Brief review of salt effects on rice production

What are salts?

- Dissolved ions
  - Both cations (+) and anions (-)
    - Ca^{+}, Mg^{+}, K^{+}, Na^{+}
    - Cl^{-}, SO_4^{-2}, CO_3^{-}, NO_3^{-}

Soils can be either:

- Saline – high concentration of soluble salts
  - EC > 4 dS/m
- Sodic – high concentration of exchangeable Na
  - SAR > 13
  - pH 8.5 – 10, dispersed soil, impermeable
- Saline-sodic – high concentration of both
  - SAR > 13 and EC > 4 dS/m

How do we measure salinity?

- Soluble salts – electrical conductivity
  - ability of soil water to conduct electricity
  - salts increase conductivity
  - dS/m; mmho/cm

dS/m = 640 ppm (800 EC>5)
1 grains = 17.1 ppm

How do we measure sodicity

- Exchangeable Na – saturated paste extract
  - Soil water slurry
  - Stands 1 to 2 hours
  - Concentrations of Ca, Mg, Na, K of solution

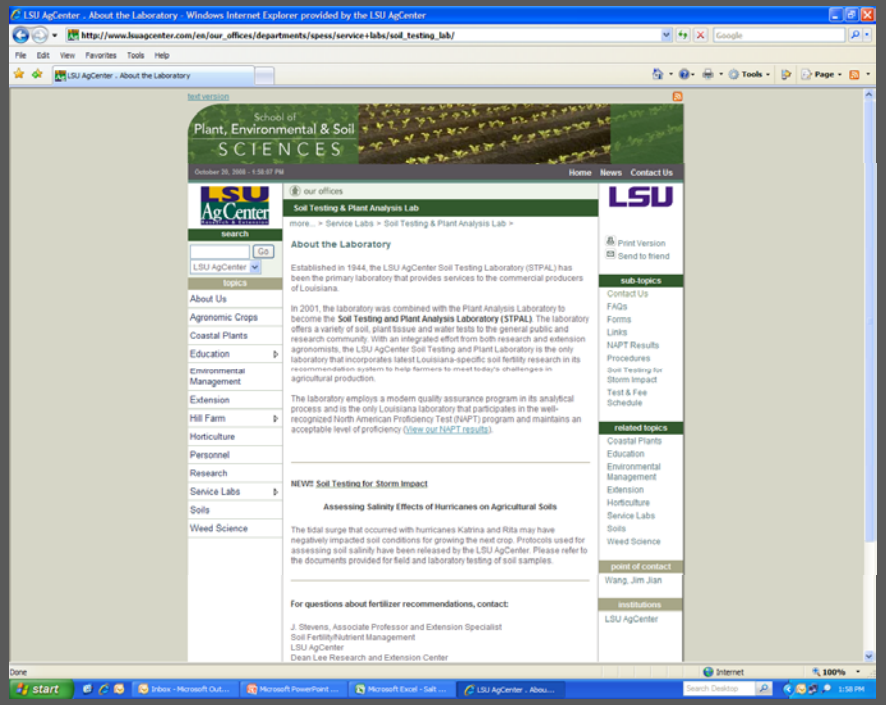
- SAR – sodium adsorption ratio

$$SAR = \frac{[Na]}{\sqrt{[Ca] + [Mg]}}$$

  - mmol/L

Recommendations

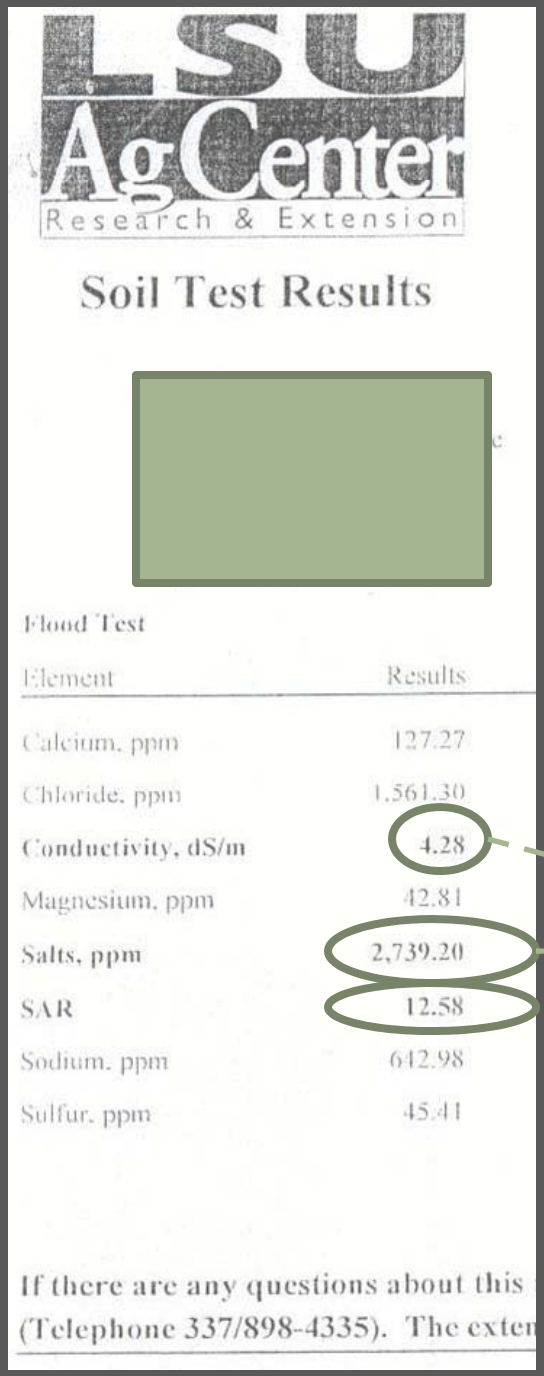
- Soil test before making planting decision
  - Prescreen – EC
    - If high…
- LSU Soil testing and plant analysis
  - http://www.lsuagcenter.com/en/our_offices/departments/agronomy_environmental_management/soil_testing_lab/storm_impact/
  - take composite sample
  - $5 – flood test
  - EC and SAR
    - Not true saturated paste
    - must multiply results by 2 (THIS IS DONE BY LAB)



Criteria used to estimate potential salt damage to rice based on soil tests.

Salt Impact	Salt	SAR	Effects
	--ppm--		
None	< 500 and	< 4	Effects unlikely
Mild	500-1000 and	< 5	Some yield reduction possiable
Moderate	1000-2000 or	< 6	Some yield reduction likely
Severe	2000 - 5000 or	< 13	Substantial yield reductions likely
Very Severe	> 5000 or	> 13	Catastorphic crop failure

- LSU = 750 ppm; SAR < 5 (conservative)
- Grey area = 750 - 1920 ppm
- EC = 3 dS/m or 1920 ppm (Mass and Hoffman, 1977)



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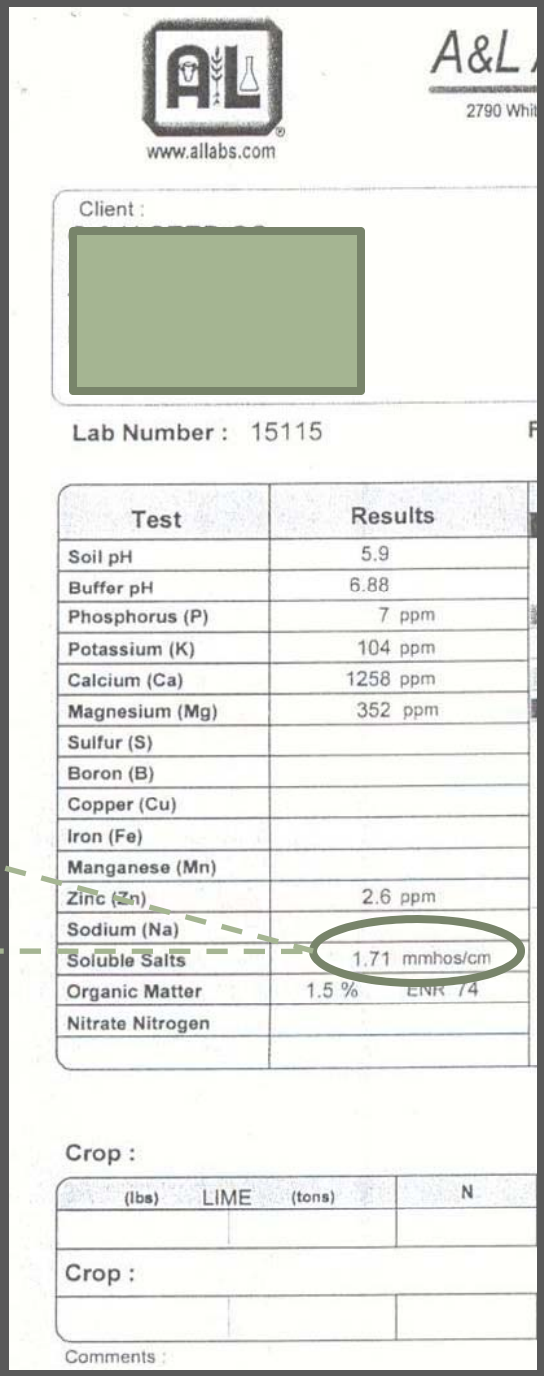
Soil Test Results

[redacted]

Flood Test

Element	Results
Calcium, ppm	127.27
Chloride, ppm	1,561.30
Conductivity, dS/m	4.28
Magnesium, ppm	42.81
Salts, ppm	2,739.20
SAR	12.58
Sodium, ppm	642.98
Sulfur, ppm	45.41

If there are any questions about this
(Telephone 337/898-4335). The exten



A&L
2790 Whit
www.allabs.com

Client : [redacted]

Lab Number : 15115

Test	Results
Soil pH	5.9
Buffer pH	6.88
Phosphorus (P)	7 ppm
Potassium (K)	104 ppm
Calcium (Ca)	1258 ppm
Magnesium (Mg)	352 ppm
Sulfur (S)	
Boron (B)	
Copper (Cu)	
Iron (Fe)	
Manganese (Mn)	
Zinc (Zn)	2.6 ppm
Sodium (Na)	
Soluble Salts	1.71 mmhos/cm
Organic Matter	1.5 % ENR 74
Nitrate Nitrogen	

Crop :

(lbs)	LIME	(tons)	N

Crop :

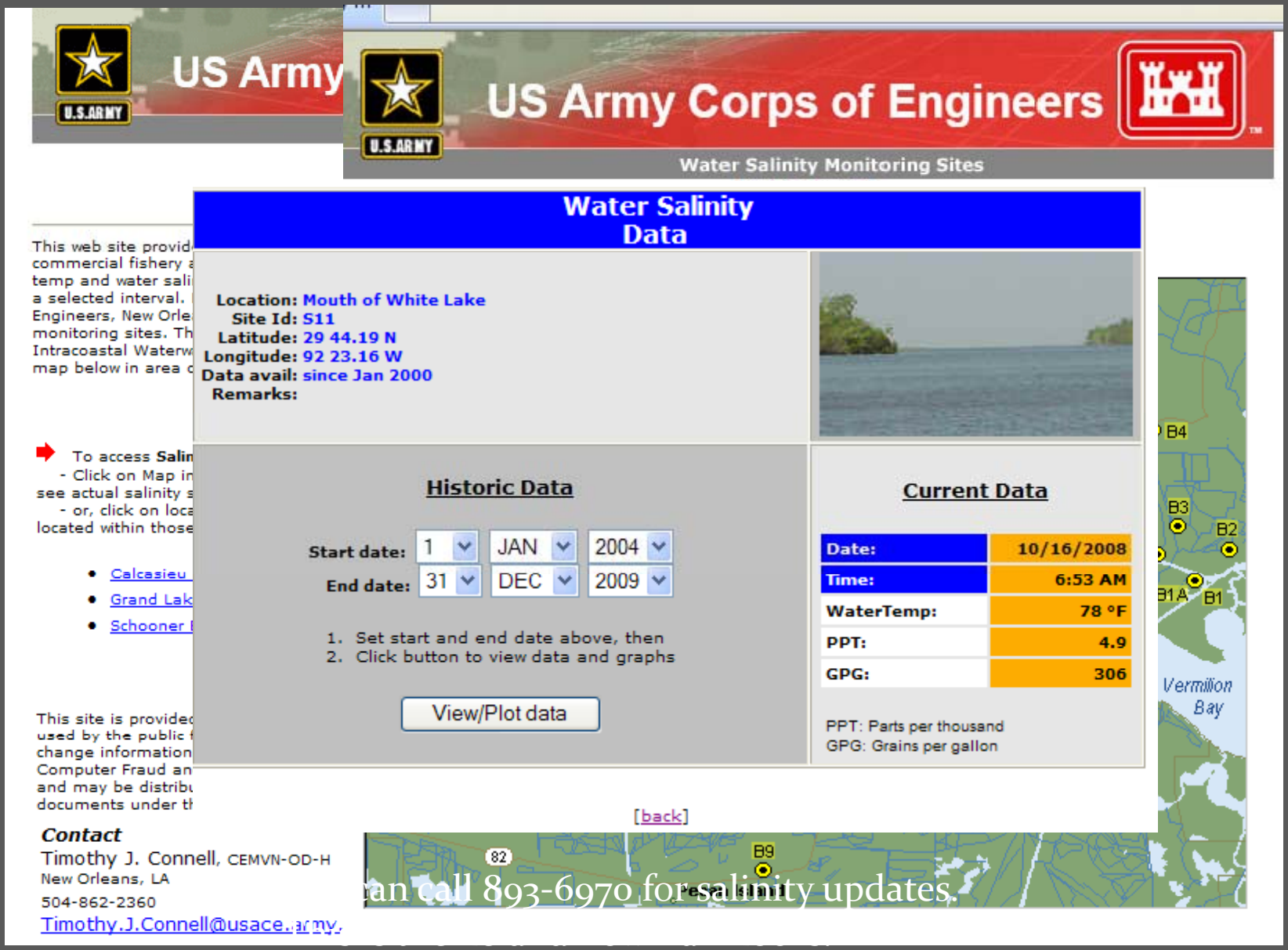
Comments :

- Salt comparison
  - All criteria based on Saturated Paste
- 2:1 dilution
- LSU
  - S.P. correction done
- A&L
  - Multiply by 2
  - Then multiply by 640 to get salts

3.42
2,188

- SAR
  - LSU complete
  - A&L separate analysis

Commonly Accepted Tolerance of Rice to Salt Water		
Concentrations of Salt as NaCl in water		
Grains per Gallon	p.p.m.	Stage of Growth
35	600	Tolerable at all stages, not harmful
75	1300	Rarely harmful and only to seedlings after soil is dry enough to crack. Tolerable from tillering on to heading
100	1700	Harmful before tillering, tolerable from jointing to heading
200	3400	Harmful before booting, tolerable from booting to heading
300	5100	Harmful to all stages of growth. This concentration stops growth and can only be used at the heading stage when soil is saturated with fresh water.



an call 893-6970 for salinity updates.

http://www.mvn.usace.army.mil/ops/sms/index.asp

Remediation Recommendations

- In the Fall and Winter
  - hold water before rainfall events
  - ≈5 days (equilibrium)
  - release water
  - repeat…

  - If available water is low salt (Vermilion River)
    - If soil is moist can pump
    - May not be most economical

  - Working in water
    - Shown to be somewhat beneficial in extreme cases
    - May not be economical
    - Shallow only

Agronomic Recommendations

- Use conventional tillage
  - ONLY when salt levels are at a tolerable level
    - Deep tillage can deposit high salt levels at lower depths
  - Reduced tillage has shown increased salts in root zone (Wilson et al., 2000)

- Omit nonessential fertilizer inputs
  - potash and starter N
    - adding salt

- Keep soils moist, flush as needed

Agronomic Recommendations

- Establish permanent flood early
  - dilute salts
- Hold off on N fertilization until rice recovers form initial salt damage
- TIME

Current evaluation criteria is not an exact science

- Varies according to:
  - Soil texture
  - OM
  - Were soils wet during surge?

- Salts move with soil water (wick)
- Deep tillage not recommended when salt content is extremely high
- Rainfall and Time best recommendation