Optimizing of Zinc Quantity and Application Method on Bread Wheat (*Triticum aestivum*) in Bam Region of Iran

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INTRODUCTION

Bam town is located in Southeast Iran where dry arid conditions are dominant. Wheat cropping ranks first in the area. A single old variety of wheat, Roshan, is grown in this part of the country. The variety can tolerate unfavorable conditions and drought-stress. However, its yield is relatively low. Zinc plays an essential role in human health for protein, insulin and DNA biosynthesis, prevention of nervous diseases, prostate and other functions (Malakouti 1997). Considering the high rate of bread consumption in Iran (650g capita^{-1} day^{-1}), there is an urgent need to increase wheat production and wheat quality (Malakouti 2000).

A critical threshold of 0.5 mg Zn kg^{-1} soil has been reported by Malakouti (2000). Despite the calcareous nature of the soil and a low soil quality, it is not a conventional practice in the Bam area to apply micronutrients. The present study was conducted to determine effects of foliar and soil application of Zn on wheat-yield quality and quantity.

METHODS

The experiment was laid out in a randomized complete block design (RCBD), and 12 factorial combinations of treatments were replicated four times. The factors included four Zn soil-application rates (0, 20, 40, 60 kg ha^{-1}) and three Zn foliar-application rates with 0.005 Zn sulfate (0, once, twice at tillering stage and 15 days later). The experiment was carried out in a calcareous sandy loam soil with an insufficient micronutrient content and low available Zn during 2003-2004. Furrow irrigation was adopted. Various parameters, including crop growth rate (CGR), leaf area index (LAI), grain and straw weight, protein percentage, grain test weight, ear length, number of grain per head, zinc absorption by leaf and grain were recorded or calculated.

RESULTS AND DISCUSSION

Results indicate that Zn application improved almost all of the measured parameters significantly (Table 1). Grain yield and protein percentage increased up to 25 and 40%, respectively. To optimize the positive effects of Zn application, it is necessary to spray Zn as 0.005 Zn sulfate solution on foliar parts at least once during the tillering stage.

Table 1. Zinc quantity and method application interactions.

Treatments	Seed weight	Straw weight	Grain weight	Protein percentage	Leaf Zn content
	ton ha^{-1}	ton ha^{-1}	gr	%	mg gr^{-1}
Zn_0 S_0	4.20^{d}	6.3^{e}	30.5^{e}	9.05^{f}	13.0^{g}
Zn_0 S_1	4.60^{cd}	6.9^{de}	36.5^{d}	9.80^{cf}	16.0^{f}
Zn_0 S_2	4.71^{c}	7.1^{cd}	37.0^{cd}	9.95^{e}	17.0^{f}
Zn_{20} S_0	4.70^{c}	6.8^{de}	36.5^{d}	10.50^{de}	23.0^{e}
Zn_{20} S_1	5.15^{b}	7.1^{cd}	38.3^{abcd}	11.25^{cd}	23.5^{e}
Zn_{20} S_2	5.40^{b}	7.3^{cd}	40.3^{ab}	11.50^{c}	28.0^{d}
Zn_{40} S_0	5.25^{b}	7.3^{cd}	37.5^{bcd}	13.00^{ab}	28.0^{d}
Zn_{40} S_1	5.40^{b}	7.6^{bc}	40.0^{abc}	12.85^{ab}	32.5^{bc}
Zn_{40} S_2	6.05^{a}	8.6^{a}	41.1^{a}	12.40^{b}	31.0^{c}
Zn_{60} S_0	5.80^{a}	8.2^{a}	39.5^{abcd}	12.47^{b}	33.5^{bc}
Zn_{60} S_1	5.87^{a}	8.2^{a}	39.0^{abcd}	13.25^{a}	37.0^{a}
Zn_{60} S_2	5.95^{a}	8.1^{ab}	39.5^{abcd}	12.60^{ab}	34.5^{ab}
CV %	4.1	3.9	4.8	4.0	5.8

CONCLUSIONS

The expected yield increase in response to Zn application was due to low available Zn concentrations in the untreated soil (lower than critical threshold). Similar results have been reported by Dvorak and Tlustos (2003) and Hamilton et al. (1993). The response may have been magnified because of the calcareous nature of the soil and the genetic characteristics of the wheat variety.

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