Scientific Papers. Series B, Horticulture. Vol. LXVII, No. 1, 2023
Print ISSN 2285-5653, CD-ROM ISSN 2285-5661, Online ISSN 2286-1580, ISSN-L 2285-5653

ANALYSIS OF THE DIVERSITY OF GARLIC *(ALLIUM SATIVUM* L.) GENOTYPES FROM THE SOUTHWESTERN PART OF ROMANIA BASED ON MORPHOLOGICAL CHARACTERISTICS

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Abstract

Garlic (Allium sativum L.) is a plant species with asexual reproduction, but also with high genetic diversity. This specialized paper aims to analyse the diversity of garlic genotypes (34) identified in the southwestern part of Romania, genetic diversity based on morphological characteristics. The observations were made on morphological features, according to the standard descriptors for garlic developed by IPGRI 2001. The analysis of the variability of some morphological characteristics (7) indicated a high variability: for bulb height, the average values ranged between 1.76 cm (OT31) and 5.16 cm (CR1); for bulb diameter, the limits of variation were from 1.60 cm (CZ17) to 6.5 cm (IZ2); for the number of cloves/bulb values are between 18.8 cloves/bulb (DN34) și 6 cloves/bulb (DG11). The 34 genotypes, identified in the south area, of selected garlic, possess important morpho-quantitative and morpho-agronomic characters, some values exceeding those recorded by the control cultivar. These genotypes are valuable in terms of biological diversity, over the years adapting to environmental factors specific to the area of cultivation and will be the subject of the following studies to determine the behaviour in culture.

Key words*: garlic, genotypes, variability.*

INTRODUCTION

Garlic (*Allium sativum* L.) is a plant species with asexual reproduction, but also with a great genetic diversity (Panthee et al., 2006). The vegetal genetic resources represent one of the most valuable resources ensuring the necessary genetic diversity for farmers and breeders. Several studies have sought after the genetic diversity of garlic, to obtain new cultivars with higher productivity, improved quality, or to acquire cultivars more adapted to abiotic stress, more resistant to pathogens and pests. To study the genetic diversity, the observations were based on morphological and physiological characters (Hirata et al., 2016; Panthee et al., 2006; Wang et al., 2014), on SSR markers (Kumar et al., 2019), RAPD (Khar et al., 2008) or AFLP markers (Ipek et al., 2006). One particular attention was paid to the identification of valuable sources of garlic germplasm with high potential for use in alternative medicine and will be the subject of the following observations to determine the behaviour in culture (Wang et al., 2014; Augusti, 1996). It is well known the role of garlic in various diseases, its antihypertensive, antidiabetic, anticancer, hypolipidemic, antimicrobial and antifungal, immunomodulatory and antioxidant, anti-inflammatory, anthelmintic, anticoagulant, and hepatoprotective potential (Londhe et al., 2011). In Romania, garlic is broadly cultivated in the household system, and over time, highly valued populations have developed a valuable base for germplasm. Many of these genotypes attract attention through their productivity, uniformity, aroma and taste, also notable for their good ecological plasticity. There are approved cultivars, but also there is a possibility to identify new valuable genotypes, starting from the valuable germplasms in rural areas. To have as much useful information about morphological and genetic characteristics used in the breeding and marketing of garlic cultivars requires precise determination and discrimination of genotypes. This paper aims to analyse the genetic diversity of some garlic genotypes identified in the southwestern part of

Romania, diversity based on morphological characteristics.

MATERIALS AND METHODS

Materials

There have been 34 genotypes of garlic (*Allium sativum* L.) analyzed, which have been identified and selected from different areas of Dolj, Olt, Mehedinți and Vâlcea counties, in 2021 (Table 1). These were coded with letters and numbers, starting with the locality from which they were selected. The selected genotypes represent old populations, which have been preserved in culture by vegetative propagation, from one year to another. For comparison, the 'Benone' variety (Vegetable Research and Development Station Buzău) was used as a control sample.

Table 1. Garlic genotypes collected from different locations (southwestern Romania)

Genotype	Locality	Coordinates	
'Benone' (control)	Buzău	45º9'N	26º49'E
CR_1, CR_{28}, CR_{29}	Cârlogani	43º31'08''N	24º10'22''E
IZ_2, IZ_{21}	Izvor	44º25'24''N	23º47'57''E
RC_3, RC_{15}, RC_{19}, RC_{20}	Răcari	44º31'27''N	23º34'34''E
PV_4	Piscu Vechi	43°54'00"N	23°9'56"E
SS_5, SS_{24}, SS_{32}	Șimnicu de Sus	44º23'26''N	23º47'40''E
GH_6	Ghindeni	44º12'41''N	23º55'13''E
DB_7, DB_9, DB_{18}	Dăbuleni	43º48'04''N	24º05'31''E
CN_8, CN_{25}	Cioroiu Nou	43º8'04''N	23º26'2''E
DN_{34}	Daneți	43º56'04''N	24º03'10''E
P_{10}	Pielești	44º19'52''N	23º57'51''E
DG_{11}	Drăgoaia	44º14'1''N	23º31'32''E
GR_{12}	Grădinari	43º33'57''N	24º16'07''E
OR_{13}	Orlești	44º47'26''N	24º13'57''E
BRT_{14}	Bratovoiești	44º7'40''N	23º53'57''E
CZ_{16}, CZ_{17}, CZ_{33}	Corzu	44º27'15''N	23º10'8''E
PS_{22}	Pișcani	44º32'31''N	23º36'22''E
RB_{23}	Robănești	44º18'00''N	23º58'00''E
GL_{26}	Gârlești	44º20'59''N	23º54'58''E
BL_{27}	Bălteni	44º26'51''N	24º32'11''E
CT_{30}	Cetate	44º07'03''N	23º02'07''E
OT_{31}	Caracal	44º07'N	23º21'E

Methods

The observations were made according to the standard descriptors for garlic developed by International Plant Genetic Resources Institute (IPGRI, 2001).

Regarding the bulb, the morphological characteristics studied were the following: bulb height, bulb diameter, number of cloves/bulb, bulb colour, cloves colour, bulb shape and volume.

The bulb weight was not used in the analysis, because the garlic genotypes were studied after selection from different locations, the environmental condition and duration of storage varied from one genotype to another. Therefore, the elimination of this character from the group of studied morphological characters, eliminated any possibility of statistical error in the results obtained.

The height and diameter of the bulb were measured with the digital caliper. Bulb/cloves color and bulb shape were determined according to IPGRI 2001 standard descriptors, using a color chart to indicate color intensity and the suggested method for the shape.

The obtained results were analyzed using Data Analysis, Microsoft Office Excel Programme and PCA. For each genotype were determined: the mean, the standard deviation and the coefficient of variation. The results represent an average of 50 observations/genotype.

RESULTS AND DISCUSSIONS

The obtained results regarding the variability of the morphological characters, for the 35 garlic genotypes analyzed, are presented in Table 2.
From the data analysis, it is found that there is great variability from one genotype to another, useful variability in garlic breeding programs. There were significant differences in morpho-quantitative characters, in special bulb height, bulb diameter and the number of cloves in one bulb. Regarding the bulb height, the average values varied between 1.76 cm (OT31) and 5.16 cm (CR1); compared to the control sample, only the CR1 genotype's values were higher. The genotypic variability was highlighted by the coefficient of variability, the highest value belonging to the GH6 genotype (27.72%). In the control sample, the coefficient of variation had a value of 5.49%, which indicates a high uniformity for the bulb height.
Bulb diameter represents an important character in the selection activity of new genotypes.

Table 2. Summary statistics of morpho-quantitative and morpho-agronomic characteristics of the 35 genotypes of garlic*

Genotip	BH (cm)		BD (cm)		NB		V (cm^3)	
	Mean±SD	CV	Mean±SD	CV	Mean±SD	CV	Mean±SD	CV
'Benone'	4.55 ±0.25	5.49	5.12 ±0.36	7.17	13.1 ±4.65	35.52	**23 ±8.23**	**35.79**
CR_1	5.16 ±0.32	6.32	5.43 ±0.73	13.60	9.83 ±1.16	11.88	28.33 ±7.52	26.56
IZ_2	4.08±0.38	9.47	6.50±0.48	7.47	14.5±2.07	14.30	43.33±5.16	11.91
RC_3	3.75±0.51	13.77	4.13±0.64	15.50	9.83±0.75	7.65	18.33±4.08	22.26
PV_4	3.35±0.27	8.17	4.06±0.3	7.56	8.83±2.31	26.22	15±5.47	36.51
SS_5	3.91±0.57	14.74	5.35±0.92	17.24	9.33±1.5	16.13	36.66±12.66	37.26
GH_6	3.60±0.99	27.72	3.31±0.37	11.34	11.16±2.13	19.12	28.33±7.52	26.54
DB_7	3.33±0.22	6.75	3.48±0.42	12.23	9.66±1.75	18.11	28.33±7.52	26.56
CN_8	3.61±0.21	5.90	3.85±0.37	9.82	10.16±1.72	16.94	41.66±4.08	9.79
DB_9	4.28±0.98	23.03	3.33±0.19	5.89	13.5±2.34	17.37	28.22±4.08	14.40
P_{10}	4.09±0.34	8.40	4.68±0.71	15.24	10.16±3.18	31.36	28.22±4.08	14.45
DG_{11}	3.35±0.21	9.25	2.40±0.12	10.0	6.00±1.65	7.5	10±0.87	8.7
GR_{12}	2.63±0.37	14.14	2.03±0.33	16.36	14.5±2.94	20.34	10±0.4	4
OR_{13}	3.28±0.64	19.49	3.53±0.34	6.85	9.16±2.78	30.40	23.33±5.16	22.13
BRT_{14}	4.16±0.92	22.23	5.0±0.39	7.89	12.0±1.50	12.90	21.66±7.52	34.74
RC_{15}	2.78±0.28	10.42	2.79±0.28	10.2	11.2±3.15	28.17	15±5.27	35.13
CZ_{16}	3.05±0.38	12.67	3.32±.28	8.72	11.4±3.13	27.49	24±5.16	21.51
CZ_{17}	1.9±0.36	19.05	1.6±0.33	20.83	12.7±3.12	24.63	10±0.35	3.5
DB_{18}	3.21±0.46	14.34	3.45±0.42	12.31	7.8±1.61	20.76	25±5.27	21.08
RC_{19}	2.83±0.35	12.58	2.26±0.30	13.55	14.2±2.29	16.19	11±3.16	28.74
RC_{20}	2.6±0.50	19.42	2.82±0.56	19.86	15±1.80	12.01	17.77±6.66	37.5
IZ_{21}	2.568±0.82	32.19	2.79±0.32	11.63	10.8±2.65	24.61	10±1.46	14.6
PS_{22}	2.46±0.22	9.23	1.86±0.15	8.28	8.3±1.33	16.11	10±0.47	4.7
RB_{23}	2.11±0.47	22.72	1.73±0.24	14.17	15.3±2.35	15.42	10±1.02	10.2
SS_{24}	2.95±0.28	9.75	2.75±0.24	8.78	11.1±2.46	22.25	17±4.83	28.41
CN_{25}	2.35±0.29	12.56	2.69±0.26	9.82	18.8±2.97	15.81	20±0.48	2.4
GL_{26}	2.04±0.21	10.38	2.52±0.31	12.52	8.9±3.14	35.31	11±3.16	28.74
BL_{27}	2.48±0.22	9.07	2.85±0.25	8.94	12.2±2.89	23.75	20±3.05	15.25
CR_{28}	2.87±0.46	16.29	3.32±0.33	10.07	9.42±3.40	36.15	24.28±5.34	22
CR_{29}	2.59±0.61	23.83	2.94±0.33	11.36	13.5±3.24	24	21±3.16	15.05
CT_{30}	2.23±0.23	10.34	2.23±0.05	2.58	13.33±2.30	17.32	10±1.64	16.4
OT_{31}	1.76±0.20	11.78	2±0.2	10	12±1	8.33	10±0.86	8.6
SS_{32}	3±0.70	23.57	3.05±0.47	15.48	13±2.28	17.54	16.66±8.16	48.98
CZ_{33}	1.91±4.88	25.58	2.5±0.60	24.07	11.5±2.79	24.33	13±4.83	31.15
DN_{34}	2.88±0.27	8.56	2.86±0.22	6.43	18.8±2.09	27.96	20±2.75	13.75

*Note: BH = bulb height (cm), BD = bulb diameter (cm), NC = the number of cloves/bulb, V = volume (cm3); SD = Standard Deviation; CV = coefficient of variation.

The analysis of the obtained data shows that the limits of variation for this characteristic were between 1.60 cm (CZ_{17}) and 6.5 cm (IZ_2). Compared to the control cultivar, in 3 of the 34 genotypes analyzed the values were higher (IZ_2-6.50 cm, CR_1-5.43 cm, SS_5-5.35 cm). The coefficient of variation varied between 5.89% (DB_9) and 24.07% (CZ_{33}), which indicates a small and medium variability for this character. The medium values obtained for this character to the IZ_2 (6.5 cm), CR_1 (5.43 cm), SS_5 (5.35 cm) and BRT_{14} (5 cm) genotypes, were higher than the one reported by Singh (2014) for a garlic genotype (LS01). The uniformity of this character represents the practical importance of the marketing of garlic bulbs.

Regarding the number of cloves/bulb was influenced by genotype, ranging from 18.8 cloves/bulb (DN_{34}) and 6 cloves/bulb (DG_{11}), while the control cultivar records an average of 13.1 cloves/bulb. The coefficient of variation indicated low-high variability within genotypes, ranging from 7.5% (DG_{11}) to 36.15% (CR_{28}). A large variability for this characteristic (4-55 cloves/bulb) was highlighted by using the observation made by Panthee et al. (2006) of garlic genotypes in Nepal.

The present results, regarding bulb equatorial diameter and the number of cloves/bulb are in agreement with the results of the previous researchers, which reported a broad range of variations of the morphological characters of the bulb to the garlic genotypes studied (Khar et al., 2006; Vatsyayan et al., 2013; Wang et al., 2014; Ranjitha et al., 2018; Tesfaye, 2021). The volume of the bulb was different from one genotype to another, from a minimum of 10 cm^3 (DG_{11}) to a maximum of 43.33 cm^3 (IZ_2) compared to the control cultivar which has an average value of 23 cm^3. In reference to the colour of the bulb (Table 3), if we talk about the 35 genotypes, including the control sample, the dominant colours were: white (7 genotypes: CR_1, PV_4, BRT_{14}, SS_{24}, BL_{27}, OT_{31}, DN_{34}), cream (19 genotypes: RC_3, SS_5, GH_6, DB_7, CN_8, P_{10}, DG_{11}, OR_{13}, RC_{15}, CZ_{16} RC_{19}, RC_{20}, IZ_{21}, PS_{22}, RB_{23}, CR_{28}, CR_{29}, CT_{30}, CZ_{33}), beige (6 genotypes: Benone, CZ_{17}, DB_{18}, CN_{25}, GL_{26}, SS_{32}), light violet (1 genotype: IZ2), a heterogeneous population with differently coloured bulbs (2 genotypes: DB9, GR12). It is found that of the 15 genotypes studied, 8 had cream-coloured parchment leaves. This colour dominates over 50% of the genotypes studied, an observation similar to that of Stavělíková (2008) in a study of a collection of 613 garlic genotypes. If we consider the colour of the cloves (Table 3), yellow/light brown (22 genotypes: 'Benone', CR_1, RC_3, SS_5, DB_7, CN_8, P_{10}, BRT_{14}, RC_{15}, DB_{18}, RC_{19}, RC_{20}, IZ_{21}, PS_{22}, RB_{23}, SS_{24}, CN_{25}, GL_{26}, BL_{27}, OT_{31}, DN_{34}, SS_{32}, CZ_{33}), brown (2 genotypes: GR_{12}, CZ_{17}), violet (8 genotypes: IZ_2, GH_6, DB_9, DG_{11}, CR_{28}, CR_{29}, CT_{30}, CZ_{16}), a heterogeneous population with differently coloured cloves (2 genotypes: PV_4, OR_{13}). Fossen & Andersen (1996) consider that the violet colour is due to the accumulation of anthocyanins. Also, the shape of the bulb varied within the genotypes analysed (Table 3). The genotypes (23) that had a circular shape are: CR_1, PV_4, GH_6, DB_7, DB_9, GR_{12}, RC_{15}, CZ_{17}, DB_{18}, RC_{19}, RC_{20}, IZ_{21}, PS_{22}, RB_{23}, CN_{25}, GL_{26}, BL_{27}, CR_{28}, CR_{29}, CT_{30}, OT_{31}, DN_{34}, SS_{32}. The broadly ovate shape is found in: Benone, IZ_2, RC_3, CN_8, P_{10}, DG_{11}, OR_{13}, BRT_{14}, SS_{24}, CZ_{16}, CZ_{33}. Only one genotype has a heart-shaped bulb (SS_5).

The correlation analysis helps to evaluate the relationship between the morphological characteristics of the bulb for the studied genotypes. The correlation coefficients between the morphological characteristics of garlic genotypes (bulb height, bulb diameter, the number of cloves/bulb, volume) are shown in Table 4. The bulb diameter was moderate correlated with the height of the bulb (r=0.852). A negative correlation between the number of cloves/bulb and the bulb diameter (r=-0.157) indicates that genotypes with large bulb weight may not necessarily produce more cloves/bulb. The results obtained in this study, regarding the correlations between the morphological characteristics of the selected garlic genotypes, according to the literature (Panthee et al., 2006; Wang et al., 2014). Given that a variable is feasible for the direct selection of garlic cultivars, it must have a direct effect on production yield and a high correlation leading in the same direction to the yield of garlic bulbs. In this sense, the variables of the equatorial diameter of the bulb and its height are the most suitable for the direct selection of the most productive garlic genotypes, because they have a cause-effect relationship with the crop yield.

Table 3. The shape and colour of bulbs in the analysed garlic genotypes

No.	Genotype	Bulb colour/Code-Colour	Cloves colour/Code-Colour	Bulb shape/Code-Shape
1.	'Benone'	3-beige	2-yellow/light brown	3-broadly-ovate
2.	CR_1	1-white	2-yellow/light brown	1-circular
3.	IZ_2	5-violet deschis	5-violet	3-broadly-ovate
4.	RC_3	2-cream	2-yellow/light brown	3-broadly-ovate
5.	PV_4	1-white	99	1-circular
6.	SS_5	2-cream	2-yellow/light brown	2-heart shaped
7.	GH_6	2-cream	5-violet	1-circular
8.	DB_7	2-cream	2-yellow/light brown	1-circular
9.	CN_8	2-cream	2-yellow/light brown	3-broadly-ovate
10.	DB_9	99	5-violet	1-circular
11.	P_{10}	2-cream	2-yellow/light brown	3-broadly-ovate
12.	DG_{11}	2-cream	5-violet	3-broadly-ovate
13.	GR_{12}	99	3-brown	1-circular
14.	OR_{13}	2-cream	99	3-broadly-ovate
15.	BRT_{14}	1-white	2-yellow/light brown	3-broadly-ovate
16.	RC_{15}	2-cream	2-yellow/light brown	1-circular
17.	CZ_{16}	2-cream	5-violet	3-broadly-ovate
18.	CZ_{17}	3-beige	3-brown	1-circular
19.	DB_{18}	3-beige	1-white	1-circular
20.	RC_{19}	2-cream	2-yellow/light brown	1-circular
21.	RC_{20}	2-cream	2-yellow/light brown	1-circular
22.	IZ_{21}	2-cream	2-yellow/light brown	1-circular
23.	PS_{22}	2-cream	2-yellow/light brown	1-circular
24.	RB_{23}	2-cream	2-yellow/light brown	1-circular
25.	SS_{24}	1-white	2-yellow/light brown	3-broadly-ovate
26.	CN_{25}	3-beige	2-yellow/light brown	1-circular
27.	GL_{26}	3-beige	2-yellow/light brown	1-circular
28.	BL_{27}	1-white	2-yellow/light brown	1-circular
29.	CR_{28}	2-cream	5-violet	1-circular
30.	CR_{29}	2-cream	5-violet	1-circular
31.	CT_{30}	2-cream	5-violet	1-circular
32.	OT_{31}	1-white	2-yellow/light brown	1-circular
33.	SS_{32}	3-beige	2-yellow/light brown	1-circular
34.	CZ_{33}	2-cream	2-yellow/light brown	3-broadly-ovate
35.	DN_{34}	1-white	2-yellow/light brown	1-circular

Table 4. Correlation matrix - Pearson (n) between the morphological characteristics of garlic genotypes*

Variables**	BH	BD	NC	V
BH	**1**	0.852	-0.225	0.686
BD	0.852	**1**	-0.157	0.786
NC	-0.225	-0.157	**1**	-0.062
V	0.686	0.786	-0.062	**1**

*Values in bold are different from 0 with a significance level alpha = 0.05; **BH = bulb height (cm), BD = bulb diameter (cm), NC = the number of cloves/bulb, V = volume (cm3).

In order to reduce the dimensionality of the data set, they were subjected to Principal Component Analysis, a method that revealed the most predominant variables. To study the diversity, the method was used, also, by authors, to garlic, but also other species (Jabbes et al., 2012; Cosmulescu and Botu, 2012). Table 5 presents the statistical processing of the data obtained regarding the main characteristics analyzed. There is a high and very high validity for the analysed characteristics, the variability highlighted by the coefficient of variation, whose values exceed 19.36%.

Table 5. Summary statistics for the 6 characteristics analysed

Variable	Min	Max	Mean	Std. dev.	CV%
Bulb height (cm)	1.7	5.1	3.07	0.81	26.58
Bulb diameter (cm)	1.6	6.5	3.27	1.16	35.44
The number of cloves/bulb	6.0	18.8	11.74	2.82	24.05
Volume (cm3)	10.0	43.3	20.0	9.08	45.41

PCA analysis for the 4 morphological characteristics analysed (bulb height, bulb diameter, the number of cloves/bulb, volume) showed that the first 3 characteristics (F1- bulb height, F2-bulb diameter, F3- the number of cloves/bulb) represented 96.83% of the total variability (Table 6).

Table 6. Eigenvalues and component score coefficients

	F1	F2	F3	F4
Eigenvalue	2.59	0.97	0.30	0.12
Variability (%)	64.83	24.42	7.58	3.16
Cumulative (%)	64.83	89.25	96.83	100.00

The chart accomplished based on the values obtained on the first 2 axes (F1- bulb height. F2-bulb diameter; Figure 1) suggests the existence of 4 groups. and the presented variability represents 89,26% of the total variability.

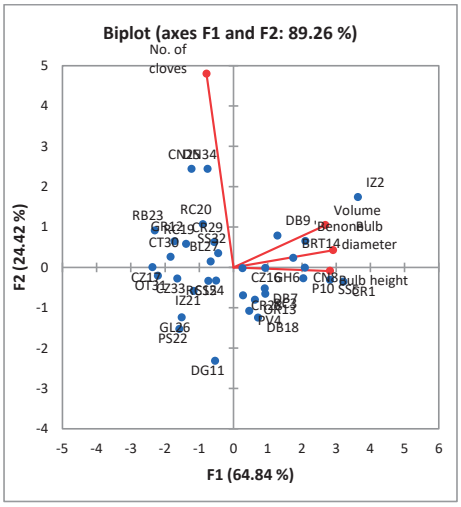

Figure 1. Two-dimensional analysis of the main components representing the F1 and F2 axes illustrating the variation of the characteristics of the bulb height (cm) and bulb diameter (cm) in 35 garlic genotypes

Group I, which consists of 9 genotypes, with negative values for both components, includes the following genotypes: CZ_{17}, DG_{11}, SS_{24}, RC_{15}, IZ_{21}, CZ_{33}, GL_{26}, PS_{22}, OT_{31}. Group II consists of 12 genotypes grouped in positive values for F1 and negative values for F2 (CZ_{16}, CR_1, GH_6, SS_5, OR_{13}, CR_{28}, DB_7, RC_3, P_{10}, PV_4, DB_{18}, CN_8). Group III includes 3 genotypes grouped in positive values for both components (BRT_{14}, DB_9, IZ_2,) and the control variety 'Benone'. Group IV includes 10 genotypes grouped in positive values for F2 and negative for F1 (CN_{25}, DN_{34}, GR_{12}, RC_{20}, RB_{23}, RC_{19}, CR_{29}, CT_{30}, BL_{27}, SS_{32},) (Figure 1).

In the figure based on the obtained values at the axes F2 (bulb diameter) and F3 (number of cloves/bulb), are shown 4 groups of genotypes; the present variability represents 32.00% of the total variability (Figure 2).

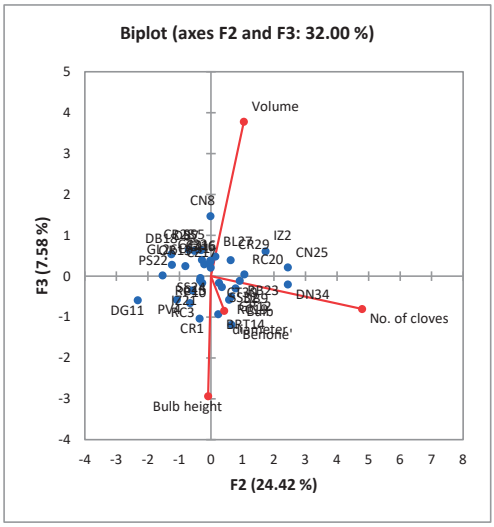

Figure 2. Two-dimensional analysis of the main components representing the F2 and F3 axes illustrating the variation of the characteristics of the bulb diameter (cm) and number of cloves/bulb in 35 garlic genotypes

Group I, consists of 7 genotypes, with negative values for both components, including the genotypes DG_{11}, IZ_{21}, RC_{15}, P_{10}, PV_4, RC_3, SS_{24}, CR_1. Group II is composed of 8 genotypes grouped in positive values for F2 and negative values for F3 (BRT_{14}, RC_{19}, SS_{32}, CT_{30}, GR_{12}, DB_9, DN_{34}, RB_{23}) and the control cultivar 'Benone'. Group III consists of 5 genotypes grouped in positive values for both components (BL_{27}, IZ_2, CN_{25}, RC_{20}, CR_{29}). Group IV consists of 14 genotypes grouped in positive values for F3 and negative values for F2 (CR_{28}, OR_{13}, GL_{26}, PS_{22}, DB_7, CZ_{17}, SS_5, CN_8, DB_{18}, CZ_{33}, GH_6, CN_8, GH_{16}, OT_{31}) (Figure 2).

The original features, which have nothing to do with the main components, are perpendicular (or almost perpendicular) to them, or are reflected in short lines ending near the origin. Therefore, the feature number of bulbs is least associated with the height of the bulb; the bulb volume feature is little associated with the bulb diameter

(although it demonstrates some positive correlation with this component) (Figure 1). The feature of the number of cloves/bulb is the least associated with the height and diameter of the bulb (Figure 2).

CONCLUSIONS

In conclusion, the study shows the existence of a large variability of morphological characteristics present in some selected garlic genotypes from southwestern Romania. The 34 selected genotypes of garlic have important morpho-quantitative and morpho-agronomic characteristics, some values exceeding those recorded by the 'Benone' cultivar, taken as a control. Those genotypes are valuable from the point of view of biological diversity, over the years adapting to the environmental factors specific to the area of origin and will be the subject of the following observation to determine the behaviour in culture.

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