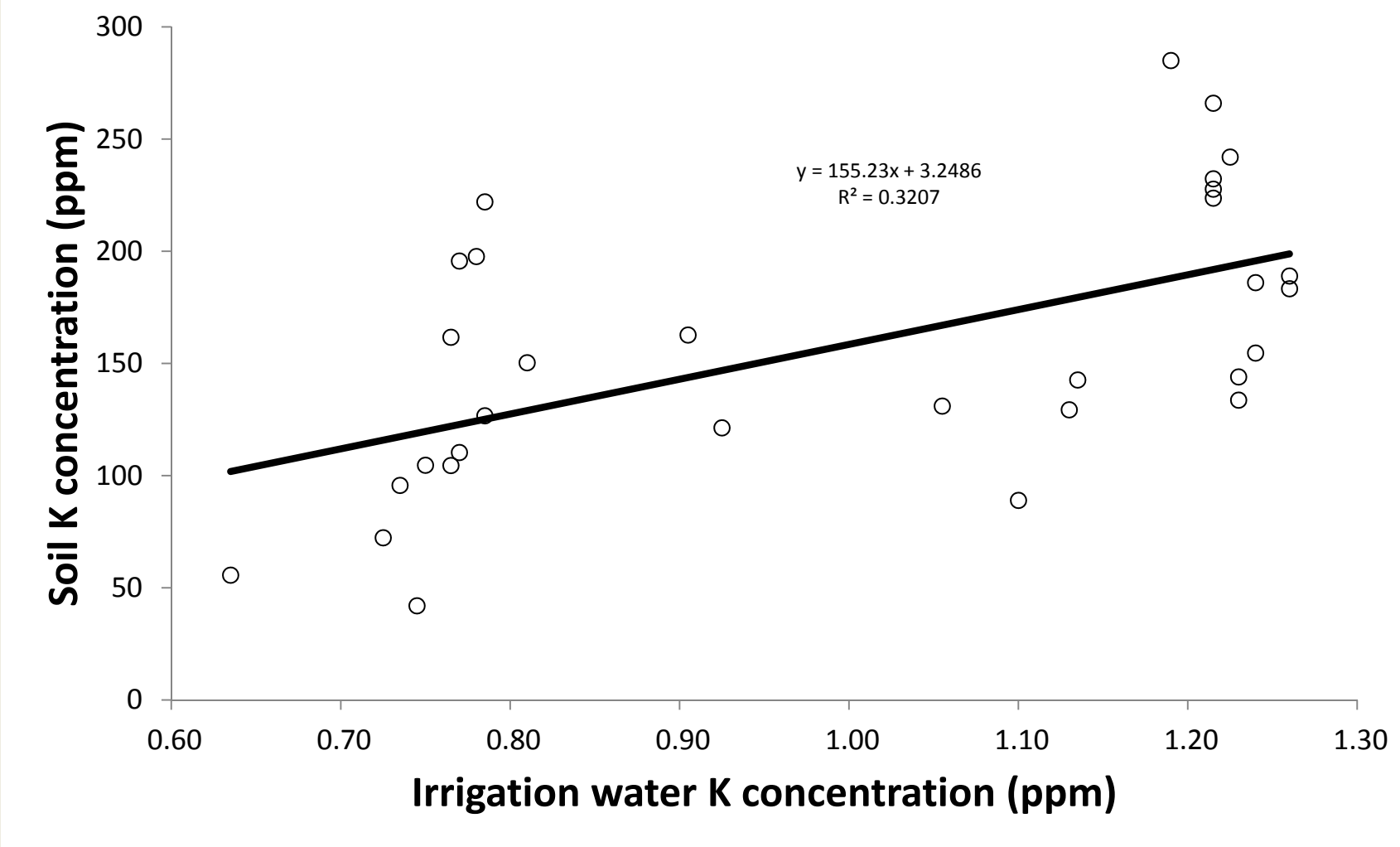


Water K inputs

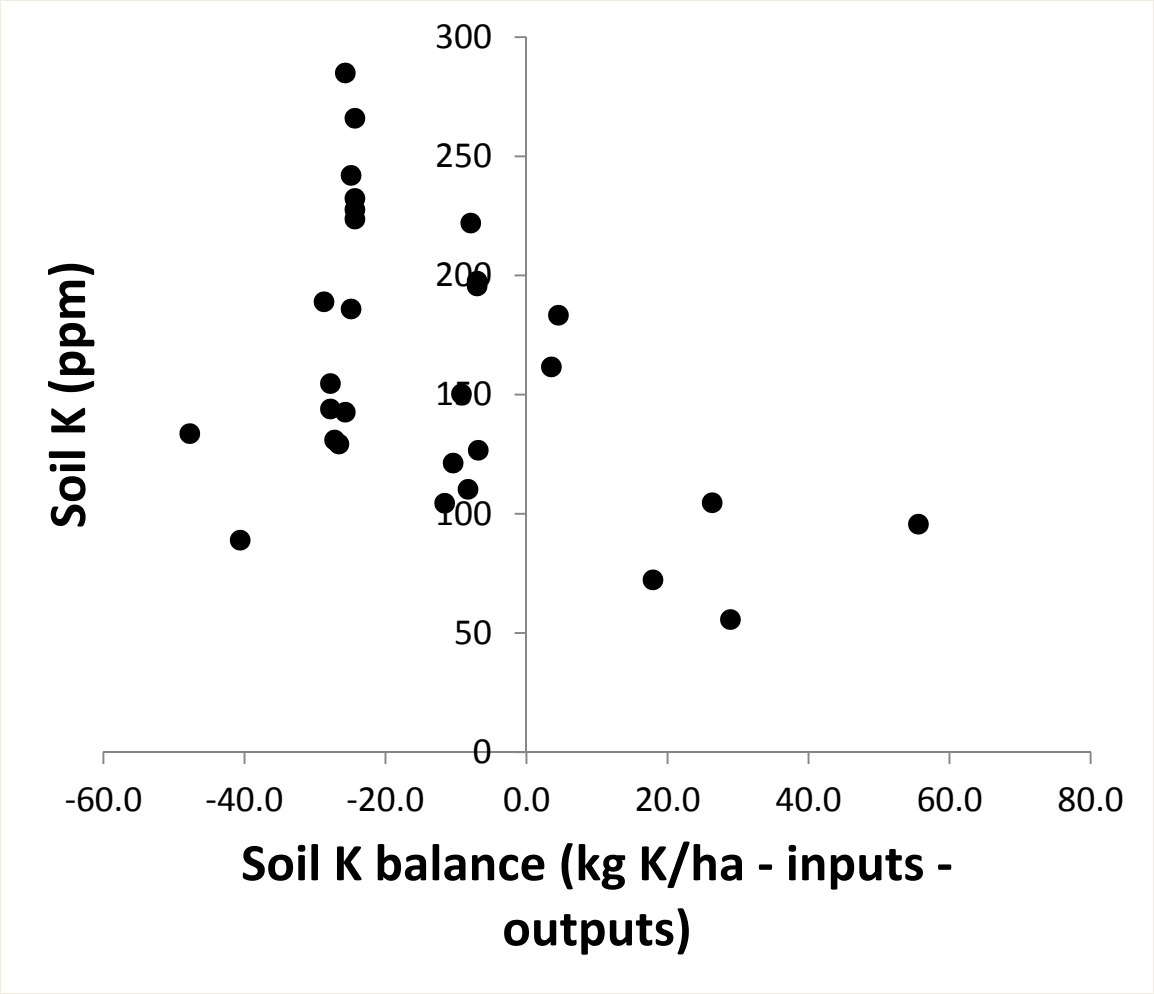
- Water sources vary in K input
- Assuming only ET water (40”)
  - Sac R = 13 lb K_2O/ac
  - Feather R and Sierra rivers = 8 lb K_2O/ac



Soil K vs. irrigation water

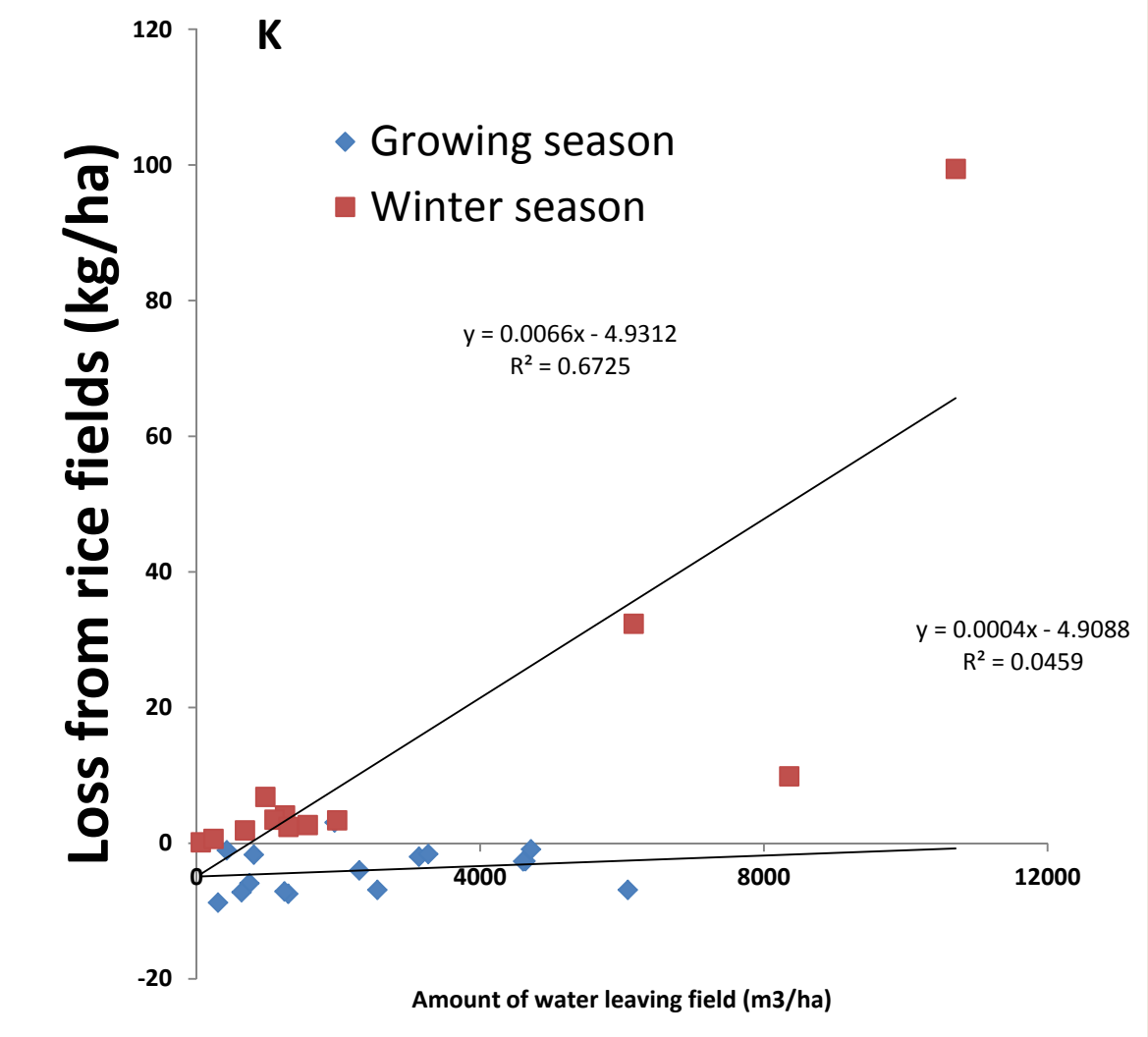


Soil K vs. water and K balance



- 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
  - Soil K
    - Critical value is 60 ppm
    - Most CA soils above this value
    - Consider applying at least maintenance levels if soil K is below 100 ppm
  - K maintenance
    - Only remove grain
      - Apply 25-30 lb K_2O/ac
    - Remove both grain and ½ straw
      - Apply 100 lb K_2O/ac

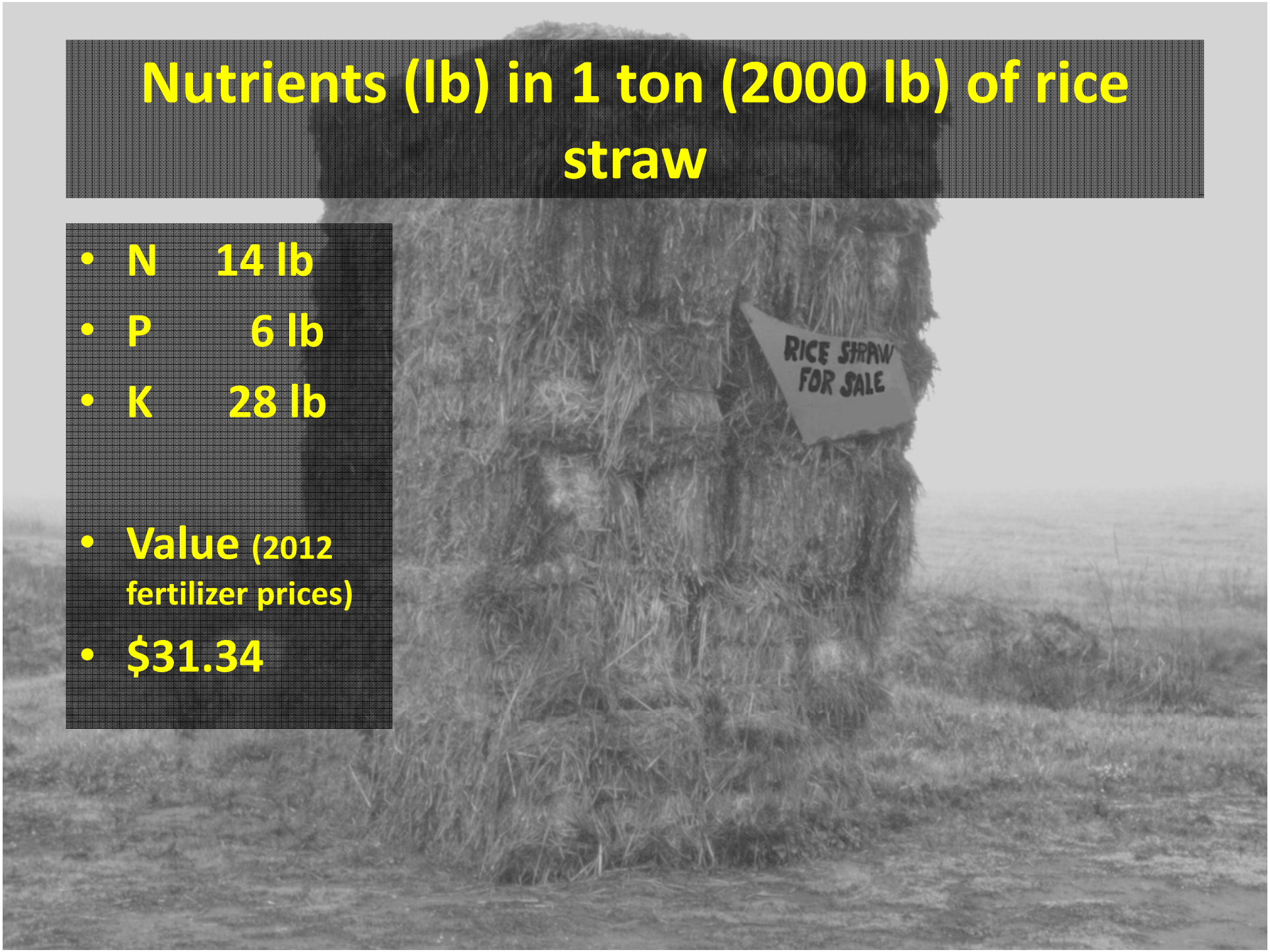
What is this material?


RICE STRAW
FOR SALE

Nutrients (lb) in 1 ton (2000 lb) of rice straw

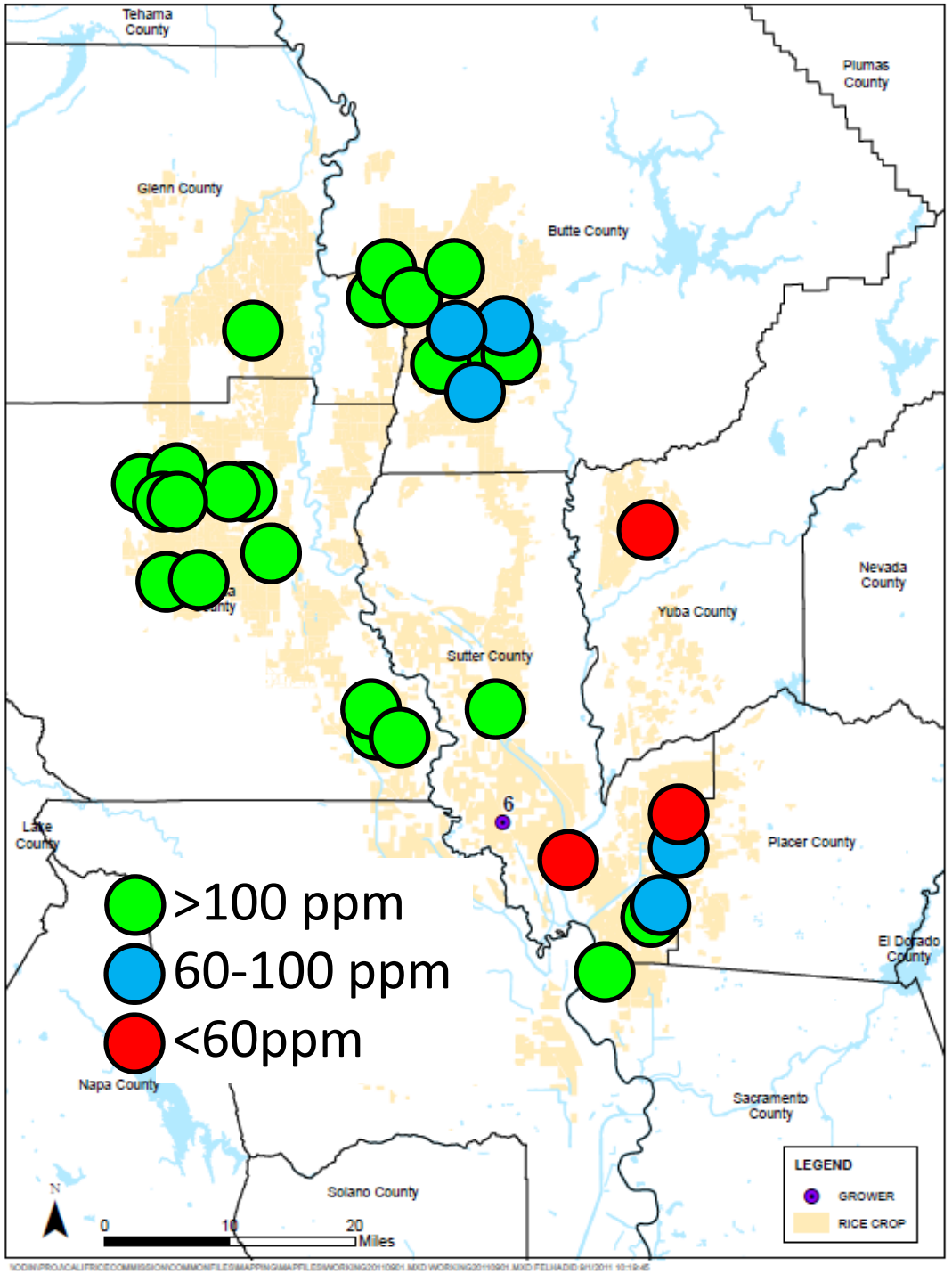
- N 14 lb
- P 6 lb
- K 28 lb

- Value (2012 fertilizer prices)
- $31.34



2013 study

- Continue 2012 study
- Focus on fields:
  - East side of Valley
  - Fields around Gridley
  - Fields without history of K fertilizer applications
  - Fields where straw is routinely removed
  - Fields with groundwater pumps
- Sign up in back if interested



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THANK YOU