Variability of Stem Height, Grain per Pod, Thousand-Grain Mass and Grain Shape for Some Bean Varieties

M. Zdravković, J. Zdravković, D. Cvikić
Agricultural Research Institute "Serbia"
Centre for Vegetable Crops Karadjordjeva 71
11420 Smederevska Palanka Yugoslavia
e-mail: cfvcsp@eunet.yu

Keywords*:* bean, stem height, number of grain per pod, absolute grain mass, grain shape, coefficient of variability, genotype variability

Abstract

Ten local genotypes were selected from a genetic resource collection of 118, for the future bean breeding programme of the Centre for Vegetable in Smederevska. Palanka. Standard analytical methods were used for describing some traits (stem height, grain per pod, 1000 seed mass and grain shape). Significant differences were observed between the bean genotypes examined. The highest stem was found in Sumporaš (91.4 cm), and the lowest in Tetovac type (38 cm). Absolute grain mass varied between 284.7 g and 583.9 g (Sumporaš and P15 S respectively). The length: width grains ratio varied between 1.41 (P 1) and 2.40 (Žutotrban). The thickness: width ratio varied between 0.62 and 0.85 (line in Tetovac type and Galeb, Roze bubrežasti respectively). There were no significant differences for grain per pod. The highest coefficient of variability was observed for stem height (33.26%), whilst the lowest was observed for grain number/pod (16.31%). The variability of analysed traits as a result of the effect of genetic and environmental factors was established. The analysis of phenotypic variance components for stem height (82.1 %) and absolute grain mass (88.8 %) showed a higher impact of genotype than environment.

INTRODUCTION

Breeding beans requires detailed knowledge of a number of traits directly affecting yield. Research carried out by Beaver et al. (1985), Nienhuis and Singh (1988), White and Gonzales (1990), Welsh et al. (1995), Ranalli (1996) suggested the importance of stem height, number of grains per pod, thousand-grain mass and grain characteristics for the breeding process. With the objective of carrying out a better and more detailed evaluation of some bean populations / varieties from the collection of the Centre for Vegetable Crops, a number of quantitative features were investigated (stem height, number of grains per pod, grain mass per plant and grain shape with its length/width and thickness/width ratio). The features investigated were significant for bean selection and they affected the yield and the manner of breeding.

MATERIALS AND METHODS

In order to investigate the variability of the current gene fund that originates from this region, the trial was set up in five replications applying the random block system, on loamy soil with ten populations/varieties from the collection of the Centre (Table 1). The basic data were recorded from 30 plants per replicate – without selection, after reaching the stage of physiological maturity at the laboratory of the Centre. In addition to recording the absolute maximum and minimum, mean value and coefficient of variation were calculated by applying statistical methods as parameters for estimating the variability. Variance analysis (ANOVA) (Hadzivukovic, 1991) was carried out for stem height, number of grains per pod and 1000-grain mass. Components of phenotypic variance were calculated using the method of Mather and Jinks (1982).

RESULTS AND DISCUSSION

There were significant differences in stem height between the genotypes. The lowest stem height was recorded in a line of Tetovac type (ξ = 38 cm), whereas the highest was found in Sumporas (ξ= 91.4 cm) (Table 1). The coefficient of variation for this feature was 33.26 %. The variance analysis suggested that there were differences between the genotypes (Table 2). By the analysis of the phenotypic variance components, it was concluded that the genetic component prevailed over the environmental one as for the stem height feature. This was also in accordance with the heritability value, 82.14 %. As for phenotypic variation, gene effects were stronger than environmental ones, suggesting the significance of major genes in forming – expression of the phenotype. According to the genotypic and phenotypic coefficients of variation, the stem height feature varied most as compared to the other features.

Number of grains per pod is an indicator, which directly affects the yield. On the basis of ANOVA, there were no differences between the genotypes. Considering the results of the variance analysis, other indicators are not discussed.

Sumporas and P1 were characterised by small mass of 1000 grains (ξ = 284.7, and 287.3 g respectively). P15 genotype with ξ= 583.9 g had the largest absolute mass of grains. High statistical significance was recorded for this feature (Table 2). The coefficient of variation was 26.08 %. The analysis of the components of the phenotypic variance for this feature suggested gene effects prevailed over the environmental variance. Another proof of a weaker environmental variance compared with the genetic variance was the heritability of h^2 = 88.8 %.

Length/width ratio ranged from 1.47 (P1) to 2.40 (Zutotrban). Grain thickness/width ratio ranged from 0.62 (a line in Tetovac type) to 0.85 (Biser and Roze bubrezasti).

CONCLUSION

Within the lines investigated, there were differences in the mean values for the following features: stem height, absolute mass of grains, grain length/width ratio, and grain thickness/width ratio. For the number of grains per pod, there were no differences between the lines. The highest stem was recorded in Sumporas (91.4 cm), with the lowest in the line of Tetovac type (38 cm). Absolute grain mass varied between 284.7 g and 583.9 g (Sumporas and P15 S respectively). Grain length/width ratio varied from 1.41 (P1) to 2.40 (Zutotrban). Grain thickness/width ratio varied between 0.62 and 0.85 (a line in Tetovac Type and Galeb, Roze bubrezasti respectively).

Based on analysis of the components of phenotypic variance, it was concluded that the genetic component prevailed. Environmental effects (non-genetic factors) affected the number of grains per pod.

The values obtained from the parameters, as well as the recorded variability of the quantitative features studied, could be used as the criteria for choosing the genotypes for future efficient bean breeding.

Literature Cited

Beaver, J.S., Paniagua, C.V., Coyne, D.P. and Freytag, G.F. 1985. Yield stability of dry bean cultivars in the Dominican Republic. Crop Sci., 25, 923 - 926.

Hadživuković, S. 1991. Statistički metodi. Univerzitet u Novom Sadu, Novi Sad.

Mather, K. and Jinks, J.L. 1982. Biometrical Genetics. Third Ed. Chapman and Hall, London.

Nienhuis, I. Singh (1988). Genetics of seed yield and its components in common bean (*Phaseolus vulgaris* L.) of middle American origin. II Genetic variance, heritability and expected response from selection. Plant Breeding, 101 (2), 155 - 163.

Ranalli, P. 1996. Phenotypic Recurrent selection in common bean (*Phaseolus vulgaris* L) based on performance of S_2 progenies. Euphytica, 87 (2), 127 - 132.

Welsh, W., Bushuk, W., Roca, W. and Singh, S.P. 1995. Characterization of agronomic traits and markers of recombinant inbred lines from intra - and interracial populations

of *phaseolus vulgaris* L. TAG, v 91, 1, 169 - 177.
White, J.W. and Gonzales, A. 1990. Characterization of the negative association between seed yield and seed size among genotypes of common bean. Field Crops Res., 23, 159 - 173.

Tables

Table 1. Mean values for steam height, grain number per pod, absolute grain mass, length:width ratio and thicknes:width ratio.

Variety -lines	**steam height (cm)**	**grain number/ pod**	**absolute grain mass (g)**	**length/ width**	**thickness/ width**
Galeb	45,8	5,4	472,6	1,54	0,85
Pe 15 r	59,0	4,4	465,2	1,95	0,75
Pe 15 s	50,0	4,8	583,9	2,12	0,76
Roze bubrežasti	55,8	4,8	336,0	2,25	0,85
Sumporaš	91,4	5,4	284,7	1,54	0,75
P 1	84,6	5,6	287,3	1,41	0,82
P 3	44,4	5,0	435,0	1,57	0,83
Žututrban	41,2	4,2	530,1	2,40	0,81
Linija u tipu tetovca	38,0	5,2	468,8	1,68	0,62
Linija u tipu gradištanca	51,8	5,0	566,4	1,80	0,75
mean	56,19	4,98	443,0	2,38	0,78
CV %	33,26	16,31	26,08	20,25	10,47
min	31	3	221	1,65	0,55
max	100	7	695	3,42	0,95

Table 2. ANOVA and phenotypic variability components.

Sources of variation	Degree of freedom	Mean square					
		plant height		grain number/ pod		1000 grain mass	
Replications	4	49,255		0,67		15,30*	
varieties/lines	9	1640,180**		0,99		596,68**	
error	36	67,694		0,59		15,0	
total	49	* p< 0.05			** p<0.01		
Genotypic variance		314,50	82,1%	0,08	11,9%	116,33	88,8%
Environment variance		67,69	17,9%	0,59	88,1%	15,02	11,2%
Phenotypic variance		382,89		0,67		131,35	
genotypic coefficient of variation		31,56		5,68		24,62	
phenotypic coefficient of variation		34,84		16,44		26,17	