PHENOTIPIC DIVERSITY EVALUATION OF SOME BULB CHARACTERS OF LOCAL SHALLOT (Allium ascalonicum) LANDRACES FROM SALINE SOILS IN BANAT AREA

Camen D., Bigyilan Laura, Popescu Ioana, Schmidt Brigitta, Beinsan Carmen, Ciulca S., Gaspar S., Sumalan R.

Banat s University of Agricultural Sciences and Veterinary Medicine from Timisoara

Keywords*: shallot, local landraces, bulb traits, UPGMA clustering*

ABSTRACT:

Though the salt tolerance in cultivated species is low, there are some genotypes which present an acceptable level of adaptability to moderate saline conditions. In legumes, these genotypes are represented especially by local landraces breeded over the time by local farmers from areas with saline soils. Identification of these cultivars represents a priority in breeding programs of vegetables all over the world. The paper aims to assess phenotypic diversity bulb character (shape, diameter, height and weight) in 16 shallots landraces grown in saline areas of southwestern Timis Count. The obtained results prove the existence of a large bulb discharged phenotypic characters, even between genotypes from the same location (Dolat and Rudna) which suggests that adaptation to specific environmental conditions have been associated with different morphological features of bulbs.

INTRODUCTION

Local shallot landraces are used in Europe, USA and Asia due to their particular taste, persistent leaves and multiple healing effects (Fritsch and Friesen, 2002; Brewster, 2008; Susheela 2007). Growers use mostly local landraces with a high adaptability to specific environmental conditions determined by the abiotic stress factors. Due to its special culinary properties and to high ecological adaptability (tolerance to drought, salinity and powerful solar insolation), shallot (*Allium ascalonicum*) is cultivated in many peasant farms mostly for consumption or to be sold.

Saline soils affect around 15% of the agricultural lands in Timis county. There are two main geographical areas affected by saline soils: the South-Western area - Livezile, Cruceni, Foeni, Uivar, Cenei, Săcălaz, Peciu-Nou Ciacova, and the North-Western area - Dudeştii-Vechi, Beba-Veche, Cenad, Sînicolaul-Mare, Sînpetru-Mare and Teremia Mare. In these area the cultivation of onion in houshold system and micro-farms is traditional but there is also a great pressure by introducing of new commercial varities for cultivation. Nevertheless, local landraces are still cultivated because they have special qualities and are accepted by local markets.

Evaluation of local onion lines have been carried out all over the world. Most of these characterizations are based either on morphological, agronomical or physical and chemical measurements (Rivera Martinez et.al 2005).

During summer 2012 a group of researchers from BUASVM Timisoara have collected bulbs from local shallot landraces from areas affected by salinity in Banat region, activity wich was financed from the project “The screening of salinity tolerance of some local vegetable landraces in order to conserve the genetic potential and biodiversity” through PN-II-PT-PCCA-2011. This paper presents some of the results regarding the phenotypic

diversity of some bulb characters at 16 local shallot landraces collected from South-Western aline area of Timis county

MATERIAL AND METHODS

The studied biological material was composed of 16 shallot landraces collected from localities of Timis county with saline soils. The experimental design was a randomized complete block (RCB) with three replications. From each plot 20 bulbs were evaluated for the following traits: bulbs height (BH); bulbs diameter (BD); bulbs weight (BW); shape index (SI).

The data were analyzed by Jaccard similarity coefficients, UPGMA cluster analysis (Fielding, 2007), principal components, ANOVA (Ciulca , 2006). The distance matrix was used for cluster analysis using the unweighted pair-group method with arithmetic averages (UPGMA), with the Neighbor program of the Phylip package, version 3.5c. 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) were used.

RESULTS AND DISCUSSIONS

Table 1

Mean values of the studied bulb traits in shallot landraces

	Diameter (cm)	Height (cm)	Weight(g)	Shape index
Dolat 1261	6.90±0.10a	5.45±0.15abcde	88.76±2.58a	0.79±0.01f
Dolat 1262	4.27±0.07b	6.00±0.46ab	49.71±4.05c	1.41±0.11abc
Dolat 198	3.60±0.10b	3.50±0.29g	25.11±4.80c	0.97±0.06def
Dolat 244	4.17±0.23b	3.93±0.18f	36.15±3.64c	0.95±0.08ef
Foieni 343	3.57±0.03b	4.70±0.15bcdefg	42.56±3.51c	1.32±0.06abcde
Giera 6	3.67±0.03b	5.70±0.65abcd	53.51±5.83abc	1.55±0.17ab
Livezile 498	3.87±0.13b	4.47±0.07cdefg	40.96±1.71c	1.16±0.04cdef
Rudna 101	3.85±0.15b	6.50±0.40a	81.43±5.58abc	1.69±0.17a
Rudna 124	4.20±0.15b	5.13±0.23abcdef	53.89±2.29abc	1.23±0.09bcde
Rudna 304	3.40±0.10b	4.50±0.17cdefg	40.67±0.80c	1.33±0.09abcd
Sanmartinu S.180	4.45±0.15b	5.90±0.10abc	82.47±4.72ab	1.33±0.07abcd
Uivar 305	4.00±0.50b	5.40±0.40abcdef	52.25±3.23abc	1.36±0.07abc
Uivar 306	3.75±0.25b	4.40±0.10defg	39.85±2.73c	1.18±0.11bcde
Toager 1	3.43±0.07b	3.67±0.17fg	24.18±2.99c	1.07±0.04cdef
Toager 29	3.87±0.13b	4.97±0.27bcdefg	50.79±5.89bc	1.28±0.05bcdef
Toager 207	3.73±0.13b	3.97±0.15efg	29.98±3.65c	1.06±0.02cdef
$LSD_{5\%}$	1.36	1.49	32.73	0.38
$LSD_{1\%}$	1.84	2.00	44.08	0.52
$LSD_{0,1\%}$	2.44	2.66	58.44	0.69

The differences between variants marked with different letters are considered to be significant

Regarding the bulb diameter of the populations, we observed that there is a variation amplitude of 3.50 cm, which is associated with a medium-high inter-genotypic variability (20.23 %), with limit values of 3,40 cm at Rudna 304 and 6.90 cm at Dolat 1261 populations. Dolat 1261 showed a significantly higher ($p<5\%$) bulb diameter compared to the rest of the populations, which did not differ significantly ($p<5\%$).

The character of bulb height presented a medium inter-population variability, with the lowest values of 3.50 cm for Dolat 198 and the highest, for Rudna 101 (6.50 cm). The variation amplitude was 3 cm. At $p<5\%$, Rudna 101 population presented a significantly superior height than the most of the other populations, with the exception of Dolat 1261, Dolat 1262, Giera 6, Rudna 124, Sanmartin S. 108 and Uivar 305. Low values for the bulb height character were observed at populations Dolat 198, Dolat 244, Toager 1 and Toager 207.

For the character bulb weight, the variability amongst the populations was very high (39,64%), associated with an amplitude of 64,58 g. The population Dolat 1261 had the highest values, which were also significantly higher at $p<5\%$ than the most of the other populations. We could also observe high values of bulb weight at populations Sanmartinu S. 108 and Rudna 101, which had bulbs with average weight over 80 g. The smallest bulbs were developed by populations Toager 1, Dolat 198 and Toager 207 (below 30 g).

Regarding the bulbs' shape, considering the shape index, most of the populations, with only three exceptions, presented elongated shape. Inter-population variability was medium, similar to the values for bulb height. Populations Rudna 101 and Giera 6 had the longest bulbs, meanwhile populations Dolat 1261, Dolat 198 and Dolat 244 had ovoid-oblate shaped bulbs.

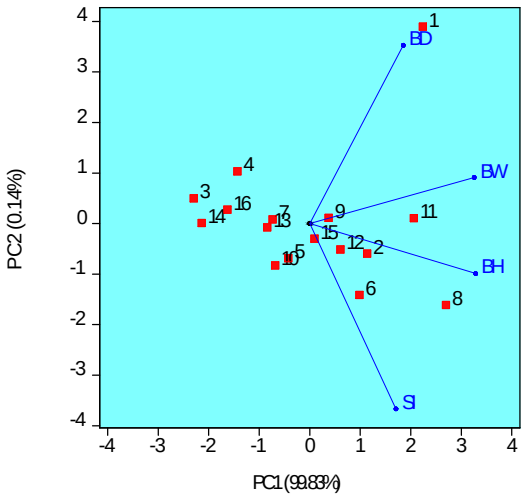

Fig. 1.Biplot for the studied shallot landraces and bulbs traits

The Biplot diagram (Fig. 1) based on the two main components expresses 99.97% of the variability for the four characters. Based on the genotypes' position in regard to the vectors of the different characters, it was expressed their performance. Thus it can be

observed that Dolat 1261, Rudna 101 and Sanmartin S. 180 present high values for the quantitative characters, such as height, diameter and weight. Values higher for these three characters than the mean were observed at populations Dolat 1262, Giera 6, Rudna 124, Toager 29 and Uivar 305. For Rudna 101 and Giera 6 populations, the quantitative values of bulbs were associated with the elongated shape.

Populations Dolat 198, Dolat 244, Toager 1 and Toager 207 presented reduced dimensions of the bulbs, associated with oblate shape.

Populations Foieni 343, Rudna 304, Livezile 498 and Uivar 306 presented medium dimensions and ovoid shaped bulbs.

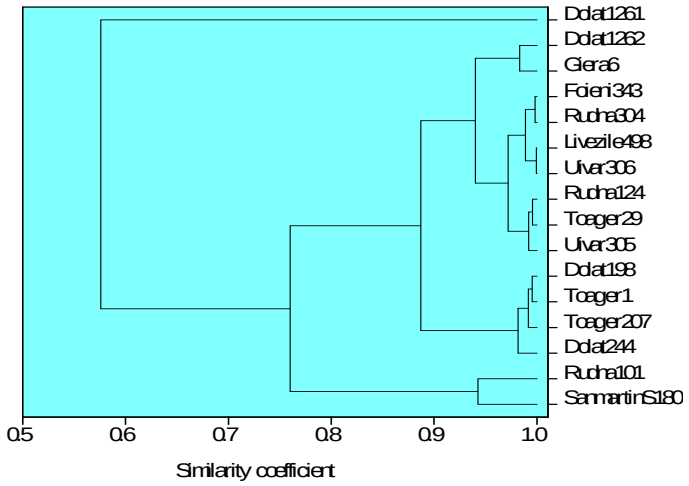

Fig. 2. UPGMA clustering of shallot landraces for studied bulbs traits

Considering the phenotypic homogeneity of the 16 shallot populations, we constructed a dendrogram using the method of clusters' average. The dendrogram shows the existence of two main clusters, one of them containing only one member, population Dolat 1261, which manifests an average phenotypic diversity of 42% compared to the rest of the populations.

The second cluster is composed of three sub-clusters: the first contains nine populations with an average similitude of 96% compared to the other seven populations, and contains sub-groups with higher (Dolat 1262, Giera 6, Rudna 124, Toager 29 and Uivar 305) or lower (Foieni 343, Rudna 304, Livezile 498 and Uivar 306) values of bulbs. The second cluster is composed of populations Dolat 198, Dolat 244, Toager 1 and Toager 207, with a similitude of 96,5%. This cluster contains populations with smaller and oblate bulbs. The third sub-cluster includes the populations Rudna 101 and Sanmartin S., which have an average similitude of 93 % and present larger bulbs.

Table 2

Analysis of variance for shallot landraces concerning the bulb traits

No.	Landraces	Between groups		Within groups		F Test
		SS	DF	SS	DF	
1	Dolat1261	5339.99	1	20.38	2	523.95**
2	Dolat1262	1574.38	1	10.75	2	292.99**
3	Dolat198	376.99	1	4.44	2	169.72**
4	Dolat244	823.36	1	6.44	2	255.88**
5	Foieni343	1162.10	1	5.92	2	392.52**
6	Giera6	1865.26	1	8.61	2	433.15**
7	Livezile498	1071.25	1	6.22	2	344.45**
8	Rudna101	4495.01	1	11.61	2	774.47**
9	Rudna124	1902.85	1	8.30	2	458.60**
10	Rudna304	1059.94	1	5.18	2	409.14**
11	Sanmartin S.180	4630.72	1	10.91	2	849.09**
12	Uivar305	1776.09	1	8.42	2	422.02**
13	Uivar306	1012.37	1	5.80	2	349.18**
14	Toager 1	345.29	1	4.13	2	167.25**
15	Toager 29	1686.26	1	7.18	2	469.84**
16	Toager 207	549.18	1	5.22	2	210.49**

Considering the results presented in Table 2, it can be concluded that populations Dolat 1261, Rudna 101 and Sanmartin S 180 give the highest differences between the bulb traits, having significant ($p<1\%$) contributions to total variability. The smallest contribution to the total variability had the populations Toager 1, Dolat 198 and Toager 207.

Table 3

Analysis of variance for bulb traits of shallot landraces

No.	Landraces	Between groups		Within groups		F Test
		SS	DF	SS	DF	
1	Bulb diameter	3.85	1	6.20	14	8.69*
2	Bulb height	4.17	1	7.76	14	7.53*
3	Bulb weight	4446.67	1	1333.25	14	46.69**
4	Shape index	0.01	1	0.79	14	0.10

Regarding the analysis of variance for the quantitative traits, significantly higher values were measured for bulb weight, which manifests a high differentiation capacity between the populations of the same cluster, and also between the populations of the other clusters. The lowest variability between the populations was observed for the bulb shape trait.

CONCLUSIONS

The study concluded that there is a considerable diversity for the bulb traits, which can be useful in plant breeding programs. It was also observed that there is a great diversity between the populations deriving from the same place, such as Dolat and Rudna. This suggests that the adaptation to specific environmental conditions was associated with different morphological traits of bulbs.

ACKNOWLEDGEMENT

This work was supported by a grant of the Romanian National Authority for Scientific Research, CNDI-UEFISCDI, project number PN-II-PT-PCCA-2011-3.1-0965.
Special thanks to all persons from villages which were very kind to let to visit their gardens and supplied us with the necessary plant material.

REFERENCES

Awale, D., Sentayehu A. and T. Getachew, 2011 , Genetic Variability and Association of Bulb Yield and Related Traits in Shallot (*Allium cepa* var. *Aggregatum* DON.) In Ethyiopia. International Journal of Agricultural Research 6(7): p 517-536.

Brewster, J.L., 2008, Onions and other vegetable Alliums, 2-nd Edn., CABI, Wallingford UK.

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

Fielding A.H., 2007. Cluster and classification techniques for the biosciences. *Cambridge University Press*.

Fritsch R.M. and N. Friesen, 2002, Evolution, Domestication and Taxonomy in Alliums. In Allium Crop Science, Recent advances, Rabinowitch, H.D. and L. Currach (Eds). CABI publishing, London, p.5-21.

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

Rivera Martinez A., Fernandez Paz J. and J.L. Andres Ares, 2005, Evaluation of Local Onion Lines from Northwest Spain; Spanish Journal of Agricultural Research 3(1), 90-97.

Susheela R., 2007, Hand Book of Spices, Seasonings and Flavorings, 2 nd Edn, Taylor and Francis Group, LLC, Boca Raton, London New York, pp: 144-146.

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