Nutrient Availability Following a 14-year Irrigated Potato Rotation Study in Manitoba

R. Mohr1, A. Nelson2, D. Tomasiewicz3, D. McLaren1, M. Monreal1,2, B. Irvine1, M. Khakbazan1, A. Moulin1, D. Derksen1,2 and K. Volkmar4

1Agriculture and Agri-Food Canada, Brandon, Manitoba; 2Canada-Manitoba Crop Diversification Centre, Carberry, Manitoba; 3Canada-Saskatchewan Irrigation Diversification Centre, Outlook, Saskatchewan; 4Agriculture and Agri-Food Canada, Southern Crop Protection and Food Research Centre, London, Ontario; Retired.

Introduction

- Long-term cropping systems have the potential to influence nutrient availability through effects of crop rotation and associated management on nutrient cycling.
- Little information is available for western Canada regarding the impact of longer-termed irrigated potato systems on subsequent soil nutrient status and crop productivity.

The objective of this study was to determine the effect of preceding irrigated potato rotations, in place for 14 years, on concentrations of P, K, Cu and Zn in soil, and in seed of a soybean (Glycine max) crop in the year following termination of the rotation treatments.

Materials and Methods

An irrigated potato rotation study was conducted on an Orthic Black Chernozem soil near Carberry, MB from 1998 through 2011, inclusive. The study was arranged in a randomized complete block design (RCBD) with four replicates. Rotation treatments consisted of potato with canola (PC), wheat (PW), canola (PC), wheat (PW), canola (PC), alfalfa (POW), wheat (PW), and underseeded to alfalfa-alfalfa-alfalfa (PCAA), with each phase of each rotation present in each year. All crops were managed using generally accepted agronomic practices for the region. Soil tests were conducted annually.

In fall 2011, all rotation treatments were discontinued. Rotation length with 2-yr rotations predominated by cereals was lower for PCAA than PWCW and annual rotations overall. Preceding alfalfa also reduced P availability versus non-legume crops. Observed differences in soil P were often reflected in the seed P concentration of the 2012 soybean crop (Fig. 2). Preceding crop also influenced seed Cu and Zn:

- Seed Cu was higher where soybean followed alfalfa (11 mg kg\(^{-1}\)) than non-legume crops (10.3 mg kg\(^{-1}\)) or 3-yr (4.5 vs 5.1 mg kg\(^{-1}\)) or 3-yr (4.5 vs 4.9 mg kg\(^{-1}\)).
- Seed Zn concentration in soybean grown after rotations predominated by cereals was lower for each of the 2-, 3- and 4-yr rotations (Fig. 2). Also, the crop preceding soybean influenced seed Zn with potato>canola>cereals (48.6>46.6>44.3 mg kg\(^{-1}\)).

Conclusions

- Long-term, intensively-managed irrigated potato rotations influenced the nutrient status of the cropping system to some degree. However, with careful management, nutrients were effectively maintained within acceptable levels for agricultural production.

- Fertilizer management practices used during the 14-yr rotation study affected the availability of P and K measured in the year after termination of the rotations.
  - Higher P levels following shorter rotations with a greater frequency of potato likely resulted because P fertilizer rates in potato exceeded P removal. As P was broadcast-incorporated in potato (due to a lack of banding capability), higher P fertilizer rates had been used to compensate for reduced plant availability of broadcast P.
  - Lower P and K levels associated with growing alfalfa were likely due both to the relatively high P and K removal rates of alfalfa hay, and fertilizer management. Fertilizer P was applied only in the establishment year of alfalfa as is common practice. Soil test K levels were sufficient for all crops except potato, so K was not applied to alfalfa until 2010 to address notable declines in soil K.

- Micronutrient availability measured in the year after termination of the rotation study varied as a function of preceding rotation and rotational crop.
  - Although rotation had little effect on soil Cu and Zn concentration, soybean grown following PCAA or potato contained higher Cu and Zn concentrations in the seed. Including mycorrhizal crops such as potato and alfalfa in rotation may have played some role in enhancing micronutrient availability. No micronutrient fertilizers were applied in the rotation study, but select fungicides applied to potato contained varying levels of Cu and Zn.

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