Copper on Winter Wheat Project

(Quinte SCIA Partner Grant Project)

Purpose:

To evaluate the use of copper (Cu) as a fungicide on winter wheat for leaf and grain disease control, and its impact on grain yield and quality.

Methods:

The copper was added to the grower's normal herbicide program after the non-treated (ie. no copper) area was sprayed. Each treatment in the field was a width or two of the sprayer. On the either side of the treatment was the grower's normal fertility program. The copper was calibrated to achieve the required amount of copper. Nortrace Copper 22% was applied at one pound/acre rate, tank mixed with the grower's herbicide program to give 0.22 pounds/acre (lbs/ac) actual Cu applied. At the S. Napanee site, Alpine Copper 7.5% was used at 0.25 l/ac in Furrow treatments, and at 0.75 L/ac as a Foliar Treatment with the herbicide. Soil samples and leaf tissue samples were collected during the growing season. At harvest, a strip was combined from both the "treated" and "untreated" blocks to compared yields. A grain sample was collected from each strip to be analyzed for visible fusarium levels (%) and graded by the Canadian Grain Commission.

Results:

Table 2 shows the grain yield and grain quality results from the Foliar Copper Strips compared to No Copper (Check) Strips in 2007. Table 1 below is used by the Alberta Agriculture, Food & Rural Development to interpret soil sample results.

Table 1: Soil copper levels for mineral soil diagnosis. DTPA extractable. 0-6" depth.

DTPA Cu (ppm)	Interpretation
< 0.4	Deficient
0.4 - 0.6	Marginal
0.6 - 1.0	Deficient in some instances
> 1.0	Usually Adequate*

Source: Alberta Agriculture, Food & Rural Development
*In fields of high variability where the copper may range from 0.2 to 2 ppm with a mean of 1 ppm, up to 50% of the land could be deficient and, therefore, responsive to applied copper, particularly when growing wheat or barley. Running a 20 ft. (6 m) strip of copper fertilizer at a 10 lb actual copper per acre rate in a diagonal across the field, which likely has variable copper levels, will show up "sufficient" and "deficient" areas in succeeding wheat and barley crops.

Table 2. Copper on Wheat 2007

Site	Soil Test pH	Organic Matter %	Soil Test Cu (ppm)	Leaf Analysis Cooper (ppm)	Treatment	Moisture (%)	Test Wt. (lbs/bu)	Yield @14.5% (bu/ac)	Yield Difference * (bu/ac)	% Fusarium	VOM (ppm)	Grade
Castleton	5.9	2.3	0.60	n/a	Nortrace Copper 22%	13.7	56.2	46.5	2.8	0.04	<0.2	2
Castleton	5.9	2.3	0.60	5.42	No copper	13.5	58.8	43.6		0.00	<0.2	2
Castleton	5.9	2.3	0.60		Nortrace Copper 22%	14.3	57.0	47.8	4.2	0.60	<0.2	2
Gananoque	6.8	4.9	2.00	3.57	No copper	23.0	61.0	76.9		n/a		
Gananoque	6.8	4.9	2.00	3.62	Nortrace Copper 22%	23.0	60.0	71.1	-5.8	n/a		
Gananoque	6.8	4.9	2.00	3.57	No copper	23.0	61.0	76.5		n/a		
Gananoque	6.8	4.9	2.00	3.62	Nortrace Copper 22%	23.0	60.0	68.5	-8.1	n/a		
Hasting	n/a		n/a	2.49	Nortrace Copper 22%	12.9	61.9	93.3	-0.1	0.10	<0.2	1
Hasting	n/a		n/a	3.50	No copper	12.9	62.2	93.4		0.10	<0.2	1
S. Napanee	7.4	6	1.80		Alpine Cu 7.5% and Buctril M	14.0	59.3	71.2	4.7	0.00	<0.2	2
S. Napanee	7.4	6	1.80	3.44	No copper	14.0	59.1	66.6		0.30	<0.2	2

Table 2 (continued).

Co-operator Site	Soil Test pH	Organic Matter %	Soil Test Cu (ppm)	Leaf Analysis Cooper (ppm)	Treatment	Moisture (%)	Test Wt. (lbs/bu)	Yield @14.5% (bu/ac)	Yield Difference * (bu/ac)	% Fusarium	VOM (ppm)	Grade
Wellington	7.7	4.2	1.60	5.53	No copper	14.4	10.1	53.9		0.10	<2.2	2
Wellington	7.7	4.2	1.60	6.77	Nortrace Copper 22%	14.5	58.1	57.3	3.4	0.01	0.4	2
Wellington	7.7	4.2	1.60	n/a	Nortrace Copper 22%	14.6	58.2	55.5	1.6	0.10	0.39	2
Napanee	7.1	4.8	1.70	1.20	Nortrace Copper 22%	12.8	60.2	79.1	5.8		0.43	
Napanee	7.1	4.8	1.70	1.81, 2.85	No copper	12.4	60.2	73.3		0.10	0.47	2
Napanee	7.1	4.8	1.70	4.11	Nortrace Copper 22%	12.7	n/a	77.0	3.7	0.20	0.56	2
Belleville	7.6	3.4	1.10	3.01	No copper	14.2	55.8	83.4		0.10	0.27	3
Belleville	7.7	3.4	1.10	6.52	Nortrace Copper 22%	14.1	56.2	79.0	-4.4	0.10	<0.2	3
Belleville	7.6	3.4	1.10	3.89	No copper	14.7	54.5	78.1		0.00	0.25	3
Belleville	7.7	3.4	1.10	6.56	Nortrace Copper 22%	14.4	55.1	71.0	-7.0	0.10	<0.2	3
								Average	**0.1**			
* Yield Difference = Treated less untreated (Check) strip yield												

Table 2. (continued) Other Treatments:

Co-operator	Soil Test pH	Organic Matter %	Soil Test Cu (ppm)	Leaf Analysis Cooper (ppm)	Treatment	Moisture (%)	Test Wt. (lbs/bu)	Yield @14.5% (bu/ac)	Yield Difference * (bu/ac)	% Fusarium	VOM (ppm)	Grade
S. Napanee	7.4	6	1.80	2.91	Alpine Cu 7.5% in furrow	14.1	59.4	62.2	6.2	0.10	<0.2	2
S. Napanee	7.4	6	1.80	3.99	No copper	14.3	59.6	56.0		0.30	<0.2	2
S. Napanee	7.4	6	1.80	3.55	Alpine Cu 7.5% on soybeans ground (June 06)	14.1	59.4	58.0	2.0	0.20	<0.2	2
S. Napanee	7.4	6	1.80	5.69	Alpine Cu 7.5% on Foliar and in furrow	14.2	59.3	63.8	-1.3	0.00	<0.2	2
S. Napanee	7.4	6	1.80	4.28	Alpine Cu 7.5% on soybeans ground (June 06)	14.4	59.6	63.3	-1.8	0.00	<0.2	2
S. Napanee	7.4	6	1.80	4.87	No copper	14.4	59.3	65.1		0.00	<0.2	2
Belleville	n/a	n/a	n/a	n/a	Liquid Copper, Boron, Seaweed, Buctril M	14.3	54.8	77.7	-0.4	0.04	<0.2	3
Belleville	n/a	n/a	n/a	n/a	Liquid Copper, Boron, Seaweed, Buctril M and Stratego	14.5	55.4	76.2	-1.9	0.10	<0.2	3

Table 3 – Soil Test and Leaf Tissue Analysis for 2008

Co-operator	Treatment	Soil Test pH	Organic Matter %	Soil Test Cu ppm	Leaf Analysis Cooper (3ppm)	Leaf Analysis Calcium (.25%)
Wellington	Copper	7.5	3.9	2	8.34	0.76
Wellington	No Copper	7.5	4.4	2	7.93	0.77
Wellington	Copper	7.5	3.9	2	8.34	0.76
Wellington	No Copper	7.5	4.4	2	7.93	0.77
Wellington	No Copper	7.5	4.4	2	7.93	0.77
Napanee	Copper	5.5	3.5	1.3	6.46	0.59
Napanee	No Copper	5.3	3.1	1.2	4.78	0.51
Picton	Copper	6.2	4.8	1.4	7.23	0.62
Picton	No Copper				7.11	0.63
Napanee S.	Copper	6.5	3.8	1.7	4.83	0.54
Napanee S.	No Copper	6.6	3.8	1.7	4.98	0.49

Summary:

In 2007, (Table 2) due to the field variability shown in this trial, it is not possible to draw any conclusions of the impact of foliar applied copper on yield. An example of this field variability is at the S. Napanee site where the yield of the no copper strips varied from 56 to 66 bu/ac. On average across all trials, the yields of the copper applied foliar with the herbicide treatments and the no copper treatments were equal. In 2007, the fusarium and vomitoxin levels were low and there was no difference in visible fusarium levels, vomitoxin levels, or grade between the grain samples from the copper and no copper (check) strips.

In 2008 (Table 4), there was no yield increase where the copper was used and the negative yield may have some toxic effect from the inclusion of the copper that resulted in a slight yield decrease where the copper was applied. From the graded samples, fusarium levels were very high in 2008 and there appears to be a reduction in the fusarium levels and a small reduction in the vomintoxin levels where the copper was applied, although these reductions are not supported in the research literature.

Based on the results of this project, it would appear that there is no yield increase due to the addition of Cu with the herbicide in winter wheat. Further research with a greater number of grain samples is needed to determine if the addition of the Cu consistently reduces fusarium and vomintoxin levels in high fusarium years..

Table 4 – Grain Yield and Quality for 2008

Site	Treatment	Rep. ID	Yield @14.5% (bu/ac)	Average Yield @14.5% (bu/ac)	Fusarium (%)	Dockage (%)	VOM (ppm) 0.2 = <0.20	Grade	DIFF Yield @14.5% (bu/ac)	DIFF Fusarium	DIFF VOM
Wellington	Copper	1	73.1		0.27	1.2	0.2	3	-3.9	-94%	0%
Wellington	No Copper	1	77.1		4.17	1.3	0.2	CE Feed			
Wellington	Copper	2	74.5						-11.3		
Wellington	No Copper	2	87.5								
Wellington	No Copper	3	84.0	85.8							
Napanee	Copper	1	40.6		1.25	0.9	0.33	3	2.7	-73%	65%
Napanee	No Copper	1	37.9		4.64	0.7	0.2	CE Feed			
Napanee	Copper	2	31.3		20.11	1.3	0.2	Sample	-2.0	-11%	-84%
Napanee	No Copper	2	33.4		22.71	0.7	1.25	Sample			
Napanee	Copper	3	31.0		1.31	1.3	1.25	3	-1.9	-59%	-14%
Napanee	No Copper	3	34.7	32.9	3.23	0.6	1.46	CE Feed			
Napanee	No Copper	4	36.5			0.6	0.95	CE Feed			
Picton	Copper	2	62.1		1.75	1.1	0.3	CE Feed	-1.1	-23%	-40%
Picton	No Copper	2	63.2		2.26	0.6	0.5	CE Feed			
Picton	Copper	3	66.9		0.4	1.5	0.26	3	1.9	-84%	-7%
Picton	No Copper	3	65.0		2.43	1.2	0.28	CE Feed			
Napanee S.	Copper	1	105.3		1	0.3	0.2	3	-1.2	-84%	0%
Napanee S.	No Copper	1	106.5		6.36	0.3	0.2	Sample			
							Average		**-2.1**	**- 61%**	**- 12%**

Soil Test Levels: In Ontario, the soil test method for Cu is considered not to be very reliable. The Alberta Ministry of Agriculture. Food and Rural Development published Table 1 to determine the requirement for Cu based on the soil test levels. Using Table 1 as a guide, in 2007 most of the sites have adequate soil Cu levels. The exception is at the Castleton site where the soil test level results would be considered deficient in some instances. This may be why there was an increase in yield at this site; however, the other three sites (Wellington, Napanee & S. Napanee) with increased yield have soil test Cu levels considered above adequate.

In 2008, Table 3 shows that all sites have above adequate Cu soil levels.

Leaf Tissue Analysis: In the Ontario Ministry of Agriculture, Food and Rural Affairs (OMAFRA) Agronomy, Publication 811, the minimum critical concentration for Cu in cereals is 3.0 ppm. From the untreated leaf tissue analysis of the various sites, only the Napanee site was below this critical concentration level.

In 2008, Table 3 shows that all sites have above adequate leaf tissue concentrations.

Product Costs: The cost of the Nortrace Copper 22% at the one pound/acre rate is $5.15/acre. Given the current market price for winter wheat, one bushel/acre increase would cover the extra product cost. The Apline Cu 7.5% retails for $7.50 per litre. Applied at 0.75 per acre, the Cu product cost is $5.63.

Next Steps:

Further research with a greater number of grain samples is needed to determine if the addition of the Cu consistently reduces fusarium and vomintoxin levels in high fusarium years.

Acknowledgements:

Thank you to the co-operators for their time, effort and inconvenience on this project. Thank you also to the local agri-business and the Canadian Grain Commission for their involvement in this project. This project was supported by the Ontario Soil & Crop Improvement Association and the Ontario Wheat Producers' Marketing Board.

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