NITROGEN MANAGEMENT FOR COOL-SEASON GRASS PRODUCTION

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ABSTRACT

Studies were initiated in 1985 on established smooth bromegrass and tall fescue to evaluate urea granule size effects on forage production and quality. Other work, evaluating N source by previous source effects and UAN placement methods and the addition of ATS, was conducted on established smooth bromegrass. Nitrogen rates were also evaluated in all these studies, and the addition of N significantly increased forage yields and N concentrations in each study. Use of large (1.0g) urea granules produced significantly higher forage N concentrations in 5 of 6 experiments, but had no significant effects on forage yield when compared to small (0.01 g) urea granules (commercial size). Urea applied after urea produced significantly higher yields than urea following ammonium nitrate 2 of 4 years, but source by previous source effects on forage quality were nonsignificant. Surface banded UAN produced significantly higher forage yields and forage N concentrations than surface broadcast UAN. The use of ATS in UAN produced inconsistent results.

OBJECTIVES

Kansas has approximately 2.5 million acres of tame pasture, most of which is in eastern Kansas and consists chiefly of the cool-season perennials smooth bromegrass and tall fescue. Cool-season grasses have tremendous forage production potential, but require a fairly intensive level of management to produce high yields of high quality forage. In most cases nitrogen (N) is the most limiting factor. Over the years, much research has been done relating to nitrogen management for cool-season grasses, but there is continued interest in looking at new ways to maximize fertilizer nitrogen efficiency for cool-season grass production. These studies were designed with the overall objective of evaluating management techniques including urea granule size, N source effects due to previous N source, N placement methods and the use of ammonium thiosulfate.

METHODS

Studies were initiated in 1985 and continued through 1988 to evaluate nitrogen management techniques. All bromegrass studies were conducted on a Smolan silty clay loam soil on established brome and the tall fescue site was a Chase silty clay loam in established fescue.

The urea granule size study evaluated urea applied with four granule sizes - 0.01, 0.08, 0.5, and 1.0 grams per granule at N rates of 54, 107 and 160 pounds per acre. The smallest size, 0.01 g, represents commercially available urea while the 0.08 size was forestry grade urea. This study was conducted on smooth bromegrass and tall fescue. The N source/previous source study was conducted on bromegrass only and evaluated N rates of 60, 120 and 180 pounds per acre as ammonium nitrate following ammonium nitrate or urea, and urea following ammonium nitrate or urea. The nitrogen placement study on bromegrass evaluated 60 and 120 pounds of N per acre as UAN applied either surface broadcast or surface banded on 10-inch centers with or without 5% v/v ammonium thiosulfate (ATS).

Fertilizer treatments on all studies were applied in late winter (January - early March) and studies were harvested in May. Forage subsamples were collected at harvest to measure moisture and forage N concentration. Forage yields are reported at 12.5% moisture.

RESULTS AND DISCUSSION

Urea Granule Size Study

Results from the urea granule size study are summarized in Tables 1 and 2.

Table 1. Urea granule size effects on bromegrass forage yields and quality.

N Rate	Granule Size	Forage Yield 1985	Forage Yield 1986	Forage Yield 1987	N Content 1985	N Content 1986	N Content 1987
lbs/a	g	- - - - lbs/a - - - -			- - - - - - % - - - - - -		
0	---	3250	2640	3360	1.45	1.48	1.74
54	1.0	4460	3800	4140	1.73	1.90	1.95
107	1.0	6760	3560	5770	2.04	2.20	2.25
160	1.0	6210	4090	5370	2.26	2.38	2.47
54	0.5	5610	3390	4130	1.71	1.87	2.14
107	0.5	5970	4260	5390	1.93	2.08	2.17
160	0.5	6600	4060	5790	2.16	2.49	2.34
54	0.08	4920	3390	4710	1.67	1.86	1.93
107	0.08	6270	4790	4790	2.00	2.13	2.24
160	0.08	6910	4230	5590	2.47	2.30	2.43
54	0.01	5550	3350	4740	1.62	1.75	1.81
107	0.01	6780	4000	5420	1.75	1.97	2.03
160	0.01	5820	4582	5760	2.26	2.21	2.32
	LSD (.05)	1380	1000	1390	0.19	0.22	0.25
Mean Values:							
Granule	1.0	5810	3820	5090	2.01	2.16	2.22
Size, g	0.5	6060	3910	5100	1.93	2.14	2.21
	0.08	6030	4140	5030	2.04	2.09	2.20
	0.01	6050	3980	5310	1.88	1.98	2.05
	LSD (.05)	NS	NS	NS	0.13	0.14	0.15
N Rate,	54	5140	3480	4430	1.68	1.84	1.96
lb/a	107	6450	4220	5340	1.93	2.14	2.17
	160	6390	4240	5630	2.21	2.34	2.39
	LSD (.05)	915	510	730	0.13	0.12	0.13

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Table 2. Urea granule size effects on tall fescue forage yield and quality.

N Rate	Granule Size	Forage Yield 1985	Forage Yield 1986	Forage Yield 1987	N Content 1985	N Content 1986	N Content 1987
lbs/a	g	- - - - lbs/a - - - -			- - - - - - % - - - - - -		
0	---	3320	2730	2350	1.32	1.32	1.78
54	1.0	6110	3850	3340	1.49	1.04	1.83
107	1.0	6310	4250	4220	1.76	1.88	2.08
160	1.0	7050	5760	4290	1.92	2.05	2.16
54	0.5	6040	4580	3560	1.44	1.55	1.75
107	0.5	6150	5830	5100	1.66	1.83	1.93
160	0.5	7140	5470	4150	1.88	2.04	2.22
54	0.08	5060	3580	3280	1.42	1.56	1.87
107	0.08	6590	5820	3980	1.62	1.89	2.12
160	0.08	6680	5350	3990	1.91	2.04	2.32
54	0.01	5310	3810	3840	1.46	1.53	1.82
107	0.01	6270	5850	4340	1.69	1.86	1.88
160	0.01	7820	6430	4640	1.94	2.08	2.15
	LSD (.05)	1160	1400	950	0.16	0.13	0.19
Mean Values:							
Granule Size, g	1.0	6490	4620	3950	1.72	1.86	2.02
	0.5	6450	5290	4270	1.66	1.81	1.97
	0.08	6110	4920	3750	1.65	1.83	2.10
	0.01	6160	5370	4270	1.61	1.82	1.95
	LSD (.05)	NS	NS	NS	0.11	NS	0.10
N Rate, lbs/a	54	5630	3960	3500	1.45	1.57	1.82
	107	6330	5540	4410	1.68	1.86	2.00
	160	7170	5750	4270	1.91	2.05	2.21
	LSD (.05)	780	700	500	0.11	0.06	0.09

- Vigil and Kissel

The addition of nitrogen significantly increased forage yields and N concentrations for both smooth bromegrass and tall fescue every year.

The evaluation of urea granule sizes produced some interesting results. Comparisons of the 0.01 g size granule (commercially available) to the largest 1.0 g granule size show that in 5 of 6 experiments use of the large granule produced significantly higher N concentrations in the forage but had no significant effects on forage yields. Increased forage N concentrations with the large granules likely resulted from better N availability later in the spring. Field observations indicated that the large granules required more time to dissolve than the smaller granules.

N Source by Previous Source Study

Results from this work are summarized in Table 3.

Table 3. N source by previous source effects on smooth bromegrass.

N Rate	N Source	Previous N Source	Forage Yield 1985	1986	1987	1988	N Content 1985	1986	1987	1988
lbs/a			- - - -	lbs/a	- - - -		- - - - - -	%	- - - - - -	
0	----	----	2270	1630	2200	1540	1.46	1.56	1.67	1.53
60	Am.N	Am.N	5850	4120	4300	2690	1.51	1.81	1.98	1.78
120	Am.N	Am.N	6720	4710	5740	4980	1.72	2.50	2.26	1.77
180	Am.N	Am.N	6660	4950	5490	4510	2.03	2.78	2.53	2.35
60	Am.N	Urea	4570	3930	4650	2620	1.60	2.13	1.85	1.82
120	Am.N	Urea	6490	5870	5730	3800	1.99	2.58	2.23	2.01
180	Am.N	Urea	6650	6060	5480	3770	1.87	2.63	2.43	2.10
60	Urea	Am.N	4700	3530	4040	2170	1.51	1.77	1.80	1.65
120	Urea	Am.N	5330	4160	5000	3480	1.59	2.36	2.18	1.86
180	Urea	Am.N	5820	4760	6030	3380	1.48	2.27	2.50	2.11
60	Urea	Urea	4370	3630	3720	2390	1.44	1.89	1.73	1.65
120	Urea	Urea	6150	5580	4960	3370	1.45	2.32	2.40	1.90
180	Urea	Urea	7320	7040	5660	3940	1.64	2.47	2.63	1.82
	LSD (.05)		1180	1270	1367	1040	0.41	0.54	0.33	0.50
Mean Values:										
Source by	Am.N	Am.N	6410	4590	5180	4060	1.76	2.36	2.26	1.97
Previous	Am.N	Urea	5900	5290	5290	3400	1.82	2.45	2.17	1.98
Source	Urea	Am.N	5280	4150	5020	3010	1.53	2.13	2.16	1.87
	Urea	Urea	5950	5420	4780	3240	1.51	2.23	2.25	1.79
	LSD (.05)		650	720	NS	590	NS	NS	NS	NS
N Rate	60		4870	3800	4180	2470	1.51	1.90	1.84	1.65
lbs/a	120		6170	5080	5360	3910	1.69	2.44	2.27	1.89
	180		6610	5700	5670	3900	1.75	2.54	2.52	2.10
	LSD (.05)		640	700	760	510	0.23	0.30	0.18	0.25

- Vigil and Kissel

The addition of nitrogen significantly increased bromegrass forage yields and N concentrations, with the 180 pound per acre N rate nearly always (3 of 4 years) resulting in the highest forage yields and always producing the highest forage N concentrations.

The interest in the source by previous source effects resulted from earlier studies in Kansas where urea sometimes preformed poorly early in long-term studies. Also, Hargrove and Kissel (1979) had found calcium nitrate to perform better than urea and UAN the first year on bermudagrass, but in the second year, both urea sources performed better than calcium nitrate. Volatilization losses in their study were insignificant and they suggested greater immobilization of urea the first year with subsequent remineralization the second year.

Results from this study show that urea following urea produced higher yields than urea following ammonium nitrate 3 of 4 years, and was significantly better two years (1985 and 1986). Source by previous source effects on forage N concentrations were generally nonsignificant. Ammonium nitrate performed better than urea in 1985 and 1988. Conditions in 1988 after application were good for volatilization losses from urea and could account for the poor performance.

Recognizing that results from studies like this are affected by many processes, these results support the suggestion of Hargrove and Kissel (1979) that performance of urea the first year on perennial forage grasses can be affected by greater immobilization with remineralization and better performance the second year.

UAN Placement, ATS Study

Results from this work are summarized in Table 4.

Table 4. UAN placement, ATS effects on smooth bromegrass

N Rate	Placement Method	5% v/v ATS	Forage Yield 1987	Forage Yield 1988	N Content 1987	N Content 1988
lbs/a			- - - lbs/a - - -		- - - % - - -	
0	----	---	3030	1910	1.52	1.58
60	Broadcast	No	6090	3300	1.65	1.55
60	Broadcast	Yes	5930	3760	1.65	1.67
60	Band	No	6260	4340	1.78	1.91
60	Band	Yes	7130	4100	1.68	1.76
120	Broadcast	No	7080	4800	2.12	2.01
120	Broadcast	Yes	7000	4480	1.94	1.99
120	Band	No	7200	4740	2.08	2.13
120	Band	Yes	7300	4780	1.99	2.12
LSD (.05)			920	720	0.17	0.17
Mean Values:						
N	60		6350	3870	1.69	1.72
Rate	120		7150	4700	2.03	2.06
LSD (.05)			440	350	0.09	0.09
N	Broadcast		6520	4080	1.84	1.80
Placement	Band		6970	4490	1.88	1.98
LSD (.05)			440	350	NS	0.09
5% v/v	No		6660	4290	1.90	1.90
ATS	Yes		6840	4280	1.82	1.88
LSD (.05)			NS	NS	NS	NS

An excellent response to nitrogen in terms of increased forage yields and tissue N concentrations was noted up to 120 pounds of N per acre. Surface banding UAN produced significantly higher yields both years and resulted in significantly higher forage N concentrations in 1988. The addition of ATS to UAN resulted in inconsistent effects both years.

These results indicate that surface banding UAN is a very efficient way to topdress established cool-season grasses.

REFERENCES

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