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THE EFFECT OF DAIRY MANURE ON SUMMER ANNUAL GRASSES GROWN AS ALTERNATIVE SILAGES IN THE CROSS TIMBERS

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Summary

SS20 forage sorghum (*Sorghum bicolor*), SS10 sorgo-sudan (*Sorghum* spp.), SM60 pearl millet (*Pennisetum glaucum*), Nutrifeed pennisetum (*Pennisetum* spp.) hybrid and CA 737 grain sorghum (*Sorghum bicolor*) were planted at the Stephenville Research and Extension Center in the spring of 1998. Stockpiled dairy manure was applied to half the plots at 5 t dry matter (DM)/acre. Average days to maturity and number of harvests per season varied from 68-103 days and 2-3 harvests, respectively. Yields were highest for SS20 (15,050 lbs DM/acre) and SS10 (14, 774 lbs DM/acre). The CA 737 grain sorghum had the lowest ADF concentration (23.8 %), one of the lowest lignin DM concentrations (2.95 %) and one of the highest CP concentrations (9.0 %). The application of manure increased DM yields, on average for all entries, by 1, 460 lbs DM/acre and phosphorus concentration in DM by 19 % (from 0.159 ppm to 0.189 ppm).

Introduction

The dairy industry in Central Texas is heavily dependent on summer silage as a high quality fiber source for ration formulation. Corn is the preferred silage due to its early maturity, single harvest and high dry matter (DM) yields. Because corn lacks drought hardiness and early spring seeding that may interfere with small grain production, forage producers are searching for alternatives. The purpose of this trial, undertaken at the Stephenville Research and Extension Center, was to look at other summer annual grasses that might fit into the dairy forage production system. The first objective of this trial was to measure days to maturity, yields and quality indicators in order to give dairymen the information they need to decide whether these might serve as alternative silage sources.

With the large amounts of dairy available for application to crop fields, phosphorus (P) build-up in the soil is a concern. By measuring differences in crop P uptake and how this is affected by soil P, silage producers can better manage manure field application and P build-up. Dairymen can also decrease P import onto dairies from purchased feed by recycling P through

forages. The second objective of this trial, therefore, was to provide both crop and dairy producers with the necessary information to reduce soil P buildup within dairy systems.

Procedure

On April 6, 1998, 28' X 12' plots were seeded with 5 commercially available summer, annual monocots (see Table 1). Nutrifeed pennisetum is new to the U.S. market and seed is currently being imported from New Zealand. Plots were replicated 4 times as blocks. These plots were split and dairy manure was applied at 5 tons/acre, DM basis, on half the plot. Manure analysis indicated that average P applied was 58 lbs/acre and average nitrogen (N) applied was 130 lbs/acre. Ammonium nitrate was applied at 160 lbs N/acre to non-manure plots and at 30 lbs N/acre to plots with manure. This resulted in all plots receiving 160 lbs N/acre. An additional 75 lbs N/acre were applied in July to all plots. Soil tests indicated 16 ppm soluble P prior to manure application. Irrigation was applied as needed (see Table 2).

The inner 6 ft X 6 ft of each plot was harvested whenever entries reached soft dough (sorghums and millet) or whenever they attained a 4 ft height (sorgo-sudan grass and nutrifeed pennisetum). Different entries were therefore harvested at different dates and number of times. Dried and ground herbage sub-samples from each harvest of each sub-plot were then batched over the season to form one final sample. This sample was analyzed for neutral detergent fiber (NDF), acid detergent fiber (ADF), cellulose, lignin, P and crude protein (CP) concentrations using traditional wet chemistry.

Results & Discussion

There was a large variability in days after planting (DAP) for first harvests (Table 1). SS20 forage sorghum took the longest time, 119 days, while SS10 sorgo-sudan and nutrifeed pennisetum took the least time to mature (85 days). These results have important implications for cropping systems. The forage sorghum, for example, was not ready for a second harvest until well into the fall. Producers who wish to plant winter small grains in the same field in August or September need to consider the DAP to maturity as they plan their individual cropping programs.

First harvest yields were greater than subsequent harvests for all entries (Table 3). Although the sorgo-sudan took 3 harvests to attain its season total yield of just under 15,000 lbs/acre, it nearly equaled the yield attained by the forage sorghum, just over 15,000 lbs/acre, attained in 2 harvests. The remaining 3 entries, pearl millet, nutrifeed pennisetum and the grain

sorghum, all had yields approximating 10,000 lbs/acre although the nutrifeed pennisetum took 3 harvests to attain this yield. The number of harvests over the season (Table 1) will affect harvest cost differences amongst entries and should be a factor in species selection by producers.

The addition of manure to the plots increased DM yield, on average for all entries, by 13% (1,460 lbs/acre; P=0.02). This increase was the same for all silage entries. This may have been due to the increase in soil P, greater cation exchange capacity which decreased N loss and, perhaps, greater soil moisture retention.

The quality of the forage harvested was very different among entries (Table 4). The CA737 grain sorghum was especially low in fiber and lignin, the latter being usually undigestible for ruminants. CA737 grain sorghum ADF (23.8 %) was only 74 % the average ADF value for the remaining 4 entries. CA737 grain sorghum lignin (2.95%) was 77 % that of the average for the other 4 entries. These are significant differences with important implications for dairy diets since digestibility usually improves and passage rates increase with lower ADF values. Although it was not quite as low, the SS20 forage sorghum also had low fiber values but lignin was rather high at 3.58 % concentration. The nutrifeed pennisetum also had very low lignin values (2.75 %).

Crude protein concentration was highest in the nutrifeed pennisetum and CA 737 grain sorghum (Table 5). The SS20 forage sorghum CP was the lowest of all the entries. It is possible that more N fertilizer needed to be applied to the higher producing entries in order to raise CP concentration in these. Manure application did not affect CP concentration in the herbage.

Plant P concentration was affected by the application of manure. Averaged over all entries, P concentration was 0.159 % when no manure was applied but was 0.189 % (19 % higher) where manure was applied. There were also differences among entries, with the forage millet, pennisetum hybred and grain sorghum having higher concentrations than the forage sorghum and sorgo-sudan (Table 5). When DM yield was multiplied by concentration, the entries removed between 16-22 lbs P/acre from the soil, averaged for plots with and without manure (Table 5).

Conclusions

When both yield and quality indicators are taken into account, the SS20 forage sorghum came out with the best combination. In a situation where a cropping system requires an August harvest in order to allow for a September small grain planting, however, yields may be considerably lower than what was obtained with a October 28 second harvest for this forage sorghum. Faster maturing varieties should be tested to determine yields. Following the same

logic, the SS10 sorgo-sudan second harvest, on August 24, would give that entry a 12,420 lbs DM/acre for the season but with a high fiber content. In view of the need for earlier second harvest dates, the CA737 grain sorghum becomes more attractive, especially since both CP and P concentration were also higher. Its second harvest date, September 10, might fit into a cropping system in which small grains for grazing need to be planted by the middle of September. The high quality indicators would offset the low yields relative to the forage sorghum and sorgo-sudan entries. In a situation where a farmer produces silage crops for a dairy, however, the price per ton needs to be higher to reflect higher quality and to compensate for lower yields.

The application of manure had a positive effect on both silage yield and P concentration. However, it should be noted that there was a net addition of up to 20 ppm P to the soil since, on average, 29 ppm P were added and 9-11 ppm P were removed per acre. Some of this might become fixed by soil particles but total soil P would certainly increase. Additional applications of manure would inevitably lead to a soil P buildup. Unless it could be proven that this additional P was taken up by subsequent crops or permanently fixed by soil particles, this might lead to P surface run-off. Research should continue, utilizing the same plots and entries, to determine the effect of additional manure to soil and plant P.

Because soil analysis indicates only what P will be available to the crop over the season (not total soil P), the removal of 20 lbs P/acre from the soil by the forage does not necessarily guarantee a 10 ppm P decrease in subsequent soil analysis. Phosphorus that was previously fixed in the soil (and not registered in the first soil analysis) may become available to take the place of the P removed by the plant roots. But there can be no argument that 10 ppm P was removed from the total soil P pool (plant-available as well as soil-fixed) if 20 lbs P/acre was removed by the crop.

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Table 1. Number of harvests, number of days after planting (DAP) to first harvest, number of DAP to last harvest and average days to maturity for five summer silage monocots grown during the 1998 season at the Stephenville Agricultural Research Center. Planting date was April 6.

Entry	# harvests	First cut (DAP)	Last cut (DAP)	Ave. days to maturity
SS20 forage sorghum	2	119	205	103
SS10 sorgo-sudan	3	85	205	68
SM60 pearl millet	2	94	157	79
Nutrifeed pennisetum	3	85	205	68
CA 737 grain sorghum	2	91	157	79

Table 2. Rainfall, irrigation, fertilizer application, cultivation and seeding dates for five monocots at Stephenville.

Date	Event	Description
September, 97	Previous crop	Peanuts
March	Rainfall	4.3”
Pre-seed	Cultivation	Mechanical
	Manure incorp.	10,000 t DM
	N incorp.	160 lbs/acre
April 6	Plant, drill	
April	Rainfall	0.3”
	Pivot	2.0”
May	Weeding	Hoe
	Rainfall	4.6”
	Pivot	3.0”
June	Rainfall	2.3”
	Pivot	1.0”
July	Weeding	Hoe
	N broadcast	75 lbs/acre
	Rainfall	1.6”
	Pivot	5.0”
August	Rainfall	0.8”
	Pivot	4.5”
September	Rainfall	3.8”
	Pivot	1.5”
October	Rainfall	3.6”

Table 3. Dry matter production of five summer grass silages grown during the 1998 season at the Stephenville Agricultural Experiment Station averaged for plots with and without manure.

Entry	First cut	Second cut	Third cut	Total DM
	----------Lbs DM/acre----------			
SS20 forage sorghum	10 038 a	5 012 a	0	15 050 a
SS10 sorgo-sudan	7 522 b	4 898 a	2 635	14 774 a
SM60 pearl millet	7 508 b	3 085 b	0	10 593 b
Nutrifeed pennisetum	6 034 c	3 152 b	1 168	10 229 b
CA 737 grain sorghum	5 647 c	3 709 b	441	9 749 b

*Means in the same column followed by different letters differ (P<0.05) according to Duncan's multiple range test.

Table 4. Quality indicators, percentage of DM, for five summer silage grasses grown under irrigation during the 1998 season at the Stephenville Agricultural Experiment Station averaged over plots with and without manure.

Entry	NDF	ADF	Cellulose	Lignin
	----------% DM----------			
SS20 forage sorghum	53.8 c	29.3 c	25.8 c	3.58 b
SS10 sorgo-sudan	56.7 b	32.5 b	28.0 b	4.50 a
SM60 pearl millet	62.9 a	35.0 a	30.6 a	4.40 a
Nutrifeed pennisetum	63.1 a	32.5 b	29.7 a	2.75 c
CA 737 grain sorghum	51.0 d	23.8 d	21.0 c	2.95 c

*Means in the same column followed by different letters differ (P<0.05) according to Duncan's multiple range test.

Table 5. Estimated crude protein (CP) and phosphorus (P) percentage of herbage DM and lbs of P removed by five summer silage grasses grown under irrigation during 1998 at the Stephenville Agricultural Experiment Station.

Entry	CP	P	P removed
	----------% ----------		#/acre
SS20 forage sorghum	5.2 c	0.107 c	16.1
SS10 sorgo-sudan	7.6 b	0.143 b	21.1
SM60 pearl millet	6.9 b	0.214 a	22.7
Nutrifeed pennisetum	9.9 a	0.211 a	21.6
CA 737 grain sorghum	9.0 a	0.193 a	18.8

*Means in the same column followed by different letters differ ($P<0.05$) according to Duncan's multiple range test.