

## Copper Deficiency

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### Biology

Copper deficiencies can occur in the Black, Gray-Black, Dark Brown, Gray Wooded, peat and transition soils. Wheat, barley, oats, alfalfa and, to a lesser extent, rye and non-cereal crops can be affected by copper deficiency. This is a non-parasitic disease disorder but can increase susceptibility to or resemble parasitic diseases.

### Damage Description

Copper deficient plants develop light-green leaves that become dry at the tips. Younger leaves, particularly in barley, may fail to unroll, or may curl, twist and pigtail. Affected roots in wheat and barley are stunted and crowns are excessively branched and rosetted, and stems are thin and spindly; elevated levels of or take-all like symptoms, may occur in wheat. Heads are bleached and may be incompletely emerged or appear normal but fail to set seed. Ergot may be common in wheat and sometimes barley, and crop lodging can be very severe.

The heads and stems of copper deficient wheat, especially the variety Park, become melanotic (brown) and either result in shrivelled seed or no seed. Neepawa and other wheats may not show the melanosis typical of Park, but yields can be equally depressed. The melanosis or brown pigment that occurs in some wheats is associated with secondary bacterial infection.

Yield losses result from empty heads, poorly-filled grains and ergot infection. Barley grown in plots deficient in copper will head-out seven to ten days later than barley grown in comparable plots that have adequate available copper; this could be important in seasons with an early killing frost.

### Diagnosis

The range between sufficient and deficient levels of copper is quite small. Rye can take copper from soils that are deficient for wheat, barley and oats. Ten per cent or more of the crop land in Alberta may be severely deficient in copper. Perhaps double or more land may have insufficient available copper levels to facilitate maximum yield in wheat or barley.

Uneven or severely lodged stands of cereals and the presence of take-all like symptoms, melanosis and ergot are good indicators of copper deficiency in the field. Specific soil tests for copper availability must be carried out at a soil testing laboratory. Representative soil

cores from across the field should be taken at the 0-15 cm and 15-30 cm soil depths. Surface and lower profile copper availability should be above 1 ppm.

### Management Strategy

Apply copper sulphate (bluestone), copper oxychloride or chelated copper to the soil alone or in combination with fertilizer, or as a foliar spray. Apply copper compounds as a foliar spray at late tillering. Rates of 10-20 kg of bluestone per acre will correct copper deficiency for 10 to 15 years.

Grow cereals such as rye or triticale or a non-cereal crop that tolerates lower levels of copper in the soil.

**Bushels per acre of barley in 1990 on plots fertilized with 18 kg of copper sulphate per acre in 1987, near Edmonton**

Cultivar	Copper	No Copper
Condor	80	26
Duke	113	103
Harrington	85	51
Noble	99	60
Viriden	99	52
Original soil tests showed 0.6 to 0.9 ppm available copper.		



*Severe copper deficiency in barley (left). Dieback of heads and failure of grain set.*



*Head deformation caused by low to deficient levels of copper particularly in later formed tillers. Mistaken for phenoxy herbicide injury in barley.*



*Degrees of copper deficiency causing stunting, increased tillering and leaf tip necrosis in barley. Copper deficiency may delay crop maturity by a week to 10 days. All plants were taken from the same field.*



*Copper deficiency in wheat is the most common cause of browning (melanosis) in wheats, particularly in the variety p. Such levels of symptoms can result in severe yield losses exceeding 75% of expected yields, not to mention quality.*



*Severely affected through moderately affected to relatively unaffected wheat heads of Katepewa wheat.*



*Oslo wheat showing severe copper deficiency left to healthy right. Little or no melanosis*

*occurs in this cultivar.*



*Park wheat samples taken from melanotic (left) and healthy appearing areas of the same field.*



*Vivid browning (melanosis) of Park wheat on sandy soil in the Camrose area of Alberta. Sandy loam and peaty (high organic) soils are the most likely to be most severely copper deficient.*

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This document is maintained by [Shelley Barkley](#).  
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