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Comparisons of Nitrogen Fertilizer Sources under Kentucky Soil and Climatic Conditions

Kenneth L. Wells
University of Kentucky

Lloyd W. Murdock
University of Kentucky, lmurdock@uky.edu

Harold F. Miller
University of Kentucky

UNIVERSITY OF KENTUCKY
COLLEGE OF AGRICULTURE
Lexington, Kentucky 40506

COOPERATIVE EXTENSION SERVICE

AGRONOMY NOTES

COMPARISONS OF NITROGEN FERTILIZER SOURCES UNDER KENTUCKY SOIL AND CLIMATIC CONDITIONS

K.L. Wells, Lloyd Murdock and Harold Miller

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A summary of yield data comparing different nitrogen fertilizer sources in field experiments conducted by the Agronomy Department staff should provide information that will help answer some of the inquiries regarding the comparative value of some of the nitrogen fertilizers being marketed in Kentucky. Since the nitrogen rates per acre shown in all tables are ACTUAL NITROGEN the COST PER POUND OF NITROGEN in the different materials is an important consideration when evaluating the various products.

Keep in mind that in order to adequately conduct a sources of nitrogen study, there must be a good yield response to the application of nitrogen. For this reason we always include a no-nitrogen treatment. If the no-nitrogen treatment yields considerably less than the nitrogen treatments, then we can validly compare the effect of sources and rates...unless some other factors unduly affect the experiment. So keep your eye on the no-nitrogen yield levels and the magnitude of response to applied nitrogen in looking over these data. Where little or no response was obtained, results for sources or rates of N mean very little.

This yield data along with the information on sources in AGR-43 (Nitrogen in Kentucky Soils) should be helpful in determining which nitrogen fertilizer is the most practical source of nitrogen for the various management and cropping systems.

COMPARISONS ON CORN

I. Nitrogen fertilizer broadcast and immediately disked-in just before planting - Conventionally prepared seedbed (Tables 1 and 2)

Table 1.

Pounds NITROGEN Per Acre	N Source	Poorly Drained Soil Stendal si.l. 2-Yr AV (1968-69)	Well Drained Soil Crider si.l. 3-Yr AV (1968-70) 1/
		bu/A	
0	---	61	71
80	A.N.	93	78
80	UREA	87	76
160	A.N.	121	80
160	UREA	115	77

1/ Lack of moisture limited production each year

Data by Harold Miller
3 reps per treatment

Table 2.

Pounds NITROGEN Per Acre	N Source	Well Drained Soil Mountview si.l. 1971	1972	1973	1974	4 Yr AV
				bu/A		
0	---	64	118	47	60	72
100	Sodium Nitrate	116	148	120	116 1/	125
100	UREA	125	143	115	131 1/	129
100	A.N.	122	---	---	---	---
200	Sodium Nitrate	125	152	128	128	133
200	UREA	134	150	134	131	137
200	A.N.	135	---	---	---	---

1/ In 1974 material applied at a rate to supply 150 pounds of nitrogen per acre

Data by W.W. Frye
4 reps per treatment

II. Nitrogen fertilizer broadcast just after planting and left on the soil surface (Tables 3, 4 and 5)

Table 3. Conventionally prepared seedbed

Pounds NITROGEN Per Acre	N Source	Poorly Drained Soil Melvin si.l. 1972	1973	2 Yr AV
			bu/A	
0	---	65	18	42
100	A.N.	134	145	140
100	UREA	122	131	127
100	Solution	128	139	134

Data by Harold Miller
4 reps per treatment

Table 4. No-till planted

Pounds NITROGEN Per Acre	N Source	Moderately Well-Drained Loring si.l. 1974	Moderately Well-Drained Tilsit si.l. 1974
		bu/A	
0	---	41	27 1/
125	A.N.	128	49
125	UREA	111	48

1/ Low yields due to late planting and early frost

Data by John Ellis
4 reps per treatment

Table 5. Summary of 1975 trials (bu corn/A) - No-till and Conventional [1/]

Nitrogen Source	lb N per A	Breathitt Co. No-till	Breathitt Co. Conv. till	Lincoln Co. No-till	Wolfe Co. No-till	Ohio Co. Conv. till	Caldwell Co. No-till	Caldwell Co. Conv. till
				APPLIED AT PLANTING				
No Nitrogen	0	131	118	69	101	33	79	41
Amm. Nitrate	75	138	138	62	125	110	---	---
Urea	75	126	141	62	130	103	---	---
Solution	75	126	127	---	150	97	---	---
Cal. Amm. Nitrate	75	---	---	---	---	109	---	---
Amm. nitrate	125	---	---	---	---	---	104	152
Urea	125	---	---	---	---	---	101	131
Amm. nitrate	150	144	139	94	124	---	---	---
Urea	150	144	151	76	153	---	---	---
Solution	150	134	146	---	149	---	---	---
				DELAYED APPLICATION [2/]				
Amm. nitrate	75	137	132	97	170	---	---	---
Urea	75	147	122	93	157	---	---	---
Solution	75	132	130	100	148	---	---	---
Amm. nitrate	150	132	167	121	184	---	---	---
Urea	150	135	140	123	164	---	---	---
Solution	150	143	143	128	209	---	---	---

Data from experiments by Wells, Bitzer, Ellis, Murdock and Miller. 3-4 reps per tmt.

1/ Soil type and drainage at sites were:

County	Soil type	Soil Drainage
Breathitt	Allegheny loam	Well drained
Lincoln	Melvin silt loam	Poorly drained
Wolfe	Allegheny loam	Well drained
Ohio	Melvin silt loam	Poorly drained
Caldwell	Tilsit silt loam	Mod. well drained (fragipan at 24 inches)

2/ Delayed application was 5-7 weeks after planting.

COMPARISONS ON SMALL GRAIN

Table 6. Late February or early March topdressing on Barley.

Pounds NITROGEN Per Acre	N Source	Well Drained Soil Maury si.l. 1973	1975	2 Yr AV
		bu/A		
0	---	67	45	56
30	A.N.	73	54	64
30	Urea	68	50	59
30	Solution	--	59	--
60	A.N.	82	69	76
60	Urea	81	52	67
60	Solution	--	73	--
90	A.N.	80	72	76
90	Urea	85	64	75
90	Solution	--	77	--

Data by K.L. Wells and M.J. Bitzer
3 reps per treatment

Table 7. Late February or early March topdressing on WHEAT

Pounds NITROGEN Per Acre	N Source	Well Drained Soil Maury si.l. 1973	1974	1975	3 Yr AV
		bu/A			
0	---	46	56	53	52
30	A.N.	52	61	51	55
30	Urea	51	58	55	55
30	Solution	--	--	62	--
60	A.N.	61	64	59	61
60	Urea	64	67	61	64
60	Solution	--	--	62	--
90	A.N.	65	68	63	65
90	Urea	59	66	61	62
90	Solution	--	--	59	--

Data by K.L. Wells and M.J. Bitzer
3 reps per treatment

Table 8. Topdressing on WHEAT applied March 26.

Pounds NITROGEN Per Acre	N Source	Moderately Well-Drained Grenada si.l. 1975
		bu/A
0	---	21
30	A.N.	33
30	Urea	34
30	Solution	37
60	A.N.	42
60	Urea	45

Data by Harold Miller
3 reps per treatment

COMPARISONS ON GRASS SODS

GRASS YIELDS - LBS DRY MATTER PER ACRE

Table 9. Materials broadcast on established BLUEGRASS and ORCHARDGRASS sod. Treatments replicated 4 times. Harold F. Miller

Pounds NITROGEN Per Acre	Source	Well Drained Soil Maury si.l. 1971	1972	2 Yr AV
1/ 0	---	2401	2095	2248
50	A.N.	4052	4038	4045
50	Urea	4033	4150	4092
100	A.N.	5719	5432	5576
100	Urea	5179	5002	5091
150	A.N.	7004	6216	6610
150	Urea	6188	5870	6029
50-0-50	A.N.	5737	4401	5069
50-0-50	Urea	5081	4099	4590
50-50-50	A.N.	7023	5930	6477
50-50-50	Urea	6706	5739	6223

1/ Initial application broadcast around the middle of March. Split applications applied in mid-March, early June and mid-August.

Table 10. Materials broadcast on an old FESCUE sod March 30. Area lost after harvesting 1st cutting June 2. Treatments replicated 4 times. Harold Miller.

Pounds NITROGEN Per Acre	Source	Well Drained Maury si.l. Production thru June 2	Pounds of Nitrogen in Herbage Harvested
1/ 0	---	1260	15
50	A.N.	3234	42
50	Urea	2660	32
50	Solution	2632	30
100	A.N.	4419	68
100	Urea	3566	48
100	Solution	3845	56
150	A.N.	4523	85
150	Urea	4150	67
150	Solution	4578	71

1/ Materials applied March 30

Table 11. Effect of date when N was applied on the agronomic effectiveness of urea as compared with ammonium nitrate at the rate of 70 lbs N/acre

	Yield of tall fescue (lbs dry matter/acre) 1/											
	1973			1974			1975			3-Yr Avg		
Date N applied	No N	A.N.	Urea	No N	A.N.	Urea	No N	A.N.	Urea	No N	A.N.	Urea
Mid-March	2771	3780	4067	----	----	----	----	----	----	2771	3780	4067
Early April	2771	4257	3904	1934	3938	3583	1442	3311	3154	2049	3835	3547
Mid-April	1579	2971	3250	2017	4378	4437	1703	3791	3598	1766	3713	3762
Early May 2/	2519	3187	3114	533	861	863	1541	3348	3018	2030	3268	3066
Mid-May	1519	3046	2406	1520	2905	2667	1410	2467	2269	1483	2809	2447
Early June	1119	2143	1833	1565	2820	2327	1662	2219	2158	1449	2394	2106
Mid-June	711	1784	1675	1300	2518	2093	2077	3274	2515	1363	2525	2094
Early July 3/	419	648	568	1127	2581	2319	1522	2608	2464	1324	2595	2392
Mid-July 3/	332	682	554	1001	2357	2083	1065	1898	1588	1033	2128	1836
Early August 3/	209	690	595	964	2413	1924	857	1578	1322	910	1996	1623
Mid-August	----	----	----	833	1812	1700	743	1157	1011	788	1485	1356
Mid-September	----	----	----	603	1830	1514	403	868	719	503	1349	1117
Early October	----	----	----	913	2433	2313	----	----	----	913	2433	2313

data by Lloyd Murdock

1/ For each treatment (date applied), grass was clipped to 2-inch height on date of N application, N was broadcast over the plots, and the plots were harvested twice--at 30 days after N was applied and again 90 days after N was applied. Yields shown are the total dry matter harvested from the two clippings (average 4 replications/treatment).

2/ Yields shown for 1974 represent only the dry matter regrowth harvested 90 days after N was applied (data for 30 day growth was lost).

3/ Yields shown for 1973 represent only the dry matter accumulated 30 days after N was applied (cattle destroyed the 60-day regrowth).

SHOULD UREA BE CONSIDERED A SLOW RELEASE SOURCE OF NITROGEN?

In 1973 a study comparing the effect of ammonium nitrate and urea on the growth of fescue was initiated. A no-nitrogen treatment and 70 lb of nitrogen per acre as ammonium nitrate and urea were applied at each treatment period. On each date of application, these treatments were applied to a separate set of plots. The nitrogen was applied to a separate set of plots. The nitrogen was applied around the first and fifteenth of each month, beginning in mid-March and ending early October. Each plot was harvested at 30 and 90 days after nitrogen application. Nitrogen content and yields were both determined. Each treatment was replicated four times.

The yields (see Table 11) and nitrogen content (not shown) of the forage indicate that more nitrogen was taken up by the plant from ammonium nitrate than urea. Presumably this is due to a volatilization loss of nitrogen that occurs when urea is added on the soil surface. Most of this loss was apparent with the first harvest made 30 days after application. The yields and nitrogen contents of the second harvest, 90 days after application, show only a small advantage favoring ammonium nitrate. The loss from urea was greater when applied during the middle of May or later. When applied before the middle of May, the yield from the urea plots was 3% less than that of ammonium nitrate. When added after this date, the difference is 13%. Over the period of time studied, no difference was found between the nitrogen release rate of ammonium nitrate and urea.

Another study was conducted comparing ammonium nitrate and urea as nitrogen sources during the 1971 and 1972 growing season on an established bluegrass-orchardgrass sod. A no nitrogen treatment along with rates of 50, 100, and 150 pounds of actual nitrogen from each of the two sources was applied in March. In addition, split applications of 50 pounds of nitrogen per acre in March, again in early June after the first harvest, and a third application following the second harvest in early August for a total of 150 pounds during the growing season were included. Each treatment was replicated four times.

The annual dry matter production along with the average yields for the 1971 and 1972 are shown in table 8. The herbage was harvested three times each season and average yields in pounds of dry matter per acre for each treatment calculated. The results by cuttings shown in the following graph show little evidence of urea being a slower release source of nitrogen than ammonium nitrate. A comparison of the yields for the second and third harvest show little difference in nitrogen availability from the two sources during the growing season, when the soil is warm and microbial activity is at its peak (see AGR-43). Where the rate of 50 pounds of nitrogen was applied in March, there was little yield increase over the no nitrogen plots for EITHER source after the first harvest in early June. Where the 100 and 150 pound rates were applied in March there was some nitrogen response, about equal for both sources, in the second harvest. The dry matter production was low for the third harvest on all treatments except the split application indicating that neither source of nitrogen at the rates of as much as 150 # N per acre applied in March was effective in supplying the nitrogen needed for fall growth of grasses under Kentucky climatic conditions.

Annual Dry Matter Production of
Bluegrass - Orchard Grass Forage

Average 1971 and 1972 yields