STUDIES REGARDING A VARIETAL ASSORTMENT OF POTTED CHRYSANTHEMUM

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Abstract

Chrysanthemum is one of the major crops in the world and it is grown for two basic ways for cut flowers and potted plants, depending of market demand. In the last years the cultivated areas with *Chrysanthemum* have gained a significant growth. Also, due to the progress made in the selection of chrysanthemum, in order to obtain valuable varieties grown in pots, knowledge of characteristics morphology has of major importance, and the enrichment of the existing assortment in our country is the main objective of the growers. The flowers occur in various forms, and can be daisy-like, decorative, pompon or buttons. In addition, many colors are available, such as white, yellow, red, purple and green. The present paper aimed to study the main characteristics of *Chrysanthemum* grown in pots of the following cultivars: 'Vanilla', 'Eté Indien', 'Camina Red', 'Pamplona Jogger White', 'Amelia Jogger', 'Avalon Salmon'. The measurements of the experiment were focused on the vegetative growth of the cultivars listed above (plant diameter, circumferences of the plant, height of plant, number of stems/plant, number of branches/stem, number of flowers/plant and the diameter of the flowers) in order to diversify the current *Chrysanthemum* assortment and to promote the cultivation of the most valuable cultivars. The obtained results shown that 'Pamplona Jogger White' cultivar registered increases in the case of the diameter, circumference of the plant, and diameter of the flowers. On the opposite side the 'Camina Red' cultivar recorded the largest number of branches/stem and number of flowers/plant and the 'Avalon Salmon' cultivar has the highest values in terms of plant height and number of stems/plant.

Keywords: characteristics, mums, potted plants, cultivars, vegetative growth.

INTRODUCTION

Ornamental plants breeding and cultivation in protected areas offers a great diversity of decorative forms and is an important part of the trade in decorative plants through flowers and leaves (Anton et al., 2007). For more than 2000 years humans have cultivated and improved *Chrysanthemum* plants. Those belong to the oldest ornamental plants of mankind and are still bred and cultivated in Europe (Halmagyi et al., 2004; Larson, 2012). According to estimates, an important place in the top of flowers grown in protected areas was occupied by the chrysanthemum, one of the most representative plant of gardens and landscape planting design in the autumn season. This is due both to its exceptional decorative qualities and to the autumn plant sale period and market requirements typical from September to December. Due to the diversity of shapes and sizes of the inflorescence, the multitude of colors, its suitability for modern homes, make this flower species to be highly appreciated

by the general public.

Kitamura (*Compositae, Anthemideae*), originates from the Greek *krus anthemon*, meaning gold flower (Fukai, 1995), originally from China and Japan, known since 1500 BC. as a vegetable plant for the consumption of leaves, without a doubt chrysanthemum is considered today 'queen of autumn flowers' (Toma, 2009).

In Europe, the chrysanthemum was cultivated only in 1789, brought from China to France in the form of three varieties, of which only one could be cultivated. The climate of France, provided seed production facilities, allowed the production of various varieties, some of them being preserved even to this day (Rayonnante variety). Under these conditions, the cultivated areas with chrysanthemums expanded both in the field and in greenhouses. Today, the achievements of Europeans in obtaining new varieties, as well as those of improving cultivation technologies are superior to those in the Far East (Barbu, 2008). Also, In Western European countries, the potted chrysanthemum is the traditional plant for decorating graves in late October-early November, when the memory of the deceased is honored (Toma, 2009).

In Romania, chrysanthemum is reported in 1750 as the 'autumn daisy'. The first imports of chrysanthemums to be cultivated around Bucharest were made before the First World War, then the assortment increased with the appearance of the first flowers in the capital, Bucharest (1925-1928), gradually numerous flower exhibitions with this species were organized. A significant development in this field is noticed with the establishment of the National Institute of Horticultural Research (1957), when valuable varieties of chrysanthemums were brought to be studied and cultivated for production. Nowadays, chrysanthemums can be admired in landscape architecture arrangements or private gardens (Vidraşcu and Teodorescu, 1993), but also in flower shops and floral design using the most cultivated species for the production of cut flowers, both in greenhouse and in the field is *Chrysanthemum x hortorum* Hort. (Cantor, 2016). Thus, commercial chrysanthemum cultivars are globally important cut flower and pot plant species usually cultivated by vegetative cuttings (da Silva, 2004). As chrysanthemums have a great impact on the flower market, numerous investigations and scientific researches of physiology, biochemistry, genetics, cellular ultrastructure have been undertaken, in order to know their biology and ways to optimize their growth and productivity and control major diseases and pests. An important contribution, in this sense, has been brought by many researchers from abroad (Zhong Yao Cai, 2008). Regarding breeding and cultivation in protected areas, where specific environmental conditions can be created, the chrysanthemum can be grown all year round, enriching the assortment of flowers from all seasons. Flowering through controlled crops at any time of year, ensuring quite a long durability in vases of 10-14 days as a cut flower, the possibility of using it in various bouquets and floral arrangements or as a potted plant recommends chrysanthemum as the most accepted and valued species (Băla, 2012). As cut flowers, chrysanthemums are useful for decorating interiors in the form of arrangements in large and medium vases, with a note of elegance and sobriety. In general, due to the richness of shapes and colors, chrysanthemums combine with each other, but can also be combined with other flowering species, having special effects. As a cut flower or in pots, chrysanthemums can be used on all occasions, all year round (van Meeteren et al., 2003; Whale, 2011; Hunter, 2012; Vahdati et al., 2012; Buta and Cantor, 2015). All these qualities mentioned before, determine a wide use of chrysanthemums: field culture for obtaining cut flowers or for decorating green spaces (parks and gardens), potted plant, culture in protected areas (greenhouses and solariums) for cut flowers, especially due to the fact that this species is present throughout the year, especially in summer until autumn when frosts appear (Vidraşcu and Teodorescu, 1993).

The areas cultivated with this flower being significant in the Netherlands, Belgium, France,

Colombia, Germany, Italy and Israel (Buta et al., 2013), and based on this fact, chrysanthemums occupying 35% of the total cutflower production in Japan alone, in accordance that cut flowers are extensively used in Japan: 40% as gifts, 25% for commercial facilities, 25% in domestic use, including religious decorations for Buddhist practices, and 10% for educational such as flower arrangement or ikebana (Boase et al., 1997; Kagami and Okamura, 1997; da Silva, 2004). Commercial hybridization to improve cultivars continues today in Europe, Asia and America. Selection is based not only on flower shape and color but also suitability of seedlings for year-round flowering programs and for postharvest qualities (Lim and Shin, 2007). In our country, in the recent years can be observed an increasingly significant development of chrysanthemum culture as potted plants for the decoration of green spaces, gardens, courtyards, balconies and terraces, but especially for the fact that in Romania the flower that ensures the decoration of graves on November is chrysanthemum. Today, more and more private producers are focusing on growing chrysanthemums in pots to be used in the fall. In this regard, the preference of varieties will be provided according to the period in which we want to have pots with well-developed and flowering plants in a proportion of at least 90% to have a commercial appearance. The high interest of *Chrysanthemum* cultivars used as cut flowers and pot plants in our country, determined to investigate the new assortment of *Chrysanthemum* grow in pot (Băla and Berecici, 2011). The aim of the present research paper was to observation of the morphological and biological traits of chrysanthemums cultivars as 'Vanilla', 'Eté Indien', 'Camina Red', 'Pamplona Jogger White', 'Amelia Jogger', 'Avalon Salmon' in accordance with the dimensions of the vegetative part of chrysanthemums.

MATERIALS AND METHODS

The study was performed for a period of two years (2018-2019) at the didactic greenhouse of the Floriculture belonging to UASVM Cluj-Napoca (Figure 1). Six cultivars of potted *Chrysanthemum* plants were used in the present work, arranged in three randomized repetitions. Each repetition consisted in five plants, a total of 15 plants/cultivar: 'Vanilla' – vanilla, 'Eté Indien' – orange-yellow, 'Camina Red' – red, 'Pamplona Jogger White' – white, 'Amelia Jogger' – pink, 'Avalon Salmon' – coral (Figure 2), and the average of the experiment was used as control.

Figure 1. Location of the experiment (Didactical greenhouse at UASVM Cluj-Napoca)

The potted *Chrysanthemum* plants subjected in our experiment were numbered from 1 to 90. Regarding the study of plant biology, the following observations and measurements were established: diameter, circumference of the plant, height of plant, number of stems/plant, number of branches/stem, number of flowers/plant and the diameter of the flowers. Periodically chemical treatments were applied against *Puccinia chrysanthemi*, *Oidium chrysanthemi* and aphids.

Figure 2. *Chrysanthemum* cultivars

MATERIALS AND METHODS

The *Chrysanthemum* cultivars were planted in three repetitions, according to the randomized block method. The data were interpreted statistically by calculating the average of experience, and the differences between the variants were established by analyzing the variance and using the Duncan test (Ardelean et al., 2005).

In our experiment, observations were made in order to establish the dimensions of the vegetative characteristics of chrysanthemums. The main observations were: diameter of the plant, circumference of the plant, plant height, number of stems/plant. The observations regarding the floral elements were made on number of stems/plant, number of branches/stem, number of flowers/plant and the diameter of the flowers. These observations were made at full maturity of the flowers, not taking into account those previously destroyed.

RESULTS AND DISCUSSIONS

To identify the possible differences, measurements were made on the vegetative plant structure and on the vigor of the cultivars, comparing with an average of the character studied on the whole group.

Under our experimental conditions, the highest increase at the diameter of the plants were measured at the `Pamplona Jogger White` cultivar which was 51.00 cm and the second was the `Camina Red` with 43.33 cm, which were statistically supported (Table 1). While the `Ete indiene` have registered the smallest increases in the diameter of the plant, which was just 31.00 cm.

Table 1. Diameter of the *Chrysanthemum* plants

Variants	Plant diameter (cm)	% compared to control	Differences compared to control	Significance of differences	Duncan test
Average (Control)	40.50	100.0	0.00	Mt.	A
Vanilla	41.67	102.9	1.17	-	C
Ete indiene	31.00	76.5	-9.50	000	A
Camina Red	43.33	107.0	2.83	***	D
Pamplona Jogger White	51.00	125.9	10.50	***	E
Amelia Jogger	34.33	84.8	-6.17	000	B
Avalon Salmon	41.67	102.9	1.17	-	C
LSD (p 5%) 1.33; LSD (p 1%) 1.89; LSD (p 0.1%) 2.74					

The highest increase in the circumference of the shrubs was registered at the `Pamplona Jogger White` cultivar which was 130 cm, and the smallest circumference was 72.33 cm, measured at the `Ete indiene` *Chrysanthemum* cultivar (Table 2). The measurements were statistically demonstrated by the Duncan test.

In the case of experimental conditions the smallest growth of mums was registered at the `Vanilla` cultivar (24.67 cm), followed by the `Pamplona Jogger White` with a 26.33 cm (Table 3). The highest chrysanthemum plant was `Avalon Salmon` cultivar, with a high of 33.67 cm, followed by `Camina Red` cultivar with a difference of just 1 cm.

Table 2. Circumference of the *Chrysanthemum* cultivars

Variants	Circumference of the plant (cm)	% compared to control	Differences compared to control	Significance of differences	Duncan test
Average (Control)	99.06	100.0	0.00	Mt.	A
Vanilla	93.67	94.6	-5.39	000	B
Ete indiene	72.33	73.0	-26.72	000	A
Camina Red	103.67	104.7	4.61	***	D
Pamplona Jogger White	130.00	131.2	30.94	***	E
Amelia Jogger	95.33	96.2	-3.72	000	B
Avalon Salmon	99.33	100.3	0.28	-	C
LSD (p 5%) 1.68; LSD (p 1%) 2.39; LSD (p 0.1%) 3.47					

The `Avalon Salmon` have registered the most number of stems/plant (10 stems/plant), it was followed by the `Camina Red` cultivar with a number of 9 stems/plant (Table 4), the data is statistically supported by the Duncan test.

Table 3. *Chrysanthemum* plant height

Variants	Plant height (cm)	% compared to control	Differences compared to control	Significance of differences	Duncan test
Average (Control)	29.28	100.0	0.00	Mt.	A
Vanilla	24.67	84.3	-4.61	000	A
Ete indiene	30.33	103.6	1.06	-	D
Camina Red	32.67	111.6	3.39	***	E
Pamplona Jogger White	26.33	89.9	-2.94	00	B
Amelia Jogger	28.00	95.6	-1.28	-	C
Avalon Salmon	33.67	115.0	4.39	***	E
LSD (p 5%) 1.55; LSD (p 1%) 2.20; LSD (p 0.1%) 3.18					

Table 4. Number of stems/plant of *Chrysanthemum* cultivars

Variants	Number of stems/plant	% compared to control	Differences compared to control	Significance of differences	Duncan test
Average (Control)	7.67	100.0	0.00	Mt.	A
Vanilla	6.00	78.3	-1.67	000	A
Ete indiene	7.33	95.7	-0.33	-	B
Camina Red	9.00	117.4	1.33	**	C
Pamplona Jogger White	7.67	100.0	0.00	-	B
Amelia Jogger	6.00	78.3	-1.67	000	A
Avalon Salmon	10.00	130.4	2.33	***	D
LSD (p 5%) 0.66; LSD (p 1%) 0.95; LSD (p 0.1%) 1.37					

The number of branches/stem (Table 5) was situated between 5.00 to 9.00 branches per stem. Regarding the number of branches a relative reduction was observed at the the 'Vanilla' cultivar (5.00) compared to the control. Although the highest number of branches/stem was determined at the 'Camina Red' cultivar (9.00) compared to the control.

Table 5. *Chrysanthemum* number of branches/stem

Variants	Number of branches/stem	% compared to control	Differences compared to control	Significance of differences	Duncan test
Average (Control)	7.00	100.0	0.00	Mt.	A
Vanilla	5.00	71.4	-2.00	000	A
Ete indiene	6.00	85.7	-1.00	00	B
Camina Red	9.00	128.6	2.00	***	F
Pamplona Jogger White	8.00	114.3	1.00	**	E
Amelia Jogger	7.33	104.8	0.33	-	D
Avalon Salmon	6.67	95.2	-0.33	-	C
LSD (p 5%) 0.58; LSD (p 1%) 0.82; LSD (p 0.1%) 1.17					

Considering the number of flowers/plant the best results were obtained at the 'Camina Red' cultivar, with an average number of 334.67 flowers/plant. On the opposite side was the 'Vanilla' *Chrysanthemum* cultivar, with an average number of 93.33 flowers/plant. The results of this measurements were statistically demonstrated (Table 6.).

Table 6. The number of flowers/plant of *Chrysanthemum* cultivars

Variants	Number of flowers/plant	% compared to control	Differences compared to control	Significance of differences	Duncan test
Average (Control)	201.72	100.0	0.00	Mt.	A
Vanilla	93.33	46.3	-108.39	000	A
Ete indiene	211.67	104.9	9.94	-	D
Camina Red	334.67	165.9	132.94	***	E
Pamplona Jogger White	192.33	95.3	-9.39	-	C
Amelia Jogger	170.67	84.6	-31.06	00	B
Avalon Salmon	207.67	102.9	5.94	-	D
LSD (p 5%) 15.31; LSD (p 1%) 21.77; LSD (p 0.1%) 31.52					

When comparing the mumscultivars flowers diameter, an increase can be observed at the 'Pamplona Jogger White', with an average of 5.57 cm, on the opposite side the 'Amelia Jogger' cultivar was placed, with an average diameter of 3.13 cm. In Table 7 it can be observed that between the cultivars there are statistically significant differences reported, however the diameters are almost similar at each cultivar.

Similar results regarding the morphological characteristics were obtained by calvalho *et al.*(2020), at the mini chrysanthemum varieties. According to uddin *et al.*, (2015) and ona *et al.*, (2015) the *chrysanthemum* cultivars showed a wide range of growth and flowering characteristics, which are preferable traits and objectives for the breeders. There are strong evidence that morphological parameters clearly indicate distictness among the mums varieties (banerji *et al.*, 2012; suvija *et al.*, 2016), like shrubs diameter; circumferences of the shrubs; shrubs height; increment in the number of stems/plant, branches/stem, flowers/plant; diameter of the flowers.

Table 7. Flowers diameter of the *Chrysanthemum* cultivars

Variants	Diameter of the flowers (cm)	% compared to control	Differences compared to control	Significance of differences	Duncan test
Average (Control)	4.46	100.0	0.00	Ct.	A
Vanilla	4.13	92.7	-0.33	00	B
Ete indiene	5.27	118.1	0.81	***	D
Camina Red	4.27	95.6	-0.19	0	BC
Pamplona Jogger White	5.57	124.8	1.11	***	E
Amelia Jogger	3.13	70.2	-1.33	000	A
Avalon Salmon	4.40	98.6	-0.06	-	C
LSD (p 5%) 0.17; LSD (p 1%) 0.25; LSD (p 0.1%) 0.36					

CONCLUSIONS

Based on the present study results can conclude that:

The diameter of the plants registered the highest value at the 'Pamplona Jogger White' cultivar, and the lowest at 'Ete indiene'. In the term of the plant circumferences the highest was determined at the 'Camina Red' and 'Pamplona Jogger White' cultivars. In the case of the plant height 'Avalon Salmon' have registered the biggest growth, followed by 'Camina Red'. The results concerning the number of stems/plant 'Avalon Salmon' showed higher increases compared to the other cultivars. The cultivar 'Camina Red' recorded the most

increases in the number of branches/stem. 'Pamplona Jogger White' was the chrysanthemum cultivar with the highest flower diameter observed in the experiment.

The data presented above shown that the 'Pamplona Jogger White' and 'Camina Red' are the most productive and decorative cultivars of those studied. The potted chrysanthemum cultivars which showed higher morphological characteristics are recommended to be promoted and cultivated in the Romanian area, and due to this the mums breeders have a wide range of choices to make.

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