THE EFFECTS OF DIFFERENT PLANTING TIMES AND VERMICOMPOST APPLICATIONS ON THE FLOWERING OF THE HYACINTH (*Hyacinthus orientalis* "Fondant") GROWING IN THE SİİRT ECOLOGICAL CONDITIONS

Arzu ÇIĞ
Assoc. Prof. Dr., Siirt University, Faculty of Agriculture, Department of Horticulture, Siirt, Corresponding Author: arzucig@yahoo.com

Arzu KOÇAK
Assist. Prof. Dr., Siirt University, Faculty of Agriculture, Department of Agricultural Biotechnology, Siirt
arzukocak@siirt.edu.tr

ABSTRACT

In this study, *Hyacinthus orientalis* "Fondant" bulbs grown in Siirt ecological conditions were planted in 2016 at 15 days each between 14 November (1PT), 01 December (2PT) and 16 December (3PT). The study was carried out with 3 replications according to the "randomized block test design" in the experimental area of the Siirt University Faculty of Agriculture. Earthworm fertilizer (V) (vermicompost) were applied to the planting pits of the bulbs planted at different planting times with 100 g/bulb In addition, control plots (C) which are not fertilized were formed. In the course of phenological and morphological observations, as a result of interactions of planting time and fertilizer application, the lowest and the highest average values were obtained, respectively, between 101.923-134.213 days for first flowering time (3PTxC-1PTxV), 103.103-135.766 days for a full flowering time (3PTxC- 1PTxV), 104.843-137.670 days for harvest time (3PTxC-1PTxV), 99.613-106.223 mm for flower height (2PTxV-1PTxV), 50.433-58.970 mm for flower width (2PTxC-3PTxV), 17.366-185.10 mm for floret length (1PTxV-2PTxV), 22.393-27.546 mm for floret width (1PTxC-3PTxC). Among these mean values, only the difference between mean length of floret was found to be statistically significant ($p<0.01$); when the planting times were taken into consideration, the difference between the average width of the flower ($p<0.05$) with all the flowering durations and the floret width ($p<0.01$) were statistically significant. The difference between the parameters of the planting time and the parameters of control and vermicompost applications were not statistically significant. As a result, the planting time interval for hyacinth plants was not determinative for the parameters examined. Regardless of the date of planting, bulbs were bloomed at approximately the same time. It is obvious that late planting time will be advantageous for irrigation and other maintenance.

Keywords: Flowering, Hyacinth, Planting Time, Siirt, Vermicompost.

FARKLI DİKİM ZAMANLARI VE VERMİKOMPOST UYGULAMALARININ SİİRT EKOLOJİK KOŞULLARINDA YETİŞTİRİLEN SÜMBÜL (*Hyacinthus orientalis* "Fondant") BİTKİSİNİN ÇİÇEKLENMESİ ÜZERİNE ETKİLERİ

ÖZET

Bu çalışmada Siirt ekolojik koşullarında yetiştirilen *Hyacinthus orientalis* "Fondant" çeşidi sümbül soğanları 2016 tarihinde, 14 Kasım (1DZ), 01 Aralık (2DZ) ve 16 Aralık (3DZ) zamanlarında 15'er gün arayla dikilmiştir. Çalışma, Siirt Üniversitesi Ziraat Fakültesi'ne ait deneme arazisinde 'Tesadüf blokları deneme desenine" göre 3 tekerrürlü olarak yürütülmüştür. Farklı dikim zamanlarında dikilen soğanların dikim çukurlarına 100 g/soğan olacak şekilde solucan gübresi (V) (vermikompost) uygulanmıştır. Bunun yanında ayrıca gübre uygulanmayan kontrol parselleri (K) oluşturulmuştur. Fenolojik ve morfolojik gözlemlerin yapıldığı araştırmada, dikim zamanı ve gübreleme

uygulamalarının interaksiyonları sonucunda elde edilen en düşük ve en yüksek ortalama değerler sırasıyla, ilk çiçeklenme süresi için 101.923-134.213 gün (3DZxK-1DZxV), tam çiçeklenme süresi için 103.103-135.766 gün (3DZxK-1DZxV), hasat süresi için 104.843-137.670 gün (3DZxK-1DZxV), çiçek boyu için 99.613-106.223 mm (2DZxV-1DZxV), çiçek genişliği için 50.433-58.970 mm (2DZxK-3DZxV), floret uzunluğu için 17.366-18.510 (1DZxV-2DZxV) ve floret genişliği için 22.393-27.546 mm (1DZxK-3DZxK) olarak tespit edilmiştir. Bu ortalama değerler içinde sadece floret uzunluğuna ait ortalamalar arasındaki fark istatistik olarak önemli bulunurken ($p<0.01$); dikim zamanları ele alındığında çiçek genişliği ($p<0.05$) ile tüm çiçeklenme süreleri ve floret genişliği ($p<0.01$) ortalama değerleri arasındaki fark istatistik olarak önemli bulunmuştur. Dikim zamanına ait diğer parametreler ile kontrol ve vermikompost uygulamalarına ait parametreler ortalamaları arasındaki fark istatistik olarak önemsiz bulunmuştur. Sonuç olarak sümbül bitkisi için belirlenen dikim zamanı aralığı olan 15 gün, incelenen parametreler için belirleyici olamamıştır. Dikim tarihleri ne olursa olsun çiçekler yaklaşık aynı zamanlarda açmıştır. Sulama ve diğer bakım işlemleri için geç tarihte dikim yapmanın avantajlı olacağı görüşü ortaya çıkmaktadır.

Anahtar Kelimeler: Çiçeklenme, Dikim Zamanı, Siirt, Sümbül, Vermikompost.

1. INTRODUCTION

Geophytes (plants with bulbs, tubers, corms and rhizomes) have been increasingly used. Daffodils, tulips, liliums and hyacinths are most preferred plants in landscaping and for cut flower and potted plant growing due to their fragrant, spectacular and colored flowers. Hyacinth (*Hyacinthus orientalis*), a species of Liliaceae family, has a special place among these plants. Flower characteristics of hyacinth vary based on nutrition status of the plant which prefers soils rich in organic matter and nutrients for growing. Recently, worm fertilizer (vermicompost) has been gaining importance as an alternative fertilizer with its soil regulating and nutrition characters as an alternative to inorganic and chemical fertilizers.

Scott (1988) reported that supplementing growing conditions with even small amounts of worm fertilizer promoted growth of *Chaemocyparis lawsonian, Elaeagnus pungens, Cuppressocypari leylandii, Pyracantha* spp., *Cotoneaster conspicus* and *Viburnum bodnantense* species. Besides, Edwards and Burrows (1988) found that *Chrysanthemum, Salvia* and *Petunia* plants reached flowering earlier with vermicompost fertilizing compared to commercial planting media. In the study of Lazcano and Domínguez (2011), vermicompost was reported to be useful in some medicinal and aromatic plants (Anwar et al., 2005; Prabha et al., 2007), in ornamental plants such as *Geranium* (Chand et al., 2007), marigold (Atiyeh et al., 2002), *Petunia* (Arancon et al., 2008), *Chrysanthemum* (Hidalgo and Harkess 2002a) and poinsettia (Hidalgo and Harkess, 2002b) and woody plants such as *Acacia, Eucalyptus* and pine (Donald and Visser, 1989, Lazcano et al., 2010a, 2010b). In their studies, Singh and Wasnik (2013) found that use of vermicompost and NPK fertilizers together positively affected herb and volatile oil yield, nutrient uptake and plant growth in rosemary (*Rosmarinus officinalis* L.).

The present study was carried out to determine the duration to flowering and flower characters of hyacinth plants produced from bulbs planted in three different periods and fertilized with solid worm fertilizer in Siirt Province of Turkey, where ornamental plants are not commercially grown.

2. MATERIAL AND METHOD

The present study was carried out in open conditions in Research and Application Garden of Siirt University, Agricultural Faculty in 2016-2017 growing season. Experimental design was randomized complete blocks with three replications. Each replication consisted of nine hyacinth bulbs. Distances between rows and between plants on rows were 25 cm. Planting was made in 10 cm deep holes (Figure 1).

Figure 1. Sprouting and Flowering of Hyacinth Bulbs

Planting material was *Hyacinthus orientalis* cv. 'Fondant' bulbs, which were obtained from Asya Lale Company.

Bulbs were planted on November 14, December 1 and December 16, 2016, with 15-day intervals. As fertilizers, 100 g worm fertilizer (vermicompost) was added to each hole prepared for planting of bulbs in each planting time. In addition, control plots were established in which no vermicompost was applied to planting holes to make comparisons with vermicompost applied plots. In the study, phenological observations such as duration to first flowering, time to full flowering and harvest time and morphological measurements such as length and width of flowers, and length and width of florets were evaluated.

Table 1. Some climate values of the year the experiment was carried out (Anonymous, 2017b)

Parameter	November 2016	December 2016	January 2017	February 2017	March 2017	April 2017	May 2017	Average
Monthly average temperature (°C)	10,4	3,3	3,0	2,6	9,7	14,2	19,5	8,9
Monthly average of daily max. temperatures (°C)	16,45	7,2	7,4	7,9	14,8	20,0	25,1	14,1
Monthly average of daily min. temperatures (°C)	6,0	0,6	-0,2	-1,5	5,3	9,3	13,9	3,0
Average monthly 50 cm of soil temperature (°C)	15,6	8,6	6,6	5,9	10,1	14,5	19,4	11,5
Average monthly relative humidity (%)	49,7	73,1	65,9	64,9	63,5	59,3	51,7	61,1
Average monthly total precipitation (mm= kg/m^2)	55,6	121,4	49,4	45,6	118,8	149,9	74,8	87,9

Table 2. Soil Properties of The Area Where The Experiment is Conducted

Analysis	Unit	Methods	Results	Evaluation
Texture class	%	Water Saturation	72	Clayey
pH	-	Water Saturation	7.33	Neutral
EC	ds/m	Water Saturation	1.12	Saltless
Lime	%	Scheibler	14.8	Medium Limestone
Organic matter	%	Walkley-Black	1.64	Little
Phosphorus (P_2O_5)	kg/da	Olsen	3.70	Little
Potassium (K_2O)	kg/da	Ammonium Acetate	128.7	Enough

Solid worm fertilizer produced by Ekosol Tarım Company using Eisenia foetida worms, also known as Red California worms, were applied to holes prepared to plant the bulbs. This fertilizer had a pH of 6.7-7.5 and contained 20-25% moisture, 0.6-0.9% organic nitrogen, 20-25% total organic matter, 0.8-1.2% total nitrogen and 10-15% total (humic + fulvic) acids (Anonymous, 2017a).

Some climatic data of vegetation period were given in Table 1, and soil characteristics where the trial was planted were given in Table 2.

Data were analyzed with two-factor randomized complete block design using SAS software (version 9.1). LSD multiple range test was used to compare means. An $\alpha = 0.05$ significance level was used (Düzgüneş et al., 1987). Descriptive statistics of the traits studied were expressed as means and standard errors.

3. RESULTSS AND DISCUSSION

Bulbs of *Hyacinthus orientalis* cv. "Fondant" were planted on November 14, December 1 and December 16 with 15-day intervals in control plots and plots fertilized with 100 g solid vermicompost per plant. Some plant growth parameters were measured and given in Figure 1 and Table 3.

Figure 2. The Effects of Planting Time and Vermicompost Applications on Flowering of Hyacinth Plants

Table 3. The Effects Of Planting Time And Vermicompost Applications On Flowering Duration And Bloom Properties Of Hyacinth Plants

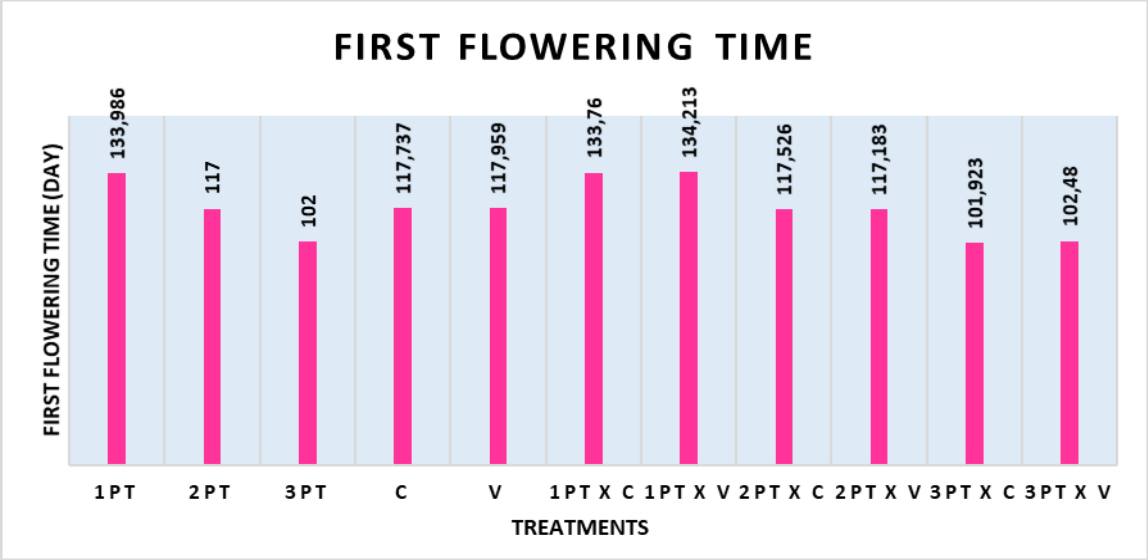
Treatments		First Flowering Time (day)	Full Flowering Time (day)	Harvest Time (day)	Flower Height (mm)	Flower Width (mm)	Floret Length (mm)	Floret Width (mm)
Planting Times	1PT	133.986 A**	135.401 A**	137.041 A**	104.957	56.346 A*	17.931	22.720 B**
	2PT	117.355 B	118.620 B	120.321 B	101.226	51.890 B	18.050	24.283 B
	3PT	102.201	103.420 C	105.348 C	101.833	55.945 A	18.000	27.528 A
Significant Degree		p<0.01	p<0.01	p<0.01	NS	p<0.05	NS	p<0.01
Fertilizer	C	117.737	118.942	120.621	102.662	53.385	18.027	24.712
	V	117.959	119.352	121.186	102.682	56.068	17.960	24.975
Significant Degree		NS	NS	NS	NS	NS	NS	NS
Planting Time x Fertilizer	1PT x C	133.760	135.036	136.413	103.692	56.803	18.496 A**	22.393
	1PT x V	134.213	135.766	137.670	106.223	55.890	17.366 B	23.046
	2PT x C	117.526	118.686	120.606	102.840	50.433	17.590 B	24.196
	2PT x V	117.183	118.553	120.036	99.613	53.346	18.510 A	24.370
	3PT x C	101.923	103.103	104.843	101.456	52.920	17.996 AB	27.546
	3PT x V	102.480	103.736	105.853	102.210	58.970	18.003 AB	27.510
Significant Degree		NS	NS	NS	NS	NS	p<0.01	NS

PT: Planting Time; C: Control; V: Vermicompost

*: In the same letter, there is no statistically significant 5% difference between the averages; **: In the same letter, there is no statistically significant 1% difference between the averages; NS: Not Significant

FIRST FLOWERING TIME (DAYS)

In terms of planting period x fertilizer interactions applications did not have significant effect on the first flowering time of hyacinth plants. Planting periods, on the other hand, significantly affected the duration to first flowering ($p<0.01$) (Table 3). The earliest flowering was observed in 3PT application by 102.201 days while 1PT resulted in the latest flowering as 133.986 days (Figure 3). Although there seemed to be 15 days difference between the applications, plants from different combinations reached to the flowering on about the same date irrespective of planting time. Vermicompost did not cause any significant effect on the first flowering time. Duration to flowering of different planting period x fertilizer interactions varied from 101.923 (3PT x C) to 134.213 (1PT x V) days, but this variation was not significant (Table 3).



1PT: 1. Planting Time (14 November), 2PT: 2. Planting Time (01 December), 3PT: 3. Planting Time (16 December), C: Control plots, V: Vermicompost (100g/bulb), 1PT x C: 1. Planting Time x Control interaction, 1PT x V: 1. Planting Time x Vermicompost interaction, 2PT x C: 2. Planting Time x Control interaction, 2PT x V: 2. Planting Time x Vermicompost interaction, 3PT x C: 3. Planting Time x Control interaction, 3PT x V: 3. Planting Time x Vermicompost interaction

Figure 3. The Effects of Planting Time and Vermicompost Applications on The First Flowering Time of Hyacinths

FULL FLOWERING TIME (DAYS)

Planting periods significantly affected full flowering time of hyacinth plants ($p<0.01$), while the effect of fertilizer applications was not significant. Besides, planting period x fertilizer interaction was not significant (Table 3). Calculated based on planting periods, duration to full blossom varied from 133.636 days (2PT) to 135.416 days (3PT) (Figure 4). Just as in duration to first flowering, 15-day differences were observed between planting periods for the duration to full flowering. A one-day difference was observed between plots fertilized with vermicompost and control plots. Duration to full flowering of different planting time and fertilizer interactions ranged from 103.103 days (3PT x C) to 135.766 days (1PT x V), and this difference was not significant (Figure 4).

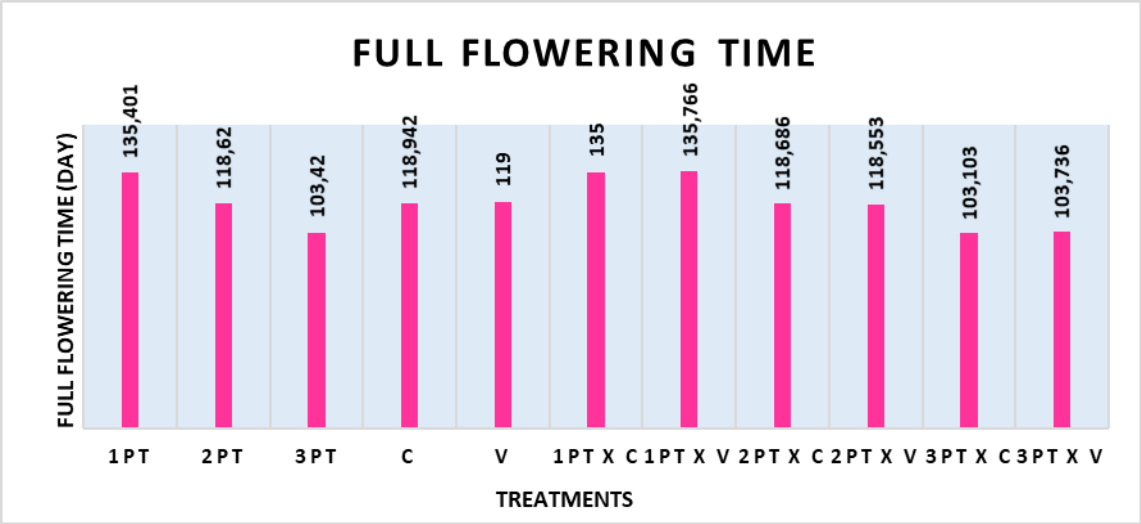


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Figure 4. The Effects of Planting Time and Vermicompost Applications on The Full Flowering Time of Hyacinths

HARVEST TIME (DAYS)

Harvest time was significantly influenced by planting period ($p<0.01$), while the effects of fertilizer application and planting period x fertilizer interaction were not significant (Table 3). Duration to harvest was calculated based on planting time, and the earliest harvests were made in 3PT plots with 105.348 days and the latest ones in 1PT plots with 137.041 days (Figure 5). A one-day difference was found between plots fertilized with vermicompost and control plots. Control plots reached to harvest in 120.621 days while vermicompost applied ones in 121.186 days. Duration to harvest of different planting periods and fertilizer interactions varied between 104.843 days (3PT x C) and 137.670 days (1PT x V), and this difference was not significant (Table 3).

FLOWER HEIGHT (MM)

Effects of planting time, vermicompost application and planting time x vermicompost interactions on flower height of hyacinth plants were not statistically significant (Table 3). The longest flowers were obtained from 1PT (104.957) while the shortest ones were obtained from 2PT (101.226 mm) (Figure 6). Three planting periods did not significantly affect average flower heights. Fertilizer applications produced almost the same flower heights. Vermicompost did not change flower height of hyacinth plants compared to the control treatment. Flower heights of different planting time and fertilizer interactions varied from 99.613 mm (2PT x V) to 106.223 mm (1PT x V), and this difference was not significant (Table 3).

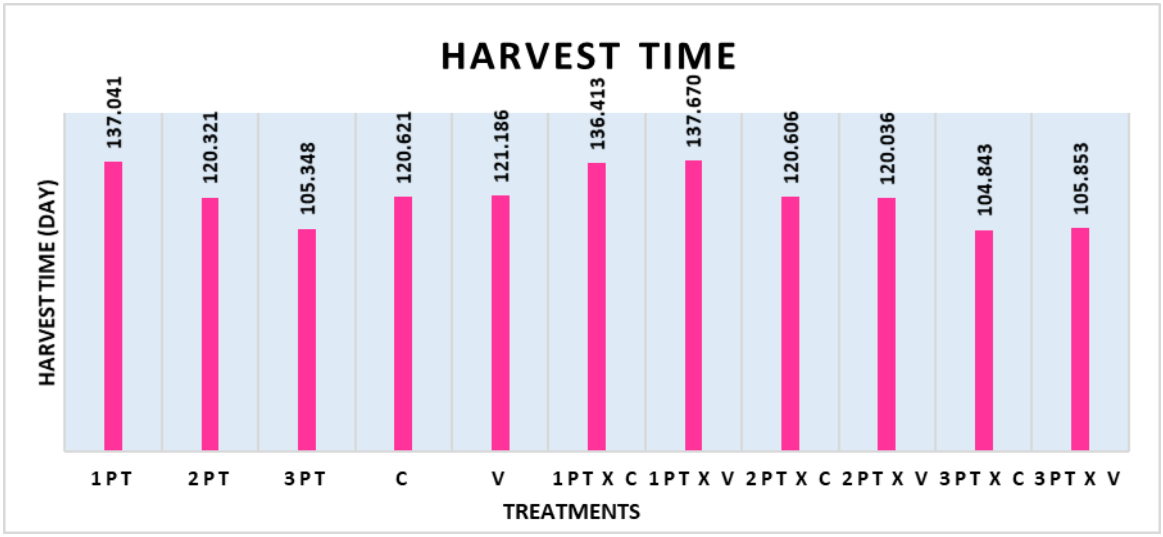

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Figure 5. The Effects of Planting Time and Vermicompost Applications on The Harvest Time of Hyacinths

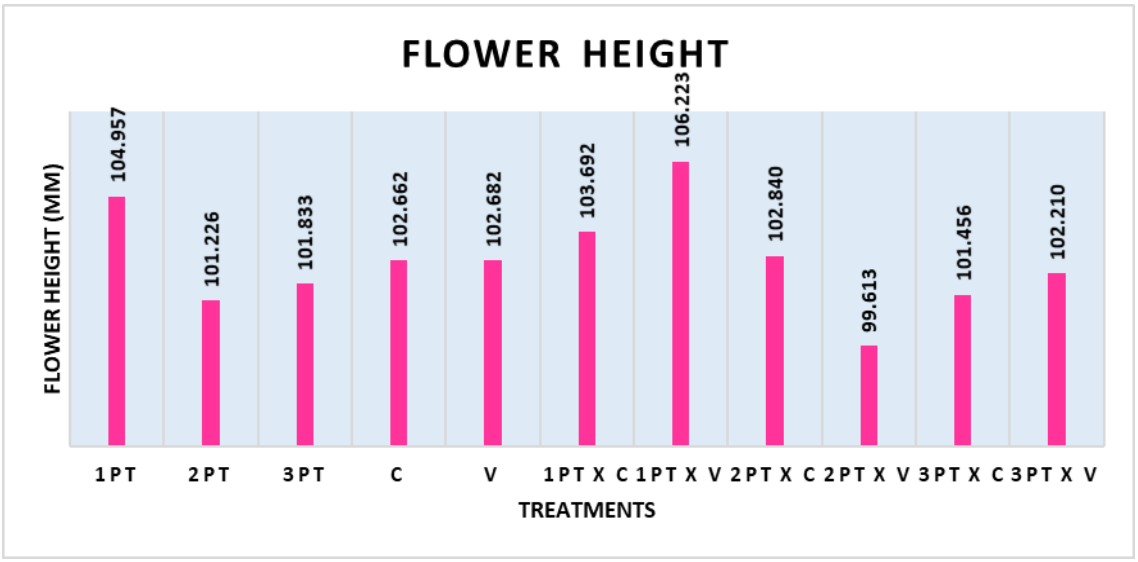

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Figure 6. The Effects of Planting Time and Vermicompost Applications on The Flower Height of Hyacinths

FLOWER WIDTH (MM)

Planting period significantly affected flower widths of hyacinth plants ($p<0.05$) (Table 3). The widest flowers were obtained from 1PT (56.346 mm) whereas 2PT produced the narrowest flowers (51.890 mm) (Figure 7). Vermicompost application did not significantly affect flower widths. Control plots produced flowers with an average width of 53.385 mm while the average width of flowers in plots with vermicpmpost application was 56.068 mm. Flower widths of different planting time and fertilizer interactions varied from 50.433 mm (2PT x C) to 58.970 mm (3PT x V), and this difference was not significant (Table 3).

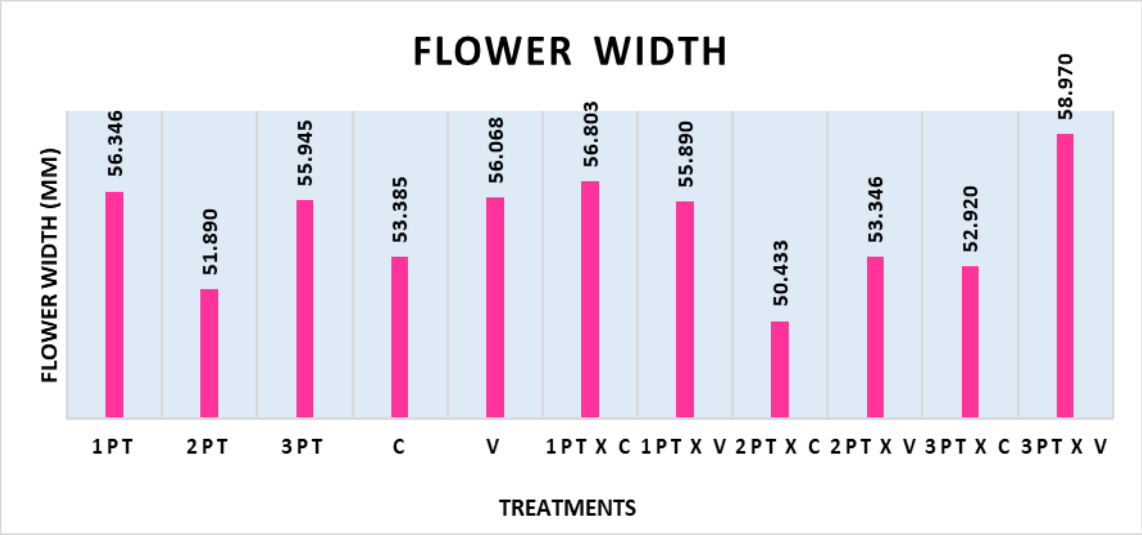

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Figure 7. The Effects of Planting Time and Vermicompost Applications on The Flower Width of Hyacinths

FLORET LENGTH (MM)

Floret lengths of hyacinth plants were not significantly affected by planting time (Table 3). The longest florets were obtained from 2PT (18.050 mm) while 1PT had the shortest florets (17.931 mm) (Figure 8). Vermicompost application did not significantly affect floret lengths. Control plots had an average of 18.027 cm floret length and worm compost applied plots had floret lengths of 17.960 mm. Floret lengths of different planting time and fertilizer combinations ranged from 17.366 mm (1PT x V) to 18.510 mm (2PT x V), and this difference was statistically significant ($p<0.01$) (Table 3).

FLORET WIDTHS (MM)

Floret widths obtained from three planting periods were significantly different ($p<0.001$) (Table 3). The widest florets were obtained from 3PT (27.528 mm) while 1PT had the narrowest florets (22.720 mm) (Figure 9). The differences between flower widths of vermicompost applied plots and those of plots to which no vermicompost was applied were not significant. Control plots had an average of 24.712 mm floret width, and vermicompost applied plots had an average floret width of 24.975 mm. Floret widths of different planting time and fertilizer interactions ranged from 22.393 mm (1PT x C) to 27.546 mm (3PT x C), and this difference was not statistically significant (Table 3).

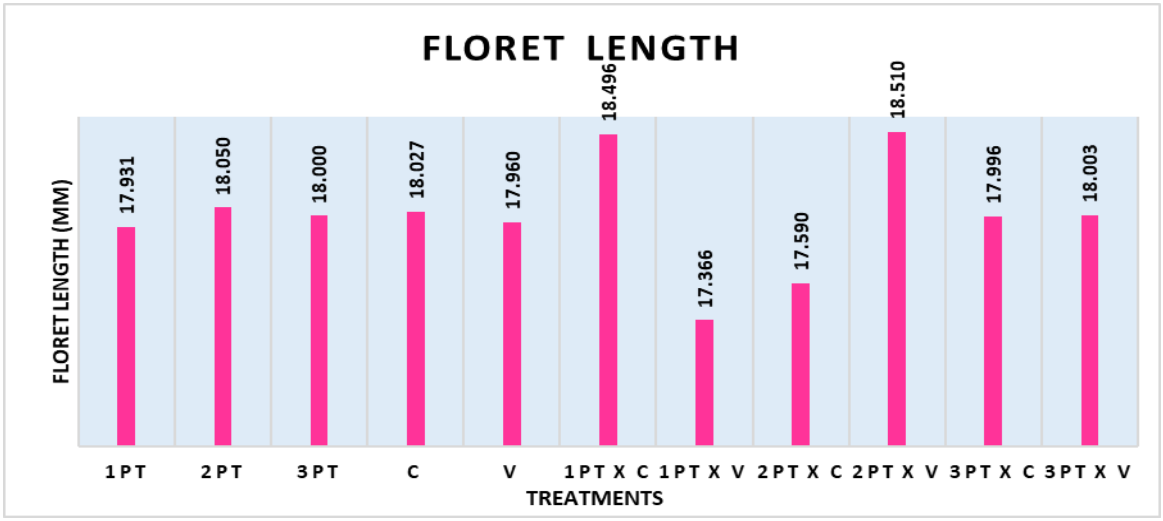

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Figure 8. The Effects of Planting Time and Vermicompost Applications on The Floret Length of Hyacinths

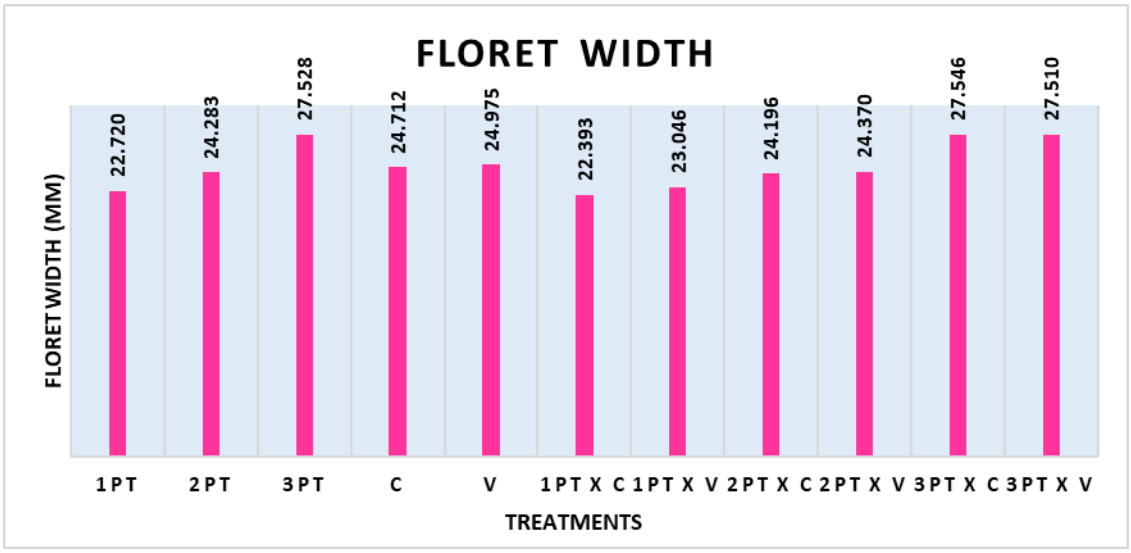

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Figure 9. The Effects of Planting Time and Vermicompost Applications on The Floret Width of Hyacinths

Height of *H. orientalis* plants are about 20-30 cm and they have bell-shaped layered or non-layered flowers in 15-20 cm tall flower spikes (Anonymous, 1999). Length of florets in cylindrical racemes of 7.5 cm wide flowers (Anonymous, 2019a) are 2.5 cm (Anonymous, 2019b). Flowering period of hyacinth bulbs planted in September-November period is April-May months (Hessayon, 1993). Lengths of the flowers in the present study were relatively small. This difference could be due to cultivar character or ecological conditions. Flowering times, on the other hand, were in accordance with the phenological structure of the plant.

In a study carried out in Van Province of Turkey, effects of diammonium phosphate (DAP) fertilizer rates were studied on hyacinth (*Hyacinthus orientalis*, cvs. 'Blue Jacket', 'Carnegie', 'City of

Haarlem' and 'Jan Bos'), and it was found that highest values of full flowering time and harvest time were obtained from 120 kg/ha rate in field conditions and from 80 kg/ha application in greenhouse conditions (Türkoğlu and Ciğ, 2006). Vermicompost application resulted in one-day delaying in flowering in all three planting periods. However, this delaying was not important for market value or usefulness of the plant. In the same study, the highest values of floret length and stalk thickness of hyacinth were obtained from 40 kg/ha DAP rate in field and 80 kg/ha DAP rate in greenhouse conditions, and from 40 kg/ha DAP rate in field and 120 kg/ha DAP rate in greenhouse conditions, respectively.

Çığ (2005) studied the effects of DAP rates on hyacinth plants (*Hyacinthus orientalis*, cvs. 'Blue Jacket', 'Carnegie', 'City of Haarlem' and 'Jan Bos') grown in Van Province of Turkey and found that highest values of flower width were obtained from 40 kg/ha rate in field conditions and from 80 kg/ha rate in greenhouse conditions.

Çığ et al. (2011) studied various parameters of four hyacinth varieties under greenhouse conditions and found that average duration to the first flowers was 118.50 days, duration to full blossom was 120.77 days, duration to harvest was 122.92 days, flower width was 65.19 mm, floret length was 18.73 mm and floret width was 30.72 mm.

Çığ et al. (2017) grew tulip, daffodil and hyacinth plants (*Hyacinthus orientalis*, cv. 'Pink Pearl') in perlite, vermiculite, peat and hydroponic culture under laboratory conditions and obtained flower lengths varying from 71.21 to 89.20 mm and flower widths from 47.70 to 54.00 mm in hyacinth. Ali and Çığ (2018) carried out field trials with chemical fertilizer and vermicompost rates in Siirt province using flower bulbs of *Hyacinthus orientalis* cv. 'Purple Star'. They found that durations to first flowering, full blossom and harvest time delayed in control plots compared to fertilizer applications. In terms of flower criteria studied, fertilizer applications led to higher values compared to control plots. In a study on daffodil plant by Bademkıran et al. (2018) under field conditions in Siirt Province, effects of solid and liquid vermicompost rates on some plant growth parameters was investigated, and it was found that fertilizer application was generally more effective on flower length and width, and produced longer and wider flowers compared to control plots.

4. CONCLUSION

In the present study conducted under field conditions in Siirt Province of Turkey, effects of three planting times with 15-day intervals and application of 100 g solid vermicompost per hyacinth plant on morphological characteristics such as phenological observations such as durations to first flowering, to full blossom and to harvest time and morphological measurements such as length and width of flowers, and length and width of florets were examined.

In terms of planting time, the latest first flowering, full flowering and harvest periods, and the highest flower lengths and widths were observed in the first planting period while the highest floret lengths and widths were observed in the second planting period and the highest floret width in the third planting period. It was clear that planting time was not a major determinant of early or late flowering. Because of the small differences, market price of the hyacinth flowers produced from these three planting periods would not increase, and no advantage would be obtained for landscape studies. When vermicompost treatment and control treatment which had no fertilizer were compared, the highest values were obtained from vermicompost applied plots for all variables except for length of florets. However, the increases due to vermicompost application was not prominent. Except for length of the floret, planting time x fertilizer interaction was not statistically significant for other parameters. The longest durations to the first flowering, to full blossom and to harvest, and the highest flower lengths and widths were observed in the first planting period and vermicompost combination while the highest floret lengths were obtained in the second planting period and vermicompost combination. These differences were statistically significant. The largest florets were observed in the third planting period and vermicompost combination. In general, it could be stated that planting periods and vermicompost application did not result in clear improvements in phenological and morphological characters of hyacinth.

In conclusion, time interval of 15 days used between planting periods for hyacinth bulbs did not significantly affect the parameters studied. Irrespective of planting periods, plants reached to flowering about the same time. Although there seemed to be a 15-day difference between flowering and harvest times, this difference resulted from the 15-day interval between different planting periods. Hyacinth bulbs planted 15 or 30 days after the previous planting period reached flowering on almost the same date. In other words, early or late planting did not affect flowering or flower quality. Considering the labor availability, weed control and ecological conditions of Siirt Province and especially watering program, late planting could be advantageous.

REFERENCES

1. Ali, S.R., Çığ, A., 2018. The effects of dosages of worm and nitrogen-phosphorus fertilizers on plant growth of *Hyacinthus* sp. in ecological conditions of Siirt province, Turkey. Applied Ecology and Environmental Research, 16 (4): 3873-3884.
2. Anonymous, 1999. Süs Bitkileri Yetiştiriciliği, Soğanlı ve Yumrulu Süs Bitkileri. TAV Tarımsal Araştırmaları Destekleme ve Geliştirme Vakfı, Yay. No: 40, Yalova. 88.
3. Anonymous, 2017a. https://www.ekosol.net/urunler (Acces date: 13 May 2017).
4. Anonymous, 2017b. Orman ve Su İşleri Bakanlığı Meteoroloji Genel Müdürlüğü Meteoroloji 15. Bölge Müdürlüğü. (Acces date: 01 June 2017).
5. Anonymous, 2019a. Http://pss.uvm.edu/pss123/bulhyac.html (Acces date: 10 April 2019).
6. Anonymous, 2019b. Auburn University Horticulture Department Http://www.ag.auburn.edu/hort/landscape/dbpages/502.html (Acces date: 10 April 2019).
7. Anwar, M., Patra, D.D., Chand, S., Kumar, A., Naqvi, A.A., Khanuja, S.P.S., 2005. Effect of organic manures and inorganic fertilizer on growth, herb and oil yield, nutrient accumulation, and oil quality of French basil. Communications in Soil Science and Plant Analysis, 36 (1-14): 1737-1746.
8. Arancon, N.Q., Edwards, C.A., Babenko, A., Cannon, J., Galvis, P., Metzger, J.D., 2008. Influences of vermicomposts, produced by earthworms and microorganisms from cattle manure, food waste and paper waste, on the germination, growth and flowering of petunias in the greenhouse, Applied Soil Ecology, 39: 91-99.
9. Atiyeh, R.M., Arancon, N., Edwards, C.A., Metzger, J.D., 2002. The influence of earthworm-processed pig manure on the growth and productivity of marigolds. Bioresource Technology, 81: 103-108.
10. Bademkıran, F., Çığ, A., Türkoğlu, N., 2018. Nergis (*Narcissus* cv. 'Royal Connection') bitkisinin gelişimi üzerine katı ve sıvı solucan gübresi dozlarının etkileri, Türk Tarım ve Doğa Bilimleri Dergisi, 5(4): 676–684.
11. Chand, S., Pande, P., Prasad, A., Anwar, M., Patra, D.D., 2007. Influence of integrated supply of vermicompost and zinc-enriched compost with two graded levels of iron and zinc on the productivity of geranium. Communications in Soil Science and Plant Analysis, 38: 2581–2599.
12. Çığ, A., 2005. Van Yöresinde Farklı Doğu Sümbülü (*Hyacinthus orientalis* L.) Kültür Soğanlarının Kesme Çiçek Yetiştiriciliği ve Peyzaj Düzenlemede Kullanılabilirliği, Yüksek Lisans Tezi, Yüzüncü Yıl Üniversitesi Fen Bilimleri Enstitüsü, Van, 48.
13. Çığ, A., Gülgün, B., Keskin, N., 2011. Determination of the growth and development different Hyacinth cultivars. Journal of International Environmental Application & Science, 6 (4): 613-618.
14. Çığ A., Gülser, F., Gökkaya, T.H., 2017. The Effects of Different Growing Media on Plant Growth Criteria of Some Bulbous Ornemental Plants (*Hyacinthus orientalis* 'Pink Pearl', Narcissus 'Mount Hood' and *Tulipa gesneriana* 'Golden Apeldoorm'). International Conference on Agriculture, Forest, Food Sciences and Technologies (ICAFOF 2017), 15-17 May 2017, Nevşehir. pp. 1173.
15. Donald, D.G.M., Visser, L.B., 1989. Vermicompost as a possible growth medium for the production of commercial forest nursery stock. Appl. Plant Sci., 3: 110-113.

16. Düzgünes, O., Kesici, T., Kavuncu, O., Gürbüz, F., 1987. Araştırma ve Deneme Metotları, Yayın No: 1021, Ders Kitabı: 295, A.Ü. Ziraat Fakültesi Yayınları, Ankara. 381.
17. Edwards, C.A., Burrows, I., 1988. The potential of earthworm composts as plant growth media. In Earthworms in Environmental and Waste Management Ed. C. A., Neuhauser, SPB Academic Publ. bv. The Netherlands. 211-220.
18. Hidalgo, P.R., Harkess, R.L., 2002a. Earthworm casting as a substrate amendment for *Chrysanthemum* production. Hortscience, 37 (7): 1035- 1039.
19. Hidalgo, P.R., Harkess, R.L., 2002b. Earthworm casting as a substrate for *Poinsettia* production. Hortscience, 37 (2): 304-308.
20. Hessayon, D.G., 1993. The Flower Expert. ISBN: 0-903505- 19-3. Pbi Publications. Britamica House-Waltham Cross-Herts, England. 117.
21. Lazcano, C., Sampedro, L., Zas, R., Domínguez, J., 2010a. Vermicompost enhances germination of the maritime pine (*Pinus pinaster* Ait.). New Forest., 39: 387-400.
22. Lazcano, C., Sampedro, L., Zas, R., Domínguez, J., 2010b. Assessment of plant growth promotion by vermicompost in different progenies of maritime pine (*Pinus pinaster* Ait.). Compost Science and Utilization, 18: 111-118.
23. Lazcano, C., Domínguez, J., 2011. The Use of Vermicompost in Sustainable Agriculture: Impact on Plant Growth and Soil Fertility. In: Soil Nutrients, Editor: Mohammad Miransari, Chapter 10. Nova Science Publishers, Inc. Pp: 1-23.
24. Prabha, M.L., Jayraay, I.A., Jayraay, R., Rao, D.S., 2007. Effect of vermicompost on growth parameters of selected vegetable and medicinal plants. Asian Journal of microbiology, Biotechnology and Environmental Sciences, 9 (2): 321-326.
25. Scott, M.A., 1988. The use of worm-digested animal waste as a supplement to peat in loamless composts for hardy nursery stock. In Earthworms in Environmental and Waste. SPB Academic Publishing, 221-229.
26. Singh. M., Wasnik, K., 2013. Effect of vermicompost and chemical fertilizer on growth, herb, oil yield, nutrient uptake, soil fertility, and oil quality of rosemary. Commun. Soil Sci. Plant Anal., 44 (18):2691–2700.
27. Türkoğlu, N., Ciğ A., 2006. The useability for cut flowering of hyacinth culture types planted in different environments. International Journal of Botany, 2 (2): 133-136.