EVALUATION OF SALINITY MANAGEMENT PRODUCTS AND PRACTICES IN WEST TEXAS IRRIGATED COTTON – 2016 RESULTS

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Introduction and Abstract

Cotton is produced on millions of salt affected acres, many of these are due to poor quality irrigation water and elevated surface water evaporation, especially in semi-arid environments. Cotton is considered a salt tolerant crop but germination, seedling establishment, and yield are much reduced in salt affected soils (Figure1). Due to recent droughts and increased irrigation, salinity problems have intensified in West Texas and salt mediation practices have been pursued for use in sub-surface drip irrigation (SDI). Soil sampling has identified high salt concentrations in many fields and also salt stratification within drip irrigated cotton beds at different rooting depths with the highest concentrations on the top of the SDI bed.

Traditional recommendations for salinity treatments have been centered around leaching salt below the root zone with additional and higher quality surface applied water. Non-traditional remedies are needed with subsurface drip irrigation and as quality water becomes more expensive and scare. Salt mediation products were applied at planting in replicated field trials in 2014-16. Although trends and numerical differences among treatments were observed in plant stand and lint yield; statistically significant results as compared to the untreated check were not obtained in any individual year. However, significant results were obtained analyzing over the 3 years of treatments. Crop rotation to dryland winter wheat, cotton, and grain sorghum reduced soil salinity over time as monitored by annual soil sampling. Greenhouse testing of cotton seed germination and seedling growth was evaluated in 2015 and 2016 for comparing soil and water treatments and cotton varieties. Significant differences were observed in cotton varieties but not for electromagnetic water treatment, seed treatment, or soil treatment.

Figure 1. Areas of cotton stand loss and stunted plants due to salinity effects in SDI cotton production in West Texas.

Materials and Methods

At Planting Treatments

Cotton was seeded into salt affected pre-watered seed beds on May 19, 2014 and June 1, 2015. Cotton seeded in May 17, 2016 was not pre-watered as soil moisture was adequate. Treatments, listed in Table 1; were mixed with water and applied on the open seed furrow with a spray nozzle, at 6 gallons/acre; after seed drop and before the closing wheels (Fig. 2). The experimental design was a modified randomized complete block with a split plot of 4 treated rows next to 4 untreated rows. Plot size was 300 ft in length with 4 replications per treatment. Plots were evaluated at the cotyledon stage and 4-5 leaf stage for stand count. Plots were also evaluated for yield at the end of the growing season. Pre and post treatment soil tests were taken and compared for differences.

Crop Rotation (2014-2016) Irrigated Cotton Production Practices

Cotton is grown in rows of 1m spacing with a subsurface drip irrigation tube placed at a depth of approximately 35 cm below the soil surface under each row or between two rows. Depending on pre-season rainfall, seed beds are frequently pre -watered in May to be able to fill the soil profile and plant into moist soil. This pre-watering may require up to 25 cm of water per ha for moisture to reach the soil surface. In this area of West Texas irrigation is from wells of 30-120m in depth and water quality varies greatly but is usually high in salts and minerals. Cotton is seeded in mid-May through mid-June. After initial stand establishment irrigation is resumed in mid-July and will continue until early September. Depending on well water yield season irrigation is approximately 38 cm. Average annual rainfall is 42 cm. Starting in 2014 an irrigated cotton field with 12 – 2.4 ha irrigation stations were monitored for soil testing and yield. The 2014 cotton was pre-watered prior to planting and full irrigation was begun in late July and continued through August.

Winter Wheat Production Practices

Winer wheat was sown without tillage in October 2015 and emerged do to soil moisture provided by precipitation. A single irrigation was applied in the spring of 2015 as moisture conditions had decreased. Wheat was harvested in June of 2015.

Dryland Cotton Production Practices

Wheat stubble was strip-tilled in early 2016 and due to good soil moisture cotton was seeded in May 2016. Cotton was harvested in September of 2016.

Pre and post season soil sample were taken at several depths and compared for differences.

Greenhouse Seedling Germination Tests

Flats were filled with dry screened field soil. Cotton seeds were placed in rows, 12 seeds per row; using tweezers and orienting the point of the seed down and planting at a depth of 3-4 cm. Seven varieties were seeded in each flat with two randomized complete blocks per flat. Rows were spaced 2.5 cm apart and separated by a plastic row divider. Flats were wet by placing in water and soaking the flat through the bottom drainage holes. Experiments were done for approximately 2 weeks or until a significant number of seedlings had emerged and maximum differences were observed. Flats were evaluated by counting emerged seedlings, germinated seeds, and measuring the hypocotyl length of each seedling (Figure 2). Two experiments with water treated by a TransGlobal H2O electromagnetic water system were conducted with 4 treated and 4 untreated flats. Two experiments of 4 replications each; with different sets of 7 cotton varieties were also conducted.

Figure 2. Spray nozzle mounted on the planter to apply salinity mediation and fertilizer products at planting, left; measurement of cotton seedlings germinated in a greenhouse using salt affected field soil and well water, right

Results and Discussion

At Planting Treatments

At planting treatments, stand count, and lint yield results are presented in Table 1. Statistically significant differences between treatments were not observed for stand count and yield in each individual year although numerical differences appear to be large. In the multi-year analysis there was a significant difference in yield over the 3 experiments and average yields for all trials were significantly different between years. The mechanism of benefit of applying Black Label at planting is not known but not assumed to be the fertilizer as there was no benefit with applying a similar fertilizer; the Asset treatment. It should be noted that these results were obtained in a single soil type with specific salt issues and may not translate to other soils and conditions.

Table 1. Stand count and lint yield for at planting treatments in a high salinity cotton field, Midkiff, TX 2014, 2015, and 2016.

Treatment	Rate banded in row Acre $^{-1}$	Stand Count Plts row ft^{-1} 2014 2015 2016	Lint Yield Pounds/acre 2014 2015 2016	Lint Yield Pounds/acre Multi-year Mean
CALFA	8 fl. oz.	Not tested '14 3.26 1.59	Not tested '14 822 290	2 yr average CALFA 556 NS Untreated 438
Black Label + Accomplish	32 fl. oz. 32 fl. oz.	1.15 2.81 1.86	1724 771 522	1006 a
Black Label	32 fl. oz.	1.14 2.20 1.70	1560 690 475	908 a
Accomplish	32 fl. oz.	1.20 2.99 1.94	1413 610 300	774 b
Asset	32 fl. oz.	1.18 2.64 1.79	1462 574 141	726 b
Untreated Check	-	1.00 2.94 1.80	1302 536 341	726 b
Statistical Significance P=0.05		NS/NS/NS	NS/NS/NS	P= 0.005Lsd = 129

Crop Rotation (2014-2016)
Crop rotation with associated changes in soil test parameters are presented in Table 2. There was a significant reduction is salinity conditions. An economic analysis of the rotation needs to be performed and the production of an irrigated cotton crop with yield to determine the benefit of the rotation.

Table 2. Crop rotation and fiber or grain yield of cropping practice from 2014-2016 in a high salinity cotton field in Midkiff, TX.

Crop rotation and year	Yield Kg/ha	Electro-conductivity (µmho/cm)
Fully Irrigated Cotton 2014	1356 (lint)	1312
Winter Wheat (single spring irrigation) 2014-2015	3219 (grain) 1585(straw)	-
Dryland Cotton 2016	403 (lint)	880

Greenhouse Seedling Germination Tests
Cotton varieties are placed into suggested salt tolerant groupings based on greenhouse germination tests in Table 3. This screening technique provided similar results in both replicated screening times. Soil moisture and temperature was also monitored daily with pre and post soil tests (results not presented).

Table 3. Ratings of salinity tolerance in the germination stage of cotton varieties in greenhouse tests during 2016 in San Angelo, TX.

Testing Period	Better	Intermediate	Poor
First replicated greenhouse trial Aug. 2016	PHY 499 WRF ATX Nitro 44 B2RF DP 1219 B2RF	FM 1944 GLB2 ST 4747 GLB2	DP 1032 B2RF
Second replicated soil trial Aug-Sept 2016	PHY 333 WRF PHY 764 WRF DG 2570 B2RF	ST 4747 GLB2 FM 2334 GLT	DP 1553 B2XF DP 1614 B2XF

Conclusions

- An at planting treatment may provide some yield benefit in salt affected conditions.
- No significant differences in cotton seed germination were identified in the TransGlobal H2O electromagnetic water treatment greenhouse experiments.
- Producers should carefully evaluate cost and potential benefit of these types of products and if they choose to use them and use them in a way as to evaluate them with untreated areas to measure potential benefits.
- A wheat and dryland cotton crop rotation reduced soil salinity levels over the 3 growing season s and needs an economic assessment.
- There are varietal differences to salinity in the cotton germination stage.

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