Yield and Nutrient Uptake of Tropical Forages Receiving Poultry Litter

R. Saunders[1], J. Johnson[1], S. Edwards[2], and J. Douglas[2]

[1]Mississippi State University, Holly Springs, MS 38635, USA.

[2]Plant Material Center, Coffeeville, MS 38922. USA.

Corresponding author's e-mail: jrsaunders@ra.msstate.edu

ABSTRACT

Mississippi requires that all poultry facilities generating dry litter or waste must obtain a permit. An essential requirement in the permitting process is a "Waste Utilization Plan". The plan's main function is to determine the total amount of land needed to utilize nutrients generated by each animal unit. Application rates and required acreage are based on soil type and the nutrient removal capacity of the plant species receiving land applied poultry litter. Nutrient removal capacity is the product of nutrient concentration in the plant tissue and dry matter yield. Nine warm season grass species and one legume were planted April 27, 2000 at the North Mississippi Branch Station in Holly Springs. The study site soil is classified as a Grenada Silt Loam with a 0-2% slope. Species were separated into two classes based on nitrogen (N) use, high or medium. Plots were machine harvested and weighed, and sub samples were taken for laboratory analyses. Dry matter yield, phosphorus (P) uptake, and N uptake were determined for each species. In this study there seemed to be no correlation between yield and litter rates among species of forages. It did show, as one might expect, that the N and P uptake increased as yield increased. There was a similar pattern in N and P uptake among cutting dates and yield. There were several instances of high CVs in the first cutting as well as significant yield differences among varieties, each of which can be explained by newly established plots.

KEYWORDS

Animal waste disposal, water quality, N uptake, P uptake

INTRODUCTION

Mississippi currently ranks fourth in the nation in broiler production behind Georgia, Arkansas, and Alabama. According to the Mississippi Agriculture Statistics Service, Mississippi placed over 722 million broiler chicks in 1998. Broiler production is integrator-controlled from egg production to final processing of the mature bird. The farmer has responsibility over daily management including periodic removal of poultry litter manure and bedding. The Mississippi poultry industry currently generates approximately 500,000 tons of poultry litter each year (Bagley and Evans, 1995).

Water quality impacts from land-applied litter are dependent on many variables: soil, rainfall, climate, plant species, shallow *versus* concentrated flow, application rate, waste characteristics, and many others (Edwards and Daniel, 1991). In an attempt to limit potential adverse environmental effects, the Mississippi Department of Environmental Quality requires permits. An essential requirement in the permitting process is a "Waste Utilization Plan".

The Natural Resources Conservation Service (NRCS) is charged with supplying technical support for these plans. The plan's main function is to determine the total amount of the land needed to utilize nutrients generated by each animal unit. Application rates and required acreage are based on soil type and nutrient removal capacity of the plant species receiving the land applied poultry litter. Nutrient removal capacity is the product of nutrient concentration in plant tissue and dry matter yield.

Results from a survey of 25 NRCS field offices and 125 poultry producers in Mississippi showed that 97% of poultry litter is land-applied. The most commonly used forages were bermudagrass and bahiagrass. Total land acreage needed to properly utilize the nutrients in the poultry could be reduced if other higher yielding plant materials were available to poultry producers. However, information is lacking on nutrient removable potential of various non-traditional forage species in the Southeast.

METHODS AND MATERIALS

In the spring of 2000 nine warm season grass species and one legume were planted at the North Mississippi Branch Station in Holly Springs, Mississippi to evaluate yield response to surface applied poultry litter (Table 1). The

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Table 1. Poultry litter application, dry matter and nutrient yield and nutrient uptake for nine tropical forages fertilized with poultry litter. Not all entries received the same rate of poultry litter, thus application rate is confounded with species..

Species and cultivar	Litter applied	Dry matter yield			Yield		Uptake	
		6/19/01	9/14/01	TOTAL	N	P	P_2O_5	N
	tons acre^{-1}	lbs acre^{-1}						
Bermudagrass								
Common	2.9	1354	3165	4519	160	217	23	43
Summerall 007	5.5	859	3430	4289	302	407	25	42
Pensacola Bahiagrass	2.9	1013	3629	4642	160	217	25	52
Alamo Switchgrass	5.5	2727	5129	7856	302	407	31	76
Gamagrass 9062680	5.5	1948	4437	6385	302	407	29	57
Weeping Lovegrass	2.9	1889	4046	5935	160	217	27	50
Johnsongrass	5.5	1350	3688	5038	302	407	24	42
Tropical sunn hemp	2.9	†	3398	3398	160	217	13	111
Caucasian bluestem	2.9	954	3763	4717	160	217	20	39
Dallisgrass	2.9	796	2641	3437	160	217	17	42
Mean		1432	3997				23	55
LSD		1066	NS				3.2	NS
CV, %		50	31				15	77

† Tropical sunn hemp, the only dicotyledoneous species evaluated, was harvested only once.

experiment design was a randomized complete block with three replications. Each plot was twelve feet by six feet with an alley between and beside other adjacent plots. Forage varieties were established either by seed, sprigs, or transplants. Pensacola Bahiagrass (*Paspalum notatum* Fl¸gge), Common Bermudagrass (*Cynodon dactylon* (L.) Pers.), Dallisgrass (*Paspalum dilatatum* Poir.), tropical sunn hemp (*Crotolaria juncea* L.), and weeping lovegrass (*Eragrostis curvula* (Schrad.) Nees var. *curvula* Nees) were established from seed planted in three rows on 3-ft. centers. Bermudagrass cv. Sumerall 007 sprigs were planted in a grid pattern with a total of 15 sprigs per plot. Alamo switchgrass (*Panicum virgatum* L.), Eastern Gamagrass (*Tripsacum dactyloides* (L.) L.), and Caucasian Bluestem (*Bothriochloa caucasia* (Trin.) C.E. Hubb.) transplants were planted in a grid pattern. The entire plot area was furrow-irrigated daily until all seeded plots had emerged and sprigs and transplants had propagated. Additional irrigation was done until soil moisture was adequate for plant survival. Plots were regularly checked for weeds until adequate ground cover had been achieved. Poultry litter was applied in the spring of 2001 to each plot according to N rates. Two poultry litter rates of 5.5 tons and 2.9 tons per acre were used to achieve 302 and 160 lbs. of N per acre (Table 1). The litter had a pH of 6.92, 26.4% moisture, 3.26% N, and 4.93% P_2O_5. This is equivalent to 55 lbs N and 45 lbs P ton^{-1} wet weight or as it is applied.

Plots were harvested twice during the summer of 2001 by cutting a three-foot swath in the center of each plot with a mower-equipped bagging system. Biomass from each plot was weighed in the field, a sub sample was taken at this time as well. The sub sample was weighed and then oven dried at 110 ˚C. Final dry weights were recorded after samples did not vary more than one percent from the first dry weight. Each dried sample was ground in a Wiley Mill to pass a 25-mesh screen, and analyzed for N and P.

RESULTS AND DISCUSSION

In this study there appeared to be no correlation between yield and the two litter rates among species of forages (Table 1). The results show that N and P uptake increased with increasing yield. There was a similar pattern in N and P uptake among cutting dates and yield. Coefficients of variation (cv) were high for the first cutting and there were significant yield differences among species, which can be explained by growth differences during establishment. There were no significant yield differences among species in the second cutting and there was a lower CV.

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