Research in Agriculture
ISSN 2740-4431 (Print) ISSN 2740-444X (Online)
Vol. 3, No. 1, 2018
www.scholink.org/ojs/index.php/ra

Original Paper

Experiment of Dutch Tulip Cultivation in Open Field in Shanghai, China—Effect of Temperature Change on Flowering Duration

Jin GUO[1*]

[1] Department of Planting and Exhibition Garden, Shanghai Flower Port Enterprise Development Co., Ltd., Shanghai, China

[*] Jin GUO, Department of Planting and Exhibition Garden, Shanghai Flower Port Enterprise Development Co., Ltd., Shanghai, 201303, China

Received: April 15, 2018 Accepted: May 10, 2018 Online Published: May 15, 2018

doi:10.22158/ra.v3n1p35 URL: http://dx.doi.org/10.22158/ra.v3n1p35

Abstract

In recent years, a large number of Dutch tulip varieties have been cultivated in the open field of Shanghai Flower Port (The biggest tulip park in China). In this paper, nine tulip varieties' growth period data were recorded for this experiment. By comparing the flowering duration of different varieties, it is concluded that planting early flowering varieties in Shanghai is more economical. At the end of this paper, by correlation detection method, it is concluded that there is a negative correlation between the flowering duration and temperature in Shanghai, China.

Keywords

tulip, open field cultivation, flowering duration

1. Introduction

China's introduction of tulip planting from the Netherlands can be traced back to the 1930s. In China, a large number of literatures have shown flowering time changes in greenhouse conditions. But in Open field cultivation, there are relatively little researches. Since 2004, Shanghai Flower Port (Belongs to the Shanghai Municipal Bureau of Agriculture) has cultivated a large number of tulip bulbs from the Netherlands for planting research and tourism exhibitions. In the winter of 2017, Shanghai Flower Port planted more than 300 varieties and more than 5 million tulip bulbs. These planted tulip bulbs provided an excellent model for academic research in Shanghai, and it also produced good tourism benefits in the spring of 2018 (Totally more than 500,000 tourists visited).

2. The Introduction of the Experiment

2.1 Material Selection

2.1.1 Source of Material

All tulip bulbs come from Dutch Company Jan de Wit en Zonen B.V and Nord Lommerse Flower Bulb Group.

2.1.2 Selection Criteria for Tulips

To ensure the scientificity of the data, the selected varieties mainly have the following conditions:

A) The flowering duration is scattered between March and April. Early flowers such as “Cape Town”, medium-term varieties “Pretty Woman”, late flowering varieties such as “Menton”.

B) Quality stability. Some tulip varieties exported to China from the Netherlands are prone to blind blooms, such as “Night Club”, “Flaming Flag”, “Ballade”, “Christmas Yellow” and so on. All such species are excluded.

C) The long flowering duration, the longer flowering duration can fully reflect the data differences.

D) In recent years, it grows well in the park.

2.1.3 Selected Varieties and Introductions

After determining the selection criteria for the varieties, the following varieties were selected. Among them, totally three varieties of Single Early (SE) group, three varieties of Lily Flowering (LF) group and three varieties of Single Late (SL) group.

Table 1. Selected Tulip Varieties

Nr.	Group	Variety	Color	Height(cm)
1	SE	North go	Orange	28±1.6
2	SE	Cape Town	Yellow/Red	21±1.1
3	SE	Ruby Prince	Red	24±1.2
4	LF	Pretty Woman	Red	39±4.2
5	LF	Yellow Spider	Yellow	27±6.7
6	LF	Marjolein	Orange	39±4.1
7	SL	Menton	Apricot	45±5.8
8	SL	Pink Diamond	Pink	39±5.3
9	SL	Grand Style	Pink/Red	49±4.7

2.2 Data Criteria and Observation Method

2.2.1 Criteria of Flowering Duration

The definition of the tulip flower period has many criteria around the world. From the specific content, the difference is not significant. In this paper, the self-determined criteria of Shanghai Flower Port is used, tulips flowering duration is defined as the period from initial flowering (15% flowering) to the flower fade (80% flower fade).

2.2.2 Temperature Observation Method

Shanghai Flower Port Priva system has 8 temperature detectors evenly distributed throughout the park. All temperature data is referenced to the Priva system's temperature log data. Data from the Keukenhof Park in Liess was measured in the field.

2.3 Experimental Design

The temperature in Shanghai changes significantly every year. Especially in recent years, in spring the temperature has increased rapidly. After obtaining flowering duration data and temperature, verify the Temperature-Flowering duration correlation of each varieties by comparison and analysis. In order to draw conclusions and guide cultivation.

3. Recorded Data and Analysis

3.1 Shanghai/Netherlands Flowering Duration Comparison

3.1.1 In Shanghai, the Average Flowering Duration in 2011-2018

Table 2. Average Flowering Duration in Shanghai (Shanghai Flower Port)

Nr.	Group	Varieties	Start Flowering-Faded	Duration (Days)
1	SE	North go	4.3-4.16	14
2	SE	Cape Town	3.30-4.12	14
3	SE	Ruby Prince	3.20-4.7	17
4	LF	Pretty Woman	4.10-4.20	11
5	LF	Yellow Spider	4.8-4.19	12
6	LF	Marjolein	4.8-4.20	13
7	SL	Menton	4.14-4.22	9
8	SL	Pink Diamond	4.11-4.20	10
9	SL	Grand Style	4.9-4.17	9

3.1.2 Original Flowering Duration in the Netherlands (Keukenhof, Liess)

Table 3. The Original Flowering Duration in Keukenhof, Liess, the Netherlands

Nr.	Group	Variety	Start Flowering-Faded	Duration (Days)
1	SE	North go	4.3-4.20	18
2	SE	Cape Town	4.2-4.19	18
3	SE	Ruby Prince	3.29-4.17	19
4	LF	Pretty Woman	4.20-5.5	15
5	LF	Yellow Spider	4.16-5.1	16
6	LF	Marjolein	4.22-5.6	14
7	SL	Menton	5.5-5.16	12
8	SL	Pink Diamond	5.1-5.12	11
9	SL	Grand Style	5.5-5.16	11

3.2 Temperature

3.2.1 2011-2018, the Average Temperature of Keukenhof and Shanghai Flower Port

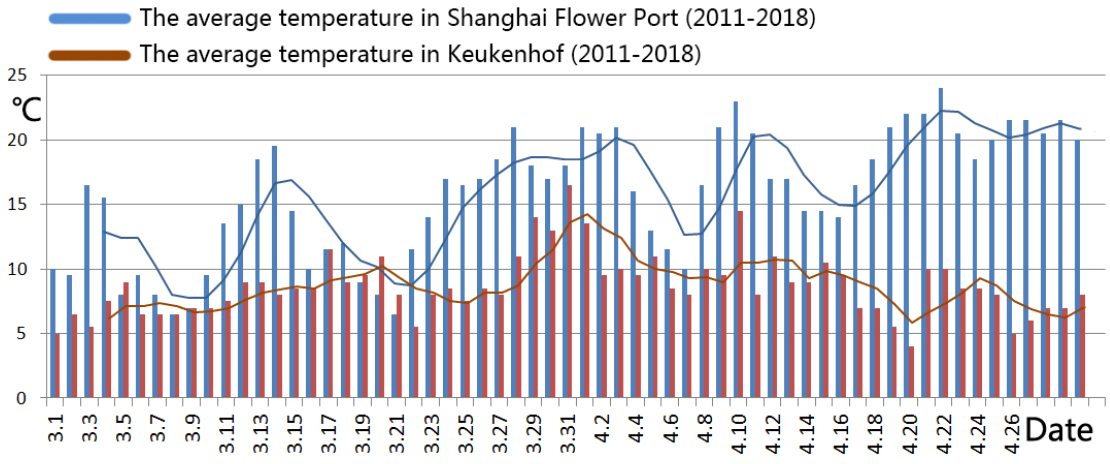

Figure 1. Temperature Changes in Keukenhof and Shanghai Flower Port

From the Figure 1, first of all, in Keukenhof the temperature were stable and less fluctuating during March and April. Secondly, the average temperature in Shanghai Flower Port for two months is much higher than in Keukenhof. In early spring, the temperature difference between the two places is small, usually around 5°C. At the end of April, the temperature gap gradually widened to 10°C.

From Table 2 and Table 3, it can be concluded that due to the temperature difference, tulip begins flowering in Keukenhof is significantly later than in Shanghai. In the Netherlands, most early flowering varieties start flowering at the end of March or early April, the medium-term varieties begin to flower

in mid-April, and the late flowering varieties flowering at the beginning of May. Almost all the varieties are flowering significantly later than in Shanghai, and at the same time flowering duration is obviously longer.

3.2.2 Temperature Changes in Shanghai Flower Port

From 2011 to 2018, the average temperature recorded by the instrument during the flowering period is listed as follows:

Table 4. 2011-2018 The Average Temperature during the Flowering Period of Each Varieties

Variety	2011	2012	2013	2014	2016	2016	2017	2018
North go	11.6℃	10.5℃	9.3℃	10.7℃	12.3℃	10.5℃	10.2℃	13.5℃
Cape Town	11.8℃	10.3℃	8.9℃	10.6℃	10.8℃	10.5℃	9.6℃	11.2℃
Ruby Prince	8.5℃	7.6℃	7.3℃	7.7℃	7.6℃	7.4℃	8.4℃	9.3℃
Pretty Woman	14.8℃	12.9℃	10.7℃	11.8℃	12.5℃	11.9℃	13.9℃	15.5℃
Yellow Spider	13.6℃	12.8℃	10.4℃	11.7℃	12.3℃	11.9℃	13.7℃	15.3℃
Marjolein	13.6℃	13.1℃	13℃	11.8℃	12.4℃	11.8℃	13.7℃	15.2℃
Menton	16.8℃	15.5℃	14.9℃	15.4℃	15.6℃	14.7℃	16.5℃	16.6℃
Pink Diamond	14.5℃	14.3℃	13.8℃	12.2℃	14.1℃	13.1℃	15.8℃	16.3℃
Grand Style	13.3℃	13.7℃	13.3℃	12.1℃	14.2℃	12.9℃	15.8℃	16.4℃

3.3 Flowering Situation in Shanghai Flower Port

The flowering time and the fade time of each varieties are different. According to the flowering time and the fade time, the flowering duration is calculated as follows:

Table 5. 2011-2018 The Flowering Duration (Days) of Each Varieties

Variety	2011	2012	2013	2014	2016	2016	2017	2018
North go	13	15	16	14	13	14	15	12
Cape Town	12	15	15	13	14	14	15	13
Ruby Prince	16	17	18	17	17	18	16	14
Pretty Woman	9	12	14	13	11	13	10	7
Yellow Spider	12	12	15	14	12	13	11	8
Marjolein	11	13	15	14	14	15	11	8
Menton	6	9	12	9	8	11	7	7
Pink Diamond	10	9	10	14	9	12	8	7
Grand Style	11	10	11	11	8	13	6	5

3.4 Discussion and Analysis

3.4.1 Correlation Study of Temperature/Flower Duration Change

According to Table 4 and Table 5, by the correlation test formula:

$$\gamma = \frac{n\sum xy - \sum x \sum y}{\sqrt{n\sum x^2 - \left(\sum x\right)^2} \times \sqrt{n\sum y^2 - \left(\sum y\right)^2}}$$

(In formula, the average temperature is defined as x and flowering duration is defined as y)

The calculated results(γ) are as follows:

Table 6. Correlation Results

Variety	γ
North go	-0.95
Cape Town	-0.86
Ruby Prince	-0.97
Pretty Woman	-0.97
Yellow Spider	-0.95
Marjolein	-0.91
Menton	-0.94
Pink Diamond	-0.94
Grand Style	-0.93

According to the correlation coefficient γ. All varieties showed a strong negative correlation, and it can be inferred that the selected varieties are strongly affected by temperature. Obviously, the higher the temperature is, the shorter flowering duration is, temperature is one of the most important factors to flowering duration. Among them, the correlation of "Cape Town" is relatively weak, which can be presumed to be a deviation of data records.

3.4.2 Average Flowering Duration of Different Group in Shanghai Flower Port

Table 7. The Average Flowering Duration (Days) of SE, LF and SL Group in Shanghai

Group	2011	2012	2013	2014	2015	2016	2017	2018
SE	13.67	15.67	16.33	14.67	14.66	15.33	15.33	13
LF	10.67	12.33	14.66	13.67	12.33	13.677	10.67	7.67
SL	9	9.33	11	11.33	8.33	12	7	6.33

It can be clearly seen from the table that SE group's flowering duration is significantly longer than LF and SL groups. Since the previous chapter shows the flowering period has a negative correlation with the average temperature, it can be deduced that the short flowering duration in the SL group is due to the high temperature in late April.

4. Conclusion

This paper completely uses the planting record data of Shanghai Flower Port. Selected tulip varieties and groups meet the standard conditions very well. It is pointed out that in open field cultivation, the flowering duration of early flowering varieties is obviously longer than other varieties. Therefore, in Shanghai, in order to better control the cost of tulip bulbs, choosing the Single Early group and other early flower varieties can get a longer flowering duration for tourism exhibitions. Secondly, medium-term varieties such as Lily Flowering group, some varieties can be selected as collocations for open field cultivation. Finally, try to avoid Single Late group tulips, the shortest flowering duration makes commercial cultivation not enough economical.

The conclusion of this article is consistent with the viewpoints of other literatures: "The key of tulip growth is the temperature. Temperature is an important factor affecting the flowering duration". This experiment confirmed that in Shanghai, the flowering time of tulip bulbs were earlier than in Keukenhof and the flowering duration was shorter. In addition, it is confirmed that in Shanghai, temperature is the absolute factor of flower duration.

At the same time, we also noticed that even if the temperature is the same and the variety is the same, the flowering period in different years will still be different. We speculate that the factors causing the difference can be summarized as follows: the natural winter cold temperature difference, light difference and humidity difference.

Acknowledgments

Thank J.C.M Buschman (Liess, the Netherlands) for offering the flowering period data in Table 3.

References

Liu, F. H. (2012). Main points of tulip cultivation management (2012). *Journal of Jilin vegetable* (China), *2*(2012), 45-46.

Tang, Q. R., Chen, Y. Y., Peng, J. H., & Xu, C. S. (1999). Study on mountain cultivation and high mountain rejuvenation of tulip. *Journal of Hunan agricultural university* (China), *2*(1999), 44-45.

Tour department of Shanghai Flower Port. (2018). *Shanghai Flower Port tour data research*. Shanghai.