Phosphorus and Zinc Fertilization Beneficial Management Practices for Corn in Manitoba: 2015 - 2016 Season Update

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Phosphorus and Zinc Fertilization Beneficial Management Practices for Corn in Manitoba

2015 - 2016 Season Update

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INTRODUCTION

Due to corn's sensitivity to P and Zn deficiency and the limited mobility of phosphorus (P) and zinc (Zn)[1] in soil, corn often needs "help" to acquire adequate amounts of these nutrients during its early stages of development. Arbuscular mycorrhizal fungi (AMF) form a symbiotic relationship with plant roots, assisting crops such as corn to acquire P and Zn.[2] Therefore, subsequent planting of corn (*Zea mays* L.) following canola may be problematic in terms of early season nutrition, because canola is non-mycorrhizal and in the year of cropping with canola AMF populations decrease. Corn after canola can be prone to P and Zn deficiencies, which may delay early season growth and development[1], possibly resulting in yield reductions.[3] In such cases, application of starter fertilizer may be helpful in offsetting these early and potentially later season drawbacks. Additionally, planting corn in high residue conditions, including strip till systems creates a high risk of cool soil zones, which may lead to development of P deficiency symptoms at the early stages of development due to reduced root growth and P uptake.[4] Under such conditions, application of starter fertilizers, especially P can help accelerate seed germination, improve early-season crop development, decrease grain moisture content at harvest and increase grain yield of corn[5]. Conversely, conventional tillage operations impose high levels of soil disturbance, which can have a negative effect on AMF quantity and colonization[3] while strip tillage creates conditions conducive to AMF over-winter survival[6]. Presence of viable hyphae in the spring allows for rapid corn root colonization, which is important for meeting the early-season nutrient requirements of corn.[6]

CROP ROTATION STUDY

METHODOLOGY

Preceding crop treatments (canola and soybeans)

- ✧ Study sites established in spring 2014 (Carman, MB, Stephenfield, MB) and spring 2015 (Carman, MB, Portage la Prairie, MB);
- ✧ Canola and soybean grain was collected for yield determination, canola and soybean seed was harvested and crop residues disked in fall;

Corn test crop (DKC 26-28 corn hybrid)

- ✧ Randomized split-block design with 4 replicates taking into consideration the preceding crop (canola or soybeans);

Fertilizer Treatments: *all treatments sidebanded in the spring (2" beside and 1" below seed)*

No P check			
27 lb P_2O_5 and 6.7 lb S ac^{-1}	Sideband	MAP+AS	
54 lb P_2O_5 and 13.4 lb S ac^{-1}	Sideband	MAP+AS	
27 lb P_2O_5 and 6.7 lb S and 0.67 lb Zn ac^{-1}	Sideband	MESZn	
54 lb P_2O_5 and 13.4 lb S and 1.34 lb Zn ac^{-1}	Sideband	MESZn	

Year	2015		2016	
Location	Carman, MB	Stephenfield, MB	Carman, MB	Portage, MB
Planting Date	May 25	May 26	May 12	May 16
Harvest Date	October 15	October 14	October 5*	flooded
Olsen-P (ppm)	19	6	9	12
DTPA-Zn (ppm)	1.50	0.82	1.91	1.81

*Carman 2016 site was hand harvested due to wind damage and green snap.

Figure 1 Greater early season growth for sideband 27 lb P_2O_5 ac^{-1} (L) versus no P check (R) at Carman following canola stubble at V4.

RESIDUE MANAGEMENT STUDY

METHODOLOGY

Preceding tillage treatments (strip tillage and conventional tillage)

- ✧ Study sites established in fall 2014 (Carman, MB, and Portage la Prairie, MB) and fall 2015 (Carman, MB, Portage la Prairie, MB);
- ✧ Uniform cereal grain production, grain was harvested, straw was left on the field, and was followed by tillage operations and fall fertilizer application;

Corn test crop (DKC 26-28 corn hybrid)

- ✧ Randomized split-block design with 4 replicates taking into consideration the preceding residue management practice (strip tillage or conventional tillage);

Fertilizer Treatments: treatments deep banded in the fall and sidebanded in the spring:

No P check				
27 lb P_2O_5 ac^{-1}	Deep Band	4 - 5" deep	MAP	fall
54 lb P_2O_5 ac^{-1}	Deep Band	4 - 5" deep	MAP	fall
27 lb P_2O_5 ac^{-1}	Sideband	2" beside and 1" below	MAP	spring
54 lb P_2O_5 ac^{-1}	Sideband	2" beside and 1" below	MAP	spring

Year	2015		2016	
Location	Carman, MB	Portage, MB	Carman, MB	Portage, MB
Planting Date	May 25	May 26	May 12	May 16
Harvest Date	October 16	October 19	October 5	October 6
Olsen-P (ppm)	8	11	5	14

*Carman 2016 site was hand harvested due to wind damage and green snap; Portage 2016 site was hand harvested due to hail and black bird damage.

Figure 2 Earlier silking in spring sideband 54 lb P_2O_5 ac^{-1} (L) versus no P_2O_5 check (R) plots at Carman on July 27, 2015.

MicroEssentials SZ STUDY

Year 1 (2015)

FIRST phase of the crop sequence (canola and soybeans)

- ✧ Study site established in spring 2014 (Kelburn Farm, MB);
- ✧ 4 replicates of each crop;

SECOND phase of the crop sequence (DKC 26-28 hybrid)

- ✧ Randomized split-block design with 12-16 replicates of fertilizer treatments; ALL treatments applied in the spring.

Fertilizer Treatments *all treatments sidebanded (2" beside and 1" below seed)*

No P check	
27 lb P_2O_5 and 6.7 lb S and 0.67 lb Zn ac^{-1}	MESZn
54 lb P_2O_5 and 13.4 lb S and 1.34 lb Zn ac^{-1}	MESZn

Year 1 (2015)	
Planting Date	June 01
Harvest Date	October 26
Olsen-P (ppm)	41
DTPA-Zn (ppm)	2.3

Year 2 (2016)	
Planting Date	May 13
Harvest Date	October 11
Olsen-P (ppm)	35
DTPA-Zn (ppm)	2.6

Year 2 (2016)

FIRST phase of the crop sequence (soybeans *only*)

- ✧ Study site established in spring 2015 (Kelburn Farm, MB);
- ✧ Uniform soybean production;

SECOND phase of the crop sequence (DKC 26-28 hybrid)

- ✧ Randomized block design with 8 replicates; ALL treatments applied in the spring.

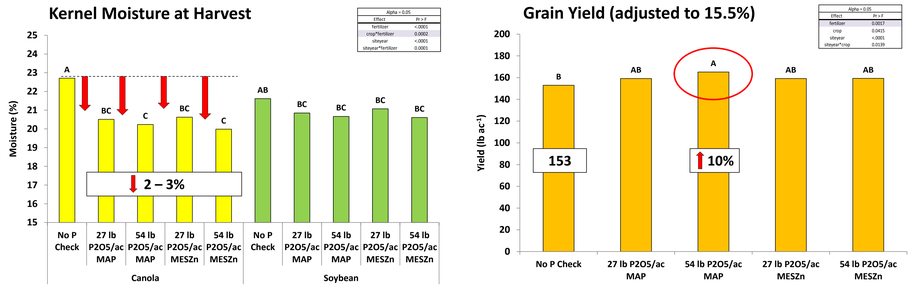
Fertilizer Treatments *all treatments sidebanded (2" beside and 1" below seed)*

No P check	
27 lb P_2O_5 ac^{-1}	MAP *only*
27 lb P_2O_5 and 6.7 lb S ac^{-1}	MAP + AS
27 lb P_2O_5 and 6.7 lb S and 0.67 lb Zn ac^{-1}	MESZn

PRELIMINARY RESULTS

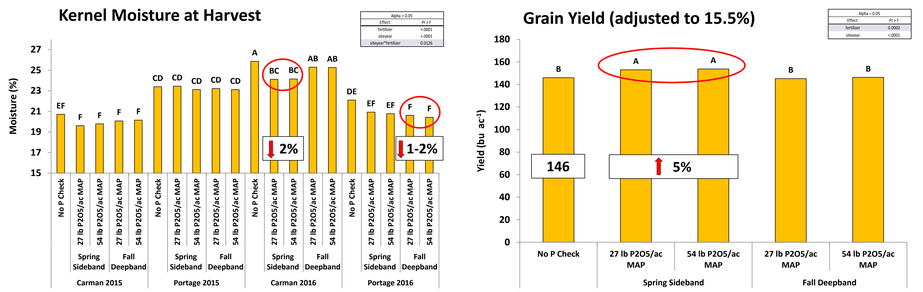
Bars labelled with the same letter are not significantly different as determined by the Tukey-Kramer grouping for treatment least squares means (alpha=0.05). Results from ANOVA are shown for significant effects.

RESULTS and DISCUSSION (Crop Rotation Study)



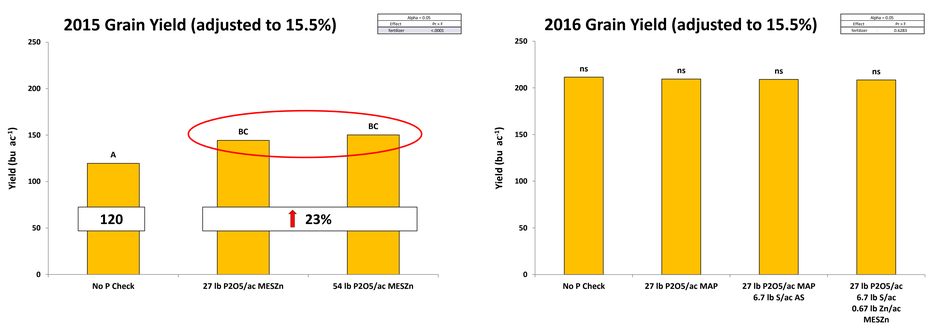
Although starter P substantially increased early season biomass (85 – 110%), especially in corn following canola and accelerated silking date by 3 – 7 days compared to the control, moisture decrease at harvest and yield response were relatively small at the end of the season.

RESULTS and DISCUSSION (Residue Management Study)



Although spring side-banded P substantially increased early season biomass (77 – 81%) and accelerated silking date by 3 days compared to the control, at 2 out of the 4 site-years, moisture decrease at harvest and yield response were relatively small at the end of the season.

RESULTS and DISCUSSION (MicroEssentials SZ Study)



2015: On average, yield increased significantly with addition of MESZn by 23% compared to the control.
2016: There was no significant yield difference between the control and treatments.

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