THE STUDY OF THE VARIABILITY OF THE MAIN PLANTS AND SEEDS CHARACTERS OF DIFFERENT SPECIES BELONGING TO *CACTACEAE*

STUDIUL VARIABILITĂTII PRINCIPALELOR CARACTERE ALE PLANTELOR ŞI SEMINȚELOR LA DIFERITE SPECII DE *CACTACEAE*

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Abstract. *At Cactaceae family the main characters relied on a botanical classification (systematic method) are: plant diameter, number of spines/areoles, and length of spines, flower diameter, and flower colour, fruits and seeds traits. The analysis of the plants peculiarities showed a relatively low variability of biological material according to genus and species. Within the 60 studied species, the coefficient of variability of the seeds weight was recorded being low. In the present study, it has been revealed a poor germination of seeds, many of the species analyzed had the germination percentage 0.0% (55 species).*
Key words: plant traits, seeds, variability, cacti.

Rezumat. *Principalele caracteristicile morfologice care pot fi luate în considerare la cactuşi, pe baza clasificării botanice (metoda sistematică) sunt: diametrul plantei, numărul de spini/areolă, lungimea lor, diametrul florilor, culoarea florilor, caracteristicile fructelor şi a semințelor. Analiza caracteristicilor plantelor a evidențiat o variabilitate relativ redusă a materialului biologic, în funcție de gen şi specie. În cadrul celor 60 de specii studiate la nivelul semințelor pe baza coeficienților de variabilitate se poate afirma că variabilitatea caracterului greutatea semințelor a fost mică. În prezentul studiu s-a pus în evidență o germinație slabă a semințelor, multe dintre speciile analizate au avut procentul de germinare 0,0% (55 de specii).*
Cuvinte cheie*:* caracterele plantelor, semințe, variabilitate, cactuşi

INTRODUCTION

In Romania, cacti are scattered mainly in the collections of the botanical gardens or in private collections and due to their characters are the most easily recognizable plants (Feszt and Mihalte, 2009).

Beside the flower traits, the variation in the *Cactaceae* family relies to spines characters and to plant shape and size. Cacti present a wide range of shapes and sizes: cylindrical, globular, or flat (cladode) stems. These traits and the plants' architecture determine their different life forms, which include arborescent, columnar, globular, barreliform, and articulated forms and give cacti the unique in the plants world.

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Cacti' economical importance consists mainly in their ornamental value. In addition to the ornamental value, several species have a particular importance in food industry, being natural food resources for the peoples from Mexico, Peru and Chile (Valdez et al., 1992).

In the arid and semi-arid areas of the American continent, located between latitude 35°NS and 5000 m above sea level, was recorded the greatest diversity of cacti (Oldfield, 1997; Anderson, 2001).

The cacti plants have a particular interest to scientists, due to their traits of metamorphosis plants, and secondly because their controversial taxonomy. Thus, Backeberg (1968-1977) established to the *Cactaceae* family 233 genera, Buxbaum (1950) established 156 genera, Barthlott and Hunt (1993) 98 genera, Götz and Gröner (1998) 146 genera, Eggli and Nyffeler (1998) described only 93 genera. The latest attempt of systematizing the *Cactaceae* family was conduct by Anderson (2001), which describes 125 genera, but this taxonomy has not been entirely adopted by botanists, geneticists etc. Based on these considerations, the aim of this study was to obtain information, respectively contributions, to the efforts of merging the four genera (*Aylostera, Rebutia, Mediolobivia, Sulcorebutia*), in single one with the name *Rebutia,* according to the modern classification.

Despite the importance of seed germination, the studies on cactus seed germination are relatively recent (Nobel, 2002). In addition, the present study designed a database with variability of the seed traits and the germination percentage, which can be useful in seed production, to improve the germination and to improve the development of seedling, which are difficult issues to cacti.

MATERIAL AND METHOD

The cacti plants used in the present study were evaluated for characters such as number of radial spines/areoles, length of spines and diameter of flower. Morphological features of the plants (Gallegos-Vásquez et al., 2011) or of the fruits (Valdez-Cepeda et al., 2003), chemical attributes and frost tolerance (Parish and Felker, 1998) were usually used for classification of different cactus species.

The characters analyzed in the present study were the same as described by the UPOV normative (UPOV, 2004) and ten plants for these measurements, represented as arithmetic mean and grouped in variation classes were used.

The biological material was represented by 247 cacti species and cultivars (genotypes) belonging to four genera of cacti: *Mediolobivia* (Backeb.), *Aylostera* (Speg.), *Rebutia* (K. Schum.) şi *Sulcorebutia* (Backeb.). A part of the studied genotypes belonged to the collections of botanical gardens, 49 species from Cluj-Napoca Botanical Garden, 20 species from the collection "Coromandel Cacti", New Zealand and the others (178 genotypes) provided from seed exchange between botanical gardens practiced in the country and abroad. For a precise determination, the following herbaria were consulted (acronyms according to Thiers, 2012): CL (Babes-Bolyai University, Cluj-Napoca), CLA (University of Agricultural Sciences and Veterinary Medicine, Cluj-Napoca) and AK (Auckland War Memorial Museum, New Zealand. Auckland).

For a better design, species were divided according to their type of plant material. In this respect, the relevance of the present is based on the peculiarities of grown plants (247 genotypes) and seed peculiarities (60 species belonged to

Aylostera, Mediolobivia and *Sulcorebutia* genera; the seeds of *Rebutia* genus have not been analyzed in the present study).

RESULTS AND DISCUSSIONS

The analysis of plants, showed a relatively low variability of biological material, according to genus and species, and according to the analyzed trait. The plant diameter (fig. 1a.), at the analyzed species varied between a minimum of 2 cm (54 species) to a maximum of 8 cm (14 species). The flower diameter varied within the limits of 0.5-2 cm to 5 cm (fig. 1b.). The flowers have presented a wide range of colors, from pink (*A. archibuiningiana, A. narvaecensis*) to red (*M. ritterii, R. orurensis*) or yellow (*R. marsoneri*), with different shades and tones (Mihalte et al., 2009).

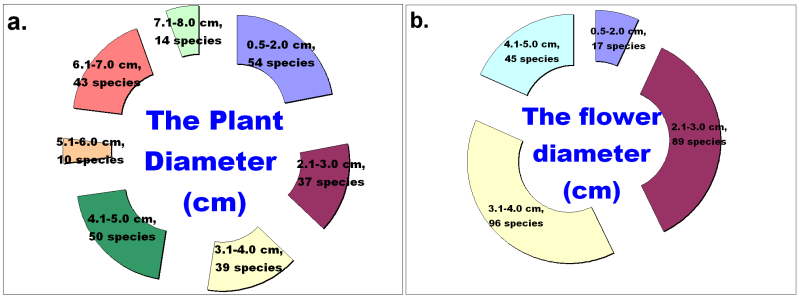

Fig. 1 – The plant diameter (a.) and the flower diameter (b.) at the analyzed cacti species

Generally the spines have a needle shape, consisting from a foot, a body and a top. Depending on the place that the spines occur in the areola may be the following forms: external (radial) spines, disposed in the outer side of the areola and central spines, arranged in the centre of the areola. At the analysed species the central spine was mostly absent or occasionally was present just one similar to radials.

The number of radial spines (fig. 2a.) ranged from 5-10 (38 species) at 40-45 (10 species). The size of the external spines (fig. 2b.) was extremely varied from 1-2 mm to over 20 mm in length.

As it has been shown in the above graphs, the variability between the main characters at *Rebutia* genus, *Aylostera*, *Sulcorebutia* and *Mediolobivia* is quite small and therefore the trend of merge these species in one genus is justified.

All the studied genera presented sessile and solitary flowers and in all the species of the genera *Rebutia*, *Aylostera*, *Mediolobivia* and *Sulcorebutia*, the hairs, foliar organs, reproductive organs, glochids, and roots developed from areoles. The species from *Rebutia* genus does not present distinctive ribs, but they have regularly arranged small tubercles and they are distinctive because of their small and globular forms. A distinct particularity of the *Sulcorebutia* genus is that the species tend to be more rot-prone and they are not as frost resistant as the *Rebutias* (Grant, 2009).

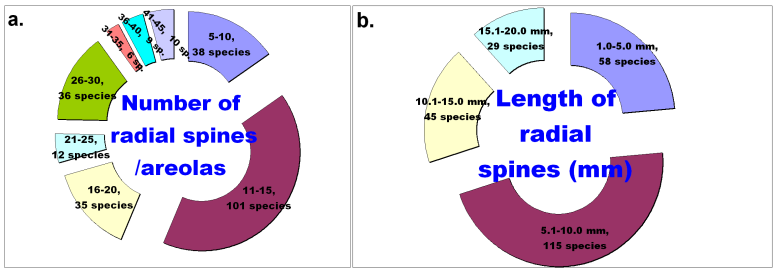

Fig. 2 – The number of radial spines/areolas (a.) and the length of radial spines (b.) at the analyzed cacti species

The shape of cactus seeds is greatly varied, spherical, ovoid, prismatic, and kidney-shaped. The seed size also varies in quite wide limits, from seeds of *Parodia, Strombocactus*, very small, like dust, to 3-4 mm at *Astrophytum, Pachycereus species* or 5-6 mm *Opuntia* species. Likewise, the studied species presented very small seeds and traits like seeds length, or shape were not visible at necked eye.

In the present study, 60 cacti seeds genotypes, mostly originating in Bolivia and Argentina, belonging to three genera (*Aylostera*, *Medilobivia* and *Sulcorebutia*), classified after Backeberg system (Backeberg, 1968-1977) were analyzed. Within the studied species, the variability of seeds weight was low to medium (28 species of *Mediolobivia* genus having the coefficient of variability between 1-10%). Species with a great variability of seed weight (17 genotypes) mainly belonged to *Mediolobivia* genus (fig. 3).

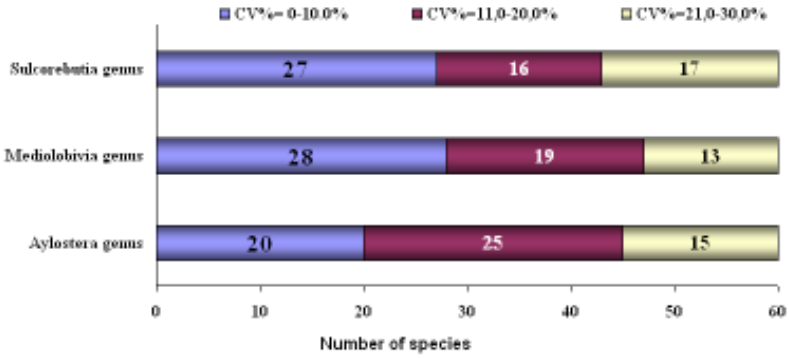

Fig. 3 – The coefficient of variability (CV%) of seeds weight at the analyzed cacti species

The obtained results confirmed that poor seed germination (fig. 4) is often a problem to obtaining new cacti plants, thus, many species (55 species), had the germination percentage 0.0%. In this respect the researches in order to improve the cactus seed germination should continue and probably the use of the growth regulators will be a great option (Mihalte et al., 2011). The treatment with gibberellic acid also increases seed germination at *Stenocereus griseus* (Moreno et al., 1992). In the present experiment, no artificial light and no heat treatment were

used for the seeds germination despite that McDonough (1964) revealed the importance of light. However, Zimmer (1969) found that some species do not require light for germination.

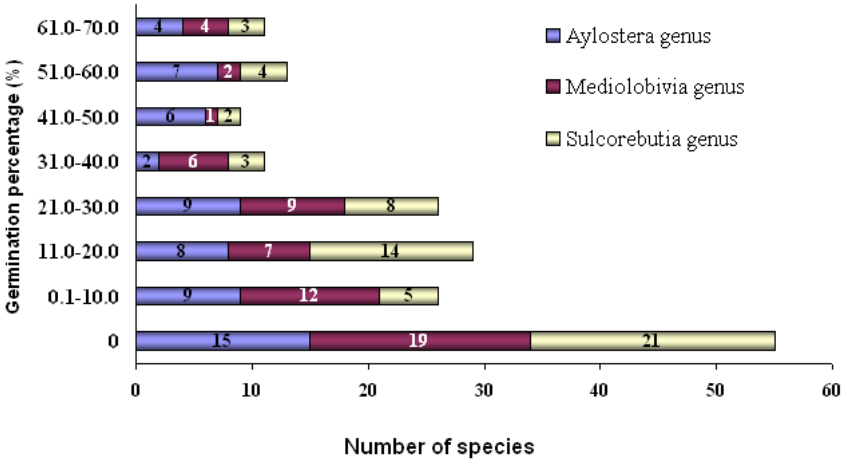

Fig. 4 – The germination percentage at the analyzed cacti species

CONCLUSIONS

1. The obtained results provide quite poor and imprecisely data and confirm the difficulties in order to classify the species in certain systematic units, only on morphological traits. Such studies are useful and can be add to other studies that aims clarify the *Cactaceae* taxonomy, and to eliminate the confusions about the cacti glossary.

2. The analyzed species in this study showed a poor germination of seeds, 55 species having no seedling at all. In this way, the researches should continue in order to improve the seed germination.

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REFERENCES

1. Anderson E.F., 2001 – *The cactus family.* Ed. Timber , Portland, OR, p. 81.
2. Backeberg C.,1968–1977 – *Das Kaktenlexicon.* Ed. Veb Gustav Fischer, Verlang Jena.
3. Barthlott W., Hunt D.R., 1993 – *Cactaceae*. In: Kubitzki K., Rohwer J.G. and Bittrich V. Eds., The families and genera of vascular plants, Springer Verlang, Berlin, p. 161-197.
4.Buxbaum F., 1950 – *Morphology of Cacti, Section I*. In: Edwin B.K. Eds., Roots and Stems, Abbey Garden Press, Pasadena, California, p.134-137.
5. Eggli U., Nyffeler R., 1998 – *Proposal to conserve Parodia against Frailea*. Taxon, 47, p. 475-476.

6. **Feszt G., Mihalte Lucica, Sestras R., 2009** – *Dynamic Analysis of the Evolution of Cereus peruvianus (Cactaceae) Areas Attacked by Phoma sp.* Not. Sci. Biol., 1, p. 41-45.
7. **Gallegos-Vásquez C., Barrientos-Priego A.F., Reyes-Agüero J.A., Núñez-Colín C.A., Mondragón-Jacobo C., 2011 –** *Clusters of commercial varieties of cactus pear and xoconostle using UPOV morphological traits*. J. Prof. Assoc. Cactus, 13, p. 10-22.
8. **Götz G., Gröner E., 1998** – *Schöne Kakteen*. Ed. Ulmer, Stuttgart.
9. **Grant, M.A., 2009 –** *Recent revisions in Sulcorebutia-a New Zealand amateur's view*. New Zeal. Cactus Succul. J., 62(3), p. 78-93.
10. **Lodé J., 1995** – *Le genre: Epithelantha Weber ex Britton & Rose.* Cactus-Aventures International, 28, p. 12-15.
11. **McDonough W., 1964** – *Germination responses of Carnegiea gigantea and Lemairocereus thurberi*. Ecology, 45, p. 155-159.
12. **Mihalte Lucica, Sestras R.E., Feszt G., 2011** – *Methods to improve seed germination of Cactaceae species.* Bulg. J. Agric. Sci., 17(3), p. 288-295.
13. **Mihalte Lucica, Sestraş R., Feszt G., Vîlcan Alina, 2009** – *The variability of seeds weight and germination percentage of different Cactaceae genera (Aylostera, Mediolobivia, Rebutia and Sulcorebutia).* Bull UASVM Horticulture, 66, p. 66-74.
14. **Moreno N., López J.J., Arce L., 1992** – *Aspectos sobre las semillas y su germinación de Echinomastus mariposensis Hester*. Cacátceas y Suculentas Mexicanas, 37, p. 21-27.
15. **Nobel P.S., 2002** – *Cacti, Biology and Uses*. Cambridge University Press, New York.
16. **Oldfield S., 1997** – *Cactus and succulent plants: status survey and conservation action plan*. International Union for Conservation of Nature and Natural resources, Gland, Switzerland, and Cambridge, UK.
17. **Parish J., Felker P., 1998 –** *Fruit quality and production of cactus pear (Opuntia spp.) fruit clones selected for increased frost hardiness*. J. Arid Environ., 37, p. 123-143.
18. **Thiers B., 2012 –** *Index Herbariorum: A global directory of public herbaria and associated staff*. New York Botanical Garden's Virtual Herbarium, http://sweetgum.nybg.org/ih/.
19. **UPOV, 2004** – Guidelines for the conduct of tests for distinctness, homogeneity and stability. International Union for the Protection of New Varieties of Plants, Geneve.
20. **Valdez B., Diaz Lifante Z., Martin Cacao M., 1992 –** *The introduction of American species through Seville past and present*. Museologica Scientifica, IX, p. 277-292.
21. **Valdez-Cepeda R.D., Blanco-Macías F., Gallegos–Vázquez C., 2003 –** *Ordering and numerical classification in prickly pear cactus using fruit attributes*. Revista Chapingo Serie Horticultura, 9(1), p. 81-95.
22. **Zimmer K., 1969** – *Uber die Keimung von Kakteensamen III.* Die Bedeutung des lichtes: Kakteen und andere Sukkulenten, 20, p. 114-147.