

Nitrogen, Phosphorous, and Potassium Uptake in Rain-fed Corn as affected by NPK Fertilization

Table S1. The least square means of nutrient concentrations at early growth stage (V6/V7), physiological maturity (R6), and grain. Corn plants were separated into stover (stalk + leaves) and ear (cob + husk) at R6 stage. Grain samples were collected during harvesting.

Site-year	Treatment	Nitrogen (g kg ⁻¹)						
		Plant component						
		V6 (Whole plant)	R6 Stover		R6 Ear		Grain	
EFAW21	N0P0K0	19.72 b	4.62 ab		9.10 bcd		10.07 def	
	N0P0K1	19.81 b	3.02 b		8.81 cd		9.53 ef	
	N0P1K0	20.52 ab	4.18 ab		8.39 d		9.32 f	
	N0P1K1	21.37 ab	4.26 ab		8.48 d		9.32 f	
	N1P0K0	23.66 ab	4.71 ab		8.71 cd		11.16 cde	
	N1P0K1	23.85 ab	4.66 ab		9.62 abcd		11.41 bcd	
	N1P1K0	24.89 ab	4.68 ab		9.16 abcd		11.19 cde	
	N1P1K1	26.11 ab	5.25 ab		9.41 abcd		10.66 def	
	N2P0K0	26.55 ab	5.86 a		10.33 abc		12.89 ab	
	N2P0K1	27.82 a	5.86 a		10.28 abc		13.09 ab	
	N2P1K0	24.91 ab	5.93 a		10.69 ab		13.27 a	
	N2P1K1	26.73 ab	5.92 a		10.81 a		12.74 abc	
	S.E.	1.8	0.53		0.33		0.32	
	Phosphorous (g kg ⁻¹)							
	N0P0K0	2.54	0.65		2.55		2.91	
	N0P0K1	2.69	0.56		2.42		2.62	
	N0P1K0	2.55	0.41		2.14		2.62	
	N0P1K1	2.82	0.43		2.19		2.80	
	N1P0K0	2.62	0.45		1.98		2.53	
	N1P0K1	2.75	0.49		2.46		2.62	
	N1P1K0	2.64	0.45		2.27		2.42	
	N1P1K1	2.66	0.44		1.94		2.39	
	N2P0K0	2.73	0.44		2.23		2.34	
	N2P0K1	2.61	0.38		1.89		2.22	
	N2P1K0	2.49	0.37		2.40		2.70	
	N2P1K1	2.88	0.50		2.31		2.93	
	S.E.	0.16	0.07		0.20		0.16	
	Potassium (g kg ⁻¹)							
	N0P0K0	43.47	14.40		5.45		4.31	
	N0P0K1	46.79	16.90		4.94		4.22	
	N0P1K0	39.90	13.97		4.70		4.05	
	N0P1K1	49.18	16.27		4.70		4.24	
	N1P0K0	46.46	15.72		4.54		3.99	
	N1P0K1	49.24	17.39		5.02		4.03	
	N1P1K0	42.66	14.89		5.07		3.88	
	N1P1K1	46.36	17.16		4.45		3.97	
	N2P0K0	45.33	15.81		4.74		3.78	
	N2P0K1	47.72	16.50		4.59		3.78	
	N2P1K0	42.36	15.54		4.51		4.13	
	N2P1K1	52.46	17.49		4.47		4.23	
	S.E.	3.49	0.98		0.24		0.16	

Table S1. Continued

Site-year	Treatment	Nitrogen (g kg ⁻¹)					
		-----Plant components-----					
		V6	R6			Grain	
		(Whole plant)	Stover		Ear		
LCB22	N0P0K0	26.32 bcd	5.54	ab	8.79	9.90	bc
	N0P0K1	24.66 d	5.71	ab	9.73	9.43	c
	N0P1K0	24.51 d	5.21	b	9.82	10.20	bc
	N0P1K1	23.74 d	5.68	ab	11.43	9.78	bc
	N1P0K0	27.07 abcd	4.54	b	9.09	11.73	abc
	N1P0K1	27.59 abcd	7.88	ab	11.30	12.73	ab
	N1P1K0	25.15 cd	5.58	ab	10.07	12.04	abc
	N1P1K1	28.79 abcd	5.32	ab	9.76	11.76	abc
	N2P0K0	29.88 abc	8.99	a	10.86	13.47	a
	N2P0K1	30.94 ab	7.47	ab	10.81	12.87	a
	N2P1K0	31.95 a	7.39	ab	11.14	13.23	a
	N2P1K1	31.12 ab	6.01	ab	10.40	14.00	a
	S.E.	1.0	0.76		0.92	0.51	
	Phosphorous (g kg ⁻¹)						
	N0P0K0	4.30 ab	2.25	ab	2.69	3.39	
	N0P0K1	4.97 a	2.48	ab	2.92	2.87	
	N0P1K0	4.81 ab	2.59	a	2.91	2.95	
	N0P1K1	4.73 ab	2.21	ab	2.95	3.37	
	N1P0K0	4.22 ab	1.74	abc	2.66	3.47	
	N1P0K1	4.50 ab	1.87	abc	3.32	3.32	
	N1P1K0	3.98 b	1.82	abc	3.10	3.57	
	N1P1K1	4.20 ab	1.98	abc	2.75	3.60	
	N2P0K0	4.24 ab	0.83	c	2.78	3.60	
	N2P0K1	4.36 ab	1.26	bc	2.85	3.70	
	N2P1K0	3.89 b	1.24	bc	2.93	3.89	
	N2P1K1	4.42 ab	0.83	c	2.98	3.83	
	S.E.	0.21	0.26		0.24	0.24	
	Potassium (g kg ⁻¹)						
	N0P0K0	44.28 ab	10.90		8.22	6.40	
	N0P0K1	50.52 a	10.59		8.29	5.37	
	N0P1K0	45.61 ab	10.55		6.59	5.33	
	N0P1K1	45.01 ab	9.78		8.51	6.17	
	N1P0K0	39.76 ab	9.66		6.84	5.22	
	N1P0K1	46.45 ab	12.51		7.20	5.27	
	N1P1K0	38.97 ab	10.29		7.32	5.82	
	N1P1K1	45.06 ab	10.57		6.71	5.56	
	N2P0K0	41.43 ab	8.63		5.61	5.70	
	N2P0K1	41.08 ab	9.47		5.79	5.90	
	N2P1K0	33.60 b	9.27		5.55	6.30	
	N2P1K1	43.50 ab	9.04		6.28	6.00	
	S.E.	2.6	1.2		0.76	0.37	

Values represent the mean of three replications. Different letter within each column denotes the significant difference at $P < 0.05$ by *Tukey test*. Columns with no letter indicates that there was no significant difference observed among treatments.

Table S2. Analysis of Variance for interaction effects and main effects of N, P, and K for total aboveground biomass accumulation, N, P, and K uptake at V6/V7 growth stage.

Site-year	Source of Variation	df	Biomass (kg ha ⁻¹)	N uptake (kg ha ⁻¹)	P uptake (kg ha ⁻¹)	K uptake (kg ha ⁻¹)
Mean Squares						
EFAW 21	N	2	ns	***	ns	ns
	P	1	ns	ns	ns	ns
	N x P	2	ns	ns	ns	ns
	K	1	*	ns	ns	ns
	N x K	2	ns	ns	ns	ns
	P x K	1	ns	ns	ns	ns
	N x P x K	2	ns	ns	ns	ns
	S.E.		158.18	3.86	0.43	8.13
	Treatment		Means			
	N0P0K0		1269.9	24.8ab	3.2	55.5
	N0P0K1		1150.1	22.2b	3.0	52.8
	N0P1K0		1293.8	26.5ab	3.3	51.9
	N0P1K1		1138.1	24.1ab	3.3	57.6
	N1P0K0		1629.3	38.1ab	4.3	75.2
	N1P0K1		1509.5	33.9ab	4.0	72.4
LCB 22	N1P1K0		1269.9	31.3ab	3.4	54.7
	N1P1K1		1245.9	31.4ab	3.3	56.5
	N2P0K0		1629.3	43.3a	4.4	72.6
	N2P0K1		1305.8	36.5ab	3.4	62.2
	N2P1K0		1665.2	41.6ab	4.2	70.7
	N2P1K1		1233.9	32.3ab	3.6	65.2
	S.E.		77.09	2.28	0.31	3.06
	Treatments					
	N0P0K0		307.6 c	8.1 c	1.33 c	13.62 d
	N0P0K1		439.4 bc	10.8 bc	2.19 bc	22.19 bcd
	N0P1K0		463.3 bc	11.3 bc	2.17 bc	20.66 bcd
	N0P1K1		439.4 bc	10.4 bc	2.08 bc	19.69 cd
	N1P0K0		738.9 ab	20.0 ab	3.11 ab	29.43 abc
	N1P0K1		774.8 ab	21.4 ab	3.48 ab	35.91 ab
	N1P1K0		798.8 ab	20.0 ab	3.17 ab	30.90 abc
	N1P1K1		846.7 a	24.6 a	3.56 ab	37.98 a
	N2P0K0		810.7 ab	24.0 a	3.40 ab	33.10 abc
	N2P0K1		1014.4 a	31.4 a	4.43 a	41.80 a
	N2P1K0		918.6 a	29.4 a	3.58 ab	30.97 abc
	N2P1K1		786.8 ab	24.6 a	3.46 ab	33.98 abc

*, **, and *** are significant at the 0.05, 0.01, and 0.001 levels respectively. ns: not significant at the 0.05 level. Treatment means values represent the mean of three replications. Different letter within each column denotes the significant difference at $P < 0.05$ by Tukey test

Table S3. The least square means of Grain nitrogen harvest index (GNHI), grain phosphorous harvest index (GPHI), and grain potassium harvest index (GKHI) by site year.

Site year	Treatments	GNHI	GPHI	GKHI
EFAW21			Means	
	N0P0K0	0.72 b	0.85	0.30
	N0P0K1	0.78 ab	0.77	0.24
	N0P1K0	0.75 ab	0.95	0.29
	N0P1K1	0.77 ab	1.01	0.30
	N1P0K0	0.94 a	1.06	0.37
	N1P0K1	0.8 ab	0.91	0.27
	N1P1K0	0.82 ab	0.85	0.30
	N1P1K1	0.82 ab	1.02	0.34
	N2P0K0	0.81 ab	0.86	0.30
	N2P0K1	0.83 ab	0.95	0.31
	N2P1K0	0.84 ab	0.92	0.36
	N2P1K1	0.83 ab	1.07	0.36
LCB22			Means	
	N0P0K0	0.22 b	0.21 c	0.09 d
	N0P0K1	0.34 b	0.31 c	0.15 cd
	N0P1K0	0.54 ab	0.46 bc	0.26 abcd
	N0P1K1	0.54 ab	0.51 bc	0.24 abcd
	N1P0K0	0.86 a	0.81 abc	0.32 abcd
	N1P0K1	0.75 ab	0.87 abc	0.30 abcd
	N1P1K0	0.85 a	0.72 abc	0.32 abcd
	N1P1K1	0.93 a	0.81 abc	0.31 abcd
	N2P0K0	0.85 a	1.22 a	0.48 a
	N2P0K1	0.86 a	1.09 ab	0.46 a
	N2P1K0	0.70 ab	0.75 abc	0.40 abc
	N2P1K1	0.89 a	1.02 ab	0.41 ab

Different letters within each column denotes the significant difference at $P < 0.05$ by Tukey test

Table S4. Least square means for nutrient uptake per plant at different growth stages during the entire crop season at EFAW21

Treatment	Nitrogen (mg pl ⁻¹)							
	Growth Stage							
	V6		VT		R2		R6	
N0P0K0	576.0	ab	842.8	b	990.1	cd	1785.4	f
N0P0K1	515.2	b	890.6	b	1020.2	bcd	1590.6	f
N0P1K0	615.1	ab	798.3	b	1035.8	bcd	1616.1	f
N0P1K1	559.3	ab	765.6	b	924.0	d	1957.0	ef
N1P0K0	883.2	ab	1074.2	ab	1286.2	abcd	2606.2	de
N1P0K1	786.3	ab	1318.9	ab	1595.0	abcd	3158.0	bcd
N1P1K0	726.0	ab	1230.8	ab	1526.2	abcd	2692.0	d
N1P1K1	729.0	ab	1254.2	ab	1520.6	abcd	2833.4	cd
N2P0K0	1003.5	a	1643.0	a	1966.2	a	3545.3	abc
N2P0K1	847.0	ab	1366.2	ab	1678.0	abcd	3668.2	ab
N2P1K0	963.4	ab	1397.2	ab	1799.3	ab	4032.2	a
N2P1K1	748.7	ab	1382.6	ab	1732.1	abc	3811.9	ab

Phosphorous (mg pl ⁻¹)								
N0P0K0	75.0	a	93.7	a	136.0	a	444.7	cd
N0P0K1	70.0	a	106.0	a	154.6	a	439.4	cd
N0P1K0	76.7	a	88.3	a	146.1	a	362.2	d
N0P1K1	76.3	a	94.8	a	140.2	a	448.9	cd
N1P0K0	99.1	a	108.1	a	161.9	a	526.6	bcd
N1P0K1	93.7	a	130.8	a	199.5	a	675.2	ab
N1P1K0	78.0	a	118.7	a	181.4	a	563.9	abcd
N1P1K1	75.5	a	111.5	a	164.3	a	518.9	bcd
N2P0K0	102.2	a	137.7	a	206.9	a	615.4	abc
N2P0K1	79.1	a	96.0	a	162.8	a	548.6	abcd
N2P1K0	96.8	a	115.7	a	194.6	a	748.5	a
N2P1K1	82.4	a	106.0	a	177.3	a	708.1	ab

Potassium (mg pl ⁻¹)								
N0P0K0	1286.6	a	1817.8	ab	1912.9	a	1835.0	c
N0P0K1	1224.3	a	1904.3	ab	1967.4	a	2383.4	bc
N0P1K0	1202.9	a	1523.8	b	1619.6	a	1895.3	c
N0P1K1	1336.5	a	1797.2	ab	1827.1	a	2298.0	bc
N1P0K0	1743.6	a	2003.3	ab	2173.1	a	2353.5	bc
N1P0K1	1679.7	a	2403.3	a	2614.1	a	3374.1	a
N1P1K0	1267.9	a	1781.2	ab	1954.9	a	2550.1	abc
N1P1K1	1310.7	a	1990.8	ab	2230.8	a	2575.4	abc
N2P0K0	1682.4	a	2001.5	ab	2225.0	a	2853.8	ab
N2P0K1	1442.9	a	1913.6	ab	2051.1	a	2830.4	ab
N2P1K0	1640.0	a	1814.4	ab	1972.0	a	2969.1	ab
N2P1K1	1511.8	a	2181.9	ab	2374.3	a	2969.5	ab

Different letters within each column denotes the significant difference at $P < 0.05$ by Tukey test

Table S5. Means for Nutrient uptake per plant at different growth stages during the crop season at LCB22.

Treatment	Nitrogen (mg pl ⁻¹)							
	-----Growth stage-----							
	V6		VT		R2		R6	
N0P0K0	194.8	e	777.8	d	888.4	b	1015.4	cd
N0P0K1	262.9	cde	865	cd	1061.2	b	909.1	d
N0P1K0	279.7	bcde	776.3	d	1153.7	ab	1285.9	bcd
N0P1K1	240.3	de	846.4	cd	1081.7	b	1115.1	cd
N1P0K0	454.9	abcde	1431.3	abcd	1510.3	ab	1145.2	cd
N1P0K1	526.1	abc	1096.5	bcd	1663.1	ab	1705.3	abc
N1P1K0	499.4	abcd	1136.8	abcd	1268.2	ab	1409.3	bcd
N1P1K1	571	a	1174.2	abcd	1530.7	ab	1339.7	bcd
N2P0K0	555	a	1420.1	abcd	2050.8	a	2250.3	a
N2P0K1	695.4	a	1917.1	a	1542.1	ab	1799.5	abc
N2P1K0	680.7	a	1541	abc	1657.9	ab	1959.8	ab
N2P1K1	544.4	ab	1686	ab	1685.3	ab	1792.5	abc

Phosphorous (mg pl ⁻¹)								
N0P0K0	31.9	d	262.9	ab	377.3	a	321.2	a
N0P0K1	53.2	bcd	296.6	ab	384	a	277.4	a
N0P1K0	53.8	bcd	244.9	ab	385.1	a	413.9	a
N0P1K1	48.2	cd	255	ab	487.9	a	328.9	a
N1P0K0	70.8	abc	302.3	ab	402.2	a	319.8	a
N1P0K1	86.0	abc	178.6	b	437.4	a	436.7	a
N1P1K0	79.5	abc	271.9	ab	407.1	a	415.7	a
N1P1K1	82.5	abc	222.5	ab	509.2	a	358.6	a
N2P0K0	79.0	abc	242.1	ab	429.7	a	331.7	a
N2P0K1	97.8	a	318.6	a	341	a	396.3	a
N2P1K0	83.0	ab	256.2	ab	367.8	a	415.1	a
N2P1K1	76.3	abc	298.6	ab	395.1	a	408.8	a

Potassium (mg pl ⁻¹)								
N0P0K0	325.4	d	1027.8	a	1919.1	a	1369.4	a
N0P0K1	537.8	bcd	1914.2	a	2006.2	a	1186.7	a
N0P1K0	514.2	cd	1501.6	a	1912.6	a	1406.7	a
N0P1K1	456.6	cd	1554.1	a	2155.1	a	1344.9	a
N1P0K0	668.1	abcd	2006.3	a	2644.0	a	1398.7	a
N1P0K1	887.9	ab	1429.3	a	2675.2	a	1992.9	a
N1P1K0	774.6	abc	2152.0	a	2453.7	a	1620.5	a
N1P1K1	880.5	ab	1493.0	a	2900.6	a	1502.6	a
N2P0K0	766.4	abc	1700.4	a	2554.0	a	1583.9	a
N2P0K1	918.5	a	2414.5	a	1648.3	a	1544.7	a
N2P1K0	718.2	abc	1490.4	a	2305.8	a	1513.7	a
N2P1K1	748.3	abc	2221.8	a	2440.7	a	1690.2	a

Different letters within each column denotes the significant difference at $P<0.05$ by Tukey test