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Potassium and Phosphorus Research on Field Crops

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REPORT OF 1982 PHOSPHORUS AND POTASSIUM RESEARCH
RECEIVING SUPPORT FUNDING BY POTASH/PHOSPHATE INSTITUTE
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Research results are presented in this report from studies conducted in 1982 receiving partial support from PPI. The PPI support was utilized mainly for the soil and plant analytical results reported. Most of these results have been reported in the annual Kansas Fertilizer Research Report of of Progress - 1982 and are taken from the research report and duplicated here. Recognition of Researchers at the Kansas River Valley, East Central Kansas and Sandyland Experiment Fields is intended for their part in conducting the experiments in the field and collection of the plant and soil samples.

I. PRODUCTION AND QUALITY OF IRRIGATED ALFALFA

MANAGEMENT OF IRRIGATED ALFALFA

Sandyland Experiment Field
Jim Ball, George TenEyck and David Whitney

An irrigated alfalfa management study was initiated in the fall of 1975 with the objectives of (1) to determine the forage yield and nutrient removal of alfalfa from phosphorus, potassium and sulfur applications; (2) to determine stand persistence to three cutting management systems; (3) to study variety effect for response to fertilization and stand persistence. The study is located on a site that consists of two sandy soil types; Pratt loamy fine sand and Naron loamy fine sand. The original fertility treatments included one treatment of a split phosphate application and one with sulfur application. Because no yield advantage over similar treatments was found through 1981, these two treatments were changed in 1982 to treatments of 320 and 640 lb K_2O/A with constant phosphorus applications.

Two varieties, Kanza and Marathon, were seeded in the fall of 1975. Although little yield difference was found over the first several years, the stand of Marathon has thinned and only results for the Kanza variety are reported. The cutting managements are as follows: cutting each time at the bud stage; cutting each time at the 1/10 bloom stage; and cutting alternately at the bud stage and full bloom stage. Four cuttings were harvested in 1976 and are not included in the following data. Five cuttings were made in 1977 and 1978 for all managements with an additional late cutting made on the bud stage in both years for the two treatments with this management and only on the 1/10 bloom stage in 1978. In 1979 through 1982, five cuttings were taken from the bud and 1/10 bloom stages and only four cuttings from the alternate cutting management. All managements had the late fall cuttings taken.

The results for 1982 as well as for the five previous years have shown a good response to P at this location. The optimum phosphate rate has increased from 40 lb P_2O_5 annually in the first years of the study to 120 lb of P_2O_5 annually in 1982. With the removal of slightly more than 50 lb P per acre annually by the top yielding treatments, the addition of 120 lb of P_2O_5 is roughly equaling P removal. Soil test results for P also are reflecting a similar trend in that the high P rate is needed to maintain soil test P levels. The application of 320 lb P_2O_5 per acre prior to planting in 1975 (preplant) has resulted in higher yields over the six years than where no P has been applied, but preplant plus annual applications has not resulted in

higher yields than where adequate annual P applications have been used, however, the optimum annual P_2O_5 has been lower. Soil test results for P reflect residual P in the soil from the preplant application. These results would suggest that over the period of the study frequency of phosphorus application is not as important as getting adequate phosphate applied to meet plant needs.

The potassium has not resulted in a significant yield response with rates going as high as 640 lb K_2O per acre. This is surprising with soil test K levels at or below 100 lb per acre on all plots. The higher K rates initiated in 1981 have resulted in greater K removal with 145 lb K per acre more in 1982 for the 640 lb K_2O/A compared to no K at 120 lb P_2O_5 annually for both treatments. These results would suggest that the K soil test is not reflecting soil K available for plant uptake.

The results of this study have clearly shown that for high yielding alfalfa, close attention must be paid to phosphorus available from the soil and from fertilizer application.

FERTILIZATION OF IRRIGATED ALFALFA

Kansas River Valley Experiment Field
L. D. Maddux and P. L. Barnes

This study was initiated in 1976 to evaluate the effects of phosphorus fertilizer applied preplant and plowed down and annual treatments of nitrogen, phosphorus and potassium on irrigated alfalfa. Kanza alfalfa was seeded April 13, 1976 at 10 pounds per acre. Annual treatments of phosphorus and potassium were applied November 17, 1981. Harvests were made June 16, July 12, August 19, and October 6 with a flail harvester. The first harvest was delayed due to the rainy weather in May and early June.

A thin stand of alfalfa was obtained when this study was established. The original stand had been fairly well maintained until this year when a substantial stand depletion occurred over the winter. Yields, plant tissue nutrient content and soil test data are shown in Table 23. There was no significant difference in protein content due to fertilizer application. The annual P treatments increased the P content in the alfalfa tissue. There was also a trend to increased P content of alfalfa tissue with the plowdown treatments, but this was not significant. There was no significant differences in K tissue content although the 0-40-0 treatment tended to be lower in K than the treatments receiving potassium fertilizer. The annual P and K fertility treatments increased total alfalfa yield by about one-third ton. Yields were fairly low due to the declining stand and the late first harvest.

soil levels of phosphorus have increased slightly with the 80 pounds P_2O_5 per acre annual treatment, while plots not receiving phosphate have decreased to a low level(11 pounds available P_2O_5 per acre) from the original 40 pound per acre soil test value. Potassium soil test levels have declined form the 1976 value of 450 pounds exchangeable K_2O per acre even with the annual applications of potash.

Effect of phosphorus and potassium rates and phosphorus frequency of application on irrigated Kanza alfalfa yield, crude protein, phosphorus and potassium removal at Sandyland Experiment Field over six years.

Fertilizer Treatment lbs/A			Forage yield Tons/A[1] 15% moisture						Nutrient Content of Forage: Crude protein yield lbs/A						P lbs/A						K lbs/A					
P205		K20																								
Preplant	Annual	Annual	1982	1981	1980	1979	1978	1977	1982	1981	1980	1979	1978	1977	1982	1981	1980	1979	1978	1977	1982	1981	1980	1979	1978	1977
0	0	0	8.2	9.1	7.1	7.4	7.7	8.1	2815	3050	2640	2909	2718	3040	29	33	26	30	27	33	270	314	265	286	341	363
0	40	80	9.7	10.6	8.5	8.9	9.3	9.3	3342	3707	3103	3581	3266	3585	39	43	35	41	35	44	334	366	317	358	415	426
0	80	80	10.4	11.4	8.8	9.5	9.7	9.3	3816	3973	3427	3875	3466	3566	50	51	44	50	42	49	334	376	341	373	449	429
0	120	80	11.4	12.1	9.5	10.0	10.6	9.6	4077	4063	3656	4124	3858	3732	58	59	53	59	49	53	354	389	360	396	479	452
320	0	80	9.4	10.1	8.3	9.0	9.9	9.4	3252	3488	3175	3609	3623	3613	35	39	34	41	40	46	320	363	325	356	466	432
320	40	80	10.2	11.4	9.1	9.7	10.7	9.9	3657	3927	3387	3931	3801	3753	44	49	42	52	45	52	334	382	340	387	480	456
320	80	80	11.2	12.1	9.2	9.7	10.3	9.5	4091	4169	3647	4047	3704	3629	55	55	49	58	48	54	370	403	364	376	463	436
320	120	80	11.1	11.9	9.5	9.6	10.6	9.8	4189	4262	3681	3964	3802	3773	59	63	54	59	51	59	350	399	357	384	485	460
0	120	0	11.5	11.9	9.6	9.6	10.5	9.6	4117	4247	3783	3991	3907	3779	60	60	53	59	53	54	310	351	329	356	472	429
0	120	160	10.9	11.9	9.5	9.9	10.6	10.0	3971	4121	3696	3981	3799	3752	54	56	50	56	49	54	369	408	379	396	491	451
0	120	320#	10.9	12.0	9.2	9.8	10.0	9.2	4064	4115	3574	3962	3587	3544	56	69	45	52	43	48	421	445	346	393	467	424
0	120	640#	10.9	11.6	9.2	9.9	10.3	9.9	3879	4064	3589	4078	3668	3729	55	57	50	59	48	53	455	472	346	386	470	436
320	120	80*	10.4	12.7	10.0	10.6	11.6	9.6	3626	4407	3827	4290	4081	3635	57	65	57	69	57	57	322	403	359	402	506	437
0	0	80*	7.4	9.5	7.8	8.3	8.3	8.3	2463	3186	2844	3225	2914	3046	25	34	29	35	28	33	265	356	302	324	374	367
LSD (.05)			0.7	0.8	0.7	0.6	0.6	0.5	252	245	269	267	257	189	4	4	4	5	4	3	23	40	33	32	31	25

#These two treatments where changed in 1981 from previous rate of 80 lb/A of K_2O
*Late cutting taken after frost when possible
[1]Averaged over three cutting managements

Effects of cutting stage on irrigated Kanza alfalfa annual yields and crude protein over six years at the Sandyland Experiment Field.

Stage of Cutting	Forage yield, T/A 15% moisture						Crude protein %						Crude protein lb/A					
	1982	1981	1980	1979	1978	1977	1982	1981	1980	1979	1978	1977	1982	1981	1980	1979	1978	1977
1/10 Bloom	10.4	11.7	9.5	10.5	10.1	9.4	20.5	19.9	22.8	23.0	20.9	21.2	3618	4056	3768	4194	3689	3508
Bud	8.3	11.0	7.8	8.9	9.6	9.3	21.7	20.6	22.6	24.0	21.2	22.3	3189	3978	3062	3700	3519	3617
Alt.	10.3	11.2	9.6	8.9	10.3	9.4	19.7	19.3	21.7	23.0	19.8	22.3	3465	3759	3517	3589	3548	3626
LSD (.05)	0.6	N.S.	0.8	0.9	0.5	N.S.	0.3	N.S.	0.5	0.7	N.S.	N.S.	253	195	287	385	193	305

Effect of phosphorus and potassium rates and phosphorus frequency of application on average forage yield and soil test phosphorus and potassium levels under irrigated alfalfa at the Sandyland Experiment Field.

Fertilizer Treatment, lbs/A			6-year avg	Soil Test Results - lbs/A									
P205		K20	Forage yield T/A	Available P					Exchangeable K				
Preplant	Annual	Annual	15% moisture	1982	1981	1980	1979	1978	1982	1981	1980	1979	1978
0	0	0	7.9	5	7	9	9	10	105	103	107	93	109
0	40	80	9.4	7	9	10	11	16	100	115	106	89	131
0	80	80	9.9	10	14	17	16	18	87	104	106	88	127
0	120	80	10.5	19	25	27	26	27	97	93	93	88	112
320	0	80	9.4	6	11	13	18	26	98	106	109	82	131
320	40	80	10.2	11	15	22	28	36	97	101	100	88	121
320	80	80	10.3	16	29	31	38	42	92	101	96	82	119
320	120	80	10.4	21	40	46	40	55	88	95	102	79	122
0	120	0	10.5	17	27	30	22	26	82	82	89	77	113
0	120	160	10.5	17	25	25	26	23	99	100	113	85	119
0	120*	320	10.2	14	18	20	24	23	115	108	102	83	134
0	120*	640	10.3	20	24	32	31	29	127	93	92	83	118
320	120**	80	10.8	33	49	49	45	49	77	83	86	73	125
0	0**	80	8.3	5	8	9	9	12	109	93	103	85	133

*These two treatments were changed in 1981 from previous rate of 80 lb/A of K_2O

**Additional cutting taken late fall.

Initial soil test level: P = 19 lbs/A, K = 252 lbs/A

TABLE 23. EFFECT OF P AND K ON FORAGE YIELD AND PERCENT PROTEIN, PHOSPHORUS AND POTASSIUM OF ALFALFA, 1982.

Kansas River Valley Experiment Field
L. D. Maddux and P. L. Barnes

Fertilizers, lb/A			Cut 1				Cut 2				Cut 3			
Pre	Annual		Forage	Protein			Forage	Protein			Forage	Protein		
P_2O_5	P_2O_5	K_2O	yield[1]	%	%P	%K	yield[1]	%	%P	%K	yield[1]	%	%P	%K
0	0	80	1.75	16.88	.195	2.36	1.01	16.15	.217	2.61	0.82	14.54	.236	2.49
0	40	0	2.22	17.65	.271	2.11	0.95	16.38	.288	2.34	1.07	13.75	.327	2.32
0	40	80	2.29	16.58	.239	2.29	0.97	16.54	.276	2.60	1.04	14.27	.331	2.53
0	80	80	2.41	17.81	.290	2.18	0.98	16.75	.300	2.50	1.04	13.65	.335	2.55
80	0	80	1.87	16.27	.233	2.39	1.06	17.79	.246	2.49	1.13	14.90	.242	2.31
80	40	0	2.08	17.06	.296	2.34	0.88	17.44	.301	2.36	1.08	14.15	.331	2.31
80	40	80	1.95	16.79	.257	2.25	0.96	17.13	.296	2.59	1.33	14.52	.288	2.27
80	80	80	1.89	17.44	.330	2.49	0.83	16.88	.343	2.74	1.22	14.58	.376	2.44
160	0	80	2.00	17.13	.241	2.42	0.97	16.71	.260	2.56	1.22	15.50	.290	2.38
160	40	0	1.74	16.96	.300	2.22	0.79	16.94	.322	2.47	1.06	14.10	.380	2.51
160	40	80	2.07	16.92	.283	2.52	1.00	16.44	.300	2.66	1.10	14.79	.320	2.44
160	80	80	2.40	16.83	.289	2.21	0.92	16.88	.322	2.53	1.23	12.96	.403	2.46
LSD(.05)			.26	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Preplant P_2O_5 Means:														
0			2.13	17.03	.250	2.25	0.99	16.45	.270	2.50	1.01	14.15	.306	2.43
80			2.00	16.86	.272	2.37	0.95	17.43	.295	2.57	1.22	14.32	.303	2.30
160			2.05	16.99	.283	2.42	0.92	16.75	.299	2.56	1.15	14.30	.347	2.44
LSD(.05)			NS	NS	NS	NS	NS	NS	NS	NS	.10	NS	NS	NS
Annual Fertilizer Means:														
	0	80	1.87	16.76	.223	2.39	1.01	16.88	.241	2.55	1.06	14.98	.256	2.39
	40	0	2.01	17.22	.289	2.22	0.88	16.92	.304	2.39	1.07	14.00	.346	2.38
	40	80	2.10	16.76	.259	2.35	0.98	16.70	.291	2.61	1.16	14.53	.313	2.41
	80	80	2.23	17.36	.303	2.30	0.91	16.83	.322	2.59	1.16	13.73	.371	2.48
LSD(.05)			.12	NS	.024	NS	.06	NS	.018	NS	.09	NS	.028	NS

Fertilizers, lb/A			Cut 4				Total	Soil Test Levels[2]	
Pre	Annual		Forage	Protein			Forage	Avail.	Exch.
P_2O_5	P_2O_5	K_2O	yield[1]	%	%P	%K	yield[1]	P_2O_5	K_2O
0	0	80	0.95	18.46	.199	2.41	4.53	11	312
0	40	0	0.97	17.83	.263	2.10	5.22	28	240
0	40	80	0.99	16.21	.264	2.20	5.36	30	323
0	80	80	1.11	16.13	.299	2.15	5.36	41	287
80	0	80	1.04	17.50	.221	2.21	5.10	12	309
80	40	0	1.03	16.92	.290	2.05	5.08	31	237
80	40	80	1.14	16.13	.279	2.21	5.38	32	304
80	80	80	1.09	15.67	.288	2.05	5.04	55	282
160	0	80	1.04	17.35	.238	2.22	5.22	17	286
160	40	0	1.06	14.79	.313	1.80	4.66	36	233
160	40	80	1.15	15.21	.291	2.17	5.32	32	271
160	80	80	1.06	15.77	.332	2.00	5.60	54	271
LSD(.05)			NS						
Preplant P_2O_5 Means:									
0			1.00	16.88	.258	2.20	5.16	28	291
80			1.08	16.60	.267	2.16	5.15	33	283
160			1.08	15.69	.292	2.04	5.20	35	265
LSD(.05)			NS	NS	NS	NS			
Annual Fertilizer Means:									
	0	80	1.01	17.77	.219	2.28	4.95	13	.302
	40	0	1.02	16.51	.289	1.98	4.99	32	237
	40	80	1.09	15.85	.278	2.19	5.35	31	299
	80	80	1.09	15.85	.306	2.07	5.39	50	280
LSD(.05)			NS	NS	.019	.13			

[1]Machine harvested yields corrected to 15% moisture, tons/A.

[2]0-6" soil depth, 1981.

II. RESIDUAL FERTILIZER EFFECT ON SOYBEANS

RESIDUAL EFFECT OF 14-YEARS OF CORN FERTILIZATION ON IRRIGATED SOYBEAN YIELDS AT THE SANDYLAND EXPERIMENT FIELD

George TenEyck and Jim Ball

An irrigated corn fertilization study was begun in 1968 at the Sandyland Experiment Field. The same fertility treatment were applied to each individual plot through 1981. Yield results on the corn have shown a good response to nitrogen and phosphorus over the duration of the study, however, grain yields the past few years have not matched those of earlier years. Soil samples taken from individual plots in 1981 showed that a wide range in soil test phosphorus levels had developed from phosphorus application and the soil pH had been lowered markedly by the highest nitrogen application rates. For 1982 the study area was cropped to soybeans without fertilization to study the residual effect of the 14 years of corn fertilization on soybean production Table 1.

Excellent soybean yields were obtained with the highest treatment averaging 67.3 bu/A. A good yield response was obtained to the residual from previous P fertilization of the corn. There was no effect from previous nitrogen, potassium or zinc applications on yield, in spite of the fact, that pH's were found to be in the high 4's on plots receiving the high nitrogen rates over the past 14 years. Soil samples taken in the late winter showed that the soil test levels of P related to previous fertilization history. Those plots receiving no P had tests in the range of 10 to 23 lb/A, those with 50 lb/A of P_2O_5 per year for the 14 years in the range of 34 to 81 lb/A and the one treatment with 100 lb/A/yr a test of 128 lb/A. The soil test results will illustrate the value of soil tests to monitor the status of soil fertility levels.

Table 1. Residual effect of 14 years of corn fertilization on irrigated soybean yields.[1]

Previous Corn Rates				Grain	1982 Soil Test Results		
N	P_2O_5	K_2O	Zn[2]	Yield	pH	Avail. P	Exch. K
---------- lb/A ----------				bu/A		lb/A	lb/A
0	0	0	0	63.2	7.2	23	304
0	50	50	10	67.2	7.2	81	387
75	50	50	10	63.5	6.8	58	347
150	50	50	10	63.3	6.4	39	318
225	50	50	10	63.3	5.9	40	331
300	50	50	10	67.3	5.3	45	292
375	50	50	10	66.7	4.9	61	318
450	50	50	10	58.4	4.9	59	243
225	0	0	0	54.6	5.5	13	248
225	0	0	10	51.9	5.8	12	265
225	50	0	10	64.8	6.2	39	279
225	50	0	0	62.8	6.1	34	290
225	0	50	10	59.2	5.7	10	298
225[3]	100	100	10	62.5	5.9	128	380
225[3]	50	50	10	59.1	5.8	39	323
225[3]	50	50	10	60.5	5.8	45	291
$LSD_{.05}$				8.0		21	62

[1] Williams 82, planted on May 21, 1982.
[2] Zinc applied as ZnSO in 1968 and 1971 through 1974.
[3] Split N applications during duration of corn study.

III. EFFICIENT PHOSPHORUS PLACEMENT

EFFECT OF P FERTILIZER PLACEMENT AND N SOURCE ON EARLY PLANT GROWTH, NUTRIENT COMPOSITION, AND YIELD OF GRAIN SORGHUM

East Central Kansas Experiment Field

K. A. Janssen and D. A. Whitney

A study to evaluate phosphorus fertilizer placement with two N sources was begun on grain sorghum at the East Central Kansas Experiment Field in 1980. The experimental site (Woodson silty clay loam soil), initially, tested low in soil available phosphorus (22 lbs. P/a) and medium in exchangeable potassium.

Procedure: Treatments evaluated were anhydrous ammonia knifed (6-8" deep on 15" centers) and ammonium nitrate broadcast, with P fertilizer broadcast, knifed (6-8" deep on 15" centers) and banded (2" side and 2" below the seed at planting time). The N application rate was 100 lbs. N/a. Phosphorus was applied at 40 lbs. P_2O_5/a using 18-46-0 fertilizer for broadcast and banded P applications and 10-34-0 fertilizer for knifed P applications. All fertilizers, except the banded fertilizer at planting time, were applied just prior to seedbed preparation. Pioneer 8272 grain sorghum was planted July 6, 1982. Planting was late due to a prolonged wet spring. Ramrod-atrazine, flowable, at 4 qt./a (pre-emergence), plus one cultivation was used to control weeds. Whole plants were collected on August 11 for measuring early plant growth, and for tissue analysis. Leaf samples for tissue analysis were also collected at the boot stage (August 30). Grain harvest was November 4. Results are presented in Table 43.

Results: Early season grain sorghum growth was influenced by P fertilizer and method of application. Compared to the check, bandplaced P fertilizer at planting increased 8-leaf stage, plant dry weights 1.5 times; knifed P fertilizer increased plant dry weights 1.4 times; and broadcast P fertilizer increased plant dry weights 1.2 times. Nitrogen sources, anhydrous ammonia knifed and ammonium nitrate broadcast, produced no significant difference in early plant growth.

Plant tissue P levels at the 8-leaf stage were highest in plants in which phosphorus fertilizer was broadcast (.264 % P) followed by knifed P (.246 % P) and banded P (.229 % P). This response pattern is opposite that observed in the two previous years of this study. Anhydrous ammonia knifed significantly increased plant tissue P compared to ammonium nitrate broadcast. This was the first year that N source influenced tissue P.

Grain sorghum maturity was advanced by the application of phosphorus fertilizer. Plants which received phosphorus fertilizer were several weeks ahead in maturity compared to plants in the check. This difference in maturity was likely an advantage in 1982 because of the lateness of planting and frost on October 21.

1982 grain sorghum yields were less than half that in 1981. Despite that, yield response to phosphorus was excellent. Averaged over all P fertilizer application methods, phosphorus increased yield 24.8 bu/a. Yield differences due to P placement were not statistically significant. These results differ from those recorded previous. In 1980 and 1981 both broadcast P and knifed P yielded better than banded P at planting time. Banded P at planting has a tendency to advance maturity more than broadcast P and knifed P. As a result, both years, banded P treatments encountered poorer weather conditions during critical growth stages which influenced yield.

This year for the first time nitrogen source, anhydrous ammonia knifed, significantly increased yield compared to ammonium nitrate broadcast. The reason could be related to the prolonged wet weather this spring.

Conclusions: Grain sorghum response to phosphorus fertilizer placement has not been consistent; also influence of N source has been variable. Part of the inconsistency seems to be related to the P application methods' influence on maturity of the grain sorghum and subsequent growing conditions during critical growth stages. As a result, no clear cut advantage has been observed for banded P, knifed P, or broadcast P in this study.

Table 43. EFFECT OF P FERTILIZER PLACEMENT AND N SOURCE ON EARLY PLANT GROWTH, NUTRIENT COMPOSITION, AND YIELD OF GRAIN SORGHUM

East Central Kansas Experiment Field

K. A. Janssen and D. A. Whitney

N Application @ 100 lbs. N/a		P Application @ 40 lbs. P_2O_5/a		Grain Yield @ 12.5%	Plant Dry Weight 8-Leaf Stage	Plant Tissue Composition [2] @ 8-Leaf		Boot	
Source	Method [1]	Source	Method	bu/a	g/4 Plants	%N	%P	%N	%P
NH_4NO_3	BC	--	--	35.8	32.7	3.18	.225	2.54	.289
NH_4NO_3	BC	18-46-0	BC	54.6	39.6	3.11	.250	2.62	.339
NH_4NO_3	BC	10-34-0	KN	67.9	51.3	2.90	.238	2.65	.314
NH_4NO_3	BC	18-46-0	BD	56.7	53.1	2.88	.222	2.64	.327
NH_3	KN	--	--	44.0	39.2	3.16	.226	2.64	.298
NH_3	KN	18-46-0	BC	72.5	45.6	3.20	.277	2.81	.349
NH_3	KN	10-34-0	KN	67.2	52.0	3.09	.254	2.86	.334
NH_3	KN	18-46-0	BD	69.6	56.3	3.02	.236	2.82	.321
LSD .05				13.4	11.0	NS	.027	0.16	.027
Mean Values:									
N-Source									
NH_4NO_3 Broadcast				53.8	44.2	3.02	.234	2.61	.317
NH_3 Knifed				63.3	48.3	3.12	.248	2.78	.326
LSD .05				6.7	NS	NS	.013	0.08	NS
P Application Method									
--				39.9	36.0	3.17	.226	2.59	.294
BC				63.6	42.6	3.16	.264	2.71	.344
KN				67.5	51.7	3.00	.246	2.75	.324
BD				63.1	54.7	2.95	.229	2.73	.324
LSD .05				9.4	7.8	NS	.018	0.11	.019

[1] BC (Broadcast).
KN (Knifed into soil 6-8" deep on 15" centers).
BD (Bandplaced at planting, 2" side and 2" below seed).

[2] 8-Leaf Stage - Whole plant, above ground. August 11, 1982.
Boot Stage - Leaf below flag leaf. August 30, 1982.