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Gübre Uygulamalarının Bazı Lale Çeşitlerinde Soğan Verimi ve Çiçek Özellikleri Üzerine Etkisi

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ÖZET

Araştırma, kompoze gübre ve amonyum nitratın lale bitkisinin çiçek ve soğan kalitesi üzerine etkilerini saptamak için gerçekleştirilmiştir. Bu amaçla, ticari yaygınlığı bulunan 8 *Tulipa gesneriana* varyetesi ('Negrita', 'Sogetsu', 'Menton', 'Oxford Elit', 'Claudia', 'Inzell', 'Leen David Mark' and 'Queen of Night') İzmir koşullarında açık araziye dikilmiştir. Araştırma, 2009 ve 2010 yılları arasında FT1 ve FT2 başlıklı 2 çeşit gübre uygulaması ile gerçekleştirilmiştir. Bağlı olarak, FT1, temel bileşke gübrenin (NPK15-15-15) dikim öncesi ve amonyum nitratın (NH_4NO_3 33-0-0) çiçeklenme zamanında uygulanması ile oluşmuştur. Benzer şekilde, FT2, temel bileşke gübrenin (NPK15-15-15) dikim öncesi ve amonyum nitratın (NH_4NO_3 33-0-0) çiçeklenme zamanına ek, çiçeklenme bitiminde uygulanmasını içermiştir. Kontrol parsellerinde her hangi bir gübre uygulaması yapılmamıştır. Her iki uygulamada kullanılan gübre miktarı, araştırma boyunca sabit tutulmuştur.

Deneme deseni, 2 faktörlü (gübre uygulaması ve kültivar çeşitleri) ve 3 tekerrürlü tesadüf bloklarından oluşmaktadır. Buna bağlı olarak, lale varyeteleri, toprak üstü çıkış zamanı, sap yüksekliği, çiçeklenme zamanı ve uzunluğu ile soğan ağırlığı ve çevresi bakımından karşılaştırılmıştır.

Elde edilen veriler kontrol bitkileri ile istatistiki olarak karşılaştırılmıştır. En önemli sonuç, soğan veriminde gözlemlenmiştir ki bu durum, gübre uygulamalarının soğan verimini hedef alan üretimler için tercih nedeni olabileceğini göstermektedir.

Anahtar Kelimeler: *Tulipa gesneriana*, lale kültivarları, gübre, çiçek özellikleri, soğan verimi.

The Effect of Fertilizer Application on the Bulb Yields and Floristic Traits on Some Tulips Cultivars

ABSTRACT

The research was conducted to determine the effects of compound fertilisers together with ammonium nitrate on the flower and bulb quality of the tulip plant. For this purpose, eight different commercially available cultivars ('Negrita', 'Sogetsu', 'Menton', 'Oxford Elit', 'Claudia', 'Inzell', 'Leen David Mark' and 'Queen of Night') of *Tulipa gesneriana* were planted in an open field situated in Izmir, Turkey. The research, carried out between 2009 and 2010, contained two fertiliser treatments, named FT1 and FT2. FT1 consisted of a base compound fertiliser (NPK 15-15-15) being used prior to planting and ammonium nitrate (NH_4NO_3 33-0-0) being added during the flowering period. Similarly FT2 also consisted of a base compound fertiliser (NPK 15-15-15) being used prior to planting and, ammonium nitrate (NH_4NO_3 33-0-0) again being added during the flowering period. However, in this instance a second round of ammonium nitrate (NH_4NO_3 33-0-0) was applied after the flowering stage was completed. No fertilisers were used for the control plots. The amount of the fertiliser used in both treatments remained unchanged for the duration of the study.

The split-plot randomised block design was used with 3 replicates and 2 factors (fertilizer treatment and cultivars). Accordingly, the tulip cultivars were compared for over ground sprouting time, stem height, flowering time and duration together with bulb weight and bulb circumference.

The obtained data was compared statistically with that of the control plants. The most notable difference observed was bulb weight suggesting that the fertiliser treatments could be a favourable option when bulb production is the horticultural aim.

Key words: *Tulipa gesneriana*, tulip cultivars, fertiliser, flower characteristics, bulb yield.

INTRODUCTION

Geophyte is the scientific term of the herbaceous plants that have underground storage organs like bulbs, corms, rhizomes and tubers. These organs contain organic and mineral reserves which are used for the growth of the plants. Tulips, hyacinths, irises, lilies and daffodils are some examples of flowering bulbs. While the bulbous plants have worldwide distribution, the Balkans, Caucasus and Anatolia are at the centre of this diversity. Today, an increased environmental awareness of wildlife preservation has led to measures being taken towards the protection of natural flower bulbs. As the export of illegally gathered wild flower bulbs decreased, bulb demand was met with the development of bulb cultivation (Güneş et al. 2007). Flower bulb production covers an approximate area of 43,000 hectares around the World. The Netherlands (53.5 %), UK (10.9%), USA (8.4 %) and China (4.7 %) are the leading countries in commercial production; followed by Chile, Brazil and New Zealand (Anonymous, 2008).

Turkey, which is among the leading countries for ornamental plant production, has yet to reach the desired level in terms of flower bulb production. One important reason for this is dependence on foreign propagation materials. On the other hand, Turkey had up until the 1990's been an historical exporter of wild flower bulbs for centuries. A quota system has now been established for the collection of bulbs from nature. Today the bulbs that are collected for legal trade are controlled by the Ministry of Food Agriculture and Livestock in compliance with the agreement of CITES (Convention on International Trade in Endangered Species of Wild Fauna and Flora). As of 2004-05, natural flower bulb production in Turkey covered an area of 226 hectares (Anonymous 2008).

The aim of this research was to examine the effects of fertilizer treatments on commercially available tulip cultivars, specifically their floristic properties and bulb yield. The research was carried out in Bayindir-Izmir where the Mediterranean climate is dominant and a deep rooted tradition in ornamental plant production exists.

MATERIALS AND METHODS

Materials

The research was conducted between November 2009 and May 2010 in an open field that belongs to Ege University's Bayindir Vocational Training School situated in Izmir, Turkey (38°20.12'N-27°67.14'E) at an altitude of 105 metres. The climate data (Table 1) were obtained from the meteorological station of Odemis - Izmir (Anonymous 2010) both for the years that the study was conducted and also for a longer period (1970-2010).

In order to identify the soil properties, sample profiles taken at 20 cm depth were analysed physically and chemically at the Soil Science and Plant Nutrition Department of the Agriculture Faculty at Ege University. It was determined that the soil was slightly acidic and that the salinity level was acceptable for cultivation. The total results are given in Table 2.

Eight different commercially available *Tulipa gesneriana* cultivars ('Negrita', 'Sogetsu', 'Menton', 'Oxford Elit', 'Claudia', 'Inzell', 'Leen David Mark' and 'Queen of Night') were obtained through the donation of a private company. The grades of the bulbs were 6-8cm circumference.

Table 1. The climate data of the research period and multiple years

Months	2009			2010			1970-2010		
	Total Rainfall (mm)	Mean Temp. (˚C)	Mean RH. (%)	Total Rainfall (mm)	Mean Temp. (˚C)	Mean RH. (%)	Total Rainfall (mm)	Mean Temp. (˚C)	Mean RH. (%)
Jan.	200,5	8,2	88,7	106.3	8.5	88.3	84.4	7.2	78.3
Feb.	149,9	8,5	85,0	124.8	10.4	86.0	85.7	8.0	78.6
Mar.	86,7	10,0	77,6	24.5	11.8	81.0	64.2	10.7	76.4
Apr.	83,0	14,9	80,2	30.9	15.9	73.4	54.1	14.7	68.8
May.	13,0	20,3	60,9	1.5	20.4	60.7	26.7	20.0	60.2
June	0,2	25,7	49,7	2.3	26.1	49.9	12.8	25.1	53.5
July	6,4	28,3	49,3	0.0	28.6	49.7	5.1	27.6	53.3
Aug.	0,0	27,2	47,9	0.0	27.6	48.1	2.2	26.8	53.1
Sep.	38,7	22,2	64,9	30.1	22.1	64.3	15.2	22.2	64.4
Oct.	20,1	18,0	78,3	75.5	17.5	71.4	36.9	16.9	80.9
Nov.	86,6	12,9	85,8	32.3	15.3	76.7	84.5	11.6	79.3
Dec.	83,6	10,8	91,1	123.7	11.0	82.2	97.0	8.4	78.3
X/Σ	768,7	17,3	71,6	551.9	17.9	69.3	569.89	16.6	68.8

RH: Relative Humidity *X/Σ:* Mean / Total

Table 2. Soil characteristics of the planting site

Sand (%)	79.1	Total soluble salt (%)	0.03
Clay (%)	1.8	Organic material (%)	2.27
Silt (%)	19.1	Total N (%)	0.090
Texture	Loamy sand	Available P (ppm)	2.54
pH	6.07	Available K (ppm)	40
Lime (%)	0.80	Available Ca (ppm)	1305

Methods

Split block experimental design was used with 3 replicates and 2 factors (fertiliser treatment and cultivars). Twenty bulbs were planted on 18.11.2009 by hand in each plot; with the planting density of 10×10cm. Plants were irrigated regularly when the natural rainfall was insufficient particularly in April and May. Each plot had a 40cm distance between itself and another. Ten plants were deadheaded for bulb production and the others were left untouched for floral investigations (flowering period and plant height) on each plot. Weeds were removed; no pests or diseases were observed.

Two fertiliser treatments were set; namely Fertiliser treatment 1 (FT1) and Fertiliser treatment 2 (FT2). FT1, consisted of a base compound fertiliser (NPK 15-15-15 / 50 kg. da^{-1}), being used prior to planting and ammonium nitrate (NH_4NO_3 33-0-0 / 10 kg da^{-1}) being added at the beginning of the

flowering period. Similarly FT2 also consisted of a base compound fertiliser (NPK 15-15-15 / 50 kg. da^{-1}) being used prior to planting and, ammonium nitrate (NH_4NO_3 33-0-0 / 10 kg.da^{-1}) again being added during the flowering period. However, in this instance a second round of ammonium nitrate (NH_4NO_3 33-0-0 / 10 kg.da^{-1}) was applied after the flowering stage was completed. No fertilisers were used for control plots.

There was a set of six investigated characteristics; start time of sprouting, start time of flowering, flowering duration, plant height, bulb yield and bulb size. The obtained data was analysed using a 2 factorial split-block experiment design with the TSARIST statistical programme (Açıkgöz et al., 1994). Variations were investigated for least significant difference (LSD 5%).

RESULTS AND DISCUSSION

1. Start Time of Sprouting

All the tulip cultivars were planted on 18.11.2009. Accordingly, the dates were taken when over ground sprouting was observable for FT1, FT2 and control plots (Table 3). Then the days passed between the planting of the bulbs and their sprouting was calculated. 'Negrita', 'Leen David Mark' and 'Queen of Night' showed the earliest sprouting duration with 23, 24 and 25 days consequently. 'Oxford Elite' and 'Inzell' were the latest cultivars, sprouting 34 and 37 days after planting. The sprouting duration changed between 23 and 37 days which is similar to the findings of previous studies (Hessayon, 2003; De Hertogh and Le Nard, 1993). The average values of sprouting duration were between 23.7 and 36.3 days.

Table 3. Dates of sprouting time and sprouting duration

Tulip Cultivars	Dates of The Sprouting Time			Duration-Planting to Sprouting			
	Control	FT1	FT2	Control	FT1	FT2	Mean
Negrita	11.12.2009	12.12.2009	12.12.2009	23	24	24	23.7
Sogetsu	16.12.2009	16.12.2009	17.12.2009	28	28	29	28.3
Menton	18.12.2009	18.12.2009	18.12.2009	30	30	30	30.0
Oxford Elite	25.12.2009	24.12.2009	24.12.2009	37	36	36	36.3
Claudia	19.12.2009	18.12.2009	18.12.2009	31	30	30	30.3
Inzell	22.12.2009	23.12.2009	23.12.2009	34	35	35	34.7
Leen David Mark	11.12.2009	12.12.2009	11.12.2009	25	24	25	24.7
Queen of Night	12.12.2009	13.12.2009	13.12.2009	24	25	25	24.7

There were no significant effects from the fertiliser treatments on the sprouting times. There are various factors which can affect the sprouting time of bulbous plants such as, planting depth, bulb weight, storage conditions of bulbs, soil properties and environmental factors (De Hertogh and Le Nard, 1993).

2. Start Time of Flowering

The dates were obtained when there were 2-3 flowers present with visible tepal colour in each plot (Table 4). 'Inzell' and 'Leen David Mark' were the earliest flowering cultivars with a duration of 94 and 99 days after planting; while 'Queen of Night' and 'Menton' were the latest ones with 120 and 124 days consecutively. The average values of the duration from planting to flowering varied between 94.3 to 123.3 days. There were no significant effects of fertiliser treatments over the flowering times.

The tulip cultivars used in the study, due to their nature, were planted in the autumn and flowered in spring. The flowering dates were in February and March. Spring flowering herbaceous plants are exposed to cold and warm climatic cycles throughout their life span and generative growth starts with increasing spring temperature. The obtained data of the flowering dates were found compatible with the findings of Hessayon (2003), Pala (2006) and Sonyol (2012).

Table 4. Dates of flowering time and duration to flowering

Tulip Cultivars	Dates of Flowering Time			Duration - Planting to Flowering			
	Control	FT1	FT2	Control	FT1	FT2	Mean

Negrita	07.03.2010	04.03.2010	04.03.2010	109	106	106	107.0
Sogetsu	14.03.2010	13.03.2010	13.03.2010	116	115	115	115.3
Menton	22.03.2010	21.03.2010	21.03.2010	124	123	123	123.3
Oxford Elite	14.03.2010	14.03.2010	13.03.2010	116	116	115	115.7
Claudia	04.03.2010	05.03.2010	06.03.2010	106	107	108	107.0
Inzell	21.02.2010	20.02.2010	20.02.2010	95	94	94	94.3
Leen David Mark	25.02.2010	25.02.2010	25.02.2010	99	99	99	99.0
Queen of Night	22.03.2010	18.03.2010	18.03.2010	124	120	120	121.3

3. Flowering End Time:

The end of flowering dates and their durations from planting to senescence is given in Table 5. The senescence was complete between the end of March to mid-April. The first cultivar to complete flowering was, with 127 days after planting, 'Inzell' and the latest one was 'Queen of Night' (149 days). The results indicate that the fertilizer treatments were not significant in this parameter.

Table 5. Dates for End of Flowering and Days of Duration From Planting to Senescence

Tulip Cultivars	Dates for End of Flowering			Duration-Planting to Senescence			
	Control	FT1	FT2	Control	FT1	FT2	Mean
Negrita	31.03.2010	29.03.2010	28.03.2010	133	131	130	131.3
Sogetsu	07.04.2010	03.04.2010	06.04.2010	140	136	139	138.3
Menton	12.04.2010	10.04.2010	09.04.2010	145	143	142	143.3
Oxford Elite	31.03.2010	30.03.2010	29.03.2010	133	132	131	132.0
Claudia	02.04.2010	29.03.2010	29.03.2010	135	131	131	132.3
Inzell	25.03.2010	26.03.2010	26.03.2010	127	128	128	127.7
Leen David Mark	28.03.2010	26.03.2010	26.03.2010	130	128	128	128.7
Queen of Night	16.04.2010	11.04.2010	13.04.2010	149	144	146	146.3

It was determined that with the increase of temperature in spring the plants began to flower. However, with further increases in temperature the flowering began to diminish (De Hertogh and Le Nard, 1993). The results were compatible with the findings of De Hertogh and Le Nard (1993), Hessayon (2003) and Pala (2006).

4. Flowering Duration:

The total flowering duration for all the cultivars is given on Table 6. This period varied between 16 to 34 days. 'Oxford Elite' had the shortest flowering period (16 days) while 'Inzell' had the longest (34 days). The data shows that there was no significant effect of fertiliser treatments.

There was an 18 day difference in flowering periods between cultivars. The effects of high temperatures on the flowering of spring plants are known (De Hertogh and Le Nard, 1993). In Mediterranean climates with a short spring season plants are exposed to high temperatures early on which shortens their flowering period. The results were compatible with the statements of Hessayon (2003), Pala (2006) and Sonyol (2012).

Table 6. Flowering Period of Different Tulip Cultivars

Tulip Cultivars	Dates for First Flowering			Dates for End of Flowering			Flowering Duration (days)			
	Contr.	FT1	FT2	Contr.	FT1	FT2	Contr.	FT1	FT2	Mean
Negrita	07.03.2010	04.03.2010	04.03.2010	31.03.2010	29.03.2010	28.03.2010	24	25	24	4.3
Sogetsu	14.03.2010	13.03.2010	13.03.2010	07.04.2010	03.04.2010	06.04.2010	24	21	24	3.0
Menton	22.03.2010	21.03.2010	21.03.2010	12.04.2010	10.04.2010	09.04.2010	21	20	19	0.0
Oxford Elite	14.03.2010	14.03.2010	13.03.2010	31.03.2010	30.03.2010	29.03.2010	17	16	16	6.3
Claudia	04.03.2010	05.03.2010	06.03.2010	02.04.2010	29.03.2010	29.03.2010	29	24	23	5.3
Inzell	21.02.2010	20.02.2010	20.02.2010	25.03.2010	26.03.2010	26.03.2010	32	34	34	3.3

Leen David Mark	25.02.2010	25.02.2010	25.02.2010	28.03.2010	26.03.2010	26.03.2010	31	29	29	9.7
Queen of Night	22.03.2010	18.03.2010	18.03.2010	16.04.2010	11.04.2010	13.04.2010	25	24	26	5.0

5. Plant Height:

The plant heights were measured as the senescence of the flowers reached completion. The obtained plant height of the cultivars with the set fertiliser treatments are given in Table 7. The highest plant height was obtained from 'Menton' (52.2cm) followed by 'Queen of Night' (47.1cm). 'Oxford Elite', 'Claudia' and 'Inzell' were the shortest cultivars with the values of 35.3, 37.1 and 37.1 cm respectively.

The effects of the fertiliser treatments and their interaction with the cultivars were significant, showing a demonstrable increase in plant height when compared to the control group. FT1 and FT2 participated in the same statistical group as an expected result; the difference between them was caused by an additional fertiliser application after the flowering period.

Table 7. Effects of Fertiliser Treatments on Varieties in Terms of Plant Height and Bulb Yield

	Plant Height (cm)				Bulb yield (g) (of 10 plants)			
Tulip Varieties (V)	Fertiliser Treatments (FT)			Mean	Fertiliser Treatments (FT)			Mean
	Control	FT1	FT2		Control	FT1	FT2	
Negrita	36.2 C	39.1 C	38.9 D	38.1 D	212.3 A	258.7 DE	242.0 C	237.7 CD
Sogetsu	36.4 C	38.7 CD	41.6 C	38.9 C	223.7 A	345.0 A	339.3 A	302.7 A
Menton	52.1 A	53.2 A	51.3 A	52.2 A	161.3 C	248.0 EF	252.0 BC	220.4 E
Oxford Elite	36,1 C	35.5 F	34.3 E	35.3 F	164.3 BC	268.3 CD	261.0 B	231.2 DE
Claudia	36,1 C	37.4 DE	37.7 D	37.1 E	164.3 BC	262.7 DE	262.0 B	229.7 DE
Inzell	35.5 C	37.1 E	38.7 D	37.1 E	154.0 C	230.0 F	214.0 D	199.3 F
Leen David Mark	32,6 D	34.2 F	35.2 E	34.0 F	180.7 B	286.0 BC	264.0 B	243.6 C
Queen of Night	47.1 B	47.5 B	46.8 B	47.1 B	227.0 A	289.7 B	246.7 BC	254.4 B
Mean	39.0 B	40.3 A	40,6 A		186.0 C	273.5 A	260.1 B	
LSD 5 %	V: 0.83 FT: 0.51 V x FT: 1.44				V: 10.86 FT: 6.65 V x FT: 18.80			

There are additional factors affecting the height of bulbous plants such as genetic traits, bulb weight, bulb storage conditions and environmental factors (Rees, 1992; De Hertogh and Le Nard, 1993). The height of a plant is particularly important for landscaping and floriculture purposes. The obtained results were compatible with the statements of Hessayon (2003), Pala (2006) and *Anonymous (2012).*

6. Bulb Yield:

Substantiated by the senescence of the leaves, 10 bulbs were harvested from the research plots, cleaned and weighed. The bulb yields of all the cultivars are given in Table 7. The highest bulb yield was obtained from 'Sogetsu' followed by 'Queen of Night' and 'Leen David Mark'. 'Inzell' and 'Menton' had the lowest values.

The effects of fertiliser treatments and their interaction with the cultivars was statistically significant. The fertiliser treatments increased the bulb yield. The highest yield was obtained from FT1 while the difference between FT1 and FT2 was not significant.

The bulb yields of commercially grown tulip cultivars, with more than 2000 examples worldwide, show a range of differences. The shortness of the spring period in Bayindir, which is dominated by the Mediterranean climate, affects the bulb yield directly.

7. Bulb Size:

The numbers of bulbs according to their grades (circumference, <6, 6-8, 8-10, 10-12 and 12+ cm) are given in Table 8. The fertiliser treatments increased the number of the bulbs in upper grades, similarly with the results of bulb yield (g) (Table 7.)

Table 8. Effects of Fertiliser Treatments on Cultivars in Terms of Bulb Number and Grade

	Negrita	Sogetsu	Menton	Oxford Elite

Grades	Control	FT1	FT2	Control	FT1	FT2	Control	FT1	FT2	Control	FT1	FT2
<6	14,3	23,8	19,7	25,7	34,0	31,0	10,7	18,7	23,3	15,3	10,7	8,3
6-8	3,7	8,7	10,0	5,3	10,3	10,0	6,7	6,7	6,7	9,7	8,7	9,0
8-10	5,3	4,3	3,7	5,0	3,7	2,0	5,7	3,3	4,0	4,7	3,7	2,3
10-12	3,0	5,9	7,7	3,3	6,3	9,3	2,0	7,0	4,0	0,7	5,3	5,7
12+	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Total	26,3	42,7	41,0	39,3	54,3	52,3	25,0	35,7	38,0	30,3	28,3	25,3
	Claudia			Inzell			Leen David Mark			Queen of Night		
	Control	FT1	FT2	Control	FT1	FT2	Control	FT1	FT2	Control	FT1	FT2
<6	9,3	11,7	9,3	18,7	11,3	10,3	14,0	11,3	7,0	25,7	26,7	26,7
6-8	9,7	9,0	9,3	5,7	8,3	3,7	8,7	7,0	4,3	20,7	22,7	13,7
8-10	3,3	6,0	5,7	6,7	1,7	4,0	4,0	2,3	2,7	6,0	10,3	7,3
10-12	1,0	4,3	4,0	0,0	5,3	3,7	2,0	6,0	5,0	1,7	3,0	2,3
12+	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Total	23,3	31,0	28,3	31,0	26,7	21,7	28,7	26,7	19,0	54,0	62,7	50,0

The desired outcome in bulb production is usually larger bulbs and a sufficient bulb yield. Therefore, the bulb size parameter is more important than the bulb number. Bulbs with the grade 6-8 cm are used for propagation while the upper grades (8cm <) are marketed. In this research no bulb was obtained above 12cm.

The fertiliser applications, in general, increased the number of bulbs in upper grades (8-10cm and 10cm <) on all cultivars. Yet the bulb number obtained from 'Inzell' and 'Leen David Mark' was low. Such differences might arise from the leaf area, vegetation period, climatic factors and cultivation facilities such as planting time and density, soil structure, nutrition, irrigation, harvest time and storage conditions (Le Nard and De Hertogh, 2002).

CONCLUSION

The results of the research which was realized with 8 *Tulipa gesneriana* cultivars in the Mediterranean conditions of Bayindir-Izmir can be concluded as follows:

- The start time of sprouting, encompassing the time period from planting to sprouting, varied between 23-37 days for all cultivars; which was not significantly affected by fertiliser treatments.
- The start time for flowering varied between 99-123.3 days for all cultivars; which was not significantly affected by fertiliser treatments.
- The end dates for flowering varied from the end of March to the middle of April for all cultivars.
- The flowering period, from the beginning to completion varied between 16-34 days for all cultivars. Using fertiliser treatments had no significant effect.
- The fertiliser treatments affected the plant height, depending on the cultivars and ranged between 34 - 52cm.
- A favourable fertilisation treatment effect was determined on bulb yield and grade.
- The ecological conditions of the region (Mediterranean climate and alluvial soil etc.) favours tulip cultivation, in particular, early bulb production.

It could be concluded from the research that if the horticultural production target is in compliance with bulb production, fertiliser treatments should be an option.

Comprehensive studies on the adaptation of other tulip cultivars and studies on different agronomic methods and fertilisation would be of further benefit.

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