



Effects of Different Growing Medium on Obtaining Bulblets from Bulb Scales in Oriental *Lilium* 'Siberia' Cultivar

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ABSTRACT

This study was carried out to determine the best medium for obtaining bulblets in the Oriental *Lilium* 'Siberia' plant using bulb scales and different media. In the research, six different growing mediums were used as growing media: soil (control), peat, soil + peat, perlite, perlite + peat, and peat + sand. In the experiment, the number of bulblets, bulblet width, bulblet length, number of healthy and infected bulb scales, and the time it took for the first bulbs to formation were measured. As a result of the study, the highest number of bulblets (110) were obtained from peat + sand. The growing medium with the highest values of bulblet width (11.38 cm) and bulblet length (16.27 cm) was determined to be peat. The highest number of healthy bulb scales (54) was obtained from perlite medium, and the highest number of infected bulb scales (20) was obtained from soil medium. In terms of the formation time of the first bulblets, perlite medium (15 days) was the growing medium where the earliest bulbs were obtained, and the latest bulblets were obtained from control (soil) and soil + peat (40 days). In general, the quality of bulblets obtained from peat medium was better than that from other mediums. In this regard, peat growing medium is recommended to obtain quality bulblets, and peat + sand is recommended if the number of bulblets is desired to be high.

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Introduction

Lilies are a geophyte with showy and colorful flowers. Lilies, which are very important commercially, are widely grown worldwide. Lily bulbs consist of fleshy scales, which are responsible for storing nutrients. Lilies do not have a protective layer (tunic) surrounding the bulb, which is why the bulbs are white [1].

Oriental *Lilium* 'Siberia', a hybrid of the oriental group, has white and fragrant flowers. The upper part of the bulb is yellow and the lower part is white. Bulb development and size vary depending on species, cultivar and plant age. After planting the seeds, the development of the bulb reaches 4-7 cm in the first year, 12-16 cm in the second year and 16 cm in the third year. Oriental *Lilium* 'Siberia' bulbs bloom approximately 110 days after planting. 6 - 8 flowers grow on each stem, which consists of a bulb, and the plant can grow up to 90-110 cm. The best development occurs in loamy-sandy soils with good drainage [2]. Seeds used in the production of ornamental plants are mainly imported. In addition to seeds, bulbs used in the production of bulbous plants are also imported. This situation increases foreign dependency on ornamental plants and production costs, causing the country's resources to be exported [3].

The ornamental plants sector is known as the sector that provides the highest added value per unit area when compared to other areas of the agricultural sector [4]. Although Turkey's ornamental plant production and exports have increased recently, it has yet to reach the desired target. Imports of ornamental plants amounted to \$37,517 and exports amounted to \$114,391. Natural flower bulb production areas are quite low, 506 decares [5]. Increasing R&D studies so that the ornamental sector can develop will contribute to our country's production and therefore its economy.

Soilless growing media have been widely used in ornamental plant cultivation in recent years [6]. It has been reported that growing mediums consisting of different growing mediums and their components significantly affect plant development [7]. When Asiatic lily hybrids 'America' and 'Novecento' varieties were grown in a different growing medium, it was reported that the medium contained a mixture of soil and rice husk and a mixture of perlite and river sand gave the best results in terms of stem length and dry matter accumulation [8].

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In Asiatic and Oriental varieties 'Gronde' and 'Cassandra', flower stem length, number of leaves, number of flowers, flower diameter, flowering time, vase life and leaf chlorophyll content were measured in plants grown in cocopeat, gravel, sand, peat and perlite media. Growing mediums significantly affected only flower stem length [9]. In another study on Oriental Liliium, earliness, quality, fresh and dry weights of flowers and leaves, root length, number of roots, bud length and root length parameters were examined. It has been reported that the best results are obtained from cocopeat medium [10]. Nine different growth media consisting of soil, chicken manure, sawdust and river sand and their combinations were used in *Mussaenda philippica*. The best results were found in the soil + sawdust + chicken manure mixture [11]. In another study, nine different media were prepared using chestnut shell, perlite, peanut shell, sand, garden soil, barnyard manure, peat, coconut shell and slag for the *Lilium* LA hybrid 'Ceb Dazzle' cultivar. It has been determined that the best results are obtained from a mixture of perlite and peanut shell (1:1) [12]. Again, in the 'Connecticut King' cultivar, shrub soil, coniferous soil, perlite and field soil were used. In the research, in terms of shoot period and heading period; the best results were obtained from plants grown in 1:1:1 field soil + perlite + coniferous soil and 1:1 shrub soil + coniferous soil mortars. In terms of plant height and maximum number of bulbs, the best results were obtained from the mixture of heather soil and coniferous soil (1:1). It has been reported that as the ratio of field soil in the mixtures increases, the flowering and flower quality of the plants decrease [13]. In their studies on different species and varieties of lily, researchers have revealed that different growing mediums have different effects on plant quality and yield. Studies on lilies are mainly studies on plant development. Therefore, this study aimed to determine the effects of different growing mediums for obtaining bulblets from bulb scales in the Oriental *Lilium* 'Siberia' cultivar on the yield of bulblets and to offer suggestions to those who aim to produce bulbs from bulb scales.

Material and Methods

This research was carried out in the application greenhouse of Ünye Agriculture and Forestry Directorate (41°06'17.7"N 37°23'04.0"E) during the summer and autumn growing periods of 2014. Oriental *Lilium* 'Siberia' cultivar, used for cut flower purposes, was used in the research. Flower bulbs were obtained from a commercial company. Before removing bulb scales, diseased, injured, wrinkled and unhealthy bulbs were removed. After the outermost scales of the bulbs were removed, the remaining three rows of scales were separated to include a piece from the growth point at the bottom of the bulb. The separated bulb scales were kept in a solution containing 1% Captan for 30 minutes. Then, the stamps were kept in a cool and shaded place to dry the surface. For planting bulb scales, 60 liter plastic crates with perforated and permeable sides and dimensions of 520×365×310 mm were used. The inside of the crates is covered with black plastic mulch. After the crates were filled with growing material, 40 bulb scales were placed at equal intervals in each crate (Figure 1), and then the flakes were covered with 1 cm of growing material. Plantings were made on June 10. In the study, six different growing medium consisting of peat (0-6 mm, PH: 5.5-6.5 and 0.6 kg NPK m⁻³), perlite (0.2- 0.5 mm) and sand were used as growing material (garden soil) (Table 1; Figure 1).

Table 1 Six different growing mediums were used as experiment factors

	Growing media	Mixing ratios
1	Soil (control)	1
2	Peat	1
3	Soil+peat	1
4	Perlite	1+1
5	Perlite+peat	1+1
6	Peat+sand	1+1

In the experiment, irrigation was done manually. The crates containing bulb scales were given only water from planting to emergence. In the experiment, number of infected bulb scales, number of healthy bulb scales, initial formation time of bulblets, number of bulblets, bulblets width and bulblets length were measured. The experiment was set up in three repetitions according to the completely randomized plot design, and 40 bulb scales were planted in each replicate plot (case). The data obtained from the experiment were evaluated using the SPSS 20 statistical package program. After applying analysis of variance to the data, differences between growing mediums were compared using the Duncan test (p<0.05).



Fig 1 Stages of bulblet production from bulb scales in the Oriental *Lilium* 'Siberia' cultivars (a. Separating the scales from the mother bulbs, sorting the bulb scales, b. Preparation for the spraying process, c, d. Planting process in plastic cases containing the prepared media, placing the boxes in the greenhouse and watering process)

Results and Discussion

Effects of growing medium on the number of bulblets

According to the study findings, the number of healthy bulb scales was 54 in the perlite, while the lowest number of healthy bulb scales was 40 in the control (soil). Again, the lowest number of infected bulb scales was obtained from perlite (4), and the highest was obtained from control (soil) (20) (Table 2). No sterilization process was applied to the media used in this study. Soil and sand taken from their natural environment are less sterile mediums than perlite and peat. In the study results, it is thought that the rate of infected bulb scales was higher in mediums containing soil and sand. It is assumed that the development of infection is low due to the absence of living matter in the perlite mediums.

Table 2 Numbers of infected and healthy bulb scales in growing medium

Growing medium	Number of infected bulb scales	Number of healthy bulb scales
Soil (control)	20 a	40 b
Peat	14 b	45 ab
Soil+peat	17 ab	42 b
Perlite	4 c	54 a
Perlite+peat	12 bc	47 ab
Peat+sand	14 b	43 b

Data shown with different letters in each column are statistically significant ($p < 0.05$).

In the study, when the bulblet formation times from bulb scale were compared in the growing medium, the earliest medium was perlite with 15 days, and perlite + peat medium followed with 20 days. It was determined that control and soil + peat were the slowest growing mediums with 40 days (Figure 2). Li et al. [16] in their study on *Lilium davidii* var. detected the earliest bulb formation on the 15th day, similar to this study.

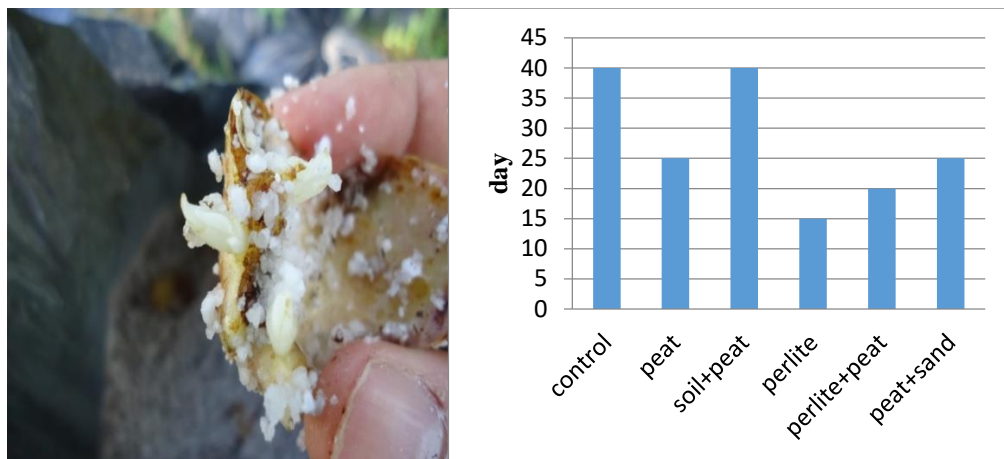


Fig 2 Initial formation time and appearance of bulblets in perlite medium (15th day)

Different growing media used to obtain bulblets statistically affected the number of bulblets. The highest value in terms of the average number of bulblets was obtained from the peat + sand (110), followed by the perlite + peat (95). The lowest value was obtained from the control growing medium (25) (Table 3; Figures 3 and 4).

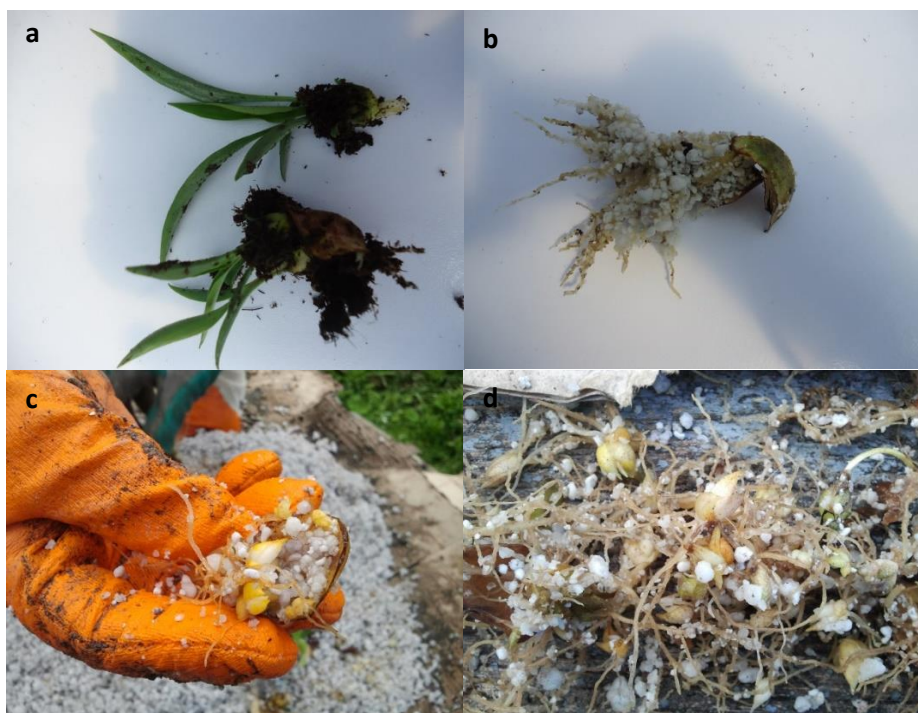


Fig 3 Obtaining bulblets from bulb scales in the Oriental *Lilium* 'Siberia' cultivar (a. Bulblets obtained from peat medium, b. Bulblets obtained from perlite medium, c. Bulblets obtained from a flake, d. A group of bulblets removed from perlite medium)

In the study, it was seen that the peat and sand mixture was more effective on bulblet formation than other applications. This may be associated with the nutrition provided by the peat, the water permeability provided by the sand, and the possible mineral content in the sand. The results of this study are compatible with the results of some previous studies showing that a mixture of organic matter and sand is more effective. Thus, it has been reported that in the Oriental *Lilium* 'Siberia' cultivar, the highest value in the number of bulblets was obtained in the peat and sand, and the lowest value was obtained in the sheep manure and sand [14]. In the study conducted by Eken and Şirin [12] on the *Lilium* LA hybrid "Ceb Dazzle" cultivar, although the effect of the media on the number of bulblets was found to be insignificant, the highest results were obtained from the peanut shell and sand medium, with 17.50. In a study on bulb development, the highest bulblet rate (43.8%) was obtained in a Taurus snowdrop grown in coconut [17]. In addition, in another study conducted on lilies, it was stated that the best values in terms of the number of mother bulbs and bulblets were obtained from the soil-rice husk mixture and river sand-perlite mixture [8]. Again, in the *Oriental Lilium* 'Siberia' cultivar, the growing medium using sheep manure reduced the number of bulblet but increased their size [14].

Table 3 Effects of growing medium on average yield of bulblet

Growing medium	Bulblet width (mm)	Bulblet length (mm)	Number of bulblets
Soil (control)	8.62 c	12.00 c	25 e
Peat	11.38 a	16.27 a	60 d
Soil+peat	10.30 b	14.02 b	50 d
Perlite	8.22 c	13.36 bc	81 c
Perlite+peat	9.45 b	14.10 b	95 b
Peat+sand	8.00 c	12.33 c	110 a

Data shown with different letters in each column are statistically significant ($p < 0.05$)

In this study, the different media used to obtain bulblets from bulb scales affected the bulblet length statistically significantly (Table 3; Figures 3 and 4). The best result for bulblet length (16.27 mm) was obtained in peat medium, while a lower result (12.00 mm) was obtained in soil (control) medium. In the study conducted on the Oriental *Lilium* 'Siberia' cultivar, the length of the bulblets formed on the mother bulb was found to be between 12.15 mm - 14.91 mm. The biggest bulblets were obtained from sheep manure and sand medium, and the smallest ones were obtained from perlite medium [14]. In the *Lilium* LA hybrid "Ceb Dazzle" cultivar, the lengths of the bulblets vary between 10.90 mm and 14.54 mm, and the bulblets with the largest length values were obtained from peanut shell + sand, and the smallest ones were obtained from volcanic slag [12]. In a study conducted based on the basal part sizes of *Lilium longiflorum*, the average bulb length was found to be 28.67 mm [15].

In the study, the different media used to obtain bulblets from bulb scales affected the bulblet width statistically significantly (Table 3; Figures 3 and 4). The best result for bulblet width (11.38 mm) was obtained in peat, while a lower result (8.22 mm) was obtained in perlite. In the study conducted on the Oriental *Lilium* 'Siberia' cultivar, the width of the bulblets formed from the mother bulb was found to be between 8.45 mm - 13.85 mm. Bulblet yields were highest in sheep manure + sand and lowest in peat + sand [14]. In addition, in the *Lilium* LA hybrid "Ceb Dazzle" cultivar, the highest values of bulblet width were obtained in peanut shell + sand medium with 14.34 mm, followed by peat + sand with 13.31 mm. The lowest value in terms of bulblet width, 10.11 mm, was determined from the volcanic slag medium [12]. In *Lilium longiflorum*, the bulb width was found to be 11.3 mm [15]. In study, values close to those found by the researchers were obtained. Bulbs and bulblets grow well in growing media with high organic matter content. As a matter of fact, in this study, the best bulblet length and width were obtained from the peat medium. However, good humidity control is required to reduce bulb losses.

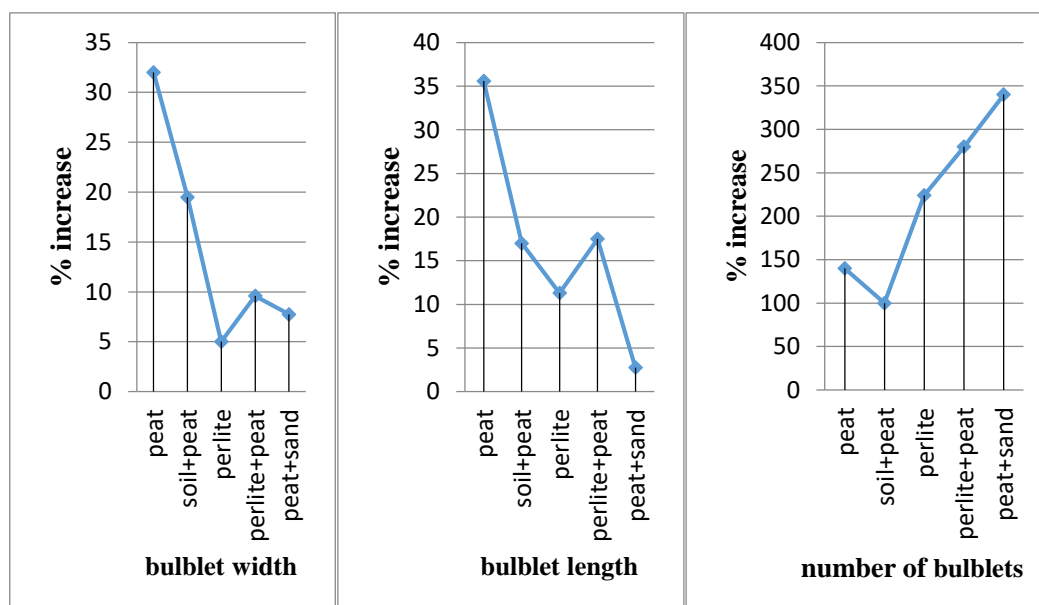


Fig 4 Effects of different growing mediums on bulblet yield, bulblet width and length obtained from bulb scales

Conclusion

In lily cultivation, it is extremely important for producers to determine the methods by which they can produce their own bulbs. In this study, which was conducted to determine the best growing medium for obtaining bulblets and to reduce the costs of supplying bulbs for cultivation, different growing mediums significantly affected bulblet length, width and number of bulblets. Peat + sand growing mediums gave better results in terms of the number of bulblets obtained. According to the measurements made between the growing mediums, the best values in terms of obtaining quality bulblets were obtained from the peat. As a result of the research, it is revealed that if the bulblet quality is desired to be high, peat can be preferred, and if the number of bulblets is desired to be high, peat + sand can be preferred. For this reason, peat + sand can be recommended for bulblet production. However, it should not be forgotten that these results may vary depending on species and varieties. For this reason, it would be beneficial to conduct more detailed studies using different types and varieties of different media to obtain bulbs.

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Data Availability statement

The author confirms that the data supporting this study are cited in the article.

Compliance with ethical standards

Conflict of interest

The author declare no conflict of interest.

Ethical standards

The study is proper with ethical standards.

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