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PRELIMINARY RESEARCH ON THE GROWTH AND FLOWERING OF DIFFERENT VARIETIES OF HERBACEOUS PEONY UNDER CONDITIONS OF CONTAINERIZED AND FORCED CULTIVATION

George Nicolae CAZAN, Sorina PETRA, Florin TOMA

University of Agronomic Sciences and Veterinary Medicine of Bucharest,
59 Mărăști Blvd, District 1, Bucharest, Romania

Corresponding author email: cazan.nic@gmail.com

Abstract

This research has been focused on the studies on the growth and flowering of some varieties of herbaceous peony under conditions of containerized and forced cultivation. The research was conducted at USAMV Bucharest using as biologic material split bushes with white, pink and red flowers originated from USAMV Bucharest and Singureni, Giurgiu County. The split bushes being planted in pots of 30cm in diameter in autumn in October. After planting, the pots were kept in cold conditions a different number of weeks, after which they have been brought in the greenhouse to be forced. For each of the forced stages, observations have been made, regarding the following phenophases of growing and developing: starting in vegetation, number of sprouts, growth of the sprouts, appearance of the buds, opening of the flowers, fading of the flowers, the flowering time, the flowering percentage. The results obtained show a good behaviour of the herbaceous peony in containerized and forced cultivation, the percentage and the quality of blooming being variable, depending on the variety and the moment of the introduction of the pots in the greenhouse.

Key words*: containerized and forced culture, early flowering, herbaceous peony.*

INTRODUCTION

Peonies are among the most popular garden plants in temperate regions. Herbaceous peonies are also widely sold as cut flowers, although they are generally available only at the end of spring and early summer. The annual growth is predetermined: if the growing tip of a sprout is removed, no new buds will develop in that season (Kamenetsky et al., 2003, 2012).

In temperate regions of the Northern hemisphere, the peonies are blooming in May - July. Modern reproduction researches from the last years lead to obtain of cultivars with flowers with very different shapes and colours (Cantor, 2016).

Some of these new cultivars were studied also in the climatic areas of the Southern Romania (Cucu et al., 2009).

In the Northern hemisphere there is a growing demand to extend the flowering period of the peony (Toma, 2009). For example, Alaska peonies are nowadays foremost only for export (Fitzgerald, 2004). Another strategy is to use cold artificial environments as well as hormonal treatments to induce flowering at different times of the year (Halevy et al., 2002).

Herbaceous peonies are grown successfully in moderate climates with cold winters, where they bloom in May-July. Anyway, there are some researches that prove the capacity of the herbaceous peony to bloom under warmer climatic conditions, e.g. California and Israel (Byrne et al., 1986; Halevy et al., 1995).

Other researches prove that peonies can be forced to bloom in greenhouse conditions (Wilkins et al., 1985; Evans et al., 1990) for the early production of cut flowers and potted plants.

Gregory et al. (2015) elaborated a database for herbaceous peony cultivated in warm climate zones, in the "Effects of temperature on stagnation and plant growth" article.

These authors introduce the first database for development parameters for the herbaceous peony cultivated in a warm areas. The data on the temperature effect during the rest and growth period are presented for 2,232 plants of two commercial varieties exposed to 14 different temperature regimes.

Recently, the possibility of cultivating peony in warm climates has been reported also by the authors Fulton et al. (2001) and Catley et al. (2001).

Evans et al. (1990) and Wilkins et al. (1985) showed that in milder areas the peonies may be forced to produce early cut flowers in greenhouse.

In order to increase early forcing and to improve the profitability of growing peonies in warmer conditions, in-depth knowledge of temperature requirements is required at different stages of the annual growth cycle Gregory et al. (2015).
In a previous study, Gregory et al. (2015) established the key relationships between the thermal regime in the rest period, the stem growing and blooming.
The cooling regime for the release from resting, was studied on peony plants grown in the field by exposing them to a cold winter climate in northern Israel (8-10°C by night, 16-26°C by day, average about 17°C from November to February).
The greenhouses were covered with plastic films on different dates, looking for the accumulation of cooling units (Fishman et al., 1987; Erez et al., 1988). The flowering occurred two months after the resting of the plants has been over (Halevy et al., 2002).
The peonies cultivated in the pots have been artificially cooled by refrigeration to 2°C for 60 days ('Sarah Bernhard', 14) or 1-7°C for 3-12 weeks ('Coral Sunset', 'Monsieur Jules Elie', 'Sarah Bernhardt') (Barzilay et al., 2002).
The time until the start of vegetation after the completion of the cooling treatment has decreased proportionally with the increase in the duration of the cooling treatment (Hall et al., 2001).
In Chinese varieties, stem height, flower size and flowering rate were also positively affected by the cooling temperature during the resting period (Cheng et al., 2009).

MATHERIALS AND METHODS

The biological material used in these researches is made up of divided herbaceous peony varieties with white, pink and red flowers. These were obtained from mother plants aged 6-7 years, from USAMV Bucharest and Singureni, Giurgiu County.
The plant divisions were planted in October, in pots with a diameter of 30 cm. The subsoil of planting was consisting of 40% peat, 30% soil, 20% soil naturally fertilised, 5% sand and 5% perlite with a granulation of 4 mm.
After planting, the pots were left outside in a shaded area in conditions corresponding to the ones in open field (9°C average daily temperature and 2°C the average nightly temperature). Here, they have been kept for 10 weeks, until the frost.
From this moment, the pots were moved in a basement with an average temperature of 5°C, where they have been kept a variable number of weeks, until the movement in the greenhouse for forcing period.
The movement of the plants pots in the greenhouse for forcing was made at four different dates: 14th of February, 21st of February, 28th of February and 7th of March 2017. By combining these dates with the varieties of colours and provenance, resulted 11 experimental varieties (Table 1).

Table 1. Experimental Variants

Variant	Cultivar	No. of cold weeks	Date of forcing	Number of buds min - max	Diameter of roots bale min – max (cm)
V1	White flower peony from SINGURENI	16	14.02.2017	2 - 9	3 - 10
V2	White flower peony from SINGURENI	17	21.02.2017	5 - 7	3 - 10
V3	White flower peony from SINGURENI	18	28.02.2017	5	8 - 9
V4	Pink flower peony from SINGURENI	16	14.02.2017	3 - 10	4 - 13
V5	Pink flower peony from SINGURENI	17	21.02.2017	3 - 11	4 - 12
V6	Pink flower peony from the USAMVB collection	16	14.02.2017	4	6 - 9
V7	Pink flower peony from the USAMVB collection	17	21.02.2017	1 - 7	2 - 4
V8	Red flower peony from the USAMVB collection	16	14.02.2017	3 - 8	4 - 15
V9	Red flower peony from the USAMVB collection	17	21.02.2017	2 - 10	4 - 11
V10	Red flower peony from the USAMVB collection	18	28.02.2017	3 - 12	5 - 9
V11	Red flower peony from the USAMVB collection	19	07.03.2017	2 - 6	2 - 4

The observations on plants had in view the following elements: starting of vegetation, number of sprouts, the growing of sprouts, the apparition of flower buds, the number of shoots with flowers, the opening of flowers, the fading of flowers. Based on these observations, the duration of blooming and the flowering percentage were calculated. Also, the possible

correlations between the plant growing elements of the plants and between them and the duration of the cold period administrated before the introduction of the plants in the greenhouse.

RESULTS AND DISCUSSIONS

The starting on vegetation was faster on the variants V6 and V8 on 09.02., besides V1 on 10.02., V4 on 11.02., V2,V5, V9 on 15.02., V3 and V7 on 17.02., V10 on 19.02. and V11 on 28.02. (Figure 1).
The appearance of the sprouts was observed starting with 10.02. at V6 and V8 until 20.02. at V10 and 01.03. at V11 (Figure 1).

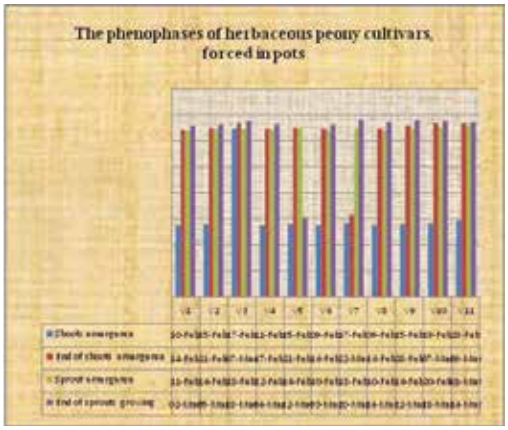

Figure 1. The phenophases of herbaceous peony growing, forced in pots, 2017

We are concluding that the varieties with pink and red flowers from USAMV Bucharest are starting earlier in vegetation compared to the white and pink flowers varieties from Singureni. Also, a bigger number of weeks of cold between the introduction of the pots in the greenhouse lead to a quicker vegetation starting on all varieties.
Details regarding the growth phenophases are shown in Figures 2-6.
Duration of buds starting was between 6 days at V7 and 21 days at V9, and the sprouts growth lasted between 16 days at V10 and 38 days at V9 (Figure 7).
The growing of sprouts lasted from 16 days at V11 up to 38 days at V9 (Figure 7).

Figure 2. Growth of sprouts, red cultivar, UASVM Bucharest, V10, 2017

Figure 3. Growth of sprouts, red cultivar, UASVM Bucharest, V8, 2017

Figure 4. Starting of vegetation of the pink cultivar from UASVM Bucharest, V6, 2017

Figure 5. Growing aspect of sprouts of pink cultivar from Singureni, 2017

Figure 6. Growing and trellising on peony sprouts, 2017

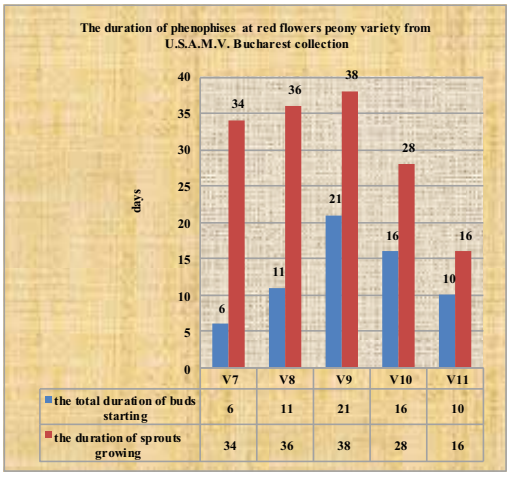

Figure 7. Dynamics of flowering, red flowers peony cultivar, UASVM Bucharest collection, 2017

It is observed a shorter period from total starting of the buds at the pink flowers variety from USAMV Bucharest compared to the red flowers variety from USAMV Bucharest.

Also, the growing period of the sprouts was shorter at the red flowers variety compared to the pink flowers variety from USAMV Bucharest.

The growth dynamics of the herbaceous peony varieties in containerized and forced cultivation is presented in Table 2.

An early vegetation start at V1, V6 and V8 and a later occurrence at V3, V9 and V11 were observed.

The percentage of the vegetation start was 33.33% and 36.36% at V1 and V2 up to 95% at V7 and 100% at V6.

The growth of sprouts started at V1 on 11.02, at V6 on 10.02 and V8 on 10.02 and continued until 20.02 at V10, and 01.03 at V11.

So, we are observing an early start of the vegetation on the pink and red flowers varieties from USAMV Bucharest compared to the white and pink flowers varieties from Singureni. Also, the maximum vegetation starting percentage was observed at the pink flowers variety from USAMV Bucharest compared to the white and pink flowers varieties from Singureni and with red flowers from USAMV Bucharest.

The beginning of buds vegetation lasted between 5 days at V1 and 7 days at V2 and V4 (Figure 8).

Table 2: Growing dynamics of the herbaceous peony varieties planted in pots and forced, 2017

Variant	Cultivar	Buds appearance	% vegetation start	Start of sprouts growth
V1	White flowers peony from SINGURENI	February 10	33.33%	February 11
V2	White flowers peony from SINGURENI	February 15	36.36%	February 16
V3	White flowers peony from SINGURENI	February 17	90%	February 18
V4	Pink flowers peony from SINGURENI	February 11	64%	February 12
V5	Pink flowers peony from SINGURENI	February 15	86%	February 16
V6	Pink flowers peony from USAMVB collection	February 9	100%	February 10
V7	Pink flowers peony from USAMVB collection	February 7	95%	February 18
V8	Red flowers peony from USAMVB collection	February 9	63.61%	February 10
V9	Red flowers peony from USAMVB collection	February 15	63.12%	February 16
V10	Red flowers peony from USAMVB collection	February 19	91.90%	February 20
V11	Red flowers peony from USAMVB collection	February 28	66.66%	March 1

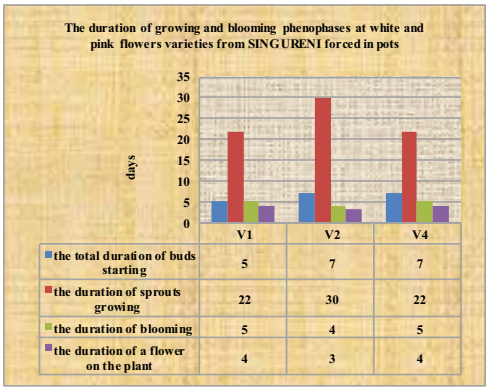

Figure 8. The dynamics of growing and flowering at the cultivars with white and pink flowers from Singureni, forced in pots in greenhouse, 2017

Regarding the growing of sprouts, the growth lasted 22 days at V1 and V4, and 30 days at V2 (Figure 8).

The flowering period as well as the duration of the flowers on the stem were short, between 3 and 5 days (Figure 8).

We are concluding that the white flower variety from Singureni had a shorter period for starting the buds compared to the pink flowers variety from Singureni. Also, the sprouts development

period, the blooming period and the duration of the flower on the plant is the same with the pink flower variety from Singureni.
The percentage of the vegetation starting was 33.33% at V1, and 36.36% at V2, up to 95% at V7 and 100% at V6 (Figure 9).

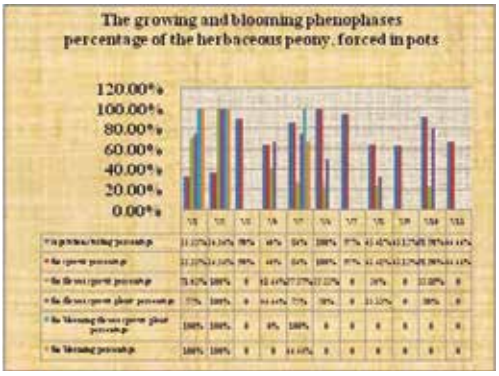

Figure 9. The growing and blooming phenophases percentage of the herbaceous peony, forced in greenhouse, 2017

The percentage of floral sprouts has been shown in 7 variants out of 11, with values between 22.22% at V6 up to 100% at V2.
The percentage of plants having floral sprouts has been shown in 7 variants out of 11, with values between 33.33% at V8 and 100% at V2 (Figure 9).
The percentage of flowering has been reached in 3 variants out of 11, at V5 with 66.66%, and 100% at V1 and V2, respectively (Figure 9).
It is determined that the variety with pink flowers from USAMV Bucharest had a maximum percentage related to the white and pink from Singureni and red from USAMV Bucharest. Also, a maximum percentage of blooming sprouts and plants with blooming sprouts was shown at the white flowers variety from Singureni related to pink and red varieties. A maximum blooming percentage is observed at the white flowers variety from Singureni related to pink and red varieties.
The influence of the cold season on the percentage of vegetation starting at the Singureni white flower variety is shown in Figure 10. There is a positive influence of the cold period on the start of vegetation of the cultivar with white flowers by Singureni. There is a correlation between the cold period and the start of vegetation: the higher the herbaceous peony plants at a higher cold season and percentage of vegetation starting.

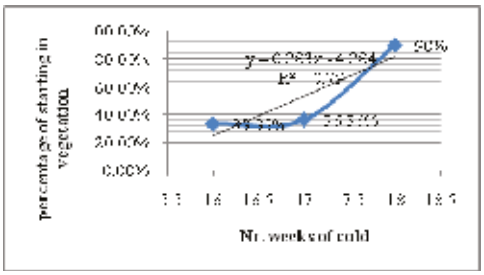

Figure 10. Influence of the cold period on the vegetation starting percentage at the variety with white flowers by Singureni, 2017

The phenophases of flowering were only conducted in 3 variants and 2 cultivars, V1 and V2 cultivars with white flowers of Singureni, and V4 cultivar with pink flowers of Singureni (Figure 11).

Figure 11. Flowering phenophases of Singureni cultivars with white and pink flowers, 2017

The appearance of the bud occurred at V1 and V4 on 18.02 and V2 on 24.02 (Figure 11).
The opening of the flower was started at V1 on 14.03, at V2 on March 21, and on V4 on 17.03, and the blooming ended at V1 on 20.03, V2 on 25.03 and V4 on 22.03. (Figure 11).
So, we are observing that only the Singureni flowers varieties were blooming and passed through the blooming phenophases. An early blooming is observed at the white flowers variety compared to the pink flowers variety from Singureni.
Details regarding the growing phenophases are found in the Figures 12-18.

Figure 12. Floral sprouts, white flowers cultivar, Singureni, V1, 2017

Figure 13. Floral sprouts, white flowers cultivar, Singureni, V2, 2017

Figure 14. Bud opening, pink flowers cultivar, Singureni, V5, 2017

Figure 15. The aspect of flower and blooming, pink flowers cultivar, Singureni, V5, 2017

Figure 16. Flower opening, white cultivar, V1, 2017

Figure 17. Flowering appearance of Singureni cultivar with pink flowers, V5, 2017

Figure 18. Flowering of white flowers cultivar, Singureni, V1, 2017

The influence of the cold period on flowering was observed in Figure 19, resulting in a correlation between plant exposure to cold and the beginning of inflorescence in herbaceous peony, which shows how much the cold period increases and the date of flowering increases and vice versa decreases the period of exposure to cold peony blooms earlier. So, the cold period has a positive influence on peony bloom.

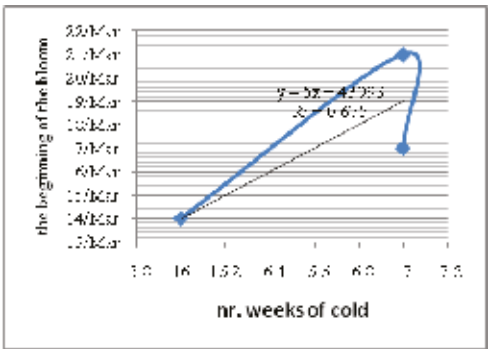

Figure 19. Influence of the cold period on blooming in the varieties with white and pink flowers by Singureni, 2017

After flowering, the plants continued to grow, forming rich bushes.
The largest begetting increases were recorded at cultivars which red flowers from USAMV Bucharest and the cultivars which white flowers from Singureni (Figures 20-21).

Figure 20. Vegetative growth of plants after flowering at cultivar of red flower from USAMV Bucharest, 2017

Figure 21. Vegetative growth of plants after flowering at cultivar of white flower from Singureni, 2017

CONCLUSIONS

The research carried out led to an early flowering compared to the culture in the field by almost two months.
In the containerized and forced culture of the herbaceous peony varieties, the researches and observations made, lead to the following conclusions:

The earliness of the passing through the growing phenophases was highlighted on all varieties of herbaceous peony studied.
The varieties with pink and red flowers from USAMV Bucharest had the earliest vegetation starting, compared to the white and pink flowers varieties from Singureni.
All varieties studied had a percentage of vegetation starting over 50%.
The increase in the cold period positively influences the percentage of starting the peony vegetation.
The shortening of the cold period positively influences the early eruption of the herbaceous peony, and the increase of the cold period influences the early blooming.
The early blooming and the earliness of the passing through the growing phenophases was highlighted at the white and pink flowers variety from Singureni.
The white flowers variety from Singureni was highlighted by a 100% percentage of blooming, compared to the pink flowers variety from Singureni (66.66%).
The earliness of the blooming was highlighted at the white flowers variety from Singureni (20.03), compared to the pink flowers variety from Singureni (22.03).

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