Managing Field Soil Fertility Variations

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Abstract

Fertilizer and crop production inputs are most often applied as a single blanket application rate across an entire field. Yet variations in field conditions including soil characteristics and measured crop yield are known to exist and often in a systematic, fashion. Grid soil sampling for fertility variations, plant analyses, and color photography were found to be most useful tools for assessing manageable field variations. Increased profit and environmentally sound improvements in fertilizer use were noted as the greatest benefits to managing field soil fertility variations.

Introduction

Farmers, fertilizer dealers, and agronomists involved in sampling soils and interpreting soil test results have all encountered results that seem incorrect or out of the realm of expectation. So what is the problem? Did the lab mess up? Did the samples get mixed up? Did the samples get taken properly?

The more basic questions might be "how much soil test variation should one expect within a field?" and "if variations exist within a field, did they warrant different rates of fertilization?".

An extension demonstration project was set out to gather information relating to field variations in soil test levels and apply lime, phosphate and potash according to those varitations within the realm of a fertilizer applicator. Results were evaluated on the basis of information gained, changes in fertilizer application from the "normal or average", and resulting economic influence.

Materials and Methods

Ten farmer fields have been intensively soil sampled on 2 to 4 acre grids to address the above questions. The ten fields were all going into corn production. Soil test results were mapped and fertilizer recommendations made accordingly. Follow-up leaf sampling and yield checks were made as verification of appropriate recommendations. For this article only the Scott County site is presented. Of the ten locations, this site represented the greatest amount of variation and potential yield enhancement from utilizing this technology.

Results and Discussion

Greater than 100 % variations in phosphorus soil tests and 60 % variations in potassium were common within any of the fields (Table 1). These variations represent a potential to improve fertilizer application by applying the appropriate rate to each area of the field where changes in soil fertility exist.

Table 1. Phosphorus and potassium soil test variation within Missouri crop production fields.

Field	Bray 1 - P (lbs/a)			Exchangeable K (lbs/a)		
	Low	High	Average	Low	High	Average
1	20	67	42	229	576	393
2	51	144	77	188	354	263
3	23	88	56	259	438	341
4	16	150	66	180	253	218
5	12	33	17	135	263	176
6	44	88	69	328	657	498
7	41	70	55	182	469	293
8	48	124	70	233	372	301
9	66	174	113	365	669	469
10	39	65	53	249	439	311

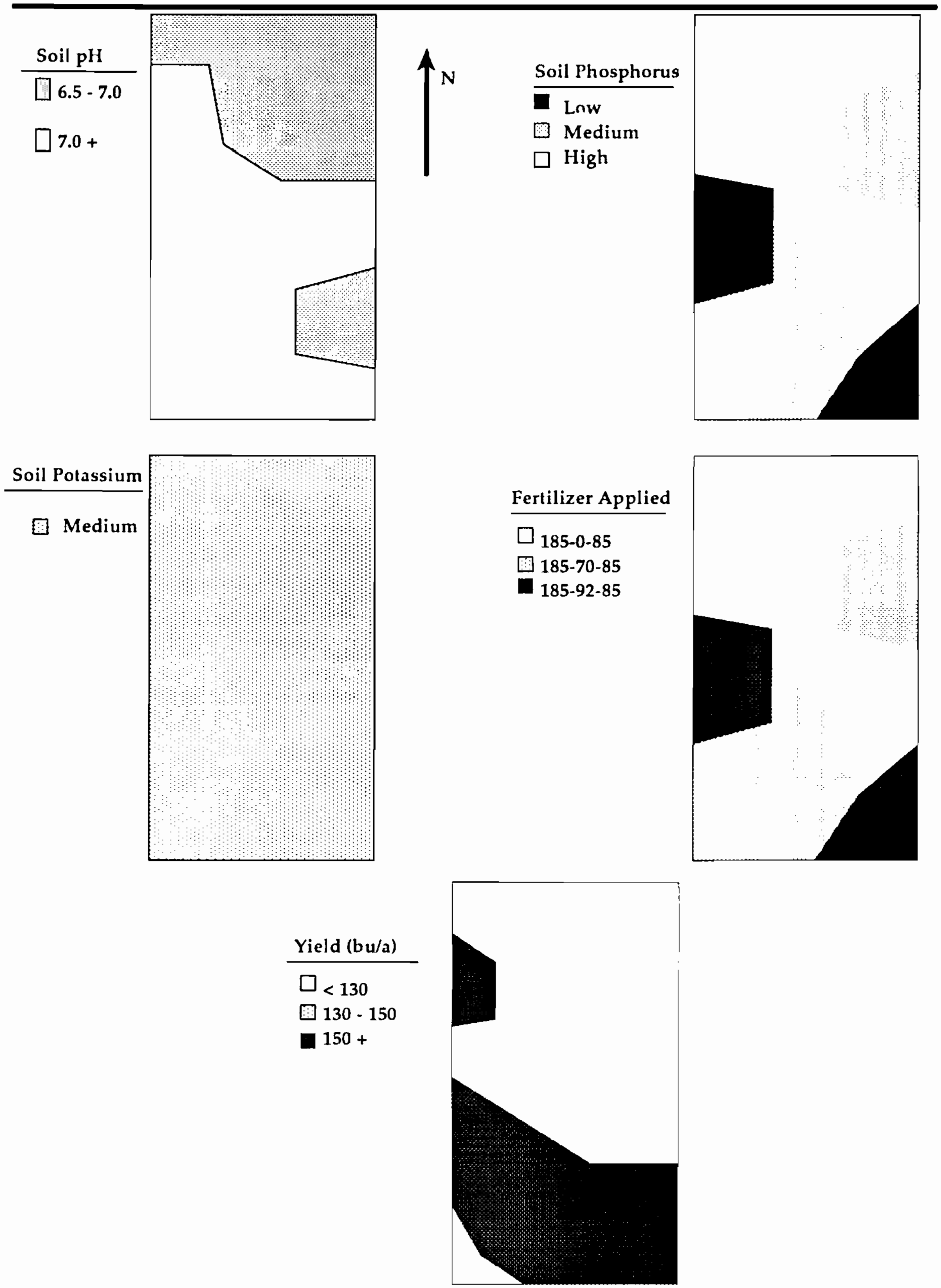
SCOTT COUNTY SITE. (FIGURE 1)

This field was 80 acres in size consisting of two center pivot irrigation systems covering the north and south 40 acre tracts. The field also represented the most diverse soils within a field as might ever be expected. However, the entire field was mapped by soil survey as being one soil. Soil texture ranged from a loamy sand to silty clay loam with definite patterns within the field. Phosphorus soil analyses on a 4 acre basis showed variation from 16 to 150 pounds per acre within the field. This would be interpreted as going from low to very high. Patterns followed soil textural changes. Conversely, potassium was uniformly medium throughout the field. Soil pH was found to be adequate.

Suggestions to the farmer were to apply the phosphate at three rates within the field. The low testing areas of the field, representing 13 acres, received 92 pounds phosphate per acre. Medium test areas, representing 21 acres, received 69 pounds P_2O_5 per acre. High and very high soil P test areas received no phosphate. The farmer also uniformly applied the 85 pounds potash per acre as recommended. Following these recommendations required additional time in spreading the fertilizer. It also represented a significant change in fertilizer rates used previously. Fertilizer rates for phosphate and potash had been 23 and 60 pounds per acre, respectively, in previous years for corn. This rate was nearly identical to the rate that would have been recommended based on the average fertility of the whole field.

The soil fertility pattern for phosphorus was striking in that the soil was most deficient in the precise areas where the farmer had previously indicated best yields were produced. Although he felt the yields were not what they should be in those areas. Thus, showing him the maps made it clear for the first time what very likely was holding back yields in that part of the field.

Figure 1. Lee Pattengill 80 acre corn field, Scott County. Soil fertility determined from a 0-6 inch soil sample. Yields determined from hand harvested check strips.



The sandy areas of the field did not produce high yields and the fertility had been built up in those areas enough to warrant no additional phosphate needs.

Plant analyses showed good nutrition for the crop throughout the growing season. Aerial photos showed only soil patterns indicative of the water holding capacity and no pattern due to fertility. At the time the corn was nearly tasselling, the farmer suggested that was the best crop of corn he had seen on that 80 acre field in years.

Yield checks in the field confirmed 165 bushel yields on the heavier textured soils of the field and an overall field average of 136 bushel per acre. This compares with his expectations based on previous years of 140 to 150 bushel yields in the good areas and a 90 bushel yield average over the entire field. Differential spreading of the phosphate had a marked effect on corn yields on the soils with high yield potential.

In this case our recommendations did result in a greater cost for total fertilizer. (Table 2).

The farmer had routinely been applying 1600 pounds of phosphate and 4800 pounds of potash over the entire field. Our recommendations resulted in his applying 2645 pounds of phosphate and 6800 pounds of potash on the entire field. Total additional cost of the fertilizer materials would be estimated at $350. A field yield increase of about 3 bushels per acre would be needed to offset that cost. Applying the fertilizer where it was needed gave an apparent substantial increase in field yield and profit potential.

If previous yields were at 90 bushel per acre, a 46 bushel yield per acre increase resulted in an estimated $6500 additional income from that 80 acres.

Table 2. FIELD FERTILIZATION PLAN - Scott County Site

lbs/a	nutrient	cost/lb	acres	field cost	notes
Farmer Past Plan and University Extension Average Recommendation(same)					
185	N	$.17	80	$2516	1/2 AA pre, 1/2 Soln side*
20	P_2O_5	.21	80	336	
60	K_2O	.11	80	528	
			Total	3380	
	Intensive Management Recommendation				
185	N	$.17	80	$2516	1/2 AA pre, 1/2 Soln side
92	P_2O_5	.21	13	251	
70	P_2O_5	.21	21	309	
0	P_2O_5	.21	46	0	
85	K_2O	.11	80	748	
			Total	3824	

*AA = anhydrous ammonia, Soln = urea ammonium nitrate solution

SUMMARY

Advantage to detailed soil fertility mapping is apparent through this project. Systematic variation in fields existed such that a logical plan to adjust fertilizer rates within the field generally was evident. Taking this step towards improved fertilizer application at rates appropriate to need within a field can yield advantages such as: improved profit for the farmer, and reduced potential for over fertilization.

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