"Crop Nutrient Uptake and Removal: Are all Regions the Same?"

> John Heard AgVise seminars January 2022







Crop uptake and <u>removal</u>

What do we use this information for?

Does it need to be updated? Does it change from area to area?

Can nutrient concentration be diagnostic of under fertilized crops?



Corn Nitrogen Uptake



Carman, 1993. 146 bu/ac corn with 125 lb N.

Manure management planning (and regulation of rates)



Crop	Example Target Yield	Ave Removal N	Ave Removal P205	
Wheat (Spring)	40 bu/acre	1.50 lb/bu	0.59 lb/bu	
Wheat (Winter)	75 bu/acre	1.04 lb/bu	0.51 lb/bu	1
Barley (Grain)	80 bu/acre	0.97 lb/bu	0.42 lb/bu	1
Oats	100 bu/acre	0.62 lb/bu	0.26 lb/bu	1
Rye	55 bu/acre	1.06 lb/bu	0.45 lb/bu	1
Corn (Grain)	100 bu/acre	0.97 lb/bu	0.44 lb/bu	1
Canola	35 bu/acre	1.93 lb/bu	1.04 lb/bu	1
Flax	24 bu/acre	2.13 lb/bu	0.65 lb/bu	1
Sunflowers	22 cwt/acre	2.80 lb/cwt	1.10 lb/cwt	1
Alfalfa	5 tons/acre	58.0 lb/ton	13.8 lb/ton	1
Grass Hay	3 tons/acre	34.2 lb/ton	10.0 lb/ton	1
Corn (Silage)	5 dry tons/acre	31.2 lb/ton	12.7 lb/ton	1
Barley (Silage)	4.5 tons/acre	34.4 lb/ton	11.8 lb/ton	1
Souboone	25 bullooro	2 97 lb/bu	0.94 lb/bu	1

6.2.4 The Fertilizer Screen (4/8)

https://www.gov.mb.ca/agriculture/environment/nutrientmanagement/marc.html#Whats_in_MARC_2008_

Effectiveness of novel products



Effectiveness of Using Low Rates of Plant Nutrients

Devid W. Prace et. NCRU Extension fact Intervo Epeciate: U.S. Department of Apriculture-Nerth Central Extension and Research Activity-105 Committee on Nonconventional Amontments and AddItives.

NOERA-103 Committee, 2000 Carl Rosen, Unkently of Ministeds, administrative advisor John Severy, town State Unkently Dorhan Rutz-Dier, Kanses State University Kurt Statine, McKinger State University Natifiere Paark, University of Missouri Mathew Faark, University of Missouri David M. Ranzen, Namin Davids State University Emerson Natifiger (stative), University of Missouri Ed Lands, This Onlie State University David M. Ranze, University of Missouri Ed Lands, This Onlie State University David M. Ranze, University of Missouri Bigen Materiae, University of Materiada Bigen Materiae, University of Nationala James Camberlio, Princip University

ATDOT 1

"Low rates" roles to supplemental crop numlerits added at rease much less than crop nomewill or much less than rates recommended by lend-grant invessity soil testily specialests. Low rates of crop nutrients sometimes are applied through the use of lartific rem with a law nutrient analysis (1.5.1) or by application of low rates of higher analysis forsizes (0.5.10).

Also, nontraditional products may promote low lotal plant mineral natrient mass through the application of low-analysis products or low rates of higher analysis products, with or without alternative additions to replace or anhance lentilizer nutrients. In each case, producers should give canaly consideration to the potential for optimal orgo response lyield or other desired outcome) that is based on university measureh conducted in similar soils or geographic regions.

Some farmers may choose to use low rates of fortilizer to reduce input costs. When not toot levals of nutrients as high end-vary high, nutrient additions are generally not recommanded or are recommanded at lower than crop numeral rates. However, if noil test levels are vary low or too, rates mare than coop numeral other are recommanded, particularly the transdom times and test.

Decisions on rate reductions need to be considered in relation to potential yield response and method of application that may enhance response, compand with traditional broadcesting. Foliar fortilizer or fortilizer applied with the seed generally site are applied at low mate due to constraints multised to plant itsue. Thus if and seed generation leveling safety. Although low rates of nutrients may be appropriate to apply at carrier in times, carried uncomplete made of all latters that may influence short-term and long-term orp yield, maintenance of soil tests and potential environmental impacts. Fourteen essential minised in particular due to apple the and the made of the made of the made of the set of the s The reason for fartilization is for the farmer to be probable in the current season and to position the soil for continued profitability into the farture. This is important because many networks are supplied at adequate levels naturally from the soil and are corrected at such law rates that forilization inst seached.

Several asamples are microsoftients or nations, particularly calcium (Ca) and (Mg), which are replaced with limiting lowpH sole. In other cases, nutrient numoral is so large that furtilization is required in the long term to maintain the sol nutrient resource.

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Phino examples are phosphores (P) and potentiam (k). For some nutriants, the soil supply of the crop available form is so fails discovery always occurs and needs tariflustion for optimal supply, typically a specific crop nutrient interaction with oration reiscoutients.

Table 1. Approximate concentrations of minoral elements in arrays grown in the North Central Region at harvest. Considerable variation accurs in a grap in elemental concentration.

				incentra	tion of na	triests is	ereps and	t oraș co	npenewis	of herve	si .		
Erop. crop.pert. X.mointure	-	P,A, 2	4	s x	Ge Z	MI	a 1	B	Cu ppm	fe ppm	Ma	20 ppm	Mo
Atala hay	2.25	0.6	2.26	0.2	1.8	0.27	0.5	75	75	100	55	54	9.1
Darley, grain	1.0	0.0	0.5	D.15	0.05	0.90	0.15	21	96	- 80	10	32	0.21
stew	0.75	0.25	1.50	0.20	0.40	0.10	9.25	25	50	25	18	25	0.1
Canola seed	3.1	0.5	1.0	0.45	0.29	0.16	0.08	75	.25	50	20	15	0.2
staw	1.0	6.5	2.0	0.0	0.6	0.10	0.00	25	90	60	20	10	0.1
Chickpeas	3.4	0.35	2.0	0.25	6.10	0.11	30.0	30	95	70	35	35	0.5
Corth grain, 15%	15	0.57	0.39	0.11	0.04	0.01	0.05	70	25	36	24	18	0.0
devar 1916	1.0	0.24	1.2	0.10	0.45	0.90	0.06	22	75	14	75	20	0.9
Corn sliage, 65%	1.8	0.95	1.0	0.2	0.25	0.22	0.04	30	50	.25	25	25	0.2
City beans	4.0	0.07	2.1	80	0.12	0.20	0.055	50	20	20	14	16	0.7
Floid pas grain	9.8	0.90	1.0	0.40	0.96	0.10	0.06	70	15	60	10	90	0.0
strav	1.2	0.00	1.3	0.45	0.15	0.10		57	23	30		15	0.3
Plax grain	3.2	0.6	1.0	0.25	0.25	0.45	_	16	12	50	30	40	
straw	12	0.90	0.80	0.15	6.3	0.2		80	- 56		42	12	
Lentil grain	4.0	EI.40	1.0	0.90	0.10	D. 10		10	. 10	185	15	45	0.1
ilian	14	0.1	0.55	0.30	0.10	0.04		5	75	.05	20	45	0.0
Clat grain	1.8	0.40	0.80	0.15	6.10	0.10	0.08	20	-46	70	50	45	0.4
utraw	33.0	0.23	2.1	0.23	0.50	0.55		25	60	0.005			0.1
Palaki tubers	0.43	0.13	0.56	0.03	0.015	0.03	_	徑	20	26	1.1	15	
VIDAS	2.2	0.60	7.2	0.22	0.18	0.10		28		55	43	28	200
Ryo, caroni	2.4	6.70	0.90	0.15	6.05	16	0.05	5	4	60	30	40	0.0
Sorghum grain	1.0	0.00	0.50	0.90	9.02	0.06			6	- 00			
skover	1.4	0.2	1.5	0.97						- 30		66	
Stybaane 19%	5.6	3.7	2.0	0.90	0.27	0.10	0.02	28	. 8	90	22	60	0.3
straw 10%	1.3	0.17	1.6	0,10	0.10	0.05	0.95	33	90	80	20	10	0.3
Sugarbeet sols	0.26	0.03	0.01	0.06	0.04	0.04	0.008	3	51	90	13	10	0.1
Boot tops	17	0.90	1.6	0.06	0.16	0.00	0.02	35	0.60	90	20	12	0.5
Bunkwats	6.0	10	3.0	0.15	0.50	0.90	-	10	20	30	30	36	
Sunikowar staver	0.5	0.22	2.0	0.25	0.30	0.13		50	5.0	10	5	28	
While grain 12%	22	0.80	0.44	0.12	0.06	0.13	0.08	55	2.8	- 190	50	. 55	0.5
stray 10%	0.44	0.00	12	0.06	0.04	0.14	0.14	11	3	80	14	20	0.1

N-ntengan, P₂O₂-phosphare, K₂O-potesti: 8- surfur: Ca-calcium: Mg-magnesium; C3-otilotide, B.-Boron; Ca-copper: Pa-Iron Mn-manganese, Zh-zho; Mo-molybdamum; Clanks Indicase no data available.

2 (Discleance of Deng Law Rate of Part Nichards) www.ndu.add/extension

Often it is simple mathematics https://www.ag.ndsu.edu/publications/crops/effectiveness-of-using-low-ratesof-plant-nutrients

Considering soil depletion, maintenance or building

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A	В	С	D	E	F	G	Н	I J	K	L	M
1	Phosphorus Balance	Calculati	on for a l	Rotation (Version 4	- October :	1, 2014)				
		Typical	Yield	Р	P Rer	noved*	Annual	Notes: Do	oes not acc	ount for n	utrients
2	Crop	Yield	Units	Applied	per unit	per acre	Balance	removed	when strav	v or chaff i	s
3					(lb P	205/ac)		removed	or burned		-
4	HR Spring wheat	60	bu/ac	30	0.59	35	-5				
5	Winter wheat	75	bu/ac	30	0.51	38	-8				
6	Barley		bu/ac		0.42	0	0				
7	Oats		bu/ac		0.26	0	0				
8	Canola	40	bu/ac	20	1.04	42	-22				
9	Soybeans	40	bu/ac	10	0.84	34	-24				
10	Peas		bu/ac		0.69	0	0				
11	Flax		bu/ac		0.65	0	0				
12	Corn (grain)		bu/ac		0.44	0	0				
13	Other**				0.00	0	0				
14	Total for Rotation			90		149	-59				
16	Fill in any of the blue	cells for	typical re	otation, vi	ields, and	P appl'n					
17	*P removal figures a	re estima	tes from	the Mani	toba Soil	Fertility Gu	ide.				
18	**For nutrient remo	val in oth	er crops	see table	in next w	orksheet.					
19											
20											
H 4 F F	Interactive P balance worksho	eet / Nutrient	removal table							4	
Ready											
		Di I						Del	с на ID-	0000.00	10 0

Simple spreadsheet to show impact of fertilization strategies over the rotation. https://www.gov.mb.ca/agriculture/crops/soil-fertility/phosphorus-balance-calculator-for-a-rotation.html

2020 National Survey: Fertilizer Recommendation Philosophy for P and K



Sufficiency versus Building/Maintenance



Sufficiency

- Apply only what is sufficient to meet crop demands
- Inputs match outputs
- Soil nutrient levels remain in a responsive range

Nutrient X soil test level

Building/maintenance

- Apply more than what is needed for the immediate crop
- Build the nutrient reserve
- Soil nutrient levels remain in a medium to high range





(Target STP – Current STP) X BC + CR

Years to Build

- Example 2 for 60 bu/ac wheat, current STP = 5 ppm and 5 years to build:
- Target STP (15 ppm)
- Crop removal (CR) = yield x P concentration
- Typical P buffering capacity (BC) by soil characteristics (assuming 25 lb P₂O₅ /ac to increase 1 ppm STP)

$\frac{(15-5) \times 25}{5} + 34 = \frac{(250)}{5} + 34 = 84 \text{ lb } P_2 O_5 / \text{ac}$



2001 – based on same data +/- 10%

Crop Parl	Nintogen My	pour usphotus (P20g)	Patiaslum (KgD) 17	Sulphur chi (S) thi 4 ci 5	art et province concernations Normern pical number: Caralitation crists, Normern, y weaker: Caralitation crists, Normern, socientitatione, can vary with valit, pocentratione, can vary with valit, picantitatione, can vary and picantitatione, can var
Grains Spring Wheat seed	60 25 85	23 9 32	55 72	9	Crops are not able to extract all average plant nurrents from the soll. For any plant nurrents from the soll.
40 bulA Tota 2550 Apiha	d 62	26 15	17 64 73	3 10	priver, years, the soli (soli prise added terroristic emount) somewhat greater than the emount somewhat by the clos
Winter Wheek stra 50 bulA Tot	w 15 ml 167	31	25	7	Erop upsets of nations in restricted of Drop upsets of nations including and senate conditions including
Barley st	ed 78 raw 28	9 43	93	12	those nature services - low sole makeure - poor aection due to competition and/or - poor aection due to competition
4300 RD/M	eed 61	26 15	18	5 13	by solution to the tool tools tools tools to the tool tools
Oats 100 bulA	total 106	4	6	20 1	5 - management Practices (BMPs)
Rye	seed 51 straw 3	3	46	31 1	 Belles are researched on potential. Shelts optimize graduation potential. which optimize graduation potential. which optimize and environmental protection.
3450 kg/h#	seed	97 56	44 19	28 101 129	8 SMPs which the details to detail 15 efficiency include: - regular and analysis to detail - regular and analysis to times
Com 100 bulA	stover Total	153	63	21	12 fertilizer foruliner soprizzer swister foruliner soprizzer proper placement methods proper placement methods control,
Oilseeds	seed	68 44	41 17	72 93	10 22 improved snown and water use effici- conservation, and water use effici- conservation, and water use effici-
a Canoia 35 bu/A +960 kp/ha	Total	112	15	15 20	5 weed control 8 . weed control 13 . weet managed tentilizer program
and Flax	seed straw	14 65	3 18	35	4 on sol tasting an even of production bys make your crop production bys officient, cost affective and such
6.7 1492 kp/he	seed	53	16 10	25	8 Consult your services subject
Suntlower 50 bu/A	strav Tota	74	26	<u> </u>	
4	a mailed b	y the			
	Company		nd .	1001	

NUTRIENT UPTAKE AND REMOVAL BY FIELD CROPS

The ranges in nutrient uptake ¹ and removal² values given in this chart are general estimates. They are based on typical nutrient concentrations and yields for good growing conditions in western Canada. Actual uptake and removal will vary with crop yield, crop variety, soil fertility and from year to year. Accurate removal values can only be determined by laboratory analysis. Crop uptake of nutrients is affected by soil and climatic conditions. Low soil moisture, poor aeration due to compaction or excessive moisture, low soil temperatures,

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WESTERN CANADA 2001

high lime in the root zone, nutrient imbalances, and other factors may restrict uptake of plant nutrients. Crop fertility requirements will differ from these nutrient removal values.

Crops are not able to extract all available plant nutrients from the soil, and fertilizers are not 100 percent efficient. For any given yield, the total nutrient supply in the soil (soil plus added fertilizer) will be somewhat greater than the amount removed by the crop. The best way to determine fertilizer requirements is regular soil analysis.

Pounds per Acre

Grains		N	P205	K,O	s
Spring Wheat	uptake'	76 - 93	29 - 35	65 - 80	8 - 10
40 bu/A (2690 kg/ha)	removal ²	54 - 66	21 - 26	16 - 19	4 - 5
Winter Wheat	uptake	61 - 74	27 - 34	64 - 78	9 - 11
50 bu/A (3360 kg/ha)	removal	47 - 57	23 - 28	15 - 19	6 - 8
Barley	uptake	100 - 122	40 - 49	96 - 117	12 - 14
80 bu/A (4300 kg/ha)	removal	70 - 85	30 - 37	23 - 28	6 - 8
Oats	uptake	96 - 117	36 - 45	131 - 160	12 - 14
100 bu/A (3584 kg/ha)	removal	55 - 68	23 - 28	17 - 20	4 - 5
Rye	uptake	83 - 101	41 - 51	117 - 144	14 - 17
55 bu/A (3450 kg/ha)	removal	53 - 64	22 - 27	18 - 22	4 - 5

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NUTRIENT UPTAKE AND REMOVAL BY FIELD CROPS

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WESTERN CANADA 2001

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Grains		N	P2O3	K,O	s	
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Winter Wheat	uptake	61 - 74	27 - 34	64 - 78	9 - 11	
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80 bu/A (<i>4300 kg/ha</i>)	removal	70 - 85	30 - 37	23 - 28	6 - 8	
Oats	uptake	96 - 117	36 - 45	131 - 160	12 - 14	
100 bu/A <i>(3584 kg/ha)</i>	removal	55 - 68	23 - 28	17 - 20	4 - 5	
Rye	uptake	83 - 101	41 - 51	117 - 144	14 - 17	
55 bu/A (3450 kg/ha)	removal	53 - 64	22 - 27	18 - 22	4 - 5	
Corn	uptake	138 - 168	57 - 69	116 - 141	13 - 16	
100 bu/A (6272 kg/ha)	removal	87 - 107	39 - 48	25 - 30	6 - 7	
Oilseeds		N	P,0,	к,0	s	
Canola	uptake	100 - 123	46 - 57	73 - 89	17 - 21	
35 bu/A (<i>1960 kg/ha</i>)	removal	61 - 74	33 - 40	16 - 20	10 - 12	
Flax	uptake	62 - 76	18 - 22	39 - 48	12 - 15	
24 bu/A <i>(1492 kg/ha)</i>	removal	46 - 56	14 - 17	13 - 16	5 - 6	

Western Canada

Where did data come from? Research plots?

Older varieties? Open pollinated canola. Production has changed:

- Less tillage
- More pesticide use (fungicide)
- Earlier seeding

Table 4.1 Total nutrient uptake* by selected crops (Last modified: May 2014).

T	1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1		
	Barley	Argentina	S
t	Bermudagrass	USA	0.2
T	Canola	China	1=
Γ	Chickpea	India	1.4
Γ	Corn	USA	7.8
T	Soybean	USA	8.6
1	Sugar beet	China	1.3
T	Sugarcane	China	
I	Sunflower	Argentina	0.50
I	Tobacco	China	
T	1021 1021	0.00000	

* Total nutrient uptake refers to the quantity of nutrient accumulated in the above ground portion, and harvested portions, of the plant by the time of sampling, usually physiological maturity or when uptake is at its maximum.



NUTRIENT REMOVAL

What's your harvest removing from the soil?







* N, P₂O₅, K₂O, and S removal coefficients derived from the IPNI Nutrient Removal Calculator as of Jan. 2018 (http://www.ipni.net/article/IPNI-3346). Mg removal coefficients derived from Alabama Extension: ANR-449 (1999), CEI (2001), IPNI (2008), North Carolina: AC-430-16 (1901) and other independent sources.

Nutrient removal values may vary regionally depending on growing conditions. Use locally available data whenever possible. Crop nutrient removal and soil test considerations should be made for proper nutrient recommendations.

https://www.cropnutrition.com/nutrient-management/nutrientremoval?gclid=CjwKCAjwqcKFBhAhEiwAfEr7zQlkSLtkV0eFtzA6uDy4Sn6i5jbzqhVEcSJ6iLLvqY1KBXJLAYVrJ BoCJk4QAvD_BwE

ILLINOIS

Modern Corn Hybrids' Nutrient Uptake Patterns

By Ross B. Bender, Jason W. Haegele, Matias L. Ruffo, and Fred E. Below

Biotechnology, breeding, and agranamic advancements have propelled corn yields to new highs with little guidance as to have to fertilize these modern corn hybrids to achieve their maximum yield potential. Current fertilization prostices, developed decades ago, may not match uptake capabilities of modern hybrids that contain transgenic insect protection now grown at population densities higher than ever before. A reevaluation of nutrient uptake and partitioning can provide the foundation for fine-tuning our practices as we strive to achieve corn's maximum yield potential.

A summarized by Broulsema et al. (2012), optimizing matrient management includes using the right source at the right rate, right time, and right place—the 4R approach. Research pertaining to primary macroautrism uptake, partitioning, and timing (Sayre, 1948; Hanway, 1962; Karlen et al., 1968), though fundamentally accurate for previous hybrids and management practices, may be unrepresentative of modern hybrids in higher yielding environments. The objective of this study was to determine how modern, transgenic insect-protected corn hybrids in high-yielding systems take up and utilize natrients.

Nutrient contents of N, P, K, S, Zn, and B were determined at six incrementally spaced growth stages: V6 (vegetative leaf stage 6), V10, V14, R2 (blister), R4 (dough), and R6 (physiological maturity) (Hanway, 1963). Field experiments were conducted at the Northern Illinois Agronomy Research Conter in DeKalb, Illinois and the Department of Crop Sciences Research and Education Center in Urbana, Illinois, A total of six hybrids ranging in relative maturity from 111 to 114 days were used with genetic resistance to feeding from Western Corn Rootworm (Diabrotica urgifera rirgifera), European Corn Borer (Ostrinia nubilalis), and other species in the Lepidoptera order. In all cases, hybrids were seeded to obtain a final stand of 34,000 plants/A. Representative plants were separated, analyzed, and evaluated in four tissue fractions: 1) stalk and leaf sheaths; 2) leaf blades; 3) tassel, cob, and husk leaves; and 4) com grain, respectively referred to as stalk, leaf, reproductive, and grain tissues. Agronomic management at planting included a soil insecticide and a broadcast application of 150 Ib P.O./A as MicroEssentials® SZ** along with 180 lb N/A as urea. This was followed by 60 lb N/A as Super-U (with urease



Fully-filed cars of cont-an indicator of successfully matching soil nutrient scopily with and demand.

nutrients required (or production, and 2) the amount of that nutrient contained in the grain, referred to as "removed with grain" (Table 1). Our grain nutrient concentration values, in grain" (Table 1) are in agreement with those recently used by the fartilizer industry to determine replacement fortilizer rates (Brunisema et al., 2012). In the past 50 years, however, the quantity of N, P, and K required for production and the amount of nutrients removed with the grain have nearly doubled across a variety of management systems used in the 1960s (Hanway, 1962).

Newer, high yielding hybrids removing less nutrients per bu than "book values"



Figure 2. Total maize N uptake and partitioning across four plant stover fractions: leaf, stalk, reproductive, and grain tissues. Each value is a mean of six hybrids across two site-years at Urbana, IL (2010) and DeKalb, IL (2010). GGD_F = growing degree days (Fahrenheit)



Figure 3. Total maize P uptake and partitioning across four plant stover fractions: leaf, stalk, reproductive, and grain tissues. Each value is a mean of six hybrids across two site-years at Urbana, IL (2010) and DeKalb, IL (2010). GGD_e = growing degree days (Fahrenheit)

Better Crops/Vol. 97 (2013, No.1)

Uptake per bu increases with yield for N,P,K,S



But removal in grain rather constant across yield ranges

Ciampitti and Vyn, 2014. https://ag.purdue.edu/agry/directory/Documents/CM-RS-13-0022_Final%20Version_4-11-2014.pdf

Lack of association between crop yields and nutrient concentration



Fig.2. Scatterplots of the concentration of A), N, B) P_2O_5 , and C) K_2O in the grain (lbs/bu) against yield (bu/ac) of field crops of corn (n = 644), soybean (n = 390), and wheat (n = 101).

Illinois. Villamil et al, 2019. https://experts.illinois.edu/en/publications/new-grain-p-and-k-concentration-values-for-illinois-field-crops

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Defined range of nutrients



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Fig. 3. Distribution of (A) P₂O₅ and (B) K₂O grain concentrations measured in 2335, 2621, and 825 samples of corn, sovbean, and wheat, respectively.

Illinois. Villamil et al, 2019. https://experts.illinois.edu/en/publications/new-grain-p-and-k-concentration-values-for-illinois-field-crops



Using results for recommendations



Figure 2. Cumulative distribution of corn grain P levels for 2,335 samples collected from 2014-2016 in Illinois. Vertical lines identify the 25th, 50th, and 75th percentile values, and the current "book value" (0.43 lb P2O5 per bushel, at the 97th percentile) is indicated by the vertical line on the right.

Illinois and Iowa choose to report the 75th percentile values for removals rather than the mean (or median). This was a cautious approach to avoid any risk of under fertilizing – but was still considerably less than the previous book value of 0.43

https://farmdoc.illinois.edu/field-crop-production/uncategorized/new-grain-phosphorus-and-potassium-numbers.html

Ohio studies – a full analysis including micronutrients – corn, soybeans, wheat



Compared to 20-30 yrs ago, K removal is: 26% less in corn, 19% less in soys, 35% less in wheat.

https://ohioline.osu.edu/factsheet/anr-74

Ohio studies – a full analysis including micronutrients – corn, soybeans, wheat



Nutrient concentrations are weakly related to yield. For most, as yields increase concentrations declined slightly suggesting higher yielding grain contains more starch (or lipids) relative to nutrient.

https://ohioline.osu.edu/factsheet/anr-74



Zn was predominantly in seed of corn so crop removal is more important than other micronutrients.

Some translocation of Zn from leaves and stem to seed. Most seed accumulation is due to continued root uptake.



Manure impact on nutrient removal

		Control	Liq-N rate	Liq-P rate	Solid N Rate	Solid P rate
Canola	Lb N/bu	1.54 – 1.71	1.72- 1.80	1.74- 1.76	1.67- 1.68	1.68- 1.71
	Lb P2O5/bu	0.62- 0.75	0.73- 0.74	0.53- 0.73	0.79- 0.82	0.64- 0.83
Barley	Lb N/bu	0.99	1.04	1.08	1.02	1.12
	Lb P2O5/bu	0.48	0.53	0.47	0.52	0.54

Manure marginally increased nutrient content of grain, but **occasionally P content was lower due to a dilution effect** brought about by the very high yield increase.

Flaten 2017. https://cdnsciencepub.com/doi/pdf/10.1139/cjps-2017-0160



Source	Graiı	n P remov P2O5/bu	val Ib	Grain	Grain K removal Ib K2O/bu			
	Corn	Soybean	Wheat	Corn	Soybean	Wheat		
IHA	0.43	0.85	0.90	0.28	1.30	0.30		
IPNI	0.38	0.84	0.60	0.27	1.30	0.34		
MI OLD NEW	0.37 0.35	0.80	0.63 0.5	0.27 0.20	1.40 1.15	0.37 0.25		
IA	0.32	0.72	0.55	0.22	1.20	0.27		
IL	0.37	0.75	0.46	0.23	1.15	0.24		
OH	0.35	0.79	0.49	0.20	1.14	0.24		
MN	0.28 0.25-0.33	0.69 0.62-0.74		0.19 0.18-0.22	1.10 1.04-1.15			
MB	0.25 0.19-0.38	0.65 0.49-0.83	0.50 0.37-0.63	0.18 0.16-0.25	1.06	0.23 0.19-0.28		

Minnesota – Removal based management of P and K, 2020

Table 12: Expected removal of phosphate and potash in harvested corn grain at 15.5% moisture

	Median	Range
Phosphate (P2O5)	0.28 (lbs/bushel)	0.25-0.33 (lbs/bushel)
Potash (K2O)	0.19	0.18-0.22

Table 6: Expected removal of phosphate and potash in harvested soybean grain at 13% moisture

Fertilizer source	Median	Range
Phosphate (P205)	0.69 (lbs/bu)	0.62-0.74 (lbs/bu)
Potash (K2O)	1.1	1.04 -1.15

https://extension.umn.edu/crop-specific-needs/fertilizing-cornminnesota#maintenance-based-p-and-k-strategies-2239912



P and K removal in Corn

Corn lb P2O5/bu



26% P 32% K





P and K Removal in Soybeans

20% P 15% K







P and K removal in Wheat



16% P 30% K







https://umanitoba.ca/faculties/afs/agronomists_conf/media/Poster_-_Heard_2.pdf

MB Evaluation – 2019 to validate historic numbers 🗫









Western Canada project led by U of SK to analyze nutrient uptake and removals of prairie grain.

not

	MB	SK	AB						
Barley	Current values a	are based large	ely on research						
Canola	site data, and	not from farm	fields, and do						
Chickpea	represent the	full geography	/ of western						
Corn	Canada, or current crop varieties. Crop vields continue to trend upwards due to								
Lentil									
Oats	changes in m	anagement (re	educed till) &						
Soybean	improved gen	improved genetics							
Field pea	With the develo	oment of new (crop varieties w						
Flax	enhanced vie	Id notential an	d different						
Mustard	anatics the	nutrient untak	a domande hav						
Spring wheat	changed aver	r timo	- uemanus nav						
Durum wheat			imataa far araa						
Winter wheat		evelop new est	intales for crop						
Dry beans	nutrient uptak	te and remova	i based on <u>crop</u>						
	grown under	typical farm co	nditions.						

Is seed nutrient concentration useful as a diagnostic tool of deficiencies? Rarely.



Common benchmark uses wheat protein to indicate N sufficiency for yield HRS = >13.2-13.5% indicates sufficient N for full yield (Racz) HRW = >11.5% (Goos)

Most of the critical or deficient values listed in "Plant Analysis: An Interpretation Manual" now fall within the normal range of current crops.

Nutrient	Corn	Soys
N%	1.5%	6.14%
P%	0.28%	0.33%
K%	0.36%	1.74%
S%	0.17%	-
Mn ppm	5	13
Zn ppm	-	23





Are reductions in nutrient concentration a problem?



No – a sign of success! Full yield expression and carbohydrate accumulation.

Despite what you might read on the internet.

Feb 17 & 18: Winnipeg, MB – Producing Nutrient Dense Food Conference



If you are doing this yourself (AgVise will analyse)

- Correct for moisture
- Analysis is on dry basis, grain is at 15.5% moisture (for corn)
- Convert P x 2.28 = P_2O_{5} , and K x 1.2 = K_2O





Nutrient Removal Values

Will change if we measure:

- Corn P and K concentration/bu 26% & 32% less
- Soybeans = 20% & 15% less
- Wheat = 16% & 30% less
- Canola = 33% & 22% less
- Impact on "maintenance and build calculations"
- Important in maintaining productive fertility levels
 - yield increases are still bigger than these reductions in concentration
- Manure regulations? (P based rates, 1000 to 1500 ac)



Questions

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