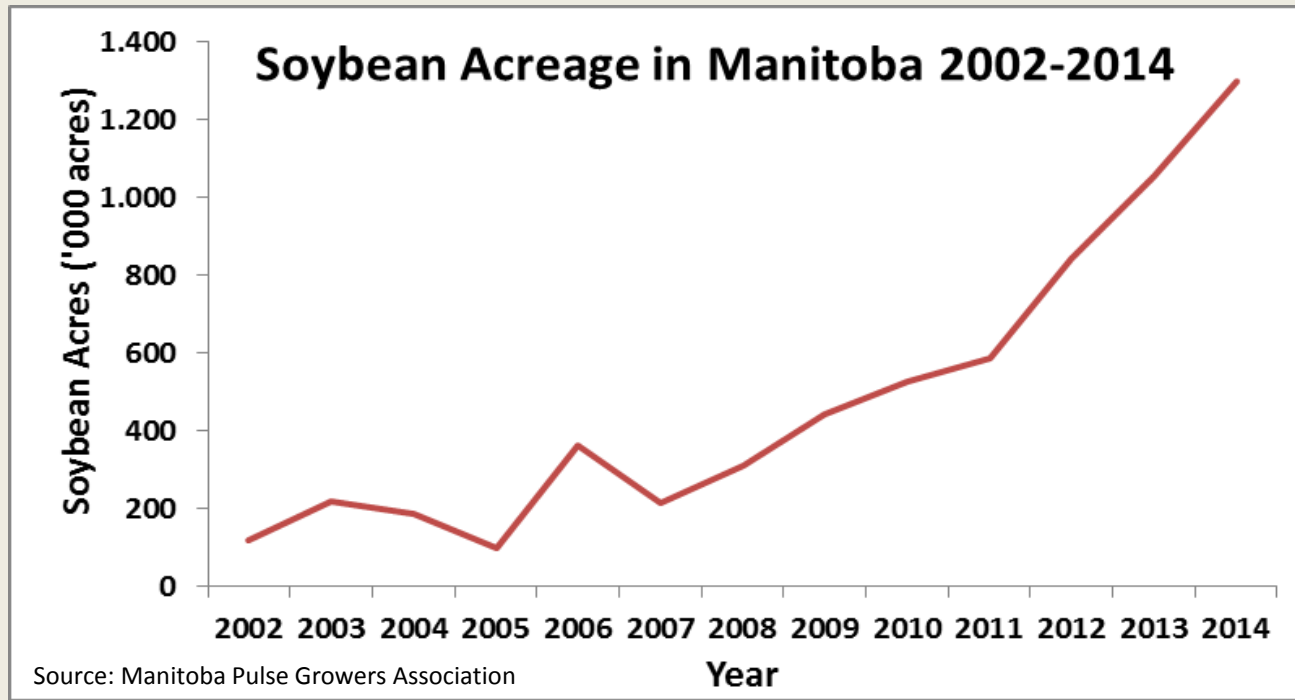




Phosphorus Management for Soybeans

**Gustavo Bardella, John Heard, Don Flaten and Cynthia Grant
University of Manitoba, MAFRD, and AAFC
Ag Days, Brandon, MB
January 21, 2015**

Background



- Soybeans remove large amounts of P (≥ 0.85 lb P_2O_5 /bu)
- Wide row spacings and narrow seed/fertilizer spread increase risk of fertilizer toxicity in seed row (current guidelines recommend a maximum of 10 lb P_2O_5 /ac)
- Questions remaining about P fertilization and placement in soybeans



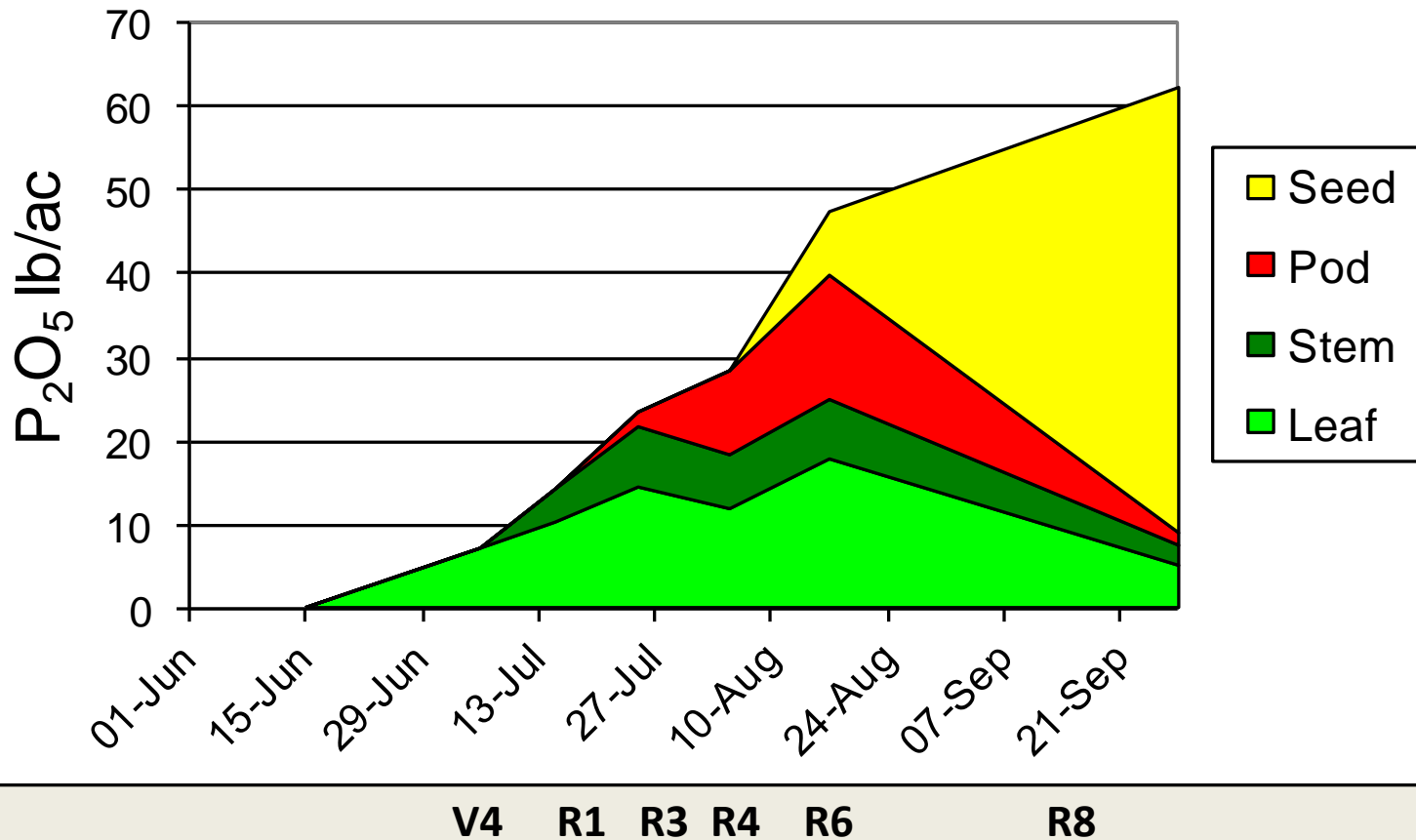
P Uptake and Removal by Annual Crops

Crop	Seed Yield bu/acre	Uptake/Removal*	
		lb P ₂ O ₅ /ac	lb/bu
Wheat	45 bu	36 (26)	0.59
Canola	45 bu	75 (46)	1.0
Soybeans	40 bu	43 (34)	0.85
Barley	80 bu	45 (34)	0.43
Peas	50 bu	43 (34)	0.68
Oats	100 bu	41 (26)	0.26
Corn	100 bu	63 (44)	0.44

*Removed in grain



Soybean Phosphorus Uptake



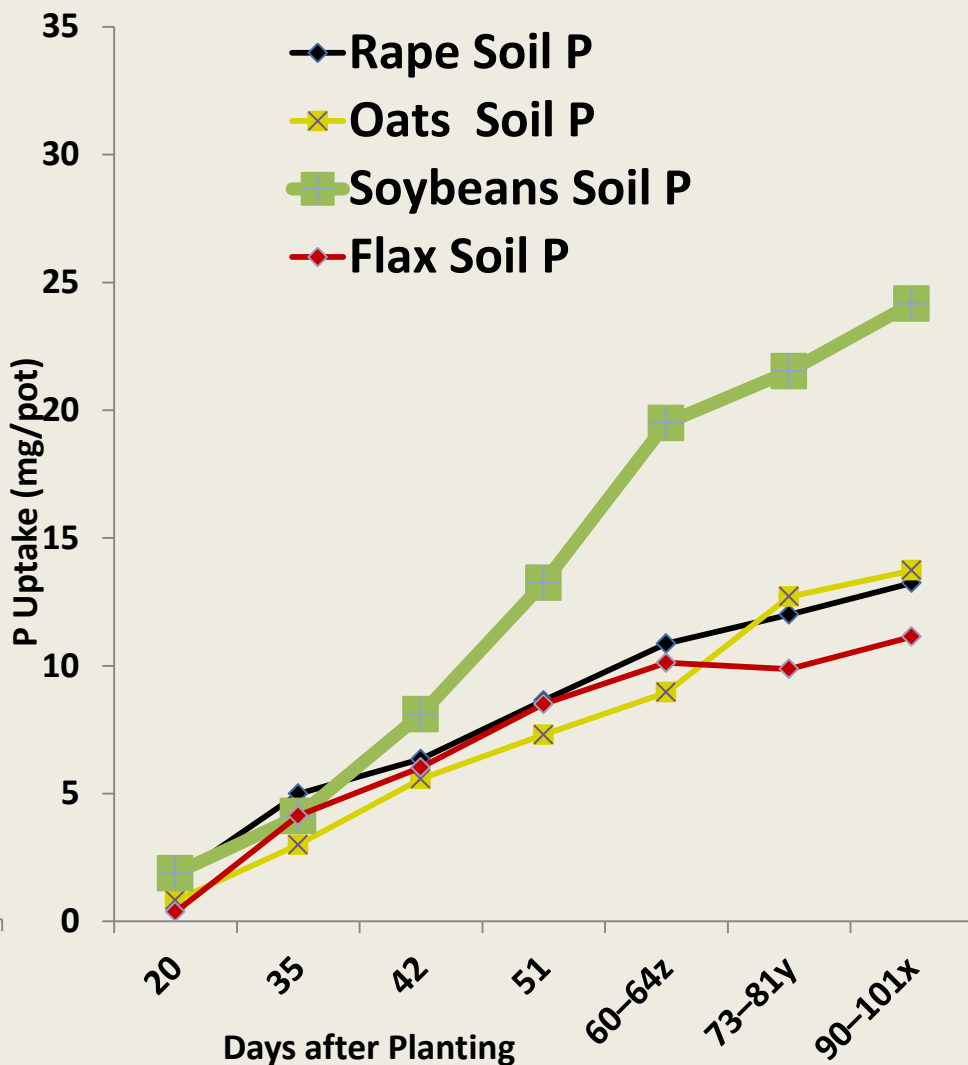
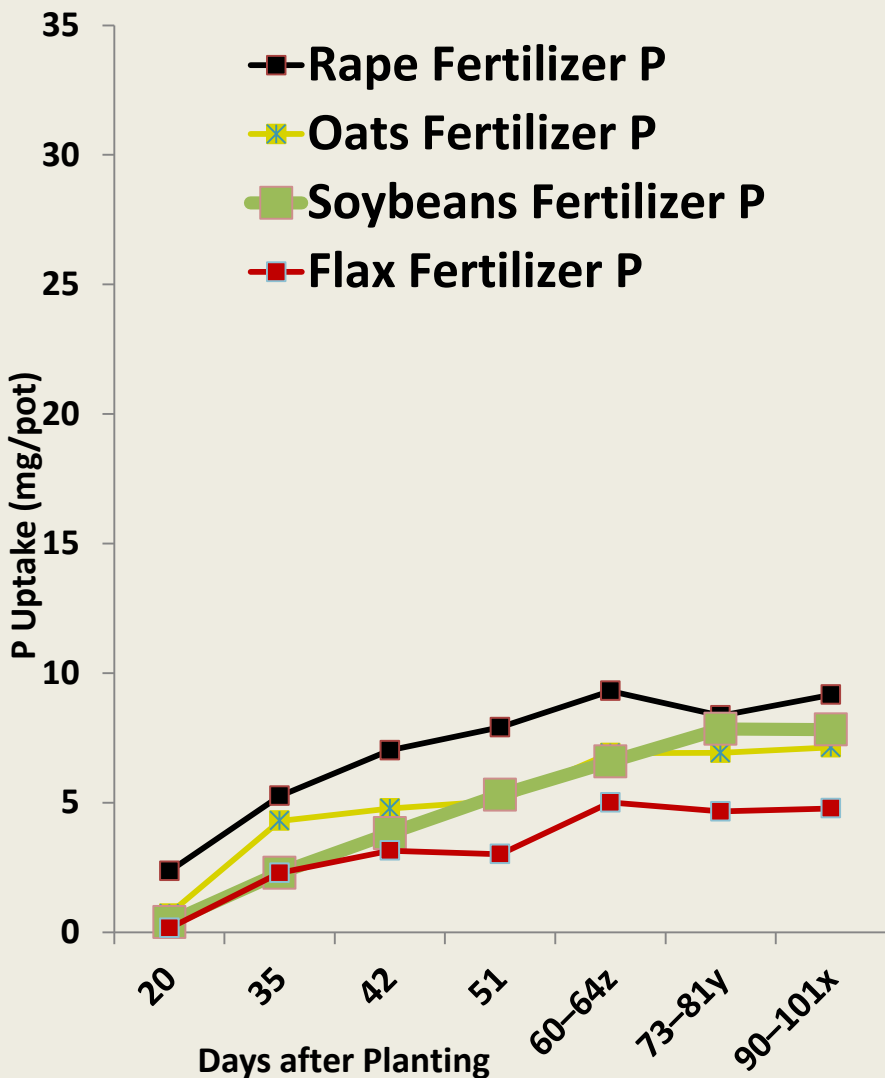
- 60% of P is taken up during the reproductive phase
- In late stages, new P is taken up and old P translocates from veg. to seed at 1 lb P_2O_5 /ac/day
- 85% of P is removed in the seed

Phosphorus uptake and removal by a 46 bu/ac soybean crop in Manitoba (Heard, 2005)



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Soybeans are efficient feeders for soil P

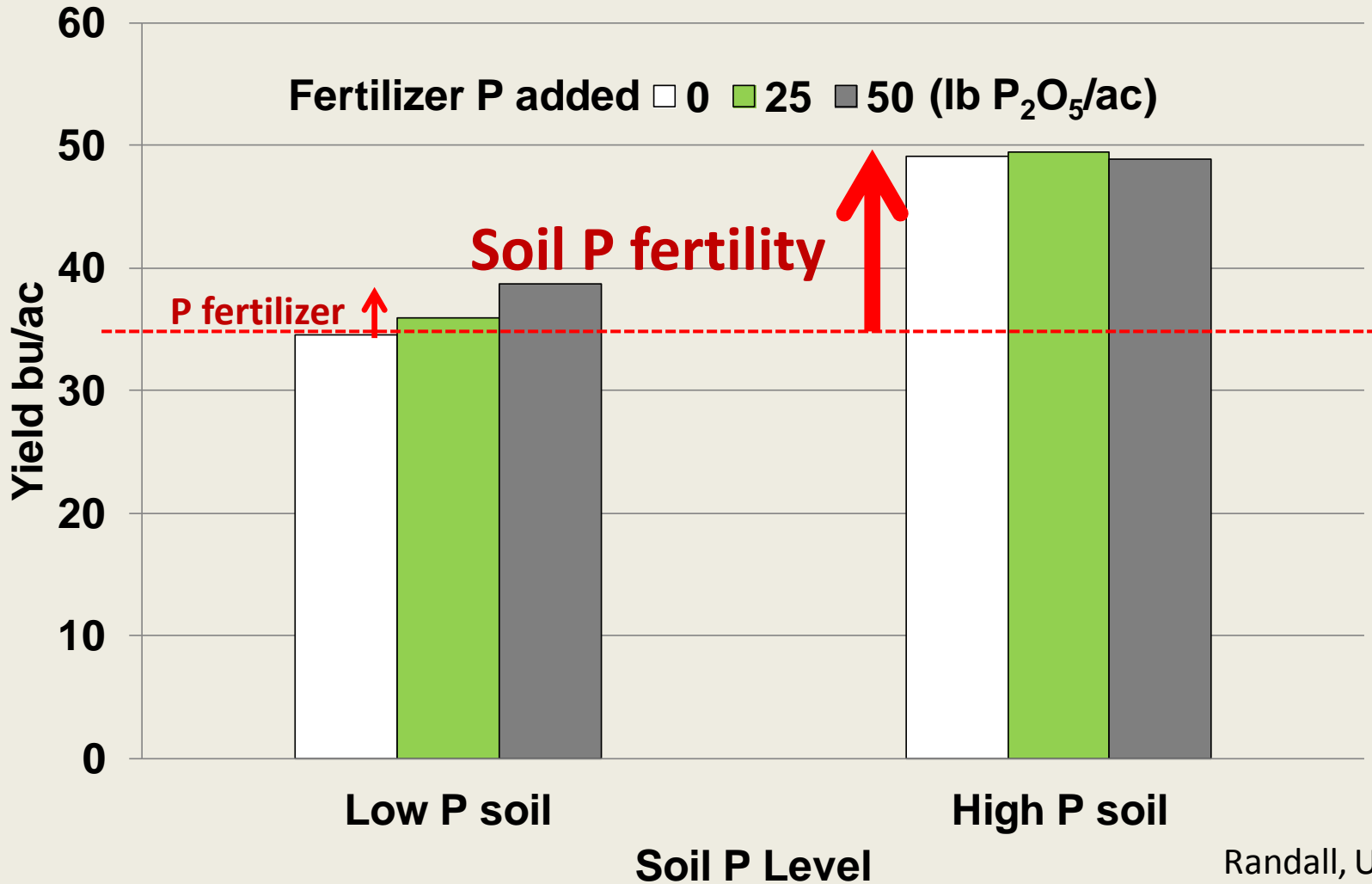


(Kalra and Soper 1968)



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Soybean response to P fertilizer and soil P fertility



Randall, U of Mn



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Manitoba Soybean P Project: Effects of P Rate & Placement on Plant Stand and Seed Yield



Materials and Methods



- 8 sites established in 2013
- 10 sites established in 2014



Materials and Methods, cont'd.

- Row spacing varied from 7 to 12"
- Opener type: knife or disc ... low seed bed utilization

Site	<u>Olsen P (ppm)</u>		Soil Texture	Row Spacing Inches	Seeder Opener Type
	2013	2014			
Roseisle	N/A	4 (VL)	L Fine Sand	8	Knife
Melita	3 (VL)	5 (L)	Loamy Sand	9.5	Knife
Brandon	5 (L)	6 (L)	Clay Loam	8	Knife
Carman	N/A	15 (H)	Loamy Sand	8	Knife
Roblin	7 (L)	22 (VH)	Clay Loam	9	Knife
Beausejour	8 (L)	13 (M)	Clay	9	Disc
Arborg	14 (M)	22 (VH)	Clay	9	Disc
St Adolphe	23 (VH)	25 (VH)	Clay	7.3	Knife
Portage	34 (VH)	18 (H)	Clay Loam	12	Disc
Carberry	44 (VH)	11 (M)	Clay Loam	12	Disc



Manitoba P Response Historical Data: Mainly Cereals

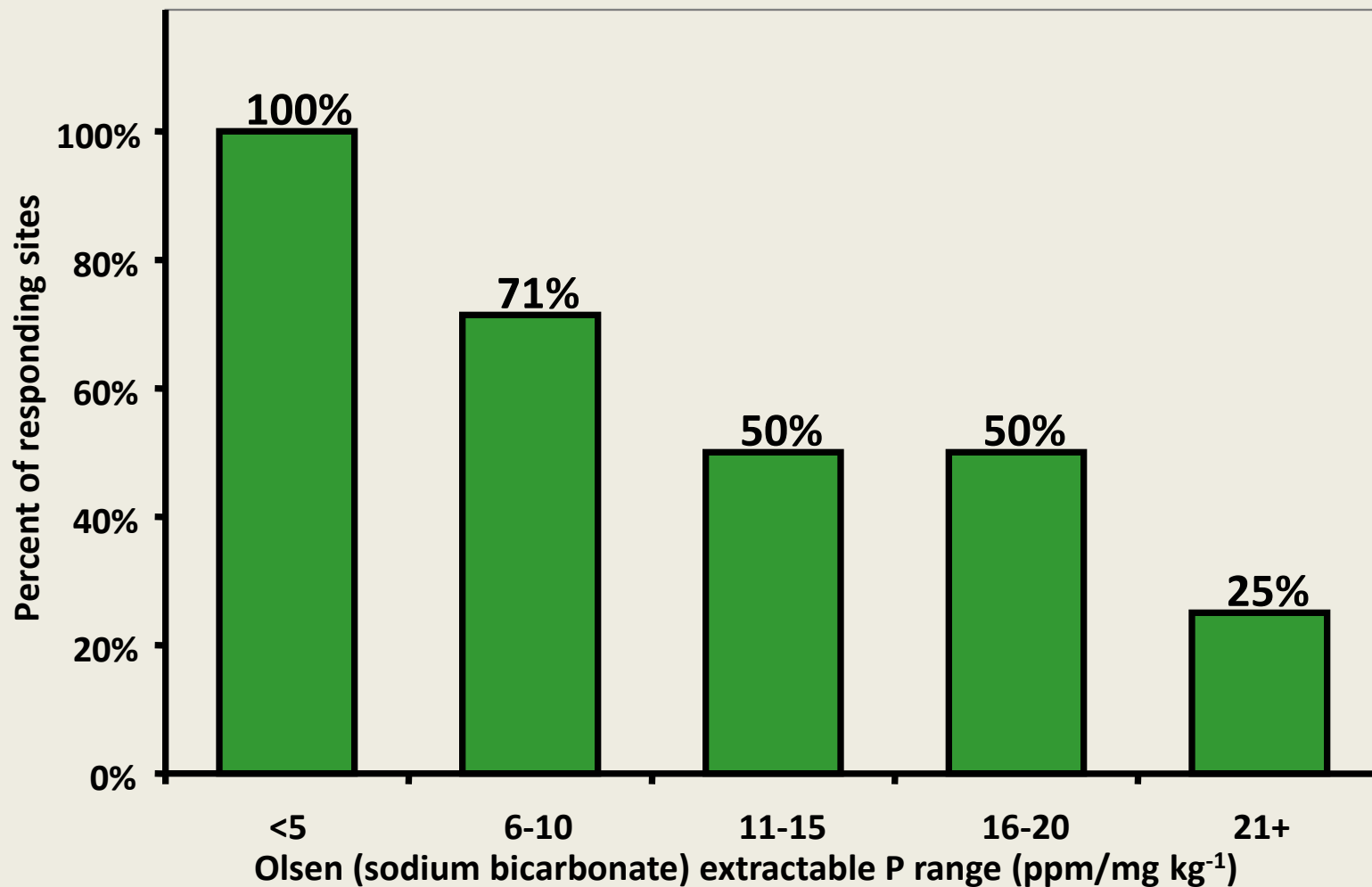
Available P (ppm Olsen)	Number of Experiments	% Responding to Fertilizer P
0-5 V. Low	15	100
5-12 Low-Med	50	62
12-18 Med-High	16	56
>18 High-VH	14	29

Hedlin, U of M, 1962



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Westco Research: Percentage of Wheat Sites Responding to P Fertilizer as a Function of Olsen Soil Test P



Karamanos, Westco data for 33 site years in AB, SK, MB 1988-1995



Materials and Methods, cont'd.

- **Monoammonium phosphate (MAP, 11-52-0) was applied in spring, at the rates of 20, 40 and 80 lb/ac ... in the seed row, side banded or broadcast**
- **Dekalb 24-10 RY was seeded for a target of 210,000 pl/ac**
- **Seeded between May 22 and June 3 in 2013**
- **Seeded between May 24 and June 9 in 2014**
- **Treatments replicated 3 or 4 times**
- **Plant stand assessed with 2, 3 and 4 weeks after planting**
- **Midseason biomass collected at R3**
- **Data analysed using SAS Proc Mixed**





CHECK
No P

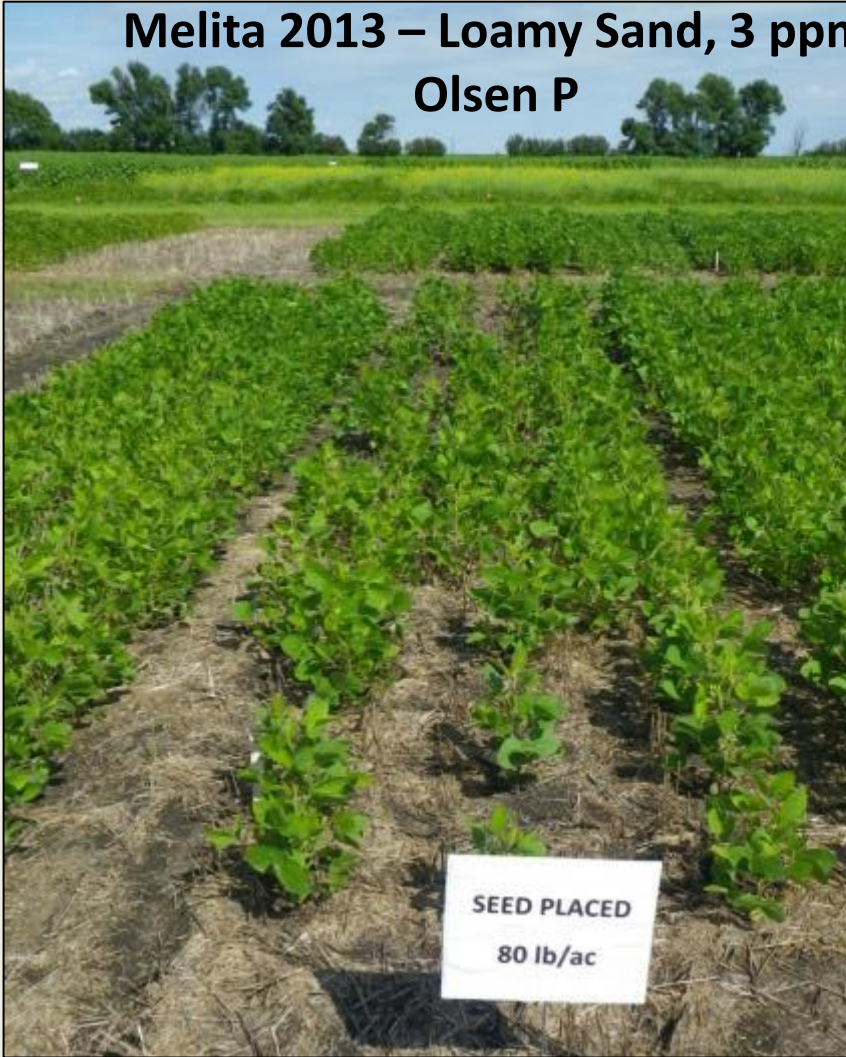
SEED PLACED
80 lb/ac

Results

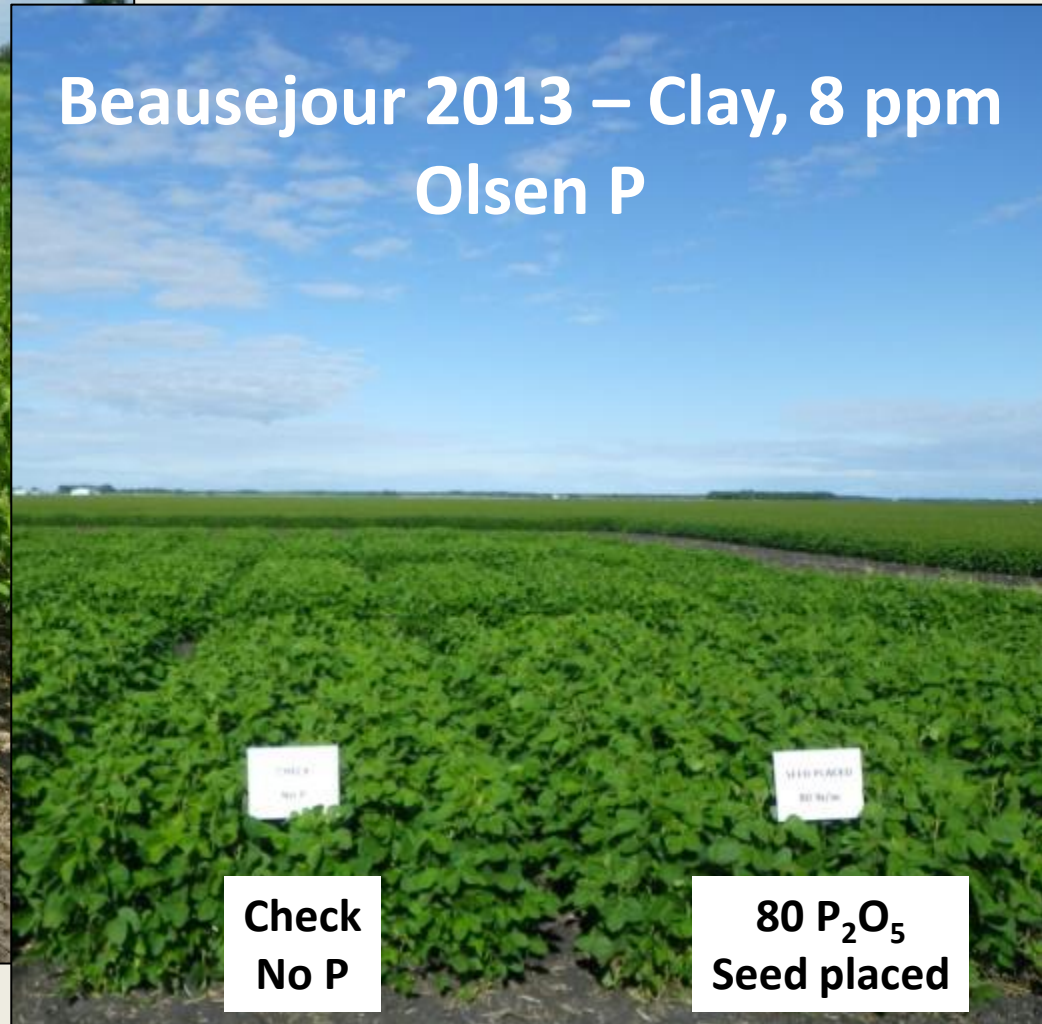
Plant Stand:

Seedrow P reduced stand only at 80 lb P₂O₅/acre and only on coarse-textured soils

Melita 2013 – Loamy Sand, 3 ppm Olsen P



Beausejour 2013 – Clay, 8 ppm Olsen P



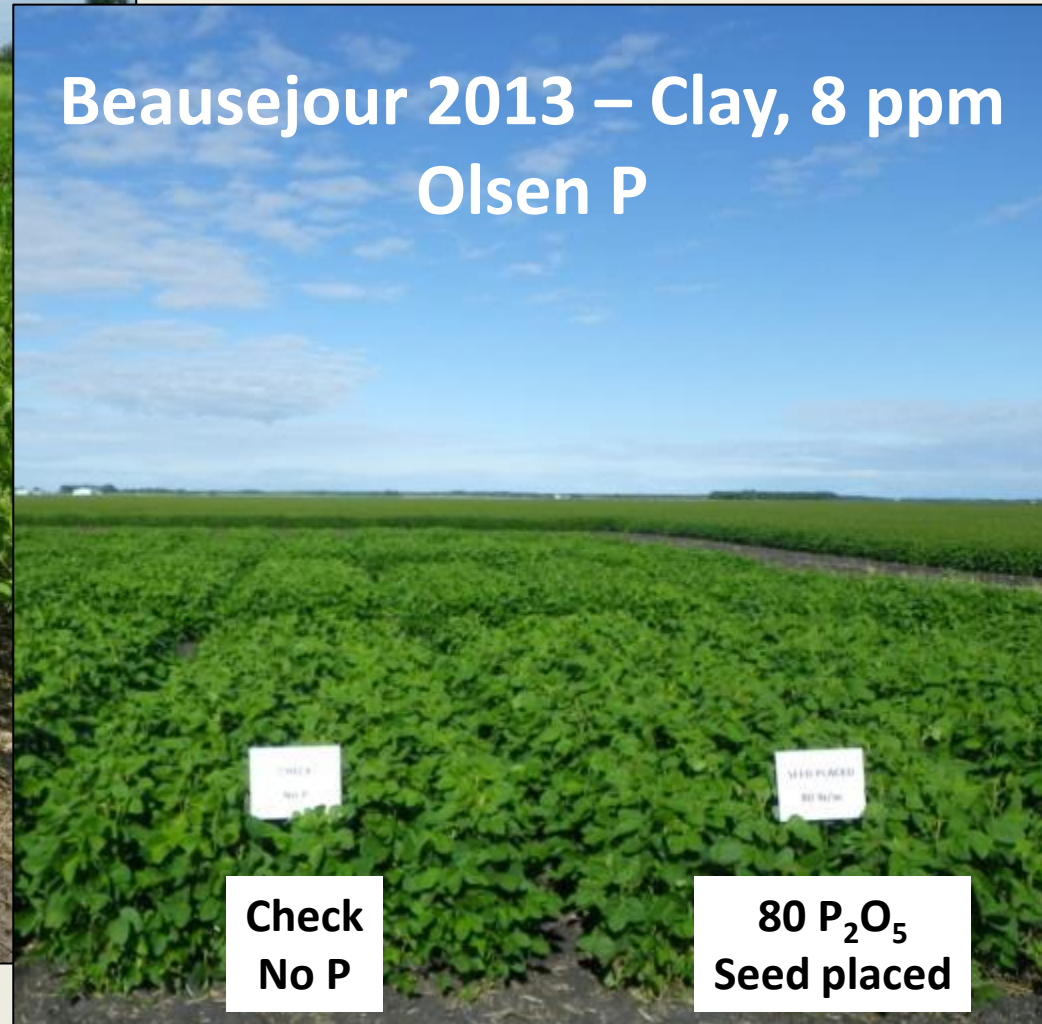
Seed Yield Response:

No yield increase due to P fertilizer at any sites;
Reduced only at 80 lb SRP/ac and < 100,000 plants/acre

Melita 2013 – Loamy Sand, 3 ppm
Olsen P

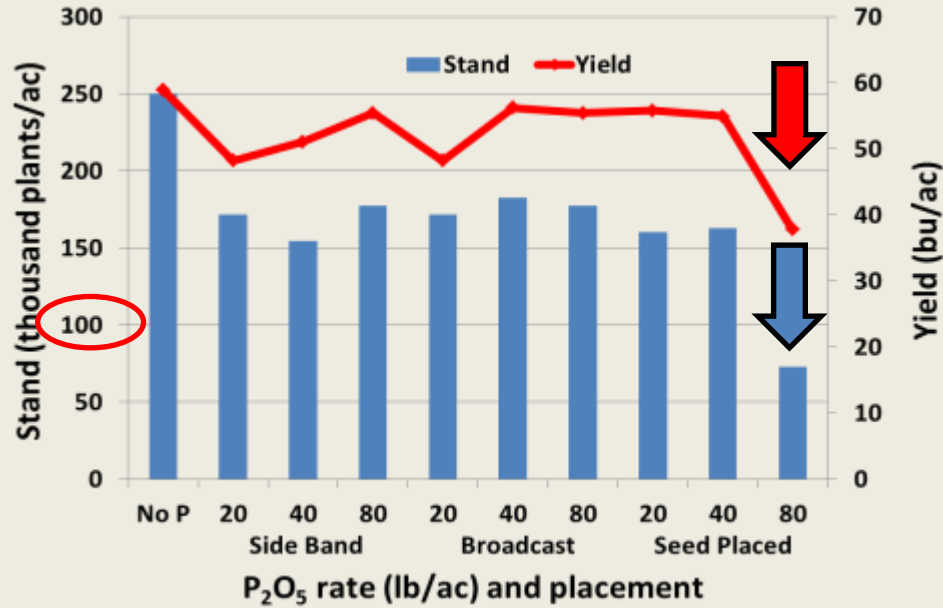


Beausejour 2013 – Clay, 8 ppm
Olsen P

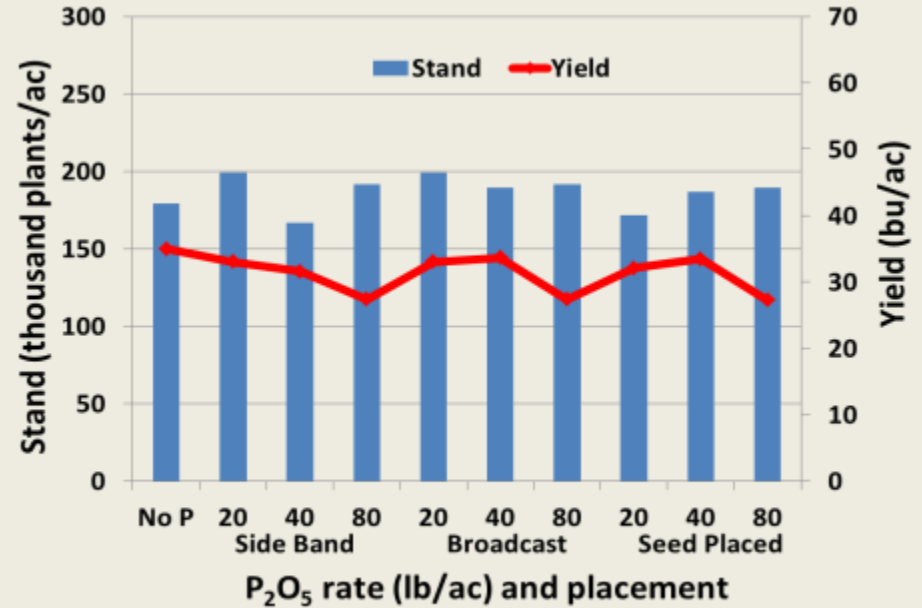


2013

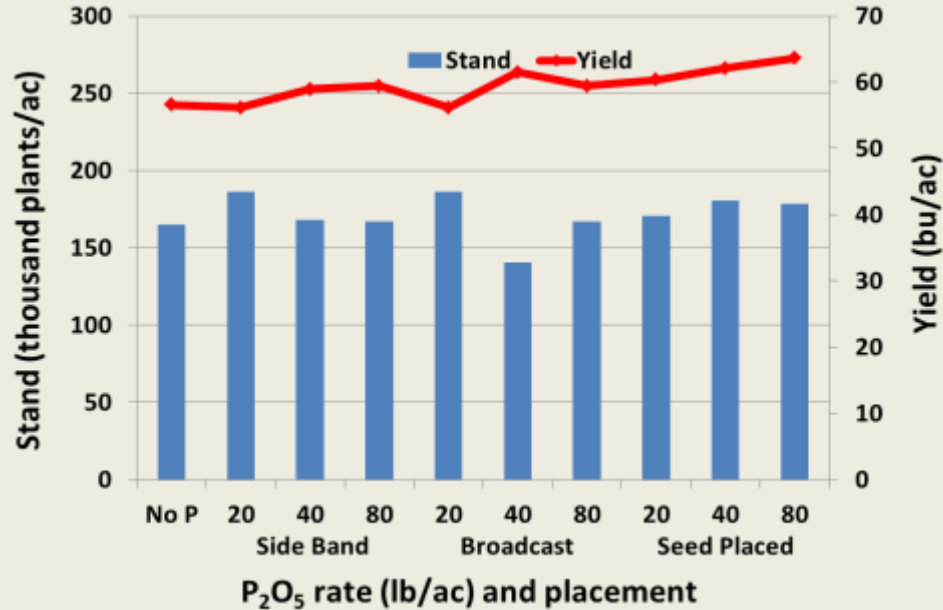
Melita – 3 ppm Olsen P



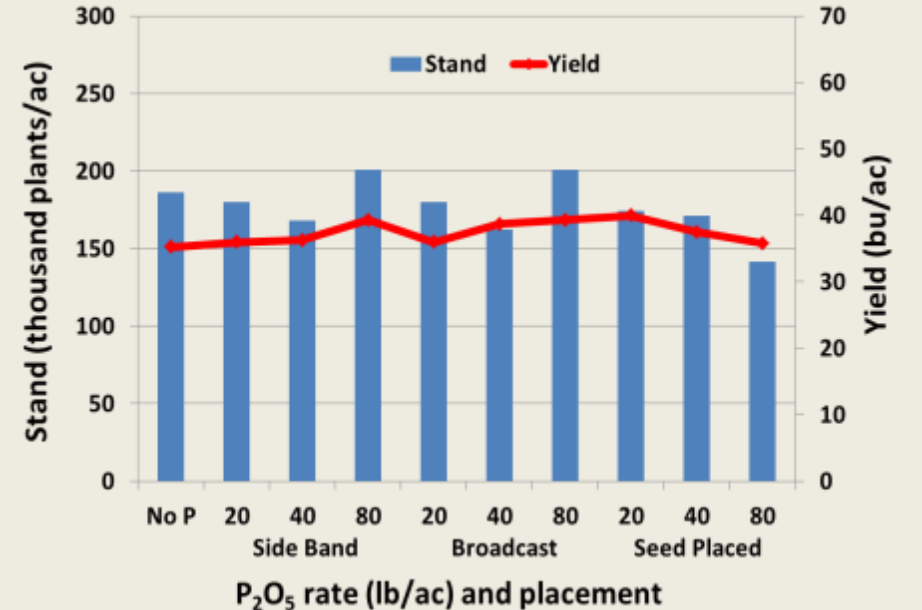
Brandon – 5 ppm Olsen P



Beausejour – 8 ppm Olsen P

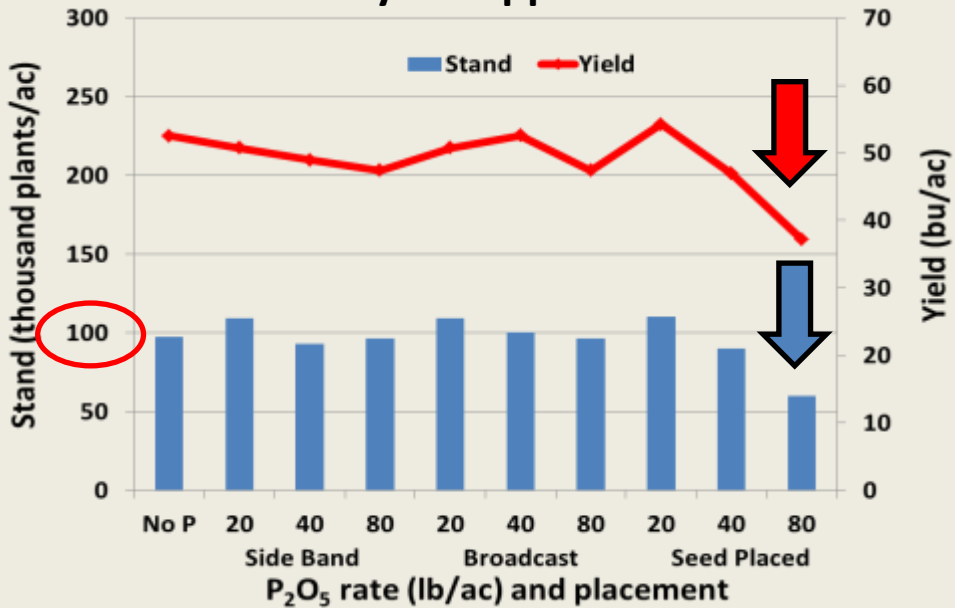


Arborg – 14 ppm Olsen P

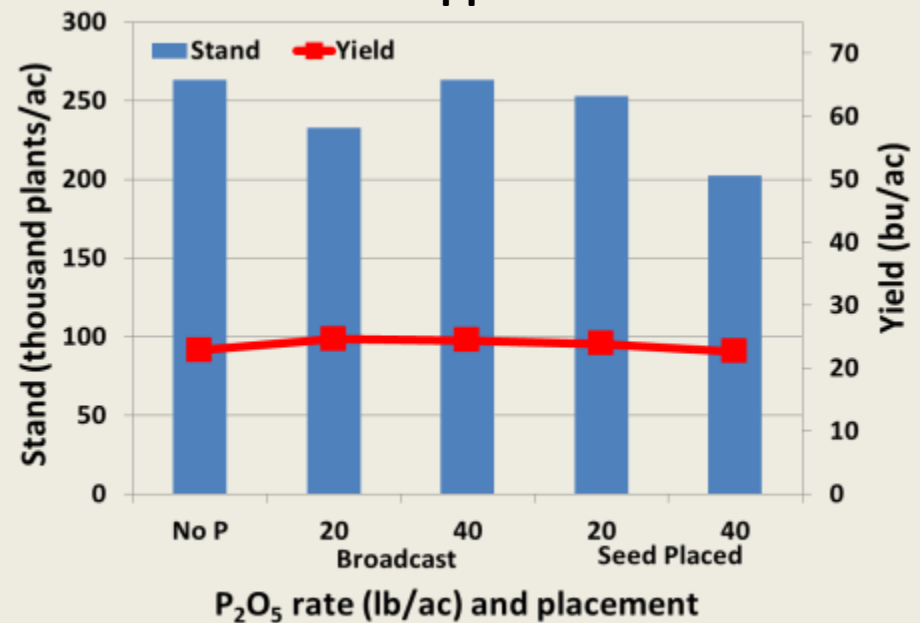


2013

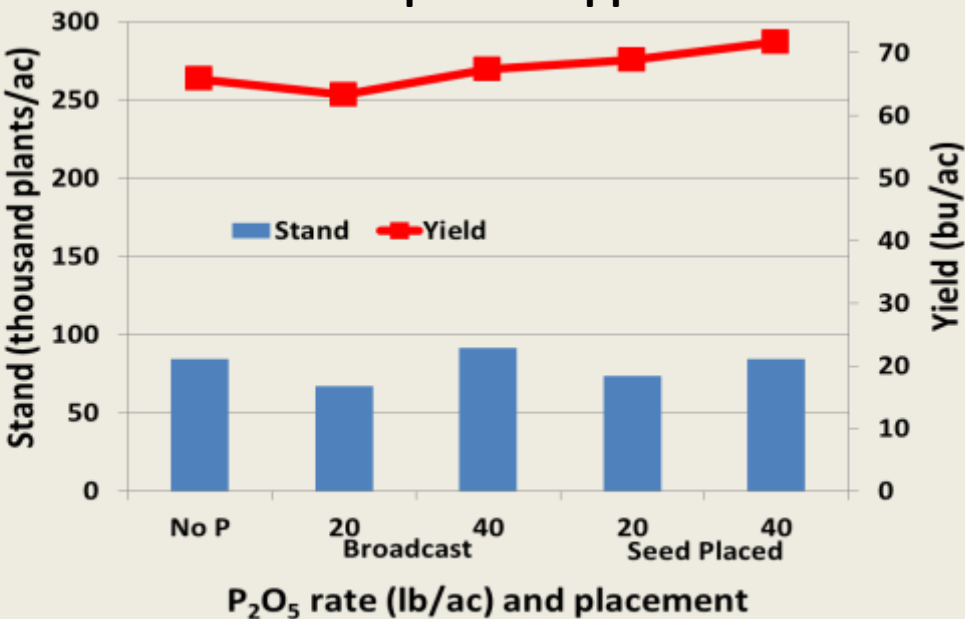
Carberry – 44 ppm Olsen P



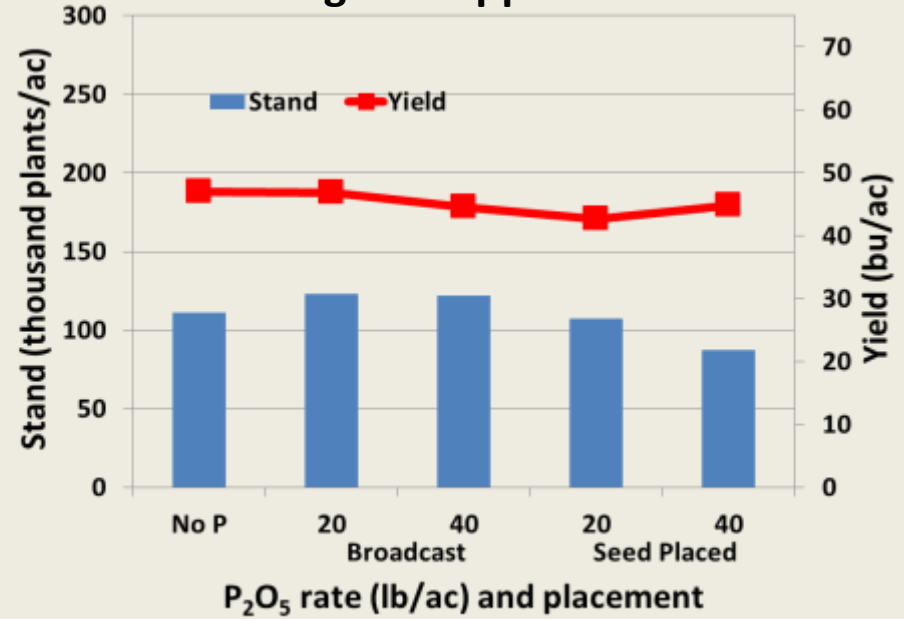
Roblin – 7 ppm Olsen P



St Adolphe – 23 ppm Olsen P

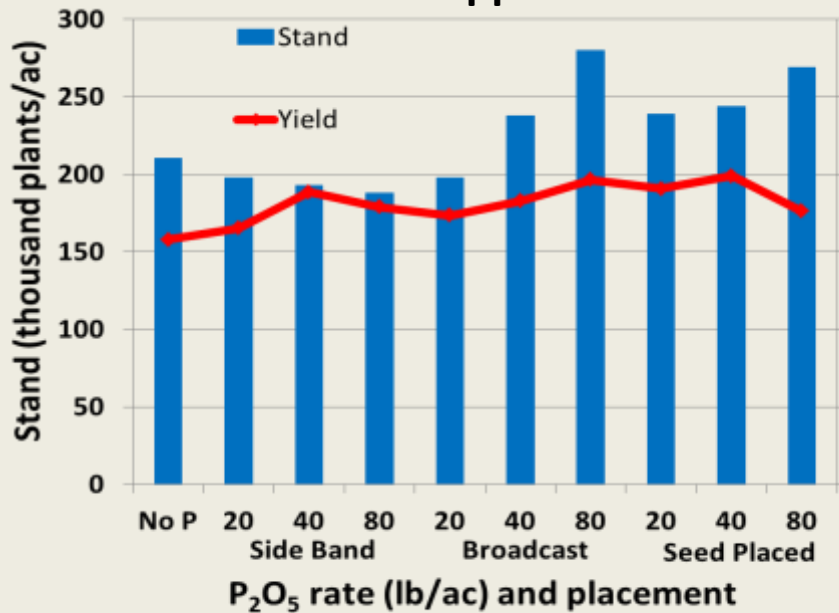


Portage – 34 ppm Olsen P

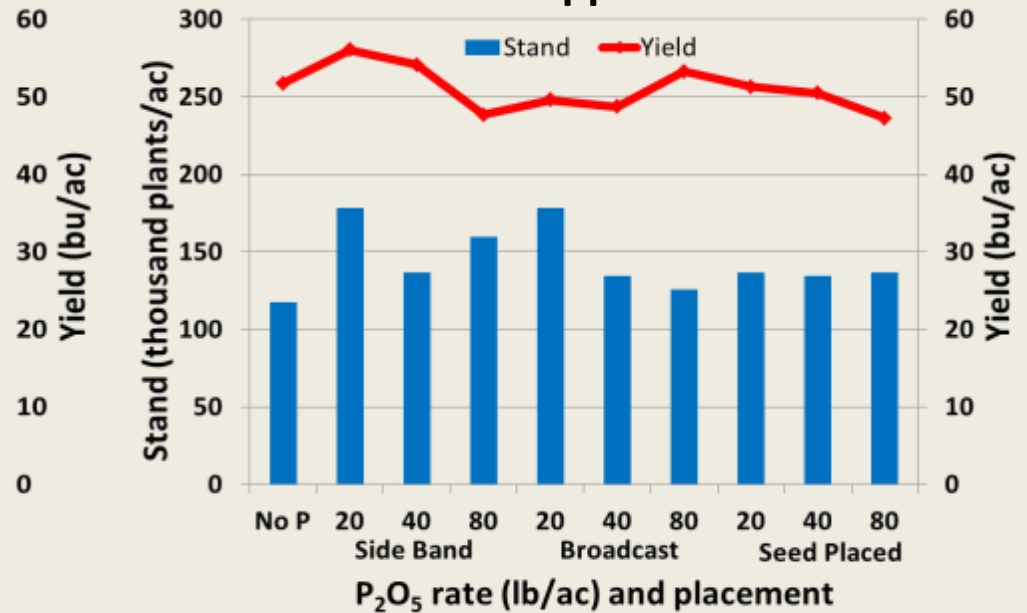


2014

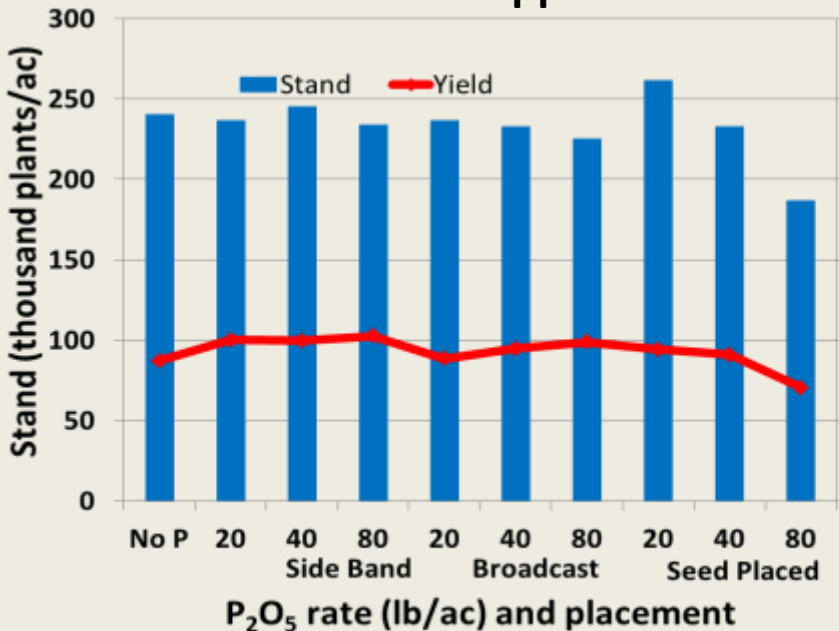
Roseisle – 4 ppm Olsen P



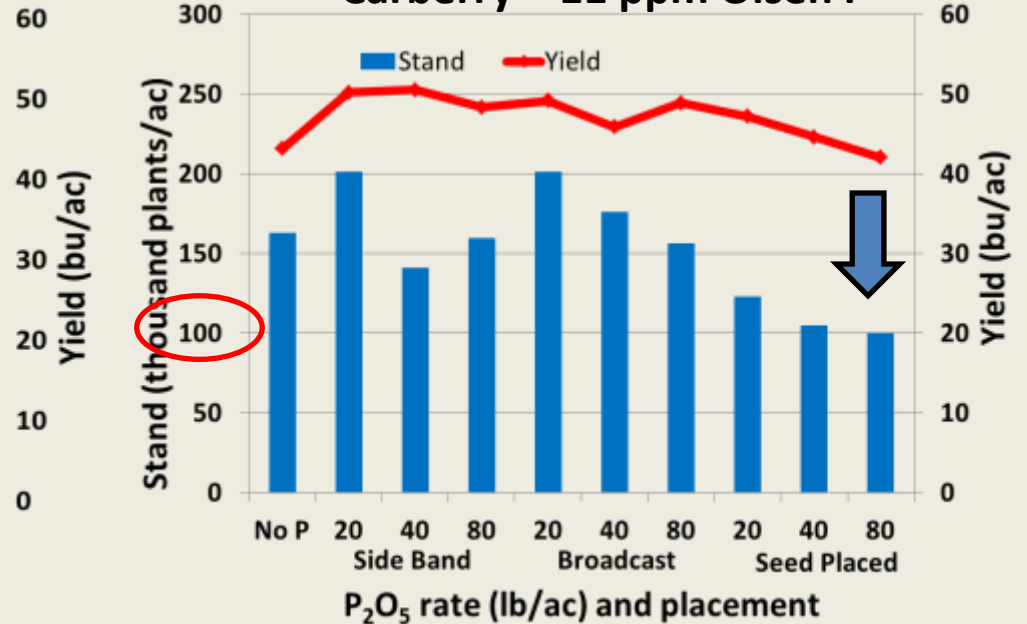
Melita – 5 ppm Olsen P



Brandon – 6 ppm Olsen P

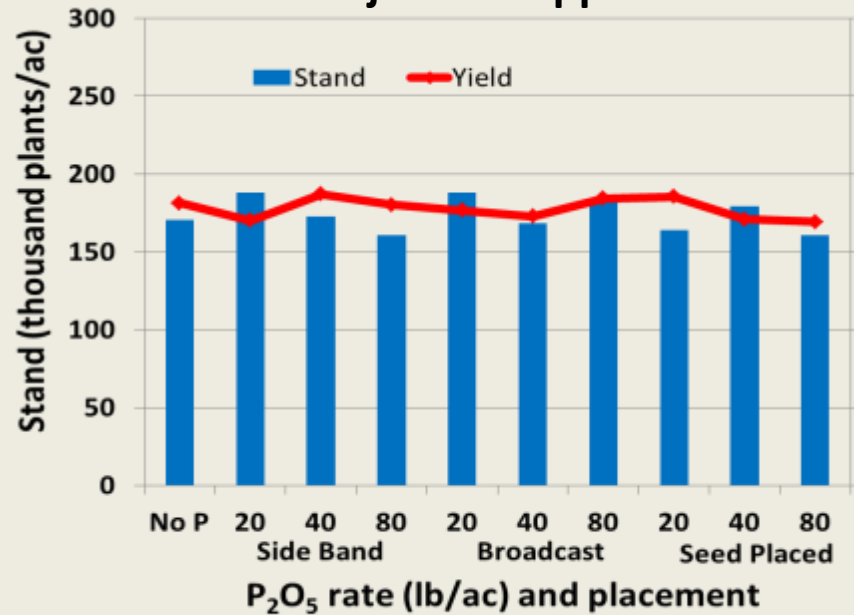


Carberry – 11 ppm Olsen P

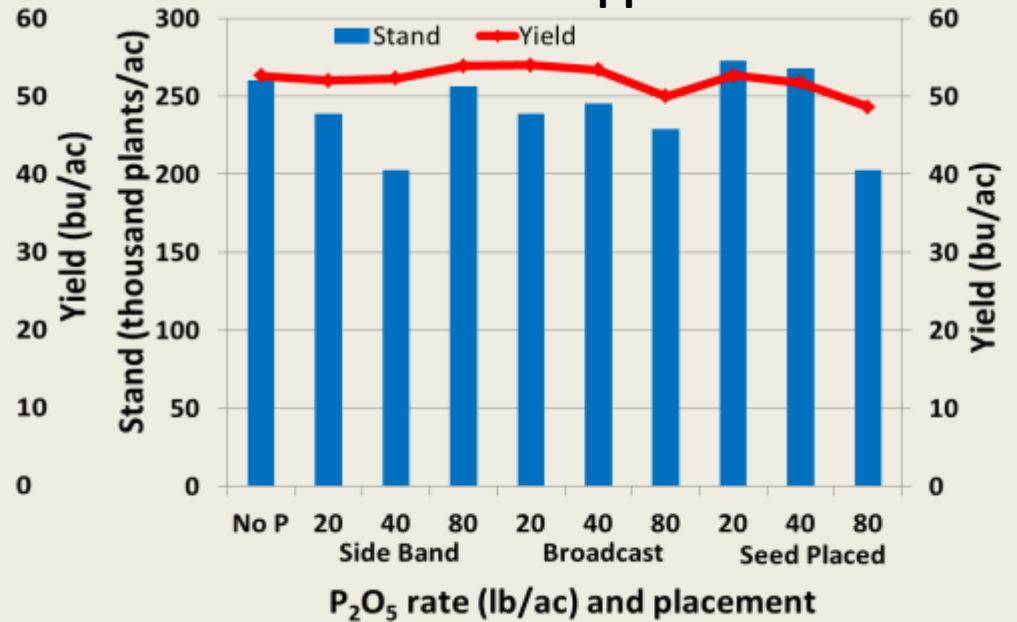


2014

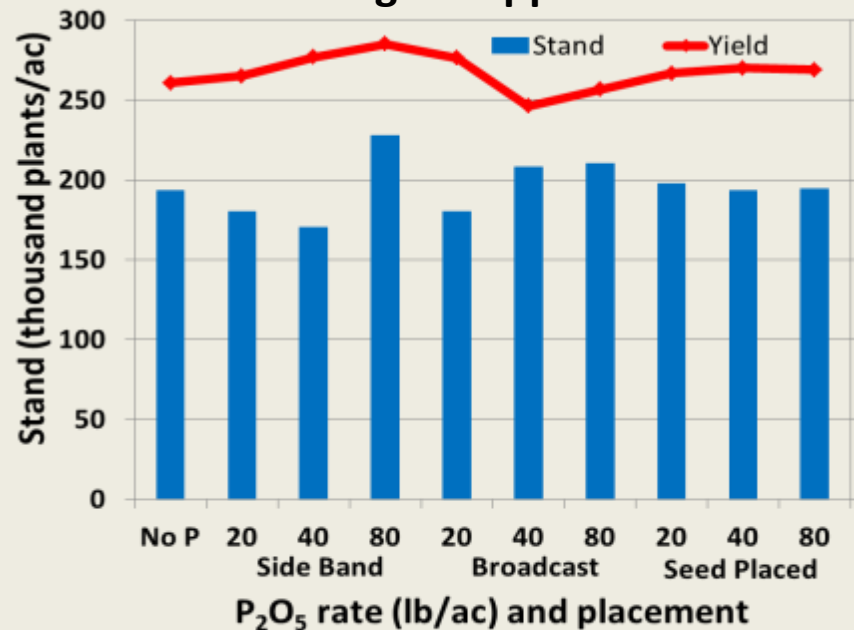
Beausejour – 13 ppm Olsen P



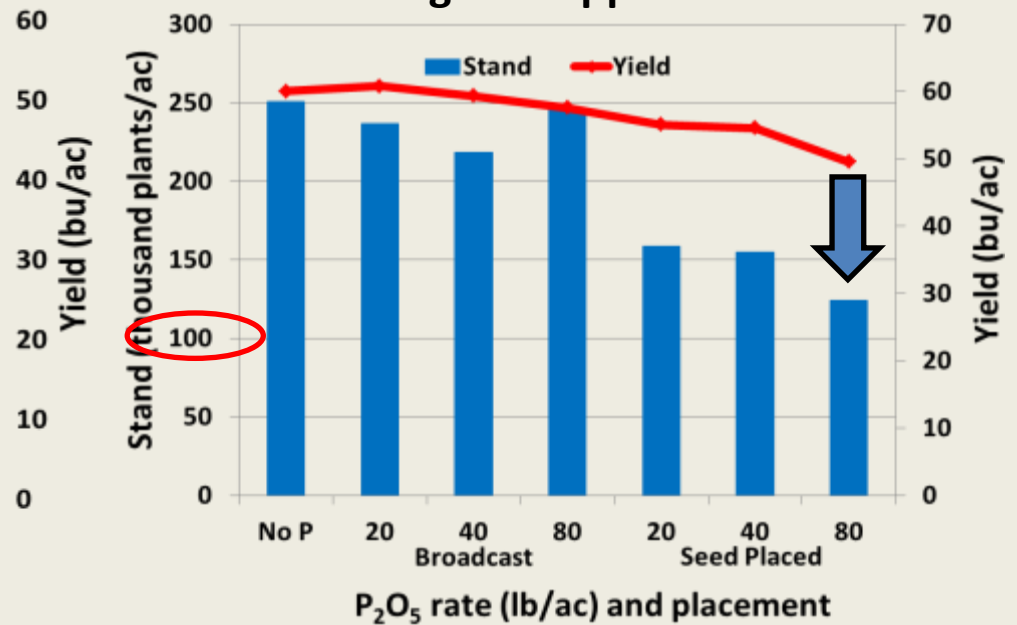
Carman – 15 ppm Olsen P



Arborg – 22 ppm Olsen P

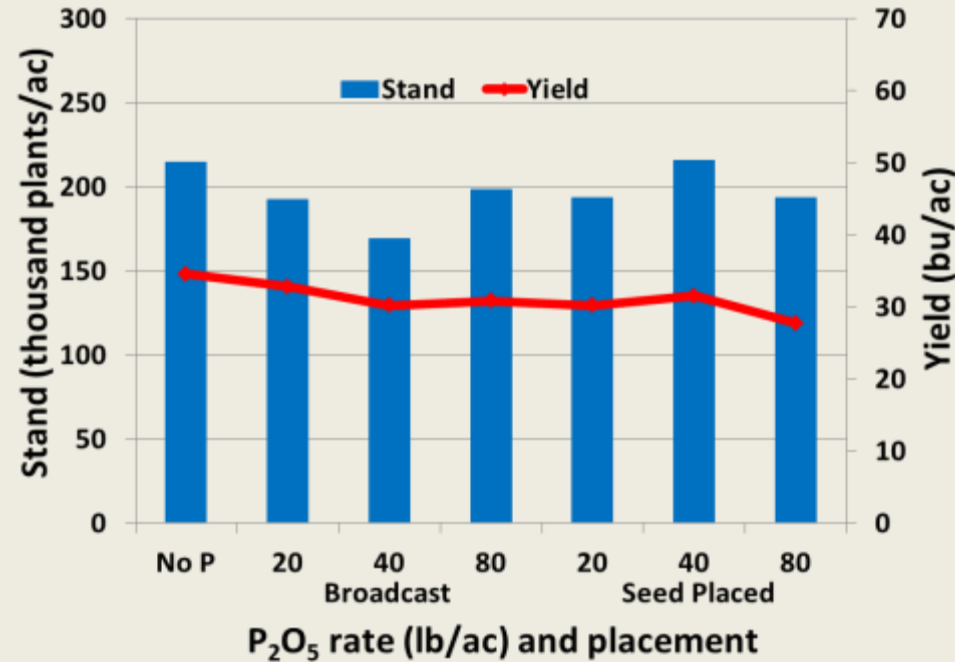


Portage – 18 ppm Olsen P

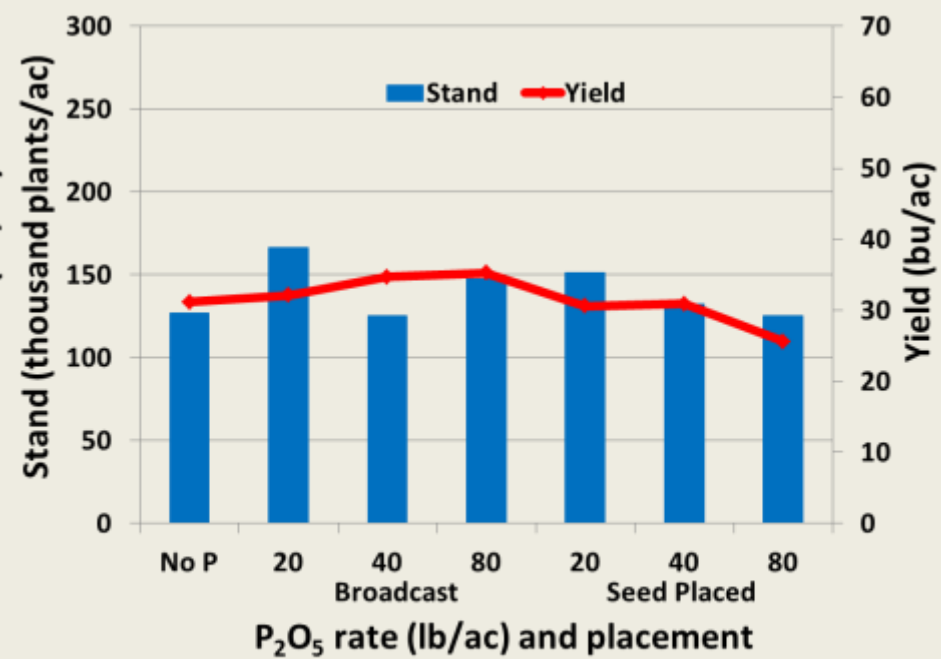


2014

Roblin – 22 ppm Olsen P



St Adolphe – 25 ppm Olsen P



Summary and Conclusions for Soybean P Fertilization Project

- P fertilization regardless of soil test P, P rate and P placement did not increase seed yield for soybean
- The probability of reduced stand from typical agronomic rates of seed-placed P is small and the risk of reduced seed yields is even smaller ... but it's still a risk ... with little reward
- Only two growing seasons, so far ... as the study goes into the third year, we look forward to learning more about P fertilization for soybeans in Manitoba



Soybeans may not “care” about P fertilizer, but what about the crop after soybeans?

The phosphorus deficit hangover ...



www.deviantart.com



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Manitoba Management Plus Program


Search [X]

Google™ Custom Search

powered by Google™

MMPP Fertilizer Data Browser

(Fertilizer Query Help)

- Navigation
- MASC
 - Insurance
 - Lending
 - Other Programs
 - Management Plus**
 - MMPP Overview
 - Management Information
 - Map Tools
 - Regional Analysis Tools
 - Variety
 - Pesticide
 - Variety/Pesticide
 - Fertilizer
 - Wildlife
 - Causes of Loss
 - Yield Manitoba NEW
 - Frequently Asked Questions
- Factsheets
- Publications
- Locations
- Calendars
- Contact
- Related Links 

Summary

Search Summary

Your selected search:

- Region(s) Selected: All
- Crop(s) Selected: SOYBEANS
- Soil Zone(s) Selected: All
- Period Selected: 2008 to 2013

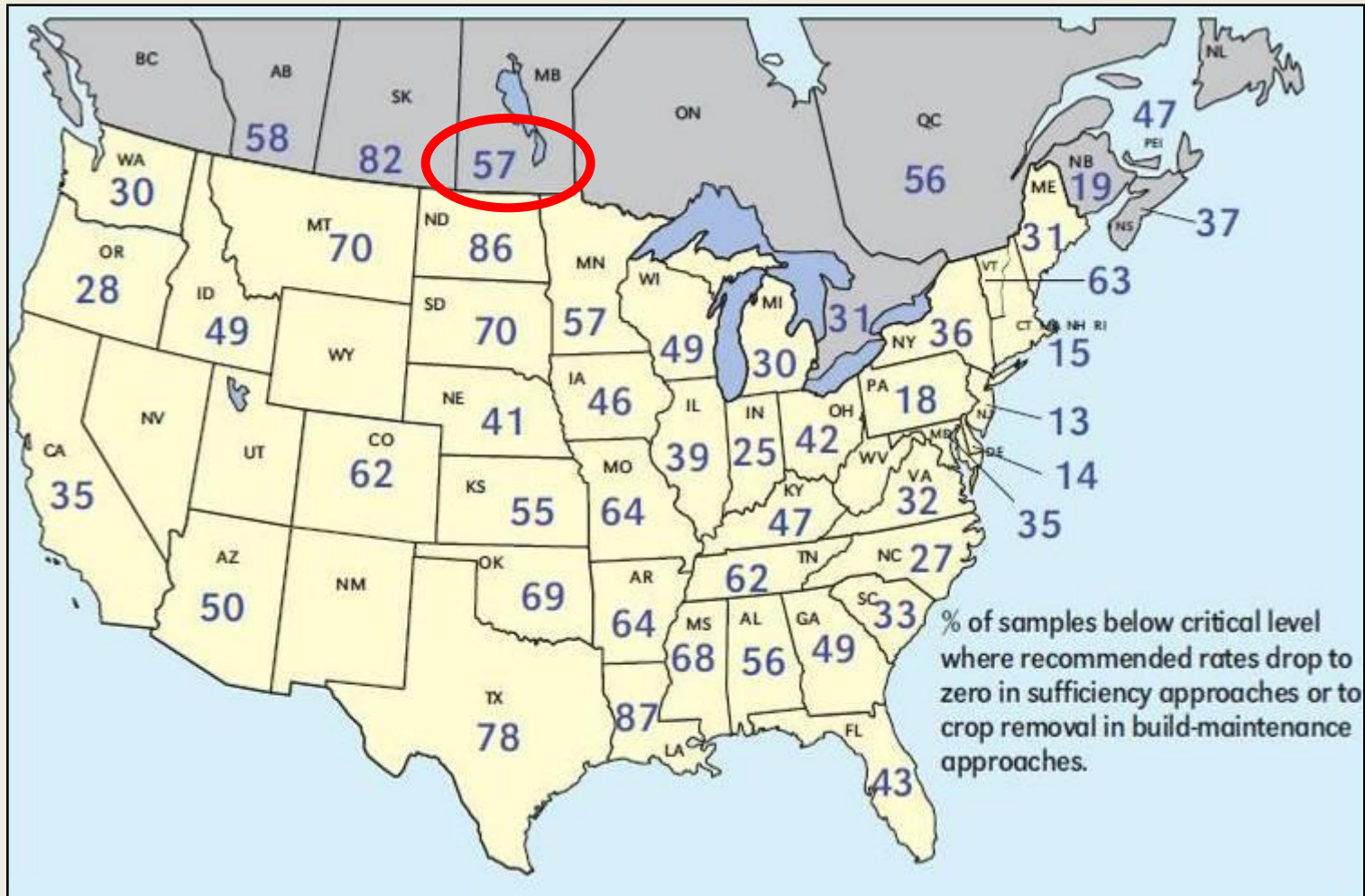
This search returned 1026 records from the MASC database, summarized below:

Total Acres:	795,442 acres	
Yield per Acre:	33.1 Bushels / acre (0.900 tonnes / acre)	
Fertilizer Applied per Acre (actual product):		
Nitrogen:	5.7 lbs / acre	(0.003 tonnes / acre)
Phosphorus:	23.6 lbs / acre	(0.011 tonnes / acre)
Potassium:	4.1 lbs / acre	(0.002 tonnes / acre)
Sulfur:	1.9 lbs / acre	(0.001 tonnes / acre)

Applied = 6 lb N, 24 lb P₂O₅, 4 lb K₂O, 2 lb S/ac

Removed = 128 lb N, 28 lb P₂O₅, 46 lb K₂O, 4 lb S/ac

Majority of Manitoba Soils are Deficient in P According to % Less than Critical Level

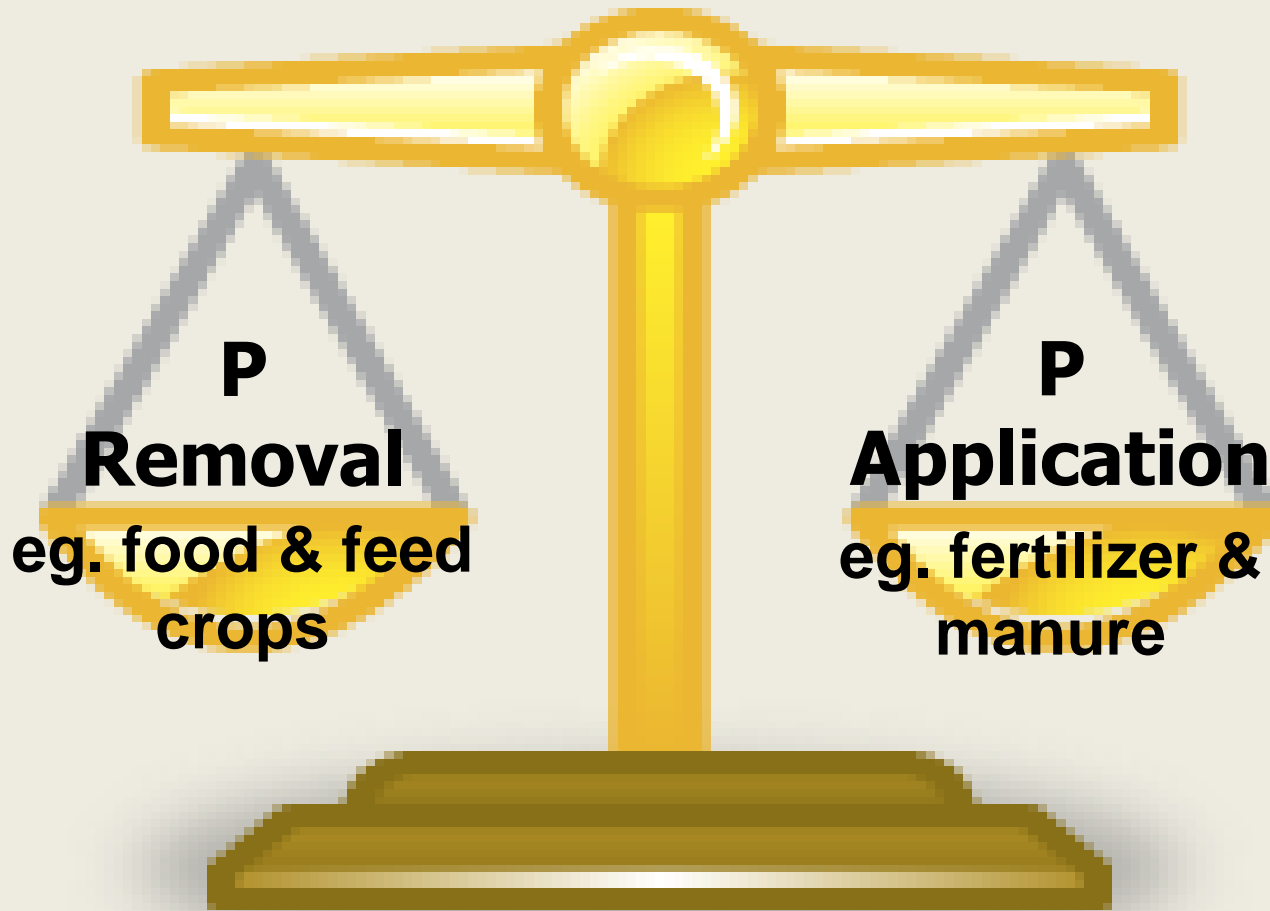


Fixen et al. Better Crops 2010



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Balancing P application with crop removal is essential to avoid excessive accumulation or depletion of P in soil



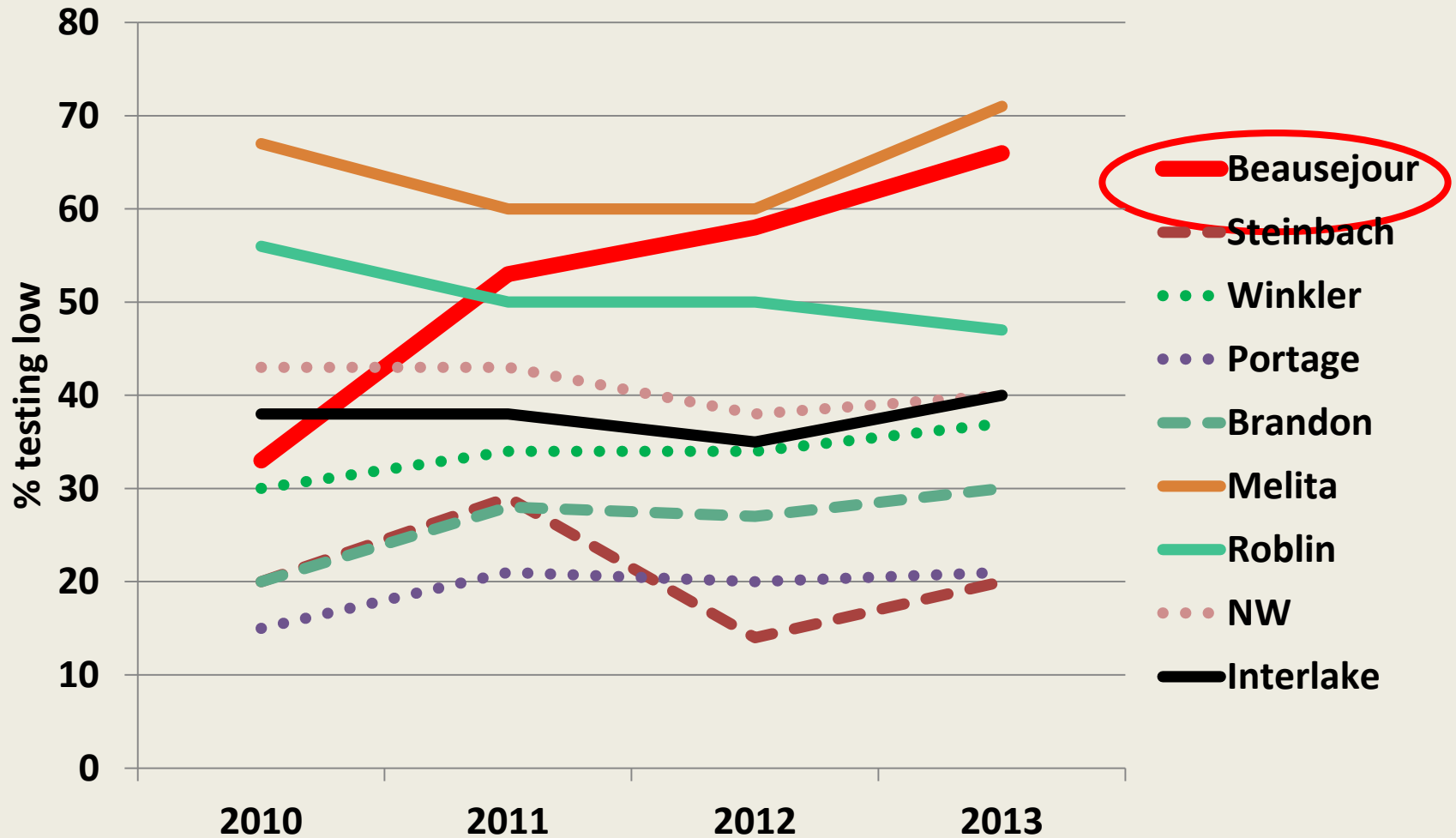
Safe Rates of Seed-Placed P Will Not Replace P Removal for Many Crops

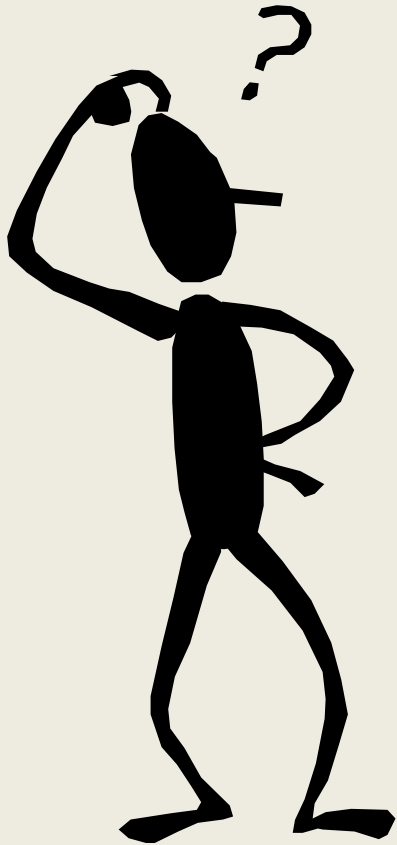
Crop	Yield (bu/ac)	P Removal Seed Limit		Balance
		----- lb P ₂ O ₅ /acre -----	-----	
Wheat	40	29	50	+21
Canola	40	40	20	-20
Soybeans	40	32	10	-22
Barley	80	38	50	+12
Flax	32	20	20	0
Peas	50	38	20	- 18
Oats	100	29	50	+21

*Rates are based on solid seeding with disk or knife openers with a 1 in. spread, 6 to 7 in. row spacing and good to excellent soil moisture



Soil Test P Trends in Manitoba: % Testing <10 ppm Olsen STP



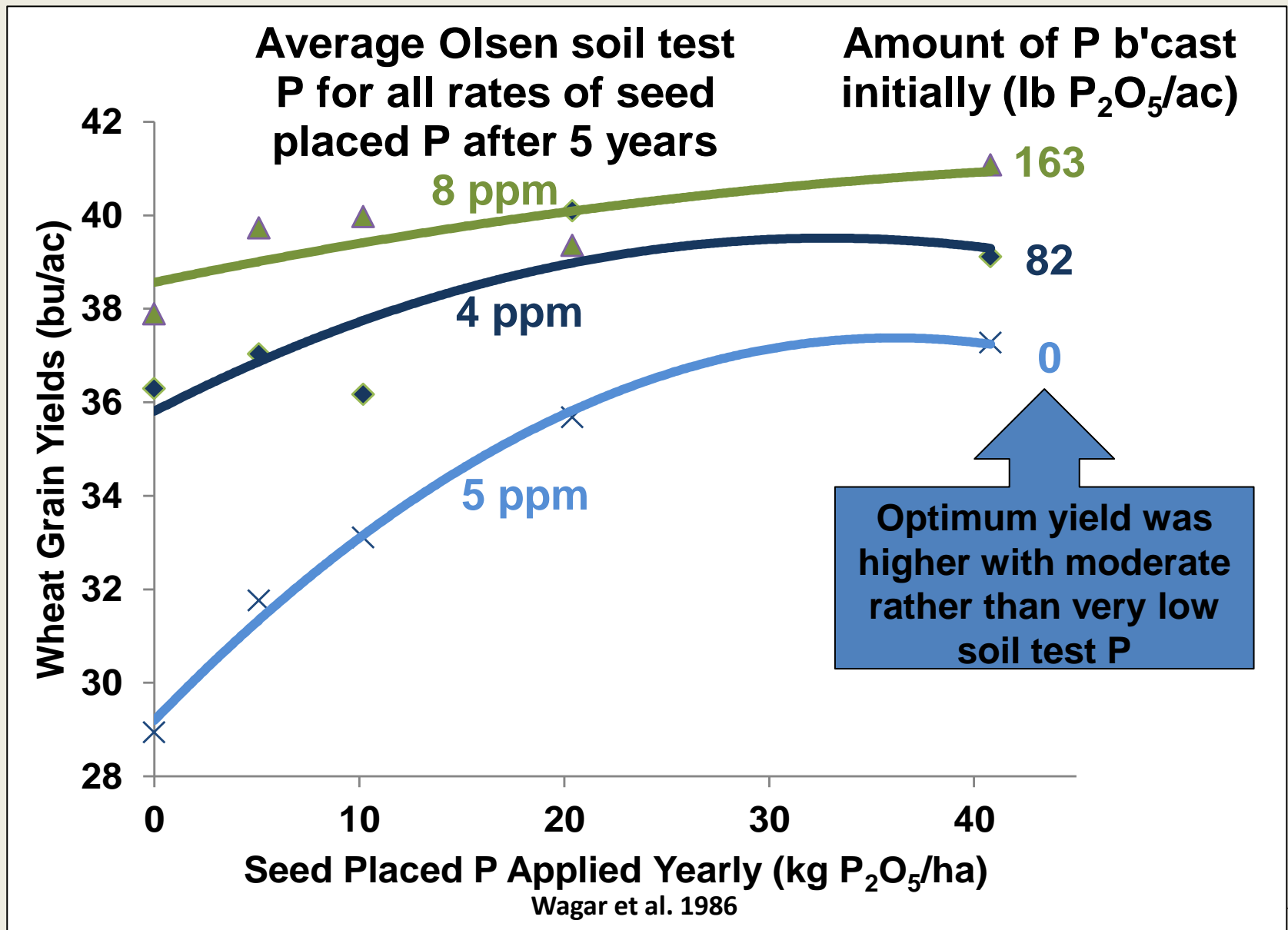


Why be concerned about declining soil P fertility?

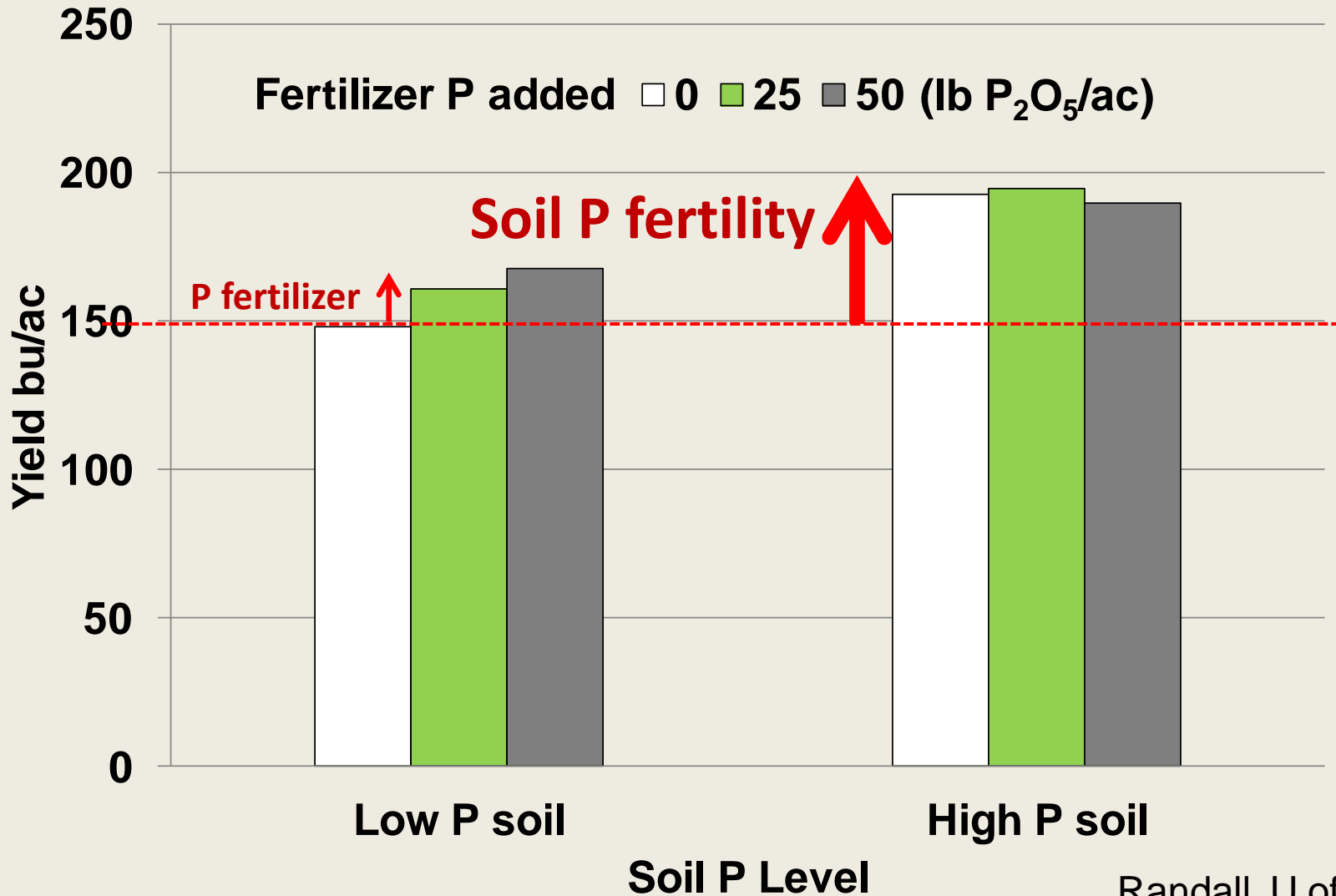


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Crops respond to P fertilizer and soil P fertility, so depleted soil P can decrease crop yield potential



Corn response to P fertilizer and soil P fertility



Randall, U of Mn



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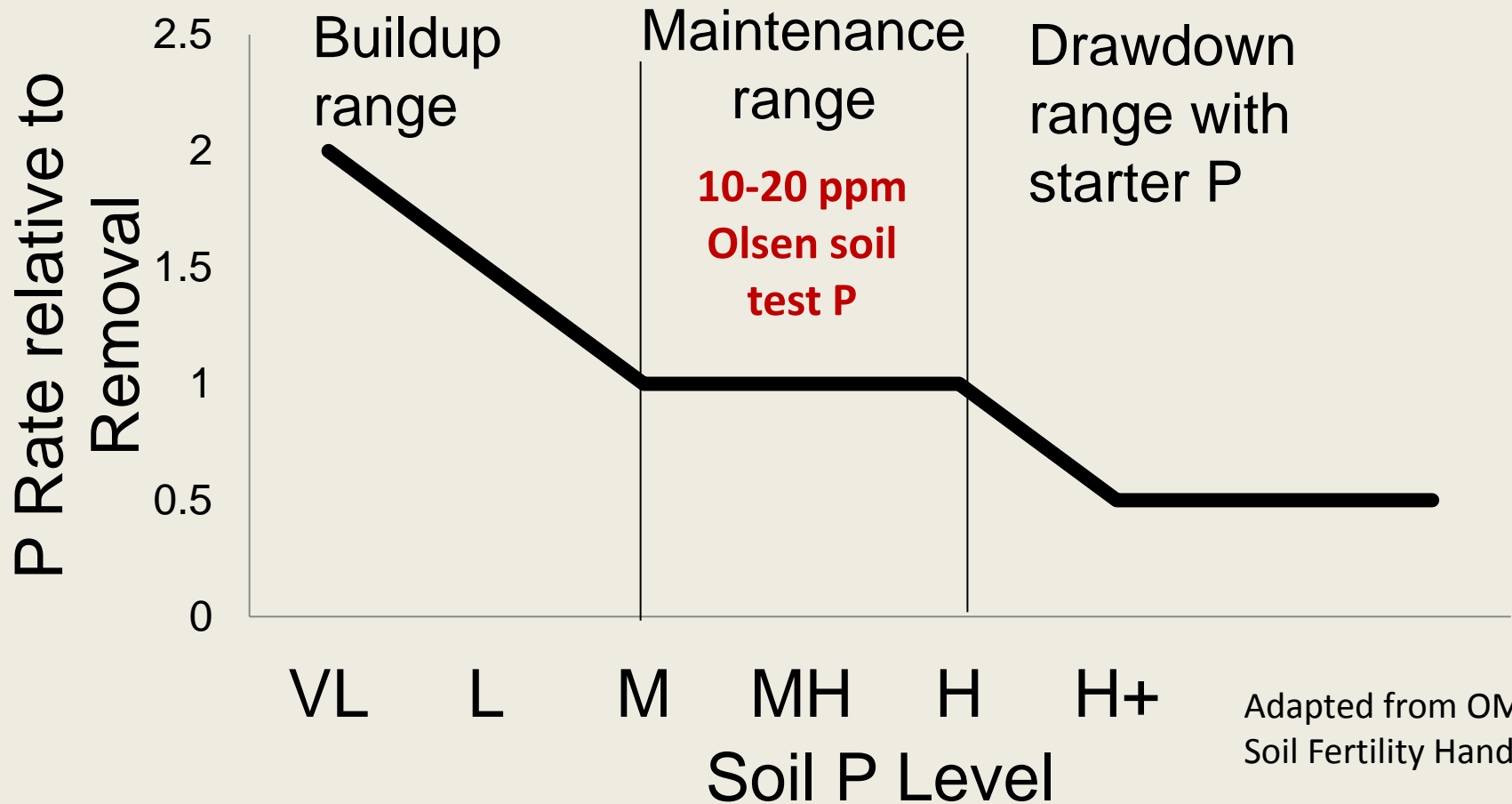
Phosphorus should be managed through the rotation ... not just on a single crop basis



- **What is the current soil P level?**
 - If excess, can draw down by using only starter P
 - If near optimum, can balance input and removal
 - If low, may want to build by applying fertilizer or manure P in excess of crop removal



A fertilization concept to move soil P levels into an optimum range over time



Adapted from OMAFRA
Soil Fertility Handbook



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**So, why not simply broadcast
fertilizer P ... eg. fall broadcast P?**



An invitation to regulation ...



Excess P & Algae in Lake Erie Shuts Down Water Supply to Toledo, Ohio – August 2014

SPECIAL REPORT

WATERSHED MOMENT

Diving into the Lake Erie algae crisis that shut off our water supply.

By Sarah Ottney and Danielle Stanton

Toledo Free Press



Algae's lake effect reveals putrid, pea green disaster

Distribution centers offer free relief to community

By MARINA MORGAN

TOLEDO, Ohio (UPI) — Distribution centers are offering free relief to the community as Toledo, Ohio, struggles to cope with a pea-green disaster.

"It's a disaster," explained Mr. Adams, 36, of the crisis.

Mr. Adams said he is grateful for the distribution centers, but it's hard to rely on them. "It's not a cure," he said. "It's a band-aid."

Mr. Adams said he is grateful for the distribution centers, but it's hard to rely on them. "It's not a cure," he said. "It's a band-aid."



Officials won't give test results on 2nd day

By TOM HENRY

The state's first sign of the crisis was seen from an aerial view of the pond, but green algae blooms in Toledo's water supply cut off less than the number of days provided to public of Toledo in front of Toledo's water supply.

The state's first sign of the crisis was seen from an aerial view of the pond, but green algae blooms in Toledo's water supply cut off less than the number of days provided to public of Toledo in front of Toledo's water supply.

TOLEDO, Ohio (UPI) — A Toledo resident holds a glass of algae-filled Lake Erie water near the Toledo water intake crib on Sunday. The Toledo Free Press conducted a media tour of the area.

FOR ASSISTANCE

Agencies are offering assistance to those who are unable to get to water stations and help with the purchase of bottled water or delivery services to your home.

DO'S AND DON'TS

Health authorities have provided the following recommendations until the water use restrictions are lifted.

- Don't:
 - Drink any quantity of water
 - Use water
 - Brush teeth
 - Wash

MORE INSIDE

Some businesses have closed their doors without municipal water available. Page A3.

How much of the water is being treated? Page

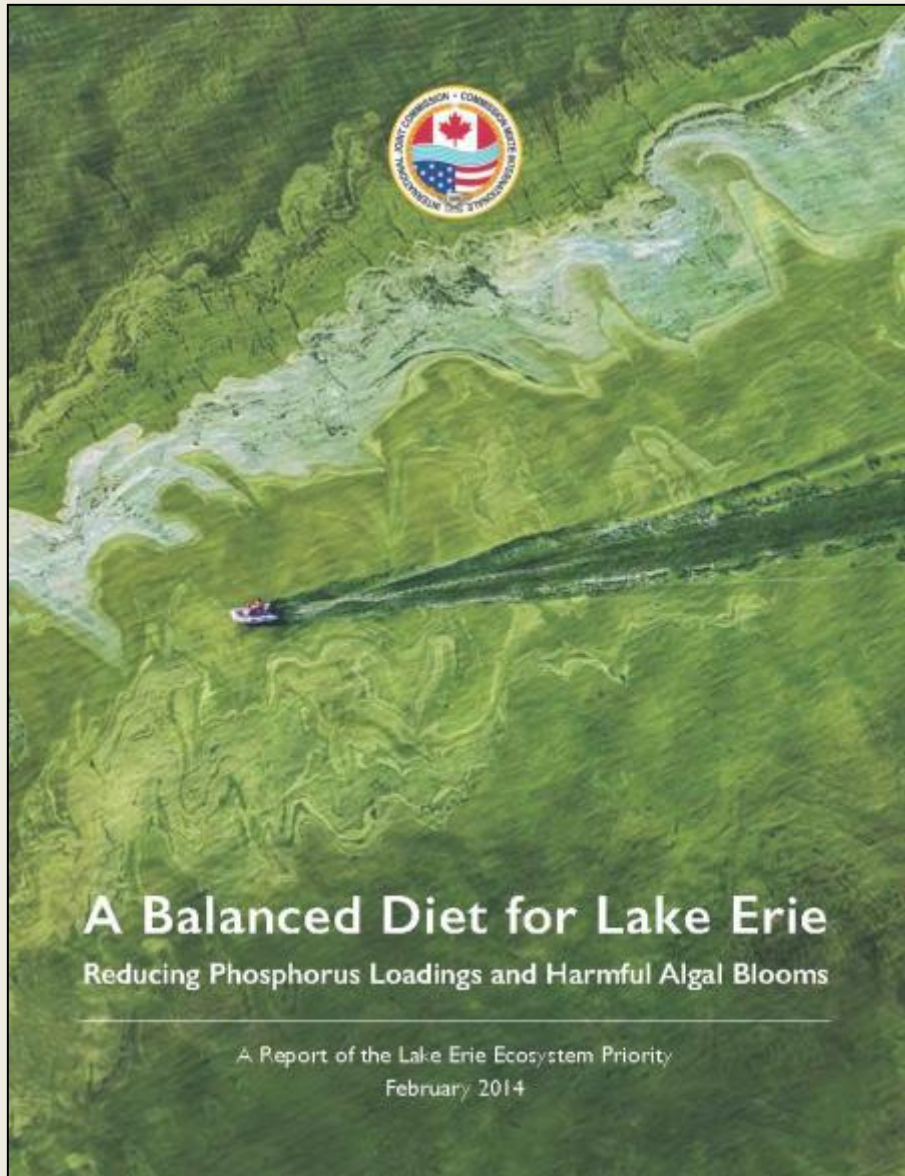


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Excess P & Algae in Lake Erie Shuts Down Water Supply to Toledo, Ohio – August 2014



International Joint Commission Report on Improving Water Quality in Lake Erie – February 2014



“The control of phosphorus in agricultural operations must focus on changes in agricultural practices that have been implemented in recent decades, such as increased prevalence of fall application of nutrients, applying two years’ worth of fertilizer in a single application, and broadcast application.”

page 7 of International Joint Commission (2014). A Balanced Diet for Lake Erie: Reducing Phosphorus Loadings and Harmful Algal Blooms. Report of the Lake Erie Ecosystem Priority.



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TOP STORIES IN U.S.



In Low Gasoline Prices, an Opening Emer...



Oil-Price Drop Takes Shine Off Steel Ce...



FBI Official: No Evidence That Sony Hac...



Thousands of Potential Jurors Summoned ...

U.S. NEWS

Ohio Regulators Aim to Help Water Problem With Fertilizer Licenses

Farmers in Ohio to Be Required to Get New Certification to Use Fertilizers

Email Print 22 Comments



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By MARK PETERS and MATTHEW DOLAN [CONNECT](#)

Updated Aug. 5, 2014 7:47 p.m. ET



Algae floats in Lake Erie on Monday at Maumee Bay State Park in Oregon, Ohio. *Getty Images*

The drinking-water crisis in one of Ohio's largest cities is drawing attention to a new requirement for farmers in the state: a license to fertilize.

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ARTICLES

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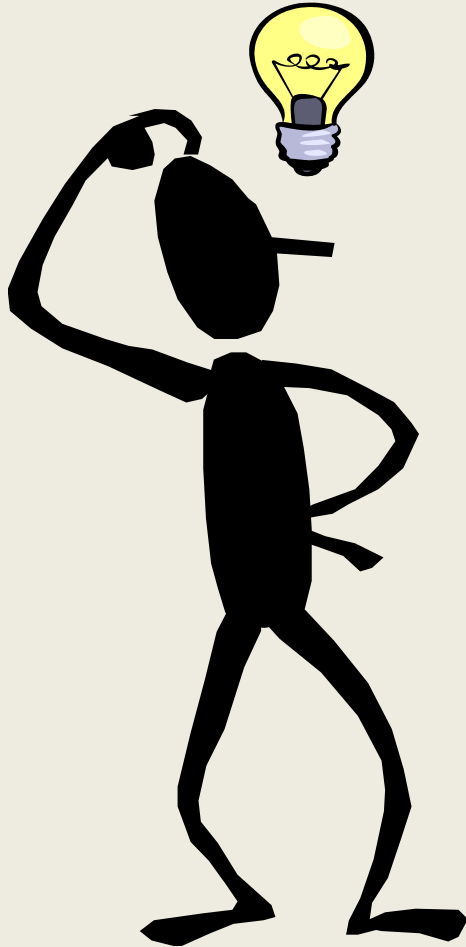
2 **Search for Paris Attack Suspects Intensifies**



Opinion: How to

Y
A

Recommended Strategies for Maintaining P Fertility in Soybean Fields



- Apply sufficient P in side- or midrow bands to match crop removal on annual basis
- Use a rotational fertilization strategy over several years :
 - Add extra P to crops in rotation that tolerate high rates of seed-placed P
 - Periodically band P into soil during fall tillage ... eg. MAP with AS prior to canola, which responds to fert. P & N
 - Build soil P to target level, but avoid excess accumulation, eg. manure applied at rate to meet crop N requirements will provide P benefit for several years



Overall Summary and Conclusions

Soybean P Fertilization: Effects of Rates and Placement

- P fertilization appears to have a low probability of increasing yield
- The probability of reduced stand or yield from typical agronomic rates of seed-placed P is small

Worrying about P fertilization for soybeans may be a distraction ... instead, focus on maintaining soil P fertility

- Consider subsurface banding away from seed, rotational P fert'n
- Avoid fall broadcast P fertilizer



Acknowledgements

- **Special thanks to Gustavo Bardella, John Heard and Cindy Grant**
- **Manitoba Pulse Growers Association**
- **Western Grains Research Foundation**
- **Canada-Manitoba Growing Forward 2 Program**
- **Agrium, Agvise Laboratories, B. Hellegards (Richardson Pioneer), C. Linde and C. Cavers (Canada Manitoba Crop Diversification Centre), J. Kostuik (Parkland Crop Diversification Foundation), M. Svistovski (Agriculture and Agri-Food Canada), R. Burak and J. Pawluk (Prairies East Sustainable Agriculture Institute), S. Chalmers (Westman Agriculture Diversification Organization), and Dennis Lange (MAFRD), Monsanto-Dekalb, Conselho Nacional de Desenvolvimento Científico e Tecnológico (Gov't of Brazil)**



Thank You!



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