

# Zn

case studies:

# Turkey

## Case Study: A Success Story with Zinc Fertilizers in Central Anatolia

### Introduction

Until the early 1990s, wheat grown in the Central Anatolia region, which is a major cereal production area in Turkey (4.5 million hectares), showed chlorotic and necrotic spots on their leaves, had reduced shoot growths, and most importantly, produced low crop yields.

Since this discovery, several soil and environmental factors have been assessed as possible reasons for the problems seen in the wheat, such as water deficiency, pathogenic infections, heat stress, boron toxicity, and micronutrient deficiencies. Soils in the region were also known to be extremely poor in moisture and organic matter, and high levels of pH and calcium carbonate. These factors typically result in zinc being deficient in the soils for use by crops.

### The Zinc Project

A field experiment was completed

at the Transitional Zone Agricultural Research Institute in Eskisehir by Mr. Mufti Kalayci in order to demonstrate the effect of different micronutrients on wheat and barley. The results of this first field trial showed that the addition of zinc resulted in significantly increased grain yield, and the necrotic and chlorotic symptoms on leaves were not developed (Figure 1). On average, zinc application enhanced grain yield of the wheat and barley crops by approximately 55%, while other micronutrients had little to no effect on the yield.

In order to identify the underlying cause of this growth problem in wheat further a long-term, multi-institutional project was conducted between 1993-1997 in Central Anatolia as a NATO-funded Zinc project under direction of Professor Ismail Cakmak with the involvement of scientists and agronomists from Cukurova University, the Transitional

Zone Agricultural Research Institute in Eskisehir, the Bahri Dagdas International Agricultural Research Center in Konya and CIMMYT-Ankara. In many locations, there were spectacular increases in grain yield resulting from application of zinc fertilizers. In certain areas where zinc availability was low in soils, wheat grain yield was extremely low and was not economic (e.g., 250 kg ha<sup>-1</sup>). Applying zinc fertilizers on these soils resulted in substantial increases in growth and enhanced grain yield by a factor of 6-8 to around 2,000 kg ha<sup>-1</sup> from approximately 250 kg ha<sup>-1</sup>.

Besides such extreme regions, there were also a number of locations in Central Anatolia where zinc fertilizers increased grain yield at least 20% and eliminated development of chlorosis and necrosis on leaves. It was also demonstrated that the yield-increasing effects of zinc fertilizers were even more pronounced under rainfed conditions



Zinc  
nutrient  
initiative





“The Anatolia initiative is one of the world’s first examples of using agricultural practices to address public health problems as well as improved crop production, and its success provides a model for countless other nations. More soils throughout the world lack zinc than any other micronutrient. About 50% of the world population suffers from iron and zinc deficiencies, which can be addressed through this cost-effective method.”

- International Fertilizer Industry Association

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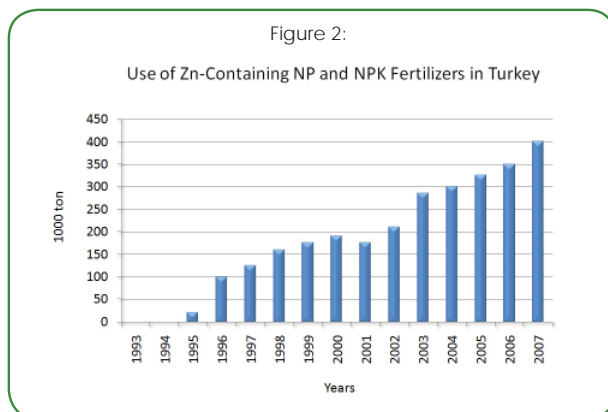
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than irrigated conditions, indicating much greater susceptibility of plants to zinc deficiency under water-deficient conditions.

### Benefits of Using Zinc Fertilizer

The dramatic effects of zinc fertilizers on wheat production in Central Anatolia resulted in a growing interest in its use among farmers and the fertilizer industry, resulting in increasing amounts of zinc-containing fertilizers being produced and applied in Central Anatolia and other regions of Turkey. Among the fertilizer companies in Turkey, TOROS Fertilizer and Chemical Industry was the first to respond to the project results and produce NP and NPK fertilizers containing 1 % Zn. Later on, other companies also started to produce Zn-containing fertilizers such as Gubretas and Bagfas. Today, nearly 15 years after the zinc deficiency problem was first diagnosed, the total amount of zinc-containing compound fertilizers applied in Turkey has increased from zero in 1994 to the current level of 400,000 tonnes per annum (Figure 2). As a result, the CIMMYT-Ankara (The International Maize and Wheat Improvement Center) and the Ministry of Agriculture have estimated an economic benefit of \$100 million US per year from the zinc fertilizer applications to crop plants.



### Cost-Benefit

In trials on four varieties of wheat grown under irrigated conditions, the increases in yield ranged from 29-355%, with an average increase in wheat yield of 58%. The average increase in value per hectare of the four wheat varieties was \$477 US. If calculated at a 20% yield increase, which may be a more realistic long-term yield benefit of using zinc fertilizer, the farmer could expect to make an additional \$123 US per hectare.

### Human Nutritional Effects

The application of zinc fertilizers also enhanced grain zinc concentration and likely contributed greatly to daily zinc intake of people with low incomes in Turkey. Wheat is still the major source of daily calorie intake; on average, wheat alone provides nearly 45% of the daily calorie intake at country level and possibly around 75% in some rural regions. Application of zinc-containing fertilizers (agronomic biofortification) offers a rapid solution to the zinc deficiency problem in people.

Currently, a large number of people rely on cereal crops as a major source of daily calorie intake. It is therefore anticipated that this NATO-Zinc project, which uses agricultural practices to address public health while improving crop production, can be applied to other zinc-deficient areas of the world. The IFA (International Fertilizer Industry Association) recognized the contribution of this successful project to human nutrition and crop production in Turkey by giving it an International Crop Nutrition Award.



Figure 1: Wheat plants grown with (+Zn: 50 kg ZnSO<sub>4</sub>/ha) and without (-Zn) Zn fertilization in Central Anatolia on a zinc-deficient soil.

## Zinc...Essential for Crops, Essential for Life!

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