

**SITE-SPECIFIC NITROGEN RATES FOR COTTON
BASED ON SOIL PROPERTIES AND PREVIOUS YIELDS**
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Introduction

Fertilizer recommendations are routinely made for whole cotton fields, even though portions of a field may be more or less productive than others, and have a different fertilizer need. Site-specific fertilizer management uses technologies such as GPS (Global Positioning System) and soil properties to identify where fertilizer rates should be modified. The objective of this project was to determine whether site-specific nitrogen management for cotton fields in the North Mississippi River Delta Region is economically feasible.

Materials and Methods

A Geonics EM38 instrument was used to map the electrical conductivity (EC) of soils in a non-irrigated 10.5-acre cotton field at the University of Missouri-Delta Center (Figure 1). The device is able to distinguish changes in soil texture because silt loam and clay soils usually conduct electricity better than sandy soils. A Natural Resources Conservation Service soil survey map for the field was obtained by using the University of Missouri website (www://cares.missouri.edu/soils, Figure 2). The following nitrogen rates were replicated four times in 1100 foot strips across a cotton field: 0, 30, 60, 90, 120, and 150 pounds N per acre. We measured chlorophyll biweekly in different soil texture areas of each strip using a Minolta Soil-Plant Analyses Development (SPAD) instrument. Before harvest, alleys were cut every 50 feet in the strips. We collected individual yields from every 50 feet area in each plot for a total of 528 yield observations. Latitude and longitude values were assigned to yields from each plot.

Results

The dominant soil type in the test site was Reelfoot loam soil (Table 1). Smaller amounts of the field contain Dundee silt loam, Reelfoot sandy loam, Dundee sandy loam, and Tiptonville silt loam. The primary difference between the Reelfoot and Dundee series is that the Dundee has a silty clay subsoil. The Tiptonville series has slightly better drainage than the Reelfoot and Dundee series. The sandy loam areas of the field contain sand flues which resulted from the New Madrid earthquake which occurred in the early 1800's (Figure 3). Many years of tillage and land leveling have mixed the sand material over large areas. Despite irrigation, cotton in these areas showed water stress faster than the loam and silt loam areas.

In the initial analyzes of the data, we tried to correlate EC with cotton response to nitrogen fertilizer. No interaction between EC and N response was found. However, when the field was divided in two management zones based on soil type and EC, a difference in response curves was found (Figure 4 and 5, Tables 2 and 3). Twenty-eight percent of the field was in Zone 1 which contained the sandiest soil in the test area (Figure 6). In Zone 1, the only year that cotton increased in yield from nitrogen fertilizer was 1999. In Zone 2, cotton yield were higher than Zone 1 and response to N was more consistent. Yield maps also showed that productivity were higher in Zone 2 (Figure 7). Chlorophyll meter readings

showed differences between N rates but a consistent trend between management zones was not found (Figure 8).

An economic analysis of the data with NITROMAX showed that the most profitable N rate in Zone 2 was 111 lb N per acre in 1999, 81 lb N per acre in 2000, and 66 lb N per acre in 2001. If no nitrogen had been applied to Zone 1 in 1999, yields would have been reduced approximately 100 lbs of lint in 1999 ($\$60 \text{ per acre} \times 2.9 \text{ acres} = \174 in crop value). No response in yield from N was found in Zone 1 in 2000 and 2001. Applying no N fertilizer in Zone 1 would have saved approximately \$25 per acre each year in fertilizer costs ($\$25 \text{ per acre} \times 2.9 \text{ acres} \times 3 \text{ years} = \218). When an extra \$1.50 per acre cost for variable rate application is added, the returns for uniform and variable rate nitrogen in this field over three years are even. This assumes that the nitrogen rate in Zone 2 is not reduced in a uniform rate system which would produce below optimum yields. Since there is no way of knowing what the weather will be at the beginning of a year, the most profitable system would be to variably apply N at 30 to 60 lb N in Zone 1 and 90 to 110 rate in Zone 2. This would have been less than the optimum N in Zone 1 in 1999 but the yield reduction would have been small compared to no N.

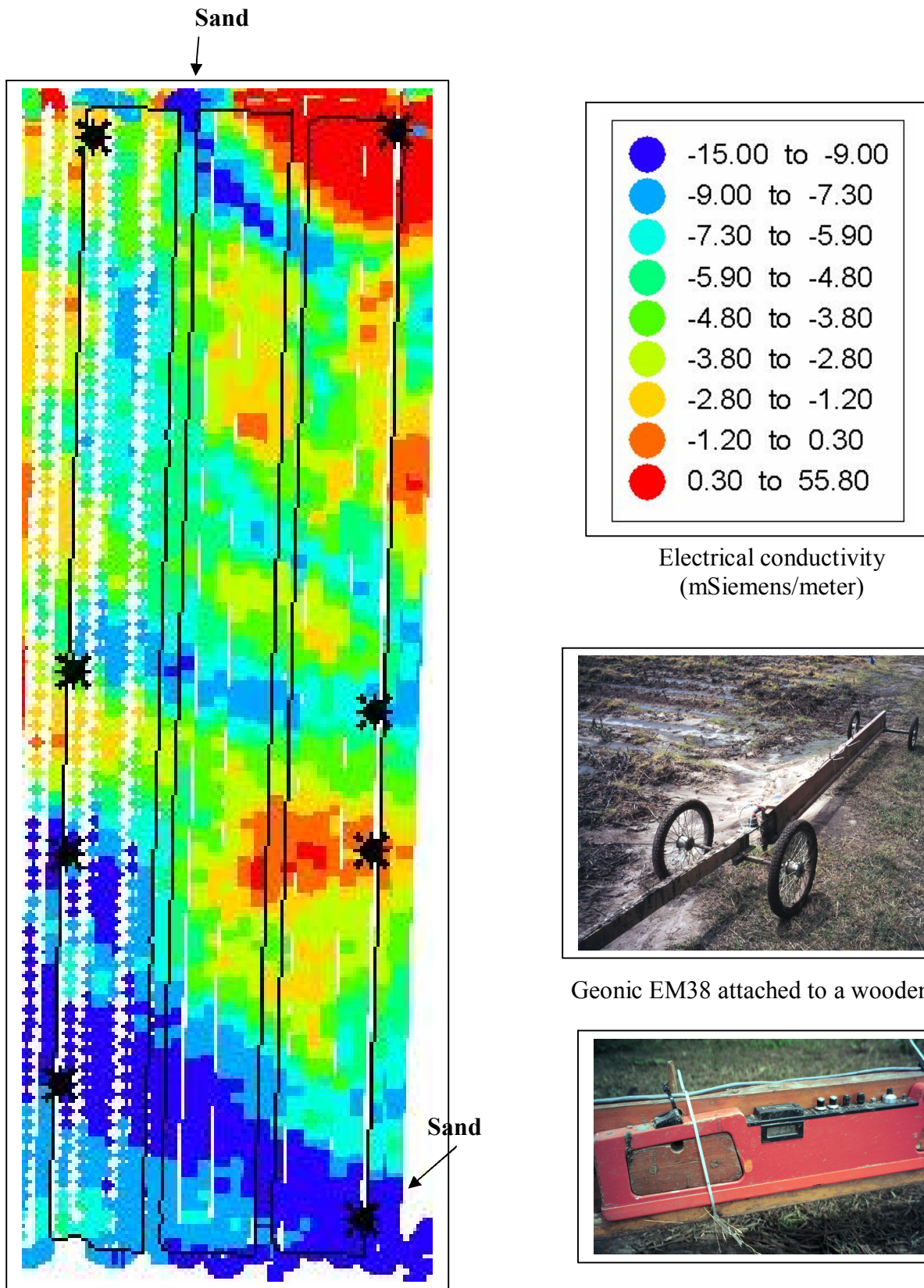


Figure 1. Electrical Conductivity (EC) map of test site made with Geonics EM38.



Figure 2. Bare soil image (top) and transparent soil series overlay (bottom) of test site from MU Center for Agricultural, Resource and Environmental Systems website.

Table 1. Management zones in test site based on Natural Resources Conservation Service Pemiscot County Soil Survey.

Zone	Soil Type	Acres	Total in zone
1	Reelfoot sandy loam	2.66	2.91
	Dundee sandy loam	0.25	
2	Reelfoot loam	5.20	7.62
	Dundee silt loam	2.27	
	Tiptonville silt loam	0.15	

Table 2. Average cotton yield response from nitrogen fertilizer in Management Zone 1 (sandy loam soils).

Treatment	Nitrogen rate lb N/acre	1999	2000	2001
			----lb lint/acre----	
1	0	471	408	596
2	30	446	524	627
3	60	540	471	583
4	90	569	470	542
5	120	586	465	617
6	150	479	443	630

Table 3. Average cotton yield response from nitrogen fertilizer in Management Zone 2 (loam and silt loam soils).

Treatment	Nitrogen rate lb N/acre	1999	2000	2001
			----lb lint/acre----	
1	0	599	617	872
2	30	738	764	899
3	60	728	815	902
4	90	814	899	1034
5	120	813	768	899
6	150	815	741	860

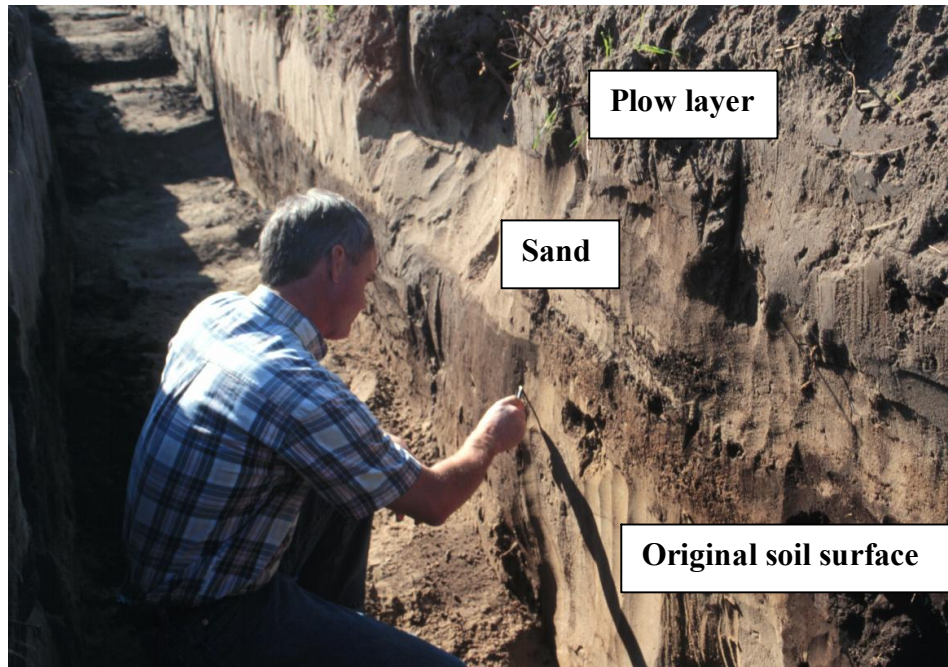


Figure 3. Soil pits showing localized effect of New Madrid earthquake on sand in fields.

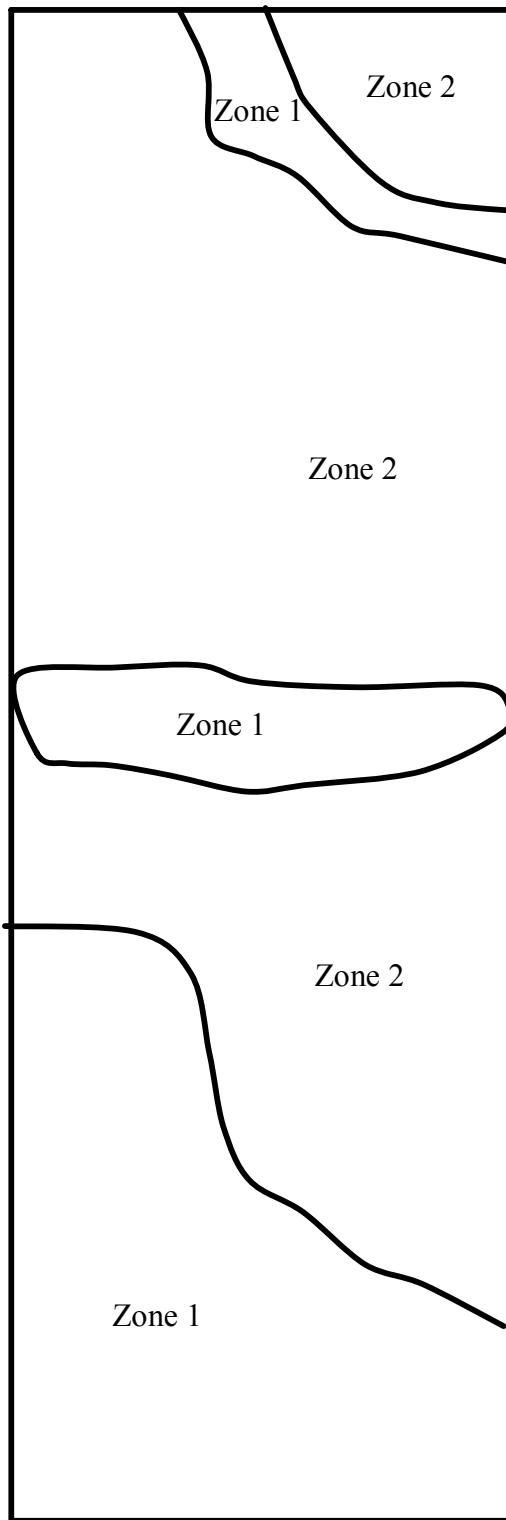
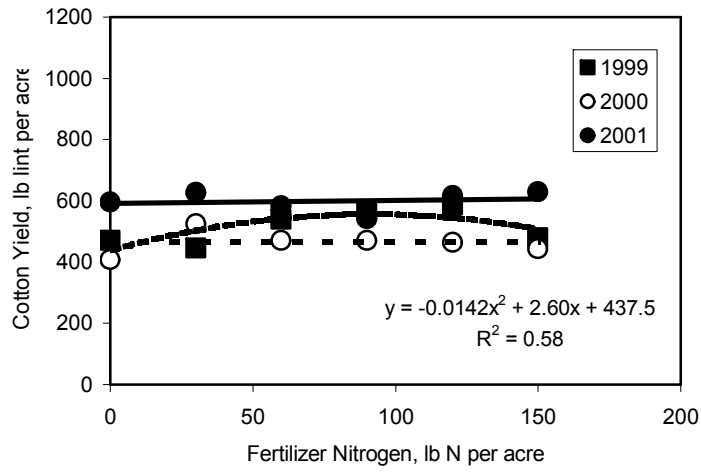


Figure 5. Management zones used in the test site.

Zone 1



Zone 2

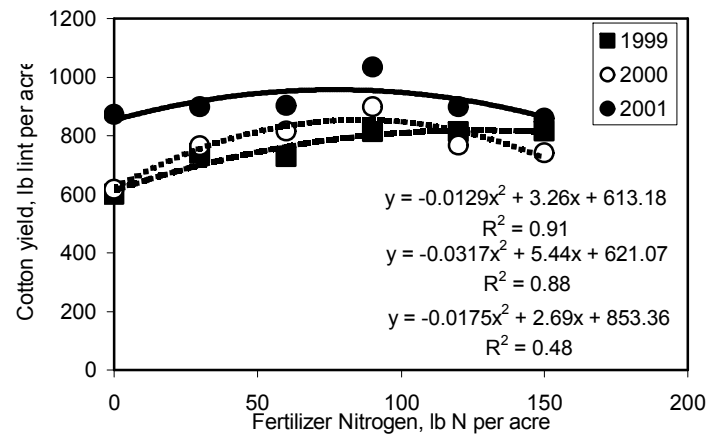


Figure 6. Response curves for cotton yields with different N rates in Zone 1 and 2.

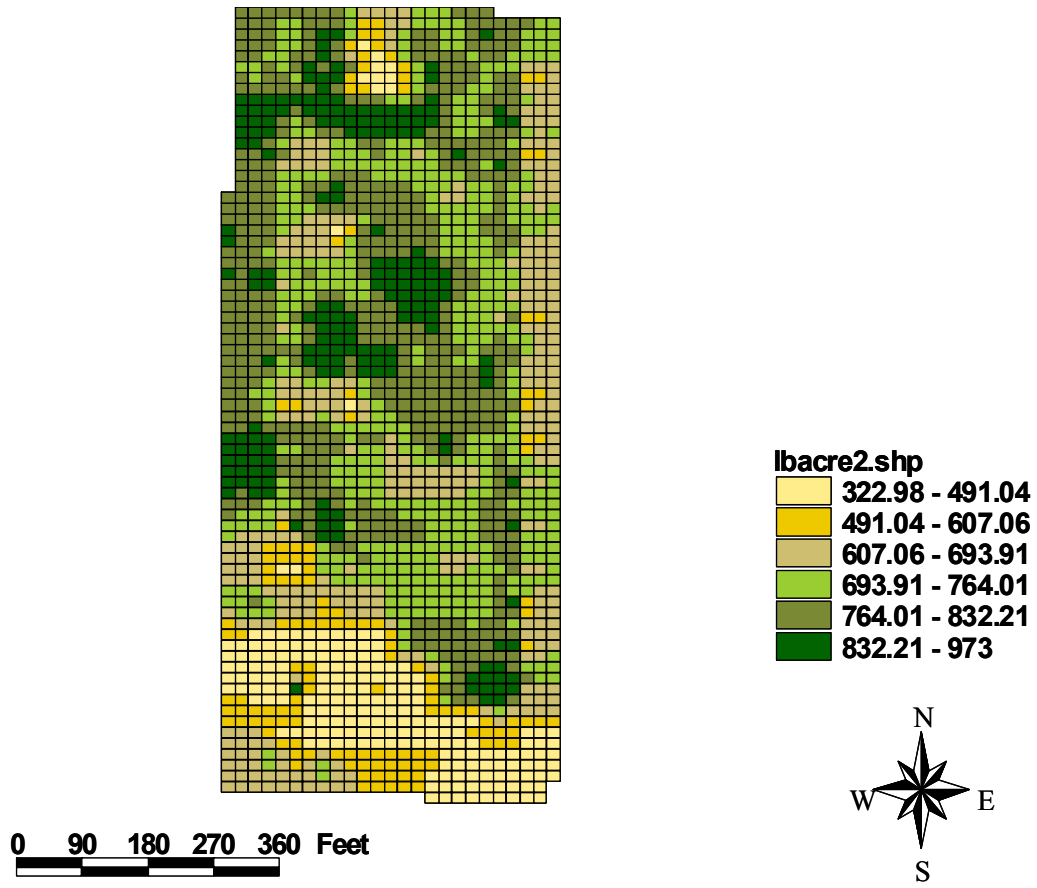


Figure 7. Actual cotton lint yields in the test area as measured with cotton picker in 2000.

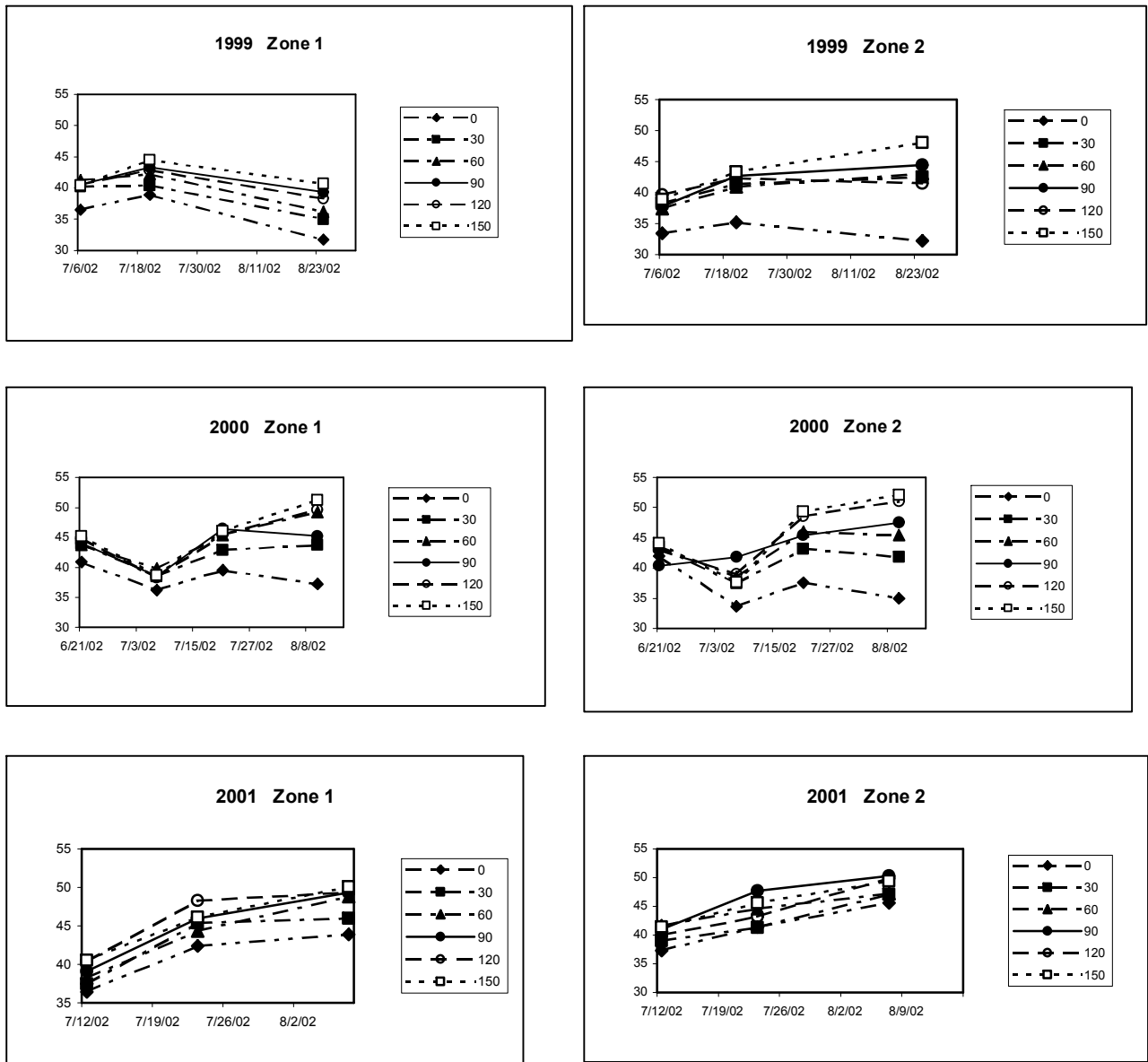


Figure 8. Effect on N rates on Minolta SPAD Chlorophyll meter readings.

