Texas A&M AgriLife Extension

Agriculture and Natural Resources

Carryover N Management in Corn
Texas A&M AgriLife Extension Service
Medina County

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Summary

Due to market volatility and increasing cost of nitrogen (N) fertilizers, Texas A&M AgriLife Extension Service and Texas A&M AgriLife Research began studying the residual-soil, nitrogen-recovery capabilities of crops at greater soil depths and found that cotton, corn and grain sorghum can efficiently recover residual, soil N to depths of up to 24 inches. Therefore, a trial was established to further demonstrate this capability in corn produced under typical growing conditions in Medina County. Soil samples were collected in the fall across the test area to a depth of 48-inches. Following soil sampling a pre-plant application of 9-24-3 at a rate of 5 gallons/ac was applied to the test area. After crop emergence on April 4, 2012 treatment applications were made as follows: 0 lb N/ac (crediting residual NO_3-N to a 24-inch depth), 40 lb N/ac (crediting residual NO_3-N to a 12-inch depth), 80lb N/ac (crediting residual NO_3-N to a 6-inch depth), and 120 lb N/ac based on a yield goal of 110 bu/ac. Due to the availability of timely irrigation, the test averaged 177.5 bu/ac with no statistical differences (P>(F)=0.5559) between treatments and means for the above treatments ranged from 166.8 to 188 bu/ac. These results support conclusive evidence from other field studies throughout Texas that corn can efficiently recover and utilize residual, soil nitrogen to a 24-inch depth in the soil profile.

Introduction and Study Objective

Nitrogen fertilizer expense has become a significant input issue for most corn producers and N is needed in greatest amounts compared to other nutrients. Nitrogen is often the largest contributor to the cost of production for most crops. For Texas crop producers trying to manage input costs and remain competitive, the volatile and upward trending price of N is a major concern. In addition to high input cost, excessive N can be a factor in higher insect numbers, more disease pressure, and when coupled with late irrigation or excessive rainfall can adversely impact crop maturity. Loss of N through leaching in soil, runoff in surface water and gaseous N losses represent reduced profitability to the grower and can have adverse environmental impacts.

The amount of additional Nand other soil nutrients needed for a crop is determined by conducting a soil test. Traditionally, soil samples have been taken to a depth of 6 inches to evaluate residual, carryover nitrogen available in the soil. However, in light of increasing nitrogen prices, the Texas A&M AgriLife Extension Service and AgriLife Research began studying the residual-soil nitrogen-recovery capabilities of cotton, corn and grain sorghum at greater soil depth and found that these crops can efficiently recover residual, soil NO_3-N down to 24 inches. This enables more effective use of carryover N in the soil and reduces N application rates and associated costs. Therefore, a replicated study was established to demonstrate this capability of corn to mine deeper soil N under typical growing conditions in Medina County.

Materials and Methods

The effect of residual, soil nitrogen recovery by corn was evaluated during the 2012 growing season at the David Kriewald Farm near LaCoste in Medina County, Texas on a Victoria clay. The experimental design was a randomized complete block with four fertility treatments and three replications. Plots consisted of eight rows on 36-inch centers and a length of 210 feet.

In November 2011, soil samples were collected across the test area to a depth of 48-inches to determine the level of residual NO_3-N at various depths within the test area. Sample cores were separated into increments of 0 to 6, 6 to 12, 12 to 24, 24 to 36 and 36 to 48-inches and submitted to the Texas A&M AgriLife Extension Service Soil, Water and Forage Testing Laboratory for analysis. Following soil sampling a pre-plant application of 9-24-3 at a rate of 5 gallons/ac was applied to the test area, delivering an additional 5 lb N/ac.

A pre-emergence application of herbicide was applied and incorporated prior to planting. "DKC66-96" corn was planted in early March into a conventional-tilled, bedded field. The test location was kept weed-free using cultivation and post-emergent herbicide.

After crop emergence on April 4, 2012 treatment applications were side-dress applied to a 5-inch depth and 8 inches off of the seed row using grower equipment. Treatments included the following: 0 lb N/ac crediting residual NO_3-N to a 24-inch depth, 40 lb N/ac crediting residual NO_3-N to a 12-inch depth, 80lb N/ac crediting residual NO_3-N to a 6-inch depth, and 120 lb N/ac based on a reduced yield goal of 110 bu/ac. 28-4-0 was the fertilizer source used. No nutrient deficiencies were observed through the course of this study.

While average irrigated corn yields are much higher in Medina County, a minimal yield goal of 110 bu/ac was used for this study due to an uncertainty on the availability of irrigation water from the local irrigation district during the 2012 growing season. However, irrigation and precipitation proved to be sufficient during the growing season. Irrigation was applied through a linear LEPA irrigation system.

Grain yield (11.83% moisture content on average) was corrected to 15.5% moisture and bu/ac calculated after hand harvesting 35 ft of the two center rows of each plot at maturity. Analysis of variance was performed to determine the effects of residual-soil nitrogen-recovery on grain yield. Where F values were significant, Fisher's protected least significant difference was used to separate means at a significance level of $p < 0.05$.

Results and Discussion

Across the study area, extensive soil sampling showed residual NO_3-N of 16 lb/ac in the first 6-inches of soil, 66 lb/ac in the 6 to 12-inch interval, 42 lb/ac in the 12 to 24-inch interval , and 4 lb/ac in the 24 to 48-inch interval (Figure 1). A total of 124 lb NO_3-N/ac were found in the soil profile from 0 to 24-inches, which met the 120 lb N/ac recommendation for 110 bu/ac corn.

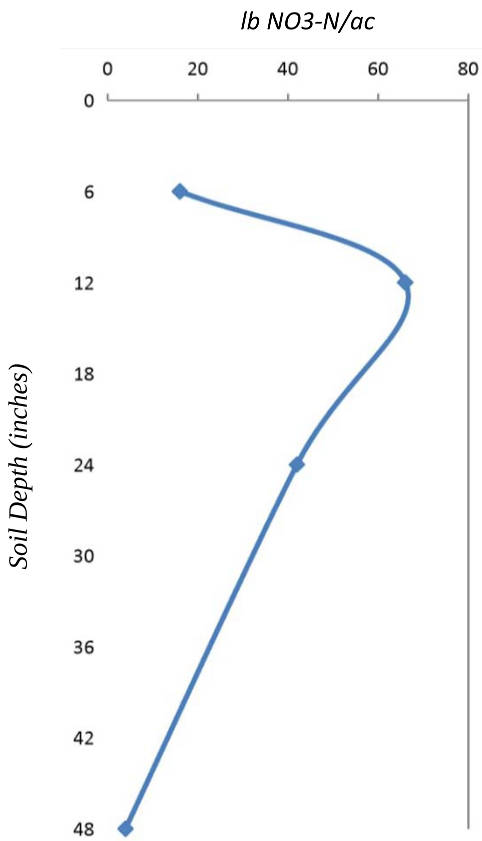

Figure 1. Residual NO_3-N at depth as determined by soil sampling.

With sufficient precipitation and the availability of timely irrigation the test averaged 177.5 bu/ac with no statistical differences (P>(F)=0.5559) between treatments. Means in order of the above treatments were as follows: 166.8, 175.6, 188.0, and 179.8 bu/ac, respectively (Table 1). Test weights were good across all treatments averaging 58.82 lb/bu with no statistical differences (P>(F)=0.3085) between treatments.

Table 1. Yield responses of corn to residual soil nitrogen, Medina County, Texas, 2012.

	Treatment			
	0 lb N/ac	40 lb N/ac	80 lb N/ac	120 lb N/ac
bu/ac	166.8†	175.6	188.0	179.8
lb/bu	58.2	58.8	59.2	59.0

†Means within a row do not differ according to ANOVA F Test (P=0.05).

Economic benefit should also be considered. Assuming a cost of $375 per ton of UAN (32-0-0), side-dressing 40, 80, or 120 lb N/ac would increase grower cost by $23.44, $46.88, and $70.31/ac, respectively. Therefore, any yield increase would have to overcome this cost along with labor and equipment expenses associated with the application of additional N in order to justify side-dressing N when levels of residual NO_3-N are elevated within the top two foot of soil profile as they were at this study site.

Conclusions

These results support the conclusion of other field trials that indicate that corn can efficiently recover residual, carryover soil N to 24 inches in the soil profile. Average corn yields for the four fertility treatments did not increase with increasing N to 120 lbs N/ac due to 124 lb of residual NO_3-N/ac identified in the soil profile to 24 inches. Producers should not assume how much residual-soil N is available in any particular field without annually soil testing to an appropriate depth for residual NO_3-N.

Acknowledgements

Special thanks to the following specialists and cooperators for assisting with this demonstration: Dr. Denis Coker, Dr. Mark McFarland, and Mr. David Kriewald. In addition, special thanks to the Medina County Crops Committee for assisting with these programming efforts.