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RESEARCH ON PROPAGATION METHODS OF PERSIAN LILY BULBS [*FRITILLARIA PERSICA LINN.*] WITH VARIOUS VEGETATIVE TECHNIQUES

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Abstract

Research was carried out to determine the propagation (of Persian Lilly [*Fritillaria persica Linn.*] bulbs) with various vegetative techniques at Ataturk Central Horticultural Research Institute in Yalova-Turkey. The experiment consisted of 24 combinations with two different locations (laboratory and store house), two different period (July and September), 5 different vegetative production techniques and control groups. The experiment was designed as a randomized block design with 3 replicates and 20 bulbs were used in each plot.

With the analysis of results, it was found that the number of bulblets were significantly high in a horizontal cutting of bulbs in July which were kept in the store house. This result indicated that the horizontally cutting the bulbs is the most suitable vegetative technique to get maximum bulbs of Persian Lily.

Introduction

Turkey has a great biological potential due to the ecological variations. It can be predicted that the biological richness will act as a source of an organic bank for the welfare of the next generations. The sustainable living materials in the gene pool naturally existing for millions of years should not be diminished. Turkey is among the countries possessing a region of enormous species of various characteristics (Kence, 1992; Zeybek, 1996; Onder, 1997).

The *Fritillaria* species is one of the most important crops which have been exported from Turkey for over a hundred years. This extensive export is mostly to the Netherlands as well as a small share to Germany, England, U.S.A., Japan and Denmark. Bulbs which grow wild crop got the commercial importance in late 1960's. Scientists warned that some measures should be taken to protect the species from natural damage that occurred through excessive export bulbs. These discussions continued until 1974. In the following years Turkish commercial enterprises were allowed to export the bulbs and baby bulbs which were produced by themselves; unfortunately, there was not enough encouragement and information given to them for production. In connection with this, a regulation was passed by the Ministry of Agriculture and Rural Affairs in 1989, to collect, produce, store and export the crop, without damaging and consuming from the natural environment. In 1997 it was forbidden by this regulation to export bulbs of some natural occurring species. *Fritillaria species* are also banned group (Korkut 1992a; Ildir, 1993; Baştug & Unal, 1997; Onder, 1997). *F. persica and F. imperialis* were allowed to export on condition that their propogation, will be carried out by the enterprises in the field conditions.

F. persica is an endemic species which grows under natural conditions in Turkey. It can be seen in Hatay, İçel (Gülnar) and Adıyaman in South Anatolia. The bulbs with 16 cm circumference are harvested and exported. There is no data available about the amount of exportation of *F. persica* available (Ekim *et al.*, 1991; De Hertogh & Le Nard, 1993).

Fritillaria persica grows naturally in the Southern Mediterranean region, Lebanon, Jordan and north-west Iran. This species grows on bushy lands covered with heath near the areas where *Berberis sp.* grows. It can be seen at 700 m height from sea level. Ekim *et al*, (1991) stated that the ecological border for this species is 1000 m, but Rix & Phillip (1981) claimed, it is 2800 m above the sea level. The crop can be successfully, grown at different sea levels from 700 m to 2800 m (Altan *et al.*, 1992).

This research is made to describe the various vegetative techniques of *Fritillaria persica* to protect itself against the danger of disappearing from nature.

The *Fritillaria species'* name was based on the word "fritullus" which means a cup marked with checks in Latin. It is an "intermediate species" between the *Lillium* and *Tulipa* (family: Liliaceae, subfamily: Liliaidea) species having great economic importance. Some species of *Fritillaria* have been grown for years in Europe and America. *Fritillaria persica* Linn. (syn. *F. arabica, F. eggerii* Bornm., *F. libernatica "*Boiss*"* Baker) have bulbs with scales. It is included in the group of "spring time blooming bulbs". Some species are grown in the pots (Altan *et al.*, 1992; Bryan & Griffiths, 1995).

The bulbs of this plant have a diameter of 3-5 cm and include 2-3 succulent leaves. The body which appears from the bulb grows up to 20-60 cm. Especially the main leaves of young bulbs are wider than the others. Lanseolate leaves are sometimes curved, have a maximum length of 15 cm and a maximum width of 3 cm. The leaves are lined up in alternate positions and they number from 10 to 25. The flowers are in racemose position and they are composed of 7 to 20 flowers. The light aromatic flowers have the shape of a bell. Both is dull light purple or deep purple color. The number of stamens is 6, the length of flaments is 5-6 mm. There's only one pistil which is consist of 3 carpels. The style has a length of 6-8 mm. The fruit have 3 valves and loculist capsula carpels are found among the middle veins. They contain so many seeds (Ekim *et al.*, 1991).

The resting period of *F. persica* bulbs are very short. De Hertogh & Le Nard (1993) found that the beginning of the vegetation period for this plant is August. For that reason the bulbs should be planted in late summer or early autumn. If they are not planted, the roots begin to form on the plants which are left in store house.

The formation of the bulblets of *F. persica* occurs after the disappearance of the main bulb. The quality and the size of the flower is directly related with the circumference measure and weight of the matter bulb. In addition, the ecological conditions and some cultural applications affect the size of the bulblets (Altan, 1989).

In a study which was made to determine the production conditions of some geofits in the "Southeast Anatolia" region which have economic importance, bulbs *of F. persica* with 19 cm circumference were used. The circumference of the bulbs at the end of the vegetation period, productivity and the growing conditions of bulblets were studied. It was concluded that the average amount of bulb loss is 4.5%, the increase of bulb circumference is 2.3% and the occurring of bulblets is 35.5% (Altan *et al.*, 1992).

Bulbs without tunic are propagated by scales. In this method every scale is separated from the main bulb and put in cases. By this technique at every possible eye of each scale the bulblets occur. The scales can be rooted directly but when they are kept in moist sand,

peat or moist vermiculite in 18°-20° C for 6 weeks the result is better (Altan, 1989; Hartman *et al*, 1990; Korkut, 1992b).

One of the techniques which is made to encourage the formation of bulblets is "crosscutting". This technique has various applications such as "cutting of the basal plate", "scoring" and "horizontal cutting". In this technique the growing conic on the basal plate is wounded by a special knife to collect the growing potential on the bulblets occurred on the basal plate during the harvesting period. The important point is to leave the bulbs in dry sand or soil for formation of "callus". After the formation of callus the bulbs are left in a dark place at 20-32° C for 2 months for growth of bulblets (Urgenc, 1992).

De Hertogh & Le Nard (1993) based on Langeslag (1989), applied a horizontal cutting to the widest part of growing axis of *F. persica* bulbs and this operation encouraged the production of bulblets. But after this method of cutting the necessity of keeping the bulbs in a moist places increased "Fusarium" infection.

The "chipping" technique is applied to the types which do not form bulblets and also to some new types to obtain a faster production period. This method is an expensive way to get a large amount of bulblets from a small number of precious bulbs. The bulb is divided into pieces vertically. A piece of basal plate must be left on each of the bulb cuttings. The probability of damage is higher in the chipping technique than the others. In this method, the sudden loss of water encourages the production of bulblets. For this reason, the bulb cuttings should be planted in moist place after keeping in a dry place for one week. Application of hormones is not suggested since the bulb is a part of the plant that contains "store substances" and this application may cause a susceptibility to disease. Some doses at certain intervals, however, may be applied (Van Leeuwen, 1993; Anon., 1996).

Material and Method

In this experiment, 1440 *F. persica* bulbs with 16-18 cm circumference and 70.77 g of average weight were used. The bulblets produced at the end of this experiment were planted in the production area of Ornamental Department, Ataturk Central Horticultural Research Institute.

The experiment consisted of 24 treatments with two different locations (laboratory and store house) with two different line periods (July and September), and 5 different vegetative techniques of bulbs production. The experiment was designed as a randomized complete block design with 3 replicates and 20 bulbs were used in each plot.

1440 bulbs with 16-18 cm circumference were grouped in 20 by random to apply the vegetative propagation techniques. The bulbs were treated with 10 % Sodium hypoclorite for 10 minutes and dried, they were then plugged into sandofan M (Oxadixyl+Mancozep) solution and dried (Anon., 1994). The operations explained above was applied to 720 bulbs and the other 720 bulbs were stored in cases filled with plane shavings in laboratory for the application in September.

The following vegetative techniques for bulb production were applied to the bulbs before planting:

Cross cutting: Two cross cuttings were applied to the bulb. In this way the growing conics on the basal plate which were cut encouraged to form bulblets (De Hertogh & Le Nard, 1993; Zencirkiran, 2002; Aksu *et al*., 2002).

Scoring: The growing conic in the centre of the bulb was taken out with a special knife. In this way the growing potential was collected at the bottom of the bulb plate which encourages the formation of bulblets (Hartmann *et al*., 1990; Zencirkiran, 1998; Aksu *et al*., 2002).

Horizontal cutting: The bulbs were cut vertical to the growing axis in two, on the widest part horizontally (Van Leeuwen, 1993).

Vertical cutting, 4 cips: The bulbs were cut into 8 pieces vertically and bulb cuttings were formed. A little part of basal plate was left on each of the bulb cutting (De Hertogh & Le Nard, 1993; Seyitoğlu & Zencirkiran, 2008).

Vertical cutting, 8 chips: The bulbs were cut into 8 pieces vertically and the bulb cuttings were formed. A little part of basal plate was left on each of the bulb cutting (Van Leeuwen, 1993; Seyitoğlu & Zencirkiran, 2008).

Control: The group to which none of the vegetative production techniques were applied is called "the control group".

The analyzed properties and analyzes methods are given below:

The number of bulblets: The number of all the healthy bulblets which formed from the main bulb and the bulb cuttings during vegetation period after planting was taken as parcel average.

The weight of bulblets (g): The weight of all the healthy bulblets from each parcel was taken as parcel average.

Circumference measures of bulblets (cm): The measure of the widest part of the bulblets from each parcel was taken as parcel average.

The variance analyses was made for the results which were observed at the end of the experiment which were conducted in the randomized block design and LSD(Least Significant Degree) was used to determine the groups where significant differences occurred according to Yurtsever (1984) and Duzgunes *et al*., (1987).

Result and Discussion

The number of bulblets: Analysis was made to determine the effect of technique x place x period, technique x place, technique x period, place x period interactions and technique, place and period main effects to the number of bulblets. As a result of this analyses; technique and period main effects and technique x place, technique x period, place x period and technique x place x period interactions have an importance of 0.1%, "place main effect" has no importance for the number of bulblets. The effects of interactions and the main effects are given in Table 1. According to Table 1; the best result as regards the number of bulblets was obtained from the application of "horizontal cutting" on July at which the bulbs were kept in store house with the number 128.33, the application of "vertical cutting, 8 chips" on July in which the bulbs were kept in laboratory following this with the number 103.66 and the third one is the application of "vertical cutting, 4 chips" on July in which the bulbs were kept in store house with the number 98.33. The least number of bulblets 18.00 was observed from the control group which was planted on July and September and kept in laboratory.

Table 1. The average values of all the properties which were analyzed at the experiment.

Analyzed property	Application technique	Store house		Laboratory		Technique
		July	September	July	September	Main effect
Number of bulblets	Cross cutting	60.00	36.00	32.33	59.33	46.92 C
	Scoring	29.66	34.66	24.00	25.66	28.50 D
	Horizontal cutting	128.33	22.66	99.33	48.33	74.66 A
	Vertical cutting (4 chips)	98.33	32.66	65.33	20.66	54.25 C
	Vertical cutting (8 chips)	67.33	24.66	103.66	54.00	62.41 B
	Control	19.00	22.00	18.00	18.00	19.25 E
	Place main effect	47.94 A		47.39 A		**General Avarage**
	Period main effect	62.11 A		33.22 B		47.66
Weight of bulblets (g)	Cross cutting	10.56	4.64	10.34	8.50	8.51 C
	Scoring	23.41	13.95	28.18	23.92	22.37 B
	Horizontal cutting	4.80	6.22	4.90	6.54	5.62 D
	Vertical cutting (4 chips)	4.30	4.37	6.60	4.69	4.99 D
	Vertical cutting (8 chips)	2.00	2.44	2.52	2.57	2.38 E
	Control	40.54	43.10	47.25	33.02	40.98 A
	Place main effect	13.36 B		14.92 A		**General Average**
	Period main effect	15.45 A		12.83 B		14.14
Circumference measure of bulblets (cm)	Cross cutting	8.74	6.71	8.72	8.14	8.08 C
	Scoring	12.21	9.09	12.39	10.97	11.17 B
	Horizontal cutting	5.64	6.52	5.58	6.30	6.01 E
	Vertical cutting (4 chips)	6.18	6.46	7.46	6.74	6.71 D
	Vertical cutting (8 chips)	4.54	4.86	4.89	5.06	4.84 F
	Control	13.85	14.42	14.31	13.11	13.92 A
	Place main effect	8.27 B		8.64 A		**General Average**
	Period main effect	8.71 A		8.20 B		8.45

The technique horizontally cut gave the highest number of bulblets 74.66. The lowest value was observed from the control group with the number 19.25.

The application of horizontal cutting gave a better result than the other applications. The reason of this might be as defined; the bulb chip at the bottom side of the bulb with a piece of basal table which was formed as a result of vertical cutting might react as a group of bulb cuttings. This observation verifies the conclusion above. Vanleeuwen (1993) based on De Hertogh & Le Nard (1993) describes this application as a "special vegetative propagation method" for to *F. persica*.

The reason of bullet production in July and low in September may be the short resting period of the bulb which germinate in August because pre evolved young roots were observed during September application as defined by De Hertogh & Le Nard (1993).

The non significance results were sea different place indicated that different conditions do not affect the number of bulblets during formation.

The weight of bulblets: The variance analyses were made to observe the effects of technique x place x period interactions, technique x place, technique x period, place x period interactions and technique -place-period main effects. According to this analyses; technique -place-period main effects, technique x place, place x period, technique x period interactions and technique x place x period interactions has an importance of 0.1 %. The effects of interactions and the main effects on the average weight of the bulblets is given in Table 1. According to Table 1; the highest value of weight was observed from the control group which was left in laboratory on July with 47.25g, the control group which was left in the store house on September follows this with 43.10 g. The lightest bulblets were observed in the group of bulbs which were cut in 8 chips, and left in the store house in July with 2.00 g, the group of bulbs which were cut in 8 chips, left in the store house on September following this with 2.44 g. This followed with group of bulbs which were cut in 8 chips, left in laboratory on July following them with 2.52 g, the group of bulbs which were cut in 8 chips, left in laboratory on September with 2.57 g .

The highest value was observed from "the control group" with 40.98 g regarding weight of bulblets, the lowest value was observed from the group which was cut in 8 chips with 2.38 g. Since no applications were applied to the control group, this is an expected result. In the group of bulbs which were cut in 8 chips each of the bulb cuttings formed large number of bulblet consequently these bulblets were lighter than the other group of bulblets.

The weight of bulblets obtained from July sowing i.e., 15.45 g uses more than September i.e., 12.83 gr. This result shows that the resting period of the bulb is very short. The effect of laboratory main effect with 14.92 g is more than the store house main effect with 13.36 g. This result shows that the different conditions are important regarding the weight of bulblets, but additional researches are needed.

Circumference measures of bulblets: The variance analyses was made to observe the effects of technique x place x period, technique x place, technique x period, place x period interactions and technique -place-period main effects to the circumference of bulblets. According to this analyses; technique -place-period main effects and technique x place, technique x period, technique x place x period interactions has an importance of 0.1%, place x period interactions has no importance.

The effects of interactions and main effects on the average circumference measures of bulblets is given on Table 1. According to this table, the control group which were left in store house on September gave the highest value of circumference measure with 14.42 cm, the control group which were left in laboratory on July follows this with 14.31 cm. The shortest circumference measure was observed from the group of bulblets which were cut in 8 chips and left in the store house on July with 4.54 cm.

The highest value of circumstance was observed from "the control group" with 13.92 cm and the lowest value was observed from the technique of "cutting in 8 chips" with 4.84 cm. This result is parallel with the results which were observed from the research about "the weight of the bulblets". However, bulblets with heavier, thin egg-like bulblets with shorter circumference lighter, pressed egg-like with longer circumference measures were observed. The effect of laboratory main effect to the circumference of bulblets with 8.64 cm is more than the effect of store house main effect with 8.27 cm. This result shows that different conditions affect the circumference of bulblets. The effect of July main effect with 8.71 cm is more than the September main effect with 8.20. This result verifies De Hertogh & Le Nard (1993).

Conclusion

The results of this research which was carried on the different vegetative propagation techniques are given below:

The largest number of bulblets was observed from the group which was cut horizontally on July and kept in store house, the heaviest bulblets was observed from the group to which none of the propagation techniques was applied and left in laboratory on July, the longest circumference measure of bulblets was observed from the group which was left in store house on September to which none of the propagation techniques were applied.

The result of obtaining the average number of 128.33 bulblets, 4.80 g weight and 5.64 cm circumference from the bulbs with 16-18 cm circumference which were cut horizontally and left in store house on July shows that this vegetative propagation method is the best one for this species.

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