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IDENTIFICATION OF MAIN PHENOTYPIC TRAITS OF *DIANTHUS* SPP. CORE-COLLECTION VARIETIES OF PGRB BUZĂU BASED ON FLOWER DESCRIPTORS

Bianca MUȘAT, Costel VÎNĂTORU, Camelia BRATU, Geanina NEGOȘANU, Matilda POPESCU, Florin BURLAN

Plant Genetic Resources Bank - for Vegetables, Floricultural, Aromatic and Medicinal Plants Buzău, Romania
Corresponding author email: zamfir_b@yahoo.com

Abstract

Carnation (Dianthus caryophyllus L.) is one of the world's main floricultural crops along with chrysanthemum and rose. Dianthus is one of the oldest ornamental plant in the world. Over time, the aim of Dianthus breeding has been to select or hybridize for totally white or double flowers. BRGV Buzău core collection contains more than 52 varieties of this species, organised in 5 groups according to the type of flower and the direction of use: C group (cut flowers), Gs group (garden type, single flower), Gd group (garden type- double flower), Pd group (pot type-double flower), Ps (pot type-single flower). From the 5 groups, 26 varieties belonging to the following species have been selected for the present work Dianthus caryophyllus and Dianthus chinensis with distinct phenotypic expression. The breeding methods used were clonal selection and repeated individual selection. From selected morphotypes, G I.3., G II.7, G III.6, G IV.3, G V.4 were completely different. The aims of breeding these varieties were the specific clove fragrance, the immaculate white colour, the presence of double flowers, the long vase life and the pleasant commercial and ornamental appearance.

Key words: *morphotype, fragrance, vase life, double flower, carnation*

INTRODUCTION

Carnation (*Dianthus caryophyllus* L.) is an important ornamental plant that is used as a potted plant as well as a cut flower (da Silva, 2020)

Wild *D. caryophyllus* is likely to have originated in the Mediterranean region (southern Spain, Italy, Sardinia, Sicily, and the Ionian Islands), but the long cultivation history makes it difficult to confirm its precise origin (Takashi O., 2018).

Carnation (*Dianthus caryophyllus* L.) is one of the world's main floricultural crops along with chrysanthemum and rose. It is cultivated year-round in the world's temperate regions, especially in cool highlands, such as in parts of Colombia, China, and Kenya, which are the main production areas (Nimura et al. 2006b; Onozaki 2006).

Carnation breeders are always trying to develop new cultivars with novel colors or other floral characteristics such as variation in the number of whorls or petal margin smoothness, variegation, or even novel leaf

shape and color variation, either through classic breeding, mutagenesis, genetic transformation, or even spontaneous somaclonal variation or mutants (Datta and Teixeira da Silva, 2006).

Caryophyllaceae is one of the largest angiosperm families. It comprises approximately 86 genera and almost 2200 species, which are distributed on all continents but concentrated in the Mediterranean and Irano-Turanian region (İlçim, A. et al., 2013).

The name carnation is derived from the latin tern "Carnatio" meaning fleshness. *Caryophyllous* means pink refers to the colour of blooms of the original species Carnations were cultivated over 2000 years ago (Ali A., 2008). The main breeding targets for ornamentals used to be visual qualities such as appearance, flower color, type, size, and plant form (Boxriker et al., 2017).

Nowadays, vase life of cut flowers has become an important quality factor, and short-lived flowers have limited marketability and consumer appeal (Onozaki T., 2018). Dianthus is one of humankind's oldest ornamental plants (Halmagyi and Lambardi, 2006). Although most carnation cultivars have been bred to produce strong coloring, the absence of such coloring is also desirable for some customers. An important aim in flower color breeding is to obtain pure white (acyanic) flowers in addition to the more familiar colored (cyanic) ones (Mato et al., 2000).

Dalmais, discovered in 1935 the continuous flowering carnation, which formed the basis of the American carnation improvement. The discovery of remontant daffodils in Sicily in 1880 and their subsequent processing through breeding and hybridization contributed to the improvement of remontant carnation varieties for cut flowers and pot culture (Neagu M. et al., 1976).

MATERIALS AND METHODS

The genetic material composed of 56 varieties was selected and systematized in 5 groups: C group (cut flowers), Gs group (garden type, single flower), Gd group (garden type- double flower), Pd group (pot type-double flower), Ps (pot type-single flower). From the 5 groups, 26 varieties of *Dianthus caryophyllus* and *Dianthus chinensis* have been selected as follows: GI1, GI3, GI4, GI5 from C group; GII1, GII2, GII3, GII4, GII5, GII6, GII7,GII8 and GII10 from Gs group; GIII1, GIII2, GIII4, GIII5, GIII6, GIII7 from Gd group; GIV1, GIV3, GIV5 from Pd and GV3, GV4, GV5 and GV6 from Ps group.
The breeding methods used were clonal selection and repeated individual selection. As results of free fertilization of the varieties, were selected some elite plants according to the following goals: specific clove fragrance, pure white colour, double flowers, pleasant commercial appearance, crack resistant calyx, remontant varieties. Statistical calculations were performed using SPSS software, Pearson correlation coefficients were determined as well as variance analysis by ANOVA test followed by DUNCAN test with 95% confidence interval and p-value < 0.05%.
The international descriptors UPOV and IPGRI were used for the phenotypic description of plants.
The RHS colour charts (Royal Horticultural Society, Sixth Edition 2019 reprint) were used for flower colour determination.

RESULTS AND DISCUSSIONS

The flowers of the 26 genotypes studied were described according to the international UPOV and IPGRI descriptors, thus determining the qualitative (Table 1) and quantitative (Table 2) characteristics in order to identify and select genotypes that meet the requirements and aims of the breeding and selection process.

Table 1. Quantitative floral characteristics of the studied genotypes

Genotype	Bud shape	Bud:extrusion of styles	Calyx shape	Calyx: intensity of anthocyanin coloration	Corolla shape
GI1	elliptic	absent	cylindrical	absent	flat
GI3	elliptic	absent	cylindrical	absent	convex
GI4	elliptic	absent	cylindrical	absent	Concave
GI5	elliptic	absent	cylindrical	absent	Convex
GII1	elliptic	absent	cylindrical	absent	Concave
GII2	elliptic	absent	cylindrical	absent	flat
GII3	circular	absent	cylindrical	Very weak	concave
GII4	circular	absent	cylindrical	absent	Flat convex
GII5	elliptic	absent	cylindrical	Very weak	concave
GII6	elliptic	absent	cylindrical	absent	flat
GII7	oblong	absent	cylindrical	absent	Flat convex
GII8	elliptic	absent	cylindrical	absent	Flat convex
GII10	elliptic	absent	cylindrical	absent	convex
GIII1	ovat	absent	cylindrical	absent	Flat convex
GIII2	ovat	absent	cylindrical	absent	Convex
GIII4	elliptic	absent	cylindrical	absent	Concav
GIII5	elliptic	absent	cylindrical	absent	Flat convex
GIII6	elliptic	absent	Funnel-shaped	Very weak	Concave
GIII7	elliptic	absent	Funnel-shaped	absent	Flat convex
GIV1	circular	absent	cylindrical	medium	Concave
GIV3	elliptic	absent	cylindrical	Weak	Flat
GIV5	elliptic	absent	Funnel-shaped	weak	Concave
GV3	elliptic	absent	Funnel-shaped	medium	Concave
GV4	elliptic	absent	cylindrical	weak	Flat
GV5	elliptic	absent	cylindrical	weak	convex
GV6	elliptic	absent	cylindrical	weak	Flat convex

In terms of qualitative characteristics, there is a high variability in the shape of the bud and corolla. However, all flowers show the absence of exserted style and only 2 calyx shapes: cylindrical, in percentage of 85% and funnel shaped, 15%. Also for most flowers it was found that there is no anthocyanin staining on the calyx.

Table 2. Qualitative floral characteristics of the studied genotypes

Genotype	Calyx length (cm)	Calyx width (cm)	Calyx: length of lobes (cm)	Flower diameter (cm)	No. Petals (only for double flowers)	Corolla height (cm)	Petal length (cm)	Petal width (cm)	Style length (cm)
GI1	2.6 a	1 a	1 a	4.6 c	28 a	2.9 b	3.1 c	1.8 b	2.5 b
GI3	2.6 a	1.3 b	0.6 b	6.4 a	29 a	3.3 a	5.3 a	3 a	1.8 c
GI4	2.8 b	1.1 a	0.5 c	5.6 b	23 b	3.3 a	4.2 b	2.8 a	4.2 a
GI5	2.6 a	1 a	0.6 b	4.3 c	23 b	2 c	0.3 d	1.6 b	2.5 b
GII1	2.1 a	0.7 b	0.6 a	6.4 a	-	1.1 c	4.3 a	2.8 b	1.4 a
GII2	2.6 a	1 a	0.5 b	3.8 d	-	1.2 c	3.7 b	2.6 b	1.2 b
GII3	2 a	0.6 c	0.5 b	5 b	-	1.1 c	3.8 b	3.4 a	1.3 b
GII4	1.9 b	0.6 c	0.4 c	4.9 c	-	1.7 b	4.4 a	3.3 a	1.6 a
GII5	2 a	0.6 c	0.3 d	4.5 c	-	1.4 c	3.9 a	2.8 b	1.1 b
GII6	2.1 a	0.6 c	0.3 d	4.8 c	-	0.9 d	3.7 b	3.2 a	0.7 c
GII7	2 a	0.7 b	0.3 d	4.1 c	-	1.4 c	3.4 b	2.4 b	0.8 c
GII8	1.6 b	0.4 d	0.3 d	3.1 d	-	1.2 c	3.2 b	2.7 b	1.1 b
GII10	1.9 b	0.7 b	0.4 c	4.6 c	-	2.4 a	3.9 b	3 a	1.5 a
GIII1	2 c	0.8 b	0.5 b	4.9 c	18 a	1.9 b	3.8 b	1.9	1.7 b
GIII2	3 a	0.8 b	0.8 a	4 c	13 b	1.9 b	4.7 a	1.9	3.1 a
GIII4	2.1 c	0.8 b	0.6 b	5.4 b	6	2 b	4.4 a	3.4 a	1.3 c
GIII5	1.7 d	0.8 b	0.5 b	5 b	10 c	2.5 a	4 a	2.6 b	1.5 b
GIII6	2.6 b	2 a	0.5 b	6.1 a	12 b	3.2 a	4.1 a	2.9 b	1 c
GIII7	2.3 b	1.5 a	0.7 a	5.4 b	8 c	2 a	3.5 b	3.2 a	1.5 c
GIV1	1.6 b	0.7 b	0.5 b	2.9 c	13 b	1.2 b	1.9 c	1.5 b	0.8 c
GIV3	1.6 b	0.6 b	0.5 b	2.5 c	17 a	1.3 b	2.7 b	1.4 b	1.2 b
GIV5	2.1 a	1 a	0.6 a	5.3 a	16 a	1.6 a	3.7 a	3 a	1.5 a
GV3	1.9 b	0.8 b	0.4 c	4.2 a	-	1.8 b	3.1 a	3 a	1.4 a
GV4	2.1 a	1.1 a	0.7 b	2.7 c	-	1.5 c	2.6 b	1.7 c	1 b
GV5	2.3 a	1 a	0.9 a	3.4 b	-	2 a	3.8 a	2.6 b	0.8 c
GV6	1.8 b	0.5 c	0.3 c	2.2 c	-	0.9 d	2.5 b	1.3 c	0.4 c

*letters represent Duncan test results with 95% confidence interval and $p<0.05\%$; CV-coefficient of variation

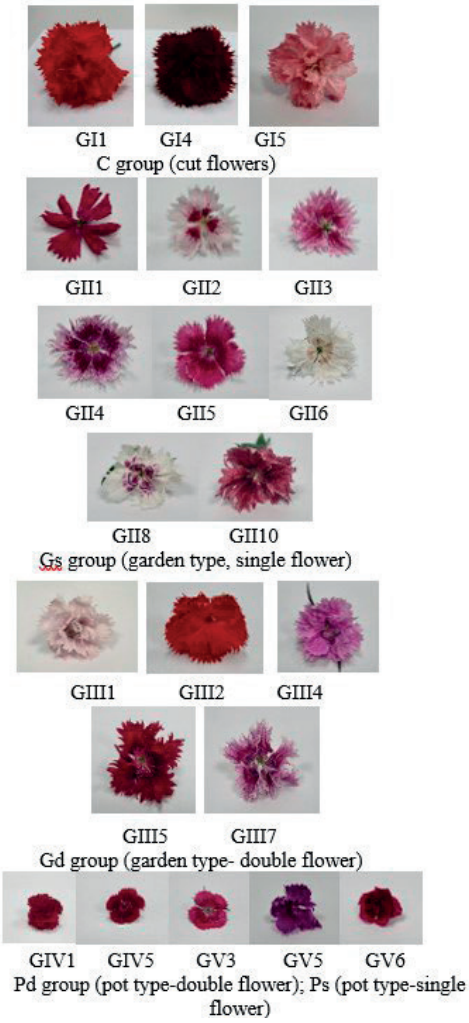

Figure 1. Aspects of floral morphology

In terms of quantitative flower characters, they showed a wide range of variability in the main measurable characters both within each group and between groups that were systematized depending on the direction of use (cut flowers, decorative purpose for gardens), type of culture (pot or garden) and type of flower (single, compound or double) (Figure 1). Following variance analysis of the variants, 5 genotypes were selected that meet the specific requirements and yield certain traits of interest.
GI3 presents flowers that are distinguished by a specific clove fragrance, a suitable habit for cut flowers, a calyx resistant to cracking and long and flexible flower stalks but rigid enough not to fall under the weight of the flower. Flowering is remontant, the flowers are procumbent, allogenous. The flower corolla is concave, the petals have many medium spinose-dentate incisions. Are no stripes or spots on the petals. The ovary is rhombic. The flower colour is RHS 54B indicating deep purplish pink. (Figure 2)

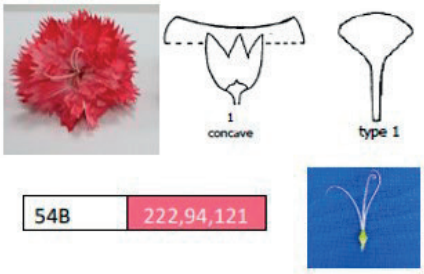

Figure 2. GI3- aspects of floral morphology (flower, corolla, petal, cod RHS, ovary)

GII7 (Figure 3) is a garden type genotype with simple flowers showing pure white flowers, acyanic flowers, flowers that do not accumulate colour pigment. Obtaining pure white flowers was one of the breeding goals at PGRB Buzau because they are a major commercial attraction and can be used in landscaping to brighten up any garden corner. The flower has a flattened convex corolla, medium wavy petals, many deep incisions with crenate dentate edges. The petals have no streaks or spots. The ovary is obovate. Flower colour RHS code NN 155D, yellowish white.

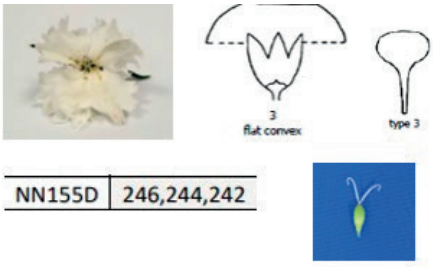

Figure 3. GII7- aspects of floral morphology (flower, corolla, petal, cod RHS, ovary)

GIII6 (Figure 4) is a garden type genotype with compound flowers showing white flowers but with the addition that the petals show a ring of secondary colour. The corolla is flattened, the petals have numerous, very deep incisions and toothed edges. The ovary is ovate. The main colour is NN 155 D, yellowish white and the median ring is 75D, very pale purple.

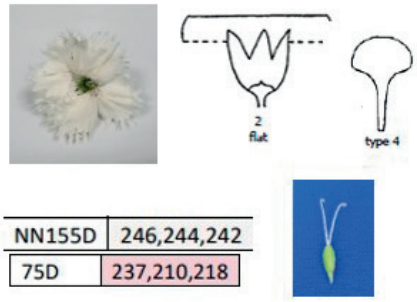

Figure 4. GIII6- aspects of floral morphology (flower, corolla, petal, cod RHS, ovary)

GIV3 (Figure 5) is a genotype of the pot group with compound flowers. The flower corolla is flattened, with medium wavy petals, numerous incisions, toothed crenate type, medium deep. The main colour is 71B, strong purplish red and the secondary colour code 64 A, moderate purplish red, is arranged in widely scattered spots, a large basal spot. The ovary is elliptical.

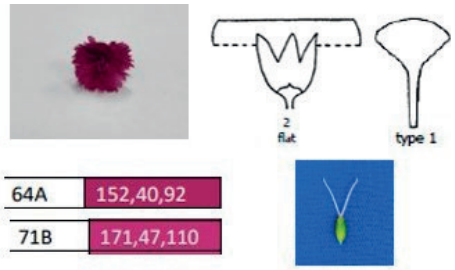

Figure 5. GIV3- aspects of floral morphology (flower, corolla, petal, cod RHS, ovary)

GV4 (Figure 6) is a genotype of the pot type with simple flowers group which shows flowers with flattened corolla, petals with weak and numerous shallow incisions, crenate-dentate and no spots or stripes.

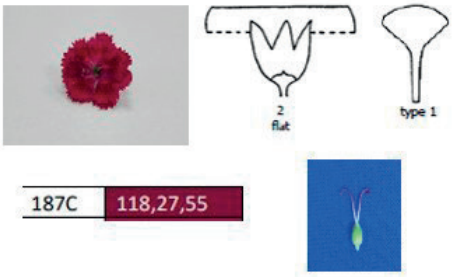

Figure 6. GV4- aspects of floral morphology (flower, corolla, petal, cod RHS, ovary)

The main colour of the flower is 187 C, dark red. The inflorescence is spray type and is the variety dedicated for pot culture as a decorative flower with continuous flowering.
The ovary is oblong.

CONCLUSIONS

The PGRB Buzau germplasm collection belonging to *Dianthus* spp. species has been organized and systematized into 5 groups.
According to the aims of the breeding process, 5 distinct genotypes were selected: GI3, suitable for cut flowers, which has as its strong point the clove scent specific to carnations, G II7, suitable for garden with simple acyanic flowers, GIII6 garden type with compound flowers also from the white flowers group, GIV3, suitable for pot with compound flowers, colour with pleasant commercial aspect and GV4, suitable for pot with simple flowers and pleasant commercial aspect. All genotypes show remontant flowering and protrusive flowers. Breeding will continue with genetic stabilization and selection of material for the purpose of releasing and patenting new varieties.

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