

# Zinc Uptake and Use Efficiency in Food Crops

N.K. Fageria

National Rice & Bean Research Center of EMBRAPA, Caixa Postal 179, Santo Antônio de Goiás, GO, CEP 75375-000, BRAZIL (fageria@cnpaf.embrapa.br)

## INTRODUCTION

Micronutrient deficiency, including Zn, is increasing in most of the annual crops due to intensive cropping systems, use of modern high yielding cultivars, loss of organic matter in top soils by erosion, burning crop residues, liming acid soils, and use of inadequate rates in most cropping systems (Fageria et al. 2002). Zinc deficiency in crop plants is reported worldwide. According to Graham and Welch (1996), about 50% of soils used for cereal production in the world contain low levels of plant-available Zn, which reduce yield and nutritional quality of grains. Rice, corn, dry bean and soybean are important food crops for human use. These four crops play pivotal economical roles in developed and developing countries. Data on Zn uptake and use efficiency are limited for food crops grown on Brazilian oxisols. The objectives of this study were to determine Zn uptake and Zn use efficiency in four annual crops grown on Brazilian oxisol.

## METHODS

A field experiment involving upland rice, dry bean, corn and soybean grown in rotation was conducted for four consecutive years. The soil of the experimental area was an oxisol. The first crop was upland rice during rainy season, and the second crop was dry bean during dry season with sprinkler irrigation. The third crop was corn during the next rainy season, and the fourth crop was soybean during the following dry season with sprinkler irrigation. The same sequence was repeated in the third and fourth year. Grain yield of four crops was determined at harvest and Zn concentration in grain was determined to calculate uptake and Zn-use efficiency.

## RESULTS AND DISCUSSION

Grain yield was in the order of corn > upland rice > dry bean > soybean (Fig. 1). Hence, cereals had higher grain yield than legumes. Zinc concentrations were 18, 30, 39, 55 mg kg<sup>-1</sup> in grain of corn, upland rice, dry bean and soybean, respectively. Zinc concentration was higher in legume crops than in cereals. High grain-Zn concentration is considered a desirable quality (Cakmak et al. 1996, Graham et al. 1992). High Zn-seed concentrations are also a desirable trait to ensure seedling vigor and grain yield of the next crop when replanted on a Zn-deficient soil (Graham et al. 1992). Graham et al. (1992) also reported that high Zn content in grain is under genetic control, is not tightly linked to agronomic Zn-efficiency traits, and may have to be selected for independently to increase the nutritional value of the grain for humans. Zinc uptake in grain (g ha<sup>-1</sup>) followed the order of corn > upland rice > soybean > dry bean (Fig. 2). The higher Zn uptake rate in corn and upland rice was associated with a higher grain yield. In soybean, the higher Zn uptake compared to dry bean was associated with high Zn concentrations in soybean seeds. Zinc-use efficiency in grain production was higher in corn and lower in dry bean and soybean than in upland rice. Higher Zn efficiencies of cereals compared to legumes were associated with higher grain yields of corn and upland rice.

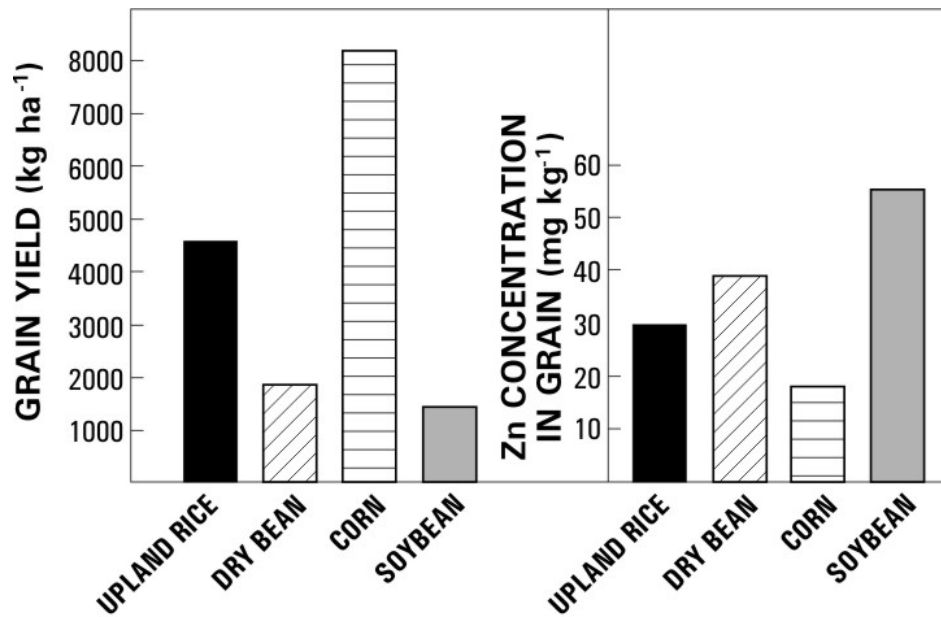


Fig. 1. Grain yield and Zn concentrations in grain of four food crops.

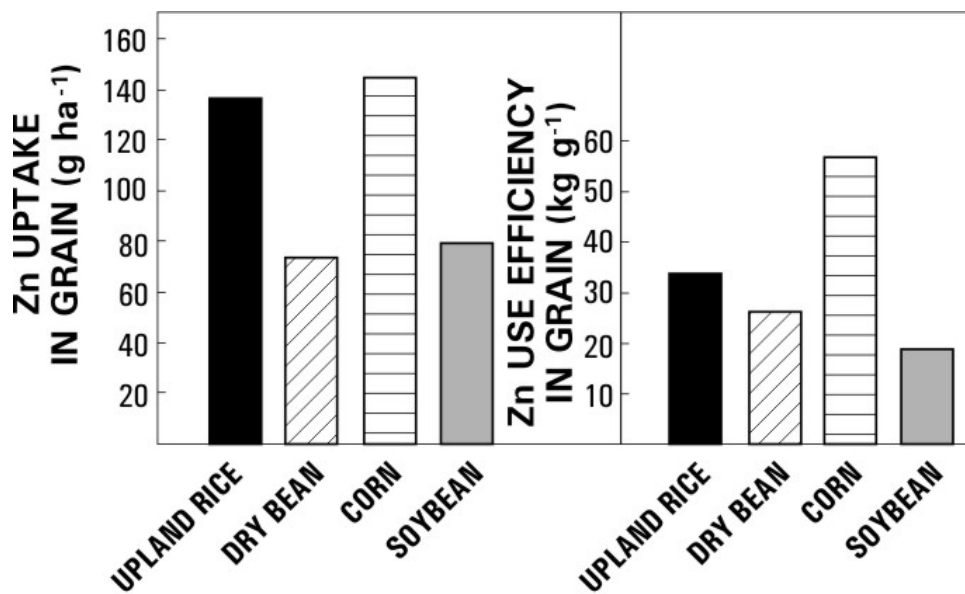


Fig. 2. Zinc uptake and Zn-use efficiency in grain of four food crops.

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