Using Zinc to Reduce Cadmium in Durum Grain

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Introduction

Cadmium (Cd) is a nonessential heavy metal that may cause health problems in some people. Diet is the main source of Cd for nonsmokers, with cereal products, including durum, contributing up to 20% of the daily intake of Cd by adults. The current official standard for maximum level of Cd in durum wheat grain is 0.2 ppm (Codex Alimentarius 1995) and the European Union has adopted this level as the maximum allowed in domestic and imported durum. Other durum buyers may also adopt this maximum level.

Durum grain grown on Montana Agriculture Research Centers and several off-station sites in eastern Montana was sampled for Cd levels in 2005. Cadmium levels ranged from 0.06 ppm to 0.26 ppm. Most durum genotypes grown in Montana accumulate Cd in the grain.

Cadmium is found naturally in some soils. Soil characteristics, such as pH and chloride content affect Cd uptake (Eriksson et al. 1990). In a greenhouse study in Saskatchewan, zinc (Zn) applied to soil prior to planting significantly reduced Cd in durum grain, while Zn applied foliarly at the four-leaf stage or at flowering had no effect on grain Cd concentration (Choudhary et al. 1995). We evaluated the use of Zn to reduce Cd accumulation in durum grain in the field.

Methods

Durum wheat was planted on both a dryland and an irrigated farm site at the Eastern Agricultural Research Center from 2007-2009. Two varieties of durum were used, one that accumulates more Cd in the grain (Alzada) and the other that accumulates less (Strongfield). Nitrogen and phosphorus were uniformly broadcast at seeding at rates determined by soil tests.

Treatments were 1) Zn sulfate applied with the seed at 1 lb Zn/ac; 2) Zn sulfate applied with the seed at 1 lb Zn/ac plus chelated Zn applied foliarly at the boot stage at 1 gal/ac; and 3) no Zn applied. The foliar Zn was 9% Zn chelated with EDTA, and 1 gal/ac applied 0.97 lb Zn/acre. There were four replications in a randomized complete block design. Irrigation and rain water were collected throughout the growing season and tested for Cd, pH, and Zn. Soil was sampled from the plots following harvest and tested for Cd, pH, and Zn. Durum grain was measured for Cd and Zn at harvest.

Results

Data were analyzed across the three years for each site. The Zn treatments did not affect grain yield, test weight or grain protein content on either the dryland or irrigated sites (Table 1). Zinc applied with the seed had no effect on grain Cd or Zn content. Chelated Zn applied foliarly at the boot stage reduced grain Cd content by about 25% at the dryland site and by about 13% at the irrigated site. Grain Cd content was reduced similarly in both varieties. The Cd level dropped from above the 0.2 ppm limit to below that limit on the dryland site. At this time we do not know if applying more foliar Zn would

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have decreased Cd concentrations more. The Zn treatments did not affect available Zn or Cd contents in soil following harvest.

Fertilizer Facts:

- Applied Zn did not affect yield or agronomic characters of the durum.
- Zinc applied with the seed had no effect on Cd content of durum grain.
- Chelated Zn applied foliarly at the boot stage reduced Cd level in durum grain by about 25% at the dryland site and by about 13% at the irrigated site.

Acknowledgements:
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References:

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Table 1. Grain Cd and Zn content, yield, protein, and test weights of durum wheat grown at the dryland and irrigated sites and averaged across three years (2007-2009).

		Dryland site					Irrigated site				
Treatment	Variety	Cd (ppm)	Zn (ppm)	Yield (bu/ac)	Grain protein (%)	Test wt (lb/bu)	Cd (ppm)	Zn (ppm)	Yield (bu/ac)	Grain protein (%)	Test wt (lb/bu)
Zn with seed		0.248a	23.6b	46.1	14.1	60.8	0.196a	31.4b	74.6	15.8	60.4
Zn with seed + foliar Zn		0.177b	26.0a	45.0	14.0	60.6	0.158b	34.4a	76.4	15.7	60.3
No Zn		0.245a	22.9b	44.7	14.1	60.9	0.182a	30.5b	78.3	15.7	60.5
LSD 0.05		0.038	1.2	NS	NS	NS	0.025	2.0	NS	NS	NS
	Alzada	0.290a	23.8	44.8	13.7b	60.9	0.217a	31.9	73.1b	15.4b	60.2b
	Strongfield	0.157b	24.6	45.8	14.4a	60.6	0.141b	32.3	79.8a	16.0a	60.6a
LSD 0.05		0.031	NS	NS	0.3	NS	0.021	NS	4.6	0.2	0.3

LSD 0.05 is the least significant difference with a 5% chance of being incorrect.
Different letters in the same column indicate significant difference at $p < 0.05$.
NS - no significant difference.

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