Features of the growth and development of tulips in the Rostov region of the Russian Federation

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Abstract. The work studied the forcing treatment of thirty grades of tulips in the conditions of the Rostov region of the Russian Federation. Studies were conducted in 2018 and 2019. The total of the planting material was 30415 bulbs in 2018 and 32405 bulbs in 2019. Thus, the technology of 5 °C cooling of the bulbs was used, the forcing treatment was carried out on the territory of the forcer with use of the hydroponic equipment. The work object is to study the characteristics of the growth and development of the various grades of tulips in the conditions of the Rostov region of the Russian Federation and to identify the most and least suitable grades for the forcing treatment in this geographical region.

1. Introduction

Tulip is one of the most beautiful and popular flowers both in the world and in the Russian Federation. In our country, this flower can by the right be called the flower of spring and the flower of March 8 (the Women’s Day). In addition, the tulip is considered the most profitable culture of the early spring cultivation [1].

The tulip is the plant with the controlled technology of cultivation that allows receiving a ready flower in the precisely certain terms [2]. Thanks to high adaptability of this species, these flowers are successfully grown up in different climatic zones [3].

The Rostov region is located in the southwest of the European part of the Russian Federation. The region is located in the climatic zone of the moderate continental climate. The existence in the geographical zone of a large number of steppes promotes strong winds. The average temperatures for the region are +23 °C in July and -7 °C in January. The average annual rainfall is 424 mm [4].

In the Rostov region, a large number of tulips are grown both in open and in closed ground. Different cultivation technologies and grades of tulips are used for the forcing treatment. When tulips are grown due to the competent selection of the grades differing on the blossoming terms the so-called conveyor of the receipt of the tulip production stretched in time is created [5].

The forcing treatment of a grade in early, average or late terms is controlled by the various external factors; one of the most important is the ambient temperature [5]. Features of the growth rate of a particular grade of the tulips variety largely determine the prospects of their forcing treatment in the Rostov region.

Depending on the differences in the climatic conditions, the blossoming of tulips differs in time.

The work object is to study the characteristics of the growth and development of the various grades of tulips in the conditions of the Rostov region of the Russian Federation and to identify the most and
least suitable grades for the forcing treatment in this geographical region. The studies were conducted in 2018 and 2019 in the Matveevo-Kurgan region of the Rostov region of the Russian Federation. The following grades of tulips were studied: Barcelona, Strong Gold, Malaysia, Mempis, Milkshake, Mascara, Jumbo Beauty, Laptop, Verandi, Bullit, Red Gold, Snow Lady, Dynasty, Canasta, Davenport, Tom Pouce, Renegade, Ice Rif, Pink Ardor, White Hero, Pink Flag, Surplace. All planting material is Dutch.

2. Materials and methods
The studies were conducted in 2018 and 2019 in the Matveevo-Kurgan region of the Rostov region of the Russian Federation on the territory of the forcer. Thirty grades of tulips became the objects of the study. They are: Barcelona, Strong Gold, Malaysia, Mempis, Milkshake, Mascara, Jumbo Beauty, Laptop, Verandi, Malaysia, Red Gold, Snow Lady, Dynasty, Canasta, Davenport, Tom Pouce, Renegade, Ice Rif, Pink Ardor, White Hero, Pink Flag, Surplace, Strong Power, Berini, Super Model, Sunbelt, Ile de France, Hunter, Lemon Ice, Jumbo Pink, Strong Red. All grades were delivered from Holland. The size of the bulbs is 12+ cm. The bulk of cultivated tulip grades is the triumph class, which has a number of significant advantages for the forcing treatment. The total of the planting material was 30415 bulbs in 2018 and 32405 bulbs in 2019 (table 1). The quantity of bulbs of each grade depends on their prevalence.

At the cultivation of all grades of tulips, the technology the technology of 5 °C cooling of the bulbs was used. The period of cooling was 18 weeks: from August 20 to December 25. Thus, before planting the bulb passed the entire period of cooling dry.

Just before planting according to technology of the forcing treatment the bulbs were cleaned [6], the dry brown scales surrounding roots and interfering intake of the moisture were removed. This process is necessary to accelerate the rooting of the planting material.

According to the Dutch technology of 5 °C cooling of the forcing treatment the greatest possible planting density fluctuates from 325 pcs/m² (for the early harvesting) to 350 pcs/m² (for the medium and late harvesting), the optimum density of planting is 200-250 pcs/m² [6]. However, these data are provided for the forcing treatment in the hothouse soil. When using the hydroponic technology the density of the planted bulbs can be higher.

The study used boxes that allow the forcing treatment using the hydroponic technology. The size of one box is 60x40 cm. The planting density was 300 pcs/m².

Table 1. The amount of the planting bulbs in 2018-2019 years.

| №  | The tulip grade | The amount of planting bulbs in 2018 | The amount of planting bulbs in 2019 | №  | The tulip grade | The amount of planting bulbs in 2018 | The amount of planting bulbs in 2019 | №  | The tulip grade | The amount of planting bulbs in 2018 | The amount of planting bulbs in 2019 |
|----|----------------|-----------------------------------|-----------------------------------|----|----------------|-----------------------------------|-----------------------------------|----|----------------|-----------------------------------|-----------------------------------|
| 1  | Barcelona      | 6886 3963                         | 11 Snow Lady                      | 583| 4373           | 21 Surplace                       | 488                               | 2  | Strong Gold    | 8319 3919                        | 12 Dynasty                        | 1086| 22 Strong Power | 1171                          |
| 3  | Mempis         | 979 2954                          | 13 Canasta                        | 766| 1766           | 24 Super Model                    | 1747                             | 4  | Milkshake      | 646 1766                         | 14 Davenport                      | 8266| 25 Sunbelt       | 461                           |
| 5  | Mascara        | 646 1766                          | 15 Tom Pouce                      | -  | -              | -                                 | -                                 |
The bulbs were planted from December 26 to January 04. First, the bulbs of the grades of late blossoming were planted, and secondly, the medium ones (table 2). The planting schedule is calculated based on the intended blossoming date. Namely, all flowers were planned to be harvested by March 05.

After planting in accordance with the technology [6], the temperature regime was maintained at the level of 9-11 °C for the first 14 days, since raising the temperature above 13 °C provokes an accelerated growth of peduncles and a decrease in the quality of the cultivated production. Since the 15th day and onwards, the temperature regime was maintained in the range of 17-19 °C.

Since the forcing treatment was carried out using the hydroponic technology, the periodic water supply to the boxes was carried out, as well as the regular fertilizing of plants in accordance with the growth stage.

The systematic processing of the results was carried out in accordance with the modern methods of the statistical analysis and Microsoft Office Excel.

### Table 2. The planting schedule.

| №  | The tulip grade | The planting date | №  | The tulip grade | The planting date |
|----|----------------|------------------|----|----------------|------------------|
| 1  | Barcelona      | December 28      | 16 | Renegade       | January 02       |
| 2  | Strong Gold    | December 29      | 17 | Ice Rif        | January 03       |
| 3  | Memphis        | December 28      | 18 | Pink Ardour    | January 02       |
| 4  | Milkshake      | December 28      | 19 | White Hero     | January 02       |
| 5  | Mascara        | December 29      | 20 | Pink Flag      | January 03       |
| 6  | Jumbo Beauty   | December 27      | 21 | Surplace       | January 03       |
| 7  | Laptop         | December 30      | 22 | Strong Power   | January 04       |
| 8  | Verandi        | December 29      | 23 | Berini         | January 04       |
| 9  | Malaysia       | December 28      | 24 | Super Model    | December 27      |
| 10 | Red Gold       | December 30      | 25 | Sunbelt        | December 27      |
| 11 | Snow Lady      | December 30      | 26 | Ile de France  | December 28      |
| 12 | Dynasty        | December 30      | 27 | Hunter         | December 29      |
| 13 | Canasta        | December 26      | 28 | Lemon Ice      | January 02       |
| 14 | Davenport      | December 26      | 29 | Jumbo Pink     | December 27      |
| 15 | Tom Pouce      | December 30      | 30 | Strong Red     | January 03       |

### 3. Results

The conducted researches showed that:
- rooting of the planting material happens within two weeks;
- in the conditions of the Rostov region the aftergrowing of tulips happens in 15-21 days after planting;
the bud appears in 30 days after rooting;
the first cut is carried out in 37 days after landing;
the mass blossoming begins on 50-55 days (figure 1).

Apparently, the presented results showed that the tulips blossoming is stretched in time for almost a month.

Three groups of planting material can be allocated at first formations of a tulip bud: the early formation of the bud; the average formation of the bud; the late formation of the bud.

The same way the grades are divided by the first blossomings. Therefore, blossoming of the early grades began during the period from February 12 to February 18, at the averages - from February 19 to February 22, at the late - since February 25 to March 04. The mass blossoming of a grade began on the third or fourth day after the first blossoming.

In two years of researches of the forcing treatment and development of the various grades of tulips in the conditions of the Rostov region, the grades, which belong to the Triumph class, had almost at the same time of blossoming. The most active blossoming was observed during the period from February 23 to March 02.

The average blossoming time was 9 days for the early tulips and 7-9 days for the late ones (table 3).

For the correct cultivation of the various grades of tulips it is necessary to distinguish technologies of the forcing treatment depending on the cultivation purposes: decorating flower beds and borders, the group plantings, the mass sale, obtaining marketable bulbs and bulbs-children [4].

In our study, the obtained tulips were used for the commercial purposes. In this regard, it is especially important to analyze the obtained material from the point of view of the blossoming productivity.

It is known that the ability of the bulb to the fully bloom and the production of the marketable material depends on its size. The study used only 12+ cm bulbs. Smaller bulbs reduce the likelihood of the production quality.

In our study the general blossoming productivity was 86% in 2018 and 89% in 2019 (table 4). The analysis on grades showed that:

- the Barcelona, Laptop, Verandi and Davenport grades have almost the identical indicators of the blossoming productivity in both 2018 and 2019;
- the Malaysia, Strong Gold and Snow Lady grades have the tangible differences in the blossoming productivity;
- the Strong Power, Sunbelt and Super Model grades have very low indicator of the blossoming productivity, and, therefore, their forcing treatment is not economically efficient.

![Figure 1. The cut-off dates of the harvest on the example of the Milkshake grade.](image-url)
Table 3. The time of blossoming for the various grades of tulips.

| No | The tulip grade | The time of blossoming, days | No | The tulip grade | The time of blossoming, days |
|----|-----------------|------------------------------|----|-----------------|------------------------------|
| 1  | Barcelona       | 10                           | 16 | Renegade        | 9                            |
| 2  | Strong Gold     | 7                            | 17 | Ice Rif         | 15                           |
| 3  | Mempis          | 8                            | 18 | Pink Ardour     | 13                           |
| 4  | Milkshake       | 17                           | 19 | White Hero      | 16                           |
| 5  | Mascara         | 6                            | 20 | Pink Flag       | 6                            |
| 6  | Jumbo Beauty    | 6                            | 21 | Surplace        | 7                            |
| 7  | Laptop          | 10                           | 22 | Strong Power    | 7                            |
| 8  | Verandi         | 8                            | 23 | Berini          | 8                            |
| 9  | Malaysia        | 12                           | 24 | Super Model     | 6                            |
| 10 | Red Gold        | 6                            | 25 | Sunbelt         | 10                           |
| 11 | Snow Lady       | 9                            | 26 | Ile de France   | 10                           |
| 12 | Dynasty         | 8                            | 27 | Hunter          | 9                            |
| 13 | Canasta         | 4                            | 28 | Lemon Ice       | 8                            |
| 14 | Davenport       | 4                            | 29 | Jumbo Pink      | 7                            |
| 15 | Tom Pouce       | 6                            | 30 | Strong Red      | 7                            |

Table 4. The blossoming productivity of the various grades of tulips in 2018-2019.

| No | The tulip grade | The blossoming productivity in 2018, % | No | The tulip grade | The blossoming productivity in 2019, % | No | The tulip grade | The blossoming productivity in 2018, % | No | The tulip grade | The blossoming productivity in 2019, % |
|----|-----------------|----------------------------------------|----|-----------------|----------------------------------------|----|-----------------|----------------------------------------|----|-----------------|----------------------------------------|
| 1  | Barcelona       | 88                                      | 11 | Snow Lady       | 96                                      | 21 | Surplace        | -                                      |
|    |                 | 87                                      |    |                 | 73                                      |    |                 | 97                                      |
| 2  | Strong Gold     | 66                                      | 12 | Dynasty         | -                                       | 22 | Strong Power    | -                                      |
|    |                 | 96                                      |    |                 | 100                                     |    |                 | 51                                      |
| 3  | Mempis          | -                                       | 13 | Canasta         | -                                       | 23 | Strong Power    | -                                      |
|    |                 | 94                                      |    |                 | 100                                     |    |                 | 51                                      |
| 4  | Milkshake       | -                                       | 14 | Davenport       | 99                                      | 24 | Super Model     | -                                      |
|    |                 | 81                                      |    |                 | 100                                     |    |                 | 70                                      |
| 5  | Mascara         | -                                       | 15 | Tom Pouce       | -                                       | 25 | Sunbelt         | -                                      |
|    |                 | 75                                      |    |                 | 91                                      |    |                 | 65                                      |
| 6  | Jumbo Beauty    | 100                                     | 16 | Renegade        | 93                                      | 26 | Ile de France   | -                                      |
|    |                 | 100                                     |    |                 | 100                                     |    |                 | 91                                      |
| 7  | Laptop          | 99                                      | 17 | Ice Rif         | -                                       | 27 | Hunter          | 100                                     |
|    |                 | 100                                     |    |                 | 100                                     |    |                 | -                                      |
| 8  | Verandi         | 100                                     | 18 | Pink Ardour     | -                                       | 28 | Lemon Ice       | -                                      |
|    |                 | 92                                      |    |                 | 97                                      |    |                 | 84                                      |
| 9  | Malaysia        | 88                                      | 19 | White Hero      | -                                       | 29 | Jumbo Pink      | -                                      |
|    |                 | 100                                     |    |                 | 97                                      |    |                 | 92                                      |
| 10 | Red Gold        | -                                       | 20 | Pink Flag       | -                                       | 30 | Strong Red      | -                                      |
|    |                 | 100                                     |    |                 | 80                                      |    |                 | -                                      |

Let us note that the grades that were not used for the forcing treatment in 2019 proved to be economically inefficient.
4. Conclusions

Rooting of the planting material and its aftergrowth in the conditions of the Rostov region of the Russian Federation happens within 4-5 weeks after planting. The mass blossoming happens in 1.5 months after planting. In the conditions of the Rostov region, the average blossoming time was 9 days for the early tulips and 7-9 days for the late ones. The average efficiency of blossoming was 87.5% in 2018-2019. The study of the flowering phenology of the various grades of tulips in the conditions of the Rostov Region revealed that the blossoming time, productivity, and the growth rate largely depend on the genotypic characteristics of the variety itself, as well as on the technology of the forcing treatment. The applied hydroponic technique of the forcing treatment is not only faster, higher in productivity, but cost-effective. From our point of view, the most suitable grades for the forcing treatment are: Jumbo Beauty, Laptop, Verandi, Malaysia, Red Gold, Davenport, Canasta, Dynasty, Renegade, Ice Rif, Pink Ardour, White Hero, Surplace, Hunter.

References

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