

Nutri-Facts

Agronomic information on nutrients for crops

Nutri-Facts #10

It's for Certain — Copper Is Required by Plants

COPPER (Cu) is a micronutrient. That means plants contain less Cu than other nutrients, like nitrogen (N). In fact, plants contain 2,500 times less Cu than N, yet Cu is as necessary for plant growth as is N. Plants need Cu to complete their life cycle — to produce viable seeds — *it's for certain*.

Photosynthesis — the production of carbohydrates from sunlight, air and water — is one of the most important chemical processes in the world. It is the only way to input energy into the living world. Yet without Cu, there would be no photosynthesis, because this nutrient is necessary for the formation of chlorophyll — the material that gives plants their green color and allows them to absorb the sunlight used in photosynthesis.

Copper Availability in Soil

Soil characteristics which affect Cu availability include the following:

- **Organic matter.** Deficiencies are often localized and associated with crops grown on high organic matter soils, peats and mucks. Copper is held more tightly by organic matter than is any other micronutrient.
- **Texture.** Sandy soils are more likely to be Cu deficient than loams and clays. Clays hold Cu in exchangeable form, available to crops. However, other soil components

Symptoms of Cu deficiency may not be as easy to identify as those for other micronutrients. Copper does not move in the plant, so deficiencies appear first in younger growth.

such as oxides and carbonates reduce the availability of Cu.

- **Soil pH.** Copper availability is decreased as pH increases to 7 and above. The higher pH reduces solubility and increases the strength by which Cu is held by soil clays and organic matter, thus making it less available to crops.
- **Nutrient balance.** Reduced Cu availability and deficiency are often the result of interaction with other plant nutrients. For example, high levels of N aggravate Cu deficiency, and high levels of phosphorus (P), zinc (Zn), iron (Fe) and aluminum (Al) may restrict Cu uptake by plant roots.

Copper for Crops

Crops differ in their response to Cu (Table 1). Cereals and citrus crops

are most sensitive to low levels of available Cu. Among small-grain cereals, rye is very tolerant of low Cu levels. In fact, it can extract twice as much Cu as wheat under the same conditions. The usual order of sensitivity for small grains is wheat > barley > oats > rye. Varietal differences are also important and at times can be as large as differences among species.

Table 1. Responsiveness of crops to Cu.

Most response	Medium response	Least response
Wheat	Corn	Beans
Rice	Oats	Peas
Citrus fruits	Sugar beets	Potatoes
Carrots	Cauliflower	Asparagus
Lettuce	Broccoli	Canola
Spinach	Cabbage	Soybeans
Table beets	Celery	Rye
Onions	Clover	Pasture-
Alfalfa	Radishes	Grasses
	Turnips	Pines
	Pineapple	

Plant Deficiency Symptoms

Symptoms of Cu deficiency may not be as easy to identify as those for other micronutrients. Mild or moderate deficiency may only result in reduced growth and yield. More acute deficiencies result in chlorosis and

dieback of terminal growth. Copper does not move in the plant, so deficiencies appear first in younger growth. Copper-deficient plants develop weak stems and appear to wilt slightly, even under conditions of adequate moisture.

In cereal crops, symptoms are most evident between late tillering and emergence of the flag leaf. Browning of the head and bending of the head and stem at maturity are common signs of Cu deficiency in wheat and barley. The heads are often empty or contain shriveled grain.

Solving the Copper Deficiency Problem

Crops require very low amounts of Cu. A good wheat crop contains less than 0.01 lb of Cu/A in the grain and straw. Because the crop requirements are so low, and the rate of uptake is slow, almost all sources are soluble enough to meet crop demands.

Soil application is the most common way to correct Cu deficiency. Application rates vary from less than 2 lb/A to 14 lb/A for mineral soils and from 10 to 45 lb/A for organic soils. Because of the low mobility of Cu in soils, broadcast plus incorpora-

tion is generally the most effective application method. Copper can also be banded or applied with the seed. Foliar application (applied between small grain tillering and boot) is effective for correcting a deficiency, but its use is generally restricted to emergency treatment.

Responses to Cu can be dramatic. Figure 1 shows how hard red spring wheat responded to Cu fertilization on organic soils in northern Minnesota. Yield increases of more than 45 bu/A were obtained. Note the banded application was not able to correct the Cu deficiency.

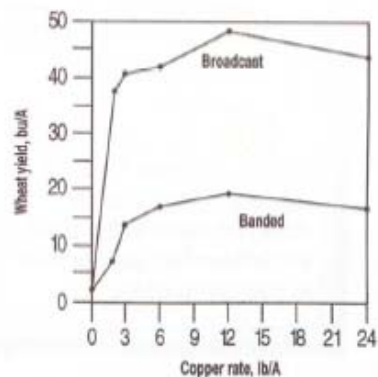


Figure 1. Wheat yield response to copper sulfate fertilization on organic soils in northern Minnesota.

Copper-deficient mineral soils are also extremely responsive to Cu fertilization. Table 2 shows Alberta data where Cu not only caused spectacular yield increases in wheat and barley, but also improved grain quality significantly.

Table 2. Copper fertilization improves yields and kernel plumpness of Alberta wheat and barley.

Crop	Treatment ¹	Yield, bu/A	Kernel plumpness, %
Barley	No Cu	62	48
	Cu	92	82
Wheat	No Cu	15	59
	Cu	36	72

¹Copper sulfate applied at rate of 10 lb Cu/A.

Copper does have some vital functions in plants — it's for certain. ■

For further information contact:



POTASH & PHOSPHATE
INSTITUTE
Suite 110
655 Engineering Drive
Norcross, Georgia, U.S.A.
30092-2837
Phone: (770) 447-0335



POTASH & PHOSPHATE
INSTITUTE OF CANADA
Suite 704-CN Tower
Midtown Plaza
Saskatoon, Saskatchewan
S7K 1J5 Canada
Phone: (306) 652-3535



FOUNDATION FOR
AGRONOMIC RESEARCH
Suite 110
655 Engineering Drive
Norcross, Georgia, U.S.A.
30092-2837
Phone: (770) 447-0335
Fax: (770) 448-0439