UPLAND COTTON RESPONSE TO DAIRY MANURE AS A N FERTILIZER UNDER CALCAREOUS, FURROW IRRIGATED CONDITIONS

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Abstract

Dairy production has risen dramatically in New Mexico, particularly in the leading cotton production counties of Doña Ana, Chaves and Eddy. A readily available source of manure is available for use in crop production systems in these regions. Plots were treated with fresh dairy manure and inorganic fertilizer to supply 128 pounds N per acre (recommended N rate based on soil test) or 256 pounds N per acre. There was a zero N check. All plots received the same P, K, Mg and S supplied by the high rate of manure. Both rates of manure decreased the amount of lint in the first picking. Final yield, however, was not significantly different among treatments with an average 796 pounds lint per acre. Nitrogen removal by the cotton plant indicated that dairy manure provided an additional 38 pounds of N per acre during the growing season over the check plot. There was no difference in N uptake due to rate of application indicating that factors other than quantity of N influenced N uptake. Furrow irrigation often results in very dry conditions in the surface horizon where manure is typically incorporated and may limit N uptake. Rain events could trigger additional N release from the manure. Based on one year of data, cotton producers using fresh manure should limit applications to less than 2 dry tons per acre to limit delays in maturity.

Introduction

The fertilizer value of manures has been known for centuries. Manures contain a readily available N source and a slow release N source (organic fraction). The organic fraction has many of the properties of an ideal N fertilizer; it is not subject to leaching or denitrification losses and is not toxic to plants. Also, since mineralization of organic to inorganic forms of N is favored by the same moisture and temperature conditions for crop growth, conversion occurs at a rate proportional to crop growth (Bouldin et al., 1984).

Manures can eliminate or reduce the need for costly nitrogen fertilizers (Ketcheson and Beauchamp, 1978; Sims, 1987). Manures alone often produce favorable crop yields (Carrecker et al., 1973; Ketcheson and Beauchamp, 1978; Sims, 1987). Increased availability of soil P, K (Robertson and Wolford, 1970; Robertson et al., 1975), and zinc (Zn) (Singh et al., 1979) has been documented for soils receiving manure applications. Benefits to soil physical properties resulting from manure applications include increased soil water holding capacity, increased water stable aggregates, and lowered soil bulk density (Weil, 1977).

The slow release nature of N from manure, however, may contribute too much N to a cotton crop late in the season and delay maturity. Since the mineralization of N from manure is controlled by soil moisture, irrigation practices in New Mexico may limit the amount of N released late in the season. Rain, although sparse (12" per year), may stimulate a release of N and cause additional growth.

In New Mexico, dairy production is the predominant confined animal feeding operation. Cash receipts for over 170,000 lactating cows were over $393 million dollars in 1994 (NMAS, 1994). Estimates from NRCS data for manure generation account for nearly 3.4 million tons of manure generated by this industry alone. Nutrients present in the manure could, if available where needed on an economically competitive basis, adequately fertilize every acre of alfalfa, cotton, chile, corn, sorghum, potatoes and peanuts grown in dairy production centers. However, because of the challenges in distribution and acceptance by local crop producers, the value of manure is not being fully realized.

Legitimate concerns for utilizing dairy manure for cotton production include potential delayed maturity, nutrient sufficiency, cotton yield and quality, economics and appropriate application rates specific for New Mexico. The objectives of this study were to determine the effect of dairy manure on cotton production parameters for a furrow irrigated, calcareous soil in New Mexico. Yield data is presented for one year of production.

Materials and Methods

Acala 1517-95, an upland cotton variety from the New Mexico Agricultural Experiment Station was planted May 14, 1996. Weed control was established with Treflan at 1 ½ pt per acre on March 19 and Staple at 1 oz/A on June 25. Dairy manure (Table 1) and an inorganic mix of fertilizer was applied April 30 to supply 128 pounds N/A as recommended by soil test data (Table 2) and 256 pounds N/A which was double the recommended N rate. Plots were arranged in a randomized complete block with five replications. Phosphorus, potassium, sulfur and magnesium were applied to all plots, including the check to match the total amounts applied in the high rate of manure. A total of 19.8 inches of irrigation water were applied through July 31. An additional 5.97 inches of rain during the growing season also contributed water to the plant.

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Results and Discussion

Dairy manure as a N source in cotton production for the first year when applied to supply 128 lb total N/A or 256 lb N/A resulted in delayed maturity (Figure 1). Seed cotton yield was reduced in the first picking by manure treated plots (Figure 1). However, a lengthy growing season characterized by 2,670 accumulated heat units (base 60°F, no upper limit) from April 1 to October 1 and a late freeze allowed the second picking to equalize the total yield. The average percent lint was 36% resulting in an average 796 pounds of lint per acre for all treatments.

N removal from the soil was greatest from the high rate of dairy manure (Figure 2). The fertilizer value of fresh dairy manure for this first year of cotton production indicated that approximately 38 to 40 pounds of N were made available to the plant over the growing season (Figure 3) (subtracting the N uptake from the check plot). On a percentage basis, this is only 30% of the total N applied from manure. It is expected that mineralization rates are reduced under furrow irrigated conditions where there is a significant amount of soil drying prior to irrigation and would account, in part, for the low quantity of N removed in the above ground portion of the plant.

Conclusions

Use of dairy manure for cotton production in New Mexico should be approached with some caution. In a good year when there is ample time for cotton development fresh dairy manure will not affect total lint yield. Further studies are under way to evaluate lint quality as affected by N source and further determine the fertilizer value of this resource for New Mexico crop producers.

References

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Table 1. Dairy manure characteristics.

Element	N	P_2O_5	K_2O	S	Mg	Ca	Na	Fe	Cu	Zn	Water
	---------- pounds per ton ----------										
dry basis	45	34	76	15	18	38	14	1.61	0.12	0.29	48%

Table 2. Surface soil (top 12") characteristics.

pH	e.c.	O.M.	P_2O_5	NO_3-N	K_2O
	mmhos/cm	%	---------- lb/A ----------		
8.0	1.4	1.3	35	24	2280

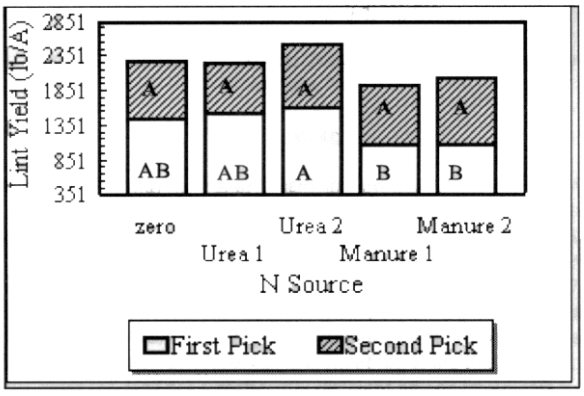

Figure 1. Seed cotton yield as affected by N source in 1996 at the NMSU Agricultural Science Center at Artesia. Same letter for each shaded bar indicates no difference at alpha=0.1.

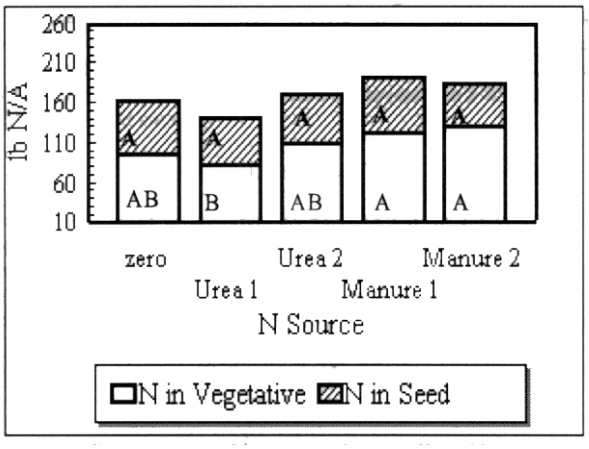

Figure 2. Nitrogen removal by cotton plant as affected by N source in 1996 at the NMSU Agricultural Science Center at Artesia. Same letter in each bar for vegetative or seed indicates no difference at alpha=0.1.

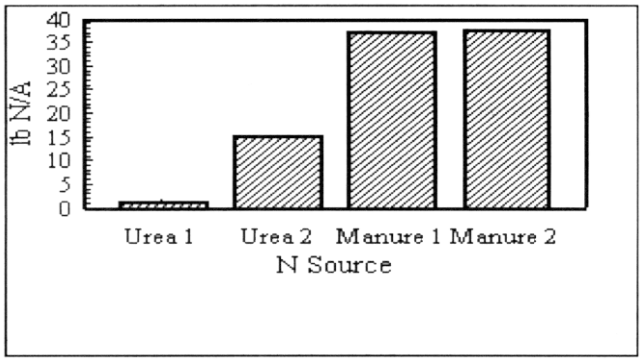

Figure 3. N uptake attributable to N source for cotton production in 1996 at the NMSU Agricultural Science Center in Artesia, NM.