Determination of Some Micro-Minerals in Dry Bean Genotypes

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INTRODUCTION

Common bean (*Phaseolus vulgaris*) is the most important food legume in the world. Given the widespread use of beans in the world, efforts to improve their micronutrient content may benefit many people (Anonymus 2006). The genetic diversity for mineral concentration in seeds has been studied in several legumes. The identification of lines exhibiting high or low mineral levels in the seed is important because these genotypes can be used in comparative studies to decipher the underlying genetic and physiological mechanisms regulating mineral transport to developing seeds. They will also be useful to evaluate whether the enhancement of one mineral influences the concentration of another (Welsh and Graham 2004). Researchers at CIAT evaluated a core collection of >1,000 accessions of common beans and found a range in Fe concentrations from 34 to 89 µg g^{-1} (average = 55 µg g^{-1} Fe). Zinc concentrations in these same accessions ranged from 21 to 54 µg g^{-1} (average = 35 µg g^{-1} Zn). Some bean accessions from Peru were recently found to contain very high levels of Fe, averaging > 100 µg g^{-1} Fe. The collected data suggest that there is suffecient genetic variability to increase Fe (by about 80%) and Zn (by about 50%) concentrations in common beans (Beebe et al. 1999, Gregorio 2002).

METHODS

The study was carried out at the Agricultural Research Center of Arak, Iran. We used seeds that were produced in 2004 from plants grown under warm and sunny conditions in a rich, well-drained and light soil with sufficient moisture in the growing season at the research station of Khomein's Bean. Minerals were analyzed by dry-ashing 1 g of the sample at 550 °C in a furnace. The ash obtained was dissolved in 10% HCl, filtered with filter paper and made up to a standard volume with deionized water. Iron, Zn and Cu were determined using an Atomic Absorption Spectrophotometer (Unicam Solar) (AOAC 1990).

RESULTS AND DISCUSSION

The evaluation of bean genotypes revealed that there was a significant difference ($P < 0.01$) in Fe, Cu and Zn contents between 15 genotypes. A range of 50.37 to118.35 ppm Fe, 28.01 to 47.55 ppm Zn, and 11.94 to 16.85 ppm Cu concentrations was found (Table 1). The results for Fe and Zn agree with the results of Beebe et al. (1999). The evaluation of the bean core collection revealed a high value of 14 ppm and an average value of 9 ppm in Cu content (Beebe et al. 1999). Bressani (2002) found a range of 33.4 to 80 ppm Fe, 14 to 65 ppm Zn, and 5 to 14 ppm Cu concentrations. In the present study, Goly, Azna red, Mahali Khomein, Wa 8563-1, Daneshkadea and W4502 genotypes had more Cu than reported in other studies. Comparison between the three groups revealed that there were no differences in Zn and Cu content, but there was a very significant difference ($P<0.01$) in Fe content. Red bean groups had the highest Fe levels.

Table 1. Mineral content (ppm) of common bean genotypes.

Bean group	Genotype name	Fe	Zn	Cu
Red bean	Akhtar	118.35±1.08 ^{a†}	28.01±0.83 ^{f}	13.22±1.25 ^{de}
	D-81083	90.49±11.07 ^{b}	30.98±2.17 ^{dfe}	13.77±0.63 ^{dec}
	Goly	59.78 ± 9.27 ^{dce}	34.99±2.99 ^{dc}	16.06±0.41 ^{ba}
	Sayad	86.39± 6.27 ^{b}	41.11±4.36 ^{b}	14.67±1.43 ^{bdc}
	Azna red	69.28±10.34 ^{c}	32.03±0.49 ^{dfe}	15.76±0.94 ^{bac}
Chiti bean	Talash	50.37±6.30 ^{e}	31.70±2.26 ^{dfe}	14.13±0.54 ^{bdc}
	Mahali Khomein	59.24±5.18 ^{dce}	30.98±0.54 ^{dfe}	16.85±0.54 ^{a}
	Cos-16	68.66±16.77 ^{dc}	32.36±0.43 ^{dfe}	14.85±1.66 ^{bdac}
	G 14088	71.19±9.27 ^{c}	34.07±2.67 ^{dce}	14.13±1.09 ^{bdc}
	GO1437	60.54±4.39 ^{dce}	47.55±4.48 ^{a}	13.22±0.32 ^{de}
White bean	Emerson -74	67.03±5.36 ^{dc}	33.69±0.98 ^{dce}	13.77±1.13 ^{dec}
	G11867	60.14±3.62 ^{dce}	34.17±0.98 ^{dc}	11.94±1.86 ^{e}
	Wa 8563-1	53.99±4.62 ^{de}	36.96±2.17 ^{c}	15.19±1.49 ^{badc}
	Daneshkadea	70.29±2.20 ^{c}	36.96±1.09 ^{c}	15.40± 0.83 ^{bac}
	W4502	61.41±5.87 ^{dce}	29.70±1.91 ^{fe}	16.85±1.08 ^{a}

†- Means within columns for genotypes with different letters differ ($P < 0.05$).

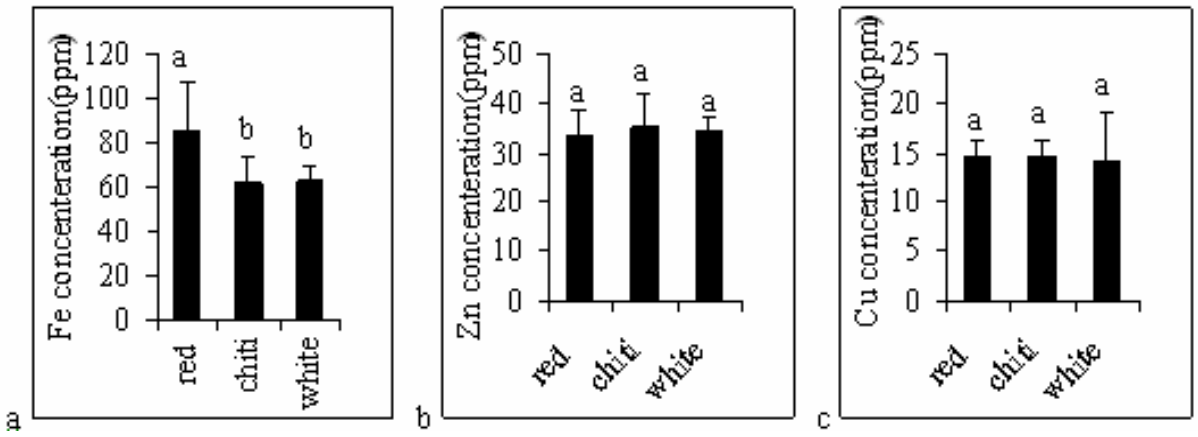

Fig. 1. Fe (a), Zn (b) and Cu (c) content of three groups of common bean.

CONCLUSIONS

There were some differences between common bean genotypes in micro-mineral contents that should be consider by breeders and nutritionists.

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