ZONE MANAGEMENT STRATEGIES FOR SODIC/SALINE SOILS

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Abstract

Irrigation water in southwestern Oklahoma can have salinity issues and some fields in this region have developed low production areas due to saline accumulation. The accumulation of salts in the soils reduces yield and causes a reduction in plant stand. The goal of this project was to evaluate potential management strategies for these areas. A producer's field with known sodic/saline issues and yield history was selected for field trials. Historic yield data was normalized and used to create a yield stability map. The yield stability map was used in a composite soil sampling strategy. Fifteen soil samples were collected from each zone, divided into depth (0-6, 6-12, 12-18, 18-24 inch) and mixed into composite samples. The soil sample results were used to determine gypsum application rates. The gypsum was applied using a commercial variable rate spreader with a Raven Viper Pro controller. Due to an unnaturally dry year and a damaging storm event during the early growing season, the crop stand was lost. Thus, yield results are not available for 2011. Correlations were found between soil test results and the developed yield stability zones for parameters such as soil test electrical conductivity. The relationships between soil test results and historic yield stability data indicated that yield data can be used to delineate management zones for sodic/saline soils. Future work will include yield and soil test data to determine if gypsum is a viable solution to manage sodic/saline problems in cotton fields in southwestern Oklahoma. If it is determined that gypsum is not a viable solution, other methods of soil management will be researched to develop strategies to manage this production challenge.

Introduction

Irrigation water in southwestern Oklahoma can have salinity issues. Salinity accumulation in this region has caused many of the fields to develop low production areas (Figure 1). High sodic/saline areas cause poor plant stands and a reduction in yields.

Figure 1. Typical poor crop stand in sodic/saline areas.

Producers in the surrounding area have questioned the value of gypsum application to these fields as a viable management option for low productivity areas. Generally, gypsum is recognized as being of value for management

of sodic soils. Sodicity is an issue in some areas, but salinity and not sodicity is apparently more problematic in many local production fields where poor stands and lower production are observed. Thus, the value of gypsum application has been questioned.

Materials and Methods

A producer field was selected for this study based on known sodic/salinity issues combined with multiple years of spatial yield data. The selected field had yield data from 2004 until the present. However, it was decided to only use yield data from 2008 on because between the 2007 and 2008 production seasons drip irrigation was installed on the field. Historically the field was furrow irrigated in a south to north direction. The drip irrigation was installed from east to west. The different directions of the irrigation were evident in yield data. Thus to ensure the yield data analyzed was similar to the current production season 2008-2010 yield data was used. Yield stability analysis was performed on the three years of yield data in the manner described by Taylor et al. (2000). A 40 foot grid was overlaid on the field. This size represented two harvester widths (20 foot wide cotton picker). Determining areas with stable yield addresses temporal variability by identifying zones that are consistently high or low yielding regardless of the growing season. Other areas are treated as average. Unstable areas are grouped within the average group because their response is unpredictable.

As shown in Table 1, yield stability data for the field were divided into five classes. This process was completed by observing the consistently high and consistently low zones. If the yield was consistently 20% higher than average it was assigned a two and called "very high stable", if the yield was consistently 20% lower than average it was assigned a negative two and called "very low stable." If the yields were from above 20% down to average was assigned a one and deemed "stable high" and if the yield fell between below average and 20% less than average they were assigned a negative one and deemed "stable low."

Table 1. Yield stability classes.

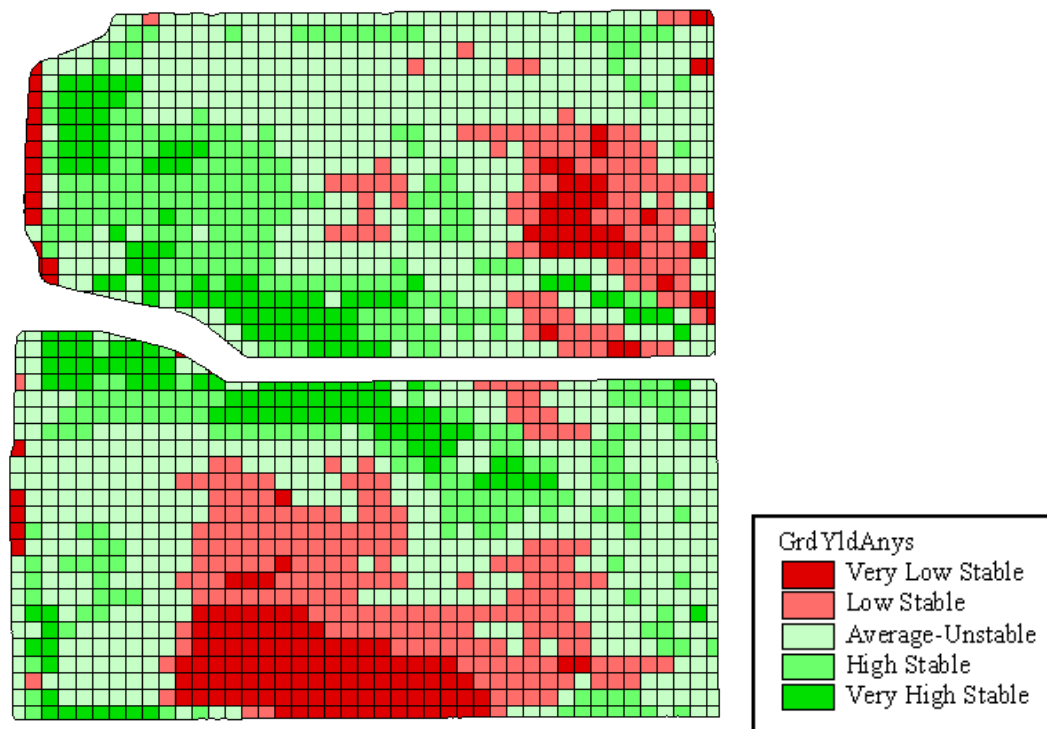| Yield Class	Definition	Normalized Yield Level
-2	Very low stable	At least 20% below average
-1	Low stable	10-20% below average
0	Average	+/- 10% of average
1	High stable	10-20% above average
2	Very high stable	At least 20% above average

Figure 2. Yield Stability Map.

The yield stability map (Figure 2) was used to delineate soil sampling zones. Small areas (2-3 grids) of one yield class included within another were merged with the surrounding yield class. Samples were collected to a 24-inch depth. Since the entire field was divided into two physical portions by a drainage ditch, five composite samples were collected from the south field and five composite samples were collected from the north field. Similar methods were used to obtain the composite samples from each potential management zone. Each composite sample consisted of fifteen subsamples. The subsamples were collected from the similar zones based using surface area weighting. To ensure the samples were collected from within each zone correctly an ATV with a handheld computer was used with the yield stability map as the background. Thus, a very high yield zone in the north field had one area of twenty acres and one area of ten acres then ten and five samples were collected from the zones respectively. As the subsamples were collected they were divided into four increments based on sample depth, 0-6, 6-12, 12-18, 18-24 inch. The samples were sent to the Oklahoma State University Soil, Water and Forage Testing Laboratory where a routine soil test, macro nutrient, micro nutrient, and comprehensive salinity paste tests were performed. Apparent soil EC was collected from the field using a Veris 3100, with the goal of finding correlations with soil test results.

Figure 2. Soil core in tray used for dividing samples into depths.

Relationships were found between the soil test results and the developed yield stability zones. These results suggest that using yield history is a viable way to delineate zones for managing sodic/saline soils in this region of Oklahoma. Figure 3 provides soil test electrical conductivity (EC) and an inverse relationship to the yield from the developed stability zones. This indicates that the lower yields are possibly caused by the higher salinity levels in the soil.
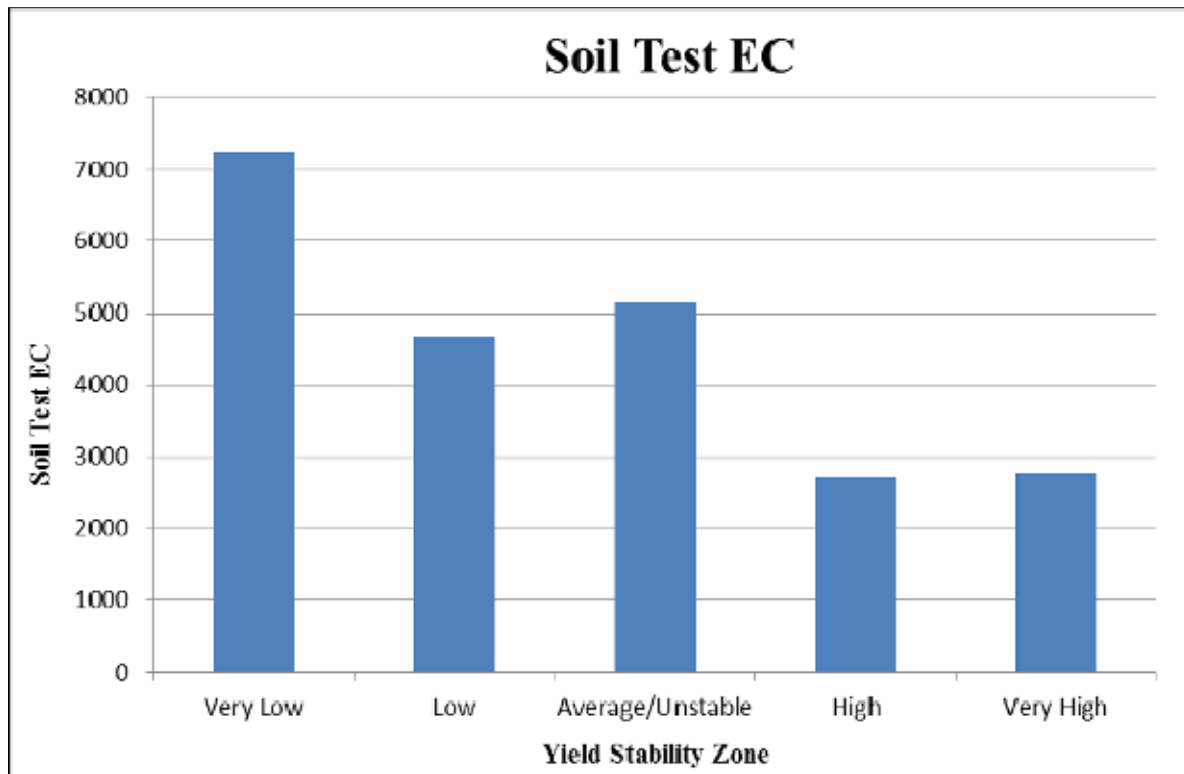
Figure 3. Soil test electrical conductivity and its correlations with yield stability zones

The results of the soil tests combined with the yield stability data were used to develop a prescription application map for agricultural gypsum. Gypsum was applied using a variable rate commercial applicator controlled using a Raven Viper Pro. Test strips were applied within both the northern and southern sections of the field. The test strips had the low (0 lbs/ac) and high (2000 lbs/ac) applied to them. The width of the strips was based on the effective commercial spreader width. The rest of the field had a variable rate application applied to it with the very high zones receiving 500 lbs/ac, the high and average zones receiving 1000 lbs/ac, the low zone receiving 1500 lbs/ac and the very low zone receiving 2000 lbs/ac (Figure 4).
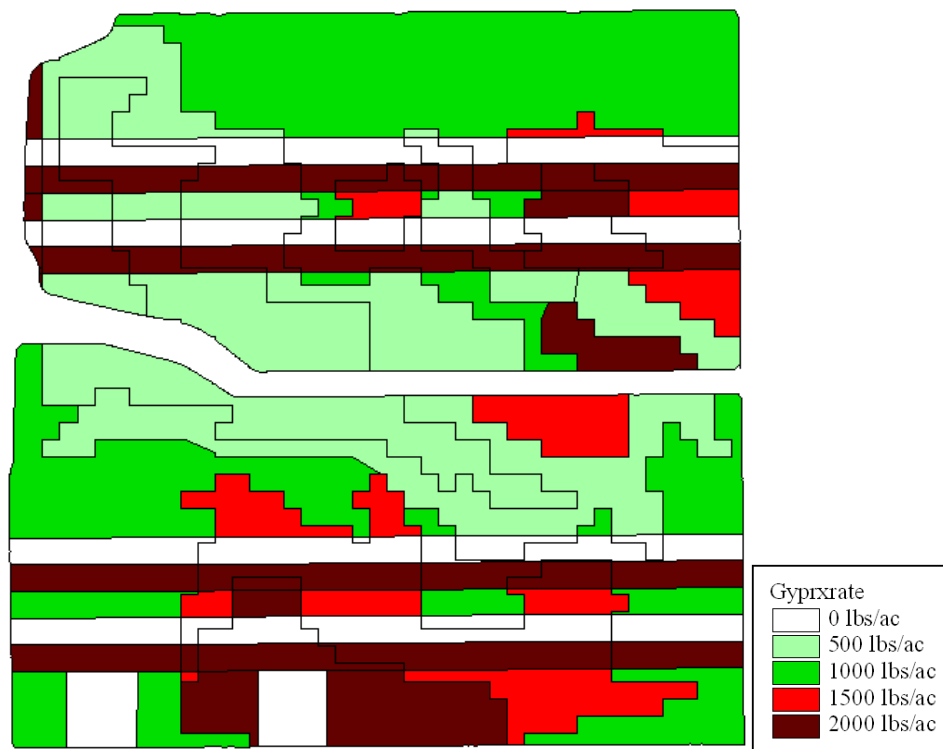
Figure 4. Gypsum Prescription Application Map

Summary

This study embraced cotton production challenges in producer fields in southwestern Oklahoma. The data collected during this study will aid extension recommendations for the producers of this area. Due to the extreme weather conditions present in the Southern Great Plains region in 2011, the crop was lost. Therefore, 2011 results cannot be reported. However, since this field is in continuous monoculture cotton, it is hoped that yield data can be obtained from the 2012 crop.

References

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