

## RESEARCH REGARDING THE INFLUENCE OF THE CULTIVAR AND CULTURE SUBSTRATE ON HYACINTHS *FORCING CULTURE*

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### Abstract

The Hyacinth (*Hyacinthus orientalis*) is a bulbous plant with a great variety of cultivars, being in the same time among the first flowers of spring. Hyacinth bulbs can brighten up the darkest days of winter if are forcing. The main aim of this research was to pursue the influence of the cultivar and culture substrate on the main characters. The study took place in greenhouses of University of Agricultural Sciences and Veterinary Medicine Cluj-Napoca (UASMV), during 15<sup>th</sup> of November 2017 - 30<sup>th</sup> of March 2018. The experience was bifactorial, first factor being the culture substrate, with three graduations (garden soil, garden soil + peat and garden soil + sand), the second factor being the cultivar, with five graduations ('City of Haarlem', 'Blue Jacket', 'Miss Saigon', 'Jan Boss' and 'Double Prince of Love'). Analyzing the combined influence of the culture substrate and hyacinth cultivars which were used in the research, the most favorable combination from the decoration period, number of florets per cluster and flower stem height point of view were 'Double Prince of Love' and 'Jan Boss' on the substrate garden soil + sand (1:1).

Keywords: cultivar, characteristics, culture substrate, hyacinth, forcing.

### 1. INTRODUCTION

Worldwide, floriculture knows a great development as a result of increasing demand and more diversified cut flowers growth in pots and gardens (www.rasfoiesc.com). *Hyacinthus orientalis* L. is an excellent garden plant and can be easily forced for use either as potted plant or as cut flower (Farzad et al., 2011).

The genus *Hyacinthus* brings together approximately 30 bulb species, native to southwestern Asia and Mediterranean basin. Of these species, the most frequently cultivated species, in the field or in forced cultures in greenhouses is *Hyacinthus orientalis* L. (Toma, 2009). Hyacinths are primarily used as pot plants (De Hertogh, 1977).

It was introduced to Europe in the 16<sup>th</sup> century, the Dutch being the first witch cultivate it, becoming very popular in the 18<sup>th</sup> century and the beginning of the 19<sup>th</sup> century. Bulbs are now grown for commercial purposes in the Netherlands and the United Kingdom (De Hertogh, 1974). In Holland the hyacinths are also sold as cut flowers. Hyacinth is cultivated to a small extent as in the Netherlands for perfumes production. However, most of hyacinths fragrance which is sold is synthetic based mainly on phenylacetaldehyde. Therefore the hyacinth is also called and the Dutch hyacinth (www.floraria-adi.ro).

Varieties grown today, especially the Dutch ones are characterized by large inflorescences, carrying of 40-50 simple flowers or 20-30 abundant flowers. *Hyacinthus orientalis* L. is the native species of

most varieties of hyacinths, and the Netherlands holds the supremacy, being the country where most varieties were created (Băla, 2012).

Applying temperature treatments to produce hyacinth in greenhouses was introduced at the beginning of this century. Like the tulip and several other bulbous plants, the hyacinth does not produce a high quality flower nor sufficient stem length until the bulb is exposed to a period of low temperature ([http://www.ruigrokflowerbulbs.com/wp-content/uploads/2016/04/Hyacinth\\_Forcing-Guide.pdf](http://www.ruigrokflowerbulbs.com/wp-content/uploads/2016/04/Hyacinth_Forcing-Guide.pdf)).

Bulbous plants are normally forced for use as cut flowers and pot plants. They can be fully programmed and sold as pot plants for consumer forcing (growing pot plants). The spring-flowering species, such as *Hyacinthus orientalis* can be utilized for one or more of this purpose. Traditionally, many pot hyacinths were forced to flower during the period before Christmas. These days, the season stretches from mid-October to their natural flowering period in March/April. Providing the bulbs with the right temperature treatment is important for good results. For this reason, order them from you supplier in plenty of time: preferably 6 months, but, even better, 12 months in advance (<https://www.vws-flowerbulbs.nl/media/org/.pdf>).

In addition the bulbs can be forced on water using special forcing glasses (Larson, 1980). In the case of fortification in water, after the end of the blooming period it is recommended to give up the bulbs because they have exhausted all the nutritional resources for a new bloom (Buzatu, 2001; Toma, 2009).

To get flowers in the off-season is recommended the forced culture, when planting is done in pots or different containers. It is important to be taken into account the management of environmental factors in relation with the aim of obtaining a gradually flowering and harvesting them in February-March (Draghia and Chelariu, 2011).

While all varieties of *Hyacinthus* force rather well, some are known to be better forcers than others. While each of these varieties are known to be good forcers at any time, some are particularly good for earlier blooming pots, while others are good for later blooming pots (<https://www.johnscheepers.com/hhyacinths-forcing.html>). The purpose of this comparative study was to assess culture substrate, alone and in combinations with cultivars on main characteristics of hyacinth (*Hyacinthus orientalis* L.).

## 2. MATERIALS AND METHODS

The study took place in greenhouses of University of Agricultural Sciences and Veterinary Medicine Cluj-Napoca (UASMV), during 15<sup>th</sup> of November 2017 - 30<sup>th</sup> of March 2018. The experience was bifactorial, the first factor being the culture substrate and the second the cultivar used (fig. 1).

*Factor A:* culture substrate with three graduations:

a<sub>1</sub> – garden soil; a<sub>2</sub> – garden soil + peat (1:1); a<sub>3</sub> – garden soil + sand

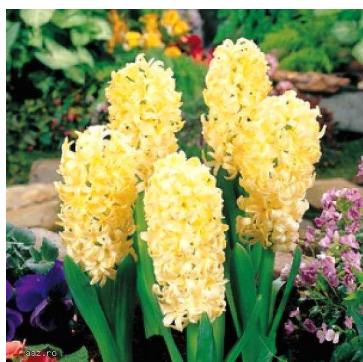
*Factor B:* hyacinths cultivars with five graduations:

b<sub>1</sub> – ‘City of Haarlem’; b<sub>2</sub> – ‘Blue Jacket’; b<sub>3</sub> – ‘Miss Saigon’; b<sub>4</sub> – ‘Jan Boss’;  
b<sub>5</sub> – ‘Double Prince of Love’

From the combination of the experimental factors with three, respectively five graduations are resulted 15 experimental variants (table 1). Five plants were used for each variant in triplicate, with a total of 15 plants per variants. Prior to cooling, bulbs with a circumference of 18-19 cm were planted in 11 cm diameter pots.

**Table 1. Experimental variants**

| Variants | Culture substrate  | Cultivar                |
|----------|--------------------|-------------------------|
| 1        | Garden soil        | 'City of Haarlem'       |
| 2        |                    | 'Blue Jacket'           |
| 3        |                    | 'Miss Saigon'           |
| 4        |                    | 'Jan Boss'              |
| 5        |                    | 'Double Prince of Love' |
| 6        | Garden soil + peat | 'City of Haarlem'       |
| 7        |                    | 'Blue Jacket'           |
| 8        |                    | 'Miss Saigon'           |
| 9        |                    | 'Jan Boss'              |
| 10       |                    | 'Double Prince of Love' |
| 11       | Garden soil + sand | 'City of Haarlem'       |
| 12       |                    | 'Blue Jacket'           |
| 13       |                    | 'Miss Saigon'           |
| 14       |                    | 'Jan Boss'              |
| 15       |                    | 'Double Prince of Love' |



'City of Haarlem'



'Blue Jacket'



'Miss Saigon'



'Jan Boss'



'Double Prince of Love'

**Figure 1. *Hyacinthus orientalis* cultivars used as biological material**Source: <http://www.pepinieramizil.aaz.ro>

During storage and until planting, the bulbs were kept in a dry room, at a temperature of 17-18°C. In the rooting room, the pots were kept at temperature of 7-9°C, and during the fortification, in heated greenhouse, the insured temperature was 20-23°C at day and 12-16°C at night. Şelaru (2002) reported that the best results are achieved by planting when the soil temperature is 9°C. Planting bulbs at temperatures higher than 13°C is inadvisable due to a reduced cold effect and increased risk of diseases caused by such pathogens, as *Erwinia* and *Fusarium*. As the temperature in the

standing ground drops further below 9°C, the effect in terms of cold requirement decreases and the cold period will have to be extended.

Measurements and observations were made on the main morpho-decorative characters of the cultivars: height of flower stem, number of florets per cluster, precocity of flowering, duration of flowering. The data obtained were interpreted statistically using the variant analysis method (LSD test) (Ardelean et al., 2007).

### 3. RESULTS AND DISCUSSIONS

The results of the unilateral influence of the variety on the floral stem are showed in the Table 2. Analyzing this table we can conclude that the tallest plants, with an average of 33.88 cm, were observed at the 'Blue Jacket' cultivar, followed by the 'Double Prince of Love' cultivar, with an average height of 33.22 cm. To the average of experience, of 30.41, for both cultivars the differences of 3.48 cm, respectively 2.81 cm are very significant positive.

Plants with the smallest height, of 23.98 cm, were recorded for the 'Miss Saigon' variety, these being with more than 6 cm shorter than the average height of the experience, the difference of these being very significantly negative.

*Table 2. Unilateral influence of cultivar on hyacinths height stem (cm)*

| Var. No.                                      | Cultivar                | The stem height Absolute value (cm) | The stem height Relative value (%) | d ± cm | Significance of difference |
|---|-------------------------|-------------------------------------|------------------------------------|--------|----------------------------|
| 1   | 'City of Haarlem'       | 32.20                               | 105.9                              | 1.79   | *                          |
| 2   | 'Blue Jacket'           | 33.88                               | 111.4                              | 3.48   | ***                        |
| 3   | 'Miss Saigon'           | 23.98                               | 78.9                               | -6.42  | ooo                        |
| 4   | 'Jan Boss'              | 28.75                               | 94.6                               | -1.66  | o                          |
| 5   | 'Double Prince of Love' | 33.22                               | 109.2                              | 2.81   | ***                        |
| Average of experience                         |                         | 30.41                               | 100.0                              | -      |                            |
| LSD 5% = 1.35; LSD 1% = 1.83; LSD 0.1% = 2.46 |                         |                                     |                                    |        |                            |

Regarding the influence of the culture substrate used for the height of the floral stems in table 3 it is found that highest average height was observed in the case of using the garden soil + peat culture substrate (average height being of 32.06 cm), followed by the substrate made up of garden soil + sand (29.98 cm). In the case of a mixture of garden soil and peat, there was a plus regarding the average plant height of 1.65 cm, statistically positive significant difference.

*Table 3. Unilateral influence of culture substrate on hyacinths height stem (cm)*

| Var. No.                                      | Cultivar           | The stem height Absolute value (cm) | The stem height Relative value (%) | d ± cm | Significance of difference |
|---|--------------------|-------------------------------------|------------------------------------|--------|----------------------------|
| 1   | Garden soil        | 29.18                               | 96.0                               | -1.23  | -                          |
| 2   | Garden soil + peat | 32.06                               | 105.4                              | 1.65   | *                          |
| 3   | Garden soil + sand | 29.98                               | 98.6                               | -0.42  | -                          |
| Average of experience                         |                    | 30.41                               | 100.0                              | -      |                            |
| LSD 5% = 1.63; LSD 1% = 2.79; LSD 0.1% = 5.22 |                    |                                     |                                    |        |                            |

In table 4, shows the combined influence of the culture substrate and cultivar on the height of the hyacinths flower stem, it is observed that the highest plants, with an average height of 35.65 cm, registered at 'City of Haarlem' cultivar, in combination with the culture substrate formed by garden

soil + sand, were followed by the combination of 'Blue Jacket' cultivar and garden soil (35.20 cm). In both experimental variants the difference registered toward the witness of the experience (30.41 cm) was very significant positive.

**Table 4. The combined influence of culture substrate and cultivar on stem height of hyacinth (cm)**

| Var. No.                                      | Culture substrate  | Cultivar                | The stem height Absolute value (cm) | The stem height Relative value (%) | d ± cm | Significance difference |
|---|--------------------|-------------------------|-------------------------------------|------------------------------------|--------|-------------------------|
| 1   | Garden soil        | 'City of Haarlem'       | 28.65                               | 94.21                              | -1.76  | -                       |
| 2   | Garden soil        | 'Blue Jacket'           | 35.20                               | 115.75                             | 4.79   | ***                     |
| 3   | Garden soil        | 'Miss Saigon'           | 23.55                               | 77.44                              | -6.86  | ooo                     |
| 4   | Garden soil        | 'Jan Boss'              | 27.10                               | 89.12                              | -3.31  | oo                      |
| 5   | Garden soil        | 'Double Prince of Love' | 31.38                               | 103.19                             | 0.97   | -                       |
| 6   | Garden soil + peat | 'City of Haarlem'       | 32.30                               | 106.22                             | 1.89   | -                       |
| 7   | Garden soil + peat | 'Blue Jacket'           | 32.50                               | 106.87                             | 2.09   | -                       |
| 8   | Garden soil + peat | 'Miss Saigon'           | 22.70                               | 74.65                              | -7.71  | ooo                     |
| 9   | Garden soil + peat | 'Jan Boss'              | 28.35                               | 93.23                              | -2.06  | -                       |
| 10  | Garden soil + peat | 'Double Prince of Love' | 34.07                               | 112.04                             | 3.66   | **                      |
| 11  | Garden soil + sand | 'City of Haarlem'       | 35.65                               | 117.23                             | 5.24   | ***                     |
| 12  | Garden soil + sand | 'Blue Jacket'           | 33.94                               | 111.61                             | 3.53   | **                      |
| 13  | Garden soil + sand | 'Miss Saigon'           | 25.70                               | 84.51                              | -4.71  | ooo                     |
| 14  | Garden soil + sand | 'Jan Boss'              | 30.80                               | 101.28                             | 0.39   | -                       |
| 15  | Garden soil + sand | 'Double Prince of Love' | 34.20                               | 112.46                             | 3.79   | **                      |
| Average of experience                         |                    |                         | 30.41                               | 100.0                              | -      | -                       |
| LSD 5% = 2.34; LSD 1% = 3.18; LSD 0.1% = 4.26 |                    |                         |                                     |                                    |        |                         |

On the other hand, plants with the smallest average height were those belonging 'Miss Saigon' cultivar, which recorded minimum values of the character studied in all three types of substrate, the height of plants being less than 20 % than the average of experience.

Analyzing table 5 shows the cultivars 'Blue Jacket' and 'Double Prince of Love' have been highlighted by the greater number of flowers in the inflorescences, with 64.25, respectively 68.35 flowers, with 17.0 %, respectively 24.5 % more than the average of experience. In both cultivars the differences toward the witness, the average of the experience, were very significantly positive.

**Table 5. Influence of cultivar on number of florets per cluster**

| Var. No.                                      | Culture substrate       | Number of florets/cluster | Relative number of florets (%) | d ±    | Significance of difference |
|---|-------------------------|---------------------------|--------------------------------|--------|----------------------------|
| 1   | 'City of Haarlem'       | 55.73                     | 101.5                          | 0.82   | -                          |
| 2   | 'Blue Jacket'           | 64.25                     | 117.0                          | 9.34   | ***                        |
| 3   | 'Miss Saigon'           | 41.93                     | 76.4                           | -12.98 | ooo                        |
| 4   | 'Jan Boss'              | 44.30                     | 80.7                           | -10.61 | ooo                        |
| 5   | 'Double Prince of Love' | 68.35                     | 124.5                          | 13.44  | ***                        |
| Average of experience                         |                         | 54.91                     | 100.0                          | -      | -                          |
| LSD 5% = 2.33; LSD 1% = 3.17; LSD 0.1% = 4.24 |                         |                           |                                |        |                            |

Varieties 'Miss Saigon' and 'Jan Boss' had a smaller number of flowers, on the average 41.93 to the 'Miss Saigon' cultivar and 44.30 to the 'Jan Boss' cultivar, the differences of 12.98, respectively 10.61 flowers/inflorescence towards the average, being very significantly negative.

Regarding the number of flowers from the inflorescence, a very important characteristic, from the point of view of the decorative value of floral plants, in the experiments realized, it is noted that the cultivar used has had a particular influence on this factor. Also Addai (2011) confirmed that the number of florets/cluster of hyacinths also depends very much on the cultivar. Others authors reported those factors influencing the number of florets are the production conditions, age/lifting date and temperature treatment (De Hertogh, 1974; Addai, 2011).

The culture substrate had an influence to the number of florets in the inflorescence. In table 6 can be observed that the best results were recorded for the substrate composed by garden soil + sand (61.36 florets/inflorescence), followed by garden soil + peat (55.18 flowers/inflorescence) and garden soil (48.20 flowers/inflorescence). To the average of the experience (54.91 florets/inflorescence) the substrate composed of garden soil + sand has recorded a plus of 6.45 florets/inflorescence, which is distinctly significant positive from a statistical point of view. On the opposite side, in the case of culture substrate composed only of garden soil, the inflorescences had 12.2 % less flowers than the witness of the experience, difference of 6.71 florets/inflorescence, being distinctly significant negative. Farzad et al. (2011) observed that flowering stem height was affected significantly and the highest flowering stem height was observed in coco peat/sand. Also they concluded that the pot mixtures did not significantly affect floret number. The highest floret length was observed in coco peat only treatment.

**Table 6. Influence of culture substrate on the number of florets per cluster**

| Var. No.                                      | Culture substrate  | Florets number Absolute value | Florets number Relative value (%) | d ±   | Significance of difference |
|---|--------------------|-------------------------------|-----------------------------------|-------|----------------------------|
| 1   | Garden soil        | 48.20                         | 87.8                              | -6.71 | oo                         |
| 2   | Garden soil + peat | 55.18                         | 100.5                             | 0.26  | -                          |
| 3   | Garden soil + sand | 61.36                         | 111.7                             | 6.45  | **                         |
| Average of experience                         |                    | 54.91                         | 100.0                             | -     | -                          |
| LSD 5% = 3.25; LSD 1% = 5.37; LSD 0.1% = 8.56 |                    |                               |                                   |       |                            |

Analyzing the combined influence of the culture substrate and the cultivar on the number of florets/cluster (table 7) there were positive, very significant differences, compared to the control, the average of the experience (54.91 florets/inflorescence) in the 'Blue Jacket' and 'Double Prince of Love' both in garden soil + peat and garden soil + sand. The lowest number of florets/cluster was observed in the 'Miss Saigon' cultivar, cultivated in all three substrates, as well as the 'Jan Boss' cultivar, cultivated in garden soil and garden soil + peat. In these variants the average number of florets in the inflorescences ranged from 34.75 to 47.55, in all cases there were very significant negative differences from the average of the experience.

Date on the influence of the cultivar of the bloom precocity (table 8) shows that 'Jan Boss' cultivar needs the fewest days to flourish from the time of placing into the greenhouse, averaging 12.44 days, 17.6 % less than the average of the experience (15.10 days), thus a difference of 2.65 days which was very significantly negative. As a significantly negative difference compared to the control it was also registered at 'Miss Saigon' variety, which on average needed 14.37 days to blossom, 4.8% less than control.

**Table 7. The combined influence of the culture substrate and the cultivar on the number of florets per cluster**

| Var. No.              | Culture substrate  | Cultivar                | Florets no/ cluster<br>Absolute value | Florets number<br>Relative value (%) | d ±    | Significance of difference |
|-----------------------|--------------------|-------------------------|---------------------------------------|--------------------------------------|--------|----------------------------|
| 1                     | Garden soil        | 'City of Haarlem'       | 51.80                                 | 94.34                                | -3.11  | -                          |
| 2                     | Garden soil        | 'Blue Jacket'           | 58.50                                 | 106.54                               | 3.59   | -                          |
| 3                     | Garden soil        | 'Miss Saigon'           | 37.90                                 | 69.02                                | -17.01 | ooo                        |
| 4                     | Garden soil        | 'Jan Boss'              | 34.75                                 | 63.29                                | -20.16 | ooo                        |
| 5                     | Garden soil        | 'Double Prince of Love' | 58.05                                 | 105.72                               | 3.14   | -                          |
| 6                     | Garden soil + peat | 'City of Haarlem'       | 56.53                                 | 102.95                               | 1.62   | -                          |
| 7                     | Garden soil + peat | 'Blue Jacket'           | 62.25                                 | 113.37                               | 7.34   | ***                        |
| 8                     | Garden soil + peat | 'Miss Saigon'           | 40.35                                 | 73.48                                | -14.56 | ooo                        |
| 9                     | Garden soil + peat | 'Jan Boss'              | 42.85                                 | 78.04                                | -12.06 | ooo                        |
| 10                    | Garden soil + peat | 'Double Prince of Love' | 70.90                                 | 129.12                               | 15.99  | ***                        |
| 11                    | Garden soil + sand | 'City of Haarlem'       | 58.85                                 | 107.18                               | 3.94   | -                          |
| 12                    | Garden soil + sand | 'Blue Jacket'           | 69.00                                 | 125.66                               | 14.09  | ***                        |
| 13                    | Garden soil + sand | 'Miss Saigon'           | 47.55                                 | 86.60                                | -7.36  | ooo                        |
| 14                    | Garden soil + sand | 'Jan Boss'              | 55.30                                 | 100.71                               | 0.39   | -                          |
| 15                    | Garden soil + sand | 'Double Prince of Love' | 76.10                                 | 138.59                               | 21.19  | ***                        |
| Average of experience |                    |                         | 54.91                                 | 100.00                               | -      | -                          |

LSD 5% = 4.03; LSD 1% = 5.48; LSD 0.1% = 7.34

**Table 8. Precocity of flowering under the influence of the cultivar (days)**

| Var. No.              | Cultivar                | Number of days<br>Absolute value | Number of days<br>Relative value (%) | d ±   | Significance of difference |
|-----------------------|-------------------------|----------------------------------|--------------------------------------|-------|----------------------------|
| 1                     | 'City of Haarlem'       | 15.23                            | 100.9                                | 0.13  | -                          |
| 2                     | 'Blue Jacket'           | 15.97                            | 105.8                                | 0.87  | -                          |
| 3                     | 'Miss Saigon'           | 14.37                            | 95.2                                 | -0.72 | o                          |
| 4                     | 'Jan Boss'              | 12.44                            | 82.4                                 | -2.65 | ooo                        |
| 5                     | 'Double Prince of Love' | 17.46                            | 115.7                                | 2.37  | ***                        |
| Average of experience |                         | 15.10                            | 100.0                                | -     | -                          |

LSD 5% = 0.67; LSD 1% = 1.19, LSD 0.1% = 1.59

The 'Double Prince of Love' cultivar took the longest period to flourish, averaging 17.46 days, with 2.37 days longer than the average of experience, the difference being thus very significant positive.

Even if the cultivar used had a powerful influence on bloom precocity, this is not available and for the substrate used. So, in the table 9 it can be seen that a significant influence on the analyzed character had only the substrate made up of garden soil + sand, variant in which blooming occurred 1.18 days later than the average of the experience.

Using the other two substrates, respectively garden soil and garden soil + peat, plants blossomed in approximately 14.5 days, from the date of introduction into the greenhouse.

The number of days required for plants to flourish from the date of introduction into the greenhouse ranged from 11.12 days, to the 'Jan Boss' cultivar grown in garden and 18.45 days, for the 'Double Prince of Love' cultivar, cultivated into a mixture made up of garden soil + sand.

**Table 9. Influence of culture substrate on precocity of flowering (days)**

| Var. No.                                      | Culture substrate  | Number of days<br>Absolute value | Number of days<br>Relative value<br>(%) | d ±   | Significance of<br>difference |
|---|--------------------|----------------------------------|---|-------|-------------------------------|
| 1   | Garden soil        | 14.44                            | 95.7                                    | -0.65 | -                             |
| 2   | Garden soil + peat | 14.57                            | 96.5                                    | -0.53 | -                             |
| 3   | Garden soil + sand | 16.28                            | 107.8                                   | 1.18  | *                             |
| Average of experience                         |                    | 15.10                            | 100.0                                   | 0.00  | -                             |
| LSD 5% = 0.88; LSD 1% = 1.46; LSD 0.1% = 2.73 |                    |                                  |   |       |                               |

The difference between the 'Jan Boss' variety cultivated in the garden soil and the witness of the experience, of 3.98 days is highly negative. Also with a very significant difference is noted this variety on the substrate garden soil + peat, flowering in these case took place in about 12 days, almost three days earlier than the calculated average.

On the opposite side, the following experimental variants can be mentioned: cultivars 'Blue Jacket' and 'Double Prince of Love', cultivated in the garden soil + sand. In both variants, the blooming took place after 18 days in the heated culture space (table 10).

The decoration period is, probably, one of the most important features of floral plants decorative by flowers. Analyzing table 11 we find that the period of decoration varied between 8.07 days at 'City of Haarlem' cultivar and 12.11 days at 'Double Prince of Love' cultivar.

In the case of 'City of Haarlem' cultivar, the difference from the difference of the experience (9.94 days) was of 1.87 days, which is very significant negative.

To the 'Double Prince of Love' cultivar, the difference recorded against the average was 2.17 days, very significant positive.

**Table 10. The combined influence of the culture substrate and the cultivar on the precocity of flowering (days)**

| Var. No.                                      | Culture substrate  | Cultivar                | Number of days<br>Absolute value | Number of days<br>Relative value<br>(%) | d ±   | Significance of<br>difference |
|---|--------------------|-------------------------|----------------------------------|---|-------|-------------------------------|
| 1   | Garden soil        | 'City of Haarlem'       | 14.95                            | 99.01                                   | -0.15 | -                             |
| 2   | Garden soil        | 'Blue Jacket'           | 14.77                            | 97.81                                   | -0.33 | -                             |
| 3   | Garden soil        | 'Miss Saigon'           | 14.37                            | 95.17                                   | -0.73 | -                             |
| 4   | Garden soil        | 'Jan Boss'              | 11.12                            | 73.64                                   | -3.98 | ooo                           |
| 5   | Garden soil        | 'Double Prince of Love' | 17.01                            | 112.65                                  | 1.91  | *                             |
| 6   | Garden soil + peat | 'City of Haarlem'       | 15.52                            | 102.78                                  | 0.42  | -                             |
| 7   | Garden soil + peat | 'Blue Jacket'           | 14.93                            | 98.87                                   | -0.17 | -                             |
| 8   | Garden soil + peat | 'Miss Saigon'           | 13.32                            | 88.21                                   | -1.78 | o                             |
| 9   | Garden soil + peat | 'Jan Boss'              | 12.15                            | 80.46                                   | -2.95 | ooo                           |
| 10  | Garden soil + peat | 'Double Prince of Love' | 16.93                            | 112.12                                  | 1.83  | *                             |
| 11  | Garden soil + sand | 'City of Haarlem'       | 15.22                            | 100.79                                  | 0.12  | -                             |
| 12  | Garden soil + sand | 'Blue Jacket'           | 18.20                            | 120.53                                  | 3.10  | ***                           |
| 13  | Garden soil + sand | 'Miss Saigon'           | 15.44                            | 102.25                                  | 0.34  | -                             |
| 14  | Garden soil + sand | 'Jan Boss'              | 14.06                            | 93.11                                   | -1.04 | -                             |
| 15  | Garden soil + sand | 'Double Prince of Love' | 18.45                            | 122.19                                  | 3.35  | ***                           |
| Average of experience                         |                    |                         | 15.10                            | 100.0                                   | -     | -                             |
| LSD 5% = 1.51; LSD 1% = 2.06; LSD 0.1% = 2.76 |                    |                         |                                  |   |       |                               |

Also with long periods of decoration are remarkable the cultivars 'Miss Saigon' and 'Jan Boss', to which the plants remain blossomed for more than 10 day, but the differences against the witness are nosignificant from a statistical point of view (table 11).

**Table 11. Influence of cultivar on decoration period (days)**

| Var. No.                                      | Cultivar                | Number of days<br>Absolute value | Number of days<br>Relative value (%) | d ±   | Significance of difference |
|---|-------------------------|----------------------------------|--------------------------------------|-------|----------------------------|
| 1   | 'City of Haarlem'       | 8.07                             | 81.2                                 | -1.87 | ooo                        |
| 2   | 'Blue Jacket'           | 9.04                             | 91.0                                 | -0.90 | oo                         |
| 3   | 'Miss Saigon'           | 10.04                            | 101.0                                | 0.10  | -                          |
| 4   | 'Jan Boss'              | 10.44                            | 105.0                                | 0.50  | -                          |
| 5   | 'Double Prince of Love' | 12.11                            | 121.8                                | 2.17  | ***                        |
| Average of experience                         |                         | 9.94                             | 100.0                                | -     | -                          |
| LSD 5% = 0.54; LSD 1% = 0.73; LSD 0.1% = 0.98 |                         |                                  |                                      |       |                            |

Table 12 shows the influence of the culture substrate on the period of decoration of hyacinths. The longest blooming period had plants grown in a mixture of garden soil + sand. In this case the decoration period was of 10.63 days, with 6.9% longer than the calculated average of the whole experience. In this case the difference of 0.69 days was distinctly significant positive.

In the case of plant cultivated in a substrate made of garden soil + peat the decoration period is only of 9.50 days, with 4.4% days less than the average of experience, difference of 0.44 days being significantly negative.

The combined influence of the culture substrate used on the duration of decorating of hyacinths flowers shows that the 'Double Prince of Love' cultivar has been highlighted with the best results (table 13).

**Table 12. Influence of culture substrate on decoration period (days)**

| Var. No.                                      | Culture substrate  | Number of days<br>Absolute value | Number of days<br>Relative value (%) | d ±   | Significance of difference |
|---|--------------------|----------------------------------|--------------------------------------|-------|----------------------------|
| 1   | Garden soil        | 9.69                             | 97.5                                 | -0.25 | -                          |
| 2   | Garden soil + peat | 9.50                             | 95.6                                 | -0.44 | o                          |
| 3   | Garden soil + sand | 10.63                            | 106.9                                | 0.69  | **                         |
| Average of experience                         |                    | 9.94                             | 100.0                                | -     | -                          |
| LSD 5% = 0.34; LSD 1% = 0.57; LSD 0.1% = 1.07 |                    |                                  |                                      |       |                            |

Cultivating this cultivar in the substrate of garden soil + peat and garden soil + sand, the duration of the decoration exceeds 12, even 13 days. Remarkable results have also been achieved in the 'Jan Boss' cultivar, which were planted in garden soil + sand, in which case the plants had a period of decoration about 12 days. From a statistical point of view, the differences recorded from the average of the experience (9.94 days), were very significantly positive.

Experimental variants with a short period of decoration are represented by 'City of Haarlem' cultivar, cultivated both in garden soil + peat, and garden soil + sand. Plants from these variants have recorded periods of decoration of 7.14 days, respectively 7.66 days, with differences of 2.80 and 2.28 days compared to the average, both being very significantly positive (table 13).

**Table 13. The combined influence of culture and variety substrate on the duration of decoration (days)**

| Var. No.              | Culture substrate  | Cultivar                | Number of days<br>Absolute value | Number of days<br>Relative value<br>(%) | d ±   | Significance<br>of difference |
|-----------------------|--------------------|-------------------------|----------------------------------|---|-------|-------------------------------|
| 1                     | Garden soil        | 'City of Haarlem'       | 9.42                             | 94.77                                   | -0.52 | -                             |
| 2                     | Garden soil        | 'Blue Jacket'           | 9.78                             | 98.39                                   | -0.16 | -                             |
| 3                     | Garden soil        | 'Miss Saigon'           | 9.16                             | 92.15                                   | -0.78 | -                             |
| 4                     | Garden soil        | 'Jan Boss'              | 9.23                             | 92.86                                   | -0.71 | -                             |
| 5                     | Garden soil        | 'Double Prince of Love' | 10.87                            | 109.36                                  | 0.93  | *                             |
| 6                     | Garden soil + peat | 'City of Haarlem'       | 7.14                             | 71.83                                   | -2.8  | ooo                           |
| 7                     | Garden soil + peat | 'Blue Jacket'           | 8.25                             | 83.00                                   | -1.69 | oo                            |
| 8                     | Garden soil + peat | 'Miss Saigon'           | 9.95                             | 100.10                                  | 0.01  | -                             |
| 9                     | Garden soil + peat | 'Jan Boss'              | 10.13                            | 101.91                                  | 0.19  | -                             |
| 10                    | Garden soil + peat | 'Double Prince of Love' | 12.03                            | 121.03                                  | 2.09  | ***                           |
| 11                    | Garden soil + sand | 'City of Haarlem'       | 7.66                             | 77.06                                   | -2.28 | ooo                           |
| 12                    | Garden soil + sand | 'Blue Jacket'           | 9.10                             | 91.55                                   | -0.84 | -                             |
| 13                    | Garden soil + sand | 'Miss Saigon'           | 11.00                            | 110.66                                  | 1.06  | *                             |
| 14                    | Garden soil + sand | 'Jan Boss'              | 11.95                            | 120.22                                  | 2.01  | ***                           |
| 15                    | Garden soil + sand | 'Double Prince of Love' | 13.42                            | 135.01                                  | 3.48  | ***                           |
| Average of experience |                    |                         | 9.94                             | 100.0                                   | -     | -                             |

LSD 5% = 0.93; LSD 1% = 1.27; LSD 0.1% = 1.70

#### 4. CONCLUSIONS

The hyacinth cultivars evaluated in this study on culture substrates differed in a number of characteristics. Thus, regarding the culture substrate made up by garden soil + sand, there have registered very good results on plant height, the number of florets into the inflorescences and decoration period, but less favorable results were obtained from the point of view of the bloom precocity.

Satisfactory results were also obtained for culture in the substrate composed of garden soil + peat, with insignificant differences on the morpho-decoratives characteristics studied.

Garden soil, has recorded less favorable results regarding the flower decoration period, height of the floral stem and the number of flowers in the inflorescence.

Regarding the inflorescence of the hyacinths the best results were registered at 'Double Prince of Love' cultivar, which though it took the longest time to flourish from the date of introduction into the greenhouse, presented most flowers in inflorescence and had the longest period of decoration.

Although 'Jan Boss' cultivar was the earliest, he shows a small number of floret in cluster, also having the shortest period of decoration.

Analyzing the combined influence of the culture substrate and the cultivars of hyacinth used in the experience, the most favorable combination in terms of decoration period and the number of florets in the inflorescence, as well as the height of the floral stems was the combination of 'Double Prince of Love' cultivar and the substrate garden soil + sand (1:1).

#### 5. REFERENCES

- Addai, I.K. (2011). Influence of cultivar or nutrients application on growth, flower production and bulb yield of the common hyacinth. *American Journal Scientific Industrial Research*, 2(2), 229-245.
- Ardelean, M., Sestraș, R., Cordea, M. (2007). *Tehnică experimentală horticola* [Horticulture experimental technique]. Ed. *AcademicPres*, (pp. 24-26). Cluj-Napoca.
- Băla, M. (2012). *Floricultură generală și specială* [General and Special Floriculture]. Ed. *Partoș*, (pp. 247-249), Timișoara.

- Buzatu, M. (2001). Plante floricole cu bulbi rezistente la îngheț [Flower plants with bulbs frost resistant]. Ed. *BRUMAR*, Timișoara.
- Farzad, N., Homayoun F., Khosh-Khui M., Salehi H. (2011). Effects of coir as a component of potting media on growth, flowering and physiological characteristics of hyacinth (*Hyacinthus orientalis* L.cv. Sonbol-e-Irani). *International Journal of Agricultural and Food Science*, 1(2), 34-38.
- De Hertogh, A. (1974). Principles for forcing tulips, hyacinths, daffodils, Easter lilies and Dutch irises. *Scientia Hort.*, 2, 313-355.
- De Hertogh, A. (1977). Holland bulb Forcers Guide. *Netherlands Flower-Bulb Institute*. New York.
- Draghia, L. Chelariu, E.L. (2011). Floricultură [Floriculture]. Ed. `Ion Ionescu de la Brad`, (pp. 253) Iași.
- Larson, R.A. (1980). Introduction to Floriculture. *Academic Press, Inc.* (217-277). New York.
- Șelaru E. (2002). Culturi pentru flori tăiate [Crops for cut flowers]. Ed. *Ceres* (pp. 258-260) Bucharest.
- Toma, F. (2009). Floricultura și Artă florală, vol. II: Specii utilizate pentru producerea floriilor tăiate [Floriculture and floral art, vol. II: Species used to produce cut flowers]. Ed. *NVELMultimedia*, (pp. 106-112). Bucharest.
- \*\*\*, [www.rasfoiesc.com](http://www.rasfoiesc.com).
- \*\*\*, [www.floraria-adi.ro](http://www.floraria-adi.ro)
- \*\*\*, [www.ruigrokflowerbulbs.com/wp-content/uploads/2016/04/Hyacinth\\_Forcing-Guide.pdf](http://www.ruigrokflowerbulbs.com/wp-content/uploads/2016/04/Hyacinth_Forcing-Guide.pdf)
- \*\*\*, <https://www.vws-flowerbulbs.nl/media/org/1935a0b773f6cb49ce1f5630c3fc4801.pdf>
- \*\*\*, [http://www.ruigrokflowerbulbs.com/wp-content/uploads/2016/04/Hyacinth\\_Forcing-Guide.pdf](http://www.ruigrokflowerbulbs.com/wp-content/uploads/2016/04/Hyacinth_Forcing-Guide.pdf)
- \*\*\*, <https://www.johnscheepers.com/hhyacinths-forcing.html>
- \*\*\*, <http://www.pepinieramizil.aaz.ro>