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IMPACT OF CROP MANAGEMENT AND WEATHER ON SOIL NITROGEN ACCUMULATION

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Abstract

Cost of nitrogen (N) fertilizers has increased 30% to $ 0.30 (per pound of N), since 2000. Preliminary soil tests collected in dryland cotton fields in the Texas Coastal Bend indicates that levels soluble N (NO_3) may be approaching 150 lbs/acre in the upper four feet. Fertilization practices of dryland cotton and grain sorghum typically approaches 90 and 110 lbs N/acre, respectively. While precipitation in the Texas Coastal Bend averages 34.5 inches annually and 13.9 during the growing season, it is quite variable. Examination of historical weather data for the past 40 years indicates that annual precipitation ranged from a high of 50 inches in 1981 to a low of 10 inches in 1962. Growing season precipitation ranged from a high of 28 inches in 1964 to a low of one inch in 1998. Seldom do years with high growing season precipitation and annual precipitation coincide. Given this backdrop of highly variable rainfall, the Crop Production and Management Model (CroPMan, a Windows® version of the EPIC: Erosion Productivity Impact Calculator Model) to evaluate the dynamic processes involving crop N utilization and fate of soil N to ascertain if high subsoil N accumulations were due to dry weather anomalies or to management (i.e., excessive N fertilization and/or crop selection). The simulations focused on typical dryland cotton and grain sorghum grown on in the Texas Coastal Bend. Simulation parameters were: a Victoria clay soil with six foot rooting depth, 1% slope, 9.0 inches of plant available soil water, February 22 and March 15 planting dates for grain sorghum and cotton, respectively, and 40 year daily weather history (1962 to 2002). Scenarios evaluated were continuous cotton, cotton/grain sorghum annual rotation and fertilizer application scenarios that represented typical operations or the CroPMan auto-fertilize mode that optimized applied N with historical daily weather or fixed annual N applications arising from auto-fertilization findings.

Simulations of continuous cotton receiving 90 lbs of applied N per year over the 40-year weather history revealed a mean yield of 1114 lbs lint/acre with 629 lbs soluble N per acre in the upper six feet of the profile. Nitrogen losses averaged 41 lbs N per acre removed by the crop, 47 lbs pounds per acre lost in percolate through the root zone, and 7 lbs per acre lost in surface run off. The cotton/grain sorghum rotation, which received 90/110 lbs applied N per year, averaged 368 lbs soluble N per acre in the six foot profile and 1209 lbs lint/acre and 5078 lbs grain per acre. Annual N losses of 66 lbs per acre were removed by the crops, 34 lbs N per acre lost in percolate through the root zone, and six lbs per acre lost in annual runoff.

CroPMan's auto-fertilize mode indicated that annual applications of 43 and 82 lbs N per acre were required to produce average annual yields of 1106 and 5135 lbs per acre of cotton and grain sorghum. These rates lowered the average soluble N in the six foot profile to 44 and 93 lbs N per acre for grain sorghum and cotton and reduced average annual soluble N losses in percolate to two lbs per acre for cotton and grain sorghum and annual losses on runoff to three and six lbs N per acre for grain sorghum and cotton.

Simulating fixed N applications of 50/85 lbs N per acre for a cotton-grain sorghum annual rotation resulted average soluble N levels in the six-foot profile of 94 lbs per acre with yields of 1200 and 4815 lbs per acre. Average annual N losses were 64 lbs N per acre removed by the crop, eight lbs N per acre lost in percolate, and four lbs N per acre lost in runoff.

These findings study suggest that judicious management of N fertilizers and the use of cotton-grain sorghum can significantly lower high levels of subsoil N without incurring loss in crop yield. On-farm field verification trails will be conducted in the Texas Coastal Bend, and Upper Gulf Coast in coming year's to test/validate these findings.