Forage Research in Texas, 1994

PERFORMANCE OF WARM-SEASON ANNUAL FORAGES UNDER NITROGEN FERTILIZER APPLICATION SCHEMES ON TWO-YEAR-OLD RESIDUAL MANURED SOIL

E. S. Chasteen, G. D. Alston, and M. A. Sanderson

Summary

Emphasis is being placed on dairy operators to improve their agronomic practices by adopting nutrient management plans to effectively utilize their animal wastes on cropland. Two sorghum-sudangrass (Sorghum bicolor L.) and three pearl millet (Pennisetum americanum (L.)Leeke) hybrids were tested under applications of 40, 80, and 120 lb nitrogen (N)/acre on previously manured soil at 0, 5, 10, and 15 tons/acre. Dry matter yields of all warm-season annuals averaged among three fertilizer N rates were greater on the 10 and 15 ton/acre (dry weight) residual manure rates compared to the 0 and 5 ton/acre rate. Yields of warm-season annuals were greatest at under 80 lb of fertilizer N/acre rates averaged among four residual manure. Sorghum-sudangrasses hybrid produced yields greater than the three millets. 'Mil-Hy-99' and 'Mil-Hy-300' yielded more than 'Tifleaf-1' millets.

Introduction

Open lot dairies in central Texas frequently spread solid manure collected from cattle confinement areas on cropland. Improper disposal of manure and over-fertilization of cropland has been blamed for high nutrient and bacteria loading from runoff into tributaries of the North Bosque River in Erath county (TWC and TSSWCB 1988). To reduce nonpoint source (NPS) pollution from cropland, dairy operators are adopting a nutrient management plan concept to utilize their wastes more effectively with sustainable forage systems. In some cases, solid dairy manure may be spread onto a particular field once every few years when the dairy has abundant cropland available for manure disposal. Therefore, integrating the use of dairy manure with inorganic N fertilizer to produce forages could be part of the operator's nutrient management plan. This demonstration was conducted to evaluate yields of warm-season annual forages grown under different rates of N fertilizer on non-manured soil and soil that has received varing rates of dairy manure two-years previously.

Keywords: N fertilizer/dairy manure/sorghum-sudangrass/millet

Procedure

Solid dairy manure was applied on 7 May 1991 at rates of 0, 5, 10, and 15 ton/acre (dry-weight) on a Waurika series, fine sandy loam soil at the Texas A&M University Agricultural Research and Extension Center at Stephenville. Manure was applied to plots 40 ft wide by 470 ft long replicated twice. Solid dairy manure was applied with a flail manure spreader and disked twice into the soil. The spreader was calibrated by driving over a 4 ft 8 in. square (21.8 sq ft) sheet and weighing the manure collected on the sheet. One lb of wet manure collected on the 21.8 sq ft sheet was equivalent to 1 ton of wet manure per acre. Manure was sampled and frozen in a plastic container until analyzed for nutrients by the Texas Agricultural Extension Service Soil, Water, and Plant Testing Laboratory at College Station. The amount of nutrients applied from rates of solid dairy manure during 1991 are in Table 1. Dryland and irrigated 'Runner' and 'Spanish' peanuts (Arachis hypogaea) grown with no inorganic fertilizer were blocked across manure rates during 1991 and 1992. Manured plots were 20 by 40 ft and randomized in two complete blocks. On 20 Apr. 1993, ammonium-nitrate (NH_4-NO_3) fertilizer at 40, 80, and 120 lb N/acre rates were disked into the soil in 100 by 320 ft strips across the two-year-old residual manure treatments of 0, 5, 10, and 15 ton/acre. Two sorghum-sudangrass (Sorghum bicolor L.) hybrids (85 lb seed/acre) and three pearl millet (Pennisetum americanum (L.) Leeke) hybrids (20 lb seed/acre) were drilled across residual manure and fertilizer rates on 21 Apr. 1993. Conlee Seed Company in Waco, TX supplied all seed. Data were analyzed as a split-split-plot with manure rates arranged as main plots, hybrids as sub-plots, and fertilizer N rates as sub-sub-plots (Gomez and Gomez, 1984). Forages were harvested once at boot-stage with a sickle mower (6-in. stubble height) and yield determined on an oven-dry (131°F for 72 hr) basis. All statistical procedures were performed with PC-SAS (SAS Institute 1988).

Results and Discussion

Dry matter yields averaged across N rates and forage varieties responded ($P<0.01$) to residual manure rates (Fig. 1). The 10 and 15 ton/acre residual manure rates produced the greatest dry matter yields. Yields were similar between the 40 and 120 lb N/acre rates but less than the 80 lb N acre rate (Fig. 2). A residual manure rate by hybrid or N fertilizer rate by hybrid interactions did not occur, indicating that all entries responded similarly to rates. Also, no interaction occurred between residual manure by fertilizer N rates, which indicated that yields responded similarly to fertilizer N and residual manure rate combinations.

Dry matter yields of 'Do-Mor' and 'Super-Su-22' sorghum-sudangrasses were similar

averaged among residual manure and fertilizer N rates (Fig. 3). Averaged among residual manure and N fertilizer rates, dry matter yields of Mil-Hy-99 and Mil-Hy-300 millets were similar and both were greater ($P<0.001$) than Tifleaf-1 millet. Mean yield of the two sorghum-sudangrasses was greater ($P<0.001$) than the three millets.

Obviously, nutrients from higher residual manure rates were still present in the soil as yields of warm-season forages were greater under higher residual manure rates averaged over fertilizer N rates. Applying 120 lb/acre of fertilizer N on previously manured or non-manured soil resulted in no advantage to forage production. Applying fertilizer N at 80 lb/acre on previously manured or non-manured soil resulted in the highest forage yields and reduced the amount of N that potentially would be susceptible to runoff from the field or leached beyond the root zone compared to the 120 lb N/acre rate.

Acknowledgements

Funding for this demonstration was provided by the USDA Water Quality Initiative for the Upper North Bosque River Hydrologic Unit Project, Texas Agricultural Experiment Station, and Texas Agricultural Extension Service. Appreciation is expressed to Chuck Dannheim for his assistance in the field and laboratory.

Literature Cited

Gomez, K. A. and A. A. Gomez. 1984. Statistical procedures for agricultural research. 2nd ed. John Wiley and Sons, USA.

SAS Institute. 1988. SAS user's guide: statistics. Ver. 6.03 SAS Inst. Cary, NC.

Texas Water Commission, and Texas State Soil and Water Conservation Board. 1988. Nonpoint source water pollution management report for the state of Texas. TWC and TSSWCB. June p. 263.

Table 1. Amount of nutrients applied from dairy manure rates on 7 May 1991.

Manure	Nutrients (Total basis)									
rate	N	P	K	Ca	Mg	Zn	Fe	Mn	Cu	Na
dry ton/acre	..... lb/acre									
5	234	39	278	268	82	3.0	47	2.4	0.4	47
10	468	79	556	536	164	6.0	93	4.8	0.8	94
15	702	118	834	804	246	9.0	140	7.2	1.2	142

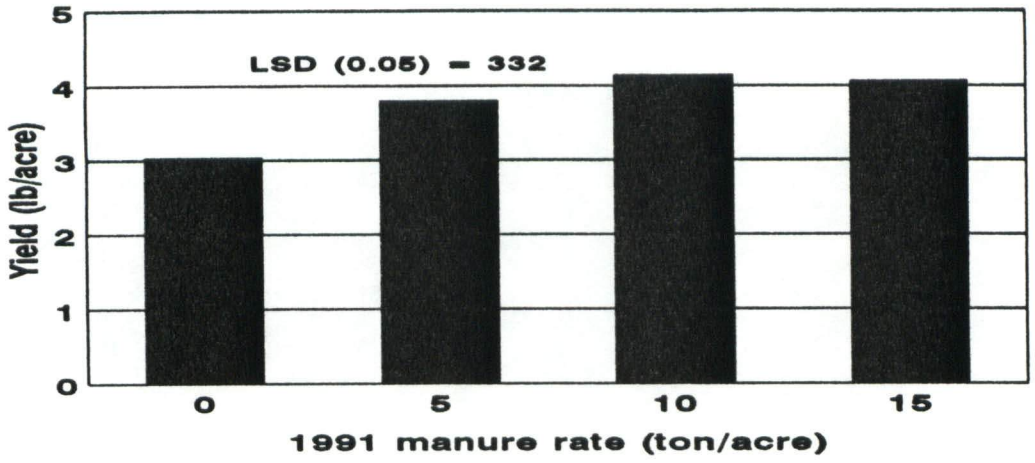

Figure 1. Yield response of warm-season annual hybrids in 1993 to four levels of residual nutrients applied as manure in 1991. Data are means of two replicates, five forages, and three fertilizer N rates.

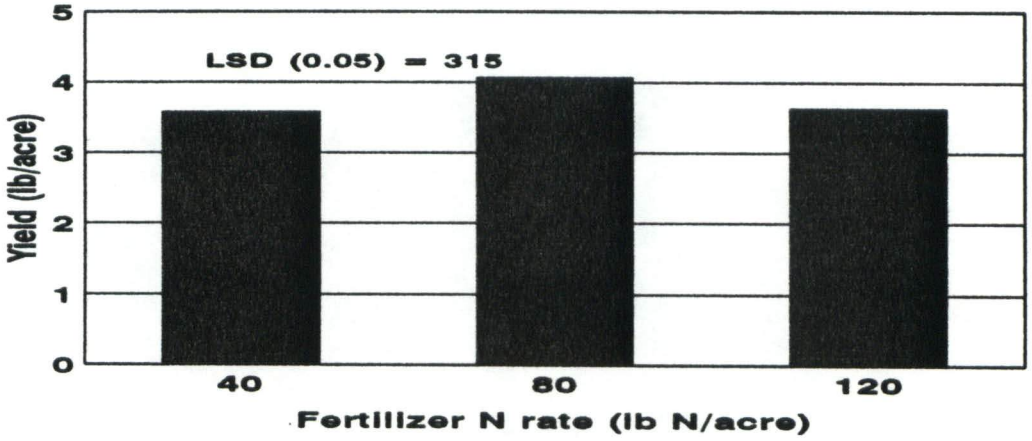

Figure 2. Yield response of warm-season annual hybrids to three N fertilizer application rates. Data are means of two replicates and four residual manure rates.

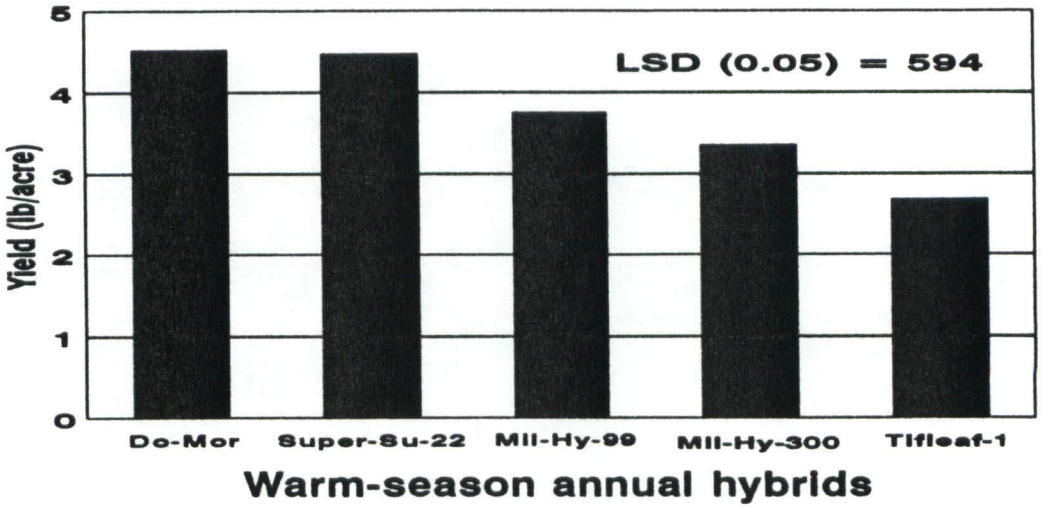

Figure 3. Dry matter yields in 1993 of two sorghum-sudangrass (Do-Mor, Super-Su-22) and three pearl millet (Mil-Hy-99, Mil-Hy-300, Tifleaf-1) hybrids averaged among N fertilizer, residual dairy manure rates, and replications.