CLEMSON
E X T E N S I O N

IL 65 March 1998

N U T R I E N T
MANAGEMENT

Field Trials on Validation of Phosphorus and Potassium Recommendations for South Carolina During 1996-1997

Nutrient recommendations made by Clemson University—and other universities in the region—are based on years of research on correlating crop responses to fertilizers and corresponding soil-test levels of nitrogen, phosphorus, and potassium. Nitrogen recommendations in the Southeast are not usually based on soil-test results but on crop responses, because nitrogen is so readily leached from the surface soil, and since soils of this region have little nitrogen-supplying power because of their low organic matter content. Whereas potassium and phosphorus reserves can be built up in the soil through fertilization, this is not true with nitrogen (with the exception of short-term storage of nitrogen in crop residues from legumes).

The likelihood that a crop will respond to phosphorus and potassium applications through fertilizers when the soil-test level for those nutrients is Low, Medium, or High is shown in the table below:

Soil-Test Level	*Response Expected*
Low	Yes
Medium	Possibly
High	No

Soil-test levels for both phosphorus and potassium are reliable indicators of how crops will respond to fertilization. The focus of an ongoing Clemson field validation is on phosphorus and potassium.

Based on research experience, Clemson does not recommend fertilization with phosphorus or potassium when the soil-test level is High or above. This has been the topic of debate among some farmers, commercial soil-testing laboratories, and fertilizer dealers.

A typical complaint is that Clemson does not recommend enough fertilizer. Several arguments have been used to support this claim. One is that newer high-yielding varieties of crops require more nutrients than old varieties upon which soil-testing technology is based. Another is that maintenance applications of nutrients are needed to replace those removed by crops, so no matter how high the soil test, some application of phosphorus and potassium is always needed.

Although research has not been able to support these claims, periodic verification of soil-test technology is important to ensure confidence in our recommendations. Therefore, Clemson initiated a research and demonstration project to identify potential weaknesses in our crop recommendations for phosphorus and potassium. This leaflet describes the results from the first year of our studies.

Experimental Details

The farmers and fields involved in the study were selected with the guidance of county Extension agents in Lee, Orangeburg, and Hampton counties. We chose farmers who routinely applied more fertilizers than the rates recommended by Clemson's Agricultural Service Laboratory. Only fields which had Medium to High levels of phosphorus and/or potassium were used in this study.

Participating farmers excluded the appropriate nutrient from one area of their field at the time fertilizer was applied. Typically, the exclusion area is in the middle of the field, the width of a grain drill or planter, and runs the length of the field. The area must be wide enough to allow for the imprecision of commercial fertilizer application. It is also important that fertilizer application to the rest of the field does not affect the test area. The excluded area was fertilized according to Clemson's recommendation, while the remainder of the field was fertilized according to the farmer's regular plan. All other crop and soil management practices were followed in the same way for both areas.

Samples were collected, using soil from the surface to a depth of 36 inches, in 6-inch intervals at three or four locations in each field, depending on its size. Fertility status was confirmed by soil tests. These samples were analyzed at Clemson's Agricultural Service Laboratory.

Results

At harvest time, researchers collected samples for yield estimates from the two areas. Grain or lint yields were recorded at four locations in both the test strip and the farmers' areas. However, in Orangeburg county, yield samples were collected from an extra four locations in the farmer's area because of variation in the terrain within the field.

At each location, wheat was harvested from an area 10 feet in length and three crop rows in width; corn from an area 10 feet long and four crop rows wide; and for cotton, 14.5 feet of row (1/1000 of acre) was hand-picked. Cotton was ginned and the results are reported on lint-weight basis. Drill width spacing was 7 inches for wheat, 38 inches for corn, and 36 inches for cotton.

Table 1. Details of Crop, Variety, and Soil Type

Case	*Location*	*Agent*	*Crop/Variety*	*Soil Type*
I	Lee	Randy Cubbage	Wheat/ NK 9835	Norfolk sandy loam
II	Orangeburg	William Hair	Wheat/ NK 9835	Orangeburg sandy loam
III	Orangeburg	William Hair	Corn/ Pioneer 3394	Lynchburg fine sandy loam
IV	Hampton	Tommy Walker and Hugh Gray	Cotton/Stoneville 474	Norfolk sandy loam

Table 2. Summary of Results

Case	*Soil Test*		*Strategy*	*Recommendation*			*Application*			*Yield**
	P	K		N	P_2O_5	K_2O	N	P_2O_5	K_2O	bu/A or lb/A
I	High	High	Clemson	80	0	0	115	0	0	70
			Farmer				85	51	102	76
II	Med	Med	Clemson	80	40	40	92.5	40	40	48
			Farmer				92.5	35	105	50
III	High	Med	Clemson	120	0	50	141	32	50	130
			Farmer				161	32	150	119
IV	Med	High	Clemson	70	60	0	100	60	0	1054
			Farmer				100	45	100	1086

*Yield differences are non-significant

Preliminary results from the first year of the study are available for two locations for wheat and one location each for cotton and corn for each of the three counties. Details of crop and soil types are given in Table 1.

A Summary of Results is contained in Table 2. Soil-test levels based on our preliminary soil sampling and the corresponding fertilizer recommendation according to *Nutrient Management in South Carolina* (EC 476) are given in this table for each location.

Since each farmer was responsible for delivering the nitrogen requirements, the applied rates of nitrogen were slightly higher than those recommended.

Similarly for Case III (Orangeburg-Corn), the farmer applied a small pop-up dosage of phosphorus, although no phosphorus was recommended due to the field's High soil-test level. Yield levels shown are given in bushels per acre except for cotton where it is given in pounds per acre.

Yield differences between the Clemson test strip and the farmer's area were all found to be statistically non-significant. Actual yields recorded at all the locations showing the field level variations within each sampling area are given in Table 3.

Table 3. Actual Recorded Yield Levels

Case	*Strategy*	*Yield levels (bu/A or lb/A)* Samples within the field			
		1	2	3	4
I	Clemson	56	74	68	83
	Farmer	74	80	78	73
II	Clemson	50	61	35	45
	Farmer	52, 58	42, 56	46, 47	35, 61
III	Clemson	157	137	124	104
	Farmer	128	122	104	123
IV	Clemson	1013	1105	1053	1044
	Farmer	1068	1112	1066	1097

Table 4. Cost Analysis and Estimated Savings: Value of Crop Less Cost of Fertilizer

Strategy	*Case*				*Average*
	I	II	III	IV	
			$		
Clemson	209.07	115.70	280.27	661.00	316.51
Farmer	211.00	112.60	228.17	656.38	304.54
Difference	-1.93	-6.90	+52.10	+4.62	+11.97

Fertilizer Cost Analysis

A cost comparison of fertilizers, applied versus recommended, was made for all the fields to estimate savings. Since the price of fertilizer can vary by dealer and by blend, we used a standard set of fertilizer costs to eliminate these sources of variation. We used current market prices for nitrogen, phosphorus, and potassium or for blended fertilizers at time of publication to make the cost analysis. Actual yield levels were considered while estimating savings for both the Clemson and the farmer strategies, in spite of the differences not being statistically significant. Values in Table 4 show the estimated savings at each location for both strategies and the resulting difference between them, along with a final average savings across all the locations. For Case I and II, the farmer's strategy saved $1.93 and $6.90 per acre respectively, and Clemson's strategy saved $52.10 and $4.62 for Cases III and IV respectively. Across all crops and all locations, Clemson's recommendations saved an average of $11.92. It should be kept in mind that these values are only an indication of the first year's trends. This analysis shows that it is possible to save money by following Clemson's fertilizer recommendations. Any fine-tuning of the recommendations can be possible only by conducting such studies on a long-term basis.

Future Work

More crops and locations will be added each year. This experiment is expected to be repeated for up to 3 years, at each location, possibly on the same farm.

Appreciation

A word of appreciation is due to Richard Gambrell, Carl Myers, Dewey Barefield, Garland Veasey, and Andrew Keeton from Clemson's Crop Science Department and Dr. Lloyd May, USDA-Florence, for their help during pre- and post-harvest operations.

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