Integrating Nutrient Management in Soybean (*Glycine max*) Health

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OBJECTIVES

To determine the impact of Potassium (K), Chloride (Cl), Manganese (Mn) and Boron (B) nutrition in soybeans on controlling frogeye spot (*Cercospora sojina)*

To evaluate the nutrient interaction effects with and without the application of fungicides.

INTRODUCTION

- The influence of plant nutrient status and efficiency of nutrient uptake on fungal diseases is a subject that has not received adequate scientific attention.
- Low plant levels of potassium (K) Chloride (Cl) and Manganese (Mn) have been correlated plant characteristics that promote fungal infection.
- Boron (B) deficiency has been associated with the presence of small fissures/cracks in the leaves that may facilitate entrance of diseases.
- Integrated approaches to manage both nutrient and fungicides are needed.

Treatment Distribution

Treatment	Fung	Mn	B	KCl	K_2SO_4
1	0	0	0	0	0
2	0	0	0	0	x
3	0	0	0	x	0
4	0	0	x	x	0
5	0	x	0	0	0
6	0	x	x	x	0
7	x	0	0	0	0
8	x	0	0	0	x
9	x	0	0	x	0
10	x	0	x	x	0
11	x	x	0	x	0
12	x	x	x	x	0

Selected soil characteristics in Brownstown and Dixon Spring Ag Research Centers previous to the experiment.

Location	Depth	pH	OM	P	K	Cl	B	Mn	CEC
	inches		%	*ppm*	*ppm*	*ppm*	*ppm*	*ppm*	*ppm*
Brownstown	0-6	6.4	1.8	49	151	16.5	0.9	26.7	9.4
	12-Jun	5.4	1.1	13	55	15	0.5	12.6	9.4
	18-Dec	4.5	1.4	4	67	20.5	0.4	5.8	10.6
Dixon Springs	0-6	7.5	2.2	40	83	17.5	1.2	10.7	13.2
	12-Jun	7.8	2.1	11	52	9.5	0.7	5.5	13.9
	18-Dec	7.8	2.1	6	38	12.5	0.4	4	13.7

Effects of nutrient treatment, fungicide, and soybean variety on diseases and grain yields of soybeans (average)

Treatment:	Brownstown Frogeye (Rating, 1-9)	Brownstown Yield (bu/acre)	Dixon Springs Frogeye (Rating, 1-10)	Dixon Springs Yield (bu/acre)
Check	1.15	41	1.69	19.7
K_2SO_4	1.15	39.5	1.69	20.4
KCl	1.5	39.6	1.38	19.4
KCl + foliar B	2.15	40	1.38	20.4
KCl + foliar Mn	1.25	38.8	1.38	18.2
KCl + foliar Mn + B	1.13	41	1.19	19.1
Contrasts:				
Ck vs others	NS	NS	NS	NS
+/- S	NS	NS	NS	NS
+/- Cl	NS	NS	NS	NS
+/- B	NS	NS	NS	NS
+/- Mn	NS	NS	NS	NS
+/- Mn & B	NS	NS	NS	NS
+/- Cl & Mn & B	NS	NS	**	NS
Fungicide:				
- Fungicide	1.19	40.4	1.67	18.8
+ Fungicide	1.21	39.6	1.23	20.3
Variety:				
P. 94B53	1.06	41.8	1.17	14.2
P. 94M70	1.33	38.2	1.73	24.8
Anova:				
Variety (V)	**	*	**	***
Fungicide (F)	NS	NS	***	**
Fert. Trt. (T)	NS	NS	NS	NS
V x F	NS	NS	NS	**
V x T	NS	NS	**	NS
F x T	NS	NS	NS	NS
V x F x T	NS	NS	NS	NS

Means within a column followed by the same letter are not statistically different.
*, **, and *** refer to significance at the 10, 5 and 1% levels, respectively. NS = not significant.

Effects of nutrient treatment, fungicide, and soybean variety on soybean trifoliate leaf potassium (K), sulfur (S), boron (B), manganese (Mn), and chloride (Cl)

	Brownstown K	Brownstown S	Brownstown B	Brownstown Mn	Brownstown Cl	Dixon Springs K	Dixon Springs S	Dixon Springs B	Dixon Springs Mn	Dixon Springs Cl
Treatment:	%	%	*ppm*	*ppm*	*ppm*	%	%	*ppm*	*ppm*	*ppm*
Check	2.57	0.25	46	71	973	1.69	0.26	37	101	2814
K_2SO_4	2.45	0.27	48	78	1106	1.93	0.27	35	101	3209
KCl	2.65	0.25	45	71	1633	2.07	0.26	36	99	3783
KCl + foliar B	2.31	0.26	51	81	1986	1.78	0.27	51	120	4004
KCl + foliar Mn	2.43	0.27	49	105	1909	1.87	0.26	34	205	4045
KCl + foliar Mn + B	2.46	0.26	50	86	1715	1.9	0.26	52	188	4475
Contrasts:										
Ck vs others	NS	**	**	***	***	*	NS	***	***	***
+/- S	NS	***	NS	NS	NS	NS	*	NS	NS	NS
+/- Cl	NS	NS	NS	NS	***	**	NS	NS	NS	*
+/- B	***	*	***	*	*	*	NS	***	NS	NS
+/- Mn	**	**	**	***	*	NS	NS	NS	***	NS
+/- Mn & B	*	NS	***	**	NS	NS	NS	***	***	NS
+/- Cl & Mn & B	NS	NS	***	***	***	NS	NS	***	***	***
Fungicide:										
- Fungicide	2.36	0.26	48	83	1618	1.64	0.26	37	142	3228
+ Fungicide	2.49	0.26	48	81	1480	1.59	0.25	42	144	3301
Variety:										
P. 94B53	2.42	0.26	47	84	1724	1.78	0.26	41	136	3372
P. 94M70	2.54	0.26	49	80	1384	1.97	0.26	41	135	4071
Anova:										
Variety (V)	NS	NS	NS	NS	**	*	NS	NS	NS	NS
Fungicide (F)	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Fert. Trt. (T)	***	***	***	***	***	NS	NS	***	***	**
V x F	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
V x T	NS	NS	**	**	NS	NS	*	NS	NS	NS
F x T	NS	NS	NS	NS	NS	NS	NS	***	NS	NS

Means within a column followed by the same letter are not statistically different.
*, **, and *** refer to significance at the 10, 5 and 1% levels, respectively. NS = not significant.

METHODS

- A 4 year field study was conducted in two locations in Illinois, Only results from year 2009 are presented.
- Measurements included soil analysis, tissue composition, and grain yield. Evaluation of frogeye spot was monitored using a visual index.
- Means for each year were analyzed as separate experiments due to differences in response between years.
- The experimental design was a split plot. The whole plot consisted of soybean varieties and the split plots were a combination of presence/absence of foliar fungicide application plus the addition of micronutrients and K sources.
- The data were analyzed using analysis of variance (ANOVA), with the general linear model PROC GLM procedure of the SAS statistical package. A probability of 0.05 or less was used to separate significant effects and means were compared using 'contrasts' and the 'Least Significant Differences' (LSD) procedures.

RESULTS AND CONCLUSIONS

- Fungicide treatment alone reduced the incidence of frogeye leaf spot without affecting yield. None of the fertilizer treatments affected soybean grain yields.
- Soybean variety had no interaction with either fungicide or fertilizer treatments.
- The foliar application of B and Mn increased leaf B and Mn and reduced the injury index, without affecting yields, suggesting an increase on soybean response.
- Potassium application did not affect the index of frogeye spot in soybean.