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Efficacy of absorption of Zinc in wheat after the application of **Defender Zn®**

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Introduction

Zinc (Zn) is an essential micronutrient required for plant growth. Involved in several enzymatic activities, Zn has a key role in physiological processes such as photosynthesis, sugar metabolism and biosynthesis of hormones. Zn also acts as a protector of the structure of the cell membrane against oxidative and abiotic stresses. Its deficiency in both the soil and the plant can be corrected by exogenous applications of this micronutrient. However, the plant doesn't absorb equally all commercial deficiency correctors of Zn products, so this element may have more or less availability to the plant as depending on the product formulation, which directly influences the expected effect.

Wheat plants are sensitive to Zinc deficiency, and its absence can lead to significant performance reduction with consequent economic losses. This study compares the absorption deficiency corrector of Futureco Bioscience **Defender Zn®** applied to wheat with another widely used commercial product based on Zn oxide, and formulated by chemical synthesis excipients.

Furthermore, it has been referenced that in Zn deficient arable areas human populations show problems with this microelement deficiency (Alloway BJ 2008; Calmak I 2008), thus increasing the content of Zn in culture can reverse in a positively higher quality and nutritive value of food to meet the needs of this mineral in the human diet.

Materials and Methods

Twenty-five wheat seeds of the variety "Valbona" (sanitized 10 minutes, 1.2% HCl) were planted in trays with substrate (vermiculite: perlite (3: 1) and peat (10%)) and maintained in a climatic chamber (22 ± 2 ° C, 60 ± 10% RH, 16:08h light:dark). The trial consisted of 7 treatments (25 replicates/treatment): Negative positive control with Zn (Ctrl) and without Zn (Zn), Commercial Product based on oxide Zn at low dose (A) and high (B), and **Defender Zn®** at low dose (C), medium dose (D) and high dose (E). Zinc deficiency was previously induced by irrigation to all treatments (except the positive control) with Hoagland solution deficient in Zn.

The products were applied by foliar irrigation (approx. 250mL/treatment) at the stage of 4-5 leaves. Doses were estimated considering that the rate of irrigation for wheat is equivalent to 60L/Ha. Samples were taken at 0, 1, 4, 7, 12 and 15 days after application of the products at different doses (DDA) determining the concentration of foliar Zn (absorbed) for each sample (Fig. 1). The ratio of applied Zn to absorbed Zn (Fig 2) and the percentage efficacy of treatment afforded by the formula:

$$\% \text{ efficacy} = \left(1 - \frac{\text{Zn (ppm) negative control}}{\text{Zn (ppm) analysed treatment}}\right) \times 100$$

Treatment	Dose mL/Ha	g Zn/Ha	ppm Zn
Control positive (Ctrl)	Hoagland Solution	0.0078	0.13
Control negative (-Zn)	Hoagland Solution 0% Zn	0	0
Commercial Product min. (A)	300*	204	3400
Commercial product max. (B)	600	408	6800
Defender Zn® (C)	250	33	550
Defender Zn ® (D)	750	99	1650
Defender Zn® (E)	1500	198	3300

Table 1 Treatments performed by foliar application to wheat plants at the stage of 4-5 leaves. Applied levels of Zn is expressed as gZn/Ha and in parts per million (ppm).
Ctrl, positive control; -Zn, negative control; A, commercial product based on zinc oxide at a low concentration; B, commercial product based on zinc oxide at high concentration; C, Defender Zn® at low doses; D, average dose Defender Zn®; E, high dose of Defender Zn®.

Results

All treatments showed foliar Zn levels except the positive control throughout the study (Fig 1).

The Zn content was proportional to foliar applied **Defender Zn®** (C, D, E) over the whole plant treated with the test dose. In the case of the commercial product of reference, a dose-effect was also observed, although not as clear, especially from 7 days. At the end of the study

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Defender Zn® is a product developed by Futureco Bioscience for the correction and prevention of zinc deficiencies. It is formulated with a mixture of sugar acid extracts obtained by natural fermentation of wheat, which facilitate the absorption and metabolism of minerals. Inside the plant, the sugar acids are metabolized to generate energy or to be included in the plant carbohydrate reserves (starch).

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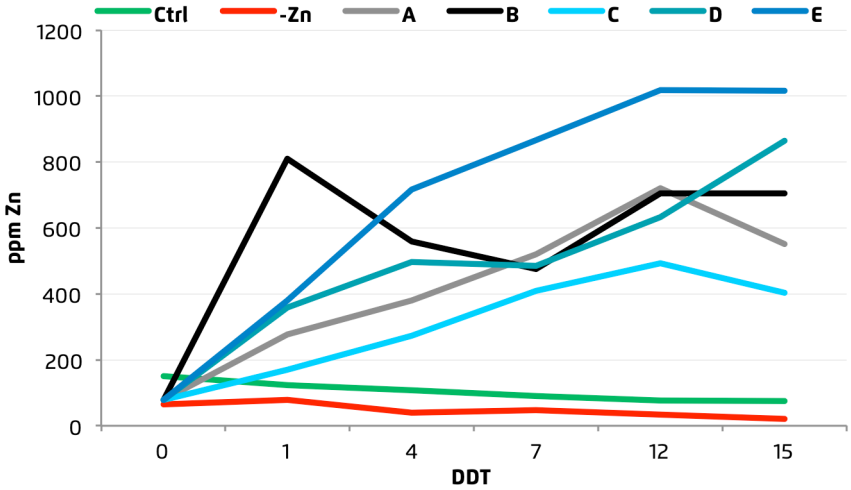
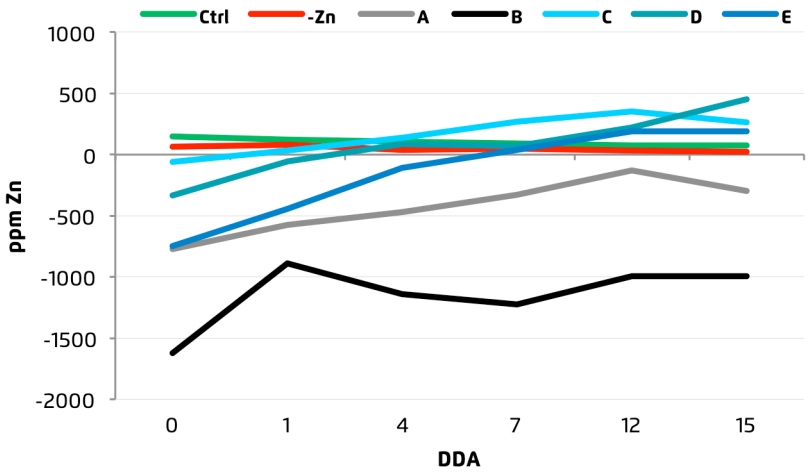
(15 DAA), a higher content of Zn was achieved in the leaves with high dose means of **Defender Zn®** (E and D), although Zn provided by the product was less.

Figure 1. Content in foliar Zn (ppm) through the study.



Ratio of Zn-applied and Zn-absorbed: the Zn concentration provided in each treatment (Fig 2) was recalculated.

Figure 2. Relationship Zn applied/Zn absorbed along the test



All treatments with **Defender Zn®** showed positive values from the 4th day (DDA), indicating a higher efficiency of absorption. In contrast, the reference product (treatments A and B) did not reach positive values at any point of the trial, suggesting that most of the Zn provided was not absorbed. The % efficacy of **Defender Zn®** uptake at 15 days (15 DDT) was 98% for the high dose (E), 97.6% of the mean dose (D) and 94.8% of the low dose (C).

Conclusions

- The content of Zn-Leaf is proportional to the dose of **Defender Zn®** applied.
- Zn levels are higher in treated plants with 0.75 L/Ha and plants with 1.5 L/Ha of **Defender Zn®** than in plants with reference product applied, although it contains less Zn concentration in **Defender Zn®** composition.
- The Zn contained in **Defender Zn®** is absorbed more efficiently (shows a higher absorption) than other commercial reference products based on zinc oxide.