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POTASSIUM EFFECTS ON YIELD AND COMPOSITION OF CORN, ALFALFA AND WHEAT

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WHEAT RESPONSES TO P MATERIALS, P RATES AND METHODS OF APPLICATION

K. W. Kelley, M. C. Lundquist, W. A. Moore, R. E. Lamond,
B. Hall, D. Buchholz and L. S. Murphy

Evaluations of ammonium orthophosphate, (AOP, 18-46-0), ammonium polyphosphate (APP, 15-62-0) and urea-ammonium polyphosphate (UAPP, 21-42-0) were continued at locations in Labette and Ford counties in 1976-77. The objective of these investigations were to gather information on the comparative performance of ortho and polyphosphates and to observe further the agronomic effectiveness of a solid material comprised of a combination of urea and ammonium polyphosphate produced by the Tennessee Valley Authority on an experimental basis.

Locations selected for these studies were low to medium in phosphorus according to soil analysis. Broadcast and banded P treatments were included at the Labette county location while those in Ford county involved only broadcast pre-plant treatments. Nitrogen at the Labette county site was held constant at 75 lb N/acre. Nitrogen needed to achieve 75 lb N/acre beyond that supplied as the P material was applied as urea in an early spring topdressing. Banded applications of P were placed in direct seed contact.

Results of the Labette county study (Table 1) indicate excellent P responses as well as significant differences between P carriers and methods of P application in 1977. Essentially a straight-line P response was recorded above 25 lb P_2O_5 per acre. Phosphorus responses continued through 75 lb P_2O_5 per acre. In 1976 at the same site, P responses stopped at 50 lb P_2O_5 per acre.

Comparisons of P carriers in 1976 had indicated near equality of the three studied despite worry over urea damage to germinating seedlings at the highest rates of application. Apparently tillering in 1976 off set any problems with emergence. In 1977, however, differences between P carriers were significant with the lowest mean yields recorded for UAPP. Apparently, the cold, dry conditions which existed from early October 1976 through the spring of 1977 combined with urea in direct seed contact to lower the emergence and tillering of the wheat on those plots. An interaction occurred between placement effects and P carrier. Band placement of P tended to offset the detrimental effects of urea in UAPP through an improvement in P availability. This fact is supported by comparisons of the yield effects of band applications of UAPP versus band placement of AOP and APP. Yield effects of the latter two materials were identical.

Placement of P also produced different results in 1977 as compared to 1976 at the same site. Broadcast treatments in 1977 were definitely inferior to P placed in direct seed contact. Apparently the difference between results in 1976 and 1977 was due in part to the cold, dry winter conditions which tended to accentuate P responses over most of the state.

Table 1 WHEAT RESPONSES TO P MATERIALS, RATES AND METHODS OF APPLICATION

K. W. Kelley, R. E. Lamond, B. Hall, D. Buchholz and L. S. Murphy

				Parsons Exp. Field, Labette County						
				1976				1977		
				Yield	Grain		Leaf	Yield	Grain	
N	P_2O_5	P Carrier	Method P Application	bu/A	% P	% Protein	% P	bu/A	% P	% Protein
0	0	——	——	25.5	.317	14.9	.310	23.0	.323	13.4
75	0	——	——	22.1	.281	15.5	.242	27.8	.338	12.8
75	25	UAPP	B'cast	30.0	.269	15.0	.305	30.3	.364	12.9
75	50	UAPP	B'cast	35.5	.275	14.9	.283	32.9	.346	13.4
75	75	UAPP	B'cast	39.1	.270	15.3	.323	38.0	.381	12.1
75	25	UAPP	Band	30.7	.335	14.9	.285	34.3	.338	12.7
75	50	UAPP	Band	30.0	.322	14.8	.271	35.7	.323	12.9
75	75	UAPP	Band	33.4	.295	14.8	.348	37.1	.331	12.6
75	25	APP	B'cast	27.1	.304	15.4	.262	29.4	.312	12.7
75	50	APP	B'cast	35.4	.292	15.0	.292	33.2	.315	12.8
75	75	APP	B'cast	35.2	.284	14.8	.344	38.8	.353	12.1
75	25	APP	Band	35.5	.263	15.1	.305	45.4	.303	12.9
75	50	APP	Band	36.1	.278	15.0	.292	45.0	.337	12.5
75	75	APP	Band	37.2	.295	14.9	.309	50.8	.328	12.1
75	25	AOP	B'cast	30.3	.283	15.3	.285	28.9	.272	12.6
75	50	AOP	B'cast	35.5	.317	14.8	.277	34.4	.298	12.2
75	75	AOP	B'cast	34.5	.296	14.9	.288	44.1	.346	12.3
75	25	AOP	Band	26.4	.287	15.1	.289	37.0	.319	13.1
75	50	AOP	Band	37.7	.271	15.2	.288	47.6	.289	11.9
75	75	AOP	Band	37.1	.299	14.4	.364	47.6	.313	12.0
LSD $_{.05}$ Treatment				6.9	.062	1.0	.033	4.4	NS	0.8
	25			30.0	.290	15.1	.289	34.2	.318	12.8
	50			35.0	.293	15.0	.284	38.2	.318	12.6
	75			36.1	.290	14.9	.330	42.8	.342	12.2
	LSD $_{.05}$ P_2O_5 lb/A			2.5	NS	NS	.029	2.6	NS	NS
	UAPP			33.1	.294	15.0	.302	34.7	.347	12.8
	APP			34.4	.286	15.0	.301	40.4	.325	12.6
	AOP			33.6	.292	14.9	.299	39.9	.306	12.3
	LSD $_{.05}$ P Carrier			NS	NS	NS	NS	4.5	NS	NS
	B'cast			33.6	.288	15.0	.296	34.5	.332	12.6
	Band			33.8	.294	14.9	.306	42.3	.320	12.5
	LSD $_{.05}$ P Method			NS	NS	NS	NS	6.4	NS	NS

Low soil test P and adverse weather conditions combine to improve the effeciency of banded P. Still, it should be remembered that when P application rates approach that recommended by soil testing, banded applications of P under Kansas conditions do not always show an advantage. Refer back to the studies reported in Table 11 to get the other side of the picture for efficiency of banded P applications.

Comparisons of the same three carriers under high pH conditions in Ford county failed to produce consistent differences between pre-plant applications of the three P sources (Tables 2+4). UAPP tended to be highest in yield at the Griffith location (Table 2) but was not significantly higher than APP. Differences between UAPP and AOP at that location were significant at the 5% level, however. Phosphorus responses at both the FFA and Griffith locations in Table 3 were excellent although grain protein tended to decline with higher P due to a dilution effect on available N.

An investigation was established in the fall of 1976 at the South Central Experiment Field in Reno county to evaluate the effects of high rates of phosphorus application on wheat yield and protein. Phosphorus soil test values at this site had been low, seven pounds of available P per acre, prior to an application of 46 pounds of P_2O_5 for an alfalfa crop which preceded the wheat. Subsequent soil test values ranged higher on this area following that application.

The study which is reported in Table 15 involved four-year applications totaling 160 pounds P_2O_5 per acre. The treatments involved initial applications of this magnitude, bi-annual applications of 80 pounds of P_2O_5 per acre, and annual applications of 40 pounds P_2O_5 per acre plus a control plot. Nitrogen was maintained constant at 60 pounds of nitrogen per acre. This design was chosen on the basis of reports of higher grain protein from very high rates of fertilization of nitrogen, phosphorus and potassium at locations in south central Kansas.

Results reported in Table 4 indicate that increasing rates of phosphorus tended to depress grain yields and grain protein concentrations. In the past we have noted similar depressions of grain protein from phosphorus applications but attributed this to increased production and subsequent dilution effect from a fixed amount of available nitrogen. Indication of greater phosphorus uptake is exhibited in the tissue analyses showing very significant increases in leaf P concentrations. No generally accepted explanation is proposed for this phenomenon (Table 4) but the suggestion is made that a high amount of available phosphorus in the soil in the form of phosphate anions could potentially have depressed uptake of the nitrogen in the nitrate form. We will continue this interesting investigation throughout the next three years.

POTASSIUM AND MICRONUTRIENT EFFECTS ON WHEAT YIELDS

R. E. Lamond, P. J. Gallagher, M. C. Lundquist and J. Ball

Potassium responses in wheat grown on high K soils in Montana prompted similar studies in Kansas. Sites were chosen in 1976 for investigations in Stafford, Ford and Harper counties on soils ranging from medium to high in exchangeable potassium. Potassium treatments ranged from 20 to 160 lb K_2O per acre and were applied prior to seeding. In addition to the K treatments,

Table 2 EFFECTS OF P SOURCES AND P RATES ON DRYLAND WINTER WHEAT

M. C. Lundquist

lb/A N	lb/A P_2O_5	P Source	Time N-P Application	Clark Co. Yield bu/A	Clark Co. Grain Protein %
60	0	—	—	29.8	12.5
60	20	APP[1/]	Pre-plant	26.9	12.6
60	20	DAP[2/]	"	30.0	13.3
60	20	UAPP[3/]	"	31.9	12.4
60	40	APP	Pre-plant	31.8	12.7
60	40	DAP	"	33.8	12.6
60	40	UAPP	"	31.4	12.8
60	60	APP	Pre-plant	30.5	13.2
60	60	DAP	"	32.3	12.9
60	60	UAPP	"	32.9	12.0
LSD $_{.05}$ Treatment				NS	NS
Means					
APP				32.3	12.7
DAP				29.6	12.8
UAPP				31.9	12.7
LSD $_{.05}$ Source				NS	NS
20 P_2O_5/A				29.7	12.8
40				32.1	12.9
60				32.0	12.4
LSD $_{.05}$ Source				NS	NS

1/ APP = 15-62-0, ammonium polyphosphate, solid.

2/ DAP = 18-46-0, diammonium (ortho) phosphate, solid.

3/ UAPP = 21-42-0, urea-ammonium polyphosphate, solid.

Table 3 NITROGEN, PHOSPHORUS AND SULFUR EFFECTS ON DRYLAND WHEAT YIELD AND GRAIN PROTEIN

M. C. Lundquist

lb/A[1/] N	P_2O_5	S	Fertilizers Used	Griffith Farm, Ford Co. Yield bu/A	Protein %
0	0	0	--	25.2	10.2
60	0	0	Am. nitrate	40.0	11.4
50	0	20	Am. nitrate + Am. sulfate	37.2	11.0
45	62	0	Am. nitrate + 15-62-0[2/]	44.5	10.8
48	46	0	Am. nitrate + 18-46-0[3/]	41.2	10.9
51	42	0	Am. nitrate + 21-42-0[4/]	47.8	10.9
LSD $_{.05}$ Treatment				6.2	0.7
				FFA Farm, Ford Co.	
0	0	0	--	14.2	9.1
60	0	0	Am. nitrate	18.0	11.8
50	0	20	Am. nitrate + Am. sulfate	17.8	11.9
50	60	0	Am. nitrate + 15-62-0	29.0	10.4
50	60	0	Am. nitrate + 18-46-0	27.3	10.0
50	60	0	Am. nitrate + 21-42-0	28.3	10.2
LSD $_{.05}$ Treatment				4.0	0.8

[1/] All applied pre-plant

[2/] Ammonium polyphosphate

[3/] Diammonium orthophosphate

[4/] Urea-ammonium polyphosphate

Table 4 EFFECTS OF HIGH RATES OF PHOSPHORUS ON WHEAT YIELD AND GRAIN PROTEIN

L. S. Murphy, C. L. Harms, W. A. Moore and B. Hall

Lb N/A	Lb P_2O_5/A 1976	1977	1978	1979	South Central Exp. Field, Reno Co. Yield bu/A	Protein %	Leaf Tissue % N	% P	% K
60	0	0	0	0	42.6		3.66	0.28	4.00
60	40	40	40	40	32.7		3.77	0.33	4.06
60	80	0	80	0	34.0		3.62	0.35	3.82
60	160	0	0	0	31.4		3.40	0.38	3.61
$LSD_{.05}$					8.3		NS	0.03	NS

Table 5 POTASSIUM AND MICRONUTRIENT EFFECTS ON WHEAT YIELDS ON MEDIUM TO HIGH K SOILS

R. E. Lamond, P. J. Gallagher, M. C. Lundquist and J. Ball

lb/A[1/] N	P_2O_5	K_2O	S	Micronutrients[2/]	Stafford Co. Yield bu/A	Stafford Co. Protein %	Ford Co.[3/] Yield bu/A	Ford Co. Protein %	Harper Co. Yield bu/A	Harper Co. Protein %
60	40	0	20	No	45.4	12.1	35.3	11.9	34.8	13.2
60	40	20	20	No	42.4	11.8	33.1	12.1	38.8	12.8
60	40	40	20	No	43.2	11.6	35.0	11.9	34.5	13.1
60	40	80	20	No	43.6	11.6	32.8	11.7	36.4	12.8
60	40	160	20	No	43.4	11.6	31.8	12.2	35.7	12.3
60	40	160	20	Yes	38.7	11.3	33.8	11.7	36.4	13.1
$LSD_{.05}$ Treatment					NS	NS	2.6	NS	NS	NS

1/ All nutrients applied preplant, incorporated by tillage. N supplied as NH_4NO_3 and $(NH_4)_2SO_4$, P as 0-46-0, K as 0-0-60, S as $(NH_4)_2SO_4$.

2/ Micronutrients 10 lb Zn, 9 lb Fe, 1 lb Mn, 5 lb Cu/A.

3/ Two additional treatments were included at the Ford county site, a control with no added nutrients and 100 lb/A of 18-46-0 on a second plot. The control yielded 17.9 bu/A with 11.0% protein. 100 lbs of 18-46-0/A increased yield to 20.6 bu/A with 10.6% protein. The protein decline was due to limited N. An additional 42 lb N/A increased yields 14.7 bu/A and increased protein 1.2%.

a micronutrient treatment was also included with single rates of Zn, Fe, Mn and Cu. Nitrogen was held constant at 60 lb N/acre.

Results of the investigations are reported in Table 5. Potassium treatments had no effect on yield or protein content of the grain despite a significant difference in Fort county. At that location, the control plot (no K) yielded best with variation in the other treatments accounting for the significant difference. Micronutrients had no significant effect on yield or grain protein which agrees with data accumulated in the Hays area.

Soil testing procedures at Kansas State University call for K determinations on dry samples. No attempt was made to correlate the K activity in the soil solution with yield. A limited continuation of this work is under way for 1977-78.

EFFECTS OF NITROGEN, PHOSPHORUS, POTASSIUM AND ZINC ON THE YIELD OF IRRIGATED CORN

George TenEyck and Jim Ball
Sandyland Experiment Field

A long-term fertilization study of irrigated corn begun at the Sandyland Irrigation Experiment Field in 1968 continued in 1977 and is summarized in Table 6. This study continues to yield excellent information concerning nitrogen and phosphorus rates for corn in south central Kansas and demonstrates the excellent responses to both elements which can be expected in that area when soil tests for either or both elements are low.

1977 yields were generally lower than in 1975 and 1976. Despite these depressed yields, yield responses to both nitrogen and phosphorus were generally excellent with an economical yield maximum being obtained somewhere between 150 and 225 pounds of nitrogen per acre. Two-way and three-way split applications of nitrogen did not significantly increase yields in 1977.

Phosphorus in this study continues to play an extremely important role. Fifty pounds of P_2O_5 per acre produced a 54 bushel yield response at a 225 pounds of nitrogen per acre in 1977. Phosphorus shortages have produced highly dramatic visible symptoms of phosphorus deficiency which include accumulation of the characteristic reddish-purple pigments at leaf margins and at the base of the stalk early in the growing season. These deficiency symptoms have been translated into a general stunting, poorly filled ears, and a general overall chlorosis.

Phosphorus application rates of approximately 50 pounds per acre have maintained a good phosphorus response but applications of an additional 50 pounds of P_2O_5 have not produced additional yield responses. These data agree well with data discussed earlier from the Tribune Branch Experiment Station where 40 pounds of P_2O_5 applied annually has maintained soil test P values and yields at an excellent level. These data tend to support current recommendations for phosphorus applications for corn which suggest that excessively high applications do little for yield and merely exert their influence on increased soil test values.

Potassium applications have had little effect over the years and produced no significant yield increase in 1977. Zinc treatments applied in 1968 and 1971-1974 had no effect on yield.

A second study of effects of nitrogen, phosphorus and potassium on the yields of sprinkler irrigated corn grown on a deep, sandy soil is reported in Table 84. 1977 yields were disappointing, but did produce some definite trends. In the absence of applied phosphorus, yields were quite depressed. Phosphorus responses were excellent.

Another effect noted in this study was that of time of nitrogen application. In 1977, a split application of nitrogen was set up as follows: 12% at planting, 20% 20 days after emergence, 26% 34 days after emergence, 18% 48 days after emergence, 13% 62 days after emergence, and 11% 76 days after emergence. Split applications of N following this schedule produced some 15 bushels more than when all of the nitrogen was applied preplant. Surprisingly, a three-way split of N application, one-third of total N applied at planting, 40 days after emergence and 60 days after emergence, respectively, produced a little lower mean yield than when all N was applied preplant although this difference was non-significant. This good performance of one split application of N and poor performance of the other split application method is somewhat hard to explain. However, looking at three-year averages, all methods of split N applications have produced higher yields than when the N was applied preplant. This is not surprising on this deep, sandy soil where preplant N would leach freely to a depth where plant roots could not recover it.

Potassium applications produced highly variable responses despite the generally low level of exchangeable potassium in the surface soil (110 pounds exchangeable K per acre).

EFFECTS OF N, P, AND K ON YIELDS OF IRRIGATED CORN IN THE KANSAS RIVER VALLEY

L. D. Maddux and J. L. Gartung

A study was initiated at the Topeka unit of the Kansas River Valley Experiment Field (Shawnee county) in 1972 to evaluate the long term and immediate effects of annual applications of N, P, and K on irrigated corn. The study is irrigated by furrow and located on a mixed alluvial soil near the Kansas River.

In 1977, application of 75 pound N/acre resulted in a mean yield increase of 38.4 bushels per acre over that of the control, but little additional yield increases were realized at the 150, 225, and 300 pound N/acre rates (Table 7). Previous years results indicated an increase in yields up to 150 pound N/acre. There was no response to phosphate fertilization on this medium phosphate soil in 1972-75 or in 1977. In 1976, the application of 30 pound P_2O_5/acre resulted in 19.7 bushels per acre yield increase. This inconsistency of results is not surprising in light of a control soil test value of 35 pound available P/acre in 1976. There was no response to potassium fertilization in 1972-75 or in 1977. The soil of the experimental area has shown a generally high exchangeable K level, so the response obtained in 1976 was surprising. However, looking at the data in Table 87, a consistent effect of K in 1976 was evident. The magnitude of K response increased as N application rate increased and also as P rate increased.

Table 6 EFFECTS OF NITROGEN, PHOSPHORUS, POTASSIUM, AND ZINC ON YIELD OF IRRIGATED CORN

J. Ball and G. TenEyck

Sandyland Experiment Field, Stafford Co.

Treatments, lb/A				Yield, bu/A			10-yr. avg. (1968-77)
N	P_2O_5	K_2O	Zn[1/]	1977	1976	1975	
0	0	0	0	5	12	16	20
0	50	50	10	6	11	22	26
75	50	50	10	23	45	81	82
150	50	50	10	93	137	163	138
225	50	50	10	111	143	159	148
300	50	50	10	116	137	179	158
375	50	50	10	94	157	167	153
450	50	50	10	103	146	172	147
225	0	0	0	57	124	115	116
225	0	0	10	50	107	134	117
225	50	0	10	104	149	170	150
225	50	0	0	123	154	178	---
225	0	50	10	56	106	120	118
225	100	100	10	101	134	166	142
225	50	50	10[2/]	117	160	132	---
225	50	50	10[3/]	112	142	145	---
LSD (.05) (bu/A)				22	32	31	

[1/] Zn applied as $ZnSO_4$ 1968, 1971 through 1974, none in 1975 through 1977.

[2/] Split nitrogen application, half at planting, half sidedressed.

[3/] Split nitrogen application, one-third at planting, one-third at approximately 40 days after emergence, one-third approx. 60 days after emergence.

Variety:	Pioneer 3306 all years
Dates Planted:	April 26, 1977; April 28, 1976; April 28, 1975
Population:	24,000
Herbicide:	Lasso (2 qts.) and Atrazine (1 lb.)
Soil Type:	Farnum fsl
Insecticide:	None in 1977
Row Spacing:	30 inches
Harvest:	September 7, 1977
Irrigation:	Furrow-10" as required

Soil Test Data - 1968

Depth	O.M. %	pH	Avail P lb/A	Exch. K lb/A	Avail Zn ppm
0-6"	1.1	6.8	28	274	1.4

Table 7. EFFECTS OF N, P, AND K ON YIELDS OF IRRIGATED CORN IN THE KANSAS RIVER VALLEY

L. D. Maddux and J. L. Gartung

Kansas River Valley Experiment Field, Shawnee County

Treatments, lb/A N	P_2O_5	K_2O	Grain yield, bu/A[1/] 1977	1976	1972-75[2/]
0	0	0	107.5	103.1	70.2
0	30	0	104.7	122.7	88.0
0	60	0	113.3	92.6	75.8
0	0	60	91.0	92.1	71.5
0	30	60	110.7	111.3	71.5
0	60	60	103.8	105.9	77.6
75	0	0	132.8	120.4	123.5
75	30	0	147.5	131.5	134.0
75	60	0	133.3	132.2	135.8
75	0	60	155.7	140.4	120.4
75	30	60	153.7	138.4	116.9
75	60	60	138.6	122.7	127.3
150	0	0	138.0	132.2	140.5
150	30	0	165.1	147.5	138.5
150	60	0	150.4	170.7	148.2
150	0	60	133.0	113.1	132.2
150	30	60	150.9	181.6	147.1
150	60	60	155.9	192.4	159.4
225	0	0	154.4	143.6	156.4
225	30	0	147.1	166.1	161.1
225	60	0	154.1	142.4	146.3
225	0	60	148.5	153.0	147.4
225	30	60	161.6	181.2	163.0
225	60	60	154.5	165.0	144.5
300	0	0	166.6	148.6	147.5
300	30	0	146.1	129.3	148.7
300	60	0	157.0	140.1	137.0
300	0	60	165.2	158.5	158.1
300	30	60	161.3	192.8	152.6
300	60	60	145.5	165.7	143.8
$LSD_{.05}$ Treatment			29.5	51.7	35.1
Mean Values:					
0 lb N/A			105.2	104.6	75.8
75			143.6	130.9	126.3
150			148.9	156.3	144.3
225			153.4	158.6	153.1
300			157.0	155.8	148.0
$LSD_{.05}$ N			12.1	21.1	14.3
0 lb P_2O_5/A			140.6	130.5	126.8
30			141.9	150.2	132.1
60			142.3	143.0	129.6
$LSD_{.05}$ P_2O_5			NS	16.3	NS
0 lb K_2O			142.3	134.9	130.1
60			140.8	147.6	128.9
$LSD_{.05}$ K_2O			NS	13.1	NS

1/ Machine harvested, corrected to 15.5% H_2O.

2/ P rates 1972-75 were 0, 50, 100, lb P_2O_5/A; K rates same period, 0, 100 lb K_2O/A.

NITROGEN, PHOSPHORUS, AND POTASSIUM FERTILIZATION OF IRRIGATED CORN AND GRAIN SORGHUM ON LOESS SOILS OF WESTERN KANSAS

R. E. Gwinn and P. J. Gallagher
Tribune Branch Experiment Station

Irrigated Corn

The 1977 yields of the long-term fertilization study of irrigated corn at Tribune is reported in Table 8.

This study has been under way since 1961, and involves variables of nitrogen, phosphorus and potassium rates. The objectives of this investigation have varied somewhat through the years but essentially involve evaluation of responses of continuous irrigated corn to various rates of nitrogen, study the response of corn to simultaneous applications of nitrogen and phosphorus, evaluation of effects of applied potassium on the yield of irrigated corn in Western Kansas, comparison of yield effects of two rates of phosphorus under identical rates of nitrogen applications (1968-1973).

Procedurally, this investigation has varied somewhat since its beginning in 1961. In 1961, fertilizer was applied broadcast and these same rates of nitrogen, phosphorus and potassium have been applied to the same plot each year since. In 1968 and 1969, a uniform application of 10 lbs of zinc was applied to the experimental area, and an additional 17.5 lbs of phosphorus was applied to one-half of the original plot areas. From 1970-1973, no zinc has been applied but the additional 17.5 lbs of phosphorus per acre has been continued on half the plot area. In 1974, and subsequent years, all phosphorus was discontinued on this half of the plot to study available phosphorus drawdown during continuous corn production.

Yield data for this continuing investigation has indicated a consistent response to nitrogen over the years. Applications up to 160 lbs of nitrogen per acre have generally increased the yield of irrigated corn. Yield responses to phosphorus applications were observed for the first time in 1965. Since that date, the response to phosphorus has been significant and consistent at nitrogen rates of 120 lbs/a and above. The additional 17.5 lbs of phosphorus initiated in 1968 has produced significant yield increases only on the plots which had not received phosphorus prior to that date. Where 17.5 lbs of elemental phosphorus (40 lbs P_2O_5/a) has been applied each year since 1961, the additional 17.5 lbs of phosphorus rate (40 lbs P_2O_5/a) has not produced any significant yield increases.

Potassium applications have had negligible effects throughout the years. This is not surprising considering the extremely high potassium test on this area which averages near 1000 lbs or above exchangeable potassium per acre.

1974 yields were generally disappointing due to heat stress, severe hail damage, August 10, and an early freeze, September 3. After much study of the responses of the 1974 crop, they have been incorporated into the long-time averages. Though the yields for 1974 were only 50-60% of the averages, the response to phosphorus and nitrogen were similar to past years. Where no phosphorus was applied, the yields were significantly equal to the yields of the continuously applied 17.5 lbs of phosphorus plots.

The 1975 yields were slightly above the long time average and show the same response as past years, with 160 lbs/a of nitrogen plus the 17.5 lbs/a of phosphorus as the highest yield, though not significantly above the 120 lbs nitrogen plus the phosphorus.

1976 and 1977 yields were above average, especially at the lower nitrogen rates. The yield differences for higher nitrogen rates were not as great as in previous years, but continued to increase through the 200 lbs/a rate. Phosphorus increased yields significantly.

The treatments with residual phosphorus yielded significantly higher than the no phosphorus check plots. Those with a residual of 18 lbs/a in 1973 were significantly lower than both the regular 17.5 lbs/a annually applied phosphorus treatments (25 lbs/a of P for soil test) and the 45 lbs/a residual phosphorus plots. There was no significant difference between the annual 17.5 lbs/a phosphorus treatments and the 45 lbs/a residual phosphorus plots. See results below:

Soil Test Values lbs/a available P December 1973	Average Yields (120, 160, 200 lbs N/A combined) Bu/a at 15.5% moisture.				
	1974	1975	1976	1977	Average 1974-77
11 1/	79	123	167	163	133
18 2/	96	144	178	173	148
25* 3/	97	168	197	211	168
45 4/	89	164	194	199	162
LSD 5%	19	19	20	--	--

* 17.5 lbs/a of Phosphorus was applied each year.

1/ Continuous corn; nitrogen only 1961-1977.

2/ 1961-1967 only nitrogen; 1968-1973 nitrogen plus 17.5 lbs/a of P; 1974-1977 nitrogen only.

3/ 1961-1977 nitrogen plus 17.5 lbs/a of P.

4/ 1961-1967 nitrogen plus 17.5 lbs/a of P; 1968-1973 nitrogen plus 35 lbs/a of P; 1974-1977 nitrogen only.

The nitrogen only plots have been significantly increasing yields at the 80 lbs/a level, but not above this level since 1972.

The decline of available soil phosphorus to approximately 11 lbs/a resulted in the initiation of phosphorus responses in 1965. Where 17.5 lbs of P per acre (40 P_2O_5) have been maintained through the life of the study, soil test levels have remained constant at about 25 lbs/a of available phosphorus.

Studies recently completed on the experimental area have indicated some accumulation of nitrate-nitrogen in the soil from the highest nitrogen rates, but application of rates of 160 lbs of nitrogen per acre have not produced significant nitrate-nitrogen accumulations, indicating that nitrogen is being rather efficiently utilized by the corn crop.

Irrigated Grain Sorghum

Results of an irrigated grain sorghum investigation conducted adjacent to the corn study reported previously have produced data quite similar to the corn study. The yields have been disappointing over the 1973-1976 years. In 1975, 1976 and 1977, the yield was increased significantly for nitrogen only through 40 lbs/a of applied nitrogen. Phosphorus increased yields and there was no difference in yield for applied zinc (Table 9). The 1977 yields were the highest ever in this test, but response to N and P was similar to the last two years.

Phosphorus response began about 5 years after the test was initiated and have been consistent since that time. Maximum yields have been obtained from 80-120 lbs of N/a/year, and at no time has potassium increased yields.

Soil test levels have reacted similar to the corn test, except the levels were still a little higher on the no phosphorus treatments. Soil test values have consistently been a good predictor of plant responses.

Table 8 EFFECTS OF NITROGEN, PHOSPHORUS, AND POTASSIUM ON YIELD OF IRRIGATED GRAIN SORGHUM - 1961-1977 - TRIBUNE

Treatment			1972		1973		1974		1975		1976		1977		AVERAGES 1968-73		AVERAGES	AVERAGES 1974-77	
			RS	RS	RS	RS	0	5-lbs	0	5-lbs	0	5-lbs	0	5-lbs	RS	RS		0	5-lbs
N	P	K	671	626	671	626	Zn	Zn	Zn	Zn	Zn	Zn	Zn	Zn	671	626	1968-77	Zn	Zn
			bu/a		bu/a		bu/a		bu/a		bu/a		bu/a		bu/a		bu/a	bu/a	
0	0	0	73	73	48	62	39	37	71	72	92	91	120	129	61	68	74	81	82
40	0	0	99	88	69	86	55	57	77	74	106	106	142	134	92	95	100	95	93
80	0	0	112	90	92	92	61	66	84	85	103	104	139	138	112	108	111	97	98
120	0	0	103	84	90	89	57	61	77	75	100	100	133	131	110	106	109	92	92
160	0	0	96	82	82	84	57	58	69	74	103	107	136	132	107	101	105	91	93
200	0	0	110	89	88	89	51	62	79	75	99	104	126	130	113	107	104	89	93
0	17	0	69	67	48	69	34	40	72	83	96	109	129	129	63	71	77	83	90
40	17	0	114	109	88	103	69	70	106	107	114	115	147	148	104	106	110	109	110
80	17	0	121	110	108	109	73	73	87	98	118	117	146	152	121	118	119	106	110
120	17	0	117	100	108	106	70	68	92	79	114	116	144	146	126	120	122	105	102
160	17	0	117	102	116	113	74	73	95	102	122	126	149	145	130	123	126	110	112
200	17	0	123	106	119	120	79	75	96	101	112	124	149	148	130	123	126	109	112
0	17	33	69	65	51	66	34	42	76	73	100	103	123	127	63	70	77	83	86
40	17	33	110	105	86	107	62	68	102	94	123	109	147	146	103	107	111	109	104
80	17	33	122	109	106	110	76	76	99	105	121	119	150	147	123	120	122	112	112
120	17	33	125	101	107	113	77	81	90	93	119	121	149	150	127	123	126	109	111
160	17	33	117	104	109	113	66	52	92	98	114	115	146	147	127	124	124	105	103
200	17	33	116	104	111	114	65	67	86	91	118	116	147	145	127	124	125	104	105

Yields corrected to 12.5% moisture

Table 9 EFFECTS OF NITROGEN, PHOSPHORUS AND POTASSIUM ON YIELD OF IRRIGATED CORN — TRIBUNE

Treatments [2/] N	P (lbs/a)	K	Yields, bushels per acre [1/] 1973		1974		1975		1976		1977		1968-73 Average		1961-77 Average	1974-77 Average	
0	0	0	53	57[3/]	21	22[4/]	56	44[4/]	106	110[4/]	93	89	68	71[3/]	61	69	66[4/]
40	0	0	120	121	56	51	105	104	146	151	148	161	115	115	109	114	117
80	0	0	140	153	76	88	119	133	150	167	151	171	133	142	127	124	140
120	0	0	145	168	74	84	123	146	167	178	164	178	133	159	132	132	144
160	0	0	144	184	75	104	120	136	162	180	167	177	142	171	138	131	149
200	0	0	163	174	87	101	126	151	172	177	157	165	145	170	141	136	149
0	17	0	57	60	19	22	51	56	113	113	97	100	70	71	64	70	73
40	17	0	117	127	57	60	109	116	165	162	145	145	122	122	116	119	121
80	17	0	156	156	78	84	156	152	187	178	178	191	149	149	139	150	151
120	17	0	183	187	95	93	168	163	186	183	203	197	166	167	155	163	159
160	17	0	196	193	105	95	172	169	197	194	211	199	175	174	162	171	164
200	17	0	189	180	96	81	163	167	209	204	219	202	174	177	163	172	164
0	17	33	55	48	23	23	51	63	127	122	104	110	70	70	65	76	80
40	17	33	126	113	58	50	104	94	160	156	157	148	122	116	109	120	112
80	17	33	145	156	71	81	146	146	179	179	183	191	142	146	137	145	149
120	17	33	180	188	93	101	159	159	178	187	208	196	164	168	148	160	161
160	17	33	189	204	97	83	173	168	199	190	199	198	174	178	162	167	160
200	17	33	191	187	97	99	174	156	203	213	207	207	174	176	164	170	169
LSD .05					19	19	19	19	20	21							

1/ Corrected to 15.5% moisture.

2/ 10 lbs. of zinc added to entire plot area as $ZnSO_4$ in 1968 and 1969.

3/ 17 lbs. of phosphorus were added to half the plots.

4/ For 1974, the additional 17 lbs/a was discontinued in order to follow phosphorus soil test value decline.

MANAGEMENT OF IRRIGATED ALFALFA

George TenEyck, Jim Ball, Larry Murphy and Gerry Posler

This irrigated alfalfa management study was formulated during 1974-1975 by several people, including R. Vanderlip, D. Whitney, E. Sorensen and the authors.

Objectives are to determine (1) the yield response of alfalfa to several levels of P_2O_5, applied annually or preplant, and to levels of K_2O applied in split and annual applications, (2) the forage yield, forage quality, and stand persistance of two varieties of alfalfa when cut continuously at 1/10 bloom, continuously at bud stage, and alternately at bud stage and full bloom, and (3) whether an additional cutting in late fall will reduce stand persistence.

Varieties Kanza and Marathon were seeded September 4, 1975, after wheat. Irrigation is by solid-set sprinkler.

Five total cuttings were made in 1977 with yields and composition as shown in Table 10. Harvests were May 13, June 14, July 11, August 12 and September 26 for the 1/10 bloom stage; May 10, June 10, July 18, August 8 and September 26 for the bud stage; and May 10, June 23, July 18, August 30 and September 26 for the alternate stage cutting managements.

The analyses of all measured parameters indicated significant differences among all treatments in all but three instances. These were potassium content for the third and fourth cuttings and protein content for the fourth cutting (Table 10).

The sulfur treatment was not applied in 1977 but was applied in 1976.

Table 10 FORAGE YIELDS[1] AND PLANT COMPOSITION FOR TWO ALFALFA VARIETIES CUT AT DIFFERENT GROWTH STAGES WITH SEVERAL FERTILIZER TREATMENTS, ST. JOHN, 1977

George TenEyck, Jim Ball, Larry Murphy and Gerry Posler

Cutting management	Fertilizers, lb/A			Cut 1				Cut 2				Cut 3				Cut 4				Cut 5			
	P_2O_5	P_2O_5	K_2O	Forage yield	Protein %	% P	% K	Forage yield	Protein %	% P	% K	Forage yield	Protein %	% P	% K	Forage yield	Protein %	% P	% K	Forage yield	Protein %	% P	% K
1/10 Bloom	0[2]	0[3]	0	2.26	23.00	.227	2.07	2.06	22.95	.255	2.47	1.88	21.97	.273	2.80	1.01	21.42	.230	2.72	1.00	16.97	.187	2.54
	0	40	80	2.62	23.28	.288	2.21	2.17	21.15	.270	2.58	1.96	22.96	.305	2.93	1.08	20.60	.265	2.83	1.06	18.14	.213	2.64
	0	80	80	2.81	23.50	.329	2.36	2.22	22.80	.297	2.61	2.05	22.52	.309	2.87	1.12	19.18	.299	2.88	1.14	17.39	.243	2.65
	0	120	80	2.85	23.64	.361	2.49	2.16	21.86	.295	2.60	1.94	22.92	.314	2.89	1.11	19.57	.338	2.97	1.11	17.21	.264	2.66
	320	0	80	2.75	23.25	.283	2.16	2.18	21.60	.265	2.51	1.89	23.09	.310	2.95	1.13	19.00	.302	2.95	1.11	17.17	.248	2.62
	320	40	80	2.83	23.15	.327	2.26	2.25	22.33	.314	2.69	2.05	21.19	.306	2.74	1.18	19.68	.315	2.98	1.14	17.38	.262	2.56
	320	80	80	2.67	22.71	.358	2.38	2.15	22.54	.319	2.68	2.06	21.65	.317	2.75	1.25	19.05	.327	2.72	1.20	17.88	.281	2.48
	320	120	80	2.85	23.27	.361	2.24	2.32	21.78	.302	2.64	2.06	22.61	.314	2.87	1.13	19.25	.348	2.88	1.12	18.06	.292	2.65
	0	120	0	2.82	23.70	.363	2.13	2.33	23.19	.290	2.44	2.08	22.60	.305	2.85	1.20	20.18	.318	2.81	1.21	18.09	.264	2.46
	0	120	160	2.62	23.62	.345	2.37	2.67	21.43	.287	2.60	2.01	21.32	.305	2.87	1.23	18.90	.305	2.77	1.15	18.05	.261	2.64
	0	80[4]	80[5]	2.78	24.16	.312	2.36	2.13	22.67	.303	2.70	1.92	23.17	.317	2.93	1.10	18.85	.320	2.98	1.19	17.56	.253	2.55
	0	120	80[5]	2.92	22.96	.339	2.22	2.22	21.45	.275	2.39	2.02	22.28	.307	2.69	1.26	18.47	.312	2.80	1.20	17.62	.254	2.57
	320	120	80[6]	2.92	22.28	.349	2.33	2.34	20.09	.284	2.38	1.93	21.54	.305	2.86	1.13	19.56	.319	2.82	1.20	16.41	.288	2.44
	0	0	80[6]	2.22	21.63	.244	2.10	1.96	21.02	.242	2.43	1.66	21.13	.261	2.59	1.00	19.93	.220	2.95	1.05	15.33	.172	2.45
Bud	0[2]	0[3]	0	1.97	23.34	.234	2.26	1.67	21.93	.260	2.68	1.54	25.07	.248	3.10	1.12	18.26	.227	3.17	1.06	19.51	.192	2.63
	0	40	80	2.76	23.29	.316	2.63	1.94	21.85	.292	2.71	1.69	25.56	.283	2.96	1.25	18.26	.241	3.20	1.20	19.23	.211	2.51
	0	80	80	2.81	24.37	.363	2.36	2.05	21.14	.326	2.61	1.80	25.08	.314	2.87	1.30	19.68	.299	2.88	1.18	20.38	.243	2.77
	0	120	80	2.78	23.64	.361	2.49	2.12	21.86	.295	2.60	1.97	22.92	.314	2.89	1.29	19.57	.338	2.97	1.29	17.21	.264	2.52
	320	0	80	2.68	24.09	.295	2.52	1.92	23.16	.292	2.83	1.78	25.78	.296	2.96	1.28	18.62	.267	3.24	1.25	20.25	.257	2.54
	320	40	80	2.73	24.55	.351	2.56	2.05	22.09	.324	2.83	1.79	25.63	.326	2.92	1.34	17.50	.294	3.22	1.26	20.03	.280	2.62
	320	80	80	2.72	25.22	.378	2.53	2.09	22.30	.348	2.86	1.84	24.97	.323	2.83	1.31	17.58	.321	3.15	1.27	19.93	.279	2.37
	320	120	80	2.71	24.10	.398	2.57	2.00	22.60	.355	2.81	1.82	24.29	.355	2.98	1.47	18.21	.315	3.06	1.31	20.09	.295	2.46
	0	120	0	2.70	24.59	.392	2.56	2.10	22.38	.330	2.60	1.87	24.89	.323	2.78	1.32	19.15	.295	3.03	1.26	20.19	.260	2.45
	0	120	160	2.80	23.68	.362	2.61	2.11	21.64	.334	2.73	1.86	24.44	.309	2.55	1.36	19.09	.297	3.14	1.29	20.21	.256	2.59
	0	80[4]	80[5]	2.93	24.70	.329	2.50	2.01	22.03	.312	2.79	1.81	25.64	.302	2.83	1.29	18.73	.311	3.17	1.33	19.94	.263	2.56
	0	120	80[5]	2.89	23.24	.373	2.40	2.12	22.64	.346	2.64	1.92	23.88	.317	2.78	1.34	18.57	.292	3.08	1.28	19.90	.250	2.67
	320	120	80[6]	2.88	23.76	.380	2.44	2.10	21.37	.350	2.62	1.78	25.28	.348	2.77	1.40	17.60	.327	2.85	1.27	16.41	.303	2.44
	0	0	80[6]	1.80	23.43	.237	2.44	1.75	21.28	.237	2.62	1.58	24.61	.239	2.81	1.13	19.26	.222	3.06	1.08	18.50	.191	2.52
Bud/ Full Bloom	0[2]	0[3]	0	1.97	22.08	.245	2.19	2.21	19.54	.204	2.18	1.62	25.04	.261	3.11	1.09	19.18	.204	2.56	.73	23.24	.244	2.83
	0	40	80	2.64	23.48	.313	2.58	2.56	19.63	.243	2.28	1.73	25.96	.305	3.22	1.12	19.13	.238	2.57	.83	22.81	.260	2.81
	0	80	80	2.77	23.76	.344	2.35	2.62	19.67	.261	2.21	1.77	25.50	.311	3.07	1.14	19.95	.252	2.54	.87	24.76	.286	2.84
	0	120	80	2.87	23.73	.345	2.54	2.53	20.04	.281	2.24	1.77	25.56	.341	3.19	1.06	20.96	.284	2.66	.85	24.34	.310	2.94
	320	0	80	2.66	23.80	.300	2.35	2.58	20.58	.263	2.24	1.77	24.82	.309	3.26	1.13	19.31	.253	2.74	.87	25.04	.303	3.04
	320	40	80	3.06	22.86	.329	2.24	2.54	18.97	.259	2.15	1.86	24.34	.316	2.99	1.14	19.73	.283	2.61	.87	24.52	.313	2.95
	320	80	80	2.69	22.84	.370	2.42	2.58	20.03	.281	2.22	1.76	25.54	.342	3.20	1.15	19.24	.315	2.72	.90	23.68	.318	2.73
	320	120	80	2.82	23.79	.374	2.43	2.46	19.91	.301	2.30	1.88	24.45	.356	3.07	1.14	19.85	.343	2.94	.95	22.91	.330	2.75
	0	120	0	2.87	24.36	.391	2.31	2.61	19.65	.285	2.13	1.79	24.98	.330	3.08	1.17	19.37	.300	2.65	.80	24.60	.313	2.88
	0	120	160	3.01	21.97	.378	2.44	2.57	19.92	.276	2.18	1.81	25.46	.326	3.10	1.23	20.04	.271	2.60	.92	23.04	.298	3.00
	0	80[4]	80[5]	2.66	23.98	.329	2.47	2.61	19.58	.251	2.25	1.76	24.99	.301	3.07	1.25	19.98	.278	2.49	.89	24.14	.298	2.86
	0	120	80[5]	2.77	23.63	.382	2.39	2.57	19.90	.280	2.23	1.75	26.13	.334	3.16	1.22	20.41	.274	2.53	.89	23.12	.303	2.77
	320	120	80[6]	2.48	22.69	.391	2.52	2.75	19.28	.289	2.43	1.71	25.54	.358	2.59	1.18	19.38	.339	2.95	.92	24.44	.332	2.72
	0	0	80[6]	1.97	22.74	.232	2.14	2.30	19.74	.210	2.16	1.55	25.00	.263	3.14	1.03	19.43	.206	2.66	.78	21.78	.230	2.63
LSD (.05)				.12	.95	.02	.15	.08	.87	.02	.12	.14	.72	.02	NS	.08	NS	.02	NS	.07	.76	.01	.14

1/ Tons per acre dry matter.
2/ Single preplant application.
3/ Annual application.
4/ Split application - spring and summer.
5/ Also includes 40 lbs/acre of sulfur.
6/ Additional cutting in late fall.

Table 11 EFFECT OF PHOSPHORUS AND POTASSIUM FERTILIZATION OF IRRIGATED ALFALFA ON THE SANDYLAND EXPERIMENT FIELD ON YIELD AND PROTEIN PRODUCTION IN FIVE CUTTINGS

J. Ball and G. TenEyck

Sandyland Experiment Field

Fertilizer Treatment, lbs./A P_2O_5 Pre – Ann. – K_2O Ann.	Yield T/A @ 15% Kanza	Yield T/A @ 15% Marathon	Protein yield #/A Kanza	Protein yield #/A Marathon
0 - 0 - 0	8.08	7.71	3040	2938
0 - 40 - 80	9.32	8.79	3585	3349
0 - 80 - 80	9.34	9.48	3565	3709
0 - 120 - 80	9.63	9.19	3732	3565
320 - 0 - 80	9.39	8.79	3613	3410
320 - 40 - 80	9.86	9.29	3753	3516
320 - 80 - 80	9.50	9.30	3629	3540
320 - 120 - 80	9.81	9.22	3773	3505
0 - 120 - 0	9.62	9.32	3779	3599
0 - 120 - 160	9.96	9.29	3752	3508
0 - 80+ - 80	9.15	9.61	3544	3732
0 - 120 - 80 + 40S*	9.86	9.53	3729	3646
320 - 120 - 80**	9.40	9.65	3536	3543
0 - 0 - 80**	8.13	7.54	2991	2770

$LSD_{.05}$ Tmt within 1 variety = .28 T/A.
$LSD_{.05}$ Tmt between varieities = .50 T/A.

$LSD_{.05}$ Tmts within 1 variety = 88 lbs.
$LSD_{.05}$ Tmts between varieities = 242 lbs.

+ split P_2O_5 application
* sulfur applied only in 1976
**Additional late cut after frost

Table 12 EFFECT OF PHOSPHORUS AND POTASSIUM FERTILIZATION OF IRRIGATED ALFALFA ON PHOSPHORUS AND POTASSIUM CONTENT AND TOTAL REMOVAL OF FIVE CUTTINGS, SANDYLAND EXPERIMENT FIELD

J. Ball and G. TenEyck

Fertilizer Treatments, lb/A P_2O_5 Pre	P_2O_5 Ann.	K_2O Ann.	% Crude Protein[1]	%P[1]	%K[1]	#P[1]	#K[1]	#N[1] Kanza	#N[1] Marathon
0	0	80	21.8	.23	2.57	32.3	352	487	470
0	40	80	22.0	.28	2.67	43.4	420	573	536
0	80	80	22.2	.30	2.65	49.7	435	570	593
0	120	80	22.3	.32	2.70	52.5	442	597	570
320	0	80	22.2	.28	2.66	44.8	421	578	546
320	40	80	21.8	.31	2.62	51.6	436	601	563
320	80	80	21.9	.33	2.64	53.8	431	581	566
320	120	80	22.0	.34	2.66	56.2	441	604	561
0	120	0	22.4	.32	2.56	53.3	421	605	576
0	120	160	21.7	.31	2.63	52.5	439	600	561
0	80+	80	22.3	.30	2.66	49.0	433	567	597
0	120	80 + 40S*	21.9	.32	2.57	53.2	433	597	583
320	120	80**	21.4	.33	2.56	55.2	423	566	567
0	0	80**	21.2	.23	2.54	31.3	346	479	443
LSD .05			.5	.01	.07	2.3		LSD .05 within a var. = 14#	
								LSD .05 between var. = 39#	

+ split P_2O_5 application, ½ spring, ½ after 3rd cut.
* Sulfur applied only in 1976.
** Additional late cut after killing frost.
1 Average of two varieties and five cuttings.

POTASSIUM EFFECT ON CORN SILAGE AND GRAIN YIELDS AND ON LEAF COMPOSITION

G. TenEyck, J. Ball, D. Whitney, R. Lamond, D. Leikam and D. Buchholz

At the Sandyland Experiment Field a potassium rate study was initiated in 1976 to study the effect of silage versus grain removal on potassium needs of irrigated corn. The study involves only K rates with N and P applied at 200 and 40 pounds per acre, respectively as blanket applications.

Potassium rates had no effect on grain or silage yields in this second year of the study, Table 13. Potassium levels in the leaf samples collected at the 8-leaf and tasseling stages of plant development were increased with increasing K rates. The calcium and magnesium levels in the leaf samples were decreased with increasing K rate. The 240 lb/A K_2O rate reduced the Mg level to the point that the level would be considered marginal. This trend in Mg level will be interesting to follow in 1978.

Difference in plant composition between grain and silage plots were relatively small, however, the K level was significantly lower at the 8-leaf stage in the silage plots than the grain plots. Differences between the silage and grain plots should become greater as more years of removal difference continues.

Table 13. POTASSIUM EFFECTS ON CORN SILAGE AND GRAIN YIELDS AND ON LEAF COMPOSITION, 1977.

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K_2O[1] lb/A	Crop	Grain Yield bu/A[2]	Silage Yield T/A[2]	Corn Leaf Composition 8-leaf stage %N	%P	%K	%Ca	%Mg	Tassel %N	%P	%K	%Ca	%M
0	Grain	115.3		2.86	.36	2.03	.57	.26	2.35	.28	1.83	.64	.1
80	Grain	91.6		2.46	.35	2.41	.50	.20	2.09	.28	1.96	.65	.1
160	Grain	91.5		2.45	.37	2.60	.45	.18	2.27	.28	2.03	.59	.0
240	Grain	109.0		2.51	.36	2.70	.44	.18	2.31	.29	2.18	.52	.0
0	Silage		15.4	2.75	.35	1.56	.73	.37	2.35	.29	1.77	.78	.2
80	Silage		15.3	2.57	.35	2.17	.56	.22	2.28	.28	1.92	.66	.1
160	Silage		14.6	2.63	.32	2.50	.53	.22	2.15	.27	1.97	.62	.1
240	Silage		16.2	2.69	.33	2.71	.40	.13	2.39	.29	2.01	.61	.0
Trt. $LSD_{.05}$	Silage	NS	NS	.22	NS	.14	.09	.06	NS	NS	.13	.07	.0
Mean Values													
Crop													
Grain				2.57	.36	2.43	.49	.20	2.25	.28	2.00	.60	.1
Silage				2.66	.33	2.23	.55	.23	2.29	.28	1.91	.67	.1
$LSD_{.05}$				NS	NS	.09	NS	NS	NS	NS	NS	NS	N

[1] N and P_2O_5 were also applied to all plots at rates of 200 and 40 pounds per acre, respectively.

[2] Grain yields at 15.5% H_2O; silage yields at 70% H_2O.