Research Report of Progress
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Potassium and Phosphorus Research on Field Crops

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REPORT OF 1979 PHOSPHORUS AND POTASSIUM RESEARCH IN KANSAS PARTIALLY SUPPORTED BY THE POTASH/PHOSPHATE INSTITUTE

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The 1979 research proposal submitted to PPI for their financial support included five areas of research. This report will be divided into these five areas of research. The discussion of each study will be relatively brief with much of the data and discussion taken from the 1979 Kansas Fertilizer Research Report of Progress.

I. Phosphorus and Potassium Effect on Crop Quality

Irrigated Alfalfa Production at Sandyland Experiment Station

Jim Ball, George TenEyck

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

The objectives are to determine (1) the forage yield and nutrient removal of alfalfa to several levels of P_2O_5 applied preplant, annualy and split during the growing season; to three levels of K_2O; and to one level of sulfur; (2) the forage yield, forage quality and stand persistence to three cutting management systems, and (3) whether an additional late fall cutting will reduce stand persistence under different fertility rates. This study is located on sandy soil. The soil types are Pratt loamy fine sand and Naron loamy fine sand.

Two varieties, Kanza and Marathon, were seeded September 4, 1975 following wheat.

Five cuttings were made in 1977 and 1978 with the additional late fall cutting being made only on the bud stage management in 1977 and on the bud and 1/10 bloom managements in 1978. In 1979 five cuttings were taken from the 1/10 bloom and bud stage managements and only four cuttings from the alternate cut management. All managements had the additional late fall cutting on the last two fertility treatments. Only four cuttings were harvested in 1976 and are not included in Table 1. The cutting managements are as follows: cutting each time at bud stage, cutting each time at 1/10 bloom, and cutting alternately at bud and full bloom stages.

The results as shown in Table 1 indicate that forage yield can be increased more than 2 tons per acre per year by addition of 80 pounds per acre P_2O_5 annually. Rates higher than 80 pounds per acre of P_2O_5 have tended to show yield increases in the range of .5 ton per acre. To date, there has been no yield increase to the addition of K_2O. The addition of 40 pounds per acre sulfur has shown a slight yield response.

The variety Kanza in 1978 increased in yield over what it was in 1977 while Marathon remained the same. Following this same trend, Kanza had larger amounts of K removed in 1978 than in 1977 while Marathon remained nearly the same in both years. The opposite was true with the P content. Both Kanza and Marathon removed less P in 1978 than in 1977.

In summary, alfalfa forage yield can be significantly increased by addition of phosphate fertilizers. The optimum level is between 80 and 120 pounds per acre. The forage yields where P rates are below 80 pounds per acre annually are decreasing; evidently the native phosphate levels have been reduced below optimum. Forage yields have not been increased significantly by addition of potassium or sulfur. Cutting managements have varied between years so more data is needed to determine if stage of cutting has an effect on yield or quality.

Table 1. Summary of Fertilizer Effects on Alfalfa Yield, Crude Protein Yield, Nutrient Removal and Soil Test Results.

FERTILITY TREATMENT LB/A			YIELD T/A @ 15% MOISTURE			CRUDE PROTEIN LBS/A DRY MATTER			NUTRIENT REMOVAL. LBS/A P			NUTRIENT REMOVAL. LBS/A K			SOIL TEST RESULTS 1/ LBS/A P		SOIL TEST RESULTS 1/ LBS/A K	
P_2O_5		K_2O																
PRE*	ANN	ANN	1979	1978	1977	1979	1978	1977	1979	1978	1977	1979	1978	1977	1979	1978	1979	1978
0	0	0	7.1	7.4	7.9	2799	2589	2989	30	25	32	277	323	352	8	10	93	123
0	40	80	8.7	9.0	9.1	3518	3205	3467	42	34	43	356	407	420	11	15	90	132
0	80	80	9.4	9.5	9.4	3848	3409	3637	52	42	50	375	445	435	17	18	87	131
0	80**	80	9.5	9.7	9.4	3876	3509	3638	52	42	49	379	443	433	27	25	80	135
0	120	0	9.5	10.0	9.5	3878	3655	3689	58	49	53	336	434	421	23	26	77	113
0	120	80	9.7	10.0	9.4	4013	3658	3648	59	46	53	384	450	442	27	29	87	117
0	120	80+40S	9.8	9.9	9.7	3961	3524	3687	58	45	53	371	443	433	32	26	83	125
0	120	160	9.6	10.0	9.6	3924	3585	3630	56	46	52	392	466	439	28	24	86	135
320	0	80	8.7	9.4	9.1	3473	3426	3512	40	37	45	351	438	421	17	26	80	131
320	40	80	9.5	10.0	9.6	3854	3585	3635	54	43	52	369	450	436	27	35	88	127
320	80	80	9.5	10.0	9.4	3916	3612	3584	56	46	54	365	445	431	37	41	86	129
320	120	80	9.4	10.1	9.5	3873	3605	3639	58	50	56	369	460	441	44	51	92	125
320	120	80***	10.3	11.0	9.7	4125	3907	3627	66	53	56	383	472	430	46	50	72	125
0	0	80***	8.0	8.0	8.0	3203	2818	2931	35	27	32	325	362	350	9	12	84	131
LSD .05			0.4	0.4	0.3	172	178	134	5	3	2	20	21	16				

1/ Original Soil Test: Avail. P = 19 lbs/a, Exch. K = 262 lbs/a. Sampled 0-6" Aug. 1975. Soil Tests were taken from the 0-6" depth on 3/30-79 and 4/3-78.

* PRE = Preplant, ANN = Annual applications.

** Split P_2O_5 application: 40 lbs. early spring, 40 lbs. after third cutting.

*** Additional late Fall cutting.

ALFALFA MANAGEMENT 1/10 BLOOM SUMMARY 1979

KANZA

TREATMENT P205 PRE	K20 ANN	S ANN	T/A DM	T/A 15%	MT/HA	% C PR	% P	% K	# CPR/A	# N/A	# P/A	# K/A
0	0	0	7.73	8.88	17.31	22.70	0.24	2.30	3503.30	560.53	37.61	352.17
0	40	80	8.72	10.03	19.53	21.88	0.24	2.23	3830.77	612.92	42.24	387.94
0	80	80	9.21	10.59	20.62	23.30	0.28	2.30	4270.21	683.23	52.06	428.42
0	120	80	9.56	10.99	21.41	23.01	0.31	2.26	4415.84	706.53	58.86	437.58
320	0	80	8.70	10.00	19.48	23.51	0.27	2.26	4160.01	665.60	48.59	397.86
320	40	80	9.14	10.51	20.48	23.30	0.31	2.28	4231.39	677.02	57.24	419.62
320	80	80	9.55	10.98	21.39	23.60	0.33	2.16	4543.65	726.98	63.86	410.47
320	120	80	9.28	10.67	20.78	23.48	0.34	2.28	4342.45	694.79	63.23	426.31
0	120	0	9.13	10.50	20.45	23.80	0.34	2.06	4370.62	699.30	63.28	373.16
0	120	160	9.99	11.49	22.38	22.66	0.30	2.20	4495.17	719.23	61.19	448.83
0	80*	80	9.25	10.63	20.71	23.29	0.30	2.27	4313.15	690.10	55.08	422.67
0	120	80	9.63	11.07	21.57	22.85	0.33	2.16	4401.02	704.16	64.43	417.54
320	120	80	9.84	11.32	22.05	23.29	0.49	2.22	4459.40	713.50	94.48	428.49
0	0	80	7.91	9.10	17.72	22.55	0.24	2.27	3468.95	555.03	38.95	339.91

MARATHON

TREATMENT P205 PRE	K20 ANN	S ANN	T/A DM	T/A 15%	MT/HA	% C PR	% P	% K	# CPR/A	# N/A	# P/A	# K/A
0	0	0	6.46	7.43	14.48	22.15	0.24	2.20	2870.87	459.34	31.65	285.23
0	40	80	8.51	9.79	19.07	23.77	0.28	2.36	4085.45	653.67	48.66	407.34
0	80	80	8.95	10.29	20.05	23.49	0.32	2.31	4278.51	684.56	59.38	424.44
0	120	80	9.24	10.62	20.70	23.31	0.36	2.29	4341.33	694.61	67.85	430.89
320	0	80	8.53	9.81	19.11	22.93	0.29	2.41	3930.20	628.83	49.66	417.83
320	40	80	9.53	10.95	21.34	23.02	0.45	2.15	4363.68	698.19	73.76	409.16
320	80	80	9.13	10.50	20.46	24.03	0.34	2.28	4401.88	704.30	63.01	427.06
320	120	80	8.40	9.66	18.81	23.56	0.34	2.25	4003.52	640.56	57.01	388.17
0	120	0	8.71	10.01	19.50	23.69	0.35	2.01	4135.10	661.62	61.98	358.72
0	120	160	8.96	10.30	20.07	23.95	0.32	2.44	4298.81	687.81	58.04	450.04
0	80*	80	8.98	10.33	20.12	23.99	0.30	2.25	4324.38	691.90	54.23	412.30
0	120	80	9.86	11.34	22.08	22.50	0.32	2.08	4482.01	717.12	64.74	419.70
320	120	80	9.43	10.85	21.13	23.06	0.33	2.18	4196.47	671.44	61.38	399.82
0	0	80	7.25	8.34	16.25	23.48	0.24	2.44	3338.60	534.18	35.57	358.79

* SPLIT APPLICATION, 40# EARLY SPRING AND 40# AFTER THIRD CUT.
** ADDITIONAL CUTTING TAKEN IN LATE FALL.

ALFALFA MANAGEMENT BUD STAGE SUMMARY 1979

KANZA

TREATMENT P205 PRE	K20 ANN	S ANN	ANN	T/A DM	T/A 15% MT/HA	% C PR	% P	% K	# CPR/A	# N/A	# P/A	# K/A
0	0	0	0	6.08	7.00	13.63	23.43	0.23	2.20	2842.58	454.81	28.51	267.51
0	40	80	0	7.27	8.36	16.28	23.92	0.27	2.30	3509.00	561.44	40.34	333.20
0	80	80	0	7.93	9.11	17.75	22.75	0.30	2.15	3553.34	568.53	48.14	337.11
0	120	80	0	8.32	9.57	18.64	24.43	0.25	2.23	4078.96	652.63	60.20	374.68
320	0	80	0	7.54	8.67	16.88	23.82	0.28	2.33	3554.34	568.69	42.07	354.11
320	40	80	0	7.79	8.96	17.46	23.29	0.29	2.27	3632.81	581.25	46.81	355.65
320	80	80	0	8.00	9.20	17.92	24.10	0.33	2.20	3919.02	627.04	53.73	358.50
320	120	80	0	7.85	9.03	17.59	24.72	0.36	2.29	3915.62	626.50	59.43	365.54
0	120	0	0	7.78	8.95	17.43	24.63	0.35	2.20	3863.75	618.20	55.46	349.18
0	120	160	0	7.90	9.08	17.69	24.13	0.32	2.19	3760.60	601.70	50.70	338.76
0	80*	80	0	8.00	9.20	17.92	23.28	0.32	2.28	3729.41	596.71	52.41	370.51
0	120	80	40	8.10	9.31	18.13	24.37	0.33	2.27	3987.81	638.05	56.34	374.03
320	120	80	0**	8.70	10.01	19.49	23.84	0.33	2.00	4171.17	667.39	59.77	353.12
0	0	80	0**	6.65	7.65	14.90	23.73	0.26	2.46	3134.27	501.48	35.83	328.29

MARATHON

TREATMENT P205 PRE	K20 ANN	S ANN	ANN	T/A DM	T/A 15% MT/HA	% C PR	% P	% K	# CPR/A	# N/A	# P/A	# K/A
0	0	0	0	5.41	6.22	12.11	24.36	0.26	2.39	2639.16	422.27	28.43	259.06
0	40	80	0	7.08	8.14	15.86	24.14	0.30	2.34	3433.49	549.36	43.54	335.32
0	80	80	0	7.35	8.46	16.47	24.85	0.34	2.36	3685.85	589.74	50.55	349.54
0	120	80	0	7.67	8.82	17.18	24.67	0.37	2.19	3814.13	610.26	57.54	338.35
320	0	80	0	6.72	7.73	15.06	22.75	0.26	2.22	3029.55	484.73	34.65	301.41
320	40	80	0	7.47	8.59	16.73	24.03	0.32	2.00	3659.18	585.47	48.76	320.13
320	80	80	0	7.69	8.84	17.22	23.07	0.32	1.99	3484.40	557.50	48.57	304.05
320	120	80	0	8.04	9.25	18.02	23.77	0.35	2.00	3832.69	613.23	56.27	337.93
0	120	0	0	7.89	9.07	17.67	22.68	0.33	1.83	3610.21	577.63	52.88	288.58
0	120	160	0	7.92	9.11	17.74	24.00	0.36	2.19	3858.71	617.39	58.01	354.53
0	80*	80	0	7.25	8.34	16.25	24.03	0.33	2.24	3501.43	560.23	48.94	326.53
0	120	80	40	7.96	9.15	17.82	23.45	0.34	2.07	3749.17	599.87	54.94	330.28
320	120	80	0**	7.96	9.16	17.84	23.68	0.35	1.92	3833.74	613.40	58.47	318.00
0	0	80	0**	6.21	7.14	13.90	23.73	0.26	2.29	2956.13	472.98	33.86	290.97

* SPLIT APPLICATION. 40# EARLY SPRING AND 40# AFTER THIRD CUT.
** ADDITIONAL CUTTING TAKEN IN LATE FALL.

ALFALFA MANAGEMENT BUD-FULL BLOOM SUMMARY 1979

KANZA

TREATMENT P205 PRE	K20 ANN	S ANN	T/A DM	T/A 15%	MT/HA	% C PR	% P	% K	# CPR/A	# N/A	# P/A	# K/A
0	0	0	5.52	6.35	12.37	21.82	0.22	2.19	2382.16	381.15	23.99	237.41
0	40	80	7.27	8.36	16.28	23.51	0.29	2.49	3403.58	544.57	41.50	353.47
0	80	80	7.73	8.88	17.31	24.48	0.33	2.34	3802.67	608.43	51.04	353.52
0	120	80	8.34	9.59	18.67	23.29	0.35	2.29	3878.71	620.59	57.44	375.62
320	0	80	7.34	8.45	16.45	21.43	0.22	2.20	3111.68	497.87	31.75	314.70
320	40	80	8.33	9.57	18.65	23.41	0.31	2.33	3927.68	628.43	51.91	386.28
320	80	80	7.89	9.07	17.67	23.24	0.35	2.29	3677.74	588.44	55.71	359.17
320	120	80	7.84	9.02	17.57	23.50	0.36	2.34	3635.02	581.60	55.57	361.31
0	120	0	8.17	9.40	18.30	23.02	0.35	2.13	3740.03	598.40	57.99	344.66
0	120	160	7.97	9.17	17.86	23.21	0.36	2.58	3687.41	589.99	56.63	409.83
0	80*	80	8.30	9.54	18.59	23.07	0.30	2.38	3842.03	614.73	49.29	385.07
0	120	80	8.11	9.33	18.16	23.78	0.35	2.29	3845.39	615.26	57.06	366.24
320	120	80	9.05	10.41	20.28	23.48	0.35	2.36	4238.70	678.19	64.15	423.24
0	0	80	7.01	8.06	15.70	22.24	0.22	2.22	3072.90	491.67	30.84	305.12

MARATHON

TREATMENT P205 PRE	K20 ANN	S ANN	T/A DM	T/A 15%	MT/HA	% C PR	% P	% K	# CPR/A	# N/A	# P/A	# K/A
0	0	0	5.92	6.81	13.26	21.99	0.25	2.25	2554.16	408.67	29.16	258.83
0	40	80	6.35	7.31	14.23	22.90	0.30	2.59	2847.87	455.66	36.82	316.91
0	80	80	7.89	9.08	17.68	22.07	0.31	2.31	3494.53	559.12	48.67	359.76
0	120	80	7.61	8.76	17.06	23.44	0.35	2.30	3551.90	568.30	53.05	346.87
320	0	80	6.62	7.61	14.82	23.24	0.27	2.46	3052.65	488.42	35.81	317.40
320	40	80	7.35	8.45	16.47	22.48	0.30	2.23	3310.49	529.68	43.16	324.20
320	80	80	7.43	8.54	16.64	23.43	0.34	2.29	3466.96	554.71	49.92	332.69
320	120	80	7.48	8.61	16.76	23.41	0.38	2.27	3510.10	561.62	56.89	334.81
0	120	0	7.68	8.83	17.21	23.13	0.37	2.04	3549.41	567.91	56.55	307.34
0	120	160	7.37	8.47	16.50	23.58	0.36	2.46	3441.56	550.65	53.83	358.95
0	80*	80	7.83	9.00	17.53	22.57	0.33	2.30	3545.18	567.23	50.99	356.51
0	120	80	7.28	8.38	16.31	23.17	0.35	2.20	3300.88	528.14	49.94	317.50
320	120	80	8.92	10.26	19.99	22.21	0.34	2.13	3850.25	616.04	59.70	376.50
0	0	80	6.90	7.93	15.45	23.43	0.26	2.42	3245.67	519.31	36.02	326.96

* SPLIT APPLICATION, 40# EARLY SPRING AND 40# AFTER THIRD CUT.
** ADDITIONAL CUTTING TAKEN IN LATE FALL.

ALFALFA MANAGEMENT 1/10 BLOOM SUMMARY 1979

TREATMENT P205 PRE	K20 ANN	S ANN	ANN	T/A DM	T/A 15%	MT/HA	% C PR	% P	% K	# CPR/A	# N/A	# P/A	# K/A
0	0	0	0	7.09	8.16	15.69	22.43	0.24	2.25	3187.08	509.93	34.63	318.70
0	40	80	0	8.61	9.91	19.30	22.83	0.26	2.29	3958.11	633.30	45.45	397.64
0	80	80	0	9.08	10.44	20.34	23.39	0.30	2.31	4274.36	683.90	55.72	426.43
0	120	80	0	9.40	10.81	21.05	23.16	0.33	2.27	4378.58	700.57	63.36	434.24
320	0	80	0	8.61	9.91	19.30	23.22	0.28	2.33	4045.10	647.22	49.13	407.85
320	40	80	0	9.33	10.73	20.91	23.16	0.38	2.22	4297.53	687.61	65.50	414.39
320	80	80	0	9.34	10.74	20.92	23.81	0.33	2.22	4472.77	715.64	63.44	418.77
320	120	80	0	8.84	10.16	19.79	23.52	0.34	2.26	4172.99	667.68	60.12	407.24
0	120	0	0	8.92	10.26	19.98	23.75	0.34	2.04	4252.86	680.46	62.63	361.94
0	120	160	0	9.47	10.90	21.22	23.30	0.31	2.32	4396.99	703.52	59.62	445.44
0	80*	80	0	9.12	10.48	20.42	23.64	0.30	2.26	4318.76	691.00	54.65	417.48
0	120	80	40	9.74	11.20	21.82	22.68	0.32	2.12	4441.51	710.64	64.59	418.62
320	120	80	0**	9.64	11.08	21.59	23.17	0.41	2.20	4327.93	692.47	77.93	414.16
0	0	80	0**	7.58	8.72	16.99	23.02	0.24	2.35	3403.77	544.60	37.26	349.35

* SPLIT APPLICATION, 40# EARLY SPRING AND 40# AFTER THIRD CUT.
** ADDITIONAL CUTTING TAKEN IN LATE FALL.

ALFALFA MANAGEMENT BUD STAGE SUMMARY 1979

TREATMENT P205 PRE	K20 ANN	S ANN	ANN	T/A DM	T/A 15%	MT/HA	% C PR	% P	% K	# CPR/A	# N/A	# P/A	# K/A
0	0	0	0	5.74	6.61	12.87	23.90	0.25	2.30	2740.87	438.54	28.47	263.28
0	40	80	0	7.17	8.25	16.07	24.03	0.29	2.32	3471.25	555.40	41.94	334.26
0	80	80	0	7.64	8.79	17.11	23.80	0.32	2.25	3619.60	579.13	49.34	343.33
0	120	80	0	7.99	9.19	17.91	24.55	0.36	2.21	3946.54	631.45	58.87	356.51
320	0	80	0	7.13	8.20	15.97	23.29	0.27	2.28	3291.94	526.71	38.36	327.76
320	40	80	0	7.63	8.78	17.09	23.66	0.31	2.18	3645.99	583.36	47.78	337.89
320	80	80	0	7.84	9.02	17.57	23.59	0.32	2.09	3701.71	592.27	51.15	331.28
320	120	80	0	7.95	9.14	17.81	24.24	0.36	2.18	3874.16	619.87	57.85	351.73
0	120	0	0	7.83	9.01	17.55	23.66	0.34	2.01	3736.98	597.92	54.17	318.88
0	120	160	0	7.91	9.10	17.72	24.07	0.34	2.19	3809.66	609.54	54.36	346.65
0	80*	80	0	7.63	8.77	17.09	23.65	0.33	2.26	3615.42	578.47	50.68	348.52
0	120	80	40	8.03	9.23	17.98	23.91	0.34	2.17	3868.49	618.96	55.64	352.16
320	120	80	0**	8.33	9.58	18.67	23.76	0.34	1.96	4002.46	640.39	59.12	335.56
0	0	80	0**	6.43	7.39	14.40	23.73	0.26	2.37	3045.20	487.23	34.84	309.63

* SPLIT APPLICATION, 40# EARLY SPRING AND 40# AFTER THIRD CUT.
** ADDITIONAL CUTTING TAKEN IN LATE FALL.

ALFALFA MANAGEMENT BUD-FULL BLOOM SUMMARY 1979

TREATMENT P2O5 PRE	K20 ANN	S ANN	ANN	T/A DM	T/A 15%	MT/HA	% C PR	% P	% K	# CPR/A	# N/A	# P/A	# K/A
0	0	0	0	5.72	6.58	12.81	21.91	0.24	2.22	2468.16	394.91	26.58	248.12
0	40	80	0	6.81	7.83	15.25	23.20	0.29	2.54	3125.73	500.12	39.16	335.19
0	80	80	0	7.81	8.98	17.49	23.28	0.32	2.33	3648.60	583.78	49.95	356.64
0	120	80	0	7.98	9.17	17.86	23.36	0.35	2.29	3715.31	594.45	55.24	361.24
320	0	80	0	6.98	8.03	15.64	22.34	0.25	2.33	3082.16	493.15	33.78	316.05
320	40	80	0	7.84	9.01	17.56	22.95	0.31	2.28	3619.09	579.05	47.54	355.24
320	80	80	0	7.66	8.81	17.15	23.33	0.35	2.29	3572.35	571.58	52.82	345.93
320	120	80	0	7.66	8.81	17.17	23.45	0.37	2.30	3572.56	571.61	56.23	348.06
0	120	0	0	7.93	9.12	17.76	23.08	0.36	2.09	3644.72	583.15	57.27	326.00
0	120	160	0	7.67	8.82	17.18	23.40	0.36	2.52	3564.49	570.32	55.23	384.39
0	80*	80	0	8.06	9.27	18.06	22.82	0.31	2.34	3693.61	590.98	50.14	378.79
0	120	80	40	7.70	8.85	17.24	23.47	0.35	2.24	3573.13	571.70	53.50	341.87
320	120	80	0**	8.99	10.34	20.13	22.85	0.34	2.25	4044.48	647.12	61.93	399.87
0	0	80	0**	6.95	8.00	15.58	22.84	0.24	2.32	3159.29	505.49	33.03	316.04

* SPLIT APPLICATION, 40# EARLY SPRING AND 40# AFTER THIRD CUT.
** ADDITIONAL CUTTING TAKEN IN LATE FALL.

ALFALFA MANAGEMENT SUMMARY 1979

TREATMENT P2O5 PRE	K20 ANN	S ANN	ANN	T/A DM	T/A 15%	MT/HA	% C PR	% P	% K	# CPR/A	# N/A	# P/A	# K/A
0	0	0	0	6.19	7.11	13.86	22.74	0.24	2.26	2798.70	447.79	29.89	276.70
0	40	80	0	7.53	8.66	16.87	23.35	0.28	2.38	3518.36	562.94	42.18	355.70
0	80	80	0	8.18	9.40	18.31	23.49	0.31	2.29	3847.52	615.60	51.67	375.46
0	120	80	0	8.46	9.72	18.94	23.69	0.35	2.26	4013.48	642.16	59.16	384.00
320	0	80	0	7.58	8.71	16.97	22.95	0.27	2.31	3473.87	555.69	40.42	350.55
320	40	80	0	8.27	9.51	18.52	23.25	0.33	2.22	3854.20	616.67	53.61	369.17
320	80	80	0	8.28	9.52	18.55	23.58	0.33	2.20	3915.61	626.50	55.80	365.32
320	120	80	0	8.15	9.37	18.26	23.74	0.36	2.25	3873.24	619.72	58.07	369.01
0	120	0	0	8.23	9.46	18.43	23.49	0.35	2.04	3878.19	620.51	58.03	335.61
0	120	160	0	8.35	9.60	18.71	23.59	0.34	2.34	3923.71	627.79	56.40	392.16
0	80*	80	0	8.27	9.51	18.52	23.37	0.31	2.29	3875.93	620.15	51.82	378.93
0	120	80	40	8.49	9.76	19.01	23.35	0.34	2.18	3961.04	633.77	57.91	370.88
320	120	80	0**	8.99	10.33	20.13	23.26	0.37	2.14	4124.96	659.99	66.32	383.20
0	0	80	0**	6.99	8.04	15.65	23.19	0.25	2.35	3202.75	512.44	35.05	325.01

* SPLIT APPLICATION, 40# EARLY SPRING AND 40# AFTER THIRD CUT.
** ADDITIONAL CUTTING TAKEN IN LATE FALL.

FERTILIZATION OF IRRIGATED ALFALFA

Kansas River Valley Experiment Field

L. D. Maddux and J. L. Gartung

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 8. The nitrogen treatment was applied June 5 after the first cutting. Harvests were made May 22, June 25, August 2, September 7, and October 10 with a flail harvester.

Annual treatments of phosphorus fertilizer increased the percent phosphorus in the alfalfa forage at both the 40 and 80 pound P_2O_5/A rates. Annual fertilization of 40 pounds P_2O_5/A increased alfalfa yield by about one-fourth ton per acre (Table 54). An additional one-fourth ton was noted with the application of 100 pounds N per acre. It is interesting to note that most of this yield increase attributed to N came with the fifth cutting while the N was applied after the first cutting. There was also a significant increase of .17 ton per acre at the first cutting attributed to the preplant plowdown treatment of 80 pounds P_2O_5 per acre. There was no significant response to the application of annual treatments of potassium. Soil test level of potassium was high at the start of the test.

Table 54.

EFFECT OF N, P, AND K ON FORAGE YIELD[1/], PERCENT PROTEIN, PERCENT PHOSPHORUS AND PERCENT POTASSIUM OF IRRIGATED ALFALFA

Kansas River Valley Experiment Field

L. D. Maddux and J. L. Gartung

Fertilizers, lb/a applied				Cut 1				Cut 2				Cut 3				Cut 4				Cut 5				Total yield
P_2O_5	N	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	
0	0	0	80	1.75	20.73	.219	2.94	1.16	21.73	.253	2.83	1.44	21.02	.253	2.95	1.26	22.04	.254	3.34	.65	22.08	.233	3.24	6.26
0	100[2/]	0	0	1.85	21.56	.278	2.95	1.11	22.86	.298	2.63	1.41	21.48	.305	2.69	1.27	22.17	.299	3.40	.79	21.68	.261	2.77	6.44
0	0	40	80	1.73	20.98	.286	2.99	1.18	21.06	.298	2.90	1.38	20.63	.295	2.87	1.23	22.25	.297	3.38	.83	21.21	.260	3.02	6.36
0	100[2/]	40	80	1.84	20.77	.308	2.98	1.26	20.65	.303	2.71	1.40	20.37	.301	2.83	1.34	21.67	.304	3.22	.89	20.58	.266	2.90	6.74
0	100[2/]	40	80	1.82	19.61	.277	2.83	1.24	22.61	.295	2.79	1.43	21.36	.293	2.80	1.33	21.48	.297	3.70	.92	20.89	.247	2.87	6.74
80	0	0	80	1.86	21.38	.248	2.87	1.14	22.00	.280	3.01	1.32	21.44	.273	2.81	1.31	22.36	.268	3.67	.76	21.25	.237	3.22	6.39
80	0	40	0	1.89	21.57	.291	2.73	1.20	22.00	.308	2.53	1.27	21.21	.309	2.80	1.41	22.60	.290	3.47	.82	22.00	.272	2.99	6.69
80	0	40	80	2.05	20.61	.295	3.09	1.25	22.07	.305	2.76	1.36	20.98	.300	2.86	1.32	21.58	.303	3.40	.84	21.10	.270	3.09	6.82
80	100[2/]	40	80	1.86	20.77	.322	3.07	1.22	22.59	.329	2.69	1.39	21.15	.313	2.89	1.29	21.88	.322	3.50	.85	21.64	.267	3.33	6.61
80	100[2/]	40	80	2.08	21.05	.271	2.95	1.26	21.84	.300	2.89	1.36	21.34	.290	2.80	1.33	22.33	.302	3.67	.97	20.50	.253	3.01	7.01
160	0	0	80	1.99	21.40	.269	2.80	1.20	21.85	.296	2.98	1.32	22.08	.297	3.02	1.28	21.59	.302	3.72	.81	21.16	.245	2.98	6.69
160	0	40	0	2.05	20.61	.287	2.62	1.22	22.81	.315	2.53	1.41	20.73	.306	2.76	1.31	21.75	.316	3.26	.85	21.12	.266	2.74	6.84
160	0	40	80	1.89	20.50	.276	2.68	1.21	22.09	.294	2.73	1.43	20.48	.287	3.12	1.36	22.69	.298	3.55	.86	20.75	.276	3.03	6.75
160	0	80	80	2.05	21.77	.317	2.84	1.30	22.09	.318	2.82	1.39	20.77	.312	2.84	1.31	21.15	.318	3.76	.92	20.96	.280	2.96	6.96
160	100[2/]	40	80	2.03	22.05	.288	2.92	1.29	23.15	.307	2.87	1.38	19.48	.300	2.95	1.33	22.00	.320	3.53	.91	20.46	.258	2.92	6.93
Preplant P_2O_5 Means:																								
0				1.80	20.73	.274	2.94	1.19	21.78	.289	2.77	1.41	20.97	.290	2.83	1.29	21.92	.290	3.41	.82	21.29	.254	2.96	6.51
80				1.97	21.07	.285	2.94	1.22	22.10	.304	2.77	1.34	21.22	.297	2.83	1.33	22.15	.297	3.54	.85	21.30	.260	3.05	6.70
160				2.00	21.26	.287	2.77	1.25	22.40	.306	2.78	1.39	20.71	.300	2.94	1.32	21.84	.311	3.57	.87	20.89	.261	2.91	6.82
LSD (.05)				.15	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	.025	NS	NS	NS	NS	NS	NS
Annual Fertilizer Means:																								
0-0-80				1.87	21.17	.245	2.87	1.17	21.86	.276	2.94	1.36	21.51	.274	2.93	1.28	22.00	.274	3.58	.74	21.50	.238	3.15	6.42
0-40-0				1.96	21.25	.285	2.77	1.17	22.56	.307	2.56	1.36	21.14	.307	2.75	1.33	22.18	.302	3.38	.82	21.60	.266	2.93	6.66
0-40-80				1.89	20.70	.286	2.92	1.21	21.74	.299	2.80	1.39	20.70	.294	2.95	1.31	22.17	.299	3.44	.84	21.02	.262	3.02	6.64
0-80-80				1.91	21.10	.316	2.96	1.26	21.77	.316	2.74	1.39	20.76	.309	2.85	1.31	21.56	.315	3.50	.89	21.06	.271	3.09	6.77
100-40-80				1.98	20.90	.279	2.90	1.27	22.53	.300	2.85	1.39	20.72	.294	2.85	1.33	21.94	.306	3.63	.93	20.62	.253	2.90	6.89
LSD (.05)				NS	NS	.020	NS	.08	NS	.015	.20	NS	NS	.015	NS	NS	NS	.015	NS	.06	.67	.011	.16	.23

1/ Machine harvested yields corrected to 15% moisture, tons/a.

2/ 100 lbs N/a applied as ammonium nitrate after first cutting.

IRRIGATED CORN AND SORGHUM GRAIN QUALITY AT TRIBUNE

Pat Gallagher and Roy E. Gwin

Grain samples were retained at harvest in 1978 on the long-term corn and grain sorghum fertility studies at Tribune Experiment Station for quality evaluation of N and P content. These studies have shown excellent yield responses to N and P fertilization but no response to K fertilization. Yield results for a period of years are shown in Tables 38 and 41. The grain analyses are given in the following tables.

Nitrogen fertilization increased N content in the corn grain from about 0.8% N to slightly above 1.2% with 160 to 200 lb N/A. This increase in N content was similar on the plots receiving no phosphorus compared to those with P applied. Potassium fertilization had no significant effect on grain N content, however, there appears to be a trend toward slightly lower N content with K fertilization compared to no K fertilization at the higher N rates. The corn study included plots which are being residualed from previous P fertilization as well as those receiving P application. Phosphorus content in the corn grain was increased with P fertilization with the P content being slightly higher in those plots receiving P application in 1979 compared to those with residual P (application 1961 through 1974). The biggest influence on P content in the grain was N rate. A marked reduction in grain P content occurred with increasing N rate. This undoubtedly reflected a dilution effect from the roughly doubling of grain yield with N fertilization.

The sorghum grain analyses show a similar trend in N content due to fertilizer N and P as does the corn. The P content of grain increases with P fertilization, however, the reduction in grain P content with increasing N rates is not as marked as was found in the corn.

In 1979 leaf samples were collected at tassel from the corn study and analyzed for N and P content. Increasing N rate increased the N content in the leaf with little or no effect from P or K fertilization. The P content in the leaf was increased with P application compared to no P application. The P content was slightly less in the residual P plots compared to those receiving P application in 1979. There was a marked reduction in P content in the leaf on plots receiving 40 lb N/A or more compared to those receiving no N. This reflects the dilution effect from the increased growth when N was applied.

Table 38. Effects of Nitrogen, Phosphorus and Potassium on Yield of Irrigated Corn, 1961-1979, Tribune.

Treatments [2] N	P	K	Yields, bushels per acre [1] 1974		1975		1976		1977		1978		1979		1968-73 Average		61-79 Avg.	1974-79 Average	
lbs/a																			
0	0	0	21	22 [4]	56	60 [4]	106	110 [4]	93	89 [4]	85	83 [4]	97	88 [4]	68	71 [3]	64	76	75 [4]
40	0	0	56	51	105	104	146	151	148	161	128	133	126	132	115	115	106	118	122
80	0	0	76	88	119	133	150	167	151	171	137	138	141	141	133	142	128	129	140
120	0	0	74	84	124	146	167	178	164	178	132	133	127	151	133	159	131	131	145
160	0	0	75	104	120	136	162	183	164	177	137	145	157	165	142	171	140	136	151
200	0	0	87	101	126	151	169	186	157	165	138	136	141	142	145	170	141	136	147
0	17	0	19	22	51	56	113	113	97	100	88	87	79	85	70	71	66	74	77
40	17	0	57	60	109	116	165	162	145	145	141	150	137	143	122	122	113	126	129
80	17	0	78	84	156	152	187	178	178	191	163	170	172	158	149	149	141	156	156
120	17	0	95	93	168	163	186	183	203	197	184	169	184	155	166	167	158	170	160
160	17	0	105	95	172	169	198	194	211	199	185	171	212	165	175	174	166	180	166
200	17	0	96	81	163	167	209	204	219	202	184	175	189	196	174	177	165	177	171
0	17	33	23	23	51	63	127	122	104	110	90	86	80	94	70	70	67	80	81
40	17	33	58	50	104	94	160	156	157	148	156	144	137	130	122	116	112	129	120
80	17	33	71	81	146	146	179	179	183	191	174	160	158	162	142	146	138	152	153
120	17	33	93	101	159	159	178	187	208	196	174	167	172	172	164	168	155	165	163
160	17	33	97	83	173	168	211	190	199	198	178	161	200	170	174	178	165	176	161
200	17	33	97	99	174	156	203	203	207	207	182	162	198	184	174	176	167	177	169
LSD .05			19	19	19	19	20	21	15	18			21	19					

[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 through 1979, all phosphorus was discontinued in order to follow phosphorus soil test value decline.

Table 41. Effects of Nitrogen, Phosphorus, and Potassium on Yield of Irrigated Grain Sorghum, 1961-1979. Tribune.

Treatment			1974		1975		1976		1977		1978		1979		Averages				
															1968-73			1974-79	
N	P	K	0 Zn	5-lbs Zn	0 Zn	5-lbs Zn	0 Zn	5-lbs Zn	0 Zn	5-lbs Zn	0 Zn	5-lbs Zn	0 Zn	5-lbs Zn	RS 671	RS 626	61-79	0 Zn	5-lbs Zn
			bu/a		bu/a		bu/a		bu/a		bu/a		bu/a					bu/a	
0	0	0	39	37	71	72	92	91	120	129	87	90	82	85	61	68	71	82	84
40	0	0	55	57	77	74	106	106	142	134	100	96	102	99	92	95	103	97	94
80	0	0	61	66	84	85	103	104	139	138	106	105	113	112	112	108	112	101	102
120	0	0	57	61	77	75	100	100	133	131	100	105	113	109	110	106	111	97	96
160	0	0	57	58	69	74	103	107	136	132	113	112	115	107	107	101	109	99	99
200	0	0	51	62	79	75	99	104	126	130	102	108	109	105	113	107	111	94	98
0	17	0	34	40	72	83	96	109	129	129	85	90	84	84	63	71	75	84	89
40	17	0	69	70	106	107	114	115	147	148	104	110	119	115	104	106	108	110	111
80	17	0	73	73	87	98	118	117	146	152	108	116	128	134	121	118	118	110	115
120	17	0	70	68	92	79	114	116	144	146	121	119	134	132	126	120	122	112	110
160	17	0	74	73	95	102	122	126	149	145	119	120	144	139	130	123	125	117	117
200	17	0	79	75	96	101	112	124	149	148	116	113	148	146	130	123	126	116	118
0	17	33	34	42	76	73	100	103	123	127	92	93	85	81	63	70	75	85	87
40	17	33	62	68	102	94	123	109	147	146	100	103	118	112	103	107	108	109	105
80	17	33	76	76	99	105	121	119	150	147	114	113	123	124	123	120	120	114	114
120	17	33	77	81	90	93	119	121	149	150	119	121	139	142	127	123	125	116	118
160	17	33	66	52	92	98	114	115	146	147	119	114	136	136	127	124	125	112	111
200	17	33	65	67	86	91	118	116	147	145	119	113	142	131	127	124	124	113	108

Yields corrected to 12.5% moisture.

LONG-TERM CORN FERTILITY TEST

1978 Grain Composition

Treatment			% N		% P	
			'61-78	Res. P	'61-78	Res. P
0	0	0	0.85	0.81	.191	.232
40	0	0	1.00	1.10	.153	.166
80	0	0	1.17	1.15	.168	.172
120	0	0	1.19	1.22	.134	.148
160	0	0	1.26	1.28	.163	.127
200	0	0	1.35	1.32	.150	.135
0	40	0	0.86	0.79	.227	.210
40	40	0	0.99	0.97	.233	.234
80	40	0	1.00	1.03	.179	.175
120	40	0	1.10	1.13	.184	.146
160	40	0	1.11	1.25	.183	.143
200	40	0	1.25	1.28	.160	.141
0	40	40	0.91	0.88	.244	.227
40	40	40	1.06	0.94	.199	.234
80	40	40	1.03	1.15	.184	.166
120	40	40	1.07	1.04	.198	.176
160	40	40	1.18	1.17	.196	.164
200	40	40	1.14	1.19	.178	.149
$LSD_{.05}$			0.20	0.20	.045	.039
$LSD_{.05}$ All Treatments			0.19		.039	

LONG-TERM SORGHUM FERTILITY TEST

Treatments			1978 Grain	
N	P	K	%N	%P
0	0	0	0.96	.214
40	0	0	1.34	.184
80	0	0	1.25	.170
120	0	0	1.32	.153
160	0	0	1.45	.197
200	0	0	1.52	.181
0	40	0	0.99	.268
40	40	0	1.08	.277
80	40	0	1.29	.262
120	40	0	1.33	.235
160	40	0	1.52	.247
200	40	0	1.49	.267
0	40	40	1.02	.284
40	40	40	1.20	.287
80	40	40	1.31	.256
120	40	40	1.35	.238
160	40	40	1.39	.293
200	40	40	1.34	.219
LSD .05			0.16	.107

LONG-TERM CORN FERTILITY TEST

1979 Leaf Composition

Treatment			% N		% P	
N	P	K	'61-79	Res. P	'61-79	Res. P
0	0	0	1.82	1.76	.208	.223
40	0	0	1.79	1.97	.156	.176
80	0	0	2.25	2.34	.161	.180
120	0	0	2.42	2.57	.152	.175
160	0	0	2.54	2.47	.173	.169
200	0	0	2.43	2.45	.163	.163
0	40	0	1.68	1.64	.299	.286
40	40	0	1.79	1.86	.221	.201
80	40	0	2.06	2.18	.204	.187
120	40	0	2.34	2.37	.219	.189
160	40	0	2.29	2.42	.217	.194
200	40	0	2.52	2.56	.226	.190
0	40	40	1.54	1.67	.257	.264
40	40	40	1.74	1.79	.211	.196
80	40	40	2.23	2.22	.216	.194
120	40	40	2.36	2.33	.227	.204
160	40	40	2.55	2.49	.224	.210
200	40	40	2.50	2.49	.217	.190
$LSD_{.05}$			0.24	0.19	.021	.025
$LSD_{.05}$ All Treatments			0.21		.017	

II. POTASSIUM REMOVAL UNDER IRRIGATED CORN SILAGE AND GRAIN PRODUCTION

A study was initiated at the Sandyland Experiment Field near St. John, Kansas to study the effect of crop residue removal on K status of the soil. This location is a sandy soil testing medium to low in available K. Results in 1979 show little K fertilization effect. The nutrient uptake results do indicate a tremendous difference in K removal for grain (30 to 35 lb K/A) compared to silage (167 to 256 lb K/A) production. This study will need to be continued for several seasons before marked differences can be expected.

Table

EFFECT OF K RATE AND CROP MANAGEMENT ON CORN YIELD AND PLANT ANALYSIS

Sandyland Experiment Field

K_2O (lb/A)	Management Crop	Yield (bu/A)	Grain Analysis			8-Leaf			Tassel			Dry Matter Yield (ton/A)	Silage			Nutrient Uptake					
			% N	% P	% K	% N	% P	% K	% N	% P	% K		% N	% P	% K	Grain			Silage		
																N	P	K	N	P	K
																(lb/A)					
0	Grain	159.4	1.28	0.26	0.38	3.23	0.37	2.30	2.88	0.25	1.68	--	--	--	--	113.9	23.0	33.7	--	--	--
80	Grain	140.5	1.37	0.28	0.39	3.18	0.35	2.67	2.90	0.25	1.78	--	--	--	--	107.9	22.2	30.9	--	--	--
160	Grain	145.8	1.32	0.26	0.38	2.76	0.30	2.66	3.06	0.26	1.78	--	--	--	--	108.2	20.8	30.8	--	--	--
240	Grain	146.8	1.40	0.27	0.37	3.00	0.32	2.89	3.10	0.27	1.72	--	--	--	--	115.4	22.0	30.6	--	--	--
0	Silage	158.7	1.33	0.26	0.38	3.26	0.38	2.20	2.68	0.24	1.85	5.6	0.58	0.12	1.55	118.2	23.4	33.4	63.5	14.4	167.0
80	Silage	166.3	1.34	0.26	0.37	3.12	0.36	2.56	3.04	0.27	1.66	6.7	0.58	0.18	1.96	124.6	24.1	34.4	77.8	25.7	256.0
160	Silage	155.5	1.35	0.27	0.38	2.94	0.32	2.67	2.72	0.24	1.85	6.4	0.66	0.10	1.77	117.2	23.3	33.0	83.5	13.1	227.2
240	Silage	157.7	1.36	0.28	0.39	3.17	0.34	2.44	2.96	0.26	1.74	5.8	0.85	0.15	1.56	119.8	25.0	34.5	98.3	17.6	182.7
LSD .05		NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	0.20	NS	NS	NS	NS	NS	NS	NS	NS
K_2O Rate (lb/A)																					
0		159.1	1.30	0.26	0.38	3.24	0.37	2.25	2.78	0.24	1.76	5.6	0.58	0.12	1.55	116.0	23.2	33.5	63.5	14.4	167.0
80		153.4	1.35	0.27	0.38	3.15	0.35	2.62	2.97	0.26	1.72	6.7	0.58	0.18	1.96	116.2	23.1	32.7	77.8	25.7	256.0
160		150.7	1.34	0.26	0.38	2.85	0.31	2.66	2.89	0.25	1.82	6.4	0.66	0.10	1.77	112.7	22.1	31.9	83.5	13.1	227.2
240		152.2	1.38	0.27	0.38	3.09	0.33	2.66	3.03	0.26	1.73	5.8	0.85	0.15	1.56	117.6	23.5	32.5	98.3	17.6	182.7
LSD .05		NS	NS	NS	NS	NS	0.04	NS	NS	NS	NS	NS	0.20	NS	NS	NS	NS	NS	NS	NS	NS
Management																					
Grain		148.1	1.34	0.26	0.38	3.04	0.34	2.63	2.98	0.26	1.74	--	--	--	--	111.4	22.0	31.5	--	--	--
Silage		159.6	1.34	0.27	0.38	3.12	0.35	2.47	2.85	0.25	1.77	--	--	--	--	120.0	24.0	33.8			
LSD .05		11.3	NS	NS	NS	NS	NS	NS	NS	NS	NS	--	--	--	--	NS	NS	NS			

III. EVALUATION OF PHOSPHORUS SOIL TEST METHODS

The Bray P-1 weak acid extraction phosphorus soil test method is widely used throughout the midwest region. There is concern with it's use on calcareous soils as the acid in the extracting solution at the soil to solution ratio commonly used (1:10) will be neutralized with a soil having about 2% free calcium carbonate. In western Kansas there are a significant number of soils containing above 2% free calcium carbonate. On these soils an alternative extraction method or modification of the Bray procedure might be advantageous.

A new P soil test method has been proposed by Mehlich for use over a wide range of soil pH's. As his M.S. thesis project, Jim Herndon conducted a study with 40 different soils from across Kansas to compare various P soil extractants. These 40 soils included 15 calcareous soils ranging from only slightly calcareous (less than 1% $CaCO_3$) to greater than 10% $CaCO_3$.

Two crops of corn (harvested at about foot height) were grown on the soils in the growth chamber and total P uptake by the two crops was correlated with 6 soil test measurements of P-Bray extraction using the routine procedure of a 1:10 soil to solution ratio and wider ratio of 1:50, Olsen's bicarbonate method, Mehlich's new extraction and two measures used by the Colorado State University Soil Testing Lab. The CSU method involves a modification of the bicarbonate procedure and the use of an ICP unit for measurement of P in solution. The ICP detects not only ortho phosphate in the solution as do the colormetric procedures but also organic phosphorus in the solution (personal communication with Dr. P. Soltanpour, CSU). An organic P extraction was calculated as the difference between **plasma results** and colormetric determination on the CSU extraction.

The correlation coefficients for the seven measures of soil P with P uptake are shown in the following table. All procedures correlated well with P uptake when compared on the 40 soils except the organic P by difference. When the soils were divided into calcareous and noncalcareous soils there was in general a better correlation on the noncalcareous soils than on the calcareous soils. On the calcareous soils the Bray P-1 at 1:10 ration gave a lower correlation than the other methods as would be expected. If a 1:50 soil to solution ratio is used for the Bray, the correlation for P uptake is very comparable to the other methods.

Although no overall conclusions can be drawn from one study, results indicate that on the majority of Kansas soils the present Bray test looks as good as alternative methods. There are probably less than 5% of the samples now being tested that have more than 2% free $CaCO_3$.

Correlation of Phosphorus Uptake by Corn with Soil Test Measurement of Soil Phosphorus Availability in the Greenhouse on 40 Kansas Soils

			Phosphorus Uptake		
		Soil Test Measurement	1.18 - 5.76 $\bar{x}$ = 2.12 Harvest 1	1.5 - 5.94 $\bar{x}$ = 2.80 Harvest 2	2.68 - 11.1 $\bar{x}$ = 4.85 Total Uptake
Range	$\bar{x}$				
2-89	22.2	Bray 1:10	0.871	0.757	0.751
1-136	43.8	Bray 1:50	0.786	0.735	0.723
1-51	14.6	Olsen Bicarbonate	0.833	0.775	0.755
4-108	29.8	Mehlich	0.757	0.740	0.711
3.3-50.1	12.7	CSU Plasma	0.687	0.613	0.636
1-45	7.2	CSU Color	0.692	0.675	0.676
1.3-17.8	5.6	Diff (Plasma-Color)	0.112	-0.037	0.016
Range	$\bar{x}$	Calcareous (15 soils)			
2-26	13.3	Bray 1:10	0.591	0.526	0.580
1-136	39.9	Bray 1:50	0.630	0.621	0.658
3-51	12.4	Olsen	0.703	0.698	0.738
12-108	31.4	Mehlich	0.655	0.683	0.709
3.3-50.1	10.7	CSU Plasma	0.654	0.631	0.674
1.3-45	7.9	CSU Color	0.654	0.619	0.666
1.3-4.9	2.7	Diff (Plasma-Color)	0.515	0.659	0.638
			1.21 - 5.76 $\bar{x}$ = 2.38	1.52 - 5.84 $\bar{x}$ = 2.96	2.73 - 11.1 $\bar{x}$ = 5.21
Range	$\bar{x}$	Noncalcareous (25 soils)			
4-89	27.5	Bray 1:10	0.875	0.785	0.751
9-130	46.2	Bray 1:50	0.887	0.783	0.770
1-51	15.9	Olsen	0.901	0.797	0.772
4-95	28.8	Mehlich	0.909	0.809	0.790
4.7-39.4	14.0	CSU Plasma	0.834	0.658	0.706
1-35.5	6.8	CSU Color	0.946	0.825	0.851
2.6-17.8	7.3	Diff (Plasma-Color)	-0.128	-0.262	-0.209

IV. SEASONAL CHANGE IN SOIL TEST POTASSIUM ON SANDY SOILS

With the relatively higher yields of alfalfa and corn being produced on irrigated sandy soils with moderate to low soil test levels for potassium, with no potassium fertilization, the question arises as to change in soil K levels over the season. Soil samples were collected at intervals over the past year starting in November of 1978 to study changes in the K soil test level with time. Sampling was done at the Sandyland Experiment Field by Jim Ball and the Kansas River Valley Field by Larry Maddux. Samples were collected from plots in alfalfa and corn during the 1979 crop season at two depths - 0-6 and 6-12 inches. A relatively small area was selected for sampling to minimize soil variability. The area sampled was either the check plot or an area unfertilized with K near an existing study with K rates. On both fields the alfalfa area was the alfalfa fertility study reported in Part I of this report.

Samples were collected and air-dried before K analysis by the KSU Soil Testing Lab. Results show little change in K levels over the season on the Sandyland Field for either crop. On the Kansas River Valley Field there is a definite depression in the K soil test in the June-July-August period in both sampling depths for the corn land. This decline would follow closely the maximum K uptake period of the corn. The alfalfa area shows a slight decline in the 0-6 inch sample K results over the sampling period.

Plans are to repeat the sampling in 1980 to see if similar results are found for a second season.

Seasonal Potassium Soil Test Results Under Two Crops at Two Locations for the 1979 Crop Year

Location and crop	Sample Depth	Sampling Date												
		Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
	in													
Sandyland Expt. Field														
Corn	0-6	57	66		88		80	140	74	51		57			66
	6-12	54	58		55		78	91	109	79		53			58
Alfalfa	0-6	83	69		82		86	74	76	65		70			85
	6-12	54	65		49		75	56	63	69		68			75
Kansas River Valley															
Corn	0-6	567	720	576	756	597		575	427	343	303	494	545	652	655
	6-12	438	522	435	556	349		349	324	256	295	352	384	364	354
Alfalfa	0-6	276	311	312	274	280		258	216	297	225	231	238	221	222
	6-12	217	194	227	216	211		211	172	236	176	204	189	186	182

V. PHOSPHORUS RESIDUAL FROM PHOSPHORUS SOURCES, RATES AND FREQUENCY OF APPLICATION.

Research was started in 1974 at the Eastcentral Kansas Experiment Field near Ottawa and at the Southeast Kansas Experiment Station, Parsons Unit to study frequency and rate of P application for grain sorghum. The studies were designed for a four year cycle. The Ottawa study was continued in grain sorghum for the second four year cycle while the Parsons study was changed to soybeans. Results as reported in the 1979 progress report follow.

EFFECT OF RATE AND FREQUENCY OF APPLICATION OF TWO PHOSPHORUS SOURCES ON GRAIN SORGHUM

Eastcentral Experiment Field
Keith Janssen, David Whitney and David Kissel

The question is frequently asked if phosphorus fertilizer must be applied each year or if more phosphorus could be applied on one application and the residual from the large application utilized by crops in following years. A study was started in 1974 to investigate the efficiency of a single large application (200 lb P_2O_5/a) compared to 100 lb P_2O_5/a applied every other year and to 50 lb P_2O_5/a applied every year, thus over a four year period all plots received 200 lb P_2O_5/a. Two phosphorus sources also were included in the study (ammonium ortho phosphate, 18-46-0 and ammonium poly phosphate, 10-34-0). Sorghum of the hybrid Pioneer 8272 was planted on June 19, 1979 at 4 pounds of seed per acre. The experimental site was broken from native sod just prior to the start of the study and the original soil tests indicated a very low available phosphorus test.

In 1979 severe lodging occurred on the plots receiving the higher phosphorus rates and without hand gleaming of the plots would have resulted in poor yields. An estimated 30 to 40% of the sorghum was lodged and lost to combine harvest compared to less than 5% on the no phosphorus plot. There was a week to 10 day delay in heading on the control compared to those plots receiving phosphorus. This maturity differential at heading may have been in part related to the lodging as severe stress at heading has been linked to stalk rot in sorghum. Moisture stress was encountered during the heading period in August and was likely more severe on the phosphorus treated plots.

Results for the sixth year of the study show the usual excellent response to phosphorus, Table 139. The 1979 and six year average yield results show no difference for frequency of application or for phosphorus source. However, if results for individual years were examined, there were differences for frequency of application. In the first year of the study with the very low phosphorus soil test level of the site, the 50 lb P_2O_5/a rate was not adequate for optimum yield. In the fourth year of the study the 200 lb P_2O_5/a applied initially resulted in lower yield than the 50 lb P_2O_5/a applied annually. The 100 lb P_2O_5/a applied every other year has consistently given excellent yields, however, yield results over the six years are no better than for the other treatments. The study will be continued for at least another two years to complete the second four year cycle of phosphorus application.

Table 139.

EFFECT OF ANNUAL AND RESIDUAL FERTILIZER PHOSPHORUS ON DRYLAND GRAIN SORGHUM - 1979

East Central Kansas Exp. Field - Ottawa, Kansas

Keith Janssen, David Whitney and David Kissel

Phosphorus Carrier	P_2O_5 Rate and Date LBS/A	Applied	GRAIN YIELD @ 12.5% 1979 BU/a	6yr. AVG. BU/a	Leaf Tissue Composition %N	%P
-------	0		81.8	45.2	2.53	.200
AOP(18-46-0)	50	Annually(74'-79')	115.0	62.7	2.64	.261
AOP	100	Biannually(74',76',78)	100.6	60.1	2.55	.255
AOP	200	Every 4 yrs.(74',78')	109.7	62.3	2.70	.272
APP(10-34-0)	50	Annually(74'-79')	101.5	62.8	2.59	.245
APP	100	Biannually(74',76',78')	95.2	60.4	2.61	.234
APP	200	Every 4 yrs(74'-78')	101.2	57.7	2.67	.247
LSD(.05)Treatment			16.6	----	----	----
Mean Values:						
AOP			108.4	61.7	2.63	.263
APP			99.3	60.3	2.62	.242
LSD(.05)Carrier			NS	----	----	----
50 lb P_2O_5 Annually			108.2	62.8	2.62	.253
100 lb P_2O_5 Biannually			97.9	60.2	2.58	.245
200 lb P_2O_5 Every 4 yrs.			105.4	59.8	2.68	.260
LSD(.05) P-Rate and Appl. Date			NS	----	----	----

Residual Effects of Phosphorus on Soybean Yield. K. W. Kelley (Table 99).

Many of the soils in southeastern Kansas are low in available phosphorus. When phosphorus fertilizer is applied, part of it becomes unavailable over time and cannot be taken up by the plant root system. The degree of phosphorus fixation resulting from residual P applications is not fully known with our clay-pan acid soils.

Procedure: Beginning in 1978, we initiated comparisons to see if heavy, first-year applications (200 pounds P_2O_5 per acre) would be as effective for soybeans as 100 pounds P_2O_5 per acre applied every other year, or as effective as annual applications of 50 pounds per acre. After 4 years all plots will have received the same total amount of P_2O_5. The two P sources used were diammonium orthophosphate (AOP, 18-46-9) and ammonium Polyphosphate (APP, 15-62-9).

Results: Yields have increased 2 to 5 bushels per acre as a result of the applied phosphorus on a silt loam soil that has an available P level of 10 pounds per acre. Two years after the 100 and 200 pound rates have been applied, phosphorus responses are still good. Likewise, the annual P treatment of 50 pounds per acre has been significant. These results support earlier works, which indicate that soybean yield responses from P fertilization are normally significant on soils testing less than 15 pounds of available P per acre.

Table 99 RESIDUAL EFFECTS OF PHOSPHORUS ON SOYBEAN YIELDS, PARSONS, 1979

K. W. Kelley
Southeast Kansas Experiment Station

Phosphorus carrier	Lbs P_2O_5/A		Yield, bu/A	
	1978	1979	1978	1979
Control	0	0	21.7	28.1
AOP(18-46-C)	50	50	25.1	31.2
AOP	100	0	25.0	30.8
AOP	200	0	26.3	32.6
APP(15-62-0)	50	50	23.8	30.4
APP	100	0	27.0	31.4
APP	200	0	27.5	32.7

Initial soil P level = 10 lbs/A