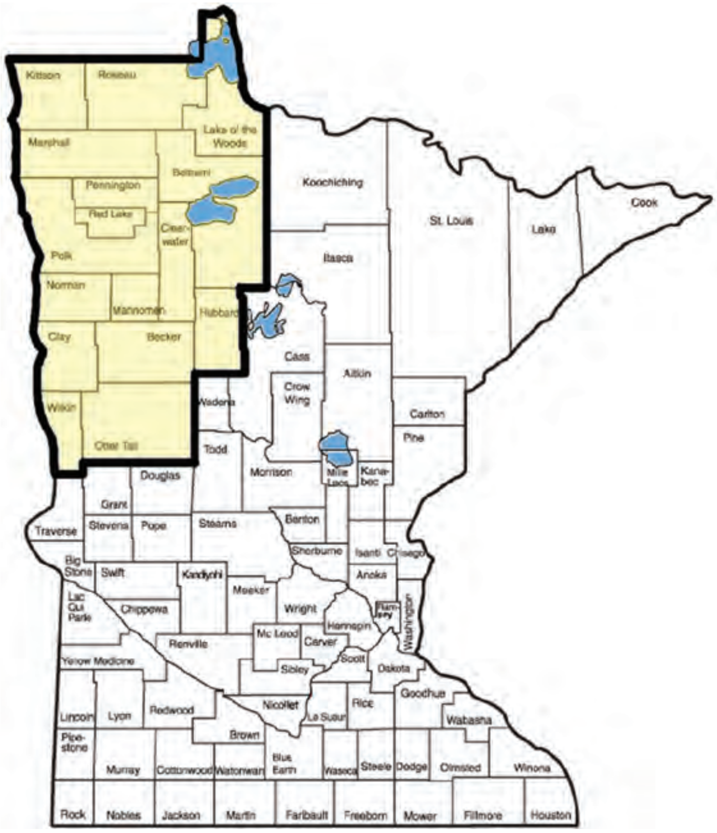

On-Farm Cropping Trials Northwest and West Central Minnesota

University of Minnesota
EXTENSION

2011 Minnesota Wheat Research Review

This is the fourth year the Research Review and On-Farm Cropping Trials have been combined into one booklet. Up until then, these reports have been published separately.

On-Farm Cropping Trials

The mission of the NWROC is to contribute, within the framework of the Minnesota Agricultural Experiment Station (MAES) and the College of Food, Agricultural, and Natural Resource Sciences to the acquisition, interpretation and dissemination of research results to the people of Minnesota, with application to the knowledge base of the United States and World. Within this framework, major emphasis is placed on research and education that is relevant to the needs of northwest Minnesota, and which includes projects initiated by Center scientists, other MAES scientists and state or federal agencies.

Contributors to the On-Farm Trials include: Russ Severson, Extension Educator, Extension Regional Office, U of M Crookston, rseverso@umn.edu; Doug Holen, Extension Educator, Extension Regional Office, Fergus Falls, holen009@umn.edu; Phillip Glogoza, Extension Educator, Extension Regional Office, Moorhead, glogo001@umn.edu; Ben Arlt, Extension Educator, Mahnomen and Norman Counties, Mahnomen, arltx013@umn.edu; Jochum Wiersma, Small Grain Specialist, Crookston, wiers002@umn.edu; Ian MacRae, Extension Entomologist, Crookston, macra002@umn.edu; Howard Person, Extension Educator, Pennington and Marshall Counties, Thief River Falls, perso005@umn.edu; Jim Orf, Dept Agronomy & Plant Genetics, St. Paul, orfxx001@umn.edu; Jeff Coulter, Extension Agronomist, Dept of Agronomy, St. Paul, coult077@umn.edu; Paul R. Peterson, Extension Agronomist-Forages, St. Paul, peter072@umn.edu; Albert Sims, Soil Scientist, Crookston, simsx008@umn.edu; Jim Stordahl, Extension Educator, Polk County, stordahl@umn.edu; Dan Kaiser, Extension Soil Scientist, St. Paul, dekaiser@umn.edu; Senyu Chen, Southern Research and Outreach Center, chenx099@umn.edu; Randy Nelson, Extension Educator, Clay County, MN, nels1657@umn.edu;

This project was made possible thanks to the hard work of many people. This includes farmers, County and Regional Extension Educators, and specialists who conducted these trials, and their names are listed. Previous On-Farm Cropping Trials booklets can be found at http://www.nwroc.umn.edu/Cropping_Issues/index.htm.

2011 Wheat Research Review

Researchers submit progress reports on projects funded partially or in full by the committee's recommendation. Research progress is communicated to the public. Crop scientists participate in a research reporting session held each year that is open to the public. The Council feels this committee has been an efficient vehicle for not only prioritizing wheat checkoff funds, but also in improving the dissemination of results.Better practices to plant better wheat is our goal. To that end, we encourage your input on this committee, and your feedback on the wheat research projects that are funded by the Minnesota Wheat Checkoff.

Members of the 2011 - 2012 Small Grains Research & Communications Committee include Brian Borge; Mark Fillbrandt, Bigg Dogg Agg; David Garrett, AgriMaxLLC; Doug Holen, U of M Regional Extension Service; Carter Hontvet; Peter Hvidsten; Carol Ishimaru, U of M Dept of Plant Pathology; Brian Jensen, MN Wheat Council; Scott Lee; Richard Magnusson; Dean Maruska, Bayer CropScience; Wayne Olson; Larry J. Smith, University of Minnesota; Brian Sorenson, Dakota Specialty Milling; David Torgerson, MN Wheat; Jochum Wiersma, U of M Small Grains Specialist; Dave Willis, Agassiz Crop Management; Marv Zutz, Minnesota Barley.

Information about the committee and previously funded research can be found online at www.smallgrains.org. Click on the Research tab.

On the Cover: University of Minnesota wheat and barley breeding material is subject to mist irrigation throughout critical growing stages to induce disease related stresses. The cover photo shows the mist irrigation system operating in the St. Paul disease nursery. These mist irrigated nurseries provide a consistent environment, on an annual basis, which allows the breeders to throw out the susceptible genetics and keep the most resistant lines that will someday become new varieties. Dr. Ruth Dill- Macky, U of M Plant Pathologist is the lead scientist running and maintaining the mist nurseries in St. Paul. Without the Small Grains Disease Initiative funding, from the State of Minnesota, these nurseries would not have been possible. The nurseries are a critical component of the process for developing varieties with improved scab resistance.

Table of Contents - On-Farm Cropping Trials For NW & WC MN

Table of Contents - Research Reporting Report

2010 Corn MESZ Rate Trials - NW MN

Cooperators: J&J Agronomy LLC (John & Jeff Halland)
Nearest Towns: Gary, MN
Planting Date: May 12, 2011 (7-inch twin rows spaced 30 inches apart)
Harvest Date: September 29, 2011 (35,000 plants/acre)
Experimental Design: Randomized Complete Block with 4 replications

Purpose of Study:
Many fertilizer suppliers in NW and WC Minnesota have switched to selling Micro-essentials MESZ which contains 10% nitrogen, 40% phosphorus, 10% sulfur and 1% zinc in each granule of fertilizer which replaces the MAP or DAP previously sold to supply starter fertilizer nitrogen and phosphorus for crop production. Additional information is needed for this new product in the market related to the crop response in corn.

Results:
The two MESZ rate trials were established in a corn growers' production field near Gary, MN in Norman County with two rates of MESZ (75lb/a and 150 lb/a) supplemented with additional N as Urea to equal 120 lb/a nitrogen compared to a control plot with 120N, 50P_2O_5, 50K_2O, 11S and 0 Zn with the three treatments replicated four times. The plots were then treated as part of the growers field for the remainder of the growing season. 10 linear feet of the center two twin-rows of the plot were hand harvested and shelled to determine corn grain yields. Ear-leaf samples were collected on August 17, 2011 and analyzed for nutrient content at AGVISE Laboratory.

There were no significant differences among the control, the 75 or 150 lb/a MESZ treatments with respect to yield, test weight, oil %, protein %, or starch % for the grain analyzed from either location. There were no significant differences to the mineral analysis of the ear-leaf samples to the variables total-N, P, K, S, Ca, Mg, Zn, Fe, Mn, Cu or B, either.

The soil test data for the north and south plots were 4 ppm Olson P, 140 ppm K, 5.5% organic matter with a pH of 8.1. The north plots had a zinc level of 0.33 ppm and an S level of 4 lb/ac, while the south plots had a zinc level of 0.42 ppm and sulfur was 70 lb/ac.

The 2011 growing season was not as favorable early on for corn growth and development due to excessive moisture and cooler conditions. Dryer and above normal heat later in the season was beneficial for the crop for growth and development. These conditions may have contributed to the lack of a response.

South plot						*North plot*				
MESZ	**Yield 15.5%**	**Test wt.**	**Ear-leaf Zn**	**Ear-leaf S**		**MESZ**	**Yield 15.5%**	**Test wt.**	**Ear-leaf Zn**	**Ear-leaf S**
lb/a	*bu/a*	*lb/bu*	*ppm*	*%*		*lb/a*	*bu/a*	*lb/bu*	*ppm*	*%*
Control	148.3	57.4	6.00	0.21		Control	131.0	55.9	9.75	0.18
75	143.0	57.1	5.50	0.23		75	145.1	56.8	10.00	0.16
170	133.2	56.8	6.75	0.22		170	130.0	56.6	9.25	0.16
$LSD_{(0.05)}$=	*NS*	*NS*	*NS*	*NS*		$LSD_{(0.05)}$=	*NS*	*NS*	*NS*	*NS*

For Additional Information:
Russ Severson, Ben Arlt, Jim Stordahl & Dan Kaiser

Research assistance provided by the NW Research and Outreach Center, Crookston

Corn Response to Micronutrients Across Minnesota

Fertilizer: Treatments
1) Control (Chk) - no fertilizer
2) Without Zinc (-Zn)
3) Without Manganese (-Mn)
4) Without Copper (-Cu)
5) Without Boron (-B)
6)All - 10 lb/ac Zn + 10 lb/ac Mn + 10 lb/ac Cu + 5 lb/ac B
Nitrogen, Phosphorus, and Potassium kept at non-limiting levels
Fertilizer was broadcast and incorporated before planting except for Delavan which was managed with no-tillage.

Weed Management: Glyphosate

Experimental Design: Randomized complete block design with 4 replications

Objective: The purpose of this study was to determine if there is a potential yield response in corn to selected micro-nutrients applied broadcast before planting.

Results:

This study used a simple drop out design to study the effects of micronutrients by comparing plots with 4 micronutrients with plots where one of the particular nutrients are not applied. To test treatment effects, an analysis of variance procedure was used to determine whether any of the treatments were significantly different. When the analysis indicated significance, all treatments with a particular nutrient were averaged and compared to averages of treatments without. Initial soil test results are given in Table 1. Soil samples were taken at 0-6" soil depth from all locations. However, at the time of this report the samples from three of the locations are still being analyzed. Soil types varied by location. The soil at Oklee was a Northwood muck, Rochester was a Marshan silt loam, Staples was a Verndale sandy loam, and Westport was a Estherville loam. The Oklee site was selected because of the high amounts of organic matter (data not shown). This was to better evaluate response to copper since these types of soils typically are more responsive to copper (Cu) in small grains. Corn is somewhat sensitive to Cu deficiency according to many reports. However, most mineral soils contain plenty of copper to satisfy the needs of most crops. Typically zinc (Zn) is the most deficient micronutrient reported in corn.

Reports of lowered micronutrient uptake in glyphosate tolerant crops have spurred interest in Manganese (Mn), especially in soybean. However, no documented cases of Mn deficiency in corn have been reported outside of areas of the country that have

Table 1. Initial soil test data for 0-6" samples collected before treatment application for corn micronutrient studies.

		Soil Test						
Location	County	P	K	Zn	Mn	B	OM	pH
		ppm					--%--	
Oklee	Red Lake	na	na	na	na	na	na	na
Rochester	Olmsted	66	185	1.9	53.7	0.4	3.2	6.1
Staples	Wadena	na	na	na	na	na	na	na
Westport	Pope	na	na	na	na	na	na	na
P, Bray-P1 phosphorus; K, ammonium acetate potassium; Zn, DTPA zinc; Mn, DTPA manganese; B, hot water extracted boron; OM, organic matter loss on ignition; pH, 1:1 soil: water; na, data not available								

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Project Funding Provided by:
Agrium

Corn Response to Micronutrients Across Minnesota (continued)

soils historically low in Mn. The final micronutrient, Boron (B) was included since soil tests ran on sandy soils typically will show lower boron levels. However, corn is not as sensitive to B deficiency as crops such as alfalfa. Therefore, the current fertilizer suggestions for corn do not include any B applications to corn. Two of the locations included sandy soils or soils that have high leaching potentials (Staples and Westport). Borate is the form of B in the soil and is highly leachable. Typically soils low in B are sandy soils low in organic matter. Another major issue with B application is B toxicity which can be a significant problem in crops due to the over application of the nutrient.

Yield data is given in Table 2 (reported yields are adjusted to 15.5% moisture). Grain yields were high at all locations except for the peat/muck soil site at Oklee. This site was wet early in the year and had a hard frost before the corn reached physiological maturity. Consequently yield potentials were limited at this site and calculated grain moistures were very high (Table 3). There were no significant yield increases at Oklee, Rochester, or Westport. The only site that soil test data were available was the Rochester location which tested high in Zn and Mn was adequate according to data from states which have Mn guidelines for crops (from the Tri State fertilizer recommendations MI, OH, IN). Soils typically responsive to Mn in those areas are high in organic matter and also have high pH. The Oklee site would fit this description, but still yields were not affected. The only site where there was a significant yield increase was Staples. At this location plots receiving Zn and Cu both appeared to have yields 7 bu/ac higher than those without. Even though we cannot tell whether both did have an effect, it is likely that Zn increased yields due to the soil type at this location and the fact that Zn is the micro-nutrient most likely to be deficient. Soil test values from this location can help to confirm this result.

Grain moisture data is given in Table 3. Nutrient deficiencies can delay maturity thereby significantly influencing grain moisture levels at harvest. In this study there was no significant increase or decrease in grain moisture at harvest for any of the micronutrient treatments. At Oklee the grain harvest moistures were extremely high. This may have been due to extreme shrinkage of the kernel following the hard freeze and the plot not being fully mature. Harvest moistures were much lower at all other locations.

Year 1 Summary
- Corn is not known to respond to any micronutrient other than zinc in Minnesota
- Grain Yield was increased by one or more micronutrients at one location
- At Staples, either Zn or Cu increased yields. Soil test data to confirm initial levels of either was not available at the time of this summary to indicate if either or both was deficient.
- Corn grain harvest moisture was not affected by micronutrient application at any location

Table 2. Corn Yield (@15.5%) summary by treatment for each location.

Site	Treatment						
	Chk	-Zn	-Mn	-Cu	-B	All	P>F +
	---bu/ac---						
Oklee	105	117	109	116	113	109	0.26
Rochester	243	238	241	227	237	233	0.30
Staples	189c	191bc	197ab	191bc	202a	199ab	0.03
Westport	196	193	194	199	194	189	0.69
+ Treatments are significantly different when $P \leq 0.05$							

Table 3. Corn grain moisture summary by treatment for each location.

Site	Treatment						
	Chk	-Zn	-Mn	-Cu	-B	All	P>F +
	---%---						
Oklee	41.6	38.5	40.2	38.9	40.0	41.7	0.14
Rochester	15.7	15.6	16.2	15.7	15.6	15.6	0.71
Staples	13.3	13.1	13.1	13.0	13.0	13.1	0.46
Westport	14.2	14.6	15.1	15.0	14.6	15.4	0.14
+ Treatments are significantly different when $P \leq 0.05$							

For Additional Information:
Daniel Kaiser (dekaiser@umn.edu)
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Soybean Variety Trial - Norman County

Cooperators: Wayne & John Brandt, Ada, MN
Location of Plot: 3 mi. North on Hwy # 9 from Hwy 200 in Ada, MN and 2 3/4 mi. east on Co. Rd 23.
Green Meadow Twp. T145N-R45W, NW 1/4 Sec. 31
Planted: June 11, 2011
Chemicals: Power Max 22 oz./A + 6 oz./A Select on July 18, 2011
Planting help: Craig Larson, Ray Bisek, Dan Ness, Ken Pazdernik, Mark Olson, John Brandt (Farmer) Data for Protein, Oil and Moisture run at NW Research and Outreach Center, Crookston, MN
Data Analyzed by Dr. Phil Glogoza
Plot Manager: Pazdernik Agronomy Services, Ken Pazdernik, 218-206-4499 or email pazdernik@loretel.net

Purpose of Study:
To expand the soybean research effort in NW Minnesota involving growers and county soybean associations in research and communications and provide more localized soybean yield data for producers to use in making choices of future soybean varieties to plant on their farms.

Table 2. Late RM Varieties evaluated for Norman County. 2011.

Company	Variety	RM	Yield*	Protein	Oil	Moisture	Plant Ht.**	Maturity***
NK Brand	S06-H5 Brand	0.6	45.3	34.4	17.5	9.1	27	5
Proseed	P2 11-60	0.6	42.4	32.9	17.1	9.1	25	8
Gold Country Seed	O840	0.8	41.4	33.0	16.9	9.3	26	9
Legend Seed	06R21	0.6	40.7	32.9	16.9	9.5	22	7
Mustang Seeds	O8331	0.8	40.5	33.5	16.8	9.5	24	9
Dairyland Seed	0603RR2Y	0.6	39.4	33.8	16.8	9.7	27	8
REA Hybrids	67G61	0.7	37.4	33.5	16.3	10.1	21	9
NK Brand	S08-A2 Brand	0.8	37.3	32.4	17.3	9.7	24	9
Renk Seed	RS061 R2	0.6	37.0	32.6	17.1	10.0	21	6
Producers Hybrids	0609 R2	0.6	35.9	33.4	17.4	13.6	24	8
Thunder Seed	3106 R2Y	0.6	35.8	32.7	17.3	14.2	26	8
		LSD *(0.05)* =	4.2	0.6	0.4	1.3	---	---

* Yield (bu/a) adjusted to 13.5 % Moisture
** Plant height measured on 8 -18-2011 from first rep. by Ken Pazdernik
*** Maturity rating on 9-14-2011, Rating 1 is ripe to 9 is green, by Ken Pazdernik

Soybean Variety Trial - Norman County (continued)

Table 1. Early RM Varieties evaluated for Norman County. 2011

Company	Variety	RM	Yield*	Protein	Oil	Moisture	Plant Ht.**	Maturity***
Legend Seed	009R20	00.9	46.0	32.8	18.3	8.5	23	5
NK Brand	S02-B4 Brand	0.2	45.2	32.8	18.5	8.5	26	3
Gold Country Seed	O241	0.2	45.1	33.6	17.8	8.8	30	3
Wensman Seed	3030	0.3	44.8	33.7	17.8	9.2	27	5
REA Hybrids	65G22	0.5	44.0	33.2	16.9	9.4	24	6
Legend Seed	02R21	0.2	43.9	33.3	17.8	9.1	30	3
Proseed	P2 10-40	0.4	43.6	33.6	17.7	9.0	24	6
Wensman Seed	L30084	00.9	43.3	33.0	17.9	8.9	24	4
Wensman Seed	R3009	00.9	42.7	33.0	18.2	8.6	24	4
Mustang Seeds	O4401	0.4	41.7	33.3	18.0	9.1	20	6
Hyland Seed	HS04RY03	0.4	40.6	33.3	17.9	9.1	21	6
Hyland Seed	HS009RY01	00.9	40.2	33.1	17.6	9.7	21	5
Thunder Seed	3103 R2Y	0.3	40.0	33.6	17.4	10.8	24	8
Thunder Seed	3105 R2Y	0.5	39.6	34.0	17.3	9.0	24	6
Proseed	P2 11-50	0.5	39.5	33.0	16.8	9.2	26	6
Fielders Choice	O092	0.1	39.2	33.0	17.5	9.5	21	4
Fielders Choice	O400	0.4	39.2	32.9	18.4	9.1	20	8
Hyland Seed	HS01RY02	0.1	38.6	33.0	18.1	9.4	21	3
Renk Seed	RS 021 R2	0.2	38.4	33.5	18.5	9.8	18	3
REA Hybrids	65G51	0.5	38.3	32.8	17.3	12.7	26	7
Stine Seed	01RA06	0.1	37.7	33.6	17.3	11.2	18	7
Seeds 2000	2051 RR2y	0.5	37.5	32.9	17.1	9.2	30	6
		LSD (0.05) =	3.5	0.5	0.3	0.6	---	---

* Yield (bu/a) adjusted to 13.5 % Moisture
** Plant height measured on 8 -18-2011 from first rep. by Ken Pazdernik.
*** Maturity rating on 9-14-2011, Rating 1 is ripe to 9 is green, by Ken Pazdernik.

For Additional Information: Ken Pazdernik
and Ben Arlt

2011 Corn Zn Rate Trials - NW MN

Cooperators: J&J Agronomy LLC (John & Jeff Halland)
Nearest Towns: Gary, MN
Planting Date: May 12, 2011 (7-inch twin rows spaced 30 inches apart)
Harvest Date: September 29, 2011 (35,000 plants/acre)
Experimental Design: Randomized Complete Block with 4 replications

Purpose of Study:
U of M calibration and correlation data on zinc is very limited in northern Minnesota. Additional information is needed on the response of the newer corn genetics to zinc fertility. There are several fields in the northern region testing less than 0.5 ppm Zn.

Results:
The two zinc rate trials were established in a corn growers' production field near Gary in Norman County with fertilizer zinc rates of 0, 2.5, 5, 10, 15 & 20 pounds of zinc per acre with the treatments replicated four times. The zinc source was 36% zinc sulfate which was broadcast and incorporated prior to planting. N, P, & K were added to the site at sufficient rates. The plots were treated as part of the growers field for the remainder of the growing season. Ten linear feet of the center two twin-rows of the plot were hand harvested and shelled to determine corn grain yields. Zinc fertilizer response is suspected with a soil test of 0.5 ppm zinc or less. The two research sites soil test zinc were north plot 0.33 ppm Zn and south plot 0.42 ppm Zn, respectively.

Neither plot responded to zinc this year for grain yield and test weight even though the soil test was below 0.5 ppm Zn. The 2011 growing season was not as favorable early on for corn growth and development due to excessive moisture and cooler conditions. Dryer and above normal heat later in the season was beneficial for crop growth and development and may have contributed to a lack of response. Ear-leaf samples from August 17, 2011 showed a significant increase in zinc uptake at both the north and south sites as one would expect with the rates applied.

South plot (0.42 ppm ZN)				*North plot (0.33 ppm ZN)*			
ZN Rate	**Yield 15.5%**	**Test wt.**	**Ear-leaf Zn**	**ZN Rate**	**Yield 15.5%**	**Test wt.**	**Ear-leaf Zn**
lb/a	*bu/a*	*lb/bu*	*ppm*	*lb/a*	*bu/a*	*lb/bu*	*ppm*
0	148.3	57.4	9.75 c	0	131.0	55.9	6.00 b
2.5	148.0	56.6	10.25 bc	2.5	127.7	57.3	6.50 b
5	137.7	56.3	12.00 a	5	128.3	56.6	6.75 b
10	146.8	57.2	11.25 ab	10	138.0	56.2	8.80 ab
15	143.6	57.3	11.25 ab	15	125.9	57.0	8.50 ab
20	160.0	58.1	11.00 abc	20	131.6	57.0	11.00 a
$LSD_{(0.05)}$=	NS	NS	1.34	$LSD_{(0.05)}$=	NS	NS	3.21

For Additional Information:
Russ Severson, Ben Arlt, Jim Stordahl & Dan Kaiser

Project Funding Provided by: Minnesota Corn Research and Promotion Council

Research assistance provided by the NW Research and Outreach Center, Crookston

Corn Response to Sulfur in Northern Minnesota

Treatments: Study 1: Combination of spring applied sulfur source and rate
- Sources: 1) Ammonium Sulfate (21-0-0-24s)
  2) Sulf-N® 26 (26-0-0-14s)
- Rates: 0, 5, 10 20, and 30 lbs S/ac

Study 2: Nitrogen rates with and without sulfur
- Sulfur rates: 0 and 25 lbs S per acre as spring applied ammonium sulfate
- Nitrogen rates: 0, 50, 100, 150, 200, 250 lbs N as spring applied urea

Previous Crops: Study 1: Soybeans; Study 2: Corn

Objective:
Study 1: To compare the effects of sulfur source and rate on corn grain yield an moisture
Study 2: To evaluate corn grain yield and harvest moisture response to nitrogen when sulfur is and is not applied.

Results:
The initial soil test values for each study are listed in Table 1. Both studies evaluated the use of sulfur for corn. For study 1 two fertilizer sources were applied at 4 rates at the Mahnomen location and 5 rates at Westport. The two sources compared were dry granular ammonium sulfate and Sulf-N®. The Sulf-N sources is a fused ammonium sulfate nitrate product that is water soluble. Space was limited at Westport so only the Sulf-n treatment was included at that location. Nitrogen was added to equal out the amount applied by all treatments. Study two focused on the interaction between nitrogen and sulfur on the yield of corn. Two locations were studied, one in SE Minnesota on low organic matter soils (3.0% or less in the top 6" depth) that have responded to sulfur in the past and on a continuous corn field in NW Minnesota. Research has found some yield benefit from applying sulfur in continuous corn regardless of soil organic matter level. The NW Minnesota fields were added to compare data from the NW area with those in southern MN that have responded to sulfur to determine if sulfur suggestions for corn can be universal across the state. The Mahnomen site included an eroded knoll similar to soil conditions in southern Minnesota on which sulfur responses have been seen. In study two, both locations were managed with continuous corn and all N and S fertilizer was spring applied and incorporated prior to planting.

Table 2 includes the summary statistics for the main treatment effects for study 1. At the Mahnomen location both sulfur source and rate significantly differed. The interaction between the two was not significantly doffer-ent but the probability level was close to the accepted level. A significant interaction would indicate that the effect of sulfur rate varied by sulfur source.

Table 1. Initial soil test data for 0-6" samples collected from Study 1 sites (Mahnomen and Westport) and Study 2 sites (Elbow Lake and Saint Charles).

Location	Soil Series	County	Soil Test (0-6")				
			P	K	S	OM	pH
			---------------ppm-----------			--%--	
Mahnomen	Barnes-Langhei	Mahnomen	15	115	3	3.1	7.9
Westport	Estherville	Pope	53	138	3	6.6	6.2
Elbow Lake	Towner	Grant	18	135	57	4.8	7.6
Saint Charles	Seaton	Winona	14	80	4	2.8	6.8

P, Bray-P1 phosphorus; K ammonium acetate potassium; S, mono-calcium phosphate extractable sulfur; OM, organic matter loss on ignition; pH, 1:1 soil:water

For Additional Information:
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Project Funding Provided by:
Pioneer Hybrid International

Corn Response to Sulfur in Northern Minnesota (continued)

Yield (adjusted to 15.5% moisture) data from this study is given in Figure 1. Sulfur applied as AMS increased yields by nearly 30 bu/ac with the 10 lb S rate at the Mahnomen site. For the Sulf-N treatment there was little yield increase until the highest sulfur rate. The 5 lb. sulfur rate did increase yields but not as much as the 10 lb. rate, which agrees with southern MN data on optimal application rate. Application of 20 lb. of S did not result in a further yield increase. There was no difference in yields at the Westport site. Yields were high at this location and it appeared that no sulfur was needed. Similar to sites in southern Minnesota, the low organic matter level at the Mahnomen site likely contributed to the sulfur response and indicates similar S guidelines may be used. Grain moisture was not significantly impacted by sulfur application at either location, therefore the data is not shown.

Table 2. Summary statistics for main treatment effects of sulfur source and rate and their interaction for Study 1.

Variable	Site	Statistics +		
		Source	Rate	Source x Rate
		--------P >F--------		
Yield	Mahnomen	0.02	0.03	0.11
	Westport	--	0.23	--
Moisture	Mahnomen	1.00	0.10	0.64
	Westport	--	0.61	--
+ Main effects and interactions are significant when *P* ≤ 0.05.				

Table 3. Summary statistics for main treatment effects of sulfur application and nitrogen rate and their interaction for Study 2.

Variable	Site	Statistics +		
		Sulfur	Nitrogen Rate	Sulfur x N
		--------P >F--------		
Yield	Elbow Lake	0.28	<0.01	0.21
	Saint Charles	0.99	<0.01	0.28
Moisture	Elbow Lake	0.49	<0.01	0.18
	Saint Charles	<0.01	<0.01	0.16
+ Main effects and interactions when *P* ≤ 0.05.				

Table 4. Corn grain harvest moisture summary by sulfur and nitrogen rate for Study 2.

Site	S rate	N Rate					
		0	50	100	150	200	250
		--------%--------					
Elbow Lake	0	10.7	12.9	11.9	13.0	12.5	12.9
	25	11.6	12.3	13.2	12.6	13.0	12.9
Saint Charles	0	20.0	18.4	19.3	20.6	20.4	21.2
	25	20.1	17.8	18.3	18.6	19.2	20.0

Corn Response to Sulfur in Northern Minnesota (continued)

For Study 2, grain yield did not respond to sulfur at either of the locations (Table 3). Other sulfur locations showed similar results in 2011, likely as a result of warmer, early season conditions potentially leading to greater mineralization of S and less S needed from fertilizer. The Elbow Lake site had the highest sulfur soil test of either location (Table 1) which is likely due to precipitated gypsum in the soil profile. Yield (Table 3 and Figure 2) was significantly affected by nitrogen rate at both locations. At the Elbow Lake location, yield responded linearly to the highest N rate. High amounts of early season rainfall resulted in the 250 lb. rate not maximizing yield due to N loss. Conversely, at the St. Charles location yield was maximized by 130 lb. of N which is lower than that recommended for continuous corn in SE Minnesota. At both locations there was no evidence that the application of sulfur changed the optimum amount of N that needed to be applied.

Grain moisture was significantly affected by N rate at both locations, while S affected moisture only at St. Charles. As the amount of N increased, grain harvest moisture increased. However, at the St. Charles site the application of sulfur generally resulted in 1% lower grain moisture at harvest. Even though there was no yield response, the savings from dryer grain at harvest could potentially cover the cost of the sulfur application, depending on the amount needed to decrease moisture. This is a result that has been seen at other locations and is likely due to a hastening of maturity.

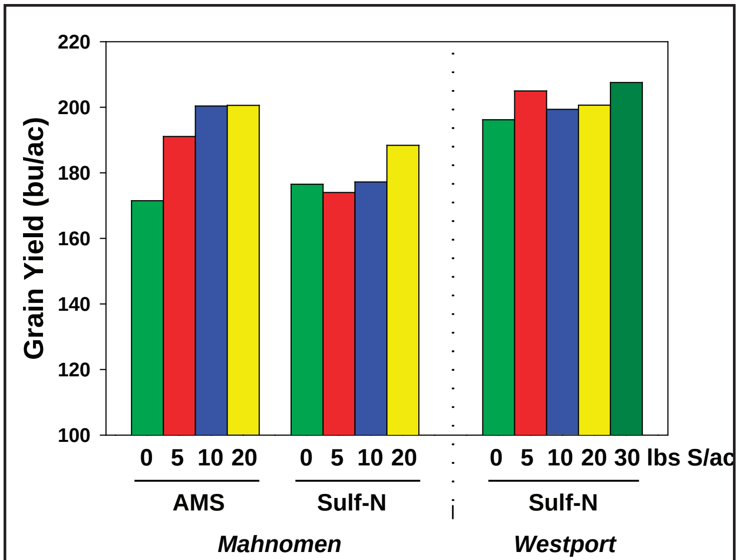

Figure 1. Yield summary data for Study 1

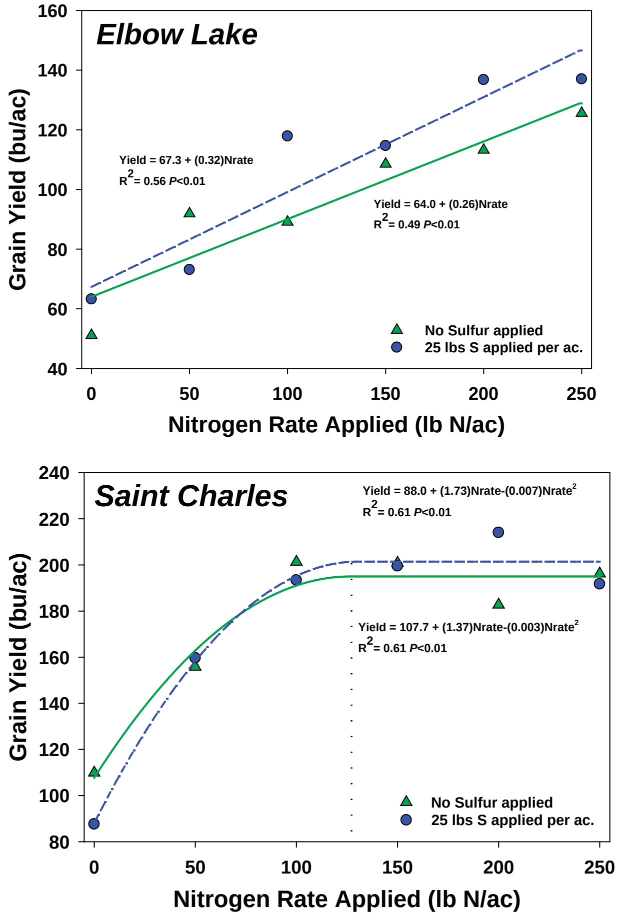

Figure 2. Yield summary data for Study 2.

For Additional Information:
Daniel Kaiser (dekaiser@umn.edu) 612-624-3482

Effects of QLF TS Terra Fed© and Organic Renewal™ on Organically Grown Corn - Clay County

Cooperator: Lynn Brakke Organic Farms
Nearest Town: Comstock, MN
Soil Type: Bearden loam
Tillage: Spring: One pass with a field cultivator
Previous Crop: Soybean
Planting Date: 5/18/11
Variety: Bison 1
Row Width: 22 inch
Fertilizer: QLF TS Terra Fed© and Organic Renewal™ was applied to the soil on each side of the middle row of three row plots (30 feet long) at 10 gal/ac using a CO_2 pressurized plot sprayer. No spray solution was applied to the untreated check. After application the soil on each side of the middle row in all plots, including the untreated check, was cultivated using a hand held garden hoe.
Planting Population: 32,000 plants/ac
Harvest Date: 10/3/11
Experimental Design: Latin Square with four replicates.

Purpose of Study:
Evaluate the effects of soil applied QLF TS Terra Fed© and Organic Renewal™ on corn yield and quality in an organic production system.

Results:
Twenty feet of row was harvested from the middle row of each three row plot and used to determine yield and quality.

There were no significant difference observed between treatments for yield, protein and oil.

Table 1. Yield and seed quality from organically grown corn treated with QLF TS Terra Fed© or Organic Renewal™. Comstock, MN, 2011.

Treatment	Spray date	Growth stage	Yield (bu/ac)	Protein (%)	Oil (%)
Untreated check	---	---	121.4	7.2	4.8
Organic Renewal™ 3.2 fl oz/ac	7/12	V10	129.3	7.2	4.9
QLF TS Terra Fed© 5 gal/ac	7/12	V10	123.9	6.9	5.0
Organic Renewal™ 6.4 fl oz/ac	7/12	V10	121.2	7.0	5.0
		$LSD_{0.05}$ =	NS	NS	NS

For Additional Information:
Randy Nelson and Phil Glogoza

Effect of Tire Ruts on Crop Growth and Yield - Yellow Medicine

Cooperator: Crop consultant, Frenchie Bellicot and the producers near Clarkfield, MN.
Nearest Town: Clarkfield, MN
Soil Type: Varies
Tillage: Either chisel plow or disk ripped with a spring field cultivation
Previous Crop: Corn and soybean rotation on all fields
Field Info: All producers used their own weed, pest, and fertility regimes

Purpose of Study:
The fall of 2009 received abnormally high levels of precipitation and a majority of the fields received ruts from the combine during harvest. Seven field were chosen to look at the long-term affect of tire ruts on the stand, height, yield of corn and soybeans.

Results:
In 2010, at seven locations, 1/1000th of an acre was flagged in a rutted area of the field and 2 to 3 rows over in a non-rutted area. Plant height and corn growth stage was lower (8.5”) for the rutted areas versus the areas that did not receive ruts (table 1). The early and final stands were not affected by the soil disruption (table 1 and 2). Corn yield (table 2) was lower by an average of 27.3 bu/ac, a 17% yield decrease.

In 2011, the same seven locations were flagged to look at the soil ruts affect on soybean growth and yield. On July 20th, the plant height was shorter by 5.3” in the rutted areas of the fields (table 3). Again, as with corn stand, soybean population was not statistically affected by rutting (table 3). Soybean vegetative growth was behind by a staging of 1.9 and the reproductive growth was behind by 1 stage in the rutted areas (table 3).

Due to the soybean grain moisture dropping at a rapid rate, 4 of the seven fields were harvested before we could hand harvest the grain. Table 4 lists the yield average for three of the seven fields. Grain moisture was not affected due to rutting, however, the yield decreased an average of 16% (4 bu/ac) due to the rutting affects from two years previous.

This study will be continued in 2012, at the seven fields, to determine if the rutting will have an affect on corn yield three years after the initial rutting event.

For Additional Information:
Jodi DeJong-Hughes and
Jeff Coulter

Project Funding
Provided by:
U of M Extension

Table 1. Corn height, population and growth stage in 2010.

Treatment	Plant Height (inches)	Early Corn Pop (plants/ac)	Corn Growth (V Stage)
No Ruts	31.0	29,900	10.4
Ruts	22.5	28,900	9.1
LSD (0.05)	*6.5*	*NS*	*0.7*

Table 2. Corn final population, grain moisture and yield in 2010.

Treatment	Final Pop (plants/ac)	Grain Moisture (%)	Corn Yield (bu/ac)
No Ruts	29,100	14.9	158.6
Ruts	29,100	15.1	131.3
LSD (0.05)	*NS*	*NS*	*11.1*

Table 3. Soybean height, stand and growth stage for 7 fields in 2011.

			Soybean Growth	
Treatment	Plant Height (inches)	Plant Pop (plants/ac)	V Stage	R Stage
No ruts	14.9	148,300	8.0	2.1
Ruts	9.6	138,500	6.1	1.1
LSD (0.05)	*2.3*	*NS*	*0.6*	*0.6*

Table 4. Soybean grain moisture and yield for 3 fields in 2011.

Treatment	Grain Moisture (%)	Soybean Yield bu/ac)
No Ruts	8.1	26.1
Ruts	8.0	22.1
LSD (0.05)	*NS*	*2.1*

County Soybean Variety Plots — Kittson - Roseau/LOW County

Cooperator: Paul Johnson (Hallock) & Drew Parsley (Warroad)
Planting Date: 5/16/11 (Hallock) 5/18/11 (Warroad)
Harvest Date: 9/27/11 (Hallock) 9/26/11 (Warroad)
Experimental Design: RCB 3 replications

Purpose of Study:
To expand the soybean research effort in NW Minnesota involving growers and county soybean associations in research and communications and provide more localized soybean yield data for producers to use in making choices of future soybean varieties to plant on their farms. Additionally these plots provide more environments to evaluate the same varieties to give more confidence in variety selection and stability. These plots will also build collaborative efforts between local soybean associations, Northern Soybean Growers Team, MN Wheat Council and U of M in providing research and education for the region.

Late RM Brand	Variety	RM	Hallock	Warroad	Site avg.
			Yield 13% (bu/A)		
Prairie Brand	PB-0240R2	0.2	63.5	59.5	61.5
REA Hybrids	61G21	0.1	62.6	60.4	61.5
Channel	0205R2	0.2	64.2	57.1	60.7
REA Hybrids	62G22	0.2	62.6	57.7	60.2
Peterson Farms Seed	11R01	0.1	64.7	53.1	58.9
Proseed	P2 10-20	0.2	59.4	57.8	58.6
Asgrow	AG0231	0.2	63.4	51.8	57.6
Legend Seeds	LS 02R21	0.2	60.8	53.7	57.3
Pioneer Hi-Bred	90Y21	0.2	59.2	55.0	57.1
Peterson Farms Seed	11R02	0.2	58.3	54.7	56.5
Nutech Seed	6025	0.2	54.4	57.9	56.1
Wilbur-Ellis	Integra 97014R	0.0	54.5	56.4	55.4
Dyna-Gro	35RY01	0.1	59.8	50.5	55.2
Wilbur-Ellis	Integra 20100	0.1	51.9	53.2	52.6
Thunder Seed	3201 R2Y	0.1	54.3	50.5	52.4
Hyland Seeds	HS 01RY02	0.1	60.1	43.8	52.0
Hefty Seed	H00Y12 (RR2)	0.0	51.2	51.8	51.5
Northstar Genetics	NS 0216R2	0.2	51.3	51.5	51.4
Hefty Seed	H01Y11 (RR2)	0.1	55.9	46.6	51.3
Channel	0100R2	0.1	55.3	45.2	50.3
Asgrow	AG0131	0.1	53.3	46.2	49.8
		$LSD_{0.05}$ =	*6.6*	*10.5*	—

For Additional Information:
Russ Severson

Project Funding Provided by:
Minnesota Soybean Research & Promotion Council

County Soybean Variety Plots — Kittson - Roseau/LOW County *(continued)*

Early RM			Hallock	Warroad	Site avg.
Brand	**Variety**	**RM**	**Yield 13% (bu/A)**		
Legend Seeds	LS 009R20	0.09	64.9	63.2	64.0
Croplan	RT20091	00.9	64.6	59.5	62.1
Prairie Brand	PB-00950R2	00.9	68.8	50.6	59.7
Asgrow	AG00632	00.6	61.7	57.5	59.6
Legend Seeds	LS 003R21	0.03	60.3	58.3	59.3
Pioneer Hi-Bred	900Y81	0.008	61.5	57.0	59.3
Asgrow	AG00932	00.9	63.6	54.5	59.0
Wensman Seed	W 30091R2	00.9	61.4	56.0	58.7
Dyna-Gro	30RY04	0.04	60.8	55.5	58.2
Pioneer Hi-Bred	900Y71	0.007	55.7	59.5	57.6
Proseed	P2 11-07	0.07	58.6	56.2	57.4
Hyland Seeds	HS 006RYS24	00.6	59.3	55.1	57.2
Croplan	RT20085	00.8	66.0	48.1	57.0
Northstar Genetics	NS 0096R2	0.09	56.8	57.2	57.0
REA Hybrids	55G22	00.5	56.8	57.1	57.0
Prairie Brand	PB-00870R2	00.6	60.2	52.0	56.1
Wensman Seed	W 30042R2	00.4	58.6	53.5	56.1
Seeds 2000	0091 RR2Y	00.9	65.7	46.3	56.0
Dyna-Gro	30RY07	0.06	53.7	57.4	55.5
REA Hybrids	53G32	00.3	55.7	54.8	55.2
Prairie Brand	PB-00560R2	00.5	58.9	51.3	55.1
Northstar Genetics	NS 0011R	0.02	58.7	51.1	54.9
Wilbur-Ellis	Integra 20052	0.05	57.6	52.0	54.8
Wilbur-Ellis	Integra 97001R	0.03	59.4	50.2	54.8
Dyna-Gro	30RY09	0.09	62.1	47.0	54.5
Wensman Seed	W 30084R2	00.8	62.5	46.5	54.5
Peterson Farms Seed	12R007	00.6	56.5	52.5	54.5
Hyland Seeds	HS 009RY03	00.9	60.8	47.6	54.2
Thunder Seed	31009 RR	00.9	63.7	44.6	54.1
Wensman Seed	W 30066R2	00.6	54.5	52.9	53.7
Northstar Genetics	NS 0057R2	0.05	54.1	53.2	53.7
Thunder Seed	30005 RR	00.5	55.6	50.5	53.1
Proseed	P2 10-08	0.08	58.4	47.6	53.0
Proseed	P2 11-05	0.05	55.2	49.7	52.5
Nutech Seed	0090	00.9	55.7	48.7	52.2
Legend Seeds	LS 004R21	0.04	55.3	47.9	51.6
Nutech Seed	6005	00.5	55.4	46.9	51.1
Thunder Seed	32005 R2Y	00.5	55.3	46.3	50.8
Hefty Seed	H007Y12 (RR2)	00.7	missing	50.6	50.6
Peterson Farms Seed	12R005	00.5	55.3	41.4	48.4
Hefty Seed	H004Y12 (RR2)	00.4	51.6	43.3	47.4
Hyland Seeds	Rosco	00.5	44.6	33.4	39.0
		$LSD_{0.05}$ =	*7.6*	*9.1*	—

MicroEssentials - SZ® as a Fertilizer Source for Soybean

Fertilizer: Treatments
1) Control (Chk) - no fertilizer
2) Nitrogen Only (N)
3) N and Phosphorus (N+P)
4) N, P, and Sulfur (N+P+S)
5) MicroEssentials-SZ applied at 200 lbs product per acre (MEZ)
Potassium kept at non-limiting levels
Fertilizer was broadcast and incorporated before planting
All nutrients were balanced to apply similar rates
Sulfur in treatment 4 was applied as 50% AMS and 50% Tiger 90

Weed Management: Glyphosate

Experimental Design: Randomized complete block design with 4 replications

Objective:
The purpose of this study was to determine the efficacy of using MicroEssentials-SZ, a multi nutrient fertilizer manufactured by Mosaic, on the yield of soybean and to determine which nutrient or nutrients may be responsible for increased yield.

Results:
This research studied the effect of MicroEssentials-SZ on the yield of soybeans. Treatments were designed to compare the impact of individual nutrients applied with the fertilizer. The product is a multi-nutrient blend of nitrogen (N), phosphorus (P), sulfur (S), and zinc (Zn) that has an analysis of 12-40-0-10-1 (% N-P_2O_5-K_2O-S-Zn). The material is manufactured using dry mono-ammonium phosphate (MAP), ammonium sulfate, elemental sulfur, and zinc oxide. In this study we compared treatments using N only as ammonium nitrate, N and P as MAP, and N , P and S as MAP, ammonium sulfate, and elemental sulfur. All treatments were intended to supply the nutrients in the same amount as the MEZ which was applied at 200 lb. of product per acre (24 lb N, 80 lb P_2O_5, 20 lb S, and 2 lb Zn per acre). Treatment differences were assessed using analysis of variance procedures. When the analysis indicated one or more treatments significantly differed treatment means were compared for response to N, P, K, S, and Zn by averaging treatments with and treatments without each individual nutrient and comparing their means'.

Initial soil test results are given in Table 1. Soil P levels were High to Very High at all locations, K ranged from Medium to Very High, and in general Zinc was higher than levels in which deficiencies are likely to occur in other crops. The only locations where a deficiency of an element was likely was K at the Warroad site which was in the medium classification for soybeans. The Very High levels of soil test P indicate that a response to P from the MEZ product is highly unlikely. There is no established critical value for Zn on soybeans in the state of Minnesota.

Results from soybean trifoliate samples collected at full bloom are given in Table 2 and 3 for the Hallock and

Table 1. Initial soil test data for 0-6" samples collected before treatment application for soybean MicroEssentials - SZ studies.

Location	County	Soil Test				
		P	K	Zn	OM	pH
		ppm			%	
Hallock	Kittson	30	610	0.8	8.8	7.0
Lamberton	Redwood	24	172	0.8	5.0	5.2
Rock Dell	Olmsted	51	130	3.9	3.2	6.8
Warroad	Lake of the Woods	29	96	1.0	2.8	7.6
Waseca	Waseca	27	172	0.9	7.1	6.5
P,Bray-P1 phosphorus; K ammoniom acetate potassium; Zn, DTPA zinc; OM, organic matter loss on ignition; pH, 1:1 soil:water						

MicroEssentials -SZ® as a Fertilizer Source for Soybean (continued)

Warroad locations (samples were collected from all sites but data are not available). Table 2 summarizes trifoliate P levels by treatment. Application of P at Warroad increased trifoliate P concentration. For the cases of S and Zn there was no difference in treatment so the data were averaged across treatments for both locations (Table 3).

All treatments tested sufficient for P and Zn (P, 0.26 to 0.50%; S, no critical level available; Zn, 20 to 50 ppm). Soybean yields (adjusted to 13% moisture) were significantly affected by one or more treatments at the Warroad location (Table 4). Treatment means comparisons indicate that N increased yield by an average of 6 bu/ac at the Warroad site. A comparison could not be made between the trifoliate N concentration and yield response since the data has not been run at this time. However, the effect of P on trifoliate concentration was not translated into higher yield.
In no cases did the MEZ treatment increase yields further than any other treatment other than the control (chk). The only other site that showed a small increasing yield trend was at Waseca where yields were slightly higher with P. However this increase, if significant, would be only 1 bu/ac which would not be economical based on the rates applied.

The lack of yield response to the MEZ treatment alone is not surprising since the only difference between that and any other treatment applied is the inclusion of zinc. Soybeans are not know to be highly responsive to zinc as compared to other crops such as corn or edible beans. In addition the sulfur in MEZ did not increase yields. Similar to Zn, soybeans are not known to be highly responsive to sulfur. When applying fertilizer sources such as MEZ or MAP for soybeans, the main consideration should be price per lb. P_2O_5 or N since these nutrients may significantly affect yields. While soybeans may not respond to S or Zn there could be a benefit from the carry over of these nutrients to following years' crops.

Year 1 Summary
- The sites had adequate P and Zn levels in the soil.
- Soybean trifoliate S and Zn concentration were not influenced by treatments. Trifoliate P concentration was affected by P application at the Warroad location
- Soybean trifoliate P, S, and Zn concentration did not fully relate to yield differences
- Application of MEZ fertilizer did not increase yields more than N, N+P, or N+P+S fertilizer treatments
- Yields were increased by N application at one location.

Table 2. Soybean trifoliate phosphorus concentration from samples taken at R2 (full bloom).

Site	Treatment					
	Chk	N	N+P	N+P+S	MEZ	P>F +
	---%---					
Hallock	0.42	0.41	0.44	0.41	0.41	0.35
Warroad	0.34c	0.35bc	0.38ab	0.39a	0.37abc	0.04
+ Treatments are significantly different when $P \leq 0.05$.						

Table 3. Soybean trifoliate nutrient concentration from samples taken at R2 (full bloom) averaged across treatments in the MEZ study.

Site	Nutrient and Sufficiency Level					
	P	SL +	S	SL +	Zn	SL +
	---%---					
Hallock	0.42	S	0.27	--	26	S
Lamberton	na	0.35bc	na	0.39a	na	0.04
Rock Dell	na		na		na	
Warroad	0.37	S	0.28	--	22	S
Waseca	na		na		na	
+ SL, sufficiency level: L, Low; S, Sufficient: H, High						

Table 4. Soybean MEZ yield summary by treatment for each location.

Site	Treatment					
	Chk	N	N+P	N+P+S	MEZ	P > F +
	---bu/ac---					
Hallock	57	60	60	58	58	0.50
Lamberton	52	52	50	54	51	0.42
Rock Dell	35	33	35	32	33	0.84
Warroad	41c	49a	47ab	51a	44bc	0.02
Waseca	51	50	52	53	52	0.38
+ Treatments are significantly different when $P \leq 0.05$.						

Soybean Response to Micronutrients Across Minnesota

Fertilizer: Treatments
1) Control (Chk) - no fertilizer
2) Without Zinc (-Zn)
3) Without Manganese (-Mn)
4) Without Molybdenum (-Mo)
5) Without Boron (-B)
6) All - 10 lb/ac Zn + 10 lb/ac Mn + 0.5 lb/ac Mo + 5 lb/ac B
Phosphorus and Potassium kept at non-limiting levels
Fertilizer was broadcast and incorporated before planting except for Delavan which was managed with no-tillage.

Weed Management: Glyphosate

Experimental Design: Randomized complete block design with 4 replications

Objective:
The purpose of this study was to determine if there is a potential yield response in soybean to selected micronutrients applied broadcast before planting.

Results:
This study used a simple drop out design to study the effects of micronutrients by comparing plots with 4 micronutrients with plots where one of the particular nutrients are not applied. To test treatment effects, an analysis of variance procedure was used to determine whether any of the treatments were significantly different. When the analysis indicated significance, all treatments with a particular nutrient were averaged and compared to averages of treatments without. Initial soil test results are given in Table 1. Soil P levels were High to Very High at all locations, P ranged from Medium to Very High, and in general Zinc (Zn) was higher than levels in which deficiencies are likely to occur. Soil tests were also run for manganese (Mn) and boron (B). There currently are no critical values for soybeans grown in Minnesota for either nutrient since neither has been shown to be deficient. Soybeans are responsive to Mn, however, yield responses are typically seen in areas of the country with soils that have been historically deficient in Mn. Research in Michigan has shown soybean yield increases due to Mn and recommendations exist in that state when soil test levels are less than 24 ppm. The only location with a soil test near that level was the Rock Dell location. Other locations that can exhibit lowered Mn availability are those with high soil pH, but in this case there was no relationship between pH and Mn.

Table 1. Initial soil test data for 0-6” samples collected before treatment application for soybean micronutrients studies.

Location	County	Soil Test						
		P	K	Zn	Mn	B	OM	pH
		--------------------------ppm------------------------					--%--	
Delavan	Faribault	na	na	na	na	na	na	na
Fosston	Polk	25	196	1.1	35.5	1.0	7.1	7.5
Montgomery	Rice	na	na	na	na	na	na	na
Rochester	Olmsted	66	185	1.9	53.7	0.4	3.2	6.1
Rock Dell	Olmsted	51	130	3.9	24.3	0.8	3.2	6.8
Warroad	Lake of the Woods	29	96	1.0	28.1	0.5	2.8	7.6

P, Bray-P1 phosphorus; K, ammonium acetate potassium; Zn, DTPA zinc; Mn, DTPA manganese; B, hot water extracted boron; OM, organic matter loss on ignition; pH, 1:1 soil:water; na, data not available

For Additional Information:
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Project Funding Provided by:
Minnesota Soybean Research & Promotion Council

Soybean Response to Micronutrients Across Minnesota (continued)

The upper most, fully developed trifoliate was sampled at R2 (full bloom) to assess plant nutrient status at selected sties (Fosston, Hallock, and Rochester were sampled, however, the data from Rochester is not currently available). Twenty samples were collected and composited from each plot and analyzed for zinc, manganese, and boron. Leaf molybdenum concentration was not determined.

Zinc was the only nutrient where the concentration differed between treatments at any site (Table 3). At Fosston leaf zinc content differed between treatments. Table 3 lists the least significant differences between treatments, however, comparisons between treatments with and without specific nutrients indicated that leaf zinc content was greater with the application of molybdenum. However, most concentrations were at or near the sufficient range of 20 to 50 ppm.

Table 4 compares the average tissue concentration for zinc, manganese, and boron across treatments at each location (sufficient ranges: Mn, 21 to 100 ppm; B, 21 to 55 ppm). At both the Hallock and Fosston sites the average tissue concentration fell in the sufficient range for all nutrients. This indicates that it was unlikely that a deficiency was present and yield would be limited. The yield data (reported at 13% moisture) in Table 5 confirms this result.

There was no significant effect of the micronutrients studied on yield at any of the locations. Glyphosate application at many of the southern locations was during periods of high temps which did induce some glyphosate flash symptoms in many fields in 2011. In the fields studied there was no advantage to Mn which has been reported to be limiting when glyphosate flash occurs. Yields in the southern sites were lower which may limit potential response to micronutrients. While there may have been some variability between treatment yields it was likely due to within plot variability.

Table 3. Soybean trifoliate zinc concentration from samples taken at R2 (full bloom).

Site	Treatment						
	Chk	-Zn	-Mn	-Mo	-B	All	P>F +
	----------------------------------ppm----------------------------------						
Fosston	21abc	20abc	19c	19c	236a	22ab	0.04
Hallock	27	26	29	27	28	26	0.51
+ Treatments are significantly different when $P \leq 0.05$.							

Table 4. Soybean trifoliate nutrient concentration from samples taken at R2 (full bloom) averaged across treatments.

Site	Nutrient and Sufficiency level					
	Zn	SL +	Mn	SL +	B	SL +
	--------------------------ppm----------------------------------					
Fosston	21	S	92	S	50	S
Hallock	27	S	51	S	49	S
+ SL, sufficiency level: L, Low; S, Sufficient; H, High						

Table 5. Soybean yield summary by treatment for each location

Site	Treatment						
	Chk	-Zn	-Mn	-Mo	-B	All	P>F +
	-----------------------------bu/ac---------------------------------						
Delavan	41	40	42	41	43	42	0.86
Fosston	64	62	66	62	66	65	0.50
Hallock	57	55	56	59	59	59	0.36
Montgomery	39	39	39	39	40	36	0.65
Rochester	38	37	37	37	38	38	0.54
Rock Dell	35	33	34	32	31	29	0.25
+ Treatments are significantly different when $P \leq 0.05$.							

Year 1 Summary

- There was no yield advantage for applying Zn, Mn, Mo, or B to soybeans at these locations.
- The potential effect of the climatic conditions at individual locations may have limited potential for determining treatment differences.
- Soil tests did not aid in the determination of where micronutrient deficiencies may occur.
- Plant tissue tests at selected sites agreed with yield data that micronutrients levels were sufficient enough to maintain soybean yields.

County Soybean Variety Plots — Marshall, Polk, Red Lake/Pennington County

Cooperator: Cecil Deschene (Argyle), Roger Hinrichs (Red Lake Falls), Kyle Vig (Fosston)
Planting Date: 5/27/11 (Argyle) 5/19/11 (Red Lake Falls) 5/20/11 (Fosston)
Harvest Date: 9/30/11 (Argyle) 9/28/11 (Red Lake Falls) 9/29/11 (Fosston)
Experimental Design: RCB 3 replications

Purpose of Study:
To expand the soybean research effort in NW Minnesota involving growers and county soybean associations in research and communications and provide more localized soybean yield data for producers to use in making choices of future soybean varieties to plant on their farms. Additionally these plots provide more environments to evaluate the same varieties to give more confidence in variety selection and stability. These plots will also build collaborative efforts between local soybean associations, Northern Soybean Growers Team, MN Wheat Council and U of M in providing research and education for the region.

Early RM Brand	Variety	RM	Fosston	Argyle	Red Lake Falls	Site avg.
			Yield 13% (bu/A)			
Dyna-Gro	30RY09	00.9	75.8	58.9		67.4
Legend Seeds	LS 009R20	00.9	73.2	63.0	65.2	67.2
Seeds 2000	0091 RR2Y	00.9	75.2	55.9	69.9	67.0
Wensman	W 30091R2	00.9	69.6	63.8		66.7
Croplan	R2T0091	00.9	74.8	61.9	62.0	66.2
Asgrow	AG00932	00.9	73.3	61.9	61.7	65.6
Croplan	R2T0085	00.8	73.7	55.3	65.7	64.9
Prairie Brand	PB-00950R2	00.9	71.6	54.4	67.6	64.5
Wensman	W 30084R2	00.8	71.8	56.9		64.4
Prairie Brand	PB-00560R2	00.5	69.3	60.4	60.2	63.3
Northstar	NS 0096R2	00.9	68.4	57.3	64.0	63.3
Thunder	31009 RR	00.9	71.8	53.7	64.3	63.3
Proseed	P2 10-08	00.8	71.5	50.2	67.0	62.9
Hyland	HS009RY03	00.9	71.3	54.2	61.1	62.2
Nutech	0090	00.9	67.5	51.8	60.5	59.9
Prairie Brand	PB-00870R2	00.6	65.3	54.1	56.4	58.6
Pioneer	900Y81	00.8	60.7	55.4	58.7	58.3
		$LSD_{0.05}$ =	*5.3*	*7.6*	*5.9*	—

Table continued on page 23

For Additional Information:
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Project Funding Provided by:
Minnesota Soybean Research & Promotion Council

County Soybean Variety Plots — Marshall, Polk, Red Lake/Pennington County (continued)

Late RM Brand			Fosston	Argyle	Red Lake Falls	site avg.
	Variety	RM	Yield 13% (bu/A)			
Stine Seeds	05RC68	0.5	77.0			77.0
REA Hybrids	65G22	0.5	77.6	62.7		70.2
Channel	0205R2	0.2	75.0	61.1	68.6	68.2
Peterson Farms	12R05	0.5	74.6	63.7	64.3	67.5
Dyna-Gro	35RY01	0.1	72.6	62.0		67.3
Asgrow	AG0430	0.4	69.0	66.5	66.2	67.2
Gold Country	241	0.2	71.8	62.0	67.9	67.2
Asgrow	AG0231	0.2	73.8	62.5	63.8	66.7
Wensman	W 3030R2	0.3	75.7	57.5		66.6
Prairie Brand	PB-0240R2	0.2	71.3	59.9	68.5	66.6
Legend Seeds	LS 02R21	0.2	74.7	63.0	61.6	66.5
Dairyland	DSR-0200/R2Y	0.2	73.2	59.6		66.4
REA Hybrids	66G22	0.5	72.9	59.8		66.4
Dyna-Gro	37RY06	0.5	69.8	62.2		66.0
Channel	0100R2	0.1	73.9	60.8	61.8	65.5
Wensman	W 3058R2	0.5	71.3	59.3		65.3
Pioneer	90Y42	0.4	75.5	57.5	62.8	65.3
Dyna-Gro	34RY03	0.3	72.2	58.0		65.1
Northstar	NS 0327NR	0.3	72.5	61.3	61.3	65.0
Thunder	3205 R2Y	0.5	71.0	61.5	62.6	65.0
Pioneer	90Y21	0.2	69.9	57.7	66.2	64.6
Peterson Farms	11R01	0.1	70.4	59.5	63.0	64.3
REA Hybrids	62G22	0.6	71.9	60.4	60.3	64.2
Proseed	P2 11-50	0.5	67.5	60.6	64.4	64.2
Hefty Seed	H04Y12	0.4	65.2	62.2		63.7
Legend Seeds	LS 06R21	0.6	76.7	59.8	54.5	63.7
Integra	97014R	0.0	66.7	60.5		63.6
Gold Country	140	0.1	72.6	57.6	60.5	63.5
Channel	0501R2	0.5	66.2	58.9	64.5	63.2
Asgrow	AG0532	0.5	70.0	55.5	63.6	63.0
Northstar	NS 0516R2	0.5	69.0	58.5	61.5	63.0

Table continued on page 24

County Soybean Variety Plots — Marshall, Polk, Red Lake/Pennington County (continued)

Table continued from page 23

Late RM Brand			Fosston	Argyle	Red Lake Falls	site avg.
	Variety	RM	Yield 13% (bu/A)			
Peterson Farms	11R02	0.2	68.5	56.2	63.8	62.8
Hyland Seeds	HS04RY03	0.4	71.4	58.0	58.4	62.6
Integra	20530	0.5	65.9	58.6		62.3
Pioneer	90Y50	0.5	67.7	57.2	61.6	62.2
Legend Seeds	LS 03R21	0.3	67.7	54.6	64.0	62.1
Hyland Seeds	HS 01RY02	0.1	70.3	54.3	60.6	61.7
Hefty Seed	H03Y12	0.3	66.0	56.6		61.3
Hefty Seed	H01Y11	0.1	65.9	55.6		60.7
REA Hybrids	61G21	0.1	71.1	54.6	56.4	60.7
Asgrow	AG0131	0.1	68.8	51.9	60.1	60.3
Croplan	R2T0240	0.2	64.9	56.1	59.8	60.3
Nutech	6052	0.4	67.9	54.5	57.5	60.0
Hefty Seed	H00Y12	0.0	66.1	53.5		59.8
Thunder	3103 R2Y	0.3	65.9	55.8	57.2	59.7
Integra	20100	0.1	65.2	53.6		59.4
Stine Seeds	01RC62	0.1			59.2	59.2
Nutech	6030	0.3	61.0	60.4	56.0	59.1
Proseed	P2 10-20	0.2	65.4	52.2	59.0	58.9
Peterson Farms	11R03	0.3	62.5	55.2	57.4	58.4
Nutech	6025	0.2	63.4	48.9	61.9	58.1
Dairyland	DSR-0603/R2Y	0.6	63.1	52.3		57.7
Proseed	P2 11-30	0.3	66.3	49.6	55.9	57.3
Thunder	3201 R2Y	0.1	67.7	52.3	50.6	56.9
Northstar	NS 0216R2	0.2	61.8	55.8	48.2	55.2
Stine Seeds	01RA06	0.1			53.1	53.1
Dairyland	DSR-0502/R2Y	0.5		51.4		51.4
		LSD $_{0.05}$ =	*6.1*	*9.0*	*6.6*	—

NOTES