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Deep Soil Testing Offers the Potential to Reduce Fertilizer Costs

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Soil testing offers the opportunity to control high and variable fertilizer costs by determining the most appropriate type and rate of fertilizer needed for each specific field and crop, and by so doing, enables agricultural producers to achieve optimum annual economic yields.

The application of fertilizer is typically necessary to achieve optimum crop yields in the Coastal Bend of Texas. Fertilizers are used to supplement the available plant nutrients already present in the soil to meet the needs of a specific crop. While plant growth is dependent on various nutrients, this study will focus primarily on nitrogen (N).

According to Lemon (2009), N is more expensive and applied at greater rates than other nutrients needed for cotton production. Prices for N fertilizer products have risen dramatically over the past few years. The cost of urea ammonium nitrate (32-0-0) increased by as much as 211% from 2003 to 2009. Similar or greater price increases have occurred for other fertilizer nutrients, although annual and seasonal price fluctuations have been substantial. The amount of N required by cotton depends on the yield potential and the residual soil N level of a given field. In Texas, research has shown that 50 pounds of available N per acre (from all sources) is needed for each bale of cotton produced. For grain sorghum, the N requirement is about 2 pounds per hundredweight (cwt).

Most plant nutrients have limited solubility and tend to concentrate in the upper 6 inches of soil in minimum till, reduced till and no till fields. Thus, traditional soil tests recommend sampling to a soil depth of 6 inches. However, N is very soluble and can move deeper into the soil with irrigation or rainfall. Fromme (2009) reported that deep soil sampling in the Coastal Bend by Extension measured in excess of 100 pounds of plant available N to a depth of 48 inches at many locations. This is sufficient to provide the N requirements for production of 2-bale/acre cotton, or a 50 cwt/acre grain sorghum crop. Much of this N was located in the 6 to 24-inch zone of soil, and research has shown that N to a depth of 24 inches can be credited at 100% toward fertilizer needs for the crop.

These results suggest that fields should be soil tested each year, as near planting time as possible, to assess the availability of N and other essential plant nutrients. Soil testing offers the opportunity to control high and variable fertilizer costs by determining the most appropriate type and rate of fertilizer needed for each specific field and crop, and by so doing, enables agricultural producers to achieve optimum annual economic yields. More importantly, deep soil sampling (6-24 inches or deeper, if feasible) should be done whenever possible to also allow plant available N below the upper 6-inch zone to be credited.

In addition to reducing fertilizer input costs, proper management of N in cotton production systems can impact the need for and rates of other crop management chemicals, including growth regulators, insecticides and harvest aid chemicals. Excess nitrogen stimulates vegetative growth in cotton and often requires the use of a growth regulator. By managing growth through proper N nutrition, earlier harvest may be possible which could eliminate the need for one or more insecticide applications. Furthermore, growth management can reduce the amount of harvest aid chemical required for harvest preparation.

This study evaluates the financial and management implications of adjusting fertilizer N application rates based on deep soil testing.

Assumptions

Dryland crop enterprise budgets for genetically modified (GMO) cotton and conventional grain sorghum for the Lower Coastal bend were used to illustrate the individual financial impacts of deep soil testing for plant available N and adjusting fertilizer N application rates. Modifications to the budgets were made to reflect assumed fertilizer and chemical applications and to focus only on estimated expenses and cost savings on a per acre basis. Five scenarios for each crop are evaluated: 1) applying the equivalent of 100% of N fertilizer per acre regardless of soil test, 2) applying 75%, 3) applying 50%, 4) applying 25%, and 5) applying 0 lbs/ac. (0%). The last four scenarios assume that results from deep soil sampling recommend a reduction in N fertilizer application rates needed to achieve yield goals.

The general per acre cost assumptions for GMO cotton are given in Table 1 and for conventional grain sorghum in Table 2. Crop yields per acre are assumed to be 40 cwt for grain sorghum and 750 lbs for cotton. It is assumed that a producer would normally apply 75 lbs of N (312 lbs per acre of 24-8-0) for cotton and 80 lbs of N (333 lbs per acre of 24-8-0) for grain sorghum to obtain these yields. A hand probe is used to obtain soil samples and costs $100. The average cost/acre for the probe was estimated at $.06 per acre based on 1,581 crop acres per average farm (2007 Ag. Census average for farms enrolled in crop insurance programs in Nueces County). It was assumed that both a standard surface soil sample (0-6 inches) and a deep soil sample (6-24 inches) were collected and analyzed for every 40 acres at a laboratory cost of $10/sample or $.50/acre. The cost of N fertilizer (24-8-0) is $310/ton in 2011.

The first scenario for cotton assumes the normal application of 75 lbs of N fertilizer (312 lbs of 24-8-0 per acre) at a cost of $37.43/acre. In scenario 2, it is assumed that deep soil sampling shows that only 75% of the normal fertilizer rate or 56.25 lbs/acre of N is needed. The estimated N fertilizer cost drops to $28.07/acre. The third scenario assumes a 50% N application rate or 37.5 lbs/acre at $18.72/acre. In scenario 4, the application rate is 25% N or 18.75 lbs/acre at $9.36/acre. The fifth scenario assumes sufficient N availability in the soil and no N fertilizer applied.

For grain sorghum, it is assumed that 80 lbs of N is required to produce a 40 cwt yield. For each 25% reduction in the amount N required, the rate is reduced 20 lbs per acre and the N cost drops approximately $9.98/acre.

For scenarios 2-5 in cotton where residual soil N levels are more substantial, it is assumed that proper N management (accounting for soil N) will enable the reduction in growth regulator application, the elimination of one insecticide application, and reduce the total harvest aid rate required for cotton defoliation by about 25%.

Residual plant nutrient levels in the soil will vary from year-to-year based on many factors, including fertilizer application rates and plant uptake and removal in the prior year. As a result, only a one-year analysis comparing the five scenarios for each crop was completed. When taken as a whole, this study provides insight into the potential net cost savings per acre that might be achieved using deep soil testing.

Results

Net cost savings per acre increase as N fertilization application rates decline (Tables 1 and 2). In cotton, the largest incremental cost savings ($29.93) per acre occurs when the N rate is reduced from 100% to 75%. This reflects additional savings from reduced boll worm and stink bug sprayings. Cost savings for the 50%, 25%, and 0% N fertilizer scenarios reflect proportionate savings. As expected, the 0% N scenario had the greatest potential savings at $59.14/acre.

Estimated cost savings in conventional grain sorghum from reducing N application rates were not as much as cotton, but still significant. For each 25% reduction in N per acre, cost savings amounted to approximately $10.19/acre. The 0% N scenario resulted in an estimated $40.77/acre cost savings.

Implications

Crop producers are continuously faced with unpredictable and often higher production costs each

Table 1. Estimated Costs per Acre for GMO Cotton & Conventional Till, 750 lb Yield, Coastal Bend

Specified Expenses	% N Applied				
	100%	75%	50%	25%	0%
Seed	$85.50	$85.50	$85.50	$85.50	$85.50
Fertilizer					
Nitrogen	37.43	28.07	18.72	9.36	0.00
Phosporus	13.98	13.98	13.98	13.98	13.98
Zinc	1.18	1.18	1.18	1.18	1.18
Soil Sampling	0.56	0.56	0.56	0.56	0.56
Herbicides					
Glyphosate	11.00	11.00	11.00	11.00	11.00
Triflurilan	5.00	5.00	5.00	5.00	5.00
2,4D	3.25	3.25	3.25	3.25	3.25
Insecticides					
Fleahopper	2.88	2.88	2.88	2.88	2.88
Bollworm	16.80	8.40	8.40	8.40	8.40
Stink Bug	14.40	7.20	7.20	7.20	7.20
Direct Equipment					
Fuel	10.59	10.59	10.59	10.59	10.59
Repairs/Maintenance	11.76	11.76	11.76	11.76	11.76
Pickup Charge	3.88	3.88	3.88	3.88	3.88
Fertilizer Applications	5.25	5.25	5.25	5.25	5.25
Additional Bollworm Spraying	0.52	0.00	0.00	0.00	0.00
Stink Bug Spraying	1.04	0.52	0.52	0.52	0.52
Growth Regulator	2.40	2.00	1.60	1.60	1.60
Harvest					
Custon, Ginning, etc. ($.23/lb.)	172.50	172.50	172.50	172.50	172.50
Defoliant & Surfactant	7.36	6.00	6.00	6.00	6.00
Boll Weevil Program	23.14	23.14	23.14	23.14	23.14
Labor	5.96	5.58	5.58	5.58	5.58
Crop Insurance	13.22	13.22	13.22	13.22	13.22
Interest on Oper. Cap. (5.5%)	12.16	11.41	11.16	10.91	10.67
Variable Expenses	**$461.76**	**$432.87**	**$422.87**	**$413.26**	**$403.66**
Fixed	21.37	20.33	20.33	20.33	20.33
Land Charge	55.00	55.00	55.00	55.00	55.00
Total Expenses	**$538.13**	**$508.20**	**$498.20**	**$488.59**	**$478.99**
Cost Savings Per Acre		**($29.93)**	**($39.93)**	**($49.54)**	**($59.14)**

Implementing the most cost-effective fertilization strategies offers crop producers the potential to improve profitability, liquidity, and ultimately, overall financial condition.

Table 2. Estimated Costs per Acre for Grain Sorghum & Conventional Till, 4,000 lb Yield, Coastal Bend					
	% N Applied				
Grain Sorghum	**100%**	**75%**	**50%**	**25%**	**0%**
Seed	$18.72	$18.72	$18.72	$18.72	$18.72
Fertilizer					
Nitrogen	39.92	29.94	19.96	9.98	0.00
Phosporus	13.98	13.98	13.98	13.98	13.98
Zinc	1.18	1.18	1.18	1.18	1.18
Soil Sampling	0.56	0.56	0.56	0.56	0.56
Herbicides					
2, 4D	3.25	3.25	3.25	3.25	3.25
Glyphosate	6.95	6.95	6.95	6.95	6.95
Atrazine	4.50	4.50	4.50	4.50	4.50
Post Emergence	12.00	12.00	12.00	12.00	12.00
Insecticides (Headworm)	3.25	3.25	3.25	3.25	3.25
Custom Application					
Fuel	15.98	15.98	15.98	15.98	15.98
Repairs/Maintenance	18.83	18.83	18.83	18.83	18.83
Pickup Charge	3.88	3.88	3.88	3.88	3.88
Fertilizer Application	5.25	5.25	5.25	5.25	5.25
Harvest					
Custom Hauling ($.30/cwt x 42)	12.60	12.60	12.60	12.60	12.60
Drying (42 cwt. x $.10)	4.20	4.20	4.20	4.20	4.20
Labor	8.06	8.06	8.06	8.06	8.06
Crop Insurance	4.36	4.36	4.36	4.36	4.36
Interest Oper. Cap. (5.5%)	4.47	4.26	4.04	3.83	3.62
Variable Expenses	$181.94	$171.75	$161.55	$151.36	$141.17
Fixed	31.67	31.67	31.67	31.67	31.67
Land Charge	55.00	55.00	55.00	55.00	55.00
Total Expenses	$268.61	$258.42	$248.22	$238.03	$227.84
Cost Savings Per Acre		**($10.19)**	**($20.39)**	**($30.58)**	**($40.77)**

year. Annual deep soil testing is a management tool that offers the potential for significant savings in production costs. By estimating the N credits available in the soil profile and tailoring N fertilizer application to crop needs to reach production goals, producers will be able to reduce costs in a given year.

In addition to reducing N fertilizer input costs, lower requirements for growth regulators, insecticides and/or harvest aid chemicals in cotton will magnify the economic advantages of proper N management. Earlier crop harvest will also reduce overall production risks and offer greater time resource potential for other on-farm or off-farm economic opportunities. This analysis showed that an "average" 1,581 acre farm with half of its acres in cotton and the other half in grain sorghum could save from $31,695 to $78,979 in production costs by initiating a deep soil sampling program.

Implementing the most cost-effective fertilization strategies offers crop producers the potential to improve profitability, liquidity, and ultimately, overall financial condition. Actual on-farm results will vary depending on weather conditions, management practices, crops produced, and scope of the annual soil testing program. Nevertheless, a judicious manager will evaluate and implement the best operational strategies that benefit the overall financial performance of the farm.

References

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