USING GRID SOIL SAMPLING IN THE MANAGEMENT OF PROBLEM SOILS[1]

M.B. Daniels, S.L. Chapman, R. Matlock and A. Winfrey

RESEARCH PROBLEMS

Underlying soil fertility problems such as high sodium levels, excess soluble salts and micronutrient imbalances can limit plant response to nitrogen, phosphorus and potassium fertilizers and lime even when soil test recommendations warrant such additions. Management options for these soils are sometimes limited due to practical and economic constraints. The objective of this study was to determine if the use of precision agricultural technology could provide information that would increase fertility management options on problem soils.

BACKGROUND INFORMATION

Grid soil sampling is primarily being used as a basis for variable rate application of fertilizers and lime. Regardless of variable rate fertilizer technology, grid soil sampling may be an important management tool. It provides information at a level of detail that may be necessary for other purposes, such as setting realistic yield goals, explaining yield variability and trouble shooting problem soils.

Plant response can vary within a field with problem soils ranging from seedling death in some locations to normal growth and yield at other locations. This variability can make it difficult to diagnose and remedy the problem with normal composite soil sampling from good and bad areas. Intensive soil sampling may provide information so that the problem can be adequately identified and the spatial extent of the problem adequately delineated. Ultimately, this increased knowledge may lead to increased management strategies for problem soils.

RESEARCH DESCRIPTION

The study was conducted in the spring of 1997 in southwestern Hot Spring County in a 70-acre production field. Historically, soybean yields in parts of this field have been severely limited due to excess soluble salts. Within this field, the soils are mapped as Adaton, Gurdon and Sardis silt loams. The Gurdon series is closely related in texture and landscape position to the Foley silt loam, which is characterized by a natric (high sodium content) horizon.

In order to determine the distribution of soluble salts and sodium within the field, soil samples were obtained on approximately a 2.5-acre grid while the field was fallow. The grid points were somewhat irregular (Fig. 1) and more dense where there was visual evidence of salt problems (lack of vegetation) to ensure that problems areas smaller than 2.5 acres were not excluded from the sampling. At each grid point, samples were collected with an NRCS probe truck using a 3-in.-diameter collection tube. Samples were taken from four depths down to 24 in. in 6-in. increments. The samples were shipped to the University of Arkansas Soil Test Lab at Marianna for routine soil analysis.

The latitude and longitude coordinates were determined for each grid point with a hand-held DGPS (Post Processing). Coordinates for the perimeter of the field were also recorded. Soil nutrient maps were constructed using SSToolbox GIS software (SST Development Group, Inc.). Soil test point data was converted to surface data using kriging procedures.

RESULTS

Soil test results indicated low fertility levels of P, K and pH (Table 1). Field averages of electrical conductivity (EC) and sodium did not indicate excessive levels of soluble salts or sodium at any depth interval. However, sodium levels at all depth intervals were highly variable ranging from 100 lb/acre to greater than 999 lb/acre (Maximum value reported by lab) with coefficients of variation, ranging from 62 to 80%. For a silt loam texture, it is thought that sodium values exceeding 500 lb/acre would adversely impact crop growth. The number of acres exceeding this threshold value increased from 6 acres in the top 12 in. to 7 acres at the 12- to 18-in. depth interval to 24 acres at the 18- to 24-in. depth interval (Fig. 1 and 2).

Because the farmer was considering land leveling this field, elevation data (locations recorded with DGPS) relative to a benchmark datum was obtained from Bowls Surveying (Fig. 3). Overlaying procedures using GIS software were performed on the maps in Fig. 2 and 3 to determine if land leveling would expose more acreage exceeding the 500-lb/acre sodium threshold (Fig. 4). From this analysis, it was determined that potentially 4 more acres of sodium exceeding the threshold might occur in the top 12 in. if land leveling was performed.

[1]Published in Arkansas Soil Fertility Studies 1997, Wayne E. Sabbe, editor. Arkansas Agricultural Experiment Station Research Series 459:24-28.

PRACTICAL APPLICATION

The results obtained from this study have been used to help make crucial management decisions related to this field. From Fig. 1, it was determined that 8% of the field could suffer crop damage from salt. From Fig. 2, 3 and 4, it was determined that land leveling could potentially increase the sodium hazard in the top 12 in. of the root zone by 4 acres up to a total of 13% of the acreage. The farmer proceeded with land leveling because he felt the advantage of better water management outweighed the small increase (5%) in sodium hazard.

By knowing the sodium distribution, the producer was able to prioritize his management options. Instead of focusing his attention on the 8% of the field affected by sodium, he can address the low fertility problems in the other 92% of the field where pH, P and K are limiting crop production. Before, it was assumed that poor crop production from the field as a whole was a result of high salt levels rather than poor fertility.

LITERATURE CITED

SSToolbox. 1996. SST Development Group, Inc. 824 N. Country Club Rd., Stillwater Oklahoma 74075-0918.

Table 1. Selected soil test results by depth.

Depth		ph	P	K	Na	EC
In.			--------lb/acre--------			µmhos/cm
0-6	Mean	4.7	11	67	320	190
	s.d. (+/-)	0.3	4	13	253	265
	Minimum	3.9	10	50	100	35
	Maximum	5.6	29	105	999	1366
6-12	Mean	4.8	11	52	328	128
	s.d. (+/-)	0.5	4	8	220	140
	Minimum	3.9	10	50	113	24
	Maximum	6.8	34	105	999	620
12-18	Mean	4.7	11	53	350	134
	s.d. (+/-)	0.4	2	12	219	141
	Minimum	3.9	10	50	143	24
	Maximum	6.8	19	129	999	620
18-24	Mean	4.6	10	57	418	153
	s.d. (+/-)	0.3	---	15	269	148
	Minimum	4.0	---	50	136	31
	Maximum	6.2	---	148	999	682

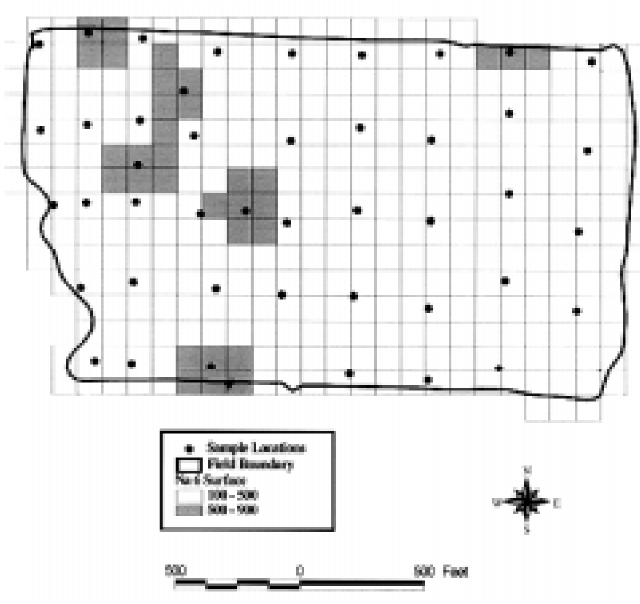

Fig. 1. Map of field boundary, soil sample location and sodium (lb/acre) distribution in the top 6 in. Grid cells represent 10,000 ft^2 (~0.25 acres).

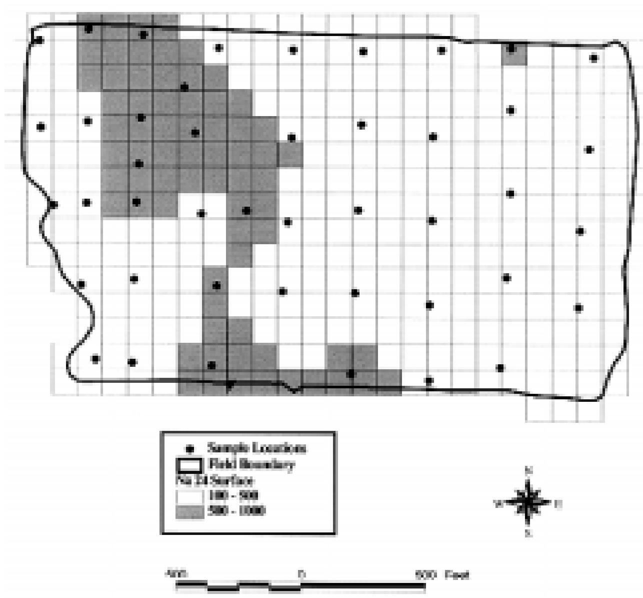

Fig. 2. Map of sodium (lb/acre) distribution at 18 to 24 in. Each grid cell represents 10,000 ft^2 (~0.25 acres).

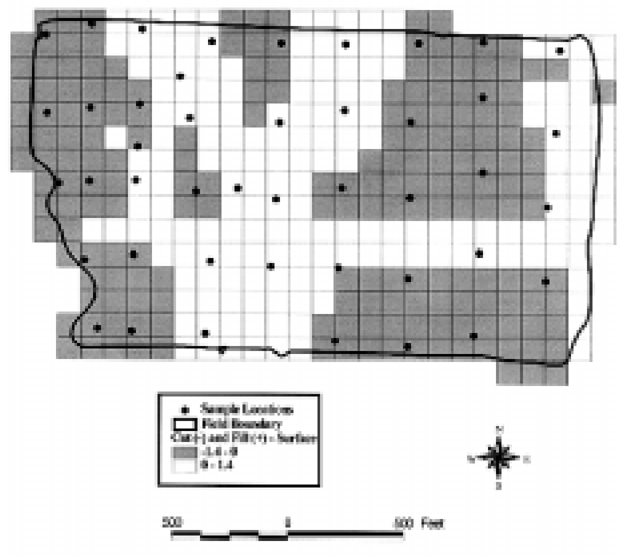

Fig. 3. Map of cut sheet used for land leveling. Positive values refer to areas of fill (ft) while negative values refer to areas of removal (ft). Data furnished by Bowls Surveying, England, Arkansas.

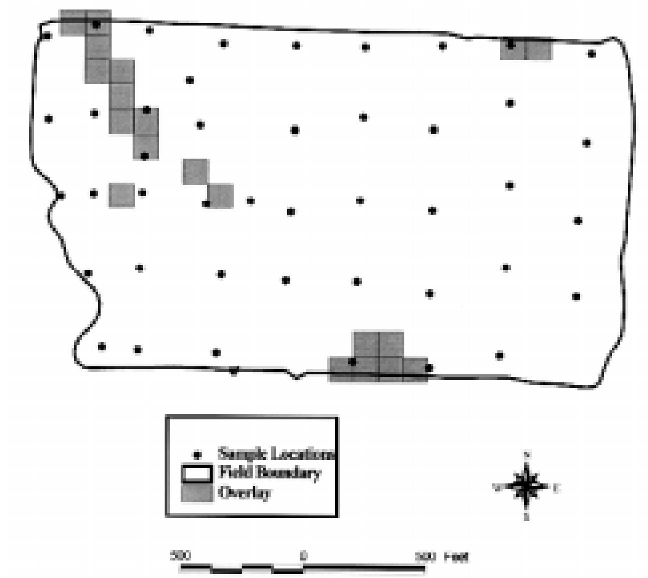

Fig. 4. Map of intersection between cut areas and sodium distribution (>500 lb/acre) at 18 to 24 in. Map created by using overlay techniques on Fig. 2 and 3.