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THE ENLARGEMENT OF *LEUCOJUM AESTIVUM* L. IN DIFFERENT SUBSTRATES UNDER GREENHOUSE CONDITION

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Abstract

Leucojum aestivum L. *(summer snowflakes) is one of the species permitted to export in a limited number from Turkey. 6-7 million summer snowflakes bulbs with more than 7.5 cm circumference are exported to the Netherlands, Denmark and USA. The bulbs obtained from propagation methods are only permitted to export. This study was conducted to enlarge the circumference of snowflakes bulb by using soilless culture techniques in different substrates such as sawdust, cocopeat and perlite+peat in a short time in a part of unheated glasshouse which belongs to Çanakkale Onsekiz Mart University, Faculty of Agriculture, Department of Horticulture, 2014-2015. The study was established according to randomised plot design with 3 replications and each plot had 20 bulbs of Leucojum aestivum* L. *Some parameters like, bulb diameter, bulb height, bulb weight, stem diameter, stem and leaf weight, dry stem and leaf weight, leaf number, leaf length, leaf thickness, leaf width, root length, root weight, dry root weight and emerging ratio were determined. As a result of the study, substrates have a significant effect on bulb diameter, bulb height, bulb weight, stem and leaf weight, dry stem and leaf weight, leaf number, leaf length, leaf thickness, leaf width, root length, root weight, dry root weight and emerging ratio. However, there was no significant difference between substrate treatments for the stem diameter. The highest average value of bulb diameter (24.80 mm), bulb height (35.38 g) and bulb weight (10.29 g) were measured in perlite+peat. While perlite+peat gives the best result for leaf length (31.23 cm), the highest average value for root length (22.58 cm) were measured in cocopeat.*

Key words*: Leucojum aestivum, geophyte, soilless culture, cultivation, ornamental plants.*

INTRODUCTION

Turkey is quite rich in terms of bulbous plants. It has 1056 taxa geopyhtes and 424 of them are endemic. Endemism ratio is 40 (Özhatay, 2013). Some natural flower bulbs have been exported over a hundred years from Turkey. Turkey has income between 2.5-3 million dollar by exporting natural flower bulbs (Yazgan, 2005; Asil and Sarıhan, 2010).

There are four firms exporting natural flower bulbs in different region in Turkey. These firms have exported the bulbs of 15 natural flower species to the Netherlands, Denmark and USA. The bulbs of *Leucojum aestivum* L. (summer snowflake, loddon lily) is one of the species permitted to export with quota restriction. The bulbs which has more than 7.5 cm circumference and propagated with reproduction techniques are permitted to export (Anonymous, 2016).

Leucojum aestivum L. can be propagated from bulblet and seeds. Yet, propagation of seed takes five or more years from seed to develop plant capable of flower production. Snowflakes has dainty white flowers above attractive dark green foliage. It is a perennial plant growing from 30-60 cm and blooms in early spring, around late February or early March. Its linear leaves are about 3-6 mm wide (Figure 1). Summer snowflake is extremely tolerant of soil such as sand, loam and clay soils. It prefers soils with a more neutral or alkaline pH and tolerates both partial and full sun exposure (Davis, 1965-1984; Zencirkıran, 2002; Aksu et al., 2002).

The aim of this study was to enlarge the circumference of snowflakes bulb by using soilless culture techniques in different substrates in a short time and to use these bulbs in exporting.

Figure 1. Summer snowflakes

MATERIALS AND METHODS

This research was conducted in 2014-2015 growing period in a part of unheated greenhouse (Figure 2) which belongs to Çanakkale Onsekiz Mart University, Faculty of Agriculture, Department of Horticulture with the dimensions; 10 m width, 50 m length, side 3 m height, 6 m roof height, and north-south directed with arched roof, Turkey.

Figure 2. Unheated glasshouse used in the research

Three different subrates such as cocopeat, sawdust and perlite+peat (1v:1v) were used in this research. Cocopeat block (5kg) was saturated with water (Figure 3) then by; it was mixed for airing and expanding (Figure 4). After this process, one block cocopeat was expanded to about 65 litres of moist coco peat. Sawdust was watered as far as drainage was out and then expanded. Perlite and peat were mixed on an equal basis (1:1 volumetrically). Styrofoam box as a pot were used for planting bulbs of *Leucojum aestivum* L.

Figure 3. Cocopeat block saturated with water

Figure 4. Ready for usage Cocopeat

Leucojum aestivum (summer snowflake, loddon lily) bulbs provided from a firm exporting flower bulbs (Figure 5) with 6 cm in circumference and 4.82 g in weight were used as a plant material (Figure 6) in the study.

Figure 5. The view from firm exporting flower bulbs

Figure 6. Bulbs of *Leucojum aestivum* L.

After the dry outer scales and roots of summer snowflakes were plucked, the bulbs of summer snowflakes were treated in 1% Captan and 0.5 % Mancozeb for 20 minutes against fungus reproduction. Then, they were left in the shade to remove the excess water and kept waiting until planting.

The styrofoam box were filled with cocopeat, sawdust and perlite+peat (1v:1v) as much as half of its depth.

Later the bulbs were planted in 7.5cm X 7.5cm spacing and depth of 7 cm and the styrofoam box were filled with those substrates completely on January, 5th 2014 (Figure 7,8).

Figure 7. Bulbs planted in styrofoam box

The bulbs were irrigated with only water till they formed their roots. Later on, they were irrigated with nutrient solution once a week. Nutient solution contains (ppm); N:193, P:64, K:242, Ca:182, Mg:37, S:55, Fe:4, Mn:1.23, Zn:0.22, Cu:3.92, Mo:0.02 (Resh, 1981). During growing period, the plants were irrigated with fresh water monthly. The study was designed as a randomized plot design with three replications and each plot (box) has 20 bulbs of *Leucojum aestivum* L. Data such as bulb diameter, bulb height, bulb weight, stem diameter, leaf number, leaf width, leaf length, leaf thickness and total bulb number obtained from the trial were analysed statistically by analysis of variance, multiple comparison test and correlation with SPSS 23 software. Separation of means was by the Duncan's multiple comparison test at p = 0.05.

Figure 8. The box filled with substrates fully

RESULTS AND DISCUSSIONS

In this research it was determined that different growing substrates have statistically ($p<0.05$) significant effect on bulb characteristics of snowflake (*L. aestivum* L.) (Table 1). In generally, diameter of bulb is an important indicator for commercial quality and flowering of bulbous plants (Kazaz and Özzambak, 2002). The highest value was obtained by perlite+peat (24.80 mm) for diameter of bulb. This was followed by cocopeat (23.29 mm) and sawdust (19.43 mm), respectively (Table 1).

Table 1. The effect of substrates on bulb characteristics

Substrates	Bulb Diameter (mm)	Bulb Height (mm)	Bulb Weight (g)
Sawdust	19.43 c	31.71 b	5.11 c
Cocopeat	23.29 b	33.33 b	8.01 b
Perlite+Peat	24.80 a	35.38 a	10.29 a

Data having the same letter in a column were not significantly differed by Duncan's multiple comparison test ($p< 0.05$).

Also, some researchers stated that growing substrates have significant effects on bulb diameter in different bulbous plants, such as lilium, freesia and snowdrop (Yılmaz and Korkut, 1998; Akçal, 2014; Kahraman, 2015).

In addition to, the highest value of bulb height was measured in perlite+peat (35.38 mm). Consequently, the effect to the other two substrates on bulb height was similar. At the

same time, for the bulb weight the highest value obtained by perlite+peat (10.29 g), followed by cocopeat (8.01 g) and sawdust (5.11 g), respectively (Table 1).

Except the stem diameter, all of the leaf characteristics were significantly ($p<0.05$) effected by substrates (Table 2).

Table 2. The effect of substrates on stem and leaf characteristics

Substrates	Stem Diameter (mm)	Leaf Number (pieces)	Leaf Witdh (mm)	Leaf Thickness (mm)	Leaf Lenght (cm)
Sawdust	5.44 a	2.03 c	6.02 b	0.99 b	18.27c
Cocopeat	6.08 a	2.75 b	6.65 ab	1.46 a	26.61 b
Perlite +Peat	6.86 a	3.26 a	7.06 a	1.26 a	31.23 a

Data having the same letter in a column were not significantly differed by Duncan's multiple comparison test ($p< 0.05$).

The maximum result for leaf number was observed with an average value of 3.26 pieces in perlite+peat, also minimum value was observed in sawdust (2.03 pieces). With a value of 7.06 mm and 6.65 mm, perlite+peat and cocopeat give the best result for leaf width. At the same time, the highest value was measured for leaf thickness, at cocopeat (1.46 mm) and (1.26 mm), perlite+peat respectively (Table 2). The means recorded for media conclude that maximum leaf length (31.23 cm) was observed in plants grown in perlite+peat, followed by those grown in cocopeat (26.61 cm), while minimum leaf length (18.27 cm) was recorded for the plants that were grown in sawdust. Similar results were observed for lamina length in a study on different freesia cultivars (Tahir et al., 2011), also these results confirmed the findings of Saygılı (2012), who observed various leaf lengths for lilium in different substrates.

The data regarding root, stem and leaf characteristics of snowflake are presented in Table 3. Planting media had a significant ($P<0.05$) effect on root, stem and leaf characteristics of snowflake. For the root length cocopeat (22.58 cm) gives the best result, while the highest values obtained from perlite+peat for root weight (2.03 g), dry root weight (0.29 g), stem and leaf weight (4.69 g), dry stem and leaf weight (0.62 g), respectively. However, perlite+peat and cocopeat showed same effects on root weight, also stem and leaf weight was affected by cocopeat and sawdust statistically at the same level.

Table 3. The effect of substrates on root, stem and leaf characteristics

Substrates	Root Length (cm)	Root Weigh (g)	Dry Root Weigth (g)	Stem and Leaf Weigth (g)	Dry Stem and Leaf Weigth (g)
Sawdust	10.68 c	0.92 b	0.12 c	1.36 b	0.19 c
Cocopeat	22.58 a	1.73 a	0.24 b	2.21 b	0.38 b
Perlite+Peat	19.17 b	2.03 a	0.29 a	4.69 a	0.62 a

Data having the same letter in a column were not significantly differed by Duncan's multiple comparison test ($p< 0.05$).

According to Kakoei and Salehi (2013) similar results were observed in different pot mixtures for spathiphyllum. On the other hand, Merhaut and Newman (2005) stayed that, the use of coir and peat did not influence plant growth such as shoot dry weight in both of the lilium varieties.

At the research, there were 20 piece of bulb were used for each plot. As it was seen in Table 4, results indicate that, differences in various substrates markedly ($P<0.05$) affected total bulb number, bulb emerging ratio and also bulb loss ratio.

Table 4. The effect of substrates on bulb number and emerging

Substrates	Total Bulb Number (pieces)	Bulb Emerging Ratio %	Bulbs Loss Ratio %
Sawdust	15.67 b	88.33 b	11.67 a
Cocopeat	17.67 a	98.33 a	1.67 b
Perlite+ Peat	18.00 a	100.00 a	0.00 b

Data having the same letter in a column were not significantly differed by Duncan's multiple comparison test ($p< 0.05$).

The highest value of total bulb number was obtained by perlite+peat (18.00 pieces), followed by cocopeat (17.67 pieces) and sawdust (15.67 pieces), respectively (Table 4). Also, maximum bulb emerging ratio was determined in perlite+peat medium with ratio of 100%, but minimum value was determined in sawdust medium with ratio of 88.33%. Hence, sawdust has taken the greatest value for the bulb loss ratio by 11.67%.

As it understood from the results, growth and development parameters were already better in perlite+peat medium, followed by cocopeat and sawdust (Figure 9 and Figure 10).

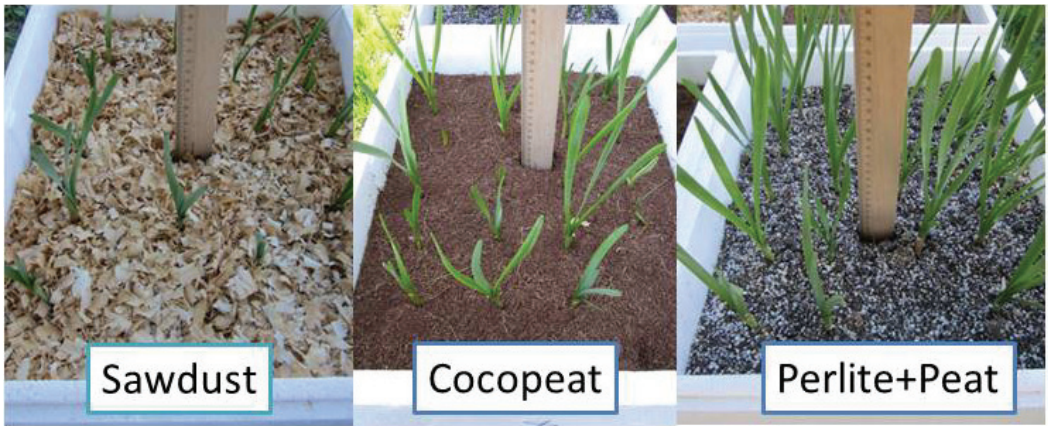

Figure 9. Plants of *Leucojum aestivum* L. growing on different substrates

Figure 10. Bulbs of *Leucojum aestivum* L. growing on different substrates

The relations between the plant characteristics of *L. aestivum* L. was seen in Table 5. According to this, it was conclude that there was a strong correlation between all the plant characteristics, except stem diameter and leaf thickness. In spite of this, strong correlations such as between bulb weight with bulb diameter (r=0.972) and bulb height (r=0.907), also between leaf length with bulb diameter (r=0.963), with bulb height (r=0.915) and bulb weight (r=0.986) indicates that there was a good relationship between underground parts with vegetative development.

Table 5. Correlation between the characteristics of *Leucojum aestivum* L.

	Bulb Diameter	Bulb Height	Bulb Weight	Stem Diameter	Stem and leaf Weigth	Leaf Number	Leaf Width	Leaf Thickness	Leaf Length	Root Length	Root Weigth	Dry Root Weigth	Dry Leaf Weigth	Total Bulb Number	Bulb Emerging Number
Bulb Diameter	1														
Bulb Height	**,856****	1													
Bulb Weight	**,972****	**,907****	1												
Stem Diameter	,464	,551	,551	1											
Stem and leaf Weigth	**,790***	**,829****	**,805****	,451	1										
Leaf Number	**,881****	**,787***	**,894****	,569	,733*	1									
Leaf Width	**,796***	**,798****	**,820****	**,752***	**,703***	**,945****	1								
Leaf Thickness	**,672***	,402	,588	,255	,202	,533	,463	1							
Leaf Length	**,963****	**,915****	**,986****	,601	**,760***	**,854****	**,817****	,631	1						
Root Length	**,825****	,587	**,735***	,290	,358	,651	,585	**,933****	**,781***	1					
Root Weigth	**,858****	**,836****	**,853****	,605	,614	**,690***	**,710***	,536	**,893****	**,741***	1				
Dry Root Weigth	**,987****	**,863****	**,979****	,524	**,740***	**,862****	**,788***	,662	**,978****	**,821****	**,913****	1			
Dry Leaf Weigth	**,915****	**,910****	**,979****	,590	**,820****	**,878****	**,812****	,523	**,955****	,630	**,782***	**,924****	1		
Total Bulb Number	**,865****	,572	**,797***	,557	**,675***	**,807****	**,749***	,634	**,777***	**,719***	**,727***	**,848****	**,728***	1	
Bulb Emerging Number	**,865****	,572	**,797***	,557	**,675***	**,807****	**,749***	,634	**,777***	**,719***	**,727***	**,848****	**,728***	**1,000****	1

*. Correlation is significant at the 0.05 level

**. Correlation is significant at the 0.01 level

CONCLUSIONS

As a conclusion it was seen that, plant characteristics of summer snowflake (*Leucojum aestivum* L.) were already affected by different substrates. This is an important factor for enlargement bulbous plants with soilless culture methods.

Fast development may obtained by different substrates with including plant nutrients. In this research, results indicate that summer snowflake was growth better in perlite+peat medium. Consequently, sawdust shows weak characteristics for a standard growing medium. In other words, enlargement and development of ornamental bulbous plants as like as *Leucojum aestivum* L, increased in substrate, which has got a better quality, such as porosity and water holding capacity.

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