Evaluating Soil Electrical Conductivity for Soil-Specific Seeding Rates in Cotton

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Purpose

Cotton lint yield and fiber quality are associated with water supplied to the crop, by the soil or by irrigation, throughout the growing season (Ping et al., 2004). Soil bulk electrical conductivity (ECa) measurements can make high resolution maps of soil variability across a field, one of which being soil water storage capacity (Sheets and Hendrickx, 1995). Reducing seeding rates in soils while maintaining production potential will decrease input costs and has the potential to improve lint yield and quality in drought stressed soils. Under drought conditions, reduced plant density may increase soil moisture late in the season, reducing water stress on the plant. This reduced stress may result in better lint quality. The ***overall goal*** of this project is to improve cotton production profitability by minimizing seeding rates, maintaining maximum yields, and improving lint quality potential in water limited soils.

Objectives

1. Evaluate the effectiveness of soil-specific seeding rates on cotton yield and quality using soil bulk electrical conductivity to define variable rate zones.
2. Quantify the effect of variable soil water availability on cotton lint yield and quality.

Materials and Methods

Fig. 1 Conducting a bulk soil electrical conductivity (ECa) survey prior to planting

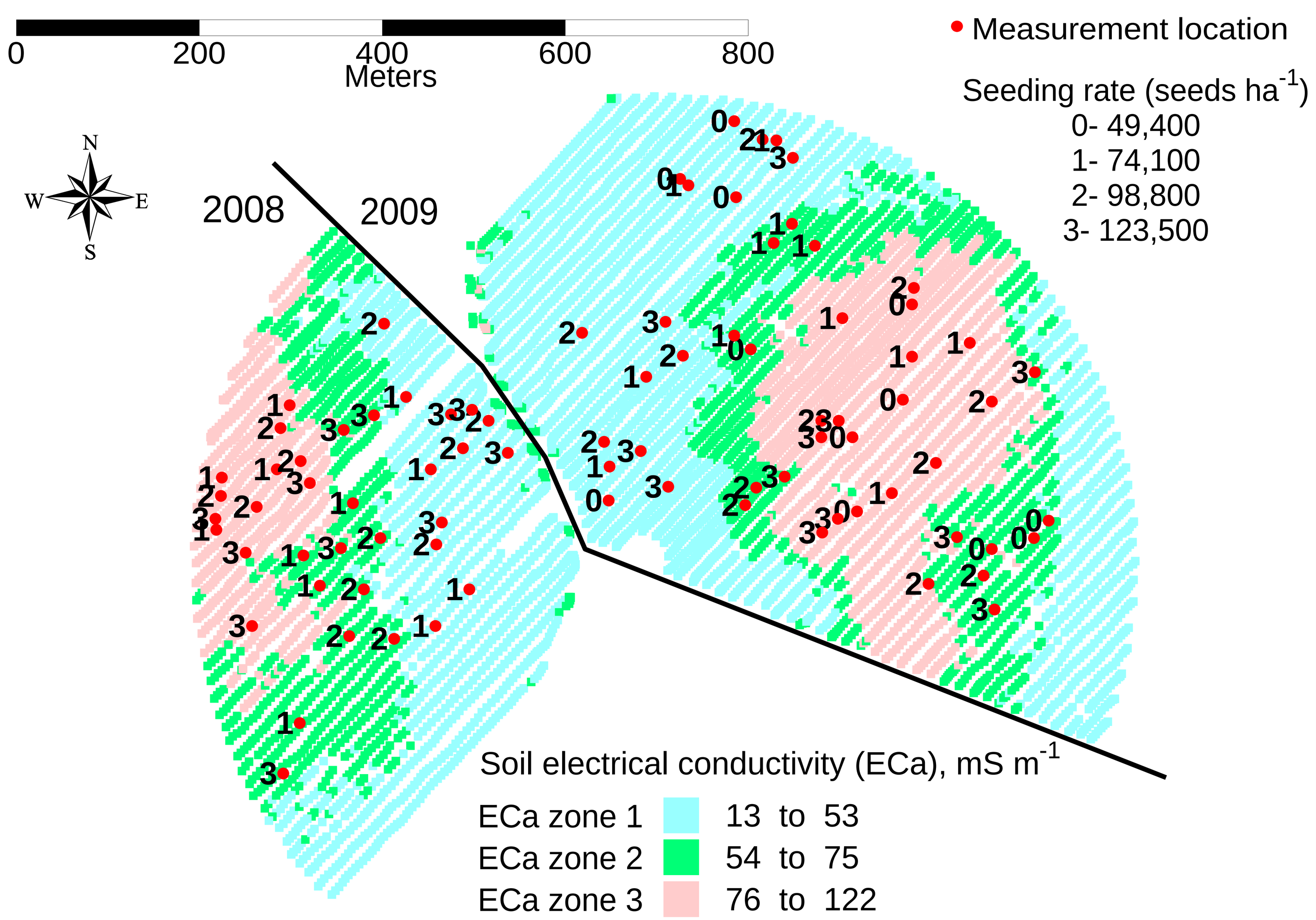


Fig. 2 Soil electrical conductivity (ECa) map of the Texas A&M University IMPACT center. The ECa is in three categories, measurement locations shown, and seeding rates indicated. Four measurement locations for each ECa zone and seeding rate.

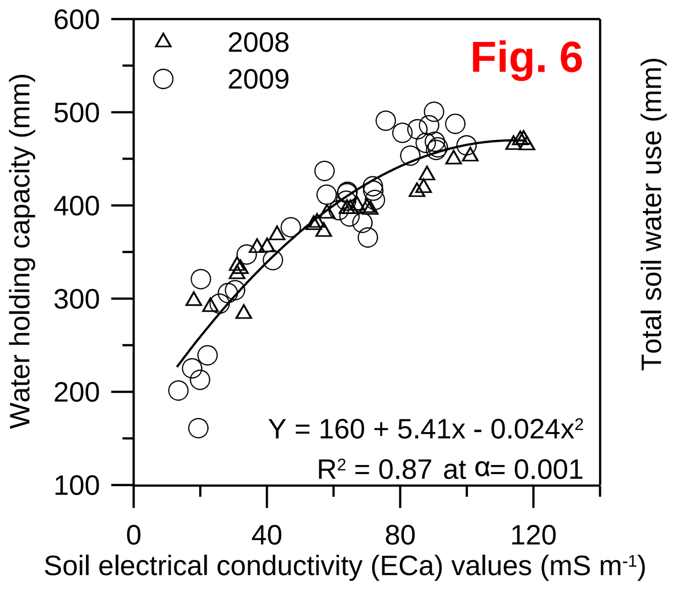
- Surveyed the fields using an EM38 soil electrical conductivity (ECa) meter (Fig. 1).
- Delineated three ECa zones using k-means classification within two irrigated fields (19 & 36 ha^{-1}) (Fig. 2).
- Randomly selected 4 replications in each of the seeding rates and ECa zones. In total, 36 locations in 2008 and 48 locations due to the addition of the 49,400 (seeds ha^{-1}) rate in 2009 (Fig. 2).
- Calculated soil water use measuring soil profile water content weekly to 1200 mm using a neutron soil moisture meter (CPN 503 DR depthprobe). The meter was calibrated for each ECa zone (Fig. 4).
- Harvested 5.5 meters of cotton lint at each measurement site to quantify yield. Lint samples were sent to the Fiber and Biopolymer Research Institute in Lubbock, TX for HVI quality measurements (Fig. 5).
- Compared lint yield, quality, and value between seeding treatments and EC zones using General Linear Model (SAS, 2002).

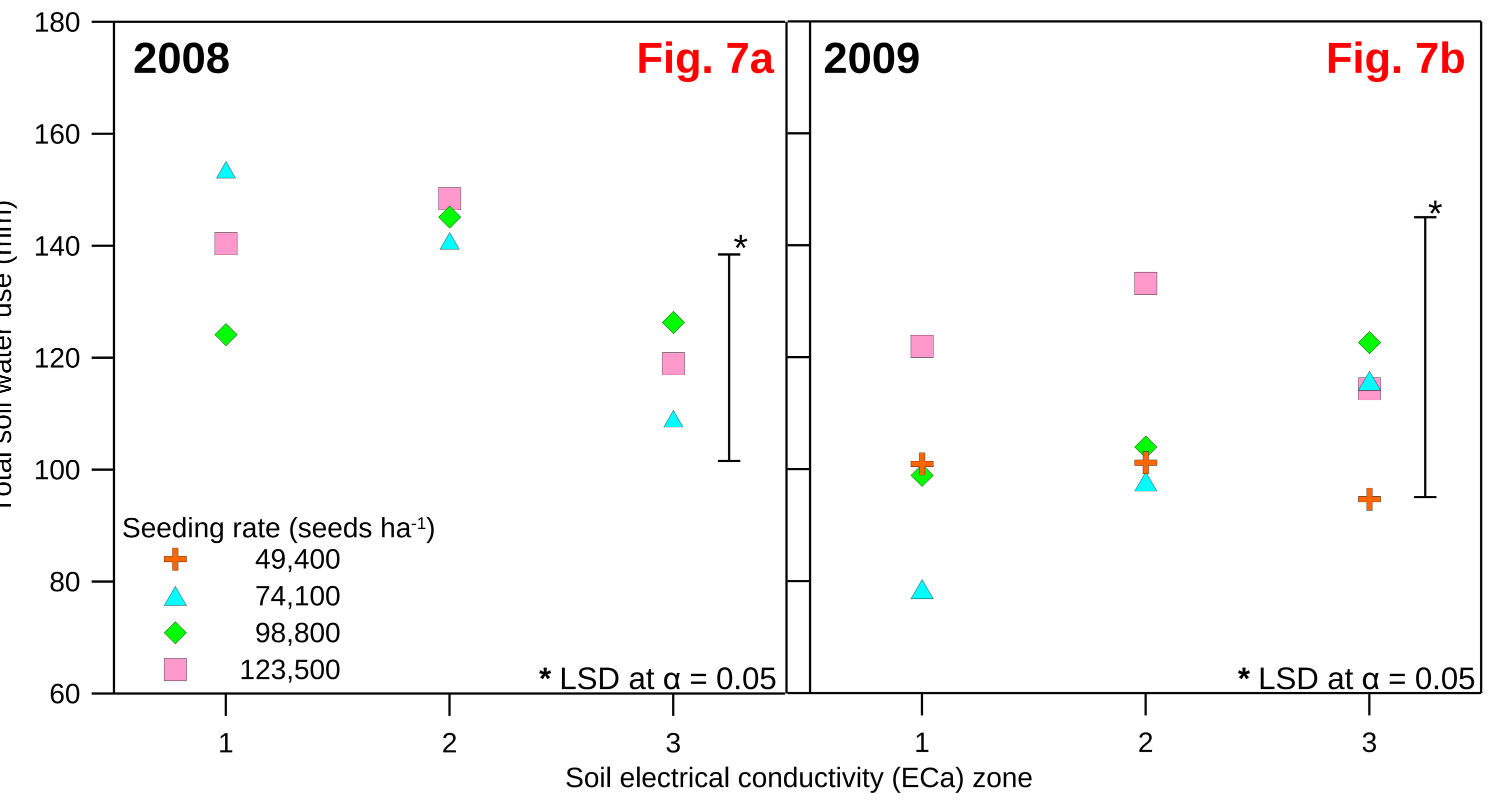
Fig. 3 Installation of neutron access tubes at measurement locations post emergence

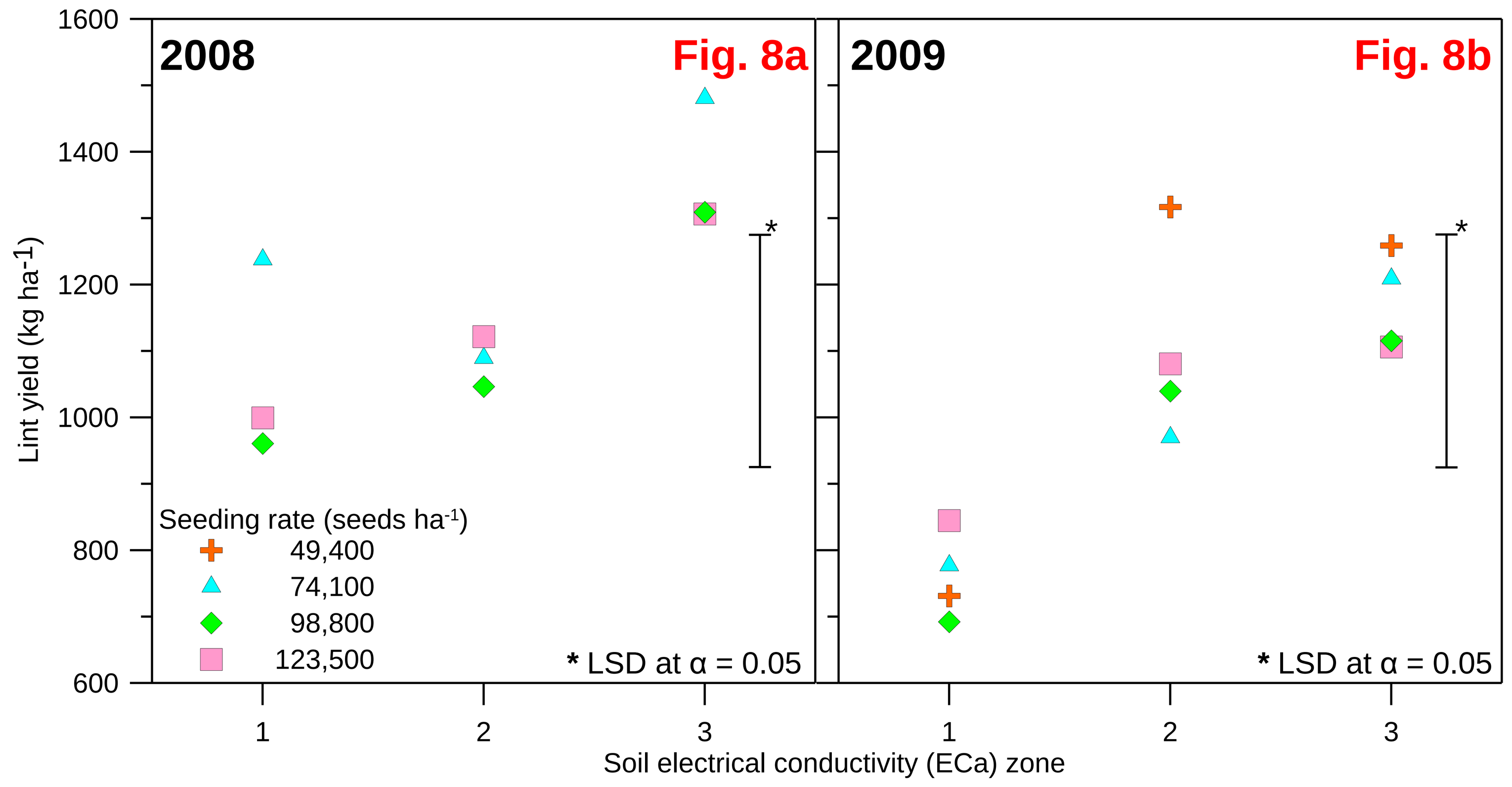
Fig. 4 Soil water content profile measurements using a neutron probe

Fig. 5 Harvesting cotton at each measurement location

Results and Discussion







- Soil water holding capacity is strongly correlated to soil ECa values (Fig. 6). Soil textures were clay, silt loam, and sandy loam for ECa zones 3, 2, & 1, respectively.
- The 2008 and 2009 growing seasons were relatively dry with weekly irrigation; 2008 received 100 mm more rain/irrigation than 2009.
- The cotton used more soil-stored water in 2008 compared to 2009 (Fig. 7a & b). Generally, smaller seeding rates used less soil water and sometimes achieved larger yields, indicating higher water use efficiency and profitability (Fig. 8a & b).
- While no seeding rate produced apparent yield trends, a clear trend of increased yield with increased ECa was evident in both years (Fig. 8a & b).
- 74,100 seeds ha^{-1} in ECa zone 1 yielded significantly higher than the two larger seeding rates in 2008. In 2009, 49,400 seeds ha^{-1} in ECa zone 2 yielded higher than the three larger seeding rates (Fig. 8a & b).

Table 1. Average of micronaire readings from 2008 and 2009. Average values represent the four replications within each seeding rate and ECa zone.

Seeding rate	ECa zone 1	ECa zone 2	ECa zone 3
	2008 Micronaire		
---seeds ha^{-1}---	---------------------value---------------------		
74,100	3.5Bb†	3.2Bc	4.0Aa
98,800	4.0Aa	3.6Ab	4.1Aa
123,500	3.7Bab	3.5Ab	3.9Aa
	2009 Micronaire		
49,400	4.1Ab	4.6Ba	4.5Aa
74,100	4.2Ab	4.6Ba	4.6Aa
98,800	4.1Ac	4.7Ba	4.4Ab
123,500	3.8Bc	4.9Aa	4.4Ab

† Means within a column followed by the same uppercase letter or in a row followed by the same lowercase letter are not statistically different at α = 0.05.

- A micronaire trend did not exist with ECa zone. In 2008, premium micronaire values were observed in ECa zone 3. In 2009, the best micronaire values were witnessed in ECa Zone 1 (Table 1).

Conclusions

1. The ECa measurements indicated soil texture and water content changes in both fields.
2. In general, soil water use by the crop decreased as seeding rate decreased, which was occasionally accompanied yield increases.
3. Though cotton lint yield increased as ECa values increased, we found no evidence to support the idea that available soil water affected yield.
4. Micronaire was the only lint quality parameter which showed significant differences (response) to ECa in both years of the study. These responses could not be explained.

References

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