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VARIABILITY AND FACTOR ANALYSIS OF MORPHOLOGICAL AND PRODUCTIVE CHARACTERISTICS OF SPECIES OF THE GENUS *AMARANTHUS*

Vesna VUJAČIĆ

Faculty of Agriculture, 11080 Zemun, Serbia and Montenegro

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Ten genotypes of amaranth were being studied for three years. Morphological and productive characteristics - plant height, foliage per plant, average foliage length, average foliage width, mass per plant, and seed mass per plant were the subject of this research. Variability of these traits was analyzed and classification of the genotypes by the method of major components was conducted. Variability within a specific trait was significant. In case of the plant height it ranged between 93.18 cm (genotype 9 - *A. cruentus*) and 160.78 cm (genotype 1 - *A mantegazzianus*); foliage per plant raged between 12.89 (genotype 10 - *A cruentus*) and 23.46 (genotype 1 - *A mantegazzianus*); average foliage length varied from 14.77 cm (genotype 9 - *A cruentus*) to 26.72 cm (genotype 1 - *A mantegazzianus*); average foliage width ranged between 6.30 cm (genotype 9 - *A cruentus*) and 14.46 cm (genotype 1 - *A mantegazzianus*); foliage mass per plant ranged between 94.05 g (genotype 3 - *A molleros*) and 246.81 g (genotype 1 - *A mantegazzianus*). Seed mass per plant varied from 45.56 g (genotype 3 - *A molleros*) to 67.55 g (genotype 1 - *A mantegazzianus*). The major components method, i.e. factor analysis indicated that the characteristics such as: plant height, average foliage length and average foliage width, had a significant factor loading with the first factor. These traits are of a crucial importance for genotype variability.

Corresponding author: Vesna Vujačić, Faculty of Agriculture, 11080 Zemun, Serbia and Montenegro
E-mail: wesnaw2002@hotmail.com

Foliage number and foliage mass were significantly correlated with the second factor, meaning that they were of a minor importance for the genotype variability. Such results offer guidance with respect to the plant modeling, i.e. indicate how to proceed with the breeding program of this species.

Key words: genotype, amaranth, foliage, seeds, variability, major components method

INTRODUCTION

Amaranth belongs to the C-4 plant group which is distinguished by a high photosynthesis productivity. Thus, the majority of amaranth research is targeted primarily at seeking for the possibility of its use as food in order to utilize its highly nutritive properties.

VRACEV (1997) outlines that, according to the results of research aimed to create a breeding program of new cultivars based on *A. caudatus*, *A . cruentus* and *A. mantegazzianus, Passer* proved to be the best nutritive cultivar.

A manner of a very complex amaranth utilization is a crucial issue of research performed with plants of *Amaranthus L.* genus. Many plants classified as the *Amaranthus L.* genus have high nutritive and medicinal traits, and may be used as fodder, as well.

Plants of *Amaranthus L.* genus are characterized by a high yielding rate and economical processing, which enables their successful introduction into many regions that have not yet experienced growing of these species (CERNOV *et al.*, 1995).

The aim of this experiment was to evaluate the variability of certain genotypes in given growing conditions, as well as to confirm the regularity of selected traits, applying the factor analysis.

MATERIAL AND METHOD

Material used in these researches originates from Russia (1992), i.e. from the Pan-Russian Scientific and Research Institute (Vir) of the Russian Academy of Agricultural Sciences.

Ten genotypes of which the genotype 3 belongs to the species *A. molleros,* genotypes 2 and 4 belong to the species *A. caudatus*, genotype 1 to the species *A. mantegazziamus* and genotypes 5 to 10 belong to the species *A. cruentus* were chosen.

The experiment was conducted in a complete random block design. It was repeated four times and was being observed for three years (1996/97/98) at the experimental field of "Zdravlje" Leskovac, without chemical control. Fundamental agro-technical measures were implemented solely. Sowing was performed in the first decade of May, while harvest was conducted in the second decade of September.

Biometrical methods - Mean value (x), standard deviation (S), and variation coefficient (CV %) were calculated as indicators of variability:

Mean sample value: $$\bar{x} = \frac{\Sigma\, xi}{N}$$

Standard deviation: $$S = \sqrt{\frac{\Sigma\, (x - \bar{x})^2}{N - 1}}$$

Variation coefficient: $$CV = \frac{S\ x\ 100}{\bar{x}}$$

The two-factor analysis of variance was performed for morphological and productive characteristics, in an experiment that lasted over several years (HADŽIVUKOVIĆ, 1991).

Table 1. The mean sample value ($\bar{x}$) in cm, standard deviation (S), and variation coefficient (Cv) % per plant height (cm) in ten Amaranthus genotypes during the period of three years

Genotype *)	1996 $\bar{x}$ (cm)	1997 $\bar{x}$ (cm)	1998 $\bar{x}$ (cm)	$\bar{X}$ (cm)	Cv (%)
1	185.90	172.90	123.55	160.78	16.69
2	162.00	120.28	105.15	129.14	18.16
4	151.95	109.08	93.78	118.27	20.81
3	158.33	156.65	114.33	143.10	14.22
5	135.50	87.38	74.05	98.98	26.66
6	134.50	88.30	81.70	101.50	23.14
7	133.35	82.80	72.55	96.23	27.61
8	129.90	82.29	76.35	96.18	24.79
9	121.90	83.70	75.89	93.83	21.42
10	125.15	85.15	78.27	96.19	21.48
I.V.	64.00	90.61	51.00	-	-
S	19.14	31.52	17.63	-	-
Cv (%)	13.30	29.49	19.68	-	-
LSD	0.05	20.35			
	0.01	29.34			

*) The species *A. mantegazzianus* - genotype 1; species *A. caudatus* - genotypes 2 and 4; species *A. molleros* - genotype 3; species *A. cruentus* - genotypes 5, 6, 7, 8, 9, and 10

The essence of the factor analysis is based on the assumption that the initial set of indicators X1, X2 . . . Xn may be expressed as a linear combination of smaller number of so-called concealed (latent) factors F1, F2 . . . Fp (p<<n) which can be mutually uncorrelated. It is in this manner that the initial factor space is depicted by linear transformation into the factor space of smaller size, thus enabling in a very specific way the dependence of the initial set of indicators to be clearly recognized and interpreted.

RESULTS AND DISCUSSION

Plant height - Variation in the mean value of plant height is expressed by the coefficient of variation and standard deviation. Analyzing the variability during the three years of research within the genotype studied, it was observed that the genotype 7 (27.61%) expressed the maximum variation, whereas the minimum variation was observed in the genotype 1 (16.69%), i.e. larger variation was recorded in case of the species *A. cruentus,* and lower in case of the species *A. mantegazzianus*. During 1996, the variability coefficient between analyzed genotypes for the plant height was 13.30%. During 1997, it was larger – 29.49%, while in 1998 it reached the value of 19.68 % (Table 1).

Obtained LSD values (for the probability level of 5% and 1%) confirmed that there was a significant variation of this trait.

Studying the amaranth plant, GERASIMOV and BERSON (1995) determined that height of a short *caudatus* was 153 cm. VRACEV (1995) drawn the conclusion that the amaranth height, for the period of 1994-1996 research, conducted in the experimental botanical garden in Vertukovsko was as follows:

A. cruentus (short) 130-120 cm; *A. Cruentus* (tall) 110-185 cm.

A. caudatus 120-210 cm; A. mantegazziunus Passer 140-210 cm.

Studying amaranth genotypes in the stage of physiological seed ripeness, BODROZA-SOLAROV and LAZIĆ (1994) revealed that plant height varied from 128.3 cm to 147.2 cm, i.e.: for *A.cruentus* 135.9-136.8 cm, *A. hypochondriacus* 147.2, *A. caudatus* 128.23 cm, and *A. molleros* 135.5 cm.

Table.2 The mean sample value ($\bar{x}$) in cm, standard deviation (S) and variation coefficient (Cv) % per foliage per plant in ten Amaranthus genotypes during the period of three years

Genotype *)	1996 $\bar{x}$ (cm)	1997 $\bar{x}$ (cm)	1998 $\bar{x}$ (cm)	$\bar{X}$ (cm)	Cv (%)
1	28.00	23.25	19.14	23.46	3.62
2	24.21	19.99	17.43	20.54	2.77
4	22.78	18.56	16.57	19.31	2.58
3	16.10	15.42	11.76	14.42	1.90
5	20.35	11.66	9.87	13.96	4.58
6	19.25	12.38	10.97	14.20	3.61
7	19.70	11.07	10.00	13.59	4.34
8	18.20	10.78	10.07	13.01	3.52
9	17.77	11.30	10.25	13.10	2.37
10	17.40	11.42	9.87	12.89	3.24
I.V.	11.90	12.47	9.27	-	-
S	3.44	4.26	3.44	-	-
Cv (%)	16.88	29.25	27.37	-	-
LSD	0.05	0.749			
	0.01	0.992			

*) The species *A. mantegazzianus* - genotype 1; species *A. caudatus* - genotypes 2 and 4; species *A. molleros* - genotype 3; species *A. cruentus* - genotypes 5, 6, 7, 8, 9, and 10

Foliage per plant - Variability observed during three years of the research within the genotypes studied, demonstrated that the genotype 2 had the minimum variation (1.9%), while the genotype 5 expressed the largest variability (4.58%). More precisely, if observed within a species, the maximum variability was recorded for *A. cruentus*, and minimum for *A. caudatus* (Table 2).

Standard variation values, as a measure of variability, were in accordance with the variation coefficient values.

In the first year, variability between the genotypes was 16.808%, in the second year it was 29.25%, while in the third year it was 27.37% (Table 2).

The data obtained by the foliage-per-plant analysis (Table 2) demonstrated the existence of variability between genotypes studied, which was confirmed by the LSD values (probability level of 5% and 1%, respectively).

It should be noted that among the cultivated species in the world nowdays, the foliage of *A. cruentus*, *A. dibtus*, *A. tricolor* and *A. blituma*, is used for nutrition purposes (DALOZ, 1979).

Table.3 The mean sample value ($\bar{x}$) in cm, standard deviation (S) and variation coefficient (Cv) % per medium foliage length in ten Amaranthus genotypes during the period of three years

Genotype *)	1996 $\bar{x}$ (cm)	1997 $\bar{x}$ (cm)	1998 $\bar{x}$ (cm)	$\bar{X}$ (cm)	Cv (%)
1	30.65	27.25	22.27	26.72	3.67
2	20.97	17.22	13.05	17.08	3.23
4	19.47	17.10	12.97	16.51	2.68
3	19.45	17.15	11.75	16.11	3.22
5	19.00	17.32	12.32	16.21	2.83
6	17.85	17.45	11.62	15.64	2.84
7	18.01	17.25	11.62	15.62	2.84
8	16.92	16.87	12.92	15.57	1.87
9	16.87	15.87	11.62	14.27	2.26
10	16.97	16.40	11.50	14.95	2.45
I.V.	13.80	11.40	10.77	-	-
S	3.89	3.12	3.09	-	-
Cv (%)	19.85	17.36	23.50		
LSD	0.05	0.978			
	0.01	1.295			

*) The species *A. mantegazzianus* - genotype 1; species *A. caudatus* - genotypes 2 and 4; species *A. molleros* - genotype 3; species *A. cruentus* - genotypes 5, 6, 7, 8, 9, and 10

In their research of *A. cruentus* and *A. tricolor* L., KOLESNIKOV and GINS (1997) reached the conclusion that amaranth is very closely related to mint. Very fragile amaranth leaves, with low ashes content and reduced cellulose content, are relatively rich in proteins, pectin and flavonoid, which ranks amaranth as equal to the other known medicinal plants.

Medium foliage length - Variability within the analyzed genotypes during the period of three-year research indicated that the genotype 8 had the minimum variation (1.87%), while the maximum variation was observed for the genotype 1 (3.67%), i.e. given by species, the maximum variation was recorded for *A. mantegazzianus*, and the minimum for *A. cruentus*. In 1996, variability within the analyzed genotypes was 19.85%, in 1997 17.36% and in 1998 23.50% (Table 3).

The minimum value of variation intervals for analyzed genotypes was 10.77 cm (in the third year), and the maximum value for the above mentioned variability indicator was 13.8 cm (in the first year of research).

The standard deviation in foliage length ranged between 3.09% (1998) and 3.89% (1996), and was in accordance with variation coefficient values (Table 3).

Table.4 The mean sample value ($\bar{x}$) in cm, standard deviation (S) and variation coefficient (Cv), % per medium foliage width in ten Amaranthus genotypes during the period of three year

Genotype *)	1996 $\bar{x}$ (cm)	1997 $\bar{x}$ (cm)	1998 $\bar{x}$ (cm)	$\bar{X}$ (cm)	Cv (%)
1	16.42	15.23	11.73	14.46	1.99
2	12.07	9.88	6.07	9.34	2.47
4	11.82	9.32	5.72	8.59	2.52
3	9.70	8.10	5.87	7.89	1.56
5	8.05	7.00	4.97	6.67	1.27
6	7.65	6.85	4.70	6.40	1.24
7	7.40	7.52	5.20	6.70	1.06
8	6.95	7.05	5.00	6.33	0.94
9	7.45	6.95	4.60	6.30	1.24
10	7.77	7.02	4.90	6.56	1.21
I.V.	9.47	8.38	7.13	-	-
S	2.88	2.46	2.00	-	-
Cv (%)	30.35	29.00	34.19		
LSD	0.05	0.050			
	0.01	0.670			

*) The species *A. mantegazzianus* - genotype 1; species *A. caudatus* - genotypes 2 and 4; species *A. molleros* - genotype 3; species *A. cruentus* - genotypes 5, 6, 7, 8, 9, and 10

The results obtained by GERASIMOVA and BERSON (1996) demonstrated that the mean foliage length value of *A. caudatus* was 24 cm, of *A. candatus* 21 cm, *A. paviculatus* 28 cm and for *A. cruentus* it was 26 cm. It is to be noted that these are the parameters of the best-quality foliage, and in this respect amaranth is classified in two categories:

tall (*A. poninculatus* – 180 cm; *A. cruentus* – 193 cm), and

short (*A. caudatus* – 153 cm and *A. candatus* – 140 cm).

Medium foliage width - Given by years of research, the minimum mean values of foliage width were recorded for the genotype 8 (6.95 cm) in 1996, genotype 6 (6.85 cm) in 1987, and genotype 9 (4.9 cm) in 1998. The maximum mean values for the above mentioned characteristic, by years of research, were observed for the genotype 1 (Table 4). Given by species, the minimum mean values for the this characteristic were observed in case of the species *A. cruentus*, and the maximum mean values in case of *A. mantegazzianus*.

The maximum value of variation interval (9.47) and standard deviation (2.88 %) was recorded in the first year, and the minimum value of variation interval (7.13) and standard deviation (2%) in the third year of research.

Results presented in Table 4 indicated that the genotype 8 had the minimum variability (0.94%) and the genotype 4 the maximum variability (2.52%). Variability among analyzed genotypes in 1996 was 30.35%, in 1997 29%, and in 1998 it was 34.19%.

Studying biometrical indicators of five amaranth genotypes in conditions of the Northern Ural, GERASIMOVA and BERSON (1996) calculated mean values of foliage width for *A. gangeticus* – 16 cm, *A. paniculatus* – 15 cm, *A. caudatus* – 13 cm, and for *A. cruentus* – 16 cm.

Foliage mass per plant - The variation interval for the analyzed genotypes ranged between 91.42 g (in the first year) and 204.83 g (during the third year of research). The maximum standard deviation value (60.40%) was recorded in 1996, and considerably lower value (24.01%) was notable in 1998 (Table 5).

Table.5.The mean sample value ($\bar{x}$) in cm, standard deviation (S) and variation coefficient (Cv) % per foliage mass per plant in ten Amaranthus genotypes during the period of three years

Genotype *)	1996 $\bar{x}$ (cm)	1997 $\bar{x}$ (cm)	1998 $\bar{x}$ (cm)	$\bar{X}$ (cm)	Cv (%)
1	340.50	237.60	162.34	246.81	72.02
2	249.37	166.47	107.45	174.43	58.21
4	219.44	170.52	104.62	164.86	47.04
3	115.61	95.63	70.92	94.05	18.27
5	180.43	160.31	82.94	141.22	42.02
6	183.94	131.94	94.74	136.87	36.58
7	184.78	123.46	91.70	133.31	38.63
8	159.88	119.54	90.36	123.26	28.07
9	156.36	121.54	85.72	121.20	28.83
10	146.87	99.15	81.14	109.05	27.73
I.V.	224.89	141.97	91.42	-	-
S	60.40	40.29	24.01	-	-
Cv (%)	31.18	28.26	24.71	-	-
LSD	0.05	22.375			
	0.01	29.672			

*) The species *A. mantegazzianus* - genotype 1; species *A. caudatus* - genotypes 2 and 4; species *A. molleros* - genotype 3; species *A. cruentus* - genotypes 5, 6, 7, 8, 9, and 10

Variability of each genotype in three years of research revealed that the genotype 3 had the minimum variation (18.27%), while the highest value of this parameter was observed for the genotype 1 (72.07%). Namely, the minimum variation was recorded for the species *A. molleros*, and maximum for the species *A. mantegazzianus*.

Variation coefficient between analyzed genotypes in the first year was 31.18%, in the second year 28.26% and in the third year of research it was 24.71% (Table 5).

The mean value of the foliage mass per plant, according to KONONKOV (1997), under the conditions prevailing in the area of Moscow, ranged between 92 g and 366 g for the genotype *A.caudatus*, 222 g and 654 g for the genotype *A.tricolor* and for the genotype *A.cruentus*, variation was approximately 220 g.

An increase in yield of biomass is the result of a specific process of CO2 photosynthetic assimilation (TCHERNOV, 1996).

According to TCHERNOV (1992), high productivity rate is based on a specific metabolyc process of carbon and nitrogen (C-4 photosynthesis), which ensure specific morphological, physiological and biochemical properties of amaranth.

Seed mass per plant - Analyzing variability between the genotypes during three years of research, it may be concluded that the genotype 8 (15.39%) had the largest variation, while the minimum variation was recorded for the genotype 3 (8.14%) (Table 6). Variability between analyzed genotypes in 1996 was 13.75%, in 1997 9.95, and in 1998 it was 8.64%. Given by species, somewhat larger variability was recorded for *A. cruentus*, while it was lower for *A.mantegazzianus*.

Table.6.The mean sample value ($\bar{x}$) in cm, standard deviation (S) and variation coefficient (Cv), % per seed mass per plant in ten Amaranthus genotypes during the period of three years

Genotype *)	1996 $\bar{x}$ (cm)	1997 $\bar{x}$ (cm)	1998 $\bar{x}$ (cm)	$\bar{X}$ (cm)	Cv (%)
1	82.02	69.10	51.53	67.55	12.49
2	66.92	47.60	41.03	51.85	10.58
4	66.06	46.81	38.04	50.30	11.70
3	56.95	41.40	38.35	45.56	8.14
5	78.77	58.51	43.90	60.39	14.29
6	70.42	57.92	41.13	56.49	12.00
7	75.00	55.74	39.90	56.88	14.35
8	78.77	49.41	43.58	57.25	15.39
9	72.25	53.14	43.42	56.27	11.97
10	67.77	53.71	43.63	55.03	9.89
I.V.	25.07	27.70	13.49	-	-
S	7.11	7.31	3.66	-	-
Cv (%)	9.95	13.72	8.64	-	-
LSD	0.05	7.20			
	0.01	9.50			

*) The species *A. mantegazzianus* - genotype 1; species *A. caudatus* - genotypes 2 and 4; species *A. molleros* - genotype 3; species *A. cruentus* - genotypes 5, 6, 7, 8, 9, and 10

Results of morphological and biochemical research of *A. cruentus*, *A. caudatus,* and *A. lividus,* indicated that the plant seed mass varied from 16.3 g to 328 g (ZELEZNIKOV, 1996).

The seed mass per plant is dependable in a larger extent on the realized yield per unit of area, thus influencing directly the total amaranth yield.

According to the research performed by BODROZA-SOLAROV (1998), there is the need for the production that determines the manner of sowing (more dense sowing for foliage, or somewhat thinner sowing for higher seed yield). Throughout these research, it has been ascertained that amaranth gave a nourishing mass, rich in protein content. Thus, both the production of foliage and production of seed should be applied. The mean seed mass value per plant was: 59.4 g *A. hypochondriacus,* 52.4 g *A.caudatus,* 46.2 g *A.molleros,* and *A. cruentus* 48.2 g - 71.7 g, respectively.

One of the characteristics of amaranth, as a plant with the C-4 photosynthesis type, is an increased production of dry substance (KASTORI, 1991).

Factor Analysis – Major Components Method - The initial space of indicators a is dimension 6 and it embraces the following indicators: A – plant height, B – foliage per plant, C - medium foliage length, D – medium foliage width, F – foliage mass per plant and H – seed mass per plant.

The correlation matrix of the initial set is presented in Table 7.

Table. 7. The correlation matrix

Characteristics	Plant Height (x_1)	Folige per Plant (x_2)	Medium Foliage Length (x_3)	Medium Foliage Width (x_4)	Foliage Mass per Plant(x_5)	Seed Mass per Plant (x_6)
Plant Height (x_1)		0.072	0.854**	0.920**	0.499	0.264
Foliage per Plant (x_2)	0.072		0.051	0.197	0.831**	-0.336
Medium Foliage Length(x_3)	0.854**	0.051		0.965**	0.271	0.348
Medium Foliage Width (x_4)	0.920**	0.197	0.965**		0.460	0.274
Foliage Mass per Plant (x_5)	0.499	0.831**	0.271	0.460		-0.245
Seed Mass per Plant (x_6)	0.264	-0.336	0.348	0.274	-0.245	

**) $p < 0,01$

There are higly significant correlation coefficients between the characteristics of plant height and medium foliage length, as well as between plant height and medium foliage width, and between medium foliage length and medium foliage width.

In order to to analyze such a complex correlation structure and to recognize the significance of particular indicators, factor analysis has been conducted applying the method of major components.

The dimension of a latent factor space has been determined according to the number of characteristic roots larger than 1. Applying the Cattell's diagram

(Fig. 1), it can be observed that the turning-point occurs immediately after the first two characteristic roots. Bearing in mind that only first two characteristic roots are larger than 1, the dimension of this space is 2.

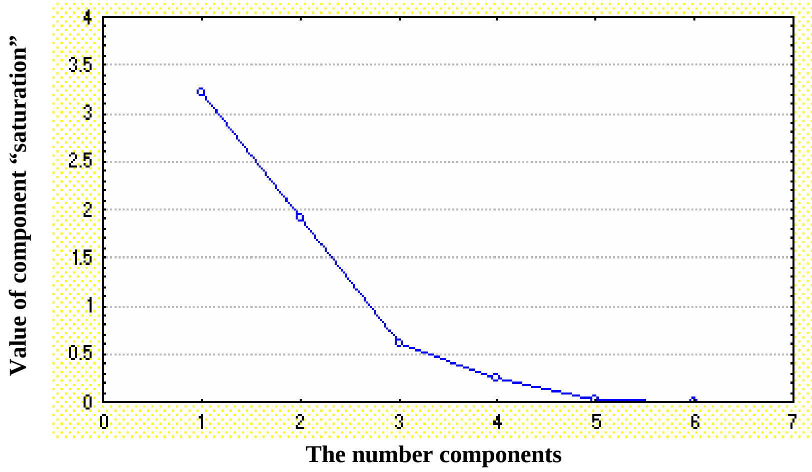

Figure 1. Kattell's diagram

Presented in Table 8 are the values of the first two characteristic roots with the percentage of their portion in the total variation.

Table 8 - Values of the first two characteristic roots with the percentage of their portion in the total variation

Factor components	Value of component "saturation"	Total variance (%)	Cumulative value component "saturation"	Cumulative variance (%)
1	3.21618	53.603	3.21618	53.603
2	1.91657	31.94284	5.13275	85.54584

As shown in Table 8, the first two characteristic roots account for 85% of the total variability of analyzed genotypes.

In the practical application of factor analysis, the factor space rotation – so-called Varimax method is most frequently used. The factor loading demonstrated in Table 9 was obtained by this method.

The major components method, i.e. factor analysis indicates that traits such as: plant height, medium foliage length, medium foliage width, have a significant factor loading with the first factor. These traits are of crucial importance for the variability of genotypes. Characteristics such as: foliage number and foliage mass are significantly correlated with the second factor, meaning that they are of a minor importance for the genotype variability. These results offer possible solution to the plant modeling, i.e. they indicate how to proceed with the breeding program of this plant species.

Table. 9. A significant factor loading

Characteristics	Factor 1	Factor 2
Plant Height (A)	0.938	0.144
Foliage per Plant (B)	0.043	0.924
Medium Foliage Length (C)	0.958	0.001
Medium Foliage Width (D)	0.969	0.176
Foliage Mass per Plant (F)	0.356	0.887
Seed Mass per Plant (H)	0.467	-0.595
Total	3.087	2.046
$\bar{X}$	0.514	0.341

CONSLUSION

Results obtained in this study indicate the following:

The major components method i.e. factor analysis indicates that characteristics such as: plant height, medium foliage length, medium foliage width, have a significant factor loading with the first factor. These features are of a crucial importance for the variability of genotypes. Features such as: foliage number and foliage mass are significantly correlated with the second factor, meaning that they are of a minor importance for the genotype variability. Such results offer guidance in respect to the plant modeling i.e. indicate how to proceed with the selection program of this culture.

Significant divergence was established in case of almost all morphological and productive traits: in plant height it varied from 93.18 cm (genotype 9 - *A. cruentus*) to 160.78 cm (genotype 1 – *A. mantegazzianus*); in foliage per plant it varied from 12.89 cm (genotype 10 - *A. cruentus*) to 23.46 cm (genotype 1 – *A. mantegazzianus*); average foliage length varied from 14.77 cm (genotype 9 – *A. cruentus*) to 26.72 cm (genotype 1 - *A mantegazzianus*); average foliage width ranged between 6.30 cm (genotype 9 – *A. cruentus*) and 14.46 cm (genotype 1 - *A mantegazzianus*); foliage mass per plant ranged between 94.05 g (genotype 3 – *A. molleros*) and 246.81 g (genotype 1 – *A. mantegazzianus*); seed mass per plant varied from 45.56 g (genotype 3 – *A. molleros*) to 67.55 g (genotype 1 - *A mantegazzianus*), while the total seed yield ranged between 2.22 t/ha (genotype 3 – *A. molleros*) and 3.20 t/ha (genotype 1 – *A. mantegazzianus*).

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VARIJABILNOST I FAKTORSKA ANALIZA MORFOLOŠKIH I PRODUKTIVNIH OSOBINA VRSTA IZ RODA AMARANTHUS

Vesna VUJAČIĆ

Poljoprivredni fakultet, 11080 Zemun, Srbija i Crna Gora

Izvod

U trogodišnjem radu je ispitivano deset genotipova amarantusa. Ispitivane su morfološke i produktivne osobine - visina biljke, broj listova po biljci, dužina srednjeg lista, širina srednjeg lista, masa lista po biljci i masa zrna po biljci. Analizirana je varijabilnost navedenih osobina i izvršena klasifikacija metodom glavnih komponenti. Varijabilnost u okviru pojedinih osobina je značajna i iznosi za visinu biljke od 93,18 cm (genotip 9 - *A. cruentus*) do 160,78 cm (genotip 1 - *A. mantegazzianus*); broj listova po biljci od 12,89 (genotip 10 - *A. cruentus*) do 23,46 (genotip 1 - *A. mantegazzianus*); dužinu srednjeg lista od 14,77 cm (genotip 9 - *A. cruentus*) do 26,72 cm (genotip 1 - *A. mantegazzianus*); širinu srednjeg lista od 6,30 cm (genotip 9 - *A. cruentus*) do 14,46 cm (genotip 1 - *A. mantegazzianus*); masu lista po biljci od 94,05 g (genotip 3 - *A. molleros*) do 246,81 g (genotip 1 - *A. mantegazzianus*),i za masu zrna po biljci od 45,56 g (genotip 3 - *A. molleros*) do 67,55 g (genotip 1 - *A. mantegazzianus*). Metod glavnih komponenti tj. faktorska analiza pokazuje da značajnu faktorsku opterećenost sa prvim faktorom imaju osobine - visina biljke, dužina srednjeg lista i širina srednjeg lista. Ove osobine su od prvorazrednog značaja za varijabilnost genotipova. Sa drugim faktorom značajno su korelirane osobine, broj listova i masa lista, što znači da su one od drugorazrednog značaja za varijabilnost genotipova. Ovakvi rezultati nas usmeravaju u modeliranje biljke, odnosno ukazuje na pravac programa selekcije ove kulture.

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