

# Wheat Diseases and Copper Nutrition

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*Field studies in Alberta show copper (Cu) fertilization plays a role in the control of ergot infection, take-all and melanosis in hard red spring wheat.*

**YIELDS AND DISEASES** of spring wheat growing in Cu deficient soils can be profoundly influenced by soil or foliar Cu amendments. Ergot infection, take-all root rot and melanosis are markedly reduced or eliminated when Cu fertilizers are added to soils containing less than 1 part per million (ppm) available Cu.



**ERGOT INFECTION** in wheat can be markedly reduced by providing adequate Cu.

## Copper Effects on Ergot

Field studies conducted in Alberta demonstrate how effectively Cu controls ergot infection. In two experiments in 1989, varying amounts of Cu, applied as copper sulfate ( $\text{CuSO}_4$ ), were applied to Cu deficient soils in replicated small plots or field-scale strips. In the small plot trials, Cu application decreased the number of ergots per square yard from 11 to 2 and increased yields by more than 300 per cent, **Table 1**.

**Table 1. Copper fertilization decreased ergot infection of Park wheat.**

Cu Rate, lb/A <sup>1</sup>	Grain yield, bu/A	Ergots, number/sq yd.
0	13	11
10	43	2

Dark Gray Chernozem with 0.6 parts per million (ppm) DTPA extractable Cu  
<sup>1</sup>40 lb  $\text{CuSO}_4$ /A applied in 1987

**Table 2** shows the results from the field scale test strips. In this study, the number of ergots per square yard ranged from a high of 45 in the non-amended soil to a low of 1 where Cu was applied.

**Table 2. Copper fertilization decreased ergot infection of Katepawa wheat.**

Cu Rate, lb/A <sup>1</sup>	Grain yield, bu/A	Ergots, number/sq yd.
0	18	45
4	34	2
10	43	1

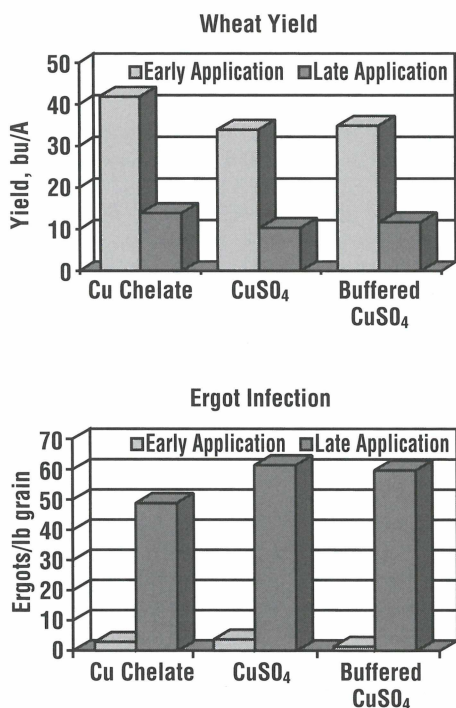
Organic soil with 0.6 ppm DTPA extractable Cu  
<sup>1</sup>15 and 40 lb  $\text{CuSO}_4$ /A applied in 1989

In another study in central Alberta, Roblin spring wheat, in a 120 acre field on soil known to be Cu deficient, developed signs of crop damage two weeks after herbicide application. The wheat showed yellowing, stunting and pig tailing, all indicative of severe Cu deficiency. Foliar applications of Cu chelate,  $\text{CuSO}_4$  and  $\text{CuSO}_4$  buffered to pH 5.0 were sprayed directly on the wheat on June 30

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**COPPER DEFICIENCY** symptoms in small grain (barley pictured here) include stunted plants, deformed leaves and heads, and chlorosis.



**Figure 1.** Foliar Cu application (0.25 lb Cu/A) improved yields and controls ergot in Roblin wheat.  
(Bearhills, Alberta, July 1992)

(early) and July 21 (late) at a rate of 0.25 lb Cu/A. The early Cu application was the most effective, averaging 2.5 ergots per pound of grain compared to 56.5 for the late application, **Figure 1**. It also produced three times more yield than the later application.

The mechanism of ergot infection is correlated with pollen sterility on Cu deficient soils. Self-pollinated florets are normally closed, but under Cu deficiency they remain open, thus greatly increasing the probability of ergot infection and possibly other diseases. Melanosis (depending on cultivar) on a Cu deficient soil can range from zero (not evident) to a chocolate brown discoloration of the stems and heads.

**Table 3.** Copper reduced take-all disease symptoms and melanosis in spring wheat cultivars.

Cultivar	Take-all, %		Melanosis	
	+ Cu <sup>1</sup>	- Cu	+ Cu	- Cu
Roblin	4	70	none	slight-severe
Oslo	12	69	none	none
Laura	4	52	none	none
Park	6	78	none	slight-severe

<sup>1</sup>DTPA extractable Cu, 0.6 ppm Stony Plain, Alberta  
Application rate, 12 lb Cu/A (as CuSO<sub>4</sub>)

**Table 3** demonstrates the dramatic effect Cu can have on take-all root rot and melanosis. In this study, applied Cu decreased the severity of take-all in several cultivars of spring wheat by 48 to 72 percent and eliminated melanosis in Roblin and Park wheat. Recent research in Australia has also shown that Cu application reduces take-all severity in wheat. Melanosis ranged from an absence of any obvious symptoms to pale brown (slight), mid-brown (moderate) and dark brown (severe) discoloration of the head and straw of the ripening wheat.

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Copper deficiency delays or reduces starch formation during grain filling, causing the accumulation of soluble carbohydrates which makes the crop susceptible to stem and head diseases like melanosis.

### Summary

Our studies in Alberta indicate a significant area, estimated to exceed 3 million acres, in wheat growing regions may be yield-limited because of Cu deficiency. It's clear that low or deficient levels of Cu predispose wheat to yield-reducing infectious diseases like take-all, ergot infection and melanosis and to a range of other disorders from seedling to crop maturity. Such yield losses and disease problems can be dramatic, but are easily minimized or eliminated with small applications of foliar Cu (0.25 lb/A) or larger amounts of soil applied Cu (10 lb/A). ■



**INCREASING MELANOSIS (right) is associated with increasing severity of Cu deficiency.**

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## Nutrient Management Conference Announced for May 16-18, 1994

**PLANS** for a 1994 conference entitled "Nutrient Management on Highly Productive Soils" have been announced by the Potash & Phosphate Institute (PPI) and the Foundation for Agronomic Research (FAR), co-organizing groups. The Conference is scheduled for May 16-18, 1994 at the Atlanta Airport Hilton Hotel, Atlanta, GA.

The program will feature a range of interesting topics including: the importance of maintaining soil fertility, fertilizer recommendations and spatial variability, site-specific nutrient management, individualized nutrient management recommendations, the roles of fertilizer placement in improving productivity, economic and environmental impacts of intensive cropping systems, outline of the U.S. Agricultural Pollution Prevention Plan and a discussion

of regulatory effects on fertility use.

The Conference is attracting co-sponsorship from both private and governmental sectors. A broad spectrum of participants is expected, ranging from agricultural producers to fertilizer and agricultural chemicals dealers, fertilizer and agricultural industry representatives, crop management consultants, state and federal regulatory agency personnel, federal service agency personnel, researchers, Extension workers and journalists. A proceedings of the Conference papers will be available at the time of the meeting.

For more information on the Conference program, registration cost and housing, contact the Potash & Phosphate Institute, 2805 Claflin Rd., Suite 200, Manhattan, KS 66502. Phone: (913) 776-0273; fax: (913) 776-8347. ■