EFFECT OF DAIRY MANURE ON N PARTITIONING IN ACALA 1517

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Abstract

Current trends in permitting large animal feeding facilities require documenting the nutrient budget for producers utilizing manure in their production system. A 2-year evaluation of cotton nitrogen uptake and removal from the field was undertaken to assist nutrient management specialists in developing nitrogen budgets for irrigated cotton. Dairy manure was applied to supply an equivalent of 120 or 240 pounds of total N per acre. Acala 1517 cotton was sampled in September from each plot and partitioned into lint, seed, and leaves plus stems and bracts. Lint yield and quality were also determined. Generally, there was no negative effect on lint yield or quality due to manure applications. High manure rates (240 lb N/A) resulted in proportionately more N in the vegetative tissue of the plant and did not affect nitrogen removal in the seed or lint. Nitrogen recovery by cotton that could be attributed to manure was approximately 35% in the second year of production. Residual effects of manure on cotton include greater plant height during a "good" year of production.

Introduction

New Mexico is experiencing one of the most rapid increases in dairy production in the U.S. Nearly 4,200 tons of manure N are produced yearly in the state's leading cotton producing counties. The manure, once stockpiled, contains an average 1.8% N. The manure could supply 173 lb N/A, 85 lb N/A and 38 lb N/A in Chaves, Dona Ana, and Eddy counties, respectively, for all the cotton, corn and 1/3 of the hay acreage (Table 1).

Irrigated cotton requires nitrogen for plant production. However, N mineralization from manure over the entire growing season could cause delayed maturity due to excess N causing vegetative growth at the wrong time of year. Excess growth could also warrant growth regulator applications when the practice would otherwise not be needed. Additionally, producers have concerns over accumulated salt content in the soil, weed problems introduced by the manure, and overall quality of the cotton crop.

Current guidelines for nutrient management require an accounting for the nitrogen that enters and leaves a production field. New Mexico has very few fertility studies that describe the nutrient budget for a cotton production system. This project was established to evaluate the short and long-term effects of dairy manure on cotton yield and quality as well as effects on soil properties.

Materials and Methods

Acala 1517 was planted at the NMSU Agricultural Science Center according to standard agronomic practices for the Artesia area. Prior to planting, stockpiled dairy manure was utilized alongside synthetic N, P and K fertilizer to supply 120 or 240 lb N/A. A control received no nitrogen. Plots were 50 feet long and 40 feet wide. Plots were further subdivided into 4, 40-inch rows to evaluate residual effects of the applied manure.

Plants were harvested from two, 3-foot lengths of rows in late September and partitioned into leaves and stems, seed, and lint. All plant parts were dried, weighed, and ground for total N analysis. All harvested plants were mapped for fruit retention, boll position, number of nodes and other factors typical for cotton performance. Lint yield was determined from two center rows of each plot with a mechanical picker. Lint quality was determined from 15-boll samples taken one week prior to harvest.

Discussion

Lint yield was not negatively affected by dairy manure. There was no delayed maturity due to manure. The best production year was 1998 with an average lint yield of 1214 lb/A (Table 2). First pick cotton yields were lower from synthetic fertilizer plots that received 240 lb N/A. Exceptional cotton yield without fertilizer warrants more years of production to evaluate the economics of nitrogen fertilization.

Nitrogen removal was similar among all treatments when lint and seed were considered in 1996 and 1997 (Table 3). However, nearly twice as much N was removed in the seed in 1996 as compared to 1997. Nitrogen removed in the lint did not change between 1996 and 1997. Nitrogen data for 1998 was not available at the time of the conference. Nitrogen appeared to accumulate in the leaves and stems at the high rate of N application from both manure and synthetic fertilizer in 1996 (Table 4). Only the high rate of manure application in 1997 favored accumulation of N in leaves and stems.

The proportion of N in leaves and stems increased from an average of 47% to 55% when manure was applied at 240 lb N/A in 1997 (Table 4). The proportion of N in the vegetative material in 1996 was 75% from the high synthetic N rate and nearly 60% for all other treatments. Nitrogen removed by the seed remained at 26% of the whole plant N. The proportion of N in the lint ranged from 9% to 29% across both years (Table 4). Generally, there was an increase in the percent N in the lint from 1996 to

Reprinted from the *Proceedings of the Beltwide Cotton Conference*
Volume 2:1273-1275 (1999)
National Cotton Council, Memphis TN

1997. If the trend continues for more N to be removed from the field as lint and seed, the better, the situation will be when environmental regulations seek to limit manure applications to agricultural land.

Many producers have expressed concern over increasing the salt content of the soil with repeated applications of manure. There was no change in soil electrical conductivity as result of three years of manure application (Table 5). If anything, the amount of extractable phosphorus increased from very low to low. Perhaps over the long term phosphorus fertility on calcareous soils will improve with repeated applications of manure.

The amount of nitrogen that could be attributed to the manure increased from an average of 7% during the first year to 35% in the second year of application. The cumulative effects of repeated application may just be starting to express in 1998. Plant height was greater from plots that received manure in 1996 and 1997 than plots that received manure in 1998 or any other treatment. It may become necessary to control plant height with growth regulators with repeated applications of manure.

Summary

Dairy manure had no detrimental effects on cotton yield over the past three years. Exceptional lint production under no N fertilizer warrants further study of NM cotton fertilizer recommendations. Up to 35% of the N from manure was accounted for in the cotton crop after two years of application. This percentage may change with further application of dairy manure. Cotton will continue to play a major role in nutrient management from dairy manure in New Mexico agriculture.

References

New Mexico Agricultural Statistics Service. 1996. United States Department of Agriculture and New Mexico Dept. of Agriculture. Las Cruces, NM.

Table 1. New Mexico manure nitrogen available to all cotton, corn, and one-third of all the hay acreage per year in the leading cotton producing counties.

County	Tons Manure (1.8% N)	lb N/A
Chaves	2400	175
Doña Ana	1400	83
Eddy	400	38

Table 2. Lint yield as affected by manure and synthetic fertilizer applied to supply 120 (1X) or 240 lb N/A (2X).

	Year		
Treatment	1996	1997	1998
	lb lint/A		
Zero	841	218	1161
Inorganic 1X	745	197	1219
Inorganic 2X	648	205	1237
Manure 1X	834	266	1260
Manure 2X	893	187	1235
$LSD_{(0.10)}$	NS	NS	NS
Mean	792	208	1214

Table 3. Nitrogen partitioning by plant part as affected by manure and synthetic fertilizer applied to supply 120 (1X) or 240 lb N/A (2X) after two years of application.

	Plant Part							
Treatment	Leaves+Stems		All Seed		All Lint		Whole	
	Year							
	1996	1997	1996	1997	1996	1997	1996	1997
	lb N/A							
Zero	119	41	58	23	28	26	205	90
Inorganic 1X	181	57	74	32	32	36	286	124
Inorganic 2X	275	63	73	36	35	31	383	129
Manure 1X	99	62	56	35	28	33	183	130
Manure 2X	142	90	59	41	36	34	237	164
$LSD_{(0.10)}$	38	35	NS	NS	NS	NS	43	25
Mean	163	63	64	33	32	32	259	127

Table 4. Proportional distribution of nitrogen as affected by manure and synthetic fertilizer applied to supply 120 (1X) or 240 lb N/A (2X) after the first year of application.

	Plant Part							
Treatment	Leaves + Stems		All Seed		All Lint		Lint+Seed	
	Year							
	1996	1997	1996	1997	1996	1997	1996	1997
	Proportion of the Whole							
Zero	0.58	0.46	0.28	0.26	0.14	0.29	0.43	0.54
Inorganic 1X	0.63	0.46	0.26	0.25	0.11	0.29	0.37	0.54
Inorganic 2X	0.72	0.48	0.19	0.28	0.09	0.24	0.31	0.52
Manure 1X	0.54	0.47	0.30	0.27	0.15	0.26	0.46	0.53
Manure 2X	0.60	0.55	0.25	0.25	0.15	0.21	0.41	0.45
$LSD_{(0.10)}$	0.08	0.05	NS	NS	0.04	0.05	0.06	0.05
Mean	0.61	0.48	0.26	0.26	0.13	0.26	0.40	0.52

Table 5. Soil properties after three years of manure supplying 240 lb N/year.

	ρH	e.c.	Organic Matter	Phosphorus	Potassium
		mmhos/cm	%	ppm	
Zero	8.2	0.88	1.3	3.45	>700
after 3 year	8.2	0.92	1.4	5.90	>700