



## The effects of different planting times on cut flower yield and quality of some *Gladiolus grandiflorus* L. varieties grown in ecological conditions of Siirt province, Turkey

Rukiye GEZER<sup>1</sup> Arzu ÇİĞ<sup>1\*</sup> Nalan TÜRKOĞLU<sup>2</sup>

<sup>1</sup>Department of Horticulture, Faculty of Agriculture, University of Siirt  
([orcid.org/0000-0002-7781-9327](https://orcid.org/0000-0002-7781-9327)); ([orcid.org/0000-0002-2142-5986](https://orcid.org/0000-0002-2142-5986))

<sup>2</sup>Department of Horticulture, Faculty of Agriculture, University of Yüzüncü Yıl, Van  
([orcid.org/0000.0003.2639-360X](https://orcid.org/0000.0003.2639-360X))

\*e-mail: [arzucig@yahoo.com](mailto:arzucig@yahoo.com)

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**Abstract:** This study was carried out, in the research and application garden of Siirt University, Faculty of Agriculture, Department of Horticulture in Turkey in 2015. The aim of the study is to observe in different planting times in different cultivars of *Gladiolus* in terms of yield and quality in Siirt ecological conditions. Four different *Gladiolus* cultivars (Nova Lux, Purple Flora, White Swan and Red Beauty) and three different planting time (8 May, 23 May and 6 June) were used in the study. Some phenological observations were made and morphological evaluations were taken in terms of yield and quality on *Gladiolus* varieties. May 23 has resulted to be the best time for planting *Gladiolus* in Siirt. When look at their cut flower properties, it has been found out that White Swan and Purple Flora are the most appropriate ones in terms of plant height, spike length, stem length and thickness, stem weight and number of candles/spike.

**Keywords:** Cut flower, *Gladiolus grandiflorus* L., ornamental plants, planting time, Siirt

### Siirt İli Ekolojik Koşullarında Yetiştirilen Farklı *Gladiolus grandiflorus* L. Çeşitlerinin Kesme Çiçek Verimi ve Kalitesi Üzerine Farklı Ekim Zamanlarının Etkisi

**Öz:** Bu çalışma 2015 yılında Siirt Üniversitesi Ziraat Fakültesi Bahçe Bitkileri Bölümü'ne ait araştırma ve uygulama bahçesinde, arazide yürütülmüştür. Çalışmanın amacı, Siirt ekolojik koşullarında farklı dikim zamanlarında, farklı glayöl çeşitlerinin verim ve kalite bakımından incelenmesidir. Araştırmada 4 farklı glayöl çeşidinin kormları (Nova Lux, Purple Flora, White Swan ve Red Beauty) ve 3 farklı dikim zamanı (8 Mayıs, 23 Mayıs ve 6 Haziran) kullanılmıştır. Glayöl çiçekleri üzerinde kalite ve verim bakımından bazı fenolojik gözlemler yapılmış ve morfolojik ölçümler alınmıştır. Siirt ekolojik koşullarında en uygun glayöl dikim zamanı olarak 23 Mayıs en iyi sonucu vermiştir. Kesme çiçek özellikleri incelendiğinde ise bitki boyu, başak uzunluğu, çiçek sapı uzunluğu, çiçek sapı kalınlığı, dal ağırlığı, kandil sayısı ve vazo ömrü bakımından en uygun çeşitlerin White Swan ve Purple Flora olduğu tespit edilmiştir.

**Anahtar Kelimeler:** Kesme çiçek, *Gladiolus grandiflorus* L., süs bitkileri, dikim zamanı, Siirt

#### 1. Introduction

*Gladiolus* spp. is a plant of the Iridaceae family with a bulbous body. There are approximately 250 different species of *Gladiolus*, which is originated from the tropical regions of South Africa, Asia and Europe. According to historical records, *Gladiolus* has been known in Anatolia for the last 2000 years and has been named as Egyptian lily (Mengüç 1996). In addition to fragrance of its flowers, *Gladiolus* has been popular and attractive due to its beautiful appearance, long life as cut flower, its easy production with low cost, resistance to pests, variety

of colours, easiness of relocation every year, longevity of flowering, rapid proli feration and easiness in production of new species (Disperati 1982; Caner 1983; Yüksel 1992). It is a cut flower demanding little workmanship when its climate and soil requirements are met and a suitable growing environment is provided, and it is easy to cultivate. Its product potential is increasing with each passing day as its production and sales can be done in any season of the year and it has very colourful and decorative flowers. Cut flowers have the highest global trade potential among the ornamental plants

in the world. Their mass production potential and easy transportation make it easy to trade. Therefore, *Gladiolus* draws the attention of the researchers in many countries in the world and in Turkey. Producers in Siirt province are active in agriculture, particularly in orcharding. Despite ecologically favourable conditions, ornamental plants are not cultivated in the region. Regardless of the species of the ornamental plant, any study carried out in the region will be first of its kind and thus will be pioneering and very important.

In this study, the impact of outdoor cultivation of *Gladiolus* spp. at different planting times on the yield and quality of cut flowers is examined for Siirt province.

## 2. Material and Methods

In this study, White Swan (white), Red Beauty (red), Nova Lux (yellow) and Purple Flora (purple) *Gladiolus* corms were used as plant material.

Siirt province, located in Turkey, in which the experiment is carried out, is located on the 41° 57' east longitude and 37° 55' north latitude in the South-eastern Anatolia Region and surrounded by Şırnak and Van in the east, Batman and Bitlis in the north, Batman in the west and Mardin and Şırnak in the south. The continental climate is dominant in the region and the four seasons are experienced with their most prominent features, e.g. the summers are hot and dry and the temperature difference between the night and the day is high. Some climate data for the study site were given in the Table 1 (MGM 2015).

**Table 1.** Some climatic properties of the study area (MGM 2015)

**Çizelge 1.** Çalışma alanının bazı iklim özellikleri (MGM 2015)

Months	April	May	June	July	August	September	October
Monthly Average Temperature (°C)	16.0	23	29.9	34.7	35.9	28.1	20.1
Monthly Average Minimum Temperature (°C)	6.6	16.5	24.8	33.1	29.1	21.4	15.1
Monthly Average Temperature of Soil 50 cm (°C)	14.0	18.9	25.6	30.9	33.1	30.9	24.7
Monthly Average Relative Humidity (%)	48.1	36.7	22.2	15.1	13.5	23.3	50.5
Monthly Total Precipitation (mm)	54.2	29.4	3.6	No rain	2.4	0.1	34.8

Analyses of the soil samples taken from the experimental field were carried out in Black Sea Agricultural Research Institute, Soil Plant and Water Analysis Laboratory. According to Aydeniz (1985),

the results showed that the soil had a clayey structure with slightly alkaline pH, medium level of lime, low organic matter, low available phosphorus, high potassium and no salinity (Table 2).

**Table 2.** Some soil properties of the study area**Çizelge 2.** Çalışma alanının bazı toprak özellikleri

Soil Properties	Amount
Sand	40.33%
Clay	47.56%
Silt	12.11%
pH	7.7
EC	584 $\mu\text{S cm}^{-1}$
Loamy	12.00%
Organic matter	1.38%
Available phosphorus ( $\text{P}_2\text{O}_5$ )	2.4 $\text{kg da}^{-1}$
Extractable potassium ( $\text{K}_2\text{O}$ )	143 $\text{kg da}^{-1}$
Texture	Clay

The experiment was established in 3 replications with 12 corms in each replicate and 432 corms in total. The corms are planted at a depth of 8 cm with a spacing of 20 x 20 cm. When the plants reached the three-leaf stage, 40 kg of potassium nitrate fertilizer was applied per decare and another 40 kg is applied when the plants reached to their earing stage.

Planting dates are determined as May 8th, May 23rd and June 6th and the corms are planted on the ground at a fifteen days interval. Flowers are cut, when the lowest 2-3 flowers on the spike became coloured, at 6-7 cm above soil surface and above two leaves (Wilfret 1980). The cultivated plants are taken to the laboratory immediately after harvesting, labelled according to the species and replications, located on the counter, and morphological observations and measurements were carried out.

1% significance level is used in the significance tests using the statistical data obtained from observations and measurements. The data obtained in the study was analysed using MINITAB and

MSTAT-C software, and variance analysis and Duncan's Multiple Range Test were used to determine statistically different groups. The results of the analysis revealed differences among the structures and implementations (Düzgüneş et al. 1983).

### 3. Results and Discussion

In the spring-summer period of 2015, four different *Gladiolus* breed corms were cultivated on May 8th, May 23rd and June 6th. Duration of sprout and flowering duration, plant height, floral stem length, floral stem thickness, spike length, number of candles, stem weight and vase life are examined by using the plants obtained and statistical analysis of the data is carried out (Table 3).

**Table 3.** Effect of planting time on some of the phenological and morphological characteristics of varieties of gladioli**Çizelge 3.** *Dikim zamanının glayöl çeşitlerinin bazı fenolojik ve morfolojik özelliklerine etkisi*

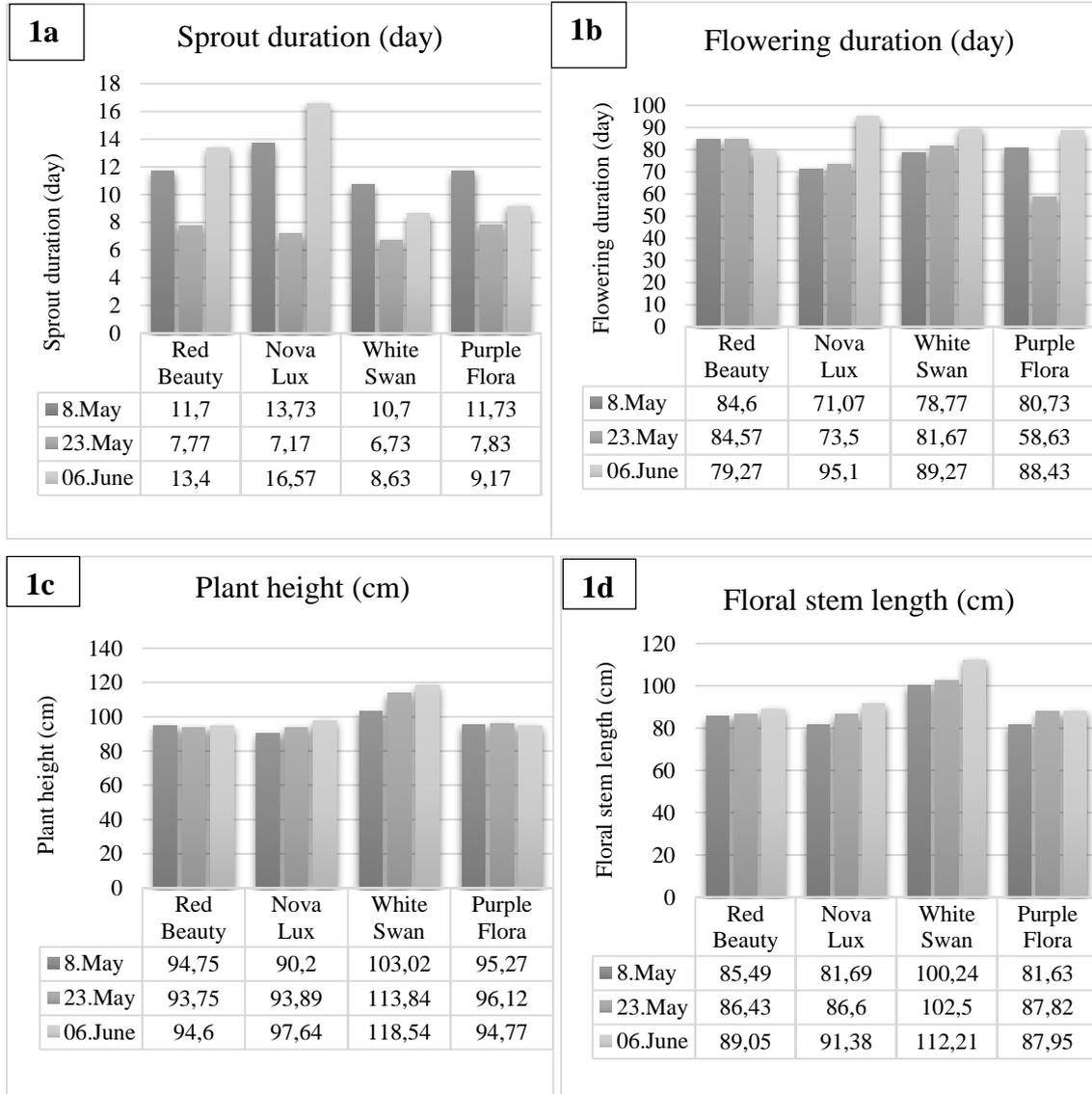
Planting Times	Varieties	Sprout Duration (day) **	Flowering Duration (day) **	Plant Height (cm)	Floral Stem Length (cm)	Floral Stem Thickness (mm)	Spike Length (cm)	Number of Candles	Stem Weight (g)	Vase Life (day) **
8 May	Red Beauty	11.7 bc	84.6 c	94.75	85.49	8.54	38.6	15.31	122.8	10.3 bc
	Nova Lux	13.73 b	71.07 ef	90.2	81.69	9.3	42.84	15.22	113.61	11.37 ab
	White Swan	10.7 cd	78.77 d	103.02	100.24	9.06	49.13	14.24	101.39	12.53 a
	Purple Flora	11.73 bc	80.73 cd	95.27	81.63	9.22	43.31	17.74	99.16	12.37 a
23 May	Red Beauty	7.77 ef	84.57 c	93.75	86.43	8.84	28.02	15.75	122.02	12.3 a
	Nova Lux	7.17 ef	73.5 e	93.89	86.6	8.78	43.18	15.63	120.13	9.33 c
	White Swan	6.73 f	81.67 cd	113.84	102.5	9.56	44.9	15.19	102.2	12.2 a
	Purple Flora	7.83 ef	68.63 f	96.12	87.82	8.79	43.17	17.35	99.77	10.2 b
6 June	Red Beauty	13.4 a	79.27 a	94.6	89.05	8.83	41.73	16.5	123.45	7.23 d
	Nova Lux	16.57 b	95.1 d	97.64	91.38	8.49	44.69	14.92	100.4	7.33 d
	White Swan	8.63 ef	89.27 b	118.54	112.21	9.74	55.6	15.28	113.55	7.77 d
	Purple Flora	9.17 de	88.43 b	94.77	87.95	9.18	39.86	17.33	102.9	7.03 d
	Significant Level	p<0.01	p<0.01	Non Sign	Non Sign	Non Sign	Non Sign	Non Sign	Non Sign	p<0.01

\*\*In the same column, the difference between the averages indicated by the same letter is non-significant at level  $p < 0.01$

### 3.1. Sprout duration (day)

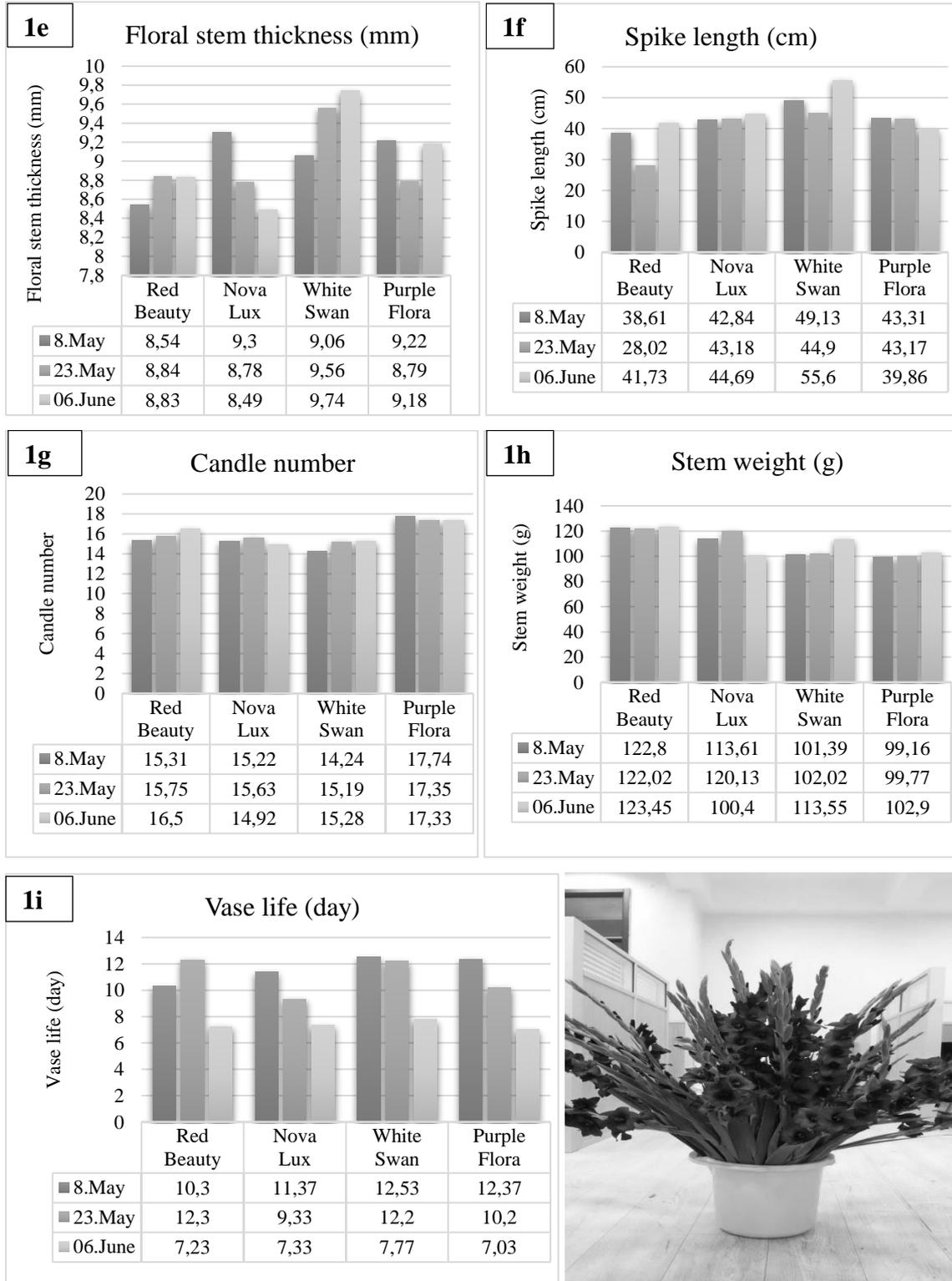
The differences in the average length of emergence period of different varieties and planting times were found statistically significant ( $p < 0.01$ )

(Table 3). The earliest sprout is observed in White Swan variety planted on May 23rd (6.73 days), followed by Nova Lux (7.17 days) and Red Beauty (7.77 days) planted on May 23rd.



**Figure 1.** Evaluations of plants on a-Sprout duration (day), b-Flowering duration (day), c-Plant height (cm), d-Floral stem length (cm), e-Floral stem thickness (mm), f-Spike length (cm), g-Candle number (pieces), h-Stem weight (g), i-Vase life (day)

**Şekil 1.** Bitkilerin değerlendirilmesi a- Çıkış süresi (gün), b-Çiçeklenme süresi (gün), c-Bitki boyu (cm), d-Çiçek sapı uzunluğu (cm), e-Çiçek sapı kalınlığı (mm), f-Başak uzunluğu (cm), g-Kandil sayısı (adet), h-Dal ağırlığı (g), I-Vazo ömrü (gün)



**Figure 1.** Evaluations of plants on a-Sprout duration (day), b-Flowering duration (day), c-Plant height (cm), d-Floral stem length (cm), e-Floral stem thickness (mm), f-Spike length (cm), g-Candle number (pieces), h-Stem weight (g), i-Vase life (day) (continued)

**Şekil 1.** Bitkilerin değerlendirilmesi a- Çıkış süresi (gün), b-Çiçeklenme süresi (gün), c-Bitki boyu (cm), d-Çiçek sapı uzunluğu (cm), e-Çiçek sapı kalınlığı (mm), f-Başak uzunluğu (cm), g-Kandil sayısı (adet), h-Dal ağırlığı (g), I-Vazo ömrü (gün) (devam)

The highest length of time for sprout is observed in Nova Lux planted on June 6th (16.57 days) (Figure 1a). As the data shows, the earliest sprout is

observed in White Swan. In a study conducted in Ankara, *Gladiolus* corms were planted on May 31st, June 15th and July 15th on open field.



**Figure 2.** *Gladiolus* plants in the field

**Şekil 2.** Arazide glayöl bitkileri

The first exit to the soil surface was observed with Purple Flora variety in 6.55 days, when planted on July 15th (Yalçıntaş 2011). The differences in the

length of the sprout period are thought to be caused by ecological factors and varieties.



**Figure 3.** Some evaluations on plants

**Şekil 3.** Bitkilerde bazı ölçümler

### 3.2. Flowering duration (day)

The differences in the average length of time required for flowering of different varieties and planting times were found statistically significant ( $p < 0.01$ ) (Table 3). The earliest flowering is observed in Purple Flora variety planted on May 23rd (68.63 days), followed by Nova Lux variety planted on May 8th and May 23rd as 71.07 days and 73.05 days, respectively. The longest time required for flowering (95.1 days) is observed in Nova Lux planted on June 6th (Figure 1b). Although *Gladiolus* plant can grow in 25-40 °C temperature range, temperatures between 10 and 25 °C are considered

to be optimum (Geelhaar 1990). The average temperature of the month of the first two plantings is 20.2 °C, while the average temperature of the third planting date is 26.9 °C. The plants grown in the third planting period are exposed to temperatures above optimum temperature values. Furthermore, relative humidity was lower than in May. It is thought that this is the main reason for the difference in flowering times.

### 3.3. Plant height (cm)

The differences in the averages of plant height of different varieties and planting times were not found statistically significant (Table 3). The maximum plant height is observed in White Swan variety planted on June 6th (118.54 cm), followed by again White Swan planted on May 23rd and May 8th (113.84 and 103.2 cm respectively). The minimum plant height is observed in Nova Lux (90.2 cm) planted on May 8th, followed by Red Beauty with 93.75 cm and Nova Lux variety with 93.89 cm planted on May 23rd (Figure 1c). It is observed that plant height increases as date of planting gets closer to summer months. This result is consistent with the findings of Yalçıntaş (2011) and Akça (2014). In the study carried by Akça (2014) in ecological conditions of Tokat, 5 different *Gladiolus* varieties were planted on May 1st, May 15th and May 30th in order to examine impact of the planting time on yield and quality of *Gladiolus* varieties. In Akça (2014)'s study, it was founded that May 30th is the best planting date in terms of plant height at Tokat's ecological conditions. The highest plant height (70.6 cm) of *Gladiolus* 'Dolce Vita' variety grown was found in the field in Van on March-2011 planting time (Çiğ et al. 2013). As the days gets longer in summer months, duration of the transition from vegetative to generative stages of the plant increases and this results in a higher plant height.

### 3.4. Floral stem length (cm)

The differences in the averages of floral stem length of different varieties and planting times were not found statistically significant (Table 3). The highest floral stem length is observed in White Swan variety (112.21 cm) planted on June 6th, followed by again White Swan planted on May 23rd and May 8th (112.5-100.24 cm respectively). The lowest figures in terms of floral stem length is observed in Purple Flora (81.63 cm), Nova Lux (81.69 cm) and Red Beauty (85.49 cm) planted on May 8th (Figure 1d). When the obtained floral stem lengths are evaluated according to the standards specified by Altan (1983), most of them are in A quality group in terms of European quality standards. According to Kabacaoğlu (1988), short stem length is an undesirable result in terms of cut flower quality standards for the market. In the study carried out in

Van with Amsterdam, Jester Gold, Rose Supreme, Nova Lux, Friendship and High Style *Gladiolus* varieties, flowers obtained from the plantings done on June 16th were cultivated in September and October. In the study, floral stem lengths of the plants cultivated in September were shorter than the ones cultivated in October. The longest stem was 115.8 cm, while the shortest one was 71.33 cm (Gürcan and Türkoğlu, 2000). In our study, the differences in stem lengths of different varieties are considered to be caused by mainly genetic differences.

### 3.5. Floral stem thickness (mm)

The differences in the averages of floral stem thickness of different varieties and planting times were not found statistically significant (Table 3). The thickest floral stem is observed in White Swan variety (9.74 mm) planted on June 6th. White Swan planted on May 23rd (9.56 mm) is in the second place and Nova Lux planted on May 8th (9.30 mm) is in the third place (Figure 1e). Wilfret (1994) highlights that stem thickness increases when humidity and temperature increases simultaneously and reduces when relative humidity increases and temperature drops down. Flowering time of the *Gladiolus* planted on May 23rd is in August, when the temperature is high and humidity is low. Thus, the lowest stem thickness is obtained from May 23rd plantings. Yalçıntaş (2011) obtained 8.8 mm stem thickness in Purple Flora variety in Ankara. It is recorded that stem thickness varies in the same varieties cultivated at different places on close dates due to climatic conditions. Gürcan and Türkoğlu (2000) determined the highest stem thickness as 9.70 mm in September and the lowest as 7.20 mm in October in their study conducted in Van province.

### 3.6. Spike length (cm)

The differences in the averages of spike length of different varieties and planting times were not found statistically significant (Table 3). The longest spike is observed in White Swan variety (55.6 cm) planted on June 6th. White Swan planted on May 8th is in the second place (49.13 cm) and White Swan planted on May 23rd (44.9 cm) is in the third place. In terms of this feature, White Swan variety is superior to other varieties in this study. The shortest spike is

observed in Red Beauty variety (28.02 cm) planted on May 23rd. This was followed by Purple Flora planted on May 8th with 38.61 cm and planted on June 6th with 39.86 cm (Figure 1f). In the open field study on different *Gladiolus* varieties (White Prosperity, Amsterdam, Nova Lux, Victor Borge) conducted at ecological conditions of Erzurum on different planting dates (June 10th, 20th, 30th), the longest spike obtained was 31.53 cm (June 20th) and the shortest one was 30.67 cm (June 30th) (Akpınar and Bulut 2016). Spike length is an important quality parameter at *Gladiolus* market. The characteristics of the variety and the length of the vegetative period affects the spike length. In our study, it is thought that the differences are caused by the features of the varieties.

### 3.7. Number of candles

The differences in the averages of the number of candles of different varieties and planting times were not found statistically significant (Table 3). The highest number of candles is observed in Purple Flora variety (17.74 pieces) planted on May 8th. The second and third were the Purple Flora (17.35-17.33 pieces) variety planted on May 23rd and June 6th, respectively. In terms of the number of candles, the Purple Flora variety dominates other varieties. The least number of candles was observed in the White Swan (14.24 pieces) variety planted on May 8th. This was followed by Nova Lux (14.92 pieces) planted on June 6th and White Swan (15.19 pieces) planted on May 23rd (Figure 1g). The appropriate temperatures during the development period have positive impact on flowering and the number of candles. It is thought that the favourable temperatures for plant growth on the first and third planting date and the genetic characteristics of the varieties are the basis of the differences in our study. In addition, the number of candles can be affected from the nutritional conditions of the plant and size of the corm. The planting time and varieties on the yield and quality of five kinds of *Gladiolus* grown in the field of Van province were found to be important. In the research, after 11th of July plantings, the number of candles decreased with the shortening of days (Aşkın et al. 1991). Also, the highest number of candles (9.33) of *Gladiolus* 'Dolce Vita' variety grown was found in the field in Van on March-2011

planting time (Çığ et al. 2013). In the study conducted at Erzurum ecological conditions with different planting dates (June 10th, 20th, 30th), it was determined that plantings done on June 30th increased the number of candles (Akpınar and Bulut 2006). According to researchers, the impact of the planting date on the number of candles is observed the highest with 10.13 pieces (June 10th) and the lowest with 9.65 pieces (June 30th). In the study conducted in Van province, the highest number of candles was obtained in September as 17.8 pieces and the lowest number of candles was obtained in October as 12.16 pieces (Gürcan and Türkoğlu 2000).

### 3.8. Stem weight (g)

The differences in the averages of the stem weight of different varieties and planting times were not found statistically significant (Table 3). The highest stem weight is observed in Red Beauty variety planted on June 6th, May 8th and May 23rd as 123.45 g, 122.8 g and 122.02 g, respectively. In terms of this feature, Red Beauty variety is superior to other varieties. The lowest stem weight is observed in Purple Flora (99.16 g) planted on May 8th (Fig. 1h). the highest stem weight is obtained from the plantings done on May 23rd (111.38 g), followed by the plantings done on June 6th as 110.08 g and the ones done on May 8th as 109.24 g (Figure 1h). It is considered that the difference in stem weights is caused by the characteristics of the varieties.

### 3.9. Vase life (day)

The differences in the averages of vase life of different varieties and planting times were found statistically significant ( $p < 0.01$ ) (Table 3). The longest vase life was observed in White Swan variety planted on May 8th (12.53 days). This was followed by Purple Flora planted on May 8th (12.37 days) and White Swan planted on May 23rd (12.2 days). The shortest vase life was observed in Purple Flora planted on June 6th (7.03 days) (Figure 1i). In the study conducted in Van province, three different planting dates did not have a statistically significant impact on the vase life (Akpınar and Bulut 2006). In Akça (2014), it was stated that there is a parallel relationship between the number of flowers and the

vase life. However, in our study it was determined that the variety with the highest spike length and stem length has the longest vase life. It is thought that vase life length is depended on genetic differences.

#### 4. Conclusions

In this study, yield and quality characteristics of four different *Gladiolus* corms planted on open field at three different planting dates at Siirt ecological conditions in 2015 vegetation period are examined (Figure 2). Red Beauty, White Swan, Purple Flora and Nova Lux varieties are used in the experiments. Duration for sprout and flowering durations, plant height, floral stem length, floral stem thickness, number of candles, spike length, stem weight and vase life are evaluated (Figure 3). Plantings are done on May 8th, May 23rd and June 6th.

The time required for harvesting, which is the flowering time, is of great importance in terms of horticulture. Planting time and variety were found statistically significant in terms of flowering time in our study. The earliest flowering is observed in Nova Lux species planted on May 8th (71.07 days), followed by Nova Lux planted on May 23rd (73.5 days) and White Swan planted on May 8th (78.77 days). The longest duration of flowering is observed in Nova Lux variety planted on June 6th as 95.1 days. Early plantings resulted in early flowering, on the other hand, duration until flowering extended as the date of planting got closer to summer months. When plant length is examined, it was found out that the maximum plant length is obtained with White Swan planted on June 6th and May 23rd (118.54 and 113.84, respectively), while the minimum plant length is obtained with Nova Lux (90.2 cm) planted in May 8th. As the date of planting gets closer to summer, plant height increases. The *Gladiolus* variety with the longest floral stem is White Swan (104.98 cm). This was followed by Red Beauty (86.99 cm), Nova Lux (86.55 cm) and Purple Flora (85.8 cm) varieties. Floral stem length varies depending on the date of planting and the variety. The longest spikes are obtained with White Swan variety planted on May 6th, May 8th and May 23rd (55.6- 49.19- 44.9 cm). Length of spikes are affected from the length of vegetative period as well as the characteristics of the variety. The longest vase life was observed in White Swan planted on May 8th

(12.53 days), followed by Purple Flora (12.37 days) planted on May 8th and Red Beauty (12.3 days) planted on May 23rd.

This study is pioneer to the following studies to be done on different planting dates and with different varieties of *Gladiolus* at Siirt conditions. It is expected that flowers with good quality can be cultivated in horticulture under these conditions and economical benefit can be obtained from this cultivation.

Siirt's ecological conditions are found to be convenient for *Gladiolus* cultivation. It is observed that good quality flowers can be obtained by sufficient irrigation even at extreme temperatures in summer. It has been concluded that early and late supply of products to the market can be attempted benefitting from long vegetation period of Siirt province.

No ornamental plants are produced in Siirt province and its vicinity. Convenience of Siirt's ecological conditions for cultivation of *Gladiolus* plant, which has high market value and requires minimum amount of care with low cost, offers the possibility of proposing *Gladiolus* as an alternative plant to the local farmers.

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