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Production of *Fritillaria imperialis* L. Bulbs Using Different Methods and Monitoring the Development of Bulb Groups Under Export Size

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THİS study was carried out in two regions: Küçükdeliller village in Osmangazi district in Bursa province (altitude: 1100 m) and Yalova (altitude: 5 m). In the study, an incubation room (with an average of 20.33°C and 88.2% relative humidity) belonging to Yalova Atatürk Horticultural Central Research Institute and a warehouse with uncontrolled conditions were used. In this study, it was aimed to reproduce *Fritillaria imperialis* L. by different methods in different regions outside its natural distribution area and to monitor the development course of bulb groups under export size (10/12, 12/14, and 14/16 cm) in these locations. The best result in the reproduction of *Fritillaria imperialis* L. was obtained from the practice of incubating, cross-cutting application in the Küçükdeliller ecology, and the chipping application after the incubation process in the same ecology. Although there were losses in the number of bulb planted in both regions in the bulb groups under export size, increases in weight and circumference of the bulbs have been found over the years, especially in Küçükdeliller ecology. As a result of the research, it was determined that the ecology of Küçükdeliller is significantly better than the ecology of Yalova regarding the growth of bulb under export size.

Keywords: Bulb, Bulblet, Cross cutting, Chipping, *F. imperialis* L.

Introductıon

Turkey is a very rich country in terms of flower bulbs as well as other plants. It is the homeland of about 700 bulbous, tuberous, and rhizome species. Flower bulbs, which have been removed from nature for many years, are exported to various countries to be considered as park and garden ornamental plants, breeding materials, or medicinal plants. An important part of the flower bulbs, which are of special importance in terms of their contribution to the economy, are removed from nature (Karagüzel et al., 2007).

With the unconscious harvesting of these traded natural species, populations are gradually decreasing and nature is being destroyed (Kesici et al., 2010). While the export of some species is completely prohibited by regulations issued in various periods, for species that are allowed to be exported, collection and production quotas were introduced and bulb sizes to be exported were determined (Asil and Sarıhan, 2010).

Although the export of flower bulbs depends largely on their collection from nature, the cultivation and production of natural flower bulbs have begun to gain importance in recent years (Karagüzel et al., 2007). According to Kesici et al., (2010) and Kazaz et al. (2015), to prevent nature destruction and preserve biodiversity, harvesting from nature should be completely banned and the production of bulbs in cultural conditions should be encouraged.

Among the species of *Fritillaria* found in the flora of Turkey, two endemic species of *F. imperialis* L. and *F. persica* L., which have the

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potential to be used as ornamental plants of their flowers, have high commercial importance (Akyüz, 2018). *F. imperialis* L. is exported to many European countries, especially the Netherlands, due to its flamboyant flowers. It is also used in the pharmaceutical industry due to the alkaloids contained in its bulbs (Arslan et al., 2008 and Tekşen & Aytaç, 2011). *Fritillaria* L.'s ornamental and landscape plant qualities were discovered in the 16th century. The fact that they can be used not only as cut flowers but also for landscaping purposes, has allowed the bulbs of these plants to have a wide trading volume. For this reason, *Fritillaria* L. is one of the most preferred plants as ornamental plants all over the world and its bulbs are among the most commercialized plants (Kahraman and Özzambak, 2006).

According to Davis (1984), *F. imperialis* L. naturally spread around the provinces of Elazığ, Siirt, Bitlis, Van, Adıyaman, Hakkari, Malatya and Gaziantep in Turkey.

According to Genders, (1973), Rix and Phillips, (1981), all individuals of the genus *Fritillaria* L. found in 1000-3000 m altitude areas, slopes, cliffs, under trees and bushes have perennial bulbs and bloom in early or late spring. Bulbs of *Fritillaria* L. species vary in size and shape. The bulbs of *F. imperialis* L. and *F. persica* species are quite large (Arslan et al., 2008). The bulb of *Fritiliaria imperialis* is 7-8 cm in diameter without a flattened shell and it has 4-8 lance-shaped bright green stem leaves, its body length is 50-100 cm and the upper half of the body is in the form of a circular array. Its flowers are bell-shaped and 5-12 in quantity (Kahraman and Özzambak, 2006). Considering that Turkey is very rich in *Fritillaria* L. species, it is necessary to investigate the methods of reproduction by generative or vegetative means and to develop their cultivation in order not to collect and to protect these species in nature (Arslan et al., 2008).

Some Production Methods Applied in Bulbous Plants

The purpose of the processes applied to the bulbs of many species, such as chipping, cross-cutting and twin-scaling, is to break the apical dominance by destroying the growth point (Aksu et al., 2002).

Cross-Cutting: Different cutting methods can be applied to promote the formation of bulblets in bulb production. One of these methods is cross-cutting. The method is based on cutting 3-4 crosses immediately after harvesting, descending from the root part of the bulb to the middle part. After this process, the bulbs are kept in incubation rooms with a temperature of 20-32ºC in controlled conditions to promote the development of bulblets (Kaşka & Yılmaz, 1974, Hartman et al., 1990, Rees, 1992, Mengüç, 1995, Akat et al., 2017 and Aksu et al., 2002). The humidity of the incubation chamber should be 80-85% according to Kaşka and Yılmaz, (1974), Rees, (1992), Mengüç, (1995), Akat et al. (2017), and 90% according to Aksu et al. (2002). Haspolat and Özzambak (2018) stated that the cross - cutting method gave positive results in the production of *Crocus* taxa.

Chipping: In another method, bulbs are again cut down into pieces according to their size immediately after harvesting. Sliced bulbs are incubated for 1-3 months at a temperature of 20-25ºC after a week of dry conditions (Rees, 1992, Altay, 1996, Zencirkıran, 2002). In the chipping method, the size of the bulb part increases if the number of slicings decreases and the bulb reaches the flowering size in a shorter time (Aksu et al.,2002). According to Nazari (2019), the bulblets obtained by the chipping method are larger and their shoot-out rate is higher. For example, for fast growing daffodil bulbs, chipping is one of the traditional propagation techniques and large numbers of bulbs can be obtained in a short time (Knippels, 2012, Khalafalla et al., 2019 and Mishra, 2021).

Alkema, (1974), Rees, (1992) and De Hertoghand Le Nard, (1993), and Aksu et al. (2002) reported that in *F. imperialis* L's bulbs, a large number of bulblets can be obtained from an bulb by the chipping method and the resulting bulblets can reach export size after 3 seasons. Arslan et al., (2008) received the best result from the bottom cutting method in *Fritillaria persica* bulbs and Uluğ et al. (2010) from the horizontal cutting method.

While Choi Minsik et al. (1995) thought that in *Fritillaria* L. species, the number of bulblets, bulb width, and bulblet weight increased as the size of the breeding bulbs used in the study increased, Uluğ et al. (2010) thought that this process occurred in the species of *Fritillaria persica* Altan et al. (1992) stated that bulb losses occurred in the harvesting of bulbs under export size in *F. imperialis* L.

This study, which aims to reproduce *Fritillaria imperialis* L. in different regions outside its

natural distribution area by different methods and to monitor the development course of the material under export size in these regions consists of 2 separate sections. In the first part, it is aimed to be able to produce *F. imperialis* L. in areas outside the natural distribution area of the plant with different production methods, and in the second part, it is aimed to monitor the growth characteristics of bulb groups under export size in areas outside the natural distribution area.

Materıals and Methods

The first part of the study

In this section, *F. imperialis* L. bulbs with an average circumference size of 18.39 cm and an average weight of 95.4 g were used as material. The study was conducted in two separate regions with different ecologies. 1st Region: Production plots belonging to Yalova Atatürk Horticultural Central Research Institute (altitude: 5 m). 2nd Region: Bursa Province Osmangazi District foothills of Mount Uludağ Küçükdelliller village production plots (altitude: 1100 m) (Fig.1). Average temperature and precipitation values of the regions are given in Table 1.

47.9% of Turkey's land is loam. According to Gedikoglu (1990), soils with a water saturation ratio between 31-50% are loamy. As a result of the analyzes made according to the percentage of water saturation in Table 2, the soil structure of both areas was found to be loamy.

TABLE 1. Average temperature and properties of the locations (for 24 months).

Ecology	Temperature Values (°C)	Precipitation Values (mm)
Yalova	14,8	52,13
Küçükdeliller	9,5	53,3

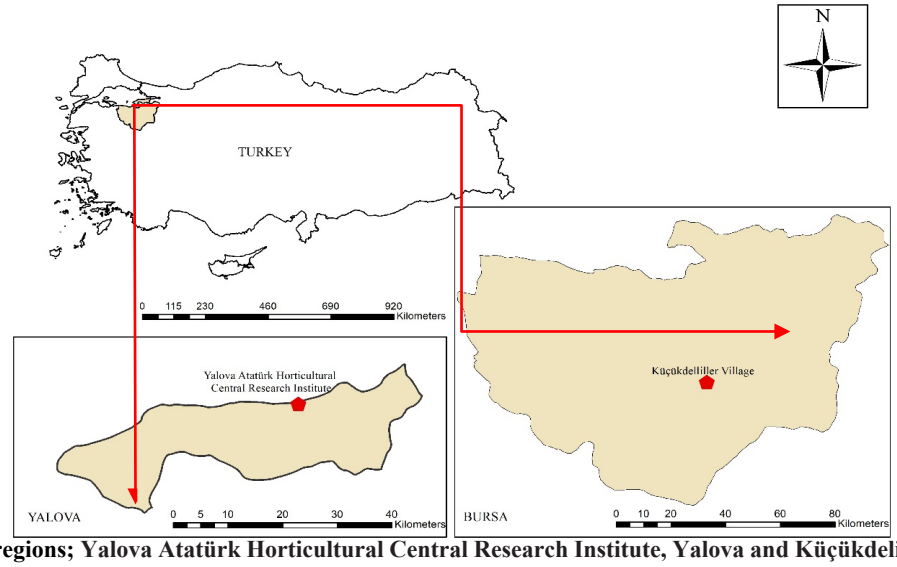

Fig. 1. Study regions; Yalova Atatürk Horticultural Central Research Institute, Yalova and Küçükdeliller village, Osmangazi, Bursa.

TABLE 2. Soil characteristics of the locations.

Ecology	Deepness (cm)	% Water Saturation Of The Soil	EC 25 (mmhos cm^{-1})	Ph	$CaCO_3$	OM	P	K
Yalova	0-20	47	0,13	7,9	13,69	2,07	25	288
Küçükdeliller	0-20	44	0,12	8,2	3,54	3,52	55	338

In addition, an incubation room belonging to Yalova Atatürk Horticultural Central Research Institute (average 20.33ºC and 88.2% relative humidity were recorded during the trial) and a warehouse with uncontrolled conditions were used in the study.

Two different cutting methods (cross-cutting and chipping) were applied to the bulbs and the group that was not cut was evaluated as the control group. Cuttings are applied just before the bulbs enter the incubation chamber. The bulbs, which are kept in uncontrolled conditions until the time of planting, were cut just before planting.

The experiment was established with 4 repetitions according to the Randomized Block Design and 10 bulbs were planted in each plot.

Bulbs measuring 18-20 cm to be used in the study were subjected to cleaning and disinfection (for 10 minutes in a 10% hypochlorite solution). The bulbs that will be kept in the warehouse under uncontrolled conditions were placed in 100x50 cm wire cases covered with perforated mesh and kept there until the planting time.

Different Cutting Methods Applied To Bulbs Before Planting

Cross-cutting: Two cuts (cross-cut) are made on the base of the bulb in a way that they cut each other in the middle. The depth of each of these cuts is down to the widest part of the bulb.

Chipping in four: The bulb was divided into four parts as a result of vertical cutting and four bulb slices were formed.

After the cutting operations described above were applied, the bulbs were subjected to disinfection. Bulbs that have been cut are kept in a dry environment for a week to ensure the formation of callus.

The control group was placed in 50x30 cm perforated plastic baskets containing clipped paper shavings in 30x40= 120 bulbs with cross-cutting and chipping in four applications. Plastic baskets containing the bulbs were placed in the incubation room. The bulbs and the control group were kept in the incubation room for 8 weeks. Cross-cutting and chipping in four applications were applied to untreated bulbs held in warehouses with uncontrolled conditions a week before planting, and then after being disinfected, callus formation was expected in a dry environment for a week.

Planting: All the bulbs kept in the incubation room and in uncontrolled storage conditions have two different ecologies.

They were planted on the Production Plots of Yalova Atatürk Horticultural Central Research Institute and the production plots in Bursa Küçükdeliller village. Plantings were made at a depth of 20x20 cm in the control group and cross-cutting groups, while in chipping groups, they were made at a depth of 15 cm with 10x10 cm row spacing and above.

The second part of the study: In this section, the effect of Yalova and Küçükdeliller regions on the development of bulb groups under export size is tried to be monitored. The circumferential measurements of the bulbs in 3 separate groups, which were planted for the purpose of growing bulbs and selected from the bulb groups under export size, are given in Table 3.

The disinfection method described above was applied to all bulb groups under export size and then the bulbs were placed in wire crates with perforated mesh on the floor. Groups of bulbs under export size were kept in an area where temperature and humidity were not controlled until planting time.

In this section, two ecologies, two different harvesting dates, and 3 different bulb circumferences are taken into consideration. For this purpose, bulbs under export size were randomly divided into groups of 10 for each size and planted in 4 repetitions (4x10 = 40 pieces). For each size, 40 bulb groups formed the harvesting group of the 1st year, while the other 4x10=40 bulb group formed the harvesting group of the second year. In this section, 240 bulbs were used. The plot widths were 35 cm and the bulb planting depth was 10 cm. The first harvest is done when a vegetation period has passed over the planting, and the second harvest is done when two vegetation periods have passed.

TABLE 3. The circumferentieal measurements of the bulbs under export size.

The Circumferentieal Measurements (cm)	10/12	12/14	14/16
Average circumference (cm)	11.1	12.92	14.98
Average weight (g)	19.77	30.61	45.77

Variance analyses of the data obtained from the 1st part of the study were carried out according to Yurtsever (2011), and the Duncan test was applied for factors and interactions that were statistically important, and groupings were made.

The data obtained from the second part of the study were evaluated comparatively according to years and ecology.

Characteristics of bulbs examined ın the study: The number of bulblets (quantity): The average number of bulblets obtained from each plot was counted.

Bulblet weight (g): The bulblets obtained from each plot were weighed and averaged.

Bulblet circumference (cm): The circumference measurement of the widest part of the bulblets obtained from each plot was measured in cm and averages were taken.

Results and Discussion

The Number of Bulblets: Significant ecological impact indicates that differences in altitude and climate between the ecologies of Küçükdeliller (22.62 units) and Yalova (5.91 units) have an effect on the formation of bulblets (Table 4). This confirms Genders (1973), Rix. and Philips (1981), which stated that *F. imperialis* L. was found naturally at altitudes of 1000-3000 m. On the other hand, the best result (24.68 units) was obtained from the chipping in four application (Table 5). As can be seen, the number of bulbs increased in the practice of chipping in four compared to the bulbs that were not cut (control group). This can be explained by the fact that each bulb slice tends to form bulblets separately, due to the excess fragmentation in bulbs that were chipped. The results are in line with Alkema, (1974), Rees, (1992), De Hertoghand Le Nard, (1993), Aksu et al., (2002), Arslan et al., (2008), Uluğ et al., (2010), who stated that a large number of bulblets can be produced from chipping practices.

TABLE 4. The effect o the ecologies on the number of bulblets*

Ecology	Average Number of Bulblets (unit)
Küçükde-liller	22.62 a
Yalova	5.91 b

*The difference between values expressed with different letters is significant at the 0.01 level.

TABLE 5. The effect of the applications on the number of bulblets*

Applications	Average Number of Bulblets (unit)
Control	3.56 c
Cross cutting	14.56 b
Chipping in four	24.68 a

*The difference between values expressed with different letters is significant at the 0.01 level.

The incubation process can be said to have different effects on the formation of bulblets according to ecological differences in the growth regions of bulbs Küçükdeliller incubated (26.41 units), Yalova incubated (10.75 units) (Table 6). Apart from the fact that the practice of chipping in four works well only when the effect of the applications is examined, as described above, it is seen that the ecological differences in both regions (altitude and climatic conditions) increase the formation of bulblets (Küçükdeliller (35.37 PCs), Yalova (14.00 PCs)) (Table 7). This can be explained by the idea that the incubation factor does not have the effect of triggering the formation of bulbs in bulb groups that are not cut (i-Incubated (2.37 pcs)), not incubated (4.75 pcs) (Table 8).

According to Table 9, incubation has been an important factor in the increase in the number of bulblets (38.50) in bulbs incubated and sliced in four in Küçükdeliller ecology. However, in the same ecology, the result (39.00 pieces) obtained from the bulbs that were cross-cut and not incubated indicated that the incubation factor for the cross-cutting method is not important in increasing the number of bulblets. In Yalova ecology, the best result (28.00 pieces) was obtained from the incubated chipping in four application. According to these results, it can be suggested that incubation is an encouraging factor for some applications in some ecologies, while in some applications it is not very effective. The result obtained from the cross-cutting application is in accordance with Arslan et al. (2008), who recommended the bottom cutting method for *F. persica* L. bulbs, and Aksu et al. (2002), who recommended cross-cutting.

TABLE 6. The effect of the ecology x incubation room interaction on the average number of bulblets*

Ecology	Incubation Room	Average Number of Bulblets (unit)
Küçükdeliller	Incubated	18.83 b
	Not incubated	26.41 a
Yalova	Incubated	1.08 d
	Not incubated	10.75 c

*The difference between values expressed with different letters is significant at the 0.01 level.

TABLE 7. The effect of the ecology x application interaction on the average number of bulblets*

Ecology	Applications	Average Number of Bulblets (unit)
Küçükdeliller	Control group	6.12 d
	Cross cutting	26.37 b
	Chipping in four	35.37 a
Yalova	Control group	1.00 d
	Cross cutting	2.75 d
	Chipping in four	14.00 c

*The difference between values expressed with different letters is significant at the 0.01 level.

TABLE 8. The effect of the incubation room x application interaction on the average number of bulblets*

Incubation Room	Applications	Average Number of Bulblets (unit)
Incubated	Control group	2.37 c
	Cross cutting	8.75 c
	Chipping in four	33.25 a
Not incubated	Control group	4.75 c
	Cross cutting	20.37 b
	Chipping in four	16.25 b

*The difference between values expressed with different letters is significant at the 0.01 level.

TABLE 9. The effect of the ecology x incubation room x application interaction on the average number of bulblets*

Ecology	Incubation Room	Applications	Average Number of Bulblets (unit)
Küçükdeliller	Incubated	Control group	4.25 cd
		Cross cutting	13.75 c
		Chipping in four	38.50 ab
	Not incubated	Control group	8.0 cd
		Cross cutting	39.00 a
		Chipping in four	32.25 ab
Yalova	Incubated	Control group	0.5 d
		Cross cutting	3.75 cd
		Chipping in four	28.00 b
	Not incubated	Control group	1.05 d
		Cross cutting	1.75 d
		Chipping in four	0.00 d

*The difference between values expressed with different letters is significant at the 0.01 level.

Bulblet Weight: The study showed that the difference between ecology was also effective in bulblet weight (57.96 g), Yalova (23.53 g) (Table 10). The effects of the applications control (84.60 g) were also different (Table 10). The different effects between the results can be explained by the excess weight of the small number of bulbs formed, as no cutting process is applied to the bulbs in the control group. Whereas, bulb pieces, which were chipped and therefore shrunk in size formed, formed bulblets with less weight. Naturally, the weight of these bulblets remained low. These results are in parallel with Uluğ et al., (2010) and Choi Minsik et al., (1995), which stated that while small bulbs can be obtained from small bulbs, heavier bulbs can be obtained from large and heavy bulbs and they are also in parallel with Aksu et al., (2002), which indicates that bulblets shrink as fragmentation increases. When the ecology x application interaction in terms of bulblet weight is taken into account, the best results Küçükdeliller (133.14 g), Yalova (36.07 g) were obtained from the control groups in both ecologies (Table 10). The findings here can also be explained by the excessive weight of the bulbs, which are not cut as mentioned above. In addition, this result reveals that the difference in altitude and climate between ecologies also affects the increase in bulb weight.

Bulblet Circumference: In terms of bulb circumference measure, similar data were obtained in the number of bulbs and the weight of bulblets. It has been observed that the ecology of Küçükdeliller (14.20 cm) works better than the ecology of Yalova (7.86 cm) (Table 11). As expected, bulb groups with excess weight (control group) had a large circumference (15.14 cm) at the end of the season (Table 11). This result is also in harmony with Choi Minsik et al. (1995), Uluğ et al. (2010) and Aksu et al. (2002).

In the Ecology x Application interaction, it is seen that the bulblets obtained from the untreated bulbs have a large circumference (Küçükdeliller, 21.35 cm) and the difference in altitude between the two ecologies is also effective on this issue (Table 11). This result is also in parallel with Uluğ et al. (2010).

Growing bulbs under export size ın different ecologies

In this part of the study, losses occurred in all bulb groups under export size (10/12, 12/14, 14/16 cm) in both ecologies, both in the harvesting of the first year and the second year, and these losses increased over the years. For example, at the end of the second year, bulb groups in Yalova ecology were completely lost in the soil and no value of the trial material could be recorded. For this reason, only average values were presented and evaluations were made based on these results, with the concern that statistical analysis of the results of the experiment in the second part of the study would be misleading (Table 12).

TABLE 10. The effect of the ecologies, the applications, and the ecology x application interaction on the average bulblet weight*.

Average Weight of Bulblet (g)	**Ecology**	Küçükdeliller		57.96 a
		Yalova		23.53 b
	Applications	Control grup		84.60 a
		Cross cutting		25.90 b
		Chipping in four		11.74 b
	Ecology x Application Interaction	Küçükdeliller	Control grup	113.14 a
			Cross cutting	26.98 b
			Chipping in four	15.92 b
		Yalova	Control grup	36.07 b
			Cross cutting	24.83 b
			Chipping in four	7.57 b

*The difference between values expressed with different letters is significant at the 0.01 level.

TABLE 11. The effect of the ecologies, the applications, and the ecology x application interaction on the average bulblet circumference*

Average Bulblet Circumference (cm)	**Ecology**	Küçükdeliller		14.20 a
		Yalova		7.86 b
	Applications	Control grup		15.14 a
		Cross cutting		10.39 b
		Chipping in four		7.56 b
	Ecology x Application Interaction	Küçükdeliller	Control grup	21.35 a
			Cross cutting	11.16 b
			Chipping in four	10.09 b
		Yalova	Control grup	8.93 b
			Cross cutting	9.63 b
			Chipping in four	5.03 b

*The difference between values expressed with different letters is significant at the 0.01 level.

TABLE 12. Characteristics of examined over the years on the bulb groups under export size and obtained results

Characteristic Of Examined	Bulb Circumference (cm)	Planting Bulb Characteristic (unit/g/cm)	Küçükdeliller				Yalova			
			I. Year Harvesting	% Loss/ Increase	II. Year Harvesting	% Loss/ Increase	I. Year Harvesting	% Loss/ Increase	II. Year Harvesting	% Loss/ Increase
The Number of Bulblet (unit)	10-12	10	8.5	-15	5.75	-42.5	3.25	-65	-	-100
	12-14	10	8,5	-15	7	-30	3	-70	-	-100
	14-16	10	8.25	-17.5	4.5	-55	5.25	-47.5	-	-100
The Weight of Bulblet (g)	10-12	19.77	31.88	61	44.64	125	24.06	21	-	-
	12-14	30.61	46.64	52	69.52	127	39.2	28	-	-
	14-16	47.77	79.11	72	101.83	122	59.93	30	-	-
Bulblet Circumference (cm)	10-12	11.1	13.15	15	14.47	30	12.68	14	-	-
	12-14	12.92	15.81	18	17.24	33	14.58	12	-	-
	14-16	14.98	17.78	15	19.51	30	16.67	11	-	-

When the average percentage values were taken into account, the bulb loss rate in Yalova ecology (2nd year harvesting, 100% loss) was higher than the Küçükdeliller ecology (Table 12). These results revealed that some of the bulbs planted in both ecologies were lost and the bulbs obtained at the end of harvest generally did not produce more than one offspring. The bulb losses experienced in the Yalova region over the years are in line with Altan et al. (1992), which stated that there may be losses in the harvesting of the material under export size in the years following planting.

In terms of bulb weight, increases in bulb weights were observed in the harvesting of both years in Küçükdeliller ecology in all bulb groups under export size. In the ecology of Küçükdeliller, there was an increase of 125% in bulbs with a circumference of 10/12 cm, 127% in bulbs with a circumference of 12/14 cm, and 122% in bulbs with a circumference of 14/16 cm at the end of

the second year (Table 12). In Yalova ecology, on the other hand, there was an increase of 21% in bulbs with a circumference of 10/12 cm, 28% in bulbs with a circumference of 12/14 cm, and 30% in bulbs with a circumference of 14/16 cm at the end of the first year and in the second year, the measurement could not be made since bulb losses reached 100% (Table 12).

When the circumferential measurements are taken into account, the ecology of Küçükdeliller gave higher values than the ecology of Yalova in the harvesting made in both years. As it happened with the bulblet weights, larger bulblets were obtained from bulbs with a large circumference. This result is consistent with Choi Minsik et al. (1995), Uluğ et al. (2010).

In terms of the circumferential measure of the bulblets, in all bulb groups under export size, an increase in bulb weights was observed in the harvesting of both years in Küçükdeliller ecology. At the end of the second year of harvesting, there was an increase of 30% in bulbs with a circumference of 10/12 cm, 33% in bulbs with a circumference of 12/14 cm, and 30% in bulbs with a circumference of 14/16 cm. In Yalova ecology, there was an increase of 14% in bulbs with a circumference of 10/12 cm, 12% in bulbs with a circumference of 12/14 cm, and 11% in bulbs with a circumference of 14/16 cm at the end of the first year of harvesting and since it was observed that the bulb losses reached 100% in harvesting in the second year, the measurement could not be made (Table 12).

The fact that Küçükdeliller ecology gives higher values for bulblet weight and circumference compared to Yalova ecology suggests that the altitude difference between the two ecologies is effective.

Characteristics and results studied over the years in bulb groups under export size are given in Table 12.

As a result; for the production of *F. imperialis* L. bulbs, cross-cutting without incubation was found to be the most suitable method among cutting methods in an ecology where the altitude is 1100 m, the average annual rainfall is 53.3 mm, and the average temperature is 9.5°C (Küçükdeliller). On the other hand, it turned out that the application of chipping in four (Avg. 20.33ºC and 88.2% proportional humidity) subjected to incubation in the same ecology could also be considered as a recommendable method.

Although there was some loss in the number of bulbs under export size, the bulb growth was observed over a two-year period.

The results obtained from this study will shed light on future studies of production and growth on *F. imperialis* L. In addition, the studies researching the production possibilities of *F. imperialis*, which is an endemic species, in large locations will also help the protection of this endemic species in nature.

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Conflicts of interest
The authors declare no conflict of interest.

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