Ca, K, Fe, P and Na CONTENT IN DIFFERENT VARIETAL TYPES OF DRY BEAN USING TWO GROWING SYSTEMS: ORGANIC AND CONVENTIONAL

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INTRODUCTION

People demand more and more foods that are both healthy and of high nutritional quality. Higher mineral content has been observed in foods cultivated under organic growing conditions (Bibak et al, 1998; Pither, 1990; Raigón et al., 2002). In dry beans, very few studies have been carried out in this respect so far. The objective of this work is to study the influence of organic cultivation on the quality of dry bean seeds and analyse whether or not changes occur in the relationship between traits as a result of this kind of cultivation.

METHODS AND MATERIALS

A total of 49 cultivars of different varietal types (including controls) were evaluated under both organic and conventional growing conditions in Valencia (Spain). The design was in random blocks with two repetitions and 20-25 plants/cultivars x repetition x growing condition. The evaluation was carried out at the level of individual plant. Twenty-one out of 49 were selected for general health reasons (including resistance to BCMV and BCMNV), external traits of the seed and yield; the chosen cultivars were grouped into 3 colours (white, red and cream) and 7 different seed shapes. In a mineralised sample (desiccated and calcinated) the content of Fe and P were measured using a visible UV light spectrophotometer; while Ca, K and Na content were measured using a flame photometer. The results are expressed as mg/100 g of dry matter. The results were measured using an ANOVA factorial with repetitions and the correlations between traits were estimated (for both cultivation systems).

RESULTS

In beans grown in organic agriculture, all the minerals, with the exception of Na, are found in greater quantities than in conventional agriculture (Table 1).

Table 1. Average values for Ca, K, Fe, P and Na content (in mg/100g dry matter) in the seeds of 21 cultivars of dry beans

System of cultivation	Seed color	Ca	K	Fe	P	Na
Conventional	White	21.1	2462.9	6.4	544.0	9.2
	Red	17.4	2050.8	5.4	507.8	16.6
	Cream	14.3	1600.8	4.2	274.6	11.2
Organic	White	21.6	2597.0	7.0	609.3	5.6
	Red	16.7	2272.5	5.8	758.7	9.5
	Cream	15.6	1699.0	6.8	424.5	7.1

In both cultivation systems, on average, the white cultivars displayed greater amounts of Ca, K and Fe, and lower amounts of Na; for P, the white and red varieties are more similar and contain higher amounts than the cream coloured ones; in almost all cases these cream coloured beans contain the lowest levels of Ca, K, Fe and P (Table 1). The white varieties with the highest mineral content were: for K, 99/311, USWK-6 and CELIA (conventional), and SIRIA and FRU4 (organic); for Fe, FRU4 (conventional and organic), and SIRIA and CLARA (conventional); for Ca, CLARA (conventional and organic), and SIRIA (conventional); for P, 99/335 (conventional and organic); those with lowest Na content were CELIA and USWK-6 (conventional) and CLARA and SIRIA (organic). IVT-7214-2 had the greatest Na content in conventional cultivation and MCM3031-10-4 in organic cultivation (data not shown). USWK-6 cultivar was kindly supplied by Dr. Miklas; IVT-7214-2 and MCM3031-10-4 are

selections from known resistant IVT-7214 and MCM3031 materials. The others ones have been obtained by our working group. The cultivation system (conventional or organic), the varietal type, the colour and the seed shape have a significant influence on the mineral content; however, the repetitions and the interactions are not significant, with the exception of what happens with Na. Table 2 indicates the most outstanding results of the ANOVA.

Table 2. Degrees of freedom and p-value for the ANOVA factorial with repetitions, considering the cultivation system with respect to the variety, colour and seed shape.

Sources of variation	fd	Ca	K	Fe	P	Na
System of cultivation	1	0.391 (ns)	0.008 (**)	0.014 (*)	0.003 (**)	0.000 (**)
Cultivar	20	0.000 (**)	0.000 (**)	0.005 (**)	0.000 (**)	0.000 (**)
System of cultivation	1	0.678 (ns)	0.196 (ns)	0.018 (*)	0.004 (**)	0.000 (**)
Seed color	2	0.000 (**)	0.000 (**)	0.024 (*)	0.001 (**)	0.000 (**)
System cultivation	1	0.864 (ns)	0.015 (*)	0.047 (*)	0.002 (**)	0.000 (**)
Seed shape	6	0.000 (**)	0.000 (**)	0.142 (ns)	0.001 (**)	0.000 (**)

Table 3. Phenotypic correlation coefficients (r) between traits. Values of r for conventional cultivation, top-right; for organic cultivation, bottom-left.

r	Ca	K	Fe	P	Na
Ca		0.55	0.56	-0.13 (ns)	-0.07 (ns)
K	0.59		0.36	0.19 (ns)	-0.30
Fe	0.07 (ns)	0.10 (ns)		-0.04 (ns)	-0.10 (ns)
P	-0.04 (ns)	0.29	0.10 (ns)		0.07 (ns)
Na	-0.25	-0.23	-0.28	0.01 (ns)	

In conventional cultivation, the highest correlations are obtained between Ca and K and between Ca and Fe (both positive) and lower and negative between K and Na; the remaining ones are not significant. In ecological cultivation, a positive correlation is maintained between Ca and K; however, the correlation between Ca and Fe is not significant; by contrast, it increases between K and P; and negative correlations are found for K, Ca and Fe with respect to Na. The negative correlations with Na favour the selection of varieties with a high content of other minerals and low in sodium, with the corresponding repercussions on diet; this is more likely to happen with beans grown in organic agriculture.

REFERENCES

Bibak, A.; Sturnp, S.; Gundersen, V. 1998. Levels of 44 elements in organically grown potatos (*Solanum tuberosum* Sava). Riso Report, 1060. 15 pp.

Pither, R. 1990. Analytical survey of the nutritional composition of organically grown vegetables. In: Organic food production. A Growing Business Organic Symposium. United Kingdom, 15 pp.

Raigón; MD.; Domínguez Gento, A.; Carot Sierra, JM.; Vidal, E. 2002. Comparación de parámetros de calidad en hortalizas de hoja ancha bajo sistemas de producción ecológica y convencional. Agrícola Vergel, 241: 26-32.

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