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The Effects of GA_3 Applications on the Yield and Quality of Gerber Daisy (*Gerbera* sp.) Cultivars in Erbaa (Tokat) Ecological Conditions

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Abstract: This study was carried out in Erbaa/Tokat in a producer greenhouse in 2017. In this study, observations and measurements were made in order to determine the effects of GA_3 treatment at different doses (0, 150, 300, 450 and 600 ppm) on *Gerbera* sp. regarding the length and thickness of the pedicle, flower diameter, cut flower weight, yield, vase life, and tillering count. The study was based on a randomized plots test pattern on three consecutive plots. The study was conducted in May, and the growth regulator was applied once each month for three months (June-July-August) by spraying it to the leaves. The results indicate that the GA_3 treatment had positive effects in terms of both the yield and the quality, compared to the control group. Evaluation of the effects of various doses applied on the cultivars reveals that the Yeliz cultivar achieved the highest yield with 300 ppm GA_3 treatment with 14.66 units per parcel. Similarly, the longest pedicle length was also achieved by the Yeliz cultivar (71.47 cm) with 150 ppm GA_3 treatment. The highest flower diameter was achieved by the Ulaş cultivar (133.05 mm) with 150 ppm GA_3 treatment, the thickest pedicle was achieved by the Yeliz cultivar (6.40 mm) at 150 ppm GA_3 treatment, and the highest cut flower weight was achieved by the Yeliz cultivar (35.935 gr/unit) at 150 ppm GA_3 treatment. The longest vase life was achieved by the Ulaş cultivar (16.33 days) flowers treated with 450 ppm GA_3.

Keywords: Cut flower, GA_3 treatment, ornamental plants, vase life

Erbaa (Tokat) Ekolojik Koşullarında Bazı Gerbera (*Gerbera* sp.) Çeşitlerinde GA_3 Uygulamalarının Verim ve Kalite Üzerine Etkileri

Öz: Bu çalışma 2017 yılında Erbaa/Tokat üretici serasında gerçekleştirilmiştir. Farklı dozlarda (0, 150, 300, 450 ve 600 ppm) GA_3 uygulamalarının *Gerbera* sp. bitkisinin Yeliz ve Ulaş çeşidinde çiçek sapı uzunluğu, çiçek sapı kalınlığı, çiçek çapı, çiçek ağırlığı, verim, vazo ömrü ve kardeşlenme sayısı üzerine etkilerini belirlemek amacıyla gözlem ve ölçümler yapılmıştır. Çalışma tesadüf parselleri deneme desenine göre 3 tekerrürlü her parsel olarak kurulmuştur. Deneme Mayıs-Eylül ayları arasında ayda bir olmak üzere üç ay (Haziran-Temmuz-Ağustos) yapraklara püskürtme şeklinde doz uygulaması yapılmıştır. Deneme sonunda GA_3 uygulamalarının kontrole göre hem verim hem de kalite açısından daha olumlu etkiler meydana getirdiğini göstermiştir. Doz uygulamalarının çeşitler üzerindeki verimi incelendiğinde elde edilen hasatta 300 ppm'lik GA_3 uygulamasında Yeliz Çeşidi (14.66 adet/parsel) en yüksek verimin sağlandığı saptanmıştır. Sap uzunluğu GA_3 150 ppm doz uygulamasında Yeliz çeşidinde (71.47 cm) elde edilmiştir. Çiçek çapı GA_3 150 ppm doz uygulamasından sonra elde edilen bitkilerde Ulaş çeşidinde (133.05 mm), çiçek sap kalınlığı GA_3 150 ppm doz uygulamasında Yeliz çeşidinde (6.40 mm), kesme çiçek ağırlığında GA3 150 ppm doz uygulamasında Yeliz çeşidinde (35.935 gr/adet) ölçülmüştür. En uzun vazo ömrü Ulaş Çeşidi GA_3 450 ppm doz uygulamasında (16.33 gün) elde edilen çiçeklerde saptanmıştır.

Anahtar Kelimler: Kesme çiçek**,** GA_3 doz uygulaması, süs bitkileri, vazo ömrü

1.Introduction

Cut flowers are ornamental plants that are used in the production of bouquets, baskets, and wreaths, and are the most widely sold and traded ornamental plants in the world. Half of the ornamental plant trade in the world is of cut flowers. The Turkish cut flower sector is one of the important agricultural production sectors with

growth and development dynamics, despite some problems in their production and marketing.

According to TÜİK (Anonymous, 2016) report, the annual cut flower production rate in our country in the latest years is at an average of 1.037.996.375 units. The same TÜİK report also reveals that, amongst the cut flowers produced, gerber daisy (gerbera) is the third most produced flower following the dianthus species. The exact number of gerber daisy produced is 128.063.850, which is a significant portion of the cut flower production. Tokat holds the 8th place in terms of cut flowers produced yearly, while it holds the 3rd place in terms of the total production area. Since the production does not go on all throughout the year, the production area and total flowers produced vary a lot (Table 1).

Table 1. Gerber daisy cut flower production data for the provinces in Turkey (Anonymous, 2016)
Çizelge 1. *Türkiye'de illere göre gerbera kesme çiçek üretim verileri (Anonim, 2016)*

Province	Production area (m^2)	Production (Unit)	Province	Production area (m^2)	Production (Unit)
Antalya*	843 000	93 200 000	Aydın	12 600	856 800
Izmir*	193 577	28 288 550	Kocaeli	3 000	675 000
Sakarya	20 000	1 600 000	**Tokat***	**30 000**	**630 000**
Yalova	12 605	1 260 500	Samsun	250	1 000
			Ankara	1 000	7 000

Gerber daisy is a perennial herbaceous plant with large chamomile-like flowers in undoubled and folded form with white, yellow, pink, orange, red tones. The underside of the leaves is hairy, and the leaves are composed of large sections that are flat, like beets. The thick and succulent roots of the plant can go down as deep as a meter if the water conditions are suitable. While there are about 50 species of gerber daisy -which are of South Africa and Asian origin-, the primarily known species of gerber daisy is the *Gerbera jamesonii*. Gerber daisy production shows continuous improvement in the world.

One of the most important problems in gerber daisy cultivation in our country in terms of its production is the fact that cultivators are dependent on other countries for high-quality production materials. When other studies on the subjects are surveyed, it can be seen that Kanwar and Kumar (2008) have reported that Gerber daisy has gained popularity all around the world in cut flower industry and that the reasons they are sought after are its large, colorful, beautiful flowers and its long vase life thanks to its rehydrating property, in addition to being very cargo-friendly. In the flowering period, the gibberellins taken into the plant from the roots increase, and with the addition of the sprayed gibberellins, the formation of the flower buds becomes accelerated (Emongor et al., 2004). In another study, Salem and Saravanan (2016) has worked on the GA_3 treatments and inspected the effects of various gibberellic acid doses (0, 50, 100, 150, and 200 ppm) on the flower stems and sprouts of gerber daisy (*Gerbera jamessonii*). The results of their study indicate that the optimum flower diameter and time to first flower stem and sprout appearance, along with the first flowering, were obtained with 150 ppm GA_3 application. In a similar study by Farina et al. (1989), 3 different species of gerber daisy were applied GA_3 from November to February, and it was found out that with 100 ppm GA_3 application on the leaves of the Joyce breeds the winter yields increase. That being said, it's clear that more studies are needed in order to reveal the effects and optimal dosages of growth regulators in various flower species and cultivars. In their study, Mehraj et al. (2013) inspected the effects of GA_3 application (150 ppm) at different time periods on the gerber daisy plants. The plants were treated in four groups: once (15th day), twice (15th and 30th days) thrice (15th, 30th, and 45th days), and the control group, in which no GA_3 was applied. While the flowering period of the plants got shorter in the

control group (65.7 days), the group with 3 times the GA_3 treatment was found to have increased length of the flowered period at 83.8 days. In addition to improving the vegetative development, GA_3 treatment had a positive impact on the flower diameter (7.4 cm) and stem length (50.5 cm) as well. Kaya et al. (2004) inspected the effects of different doses of treatment (100, 200, 400 ppm) in gerber daisy (*Gerbera jamessonii* X hybrida Pink Elegance) with GA_3. The results of their study indicate that GA_3 application is successful in compared to benzyl adenine (BA) treatments, and the highest yield increase was obtained with 125 ppm GA_3 dose, while the 500 ppm dose had the strongest effect on flower stem length and flower diameter properties. Cut flower producers are having difficulty in reaching the desired target quality due to low-quality production materials available. Furthermore, the ecological needs of the plant are not being met, and diseases caused by the soil are reducing the yield and the quality (Yazici and Gülgün, 2016). The greenhouse gerber daisy cultivation is becoming widespread day by day in the Erbaa district of Tokat, and the quality criteria are becoming more and more important every day, which brings together the need for studies for the cultivation techniques for the species (Yazici and Güneş, 2018).The aim of this study was to determine the effects of GA_3 treatment on yield and quality properties of certain gerber daisy cultivars (*Gerbera jamessonii B*) under the ecological conditions of the Tokat province.

2. Material and Method

The study was carried out in the polyethylene greenhouse of a producer in Erbaa District of Tokat province between May-October 2017. The red and white varieties of the gerber daisy species were used in the study, considering they were the most preferred varieties. Seedlings of *Gerbera jamessonii x* hybrida "Terre Ice" (local name: Ulaş White) and "Terra Yeliz" (Local name: Red gerber daisy Yeliz) produced in Antalya were used as the plant material of the study (Figure 1).

Gerbera'Ulaş' (a) Gerbera'Yeliz' (b)

Figure 1. Images of materials used (a,b)

Şekil 1. *Kullanılan materyallerden görüntüler (a,b)*

Vertical planting of pans and pads was performed with a 30x30 cm interval in a diamond pattern in the month of May. The distance between the pads was set at 60 cm. The treatment doses and names of the cultivars were placed on each of the pads as labels. A sandy-tanned soil containing equal amounts of sand, clay, and silt was used as the cultivation substrate. This soil setup was selected as it provided the optimum conditions of water-holding capacity, ventilation, structure, pore structure and water-air balance for the plant growth. The drip irrigation system was preferred for the pads and pans. Irrigation was performed in the evening (between 20:00 - 22:00) since the temperature of the greenhouse was too high for irrigation during the day hours. The plants were treated with GA_3 once a month -as three sprays of the substance- in July, August, and September, before the plants developed their stems. A total of 5 treatment groups were created, with their corresponding GA_3 doses as 0, 150, 300, 450, and 600 ppm, which were applied during the morning

hours (between 06:00 - 07:00). GA_3 doses were applied with three replication in randomized complete block design. In the study, 14 gerber plants were used for each plot.

The seedlings were planted on May 15, 2017, and 28 days later on June 12, 2017, the first leaves began to emerge. As of July 25, 2017, approximately 50% of the seedlings began to flower. On July 30, 2017, the first treatments were made, and the first measurements were performed one week after the first treatment, which was repeated every week thereafter. The second treatments were carried out one month later on July 30, 2017, and the one-week periodic harvests and measurements were performed once more. The third treatments were carried out again one month later on August 30, 2017, and once again, the one-week periodic harvests and measurements were made. Yields, pedicle lengths, pedicle thicknesses, flower diameters, cut flower weights (unit/gr) and vase life properties were determined in each harvest. Tillering counts, on the other hand, were determined with measurements performed before the harvest. Plants were harvested 3 times (including the first harvest) and observations were made. After the plants were harvested, measurements were made in the laboratory of the Department of Horticulture of Gaziosmanpaşa University, Faculty of Agriculture.

The data were analyzed by using variance analysis. The means were separated by Duncan's multiple range test. All data analysis were made by using SAS software.

3. Results and Discussion

3.1. Phenological observations

Time to the first exfoliation; this was determined as the day the seedlings first exfoliated a leaf that stayed alive, and as an average of the parcels. The seedlings which were planted on May 15, 2017, exfoliated first 28 days later, on June 12, 2017. *Florescence time;* this was determined as the average time in which 50% of the flowers bloomed their flowers first, and as an average of parcels. For seedlings which were planted on May 15, 2017, more than half of the parcels flowered first 40 days later, on June 25, 2017**.**

Harvest time; the harvest time for the gerber daisy flowers is the maturation date of an average of 2-3 male organs (anthers). Earlier harvests result in shortened vase life, so the flowers were kept uncut till they reached maturity, after which they were cut by bending slightly to the side at the point they are connected to the stem. The harvest was performed one week after the first application, on July 10, 2017.

3.2. Morphological observations

Yield (unit): When the average flower produced per plant during the tests is inspected, no significant difference was determined in terms of flower per plant in the first and second harvests between the flower cultivars. In the third harvest, on the other hand, the Yeliz cultivar was found to have a higher yield (10.857 unit/parcel) compared to the Ulaş cultivar (7.867) at the third harvest. Comparison of total flower count reveals no significant difference between Ulaş and Yeliz cultivars. When the cultivars are compared in terms effects of the GA_3 treatment, it was found out that GA_3 application caused no significant difference between the cultivars in neither of the 3 harvests compared to the control group. When the effects of various doses were evaluated between the cultivars, it was found out that the difference between the Ulaş (7 units) and Yeliz (12.66 units) cultivars in harvest 3 was statistically significant for the 450 ppm dose. Furthermore, the difference between the Ulaş (14.66 units) and Yeliz (8.66) cultivars in harvest 2 was found to be significant in the 300 ppm dose (Table 2). In light of the results obtained in control group and 150, 300, and 450 ppm dosages, the 300 ppm dosage was found to have positive effects on the yield for the Ulaş cultivar (114.66 per parcel) after the second treatment, which is in line with the findings of the study of Mehraj et al. (2013) where they report that increased treatment count result in better performance improvements. Nair et al. (2002) conducted a study where they report the longest pedicle was obtained with 150 ppm GA_3 treatment, which is also true for our study where we obtained it with the Yeliz cultiva at the same dose (71.47 cm).

Table 2. The effects of GA_3 on yield of gerbera cultivars
Çizelge 2. *GA_3 'in gerbera çeşitlerinde verim üzerine etkileri*

	Yield 1		**Yield 2**		**Yield 3**		**Mean of yield**	
	Ulaş Cultivar	**Yeliz Cultivar**	**Ulaş Cultivar**	**Yeliz Cultivar**	**Ulaş Cultivar**	**Yeliz Cultivar**	**Ulaş Cultivar**	**Yeliz Cultivar**
Control	6.0abA	7.33aA	15.33aA	17.66aA	10.33aA	10.33abA	32.33aA	32.0aA
$GA_3$150	4.66bA	5.66aA	11.0aA	10.33aA	9.33aA	13.66aA	25.0aA	29.66aA
GA300	3.0bA	7.33aA	14.66aA	8.66aB	6.0aA	7.33bA	23.66aA	23.33aA
$GA_3$450	4.0bA	6.33aA	10.0aA	9.33aA	7.0aA	12.66abB	21.0aA	28.33aA
$GA_3$600	9.66aA	7.66aA	8.0aA	10.0aA	6.66aA	10.0abA	24.33aA	24.33aA
General Total	5.46 A	6.86 A	11.800 A	11.200 A	7.867 B	10.857 A	25.26 A	27.53 A

The difference between means shown in the same column with the same lower letters is insignificant. The difference between means shown in the same line with the same capital letters is insignificant (P<0,005)

Pedicle length (cm): When the effects of GA_3 treatment on the pedicle length between the cultivars and doses were inspected, it was observed that the average pedicle length of the Ulaş cultivar in the first and second harvests was 51.71 cm and 64.12 cm respectively, which was found to be statistically significant. The treatment was found to have a positive effect on the pedicle length for both the Ulaş and Yeliz cultivars for the second and third harvests, and the difference between 150 ppm GA_3 treated Yeliz plants (71.47) and control group plants (55.62) was found to be statistically significant. Inspection of the effect of dose between them reveals that no statistically significant difference exists between the Ulaş and Yeliz cultivars (Table 3). El-Shafie and Hassan (1987) have found out that the lower concentrations of GA_3 had positive effects on the flowering time, flower count, flower diameter, and pedicle development of the plants. Similarly, the flower diameter of Ulaş cultivar (133.05 mm) and the pedicle thickness of Yeliz cultivar (6.40 mm) was achieved with 150 ppm GA_3 treatment after the second treatment.

Table 3. The effects of GA_3 on pedicle length of gerbera cultivars
Çizelge 3. *GA_3 'in gerbera çeşitlerinde çiçek sap uzunluğu üzerine etkileri*

	Pedicle length 1		**Pedicle length 2**		**Pedicle length 3**		**Mean of pedicle length**	
	Ulaş Cultivar	**Yeliz Cultivar**	**Ulaş Cultivar**	**Yeliz Cultivar**	**Ulaş Cultivar**	**Yeliz Cultivar**	**Ulaş Cultivar**	**Yeliz Cultivar**
Control	47.83aA	45.7bA	54.52cA	55.3bA	60.13cA	55.62cA	54.16cA	52.22bA
$GA_3$150	54.33aA	52.25aA	68.50aA	66.75aA	70.72aA	71.47aA	64.7aA	63.48aA
$GA_3$300	52.88aA	49.83abA	65.82abA	62.5abA	66.50abA	63.41bA	61.7abA	58.58abA
$GA_3$450	52.48aA	48.95abA	62.72bA	59.9abA	59.01cA	62.1bA	58.07bcA	56.97bA
$GA_3$600	51.04aA	48.22abA	68.50aA	61.9abA	63.91bcA	65.33bA	61.14abA	56.74bA
General Total	51.71A	48.99B	64.12A	61.29B	64.05A	63.46A	59.96A	57.60B

The difference between means shown in the same column with the same lower letters is insignificant. The difference between means shown in the same line with the same capital letters is insignificant (P<0,005)

Flower diameter (mm): The flower diameter represents a very important property for the cut flower sector, and the inspection of the effects of the growth regulator in flower diameter reveals that no significant difference exists for the first harvest and average flower diameters between the cultivars, while for the second and third harvests, the flower diameter of the Yeliz cultivar (125.53 mm) was found to be statistically higher compared to the Yeliz cultivar's (120.32 mm). When the

flower diameter property of the cultivars was inspected for different GA_3 treatment doses, the 150 ppm GA_3 dose revealed no significant difference for neither of the cultivars compared to the control in the first harvest, while for second and third harvests, the flower diameter of Ulaş (133.05 mm) and Yeliz (132.22 mm) at this dose was found to be statistically higher compared to the control (117.97 mm) group average flower diameter. When the results of the harvests performed after the first treatment (harvest 1) are inspected, the average flower diameter for the Yeliz cultivar at 300 ppm was found to be 110.12 mm. Significant differences were found compared to the control group. That being said, no statistically relevant difference was detected between other doses. The highest flower diameter obtained after the application of the second dose (harvest 2) occurred in the Ulaş cultivar treated with 150 ppm, which resulted in a flower diameter of 133.05 mm (Table 4). In their study, Pobudkiewicz and Nowak (1992) have determined that various doses had a positive effect on pedicle thickness and flower diameter, but shortened the plants' vase lives. Dash (2013) has conducted a study in 2013 and inspected the flower diameter, pedicle length, and yield properties with 50 and 100 ppm GA_3 treatment.

Table 4. The effects of GA_3 on flower diameter of gerbera cultivars
Çizelge 4. *GA_3'in gerbera çeşitlerinde çiçek çapı üzerine etkileri*

	Flower diameter 1		**Flower diameter 2**		**Flower diameter 3**		**Mean of Flower diameter**	
	Ulaş Cultivar	**Yeliz Cultivar**	**Ulaş Cultivar**	**Yeliz Cultivar**	**Ulaş Cultivar**	**Yeliz Cultivar**	**Ulaş Cultivar**	**Yeliz Cultivar**
Control	97.96aA	95.0bA	110.05cB	117.97cA	114.17bA	117.88bA	107.4cA	110.28aA
$GA_3$150	103.27aA	103.06abA	133.05aA	132.32aA	126.59aA	131.65aA	120.97aA	122.34aA
$GA_3$300	103.63aA	110.12aA	119.63bB	124.94bA	121.50abA	124.6abA	114.92abA	84.17aA
$GA_3$450	105.67aA	100.94abA	120.01bB	125.16bA	112.65bB	129.7aA	112.77bcB	118.59aA
$GA_3$600	101.33aA	106.97aA	118.88bA	127.24abA	118.91abA	124.4abA	113.04bcA	118.32aA
General Total	102.37A	103.20A	120.32B	125.53A	118.76B	125.72A	113.81A	110.74A

The difference between means shown in the same column with the same lower letters is insignificant. The difference between means shown in the same line with the same capital letters is insignificant (P<0,005)

Pedicle thickness (mm): Evaluation of the effects of the treatment on the pedicle thickness reveals that the GA_3 treatment had an effect of increasing the pedicle thickness with the second treatment onwards (Table 5). Based on the obtained data, the thickest pedicle was achieved by the Yeliz cultivar (6.40 mm) with 150 ppm GA_3 treatment and at the second treatment. Inspection of the data summarized in Table 5 revealed that 150 ppm GA_3 treatment caused an increase in the pedicle thickness in all of the test groups compared to the control group. Evaluation of the measurements performed after the initial treatment (harvest 1) reveals that no statistically relevant difference exists between the cultivars or the doses applied. But the measurements of pedicle thickness performed after the second treatment (harvest 2) indicate that 150 ppm GA_3 causes a significant difference between the Yeliz cultivar (6.40 mm) compared to the control group (5.25 mm). For the pedicle thickness of the Ulaş cultivar (6.26 mm), the treatment with 150 ppm GA_3 dose was statistically different compared to the other treatment doses (300-600 ppm). Similarly, 150 ppm GA_3 treatment causes statistically significant pedicle thickness increase for both the Ulaş (5.93 mm) and Yeliz (6.25 mm) pedicles compared to their control group counterparts (5.14 and 5.49 mm). The treatment also has good effects on tillering count and pedicle thickness, so we believe it may also be useful in year-long cultivations. In his study, Matsumoto (2006) also found out that GA_3 treatments result in better performance compared to controls.

Table 5. The effects of GA_3 on pedicle thickness of gerbera cultivars
Çizelge 5. *GA3'in gerbera çeşitlerinde çiçek sap kalınlığı üzerine etkileri*

	Pedicle thickness 1		Pedicle thickness 2		Pedicle thickness 3		Mean of Pedicle thickness	
	Ulaş Cultivar	Yeliz Cultivar	Ulaş Cultivar	Yeliz Cultivar	Ulaş Cultivar	Yeliz Cultivar	Ulaş Cultivar	Yeliz Cultivar
Control	4.85aA	4.34aA	5.32cA	5.25cA	5.14bA	5.49bA	5.1bcA	5.02bA
$GA_3$150	4.32aA	4.28aA	6.26aA	6.40aA	5.93aA	6.25aA	5.50aA	5.64aA
$GA_3$300	4.9aA	4.30aA	5.94abA	5.47bcA	5.22bA	5.08bA	5.35abA	4.94bB
$GA_3$450	4.63aA	4.25aA	5.48bcA	5.89abA	4.76bA	5.39bA	4.95cA	5.17bA
$GA_3$600	4.85aA	4.51aA	5.72bcA	5.76bcA	5.12bA	5.30bA	5.23abcA	5.13bA
General Total	4.71A	4.33B	5.74A	5.75A	5.23B	5.51A	5.22A	5.18A

The difference between means shown in the same column with the same lower letters is insignificant. The difference between means shown in the same line with the same capital letters is insignificant (P<0,005)

Cut flower weight (gr); this value was determined by weighing each of the flowers harvested from each plant during the whole test period. The effects of GA_3 treatment was found to have statistically significant effects on this value (P≤0,005). When Table 6 is evaluated, it can be seen that at the harvest obtained after the treatment with the third dose (harvest 3), the Yeliz cultivar achieves the highest cut flower weight (35.935 gr/unit), with 150 ppm GA_3 treatment. Evaluation of the effects of applications on the flower weight reveals that GA_3 treatment causes an increase of cut flower weight compared to the control group after the third treatment.

Table 6. The effects of GA_3 on the cut flower weight of gerbera cultivars
Çizelge 6. GA_3 'in gerbera çeşitlerinde çiçek ağırlığı üzerine etkileri

	Cut flower weight 1		Cut flower weight 2		Cut flower weight 3		Mean of Cut flower weight	
	Ulaş Cultivar	Yeliz Cultivar	Ulaş Cultivar	Yeliz Cultivar	Ulaş Cultivar	Yeliz Cultivar	Ulaş Cultivar	Yeliz Cultivar
Control	13.283aA	12.779aA	26.299aA	30.825aA	22.353bcA	27.047bA	20.644bcA	23.550bA
GA150	16.602aA	14.956aA	29.542aA	33.734aA	30.063aA	35.935aA	25.413aA	28.208aA
GA300	17.088aA	13.544aB	29.353aA	29.743aA	26.246abA	25.206bA	24.229aA	22.831bA
GA450	15.683aA	13.056aA	24.575aB	29.121aA	19.878cB	32.121abA	20.045cB	24.766abA
GA600	16.969aA	14.369aA	29.395aA	32.212aA	24.763abcA	28.867abA	23.709abA	24.110abA
General Total	15.925A	13.741B	27.833B	31.127A	24.660B	29.904A	22.807B	24.692A

The difference between means shown in the same column with the same lower letters is insignificant. The difference between means shown in the same line with the same capital letters is insignificant (P<0,005)

The measurements performed after the first (harvest 1) and second (harvest 2) doses were inspected as well, and no statistically significant difference was found between the doses. That being said, according to the findings of the measurements performed after the third dose (harvest 3), the difference between cut flower weights of Ulaş and Yeliz cultivars (30.063 gr/unit and 35.935 gr/unit) at 150 ppm GA_3 treatment and their control group counterparts (22.353 gr/unit and 27.047 gr/unit, respectively) was found to be statistically significant. Other doses, however, achieved no significant difference compared to the control group. Based on the measurements after the third treatment, significant differences between the cultivars (Yeliz: 32.121 gr/unit, Ulaş: 19.878 gr/unit) were determined at 450 ppm GA_3 treatment, while no influence of other doses was detected for the two cultivars. After the third treatment, the Ulaş cultivar at 150 ppm (30.063

gr/unit) and 300 ppm (26.246 gr/unit) GA_3 cut flower weights were found to be statistically important, compared to the cut flower weight at the 450 ppm (19.878 gr/unit). The analysis of the interaction between the GA_3 treatment and the cultivars reveal that the difference between the cut flower weights of the Ulaş (17.088 mm) and Yeliz (13.544) cultivars at 300 ppm GA_3 treatment for harvest 1 was statistically significant. Another significant difference was determined for the difference of Ulaş (24.757 mm) and Yeliz (29.121 mm) cultivars at harvest 2 for 450 ppm GA_3 treatment. Similarly, a statistically significant difference was determined for the difference of Ulaş (19.878 mm) and Yeliz (32.121 mm) cultivars at harvest 3 for 450 ppm GA_3 treatment. Analysis of the average cut flower weight reveals that a significant difference exists between the Ulaş (20.045 mm) and Yeliz (24.766 mm) cultivars at 450 ppm GA_3 treatment (Table 6).

Vase life (day): GA_3 treatment was found to have a statistically significant effect on the vase life property of the flowers at various configurations. The longest vase life was achieved the by flowers obtained from the Ulaş cultivar (16.33 days) in the first harvest with 450 ppm GA_3. Increased doses of GA_3 treatment was found to have both prolonging and shortening effects on the vase life of the plants. Inspection of the measurements performed after the first and second doses (harvests 1 and 2) reveals a significant difference between 300 and 450 ppm GA_3 treatments. In 300 ppm GA_3 treatment, a significant difference was detected between the Ulaş (15.16 days) and Yeliz (11.3 days) cultivars. The data obtained from harvest 3 were the same as the second dose data, so they were not taken into consideration. It was also determined that treatment with 450 ppm GA_3 dose was important in Ulaş cultivar, compared to the Yeliz cultivar. For the flowers harvested after the first treatment (2002).

(harvest 1), the flowers of the Ulaş cultivar (14.7 days) have longer vase life compared to the Yeliz variety (10.9 days) in the control groups, while the measurements after the second treatment (harvest 2) reveal that the Ulaş cultivar (15.43 days) has longer vase life compared to Yeliz cultivar (11.4 days) at treatment 300 ppm dose. Furthermore, the evaluation of the difference between the cultivars reveals that Ulaş cultivar has a longer vase life compared to the Yeliz cultivar. Inspection of the interaction between the GA_3 treatment and the cultivars reveal that the interaction is significant for the Ulaş cultivar at the first harvest control group (14.7 days), and at 300 ppm GA_3 (15.16 days) and 450 ppm GA_3 (16.33 days) dose groups. For the Yeliz cultivar, a statistically significant difference was detected for the control group (10.9 days), and for 300 ppm GA_3 (11.3 days) and 450 ppm (10.5 days) GA_3 groups. For harvest 2, the 300 ppm GA_3 treatment caused a significant difference between the Ulaş (15.43 days) and Yeliz (11.4 days) cultivars. Comparisons of average vase lives reveal significant differences for the Ulaş cultivar at control group (13.33 days), and 300 ppm (15.30 days) and 450 ppm GA_3 doses, and for the Yeliz cultivar at control group (11.1 days) and 300 ppm GA_3 (11.4 days) and 450 ppm GA_3 (11.3 days) (Figure 2). Yet, the findings of our study reveal that the highest vase life (16.33 days) was achieved by the Ulaş cultivar treated with 450 ppm GA_3 in the first harvest. In terms of vase life, there is no statistically significant difference between any of the Ulaş cultivar groups. For the Yeliz cultivar, 150 ppm GA_3 treatment resulted in 14.4 days vase life, while treatment with 600 ppm GA_3 resulted in 14.2 days. The results are mostly in line with the findings of Pobudkiewicz and Novak (1992), Sekar and Sujata (2001), El-Shafie and Hassan (1987) and Nair et al.

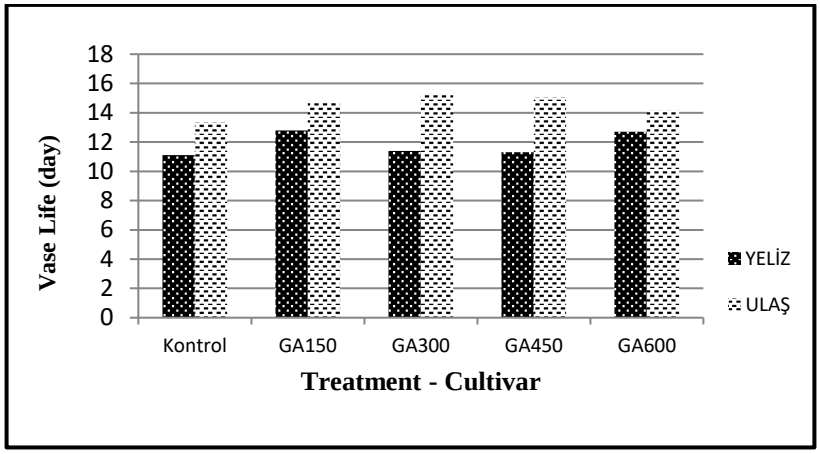

Figure 2. The effects of GA_3 on the vase life
Şekil 2. *GA_3 'in gerbera çeşitlerinde vazo ömrüne etkileri*

The tillering count: Evaluation of the GA_3 treatments on the tillering count reveal that the plants with the most tillering occurred in the parcels treated with 150 ppm GA_3. 300, 450, and 600 ppm GA_3 treatments were also found to have statistically significant positive effects on the tillering count. No statistically significant difference was detected between the cultivars or the different treatment groups after the first doses (harvest 1). But the evaluation of the measurements performed after the second dose (harvest 2) reveals that the Yeliz cultivars had more tillering (13.55 per plant) compared to the Ulaş cultivar at 300 ppm GA_3 treatment group. With 450 ppm GA_3 treatment, on the other hand, Yeliz cultivar had more tillering (14.35 per plant) compared to the Ulaş cultivar. The differences in terms of the tillering count were insignificant between the doses. The evaluation of the differences between the cultivars at each dose level revealed no differences for the harvest 1. That being said, for the harvest 2, the Yeliz cultivar was found to achieve more tillering at 300 ppm GA_3 (13.55 per plant) and 450 ppm GA_3 (14.35 per plant). For the Ulaş cultivar, more tillerings were counted at 300 ppm GA_3 (8.55 per plant) and at 450 ppm GA_3 (7.67 per plant) (Table 7).

Table 7. The effects of GA_3 on the tillering count of Gerbera cultivars
Çizelge 7. *GA_3 'in gerbera çeşitlerinde kardeşlenme sayısı üzerine etkileri*

	Tillering count 1		**Tillering count 2**		**Mean of Tillering count**	
	Ulaş Cultivar	**Yeliz Cultivar**	**Ulaş Cultivar**	**Yeliz Cultivar**	**Ulaş Cultivar**	**Yeliz Cultivar**
Control	6.40aA	7.01aA	10.78aA	13.98aA	8.58aA	10.50aA
GA150	5.61aA	6.37aA	11.80aA	14.34aA	8.70aA	10.35aA
GA300	5.71aA	6.56aA	11.40aB	13.55aA	8.55aB	10.05aA
GA450	5.15aA	6.66aA	10.19aB	14.35aA	7.67aB	10.50aA
GA600	6.32aA	6.59aA	11.59aA	13.03aA	8.95aA	9.81aA
General Total	5.84A	6.64A	11.15B	13.85A	8.49B	10.24A

The difference between means shown in the same column with the same lower letters is insignificant. The difference between means shown in the same line with the same capital letters is insignificant (P<0,005)

4. Conclusion

In our study, the highest flower diameter was achieved by the Ulaş cultivar (133.05 mm) treated with 150 ppm GA_3 after the second treatment. Also 150 ppm treatment was found the be the most successful for the flower diameter. At the same time, the highest pedicle thickness was also achieved by the Yeliz cultivar (6.40 mm) in the

second harvest at 150 ppm GA_3 treatment dose. In this study, the Yeliz cultivar achieved the highest cut flower weight (35.935 gr/unit) with 150 ppm GA_3 treatment at the third treatment. When the effects of the GA_3 application on the tillering count is inspected, the difference between the doses was found to be insignificant, while the difference between the 300 and 450 ppm Yeliz and Ulaş cultivars' tillering count was found to be statistically significant. For the cut flower sector to develop faster in the province of Tokat, the sector needs to offer more professional solutions, develop newer strategies, and make investments as dictated by the current economic era to renew itself, while the support of the local authorities and private organizations are also required. The ornamental plants are sensitive to environmental effects, but the sector has garnered great national and international interest and support.

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