Evaluation of Sidedress Applications of Potassium and Nitrogen on Corn Grain Yield

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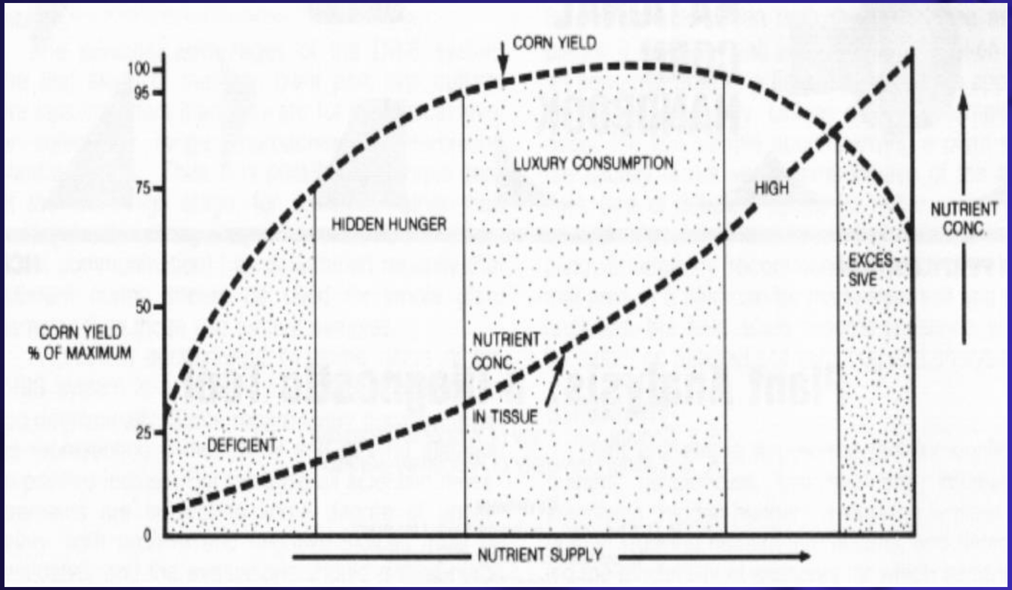
Plant Nutrition



Plant nutrient content has been classified in five ranges as it relates to yield.

Corn ear leaf nutrients at growth stage VT represent a synopsis of plant nutrition at the end of the vegetative growth.

http://www.extension.purdue.edu/extmedia/nch/nch-46.html Adapted from Brown, J. R. 1970. Plant analysis. Missouri Agr. Exp. Sta. Bull. SB881

Miller et al, 2016

University of Illinois Publication

http://corn.agronomy.wisc.edu/Management/L011.aspx

The potassium paradox: Implications for soil fertility, crop production and human health

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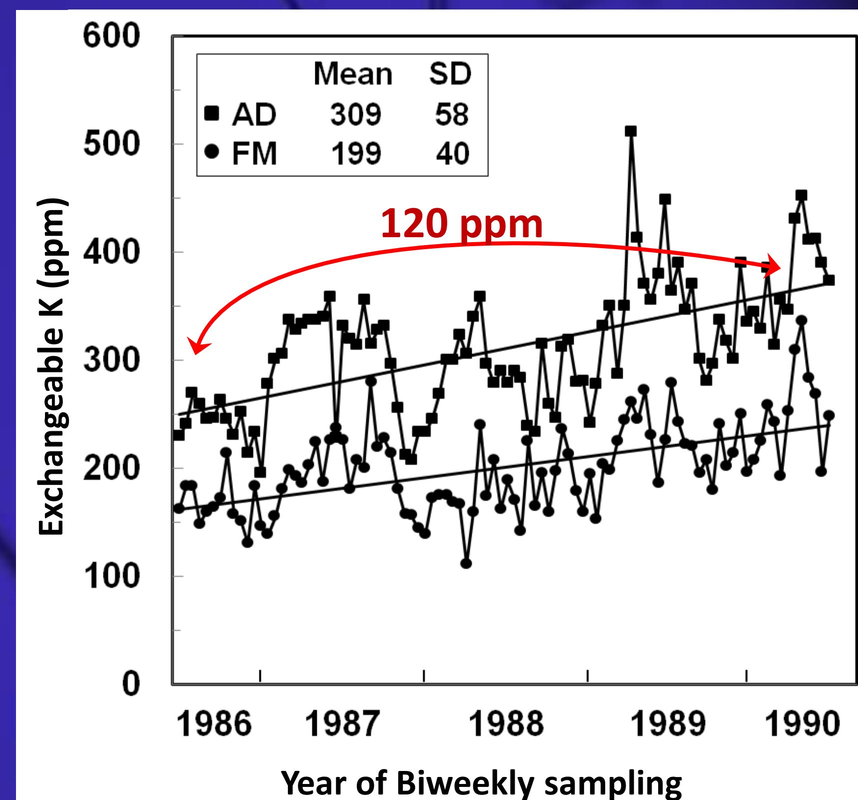
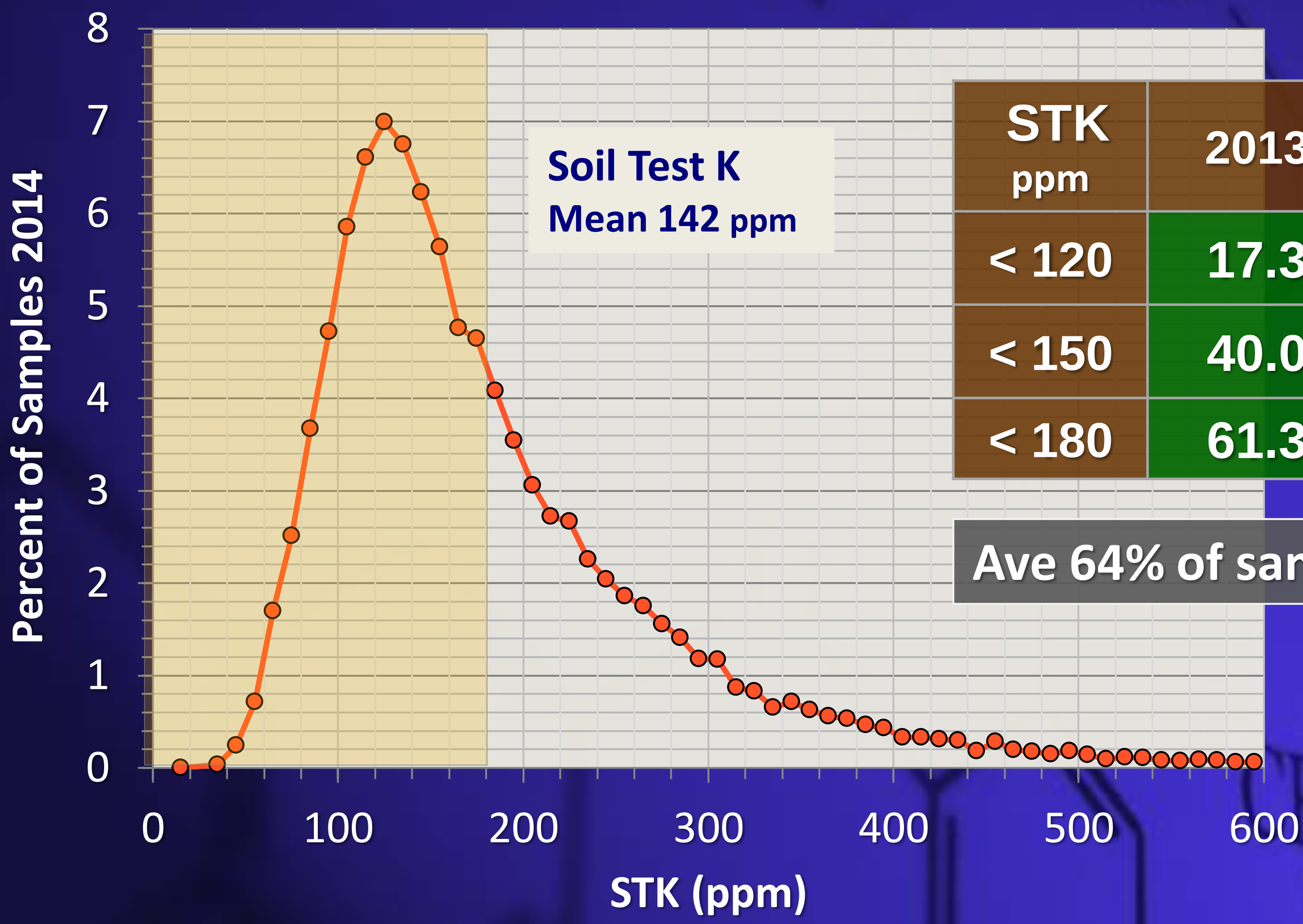
"Khan and Mulvaney see no value in soil testing for exchangeable K and instead recommend that producers periodically carry out their own strip trials."

University of Illinois, October 28, 2013
AgProfessional.com/News



Lab Soil Test K: IA and MN

Observations 245,000 samples



STK ppm	2013	2014	2015
< 120	17.3	16.4	24.8
< 150	40.0	43.1	47.3
< 180	61.3	63.6	69.4

Ave 64% of samples have K Rec

What Does Plant Analysis Show

[1] Source: MVTL MN-IA, Mehlich 3 K

Miller et al, 2016

Corn Ear Leaf Nutrients - IN

Ear Leaf VT-R1 2518 samples, 6 years

Nutrient	Deficiency Threshold [1]	Percent of Samples Deficient [2]					
	< Less Than	*2010*	*2011*	*2012*	*2103*	*2014*	*2015*
N (%)	< 2.76	5.1	5.0	33.1	10.5	16.6	44.7
P (%)	< 0.25	0.6	1.1	20.4	2.7	1.1	13.2
K (%)	< 1.75	29.4	15.3	57.3	17.9	21.4	6.9
S (%)	< 0.16	1.1	0.2	8.1	2.4	7.4	23.2
Zn (ppm)	< 19	4.5	7.2	0.6	6.6	3.0	20.4

18.2 %

24.7 %

[1] http://www.extension.purdue.edu/extmedia/nch/nch-46.html
[2] Data Ceres Solutions, Lafayette, IN, corn ear leaf VT-R2

CERES SOLUTIONS
Cultivating results.

Miller and Bower, 2016

Corn Ear Leaf Nutrients - IN

Ear Leaf VT-R1 2014, 281 samples

Nutrient	Percent of Samples Nutrient Deficient					
	P	*K*	*Mg*	*S*	*B*	*Zn*
Threshold [1]	< 0.28	< 1.76	< 0.16	< 0.16	< 5	< 20
Low N Sites < 3.00 (%)	5.7	11.4	20.1	16.1	23.8	9.5
High N Sites > 3.20 (%)	0.7	22.5	18.3	1.2	11.9	2.8

[1] *http://www.extension.purdue.edu/extmedia/nch/nch-46.html*

[2] *Data Ceres Solutions, corn ear leaf VT-R2*

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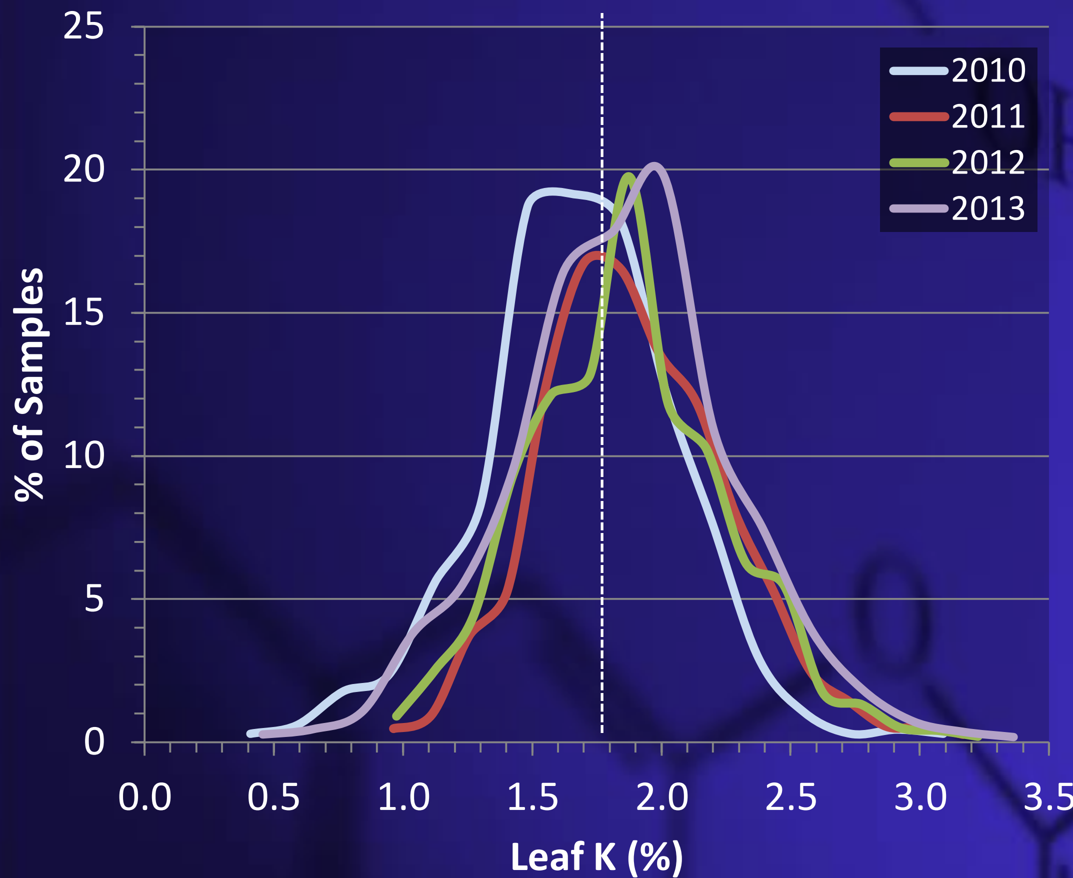
Miller and Bower, 2016

Corn Ear Leaf Potassium - MN

Ear Leaf VT-R1 4241 samples, 4 years [1]



Over four years K deficiency [2] in Minnesota constituted 42.3 – 56.8% of ear leaf tissue samples, whereas N deficiency average was 33.5% of samples.

WINFIELD™ SOLUTIONS

[1] *Source Winfield Solutions 2010-2014, Randy Brown, Tim Eyerich*

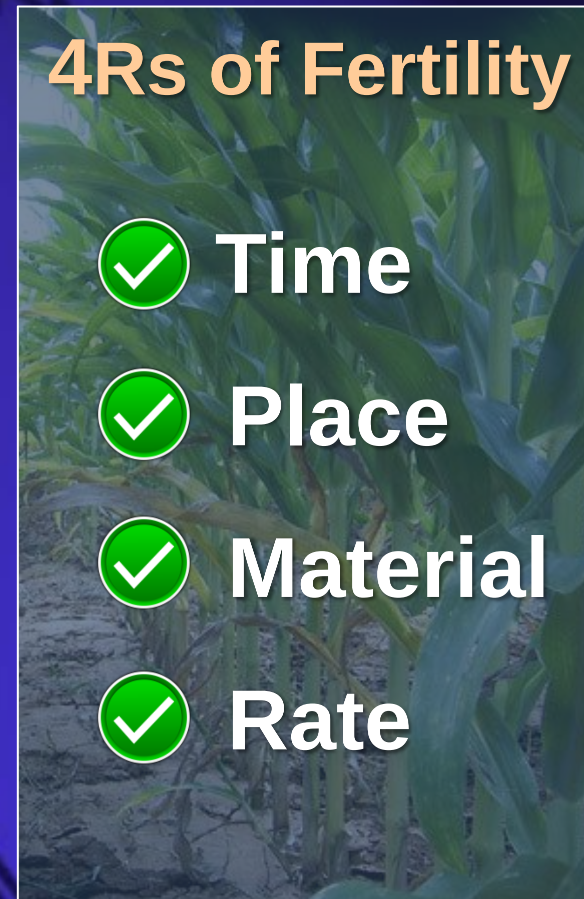
[2] *http://www.extension.purdue.edu/extmedia/nch/nch-46.html*

Miller et al, 2016

K_{RX} Corn Research

2011-2014 a study was conducted across 76 sites across six states to evaluate response to K. K was applied at 0, 50, 100 lbs/ac at growth stage V3 – V5, ranging 18,600 – 42,400 plts/ac, eight replications.

STK sampled at planting, corn ear leaves were sampled at VT, and grain yield and moisture determined based on 3/1000th acre of each plot at black layer.



Robert Nielsen, 2009

http://a1.sphotos.ak.fbcdn.net/hphotos-ak-snc6/58602_151587434865720_111267718897692_355055_4317263_n.jpg

Miller et al, 2016

KR_X Corn Yield Response

K*rx* Project Yield Results 2012

Six Iowa sites

Site	STK	Check	+K	Increase
Cty / State	ppm	bu/ac		
Pocahontas, IA	**163**	**172**	**165**	**- 7**
Palo Alto, IA	**196**	**152**	**185**	**+ 33***
Calhoun, IA	**126**	**166**	**171**	**+ 5**
Wright, IA	**135**	**155**	**175**	**+ 21***
Cherokee, IA	**290**	**211**	**227**	**+ 9 ***
Hardin, IA	**147**	**204**	**216**	**+ 12***

* Yield significant at the 0.10 level, corn 15.5% moisture. STK 0-6” Depth

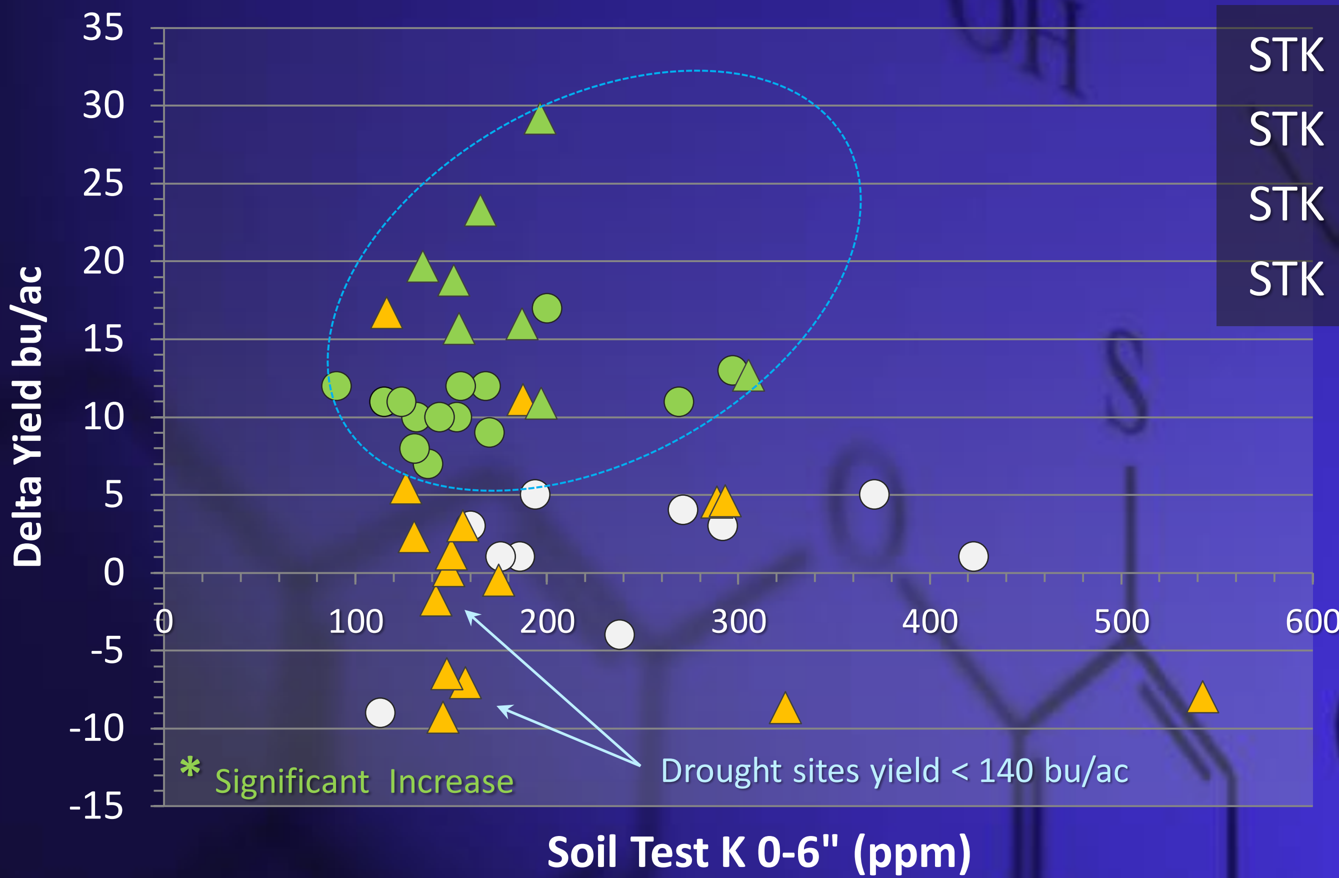
K effect on ear size

K increased yield on soils STK - 200 ppm

Miller, 2016

KR$_X$ Corn Yield vs STK 3 years

A K application[1] of 50 lbs/ac improved grain yield at twenty-seven of sixty locations.



Probability of yield response

STK 75 to 150	-	58%
STK 150 to 200	-	56%
STK 200 to 300	-	38%
STK 300 to 600	-	20%

Ave yield increase
11 bu/ac

[1] Yield increase to application of 50 lbs/ac K at V4-V6.

Miller, 2013

KR_X Corn Research 2015

2015 research expanded to include population component and N x K treatments. Four populations 26k, 32k, 38k and 44k plants per acre. at four sites: WI, IA, IL and CO. Fertilizer treatments consisted of side dress N, K and N x K, six replications.

Additional studies were conducted at five locations evaluating K sources and in combination with N and B, applied side dress at V4-V5, eight replications. Ear leaves were sampled at VT-R1.

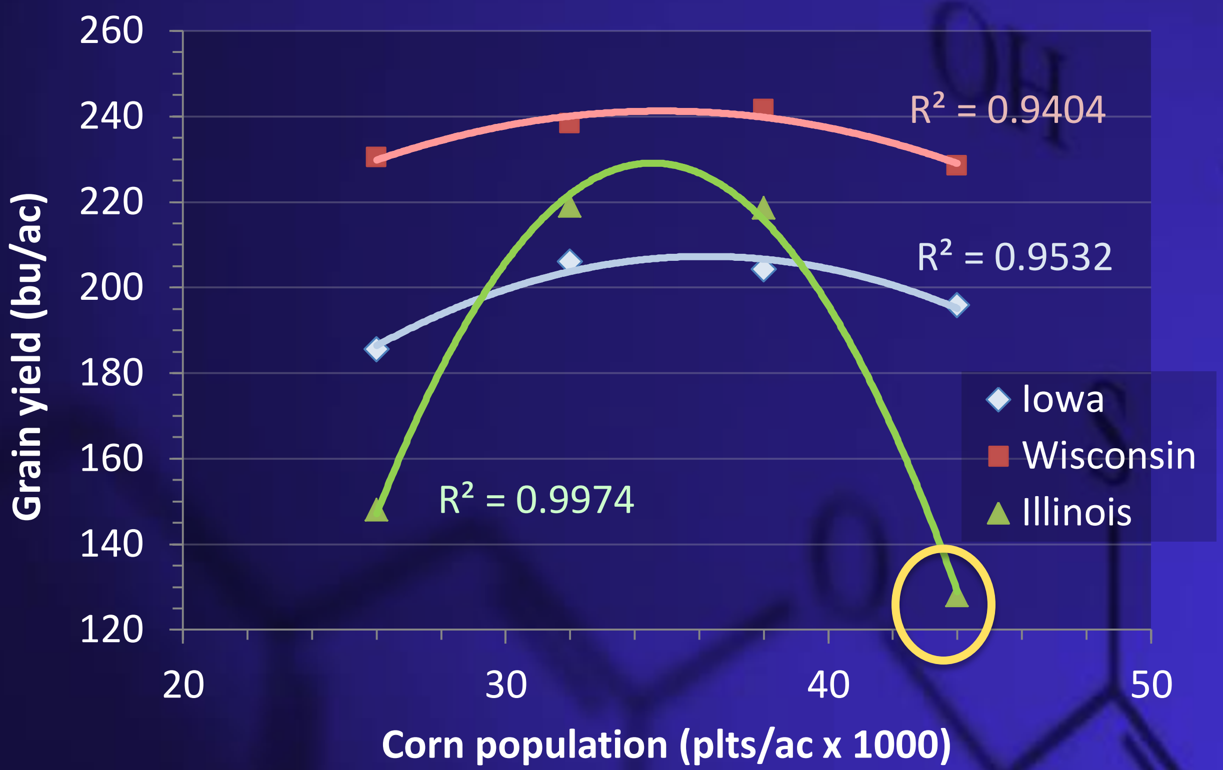
Robert Nielsen, 2009

http://a1.sphotos.ak.fbcdn.net/hphotos-ak-snc6/58602_151587434865720_111267718897692_355055_4317263_n.jpg

Miller et al, 2016

Population and Yield Response

Four plant populations, three sites



Yield max occurred between 32k and 38k

No response to applied K across population, yield increase to N, and NxK.

Significant loss of stalks with ears with increasing population, 16% loss at 44k population, vs 6.2% at 26k, WI and IA sites.

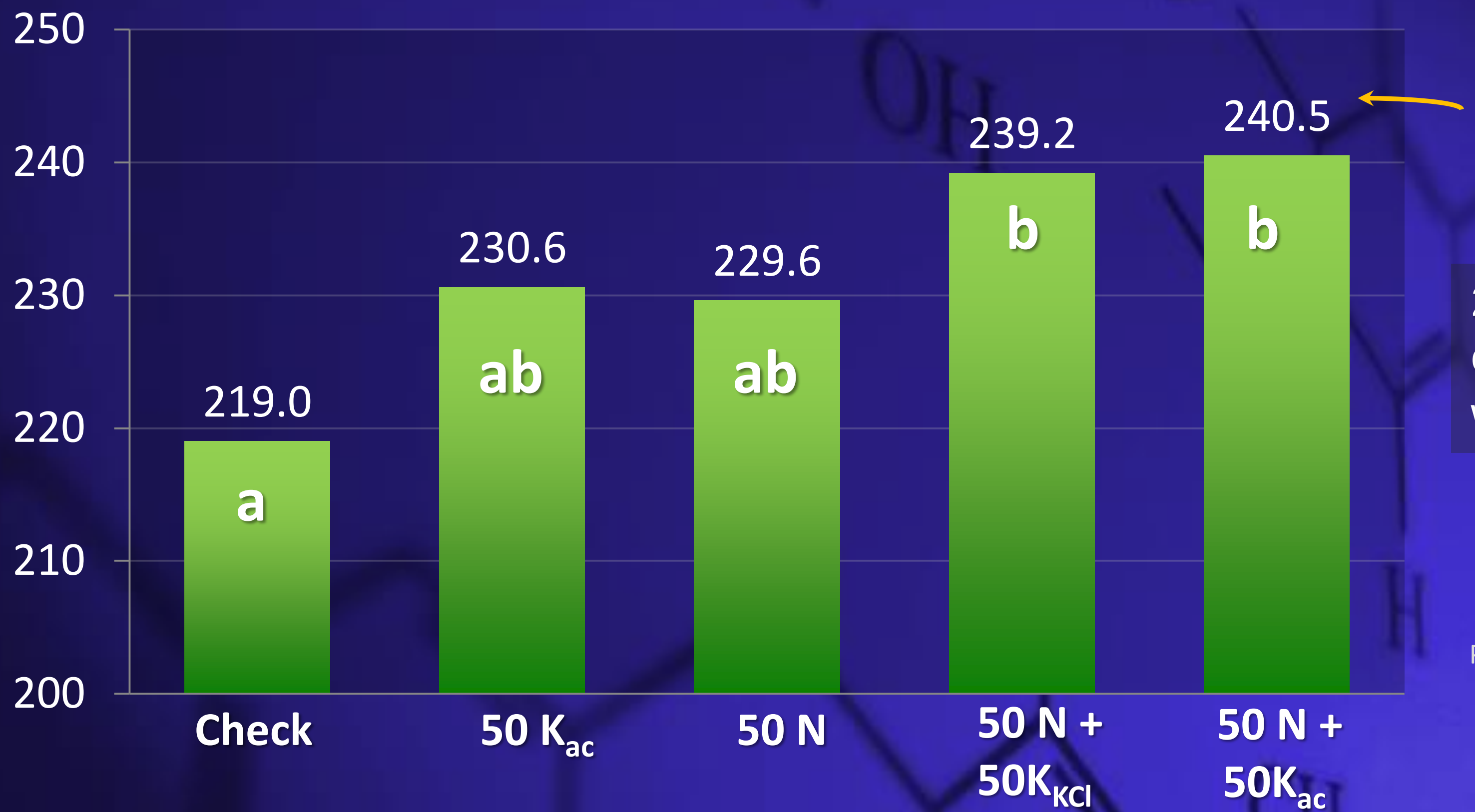
[1] *Yields average overall all treatments, corn 15.5% moisture, six replications*

[2] *Illinois site, 44k treatment impacted by herbicide overspray.*

Miller, 2016

KR_X: N x K Corn Yield Response

KR*x* Project Dodgeville, WI 2015



20 g increase on 1000 seed weight with N

Population 32,900

Fertilizer: UAN 32 and K acetate (Nachurs); applied spoke wheel injector at V3-V4 growth stage, 2-3” depth, 4” both sides of row, eight replications. Soil STK 182 ppm.

Miller et al, 2016

* Yield significant at the 0.10 level, corn 15.5% moisture.

KR_X: N x K Corn Yield Response

Grain Yield Response to N and K (two sources)

Treatment (lbs/ac)	*Iowa* *Sutherland*	*Wisconsin* *Dodgeville*	*Illinois* *Farmer City*
STK (ppm)	192	178	154
Check	194.1	219.0	183.2
50 K_{ac}	205.9	230.6 *	187.4
50 N	217.1 *	229.6	200.2 *
50 N + 50 K_{ac}	212.1 *	239.2 *	195.4 *
50 N + 50 K_{KCl}	204.1	240.5 *	203.8 *

[1] *Significant at p 0.1 level, 8 reps*

Miller et al, 2016

KRx K Corn Yield Response

Grain yield response to K at three sites, to application of K sulfate applied at V4-V5 using spoke wheel injector.

Treatment	Wisconsin Site Yield	Wisconsin Site Delta [2]	Illinois Site Yield	Illinois Site Delta [2]
(K lbs/ac)	bu/ac		bu/ac	
Check	203.4	-	147.7	-
50 K_{SO4}	216.7	+ 13.3*	156.2	+ 8.5
50 K_{SO4} + B[1]	215.2	+ 11.8*	162.2	+ 14.5*
25 K_{SO4} 2X	217.6	+ 14.2*	159.1	+ 11.4

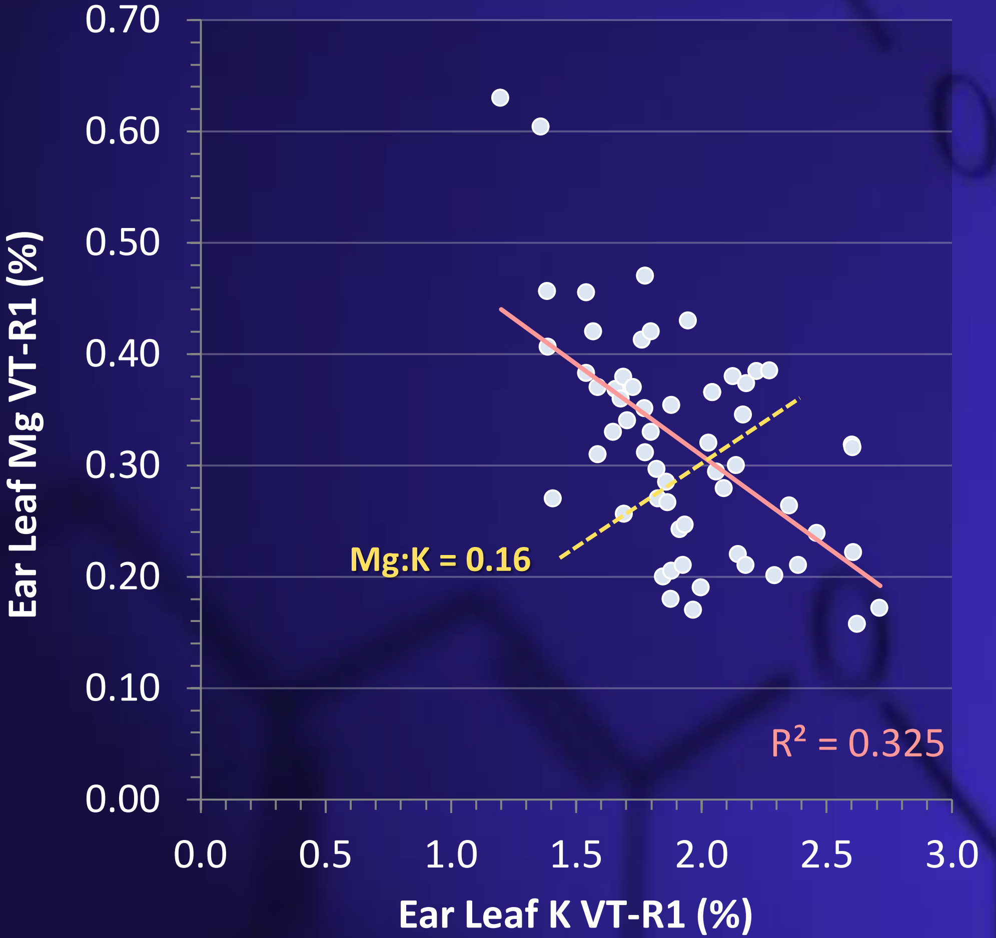
[1] Wolf Trax Boron DDP at 0.6 lbs per acre of product (18.5% B).

[2] Significant at p 0.1 level, 8 reps.

Miller, et al, 2016

Corn Ear Leaf VT-R1 K vs Mg

64 K*Rx* sites, across 7 states 2011-2015.



Variable Average	Cluster [3]	
	Low K	*High K*
Yield (bu/ac)	**159**	**202**
N %	**2.92**	**2.89**
K %	**1.48**	**2.40**
Mg %	**0.42**	**0.29**
Mg:K	**0.29**	**0.12**
N:K	**1.99**	**1.20**

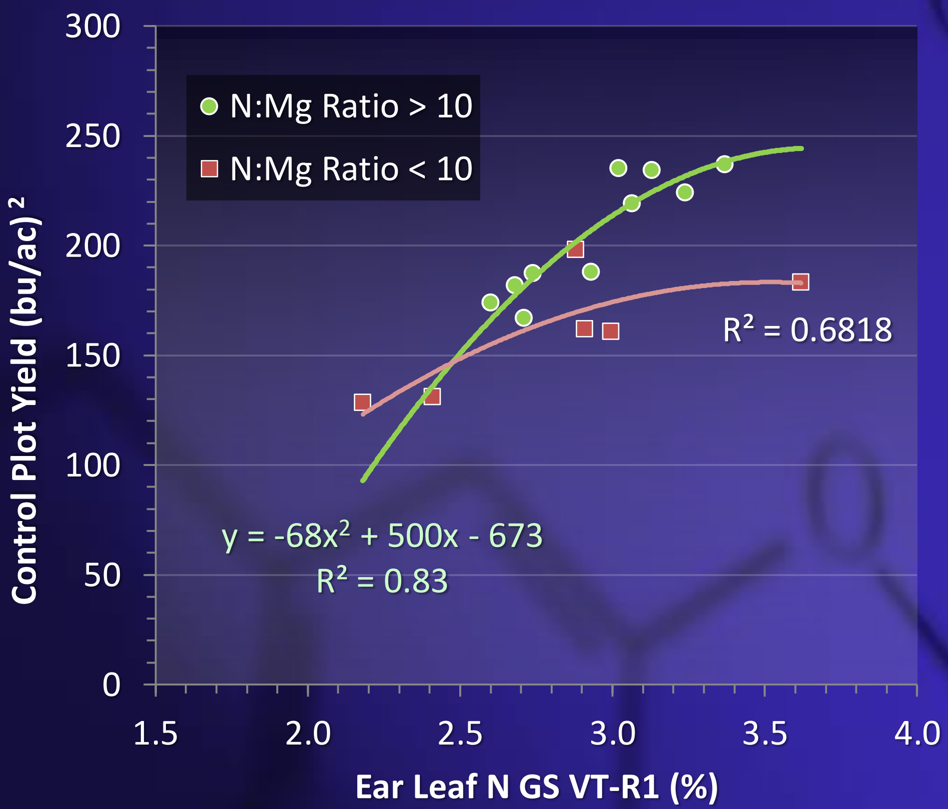
[3] Clusters based on 12 sites each.

1 Each site represents the mean of 4 check plots, across 7 states.
2 Mg:K > 0.16 K deficient, Elwali ,1984 Agron J.

Miller et al, 2016

Leaf Nutrition vs Grain Yield 2014

Parsing maize grain yield[1] by ear leaf ratios, shows 83% of yield is explained by leaf N, N:Mg > 10 (green) at ten sites. Six sites with N:Mg < 10 (red), averaged 44 bu/ac lower yields.



Analysis	N:Mg Ratio [3]	
	< 10	*> 10*
N %	2.90	2.95
K %	1.65	2.02
Mg	0.35	0.23
Mg:K	0.22	0.12
N:Mg	8.1	13.3
Yield bu/ac	204	159

[3] Mean results based on N:Mg Ratio.

[1] 2014 KRx control plot grain yields 16 sites, 4 states, 8 replications.
[2] Sites vary in hybrids, tillage, soil types and crop history.

Miller et al, 2015

Conclusions

Additional Research is planned for 2016 in IN, IL ,IA WI and MN.

Results show side dress K response at 46% of 76 research sites, yield response 8 – 33 bu/ac in Midwest.

Optimum population was between 32k and 38k per acre at three locations. N x K treatment increased grain yields STK at 4 of 5 sites 2015. Response was anion independent.

Five years of data show grain yields are optimum when ear leaf K > 1.9%, ratios Mg:K < 0.15 and N:Mg ratios > 10. Sites outside these leaf ranges show significant limitations on yield.

Miller et al, 2015

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Thank you for your time
and attention