GENOTYPIC AND SEASONAL EFFECTS ON SEED PARAMETERS AND COOKING TIME IN DRY, EDIBLE BEAN

Lech BOROS, Anna WAWER, Plant Breeding Institute, Radzikow, 05-870 Blonie, Poland

INTRODUCTION

Dry bean seeds are good source of protein, starch and nutrients such as fibre, vitamins and minerals and are well suited to meet demands of health-conscious consumers. Soaking and cooking are traditional forms of processing. Cooking time is one of the major criteria used in evaluating cooking quality. The cooking quality of dry beans is affected by varietal differences, composition of seeds and physical properties such as size or weight, seed volume, seed coat (Boros 2003; Boros & Wawer 2003; Castellanos *et al.*, 1995; Shellie & Hosfield, 1991; Elia *et al.* 1997). Weather conditions prevailing during crop cultivation, as a major element of environment, significantly influence seed physical and functional characteristics and cooking time (Illiadis 2001, Coskuner & Karababa 2003). The purpose of this work was to study the effect of climatic conditions during growing season on quality seeds properties and cooking time in a group of dry bean cultivars adapted to local conditions.

MATERIALS AND METHODS

Seeds of twenty-one dry bean cultivars of Polish origin from field experiment grown in 1999, 2000 and 2001 in randomized, complete block design at IHAR Radzików were used in this study. The Food and Feed 1250 apparatus was used for seed protein content determination. The percentage of testa in seed is an average of 10 seeds in 3 replications. Water absorption of the entries and conductivity of soaking water were determined on samples of known mass of 50 seeds soaked in distilled water for 18 hours at 25 °C temperature. Bean cooking time was estimated with a 25-seed Mattson pin-drop cooker (Jackson & Varriano-Marston 1981). Cooking time was calculated as a time from initial cooking until the time when 20 of pins penetrate seeds in cooker (CT 80%). Data were subjected to analysis of variance (ANOVA).

RESULTS

Large differences in air temperature and in the amount as well as the distribution of rainfall during 3 growing seasons (May - September) were noticed, mainly at seed filling and maturation of dry bean. Results of the variance analysis have shown significance of genotype, year and genotype x year components of variance (table1).

Table1. Mean squares from ANOVA analysis of variance for dry bean seed parameters and cooking time of 21 dry bean genotypes grown for 3 seasons.

Sources	Mean squares		
traits	Genotype(G)	Harvest years (HY)	GxHY
df	20	2	40
100 seed mass (g)	1781.55**	2808.81**	89.36**
Testa content (%)	4.42**	6.43**	0.22**
Protein content (%)	5.69**	339.46**	4.54**
Water absorption (%)	190.79**	60.94**	53.85**
Coductivity (µS $cm^{-1}g^{-1}$)	430.47**	23.78**	85.93**
Cooking time (min)	78.22**	85.24**	11.79**

The year effect was significant for all seed parameters measured (table 2.). The ranges averaged over 3 seasons indicated large differences among genotypes, particularly for 100-seed weight, testa content and cooking time. The means and the ranges of tested traits among the cultivars used in this study were similar or slightly higher than reported earlier (Boros & Wawer 2003, Shellie& Hosfield 1991). Significance of genotype x year interaction indicates that genotypes responded differently in each season. The most likely temperature and rainfall distribution had the major effect on genotype x year interaction.

Table 2. Seasonal means, grand means and ranges for seed quality parameters of 21 dry bean genotypes

Traits	1999	2000	2001	Grand Mean	Range
100 seed mass (g)	34.52 b	46.89 a	36.34 c	39.5	17.1- 66.8
Testa content (%)	8.16 a	7.63 b	8.21 a	8.0	7.1 – 9.0
Protein content (%)	23.19 b	22.49 a	21.61 c	22.4	21.2 – 24.0
Water absorption (%)	103.6 a	102.1 b	101.7 b	102.4	96.8 – 111.0
Conductivity (μS $cm^{-1}g^{-1}$)	24.2 b	24.2 b	25.3 a	24.6	16.2 – 30.4
Cooking time (min)	19.97 a	17.89 b	19.84 a	19.2	15.24 – 26.2

To examine nature of experimental variability, variance component analysis for all traits was performed. Examining variance components estimates indicated that genotypic component was substantially larger than season and genotype x season components, indicating that genotypic effect predominated over environmental effects for tested parameters. Obtained results differed to some extent with that reported by Hosfield et al. (1984) and Balasubramanian et al. (1999) who found that both, year and genotype x year effects were larger than genotype effect for most quality traits.

Table 3. Spearman's rank correlation between seasonal pairs for 21 dry bean cultivars

Traits	Seasonal comparison		
	1 vs.2	1 vs. 3	2 vs.3
100 seed weight (g)	0.8125**	0.8818**	0.9093**
Testa content (%)	0.7343**	0.8347**	0.7737**
Protein content (%)	0.1633	0.0557	0.4367**
Absorption (%)	0.3741**	0.6522**	0.4765**
Conductivity (μS $cm^{-1}g^{-1}$)	0.2627*	0.6861**	0.3118**
Cooking time (min)	0.5310**	0.5660**	0.4918**

Spearman's coefficient of rank correlation between pairs of seasons showed significant values of tested traits indicating that cultivars ranked similarly from season-to-season, mainly for hundred seed weight and testa content, to lower extent for absorption and cooking time and differently ranked for protein (table3.). The data, likewise other (Shellie & Hosfield 1991, Hosfield et al.1984, Balasubramanian et al.1999) suggests that several year of testing are needed for proper assessment of cultivar performance for processing seed quality.

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