The Variability Study of Some Quantitative Traits at *Momordica charantia* L.

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Abstract. Bitter gourd (*Momordica charantia* L.), an important medicinal plant from the warm climate area of the Asian continent (India, China, and Malaysia), can be cultivate in Romania for their high therapeutic value, but with low productivity. The aim of this study was to evaluate the measure and the different forms of the variability between donor and regenerant genotypes resulted through *in vitro* cultures.

Based on obtained results we can observed that there are evident differences between donor genotypes and their regenerants, as for the variability measure of different traits and variation sources. In the case of the donor genotypes, the fruit length has the higher contribution at fruits production variability per plant, succeeded by the fruits number. For regenerant genotypes, the production variability per plant is mainly due to the fruits number and their average weight. Also, we registered evident differentiations between donor genotypes group and regenerant genotypes group as for relationship between production traits and genotypes performance for these traits.

Keywords: *Momordica charantia* L., *in vitro* regenerants yield

INTRODUCTION

Bitter gourd (*Momordica charantia* L.), an important medicinal plant from the warm climate area of the Asian continent (India, China, and Malaysia), can be cultivate in Romania for their high therapeutic value, but with low productivity. By applying indirect regeneration methods via the callus we can obtain plants that have higher productive features, which allow the selection of some genotypes valuable for the temperate climate area.

The aim of this study was to evaluate the measure and the different forms of the variability between donor and regenerant genotypes resulted through *in vitro* cultures.

MATERIAL AND METHODS

The vegetal material studied vas represented by five *Momordica charantia* L. genotypes from a crop cultivated in Western Romania and five *in vitro* regenerant lines, obtained from callus culture on MS suplimented with ANA (1,5 g/l) and BAP (1g/l) (Malic and colab., 2007; Botău and Frant, 2008).

The field experiment was organized in a complete randomized blocks design in three repetitions on 30 plants (70 x 40 cm) plots, during 2007-2009. Regenerated plants were acclimated in normal conditions and transferred to the field. Their cultivation was done under normal conditions, with no chemical or organic fertilisers, ensuring the necessary water during periods of drought (Palada and Chang, 2003).

The different forms of the variability between donor and regenerant genotypes resulted through *in vitro* cultures, were evaluated using correlations and variance analysis of multiple regression (Ciulca, 2006). To make possible the display in a single graph of the performance of each genotype for each of the five traits, the basic principle of the biplot technique developed by Gabriel (1971) and GGE biplot method developed by Yan et. al. (2000) was used.

RESULTS AND DISCUSSIONS

The variance analysis of multiple regression regarding the four traits influence on plant yield of donor genotypes demonstrates that 84,73 % of fruits weight variability per plant is due to these traits influence.

Tab. 1

Variance analysis of multiple regression between fruit yield/plant and fruit number, fruit weight, fruit length and fruit diameter in donor genotypes of bitter gourd

Variability source	SS	DF	MS	F Test
Regression	180709 (100 %)	4	45177.25	F=62.42**
Fruit number (x_1)	135649 (75.06 %)	1	135649	F=187.43**
Fruit weight (x_2)	1104 (0.61 %)	1	1104	F=1.53
Fruit lenght (x_3)	43479 (24.06 %)	1	43479	F=60.08**
Fruit diameter (x_4)	477 (0.26)	1	477	F=0.66
Residual	32567	45	723.71	
Total	213276	49		

$y = 3477.19 + 0.98x_1 + 2.84x_2 - 2.44x_3 - 0.70x_4$; $R^2 = 0.8473$; $R = 0.9205$

The fruits number per plant has a major and a high significant contribution (about 75%) to fruits production/plant carrying out. The length fruit has a influence of 24 % to the variability of this trait, while the fruit number, fruit weight and diameter have a very low influence.

Based on table 2 results, we observed that 88,52 % of fruits yield per plant at regenerant genotypes can be explain by the influence of the four studied traits. The fruits number per plant has a high significant and major influence (about 92,05 %) at yield / plant carrying out. Also, we observed that the modification of fruit diameter and length shows a low unsignificant effect on yield / plant.

Regarding on table 3 results, we observed that there are statistical assured correlations between all studied traits. Hence, the fruits number shows negative correlations regard fruit weight and length, respective positive correlations with fruit diameter and yield per plant. Also, fruit diameter shows negative correlations regard fruit weight and length. Based on these results, we can affirm that the application of selection for high values of fruit length can increase the fruit mean weight.

Tab. 2

Variance analysis of multiple regression between fruit yield/plant and fruit number, fruit weight, fruit length and fruit diameter in regenerant genotypes of bitter gourd

Variability source	SS	DF	MS	F Test
Regression	365653 (100 %)	4	91341.25	F=86.15**
Fruit number (x_1)	336328 (92.05%)	1	336328	F=317.23**
Fruit weight (x_2)	27449 (7.511 %)	1	27449	F=25.89**
Fruit lenght (x_3)	93 (0.03 %)	1	93	F=0.09
Fruit diameter (x_4)	1783 (0.49)	1	1783	F=1.68
Residual	32567	45	1060.20	
Total	413074	49		

$y = 1907.55 + 8.08x_1 - 0.22x_2 + 4.19x_3 - 3.16x_4$; $R^2 = 0.8852$; $R = 0.9408$

Tab. 3

Covariance and correlation coefficients values between studied traits in donor genotypes of bitter gourd

Trait	1. (s^2=2,19)	2. (s^2=397,06)	3. (s^2=1,69)	4. (s^2=0,15)	5. (s^2=45177)
1. Fruit number/plant		r = -0,745^{000} S^2_{XY} = -21,98	r = -0,685^{000} S^2_{XY} = -1,32	r = 0,792*** S^2_{XY} = 0,45	r = 0,866*** S^2_{XY} = 272,68
2. Fruit weight (g)			r = 0,954*** S^2_{XY} = 24,73	r = -0,925^{000} S^2_{XY} = -7,12	r = 0,593*** S^2_{XY} = 2512,73
3. Fruit length (cm)				r = -0,775^{000} S^2_{XY} = -0,39	r = -0,396^{00} S^2_{XY} = -109,43
4. Fruit diameter (cm)					r = 0,809*** S^2_{XY} =66,43
5. Fruit yield/plant (g)					

$r_{5\%} = 0,288$; $r_{1\%} = 0,372$; $r_{0,1\%} = 0,465$

Variance and covariance analysis indicate us that there are linear relations between the five studied traits, so that it is possible to estimate reciprocal influences among these.

The analysis of correlation coefficients between the five production traits studied in regenerant genotypes demonstrate the existence of some very significant positive correlations between fruits number and diameter, respective yield/plant. The fruit diameter shows a negative significant correlation regard fruits length and weight.

Hence, we observe that to obtain superior values of yield/plant, the selection can be orientated to increase the fruit number and the fruits diameter. The efficiency of selection based on significance correlations anterior noticed, is confirmed by the fact than between pairs of characters there are linear relations that permit us to predict the modifications of these traits in a certain aim.

Tab. 4

Covariance and correlation coefficients values between studied traits in regenerant genotypes of bitter gourd

Trait	1. (s^2=9,70)	2. (s^2=13,32)	3. (s^2=1,36)	4. (s^2=0,43)	5. (s^2=91413)
1. Fruit number/plant		r = -0,172 S^2_{XY} =-1,95	r = -0,935^{000} S^2_{XY} = -3,40	r = 0,889*** S^2_{XY} = 1,82	r = 0,959*** S^2_{XY} = 902,91
2. Fruit weight (g)			r = 0,091 S^2_{XY} = 0,39	r = -0,366^{0} S^2_{XY} = -0,88	r = 0,105 S^2_{XY} = 115,92
3. Fruit length (cm)				r = -0,676^{000} S^2_{XY} = -0,52	r = -0,922^{000} S^2_{XY} = -325,48
4. Fruit diameter (cm)					r = 0,785*** S^2_{XY} =156,41
5. Fruit yield/plant (g)					

$r_{5\%}$ = 0,288; $r_{1\%}$ = 0,372; $r_{0,1\%}$ = 0,465

The biplot of first two principal components for the studied donor genotypes (fig. 1) explain about 90 % from the variability of the five traits studied. We observed that the donor genotype 2A shows the most superior values for majority yield traits excepting fruits weight / plant. Also, donor genotypes 1A and 2A registered the most superior values of different traits, especially yield / plant. In the case of genotypes 3A and 5A we observed low values of all traits.

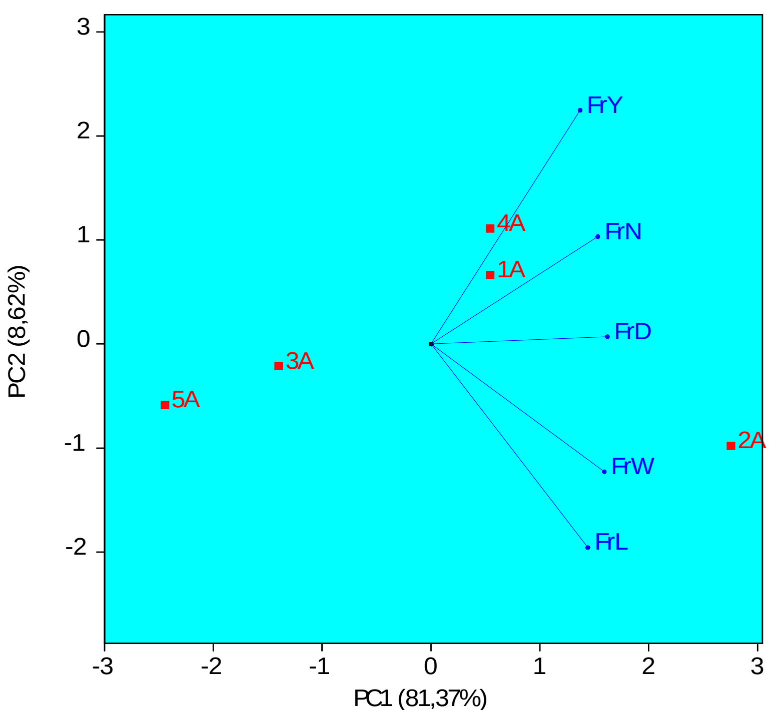

Fig.1. Biplot of first two principal components for the studied donor genotypes and traits
(FrY- Fruit yield/plant; FrN-Fruit number/plant; FrD-Fruit diameter; FrL-Fruit length, FrW-Fruit weight)

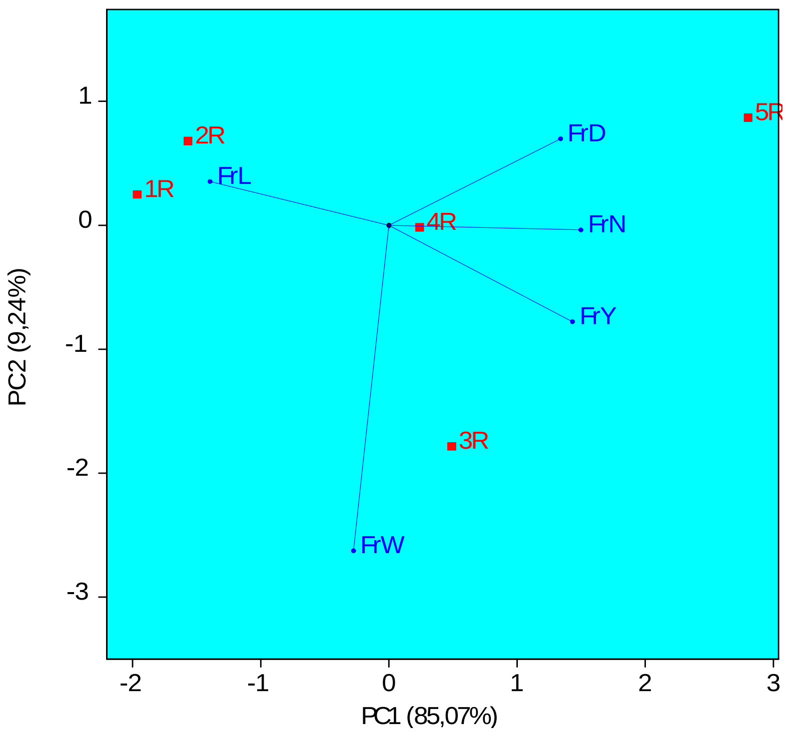

Fig.2. Biplot of first two principals components for the studied regenerant genotypes and traits
(FrY- Fruit yield/plant; FrN-Fruit number/plant; FrD-Fruit diameter; FrL-Fruit length, FrW-Fruit weight)

Regarding to biplot (fig.2) of principal components that express about 94 % from the variability of studied traits, the regenerant genotype 5R shows the most superior values of the fruit diameter, fruits number and weight per plant. Also, the regenerant genotype 3R registered the most superior values of the fruit weight, while genotypes 1R and 2R present the most longs fruits. Because the vectors length of traits gives information about their variability, in the case of fruits main weight we observed a superior variability regard other traits.

CONCLSIONS

Based our results, we conclude that there are evident differences between donor genotypes and their regenerants, as regarding variability amount of different traits, as variation sources. Thereby, in the case of donor genotypes, the fruits length has the most large contribution at fruit yield variability / plant, followed the fruits number. For regenerant genotypes, the yield variability / plant is due to fruits number and main weight of these.

Also, it was registered evident differences between donor and regenerant genotype groups, as regarding at correlations between different yield traits as regarding genotype performances for these traits.

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REFERENCES

Botau ,D., Frant, A., (2008). Researches regarding in vitro cultures conditions influencing on *Momordica charantia* L. regeneration, Cercet. St. Hort.Ing.genet., s XII: 48-50.

Ciulca, S. (2006). Metodologii de experimentare în agricultură şi biologie, Ed Agroprint, Timişoara.

Gabriel, K.R. (1971). The biplot graphic display of matrices with application to principal component analysis, Biometrika, 58, 453-467**.**

Malic, S., Zia, M., Riaz-ur-Rehman., Chaudhary F. (2007). In vitro plant regeneration from direct and indirect organogenesis of *Momordica charantia* L. Pakistan Journal of Biological Sciences. 10 (22): 4118-4122.

Manye, Y., Z.Maojun, Z. Yu, L. Liqong, Fang, C. (2004). Establishment of in vitro regeneration system of Bitter Gourd (*Momordica charantia* L.) High Technol. Lett., 10: 44-48.

Yan ,W., et al., (2000). Cultivar evaluation and mega-environment investigation based on the GGE biplot. Crop. Sci., 40: 597-605.