Winter Wheat Response to Applied Copper Fertilizer

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 growers 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 1 pound per acre rate, tank mixed with the growers herbicide program to give 0.22 pounds per 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 1 shows the grain yield and grain quality results from the Foliar Copper Strips in 2007. Table 2 shows the grain yield and grain quality results from the No Copper (Check) Strips in 2007. Table 3 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 per cent 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. 2007 Copper on Winter Wheat Project

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
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

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 3. Other Treatments:

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
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

Summary:

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.

Soil Test Levels - In Ontario the soil test method for Cu is considered not very reliable. The Alberta Ministry of Agriculture. Food and Rural Development published Table 3 to determine the requirement for Cu based on the soil test levels. Using Table 3 as a guide, 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.

Leaf Tissue Analysis - In the 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.

Product Costs – The cost of the Nortrace Copper 22% at the 1 pound per acre rate is $5.15 per acre. Given the current market price for winter wheat, 1 bushel per 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:

The project is planned to be continued again in 2008 and a final report to be prepared summarizing the data from 2007 & 2008 crop years. More replications of the same treatments are needed to better assess the impact of foliar applied copper.

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