The Influence of Zinc Fertilization on Lentil Seed Yield and Zinc Concentration in Ten Saskatchewan Soils

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INTRODUCTION

Saskatchewan is the largest producer and exporter of lentils in the world. Continuous development in production techniques is required in order to maintain this leading role. Recently, much emphasis is being put on quality of product alongside quantity. Optimum level of essential nutrients in grain consumed is an important but neglected quality parameter. Zinc (Zn) is one essential nutrient that is deficient in developing countries where Saskatchewan lentil is marketed. Both genetic and agronomic approaches can be effective in increasing Zn concentration in grain of lentil (White and Broadley, 2009). Some studies have been conducted previously on yield response of lentil to Zn application (Thavarajah et al., 2009). However, there are many gaps in information about effect of Zn fertilization on lentil Zn concentration, and its interaction with soil type and lentil class in Saskatchewan. The main goal of this project was to evaluate the response of three major lentil classes to Zn fertilization at three rates on ten soils from the Brown, Dark Brown and Black soil zones of Saskatchewan prairies. A second objective, given the large variation in soil properties across Saskatchewan, was to evaluate the distribution of Zn in various labile and stable fractions chemically separated from the soil.

METHODOLOGY

Ten surface soils (0-15cm) were collected from the lentil growing regions in Saskatchewan. Soil associations represented were Chaplin, Haverhill, Hatton, Regina, Ardill, Fox Valley, Echo, Indian Head and Melfort. Soils were analyzed for physicochemical properties, total Zn, DTPA extractable Zn and exchangeable available Zn supply rate using Plant Root Simulator (PRS) probes. Furthermore, Zn bound in various soil fractions was determined using BCR technique. Subsamples of homogenized soil were placed in 1kg pots. Basal dose of N, P and S was supplied to all pots. Zinc sulfate was used to supply Zn at a rate of 2.5 and 5 kg Zn ha^{-1}. A popular CDC variety of each of the three (large and small green, small red) lentil classes (Impower, Imvincble, Maxim) was grown on each soil. Lentils were harvested at maturity, straw and grain yield determined, and analyzed for Zn concentration.

RESULTS AND DISCUSSION

Zinc fertilizer application significantly influenced grain yield of lentil classes. This influence was soil dependent (Figures 1). A significant increase in grain yield over control was observed from application of Zn on some soils such as Echo and Ardill association soil, whereas decrease in grain yield over control was observed in other soil such as Melfort soil. Lack of positive yield responses to addition of Zn were related to high Zn supply rate and native Zn in exchangeable and Fe/Mn oxide bound fractions (Figure 3). Application of Zn fertilizer generally increased the grain concentration of Zn. For example, an increase of ~20% in Zn concentration over control was observed when supplied with 5 kg Zn ha^{-1} on Fox Valley soil (Figure 2). When supplied with Zn, the lentil classes maintained Zn concentration in grain close to, or above, the average Zn concentration observed in lentil classes grown on Saskatchewan soils.

CONCLUSIONS

This project aims to generate valuable information on the role of balanced site-specific Zn fertilizer application to lentil crops to ensure maximum yield and a high quality, competitive product for local and international markets. Field trials are warranted to further validate the results, along with assessment of the bioavailability of the Zn contained within the grain.

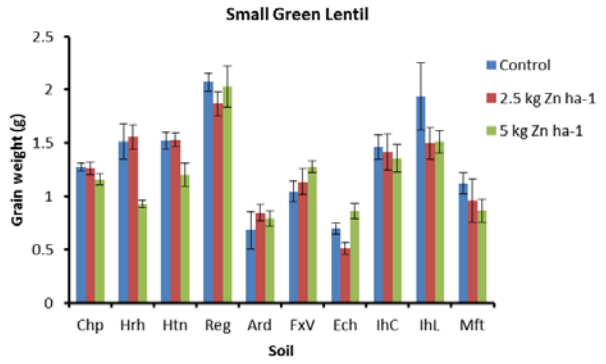

Figure 1. Grain yield of small green lentil on ten Saskatchewan soils as influenced by Zn application

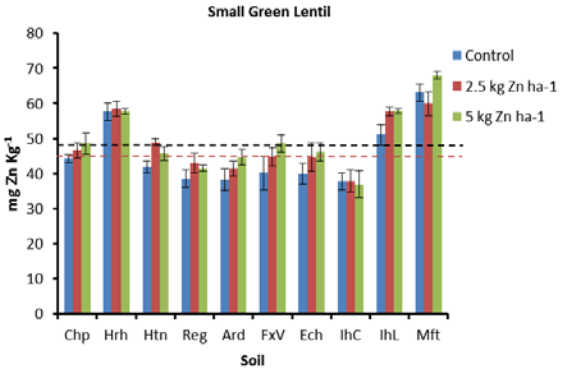

Figure 2. Grain Zn concentration in small green lentil on ten Saskatchewan soils as influenced by Zn application

----- Average Zn concentration in lentil classes grown across Saskatchewan (Thavarajah et al. 2011)

----- Average Zn concentration in 3 lentil classes grow in 10 Saskatchewan soils

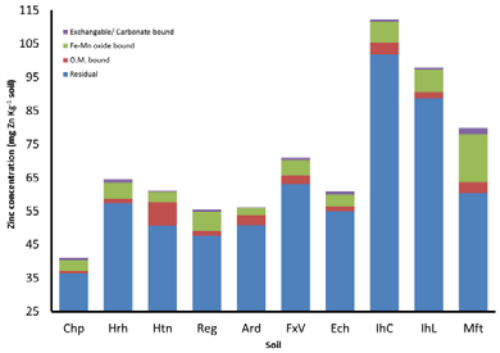

Figure 3. Zinc contained in various soil fractions in ten Saskatchewan soils

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