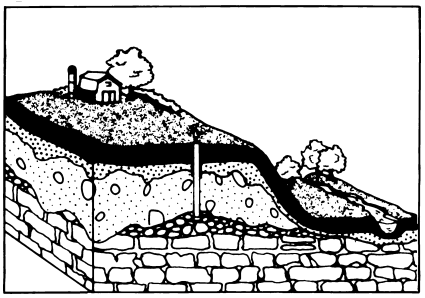

Soil Facts

The Economics of Fertilizer Management

Growers who practice nutrient management apply the proper rate and type of nutrients, and they place these nutrients correctly and at the right time based on their crop needs. Correctly applied nutrients can protect the environment and save money. Part of nutrient management is selecting the correct fertilizers. When choosing commercial fertilizers, remember that there are many different types of materials available that have a wide variation in cost, as can be seen in Table 1. In 2001, nitrogen (N) costs varied from $0.28 to $2.48 per pound and potassium (K) from $0.13 to $1.03 per pound.

Table 1. Comparative costs of nutrients from commonly available fertilizer sources.[a]

Fertilizer Source	Bulk Cost Price/ton	Nitrogen (N)	Phosphate (P_2O_5)	Potash (K_2O)
		Cost/lb of nutrient		
34-0-0	$270	$0.40	NA	NA
30-0-0	$166	$0.28	NA	NA
25-0-0-3	$144	$0.29	NA	NA
21-0-0	$188	$0.45	NA	NA
0-46-0	$224	NA	$0.24	NA
0-0-60	$159	NA	NA	$0.13
0-0-22	$210	NA	NA	$0.48
18-46-0	$210	$0.58	$0.23	NA
17-17-0	$172	$0.51	$0.51	NA
10-34-0	$240	$1.20	$0.35	NA
16-0-0	$255	$0.80	NA	NA
13-0-44	$384	$1.48	NA	$0.44
15-0-14	$288	$0.96	NA	$1.03
8-0-24	$223	$1.39	NA	$0.46
5-10-30	$155	$1.55	$0.78	$0.26
8-8-24	$230	$1.44	$1.44	$0.48
6-6-18	$211	$1.76	$1.76	$0.59
3-6-36	$149	$2.48	$2.48	$0.21

[a] Average costs obtained through a phone survey of three major fertilizer companies in the Neuse River Basin conducted in June, 2001.

Many factors go into decisions about the type of fertilizer used for each crop, including the cost. Table 2 shows some common fertilizers, used both at planting and also during the season, for different crops. As a reminder, fertilizer grades specify relative percentages on a weight basis with N the first number, P_2O_5 the second number, and K_20 the third number: for example, 5-10-30 is 5% N, 10% P_2O_5, and 30% K_2O.

The price of fertilizer programs depends on the amount of fertilizer needed and the fertilizer grade selected. Table 2 shows three standard fertilizer programs for each of the five most commonly grown crops in North Carolina: corn, cotton, flue-cured tobacco, wheat, and soybeans. The amounts of nutrients applied by each program and the costs are shown in Table 3. There is as much as a $42 per acre difference between one fertilizer program and another in the case of tobacco (Table 3).

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Table 2. Fertilizer programs commonly used by growers in eastern North Carolina.[a]

Crop	Program	Starter Fertilizer	Rate lb/acre	In-season Fertilizer[a]	Rate lb/acre
Corn	A	5-10-30	300	30-0-0	350
		30-0-0	100		
	B	5-10-30	300	25-0-0-3[b]	425
		30-0-0	100		
	C	18-46-0	125	30-0-0	430
		0-0-60	300		
Cotton	A	10-34-0	200	25-0-0-3[b]	280
		0-0-60	180		
	B	10-34-0	200	30-0-0	200
		0-0-60	150		
	C	17-17-0	120	30-0-0	200
		0-0-60	175		
Tobacco	A			8-8-24	600
				16-0-0	200
	B			6-6-18	700
				15-0-14	200
	C			6-6-18	1000
				16-0-0	250
Wheat	A	5-10-30	300	30-0-0	350
	B	5-10-30	300	25-0-0-3[b]	425
Soybeans	A	0-0-60	150		
	B	5-10-30	300		
	C[c]	-	-	-	-

[a] Information obtained through electronic mail survey of 15 county Extension agents in the piedmont and coastal plains.
[b] Contains 3% sulfur by weight.
[c] No fertilization in many double-cropped situations.

In North Carolina, most soils utilized for agricultural production have been intensively fertilized for many years and, as a result, have high to very high soil test levels of P and K. Soil test index levels between 51 and 100 are rated as high and levels greater than 100 are considered very high. When P and K indices (P-I and K-I) are greater than 50, most soils need either no extra P and K or only small amounts of P and K to have sufficient amounts of nutrients for many row crops. In 2001, about 75 percent of all soils tested by the Agronomic Division of the North Carolina Department of Agriculture and Consumer Services for major crops in the coastal plains and piedmont had P and K indices greater than 50 (Table 4). Many fields simply do not need additional P or K, and adding these nutrients wastes money and places excess nutrients in the environment.

Table 4. Percentages of soils testing high to very high in P and K by crop, 2001.[a]

Crop	P-I Value > 50	K-I Value > 50
	--%--	--%--
Corn	66	69
Cotton	84	75
Small grains	78	73
Soybeans	76	69
Flue-cured tobacco	87	63

[a] Data compiled by NCDA&CS yearly summary reports; means are compiled across eastern N.C., coastal plains, and piedmont. Indices of 51-100 are high; indices of greater than 100 are very high.

Table 5. Estimated nutrient removal rates of N, P, and K by crops.[a]

Crop	Yield	N	P_2O_5	K_2O	S
		lb/acre			
Corn (grain)	150 bu	112	53	40	10
Cotton	2,600 lb (seed and lint)	63	25	31	5
Potatoes, sweet	300 bu	40	18	96	6
Tobacco, flue cured	3,000 lb	85	15	155	12
Wheat (grain)	40 bu	50	25	15	3

[a] Condensed from Zublena, 1991.

Table 3. Nutrients supplied and costs of standard fertilizer programs used by growers in eastern North Carolina.[a]

Crop	Program	Nitrogen	Phosphate (P_2O_5)	Potassium (K_2O)	Sulfur	Total Cost
		lb/acre				per acre
Corn	A	150	30	90	0	$60.60
	B	151	30	90	13	$62.15
	C	152	58	180	0	$72.67
	Average					**$65.14**
Cotton	A	90	64	108	8	$60.06
	B	80	64	90	0	$52.53
	C	70	20	105	0	$40.83
	Average					**$51.14**
Flue-cured Tobacco	A	80	48	144	X[b]	$94.50
	B	72	35	154	X[b]	$102.60
	C	100	60	180	X[b]	$137.40
	Average					**$111.50**
Wheat	A	120	30	90	0	$48.15
	B	121	30	90	13	$53.85
	Average					**$51.00**
Soybeans	A	0	0	90		$11.93
	B	15	30	90		$23.25
	C[c]	-	-	-		$0.00
	Average					**$11.72**

[a] Fertilizer programs presented in Table 2.
[b] Premium grades of complete tobacco fertilizer contain approximately 3-5% sulfur by weight.
[c] No fertilization in many double-cropped situations.

Although well-fertilized fields are important for optimum production, most crops remove P and K in relatively small quantities (Table 5). Note that potassium is used at much higher levels by tobacco and sweet potatoes than by other crops.

Approximately 50 percent of any fertilizer N that is applied will be used by the crop, and the rest will be potentially lost either through denitrification or leaching. Given these ongoing variable processes in North Carolina, a soil test is not used to predict N needs. Therefore, to determine proper N rates, it is critical to match soil productivity and crop N needs with N fertilizer rates. Nitrogen fertilization should be based on Realistic Yield Expectations (RYEs). Realistic Yield

Expectations estimate soil productivity by taking the average of the best three of five seasons that the same crop is grown in a given field. If producers do not have records to determine RYEs, they can use a statewide database that provides these crop yield numbers by soil type (http://www.soil.ncsu.edu/nmp).

Producers who do not use RYEs to determine their N fertilization rates may apply more N than needed. Table 6 shows different savings levels possible through using RYEs. For cotton there is no savings since the final N rate applied by growers and the amount that should be applied based on the RYEs of cotton are similar. For corn, however, using RYEs reduced the N application rate by 19 pounds per acre, producing a savings of over $5 per acre.

Farmers who follow soil tests and use RYEs to determine N fertilization rates can save over $50 per acre depending on the crop and the nutrient program. For some producers this amount will be much less, while for others it will be greater (Table 7).

Nutrient management costs go beyond simple fertilizer expenses, as seen in Table 8. The cost of these nutrient management activities vary, and some are expenses associated with management.

When the majority of costs are accounted for, farmers can generally save from $2 to over $50 per acre by implementing a nutrient management plan that matches fertilizer applications with nutrient needs, depending on the soil nutrient levels (Table 9).

Reference

Zublena, J. P. 1991. *Soil Facts: Nutrient removal by crops in North Carolina*. The North Carolina Cooperative Extension Service, publication number AG-439-16.

Table 6. Savings through N rate reductions and source selection of nutrient management as compared to average of standard grower programs.[a]

Crop	Soil	Final N Rate Grower	Final N Rate RYE	N Source	Price/Ton	Savings/Acre
		lb/acre				
Cotton	Norfolk	80	79	30-0-0	$166	$0.00
Corn	Norfolk	150	131	30-0-0	$166	$5.26
Corn	Norfolk	150	131	25-0-0	$144	$5.47

[a] Assumes 20 and 40 pounds N per acre applied to cotton and corn at planting from the same source, respectively, and rate differences are in side-dress N. Also assumes that other nutrient applications are the same.

Table 7. Savings through nutrient management utilizing soil tests assuming high soil test levels of P and K with no recommendation as compared to average of grower programs.[a]

Crop	Grower[b]	Nutrient Management	Savings
	$/acre		
Corn	$65.14	$10.32[c]	$54.82
Cotton	$51.14	$10.32[c]	$40.82
Wheat	$51.00	$0.00	$51.00
Soybeans	$11.72	$0.00	$11.72

[a] For each crop, assume that N is applied at the same rates when both programs are compared. Savings are related to costs for P and K inputs only.
[b] Costs are averages of standard fertilizer programs as found in Table 3.
[c] Assumes that a starter of 17-17-0 at 120 pounds per acre is used at planting for both corn and cotton to supply 20 lbs of N and P_2O_5.

Table 8. Economic considerations of nutrient management.

Activity	Additional Costs: Management	Labor	Capital	Potential Returns[a]
Attain tract maps; identify tracts, fields, predominant soil type for each field, rotation[b]	✓		✓	
Soil sampling[c]		✓		
Soil test[d]				
Realistic Yield Expectations (RYE) by crop and site[e]	✓	✓		+
Calculate N rates for each crop and RYE	✓			
Develop a nutrient management plan	✓			
Cost share application	✓			
Split N applications[f]	✓	✓		

[a] Returns will vary by field, crop, year (weather), and management.
[b] Activity will be required only in the first year.
[c] Cost depends on current management.
[d] Free service provided by NCDA&CS Agronomic Services.
[e] Labor involved if monitoring is used to establish RYEs.
[f] Potential cost if not currently implemented.

Table 9. Example of partial budget for nutrient management.[a]

BENEFITS[b]	**PER ACRE PER YEAR**
Reduced inputs	$5.26 (N only) $50.00 (no P and K inputs)
Subtotal	$5.26 - $55.26
COSTS	
Additional expenses or reduced income	$0.75 (soil sample)[b] $1.75 (management)[c]
Subtotal	$2.50
NET PROFIT	**$2.76 - $52.76**

[a] Based on corn data presented in Tables 6 and 7.
[b] Based on soil sampling every 2 years; cost per sampling is $1.50 per acre.
[c] Assuming nutrient management requires 5 days of management time @ $8.50 per hour for 200-acre farm.

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