Canada-Saskatchewan Irrigation Diversification Centre

Micronutrients in Potato Production

Research Highlights: March 2001

Introduction

Plants require varying amounts of 16 essential nutrients during the different stages of their development. Those required in relatively large amounts (Nitrogen, Phosphorus, Potassium, Calcium, Magnesium, and Sulphur) are called macronutrients and those required in small quantities are called **micronutrients**. Although micronutrients are used in smaller quantities, they are just as important as the macronutrients. The micronutrients required by plants include Boron (B), Chlorine (Cl), Cobalt (Co), Copper (Cu), Iron (Fe), Manganese (Mn), Molybdenum (Mo), Selenium (Se), Sodium (Na), and Zinc (Zn). The availability of these nutrients in the soil depends on the soil and the environment. For example, Zn is a relatively immobile nutrient that is concentrated in the soil organic matter near the soil surface. Cool, wet weather reduces the availability of Zn, possibly resulting in a deficiency.

Micronutrient availability generally decreases as soil pH increases. Availability of B, Cu and Zn declines rapidly as soil pH rises above 7 (Figure 1). Therefore, deficiencies can occur in soils with high pH, such as those found in Saskatchewan. Also, sandy soils are more likely to show micronutrient deficiencies than clay soils. Micronutrient deficiency symptoms can be visually identified in potato plants (Table 1).

Table 1. Boron, zinc and copper deficiency symptoms of potato.

Micronutrient	Role in Plant	Deficiency Sypmptoms
Boron (B)	Boron regulates transport of sugars through membranes, and also plays a key role in cell division, cell development and auxin metabolism.	Growing buds die. Plants appear bushy, having shorter internodes, leaves thicken and roll upward. Leaf tissue darkens and collapses.
Copper (Cu)	Copper is involved in several enzyme systems, cell wall formation, electron transport and oxidation reactions.	Young leaves exhibit a pronounced rolling, and then leaf tips wilt and die. Leaves remain green and are of normal size.
Zinc (Zn)	Zinc has many important roles in plant growth and plant enzyme formation.	Young leaves are chlorotic (light green or yellow), narrow, upwardly-cupped and develop tip-burn. Other leaf symptoms are green veins, spotting with dead tissue, blotching, and erect appearance.

The potato plant is no exception in its nutrient requirements. Standard fertility management supplies the crop needs. Micronutrient deficiencies have been reported for potato in many potato growing regions. CSIDC has conducted research to evaluate the response of potato to added micronutrients under Saskatchewan conditions.

Study Description

Small plot studies were carried out at CSIDC to examine the effects of soil and foliar applied B, Cu, and Zn on the productivity and quality of seed and consumption (table or processing) grade potatoes.

A seed potato crop may respond to micronutrient application differently than a consumption crop as the seed crop is harvested earlier and the marketable tubers are generally smaller than potatoes grown for consumption (i.e. table or processing).

Norland and Russet Burbank were used in these studies as they are the leading table and processing cultivars grown in western Canada. Norland is an early maturing table cultivar,

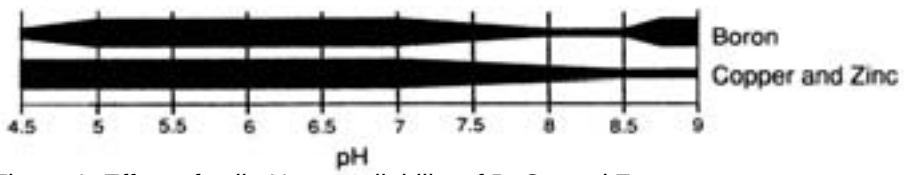

Figure 1. Effect of soil pH on availability of B, Cu and Zn.

whereas Russet Burbank is late maturing, and is the processing standard.

Trials were conducted on an irrigated sandy loam soil with no previous history of micronutrient use. The concentrations of micronutrients used in these studies were based upon commercial recommendations. Soil applications included, 1.6 kg B/ha (1.44 lb/ac) in the form of granular Borate, 10 kg Cu/ha (9 lb/ac) in the form of Copper chelate, and 10 kg Zn/ha (9 lb/ac) in the form of Zinc sulphate broadcast on to the seedbed prior to planting. The foliar treatments included 0.3 kg B/ha (0.27 lb/ac), 0.5 kg Cu/ha (0.45 lb/ac), and 0.5 kg Zn/ha (0.45 lb/ac) applied as a foliar spray at the time of early tuber bulking. The sources of the foliar micronutrient applications included commercial formulations of liquid Boron, Copper chelate, and Zinc EDTA.

The test plots were managed using standard cultural practices for irrigated potato. Harvested tubers were graded into seed and consumption market classes based on tuber diameter. Seed grade included tubers between 30 and 90 mm (1.2 and 3.6 in) diameter. Consumption grade included tubers larger than 45 mm (1.8 in) in diameter. Tuber specific gravity and fry colour were determined for processing grade tubers. Fry colour was evaluated according to USDA standards.

Results and Discussion

Neither soil-applied nor foliar-applied B, Cu or Zn affected seed or consumption grade yields, specific gravity, or fry colour of processing cultivars. Yield responses for micronutrient treatments in Norland and Russet Burbank potato are shown in Figure 2.

The lack of any significant yield or quality responses to micronutrient supplements is likely due to the presence of adequate levels of micronutrients in the soil. For example, soil testing to 30 cm (12 in) in the spring of 1997 showed that the soil contained 4.4 kg B/ha (4.0 lb/ac), 3.4 kg Cu/ha (3.1 lb/ac), and 2.4 kg Zn/ha (2.2 lb/ac). Recommended soil levels for potato production are 1.1 kg B/ha (1.0 lb/ac), 0.4 kg Cu/ha (0.4 lb/ac), and 1.1 kg Zn/ha (1.0 lb/ac).

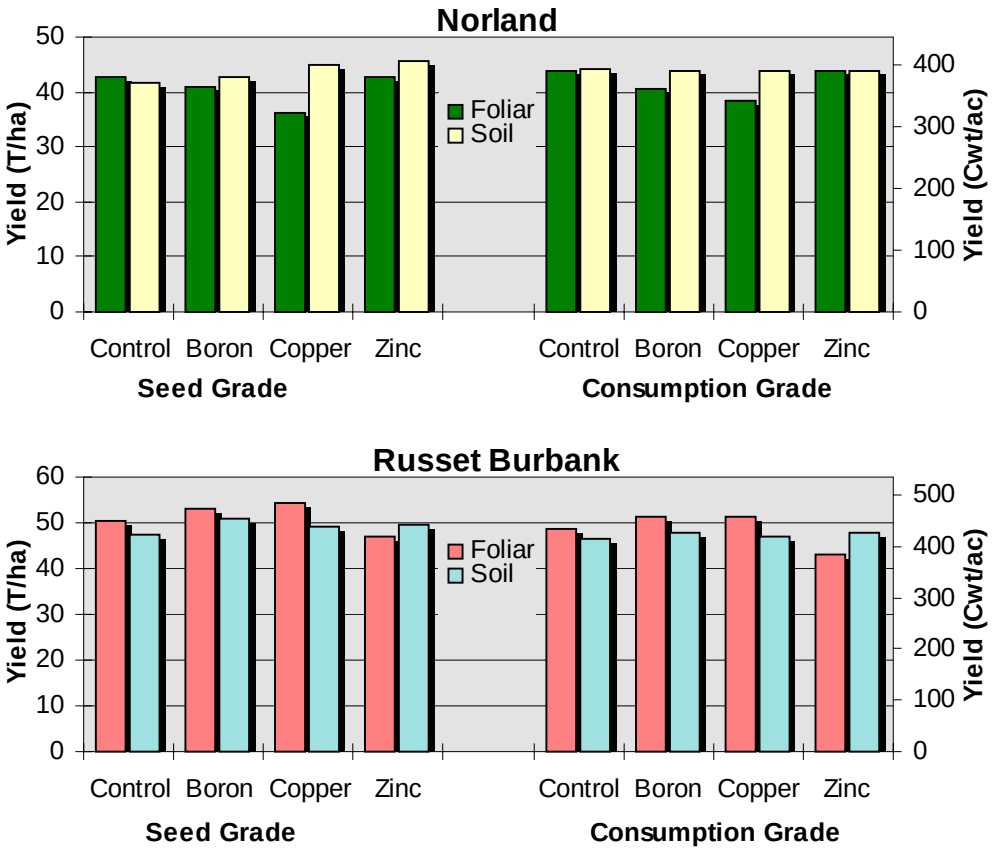

Figure 2. Seed and consumption grade tuber yields for Norland and Russet Burbank cultivars as influenced by type and method of micronutrient application: (averaged from 1995, 1996, 1997).

Conclusion

Nutrient management is a critical component for successful potato production. The use of micronutrient supplements should be based on soil tests, tissue tests and close visual examination of the potato crop for deficiency symptoms. Growers should carefully follow recommendations for micronutrients to avoid unnecessary costs and possible toxic effects or deleterious interactions with other nutrients. Selection of an effective application method depends on the micronutrient needed, local soil conditions, and the stage in the growing season at which a deficiency is detected.

Funded by

Canada-Saskatchewan Agri-Food Innovation Fund

The Bottom Line...

Micronutrient deficiencies can occur in the high pH soils of Saskatchewan. On sandy loam soils at the CSIDC, soil or foliar applied micronutrients did not produce added benefits for potato grown under irrigation. Use micronutrient supplements for potato production if deficiency is detected through soil and tissue tests and visual observations. This will avoid the expense and potential problems associated with unnecessary use of these products.

Canada-Saskatchewan Irrigation Diversification Centre

Phone: (306) 867-5400
Fax: (306) 867-9656

901 McKenzie St. S.
Outlook, Saskatchewan S0L 2N0 Canada

Email: sidc@em.agr.ca
Website: http://www.agr.ca/pfra/sidcgene.htm