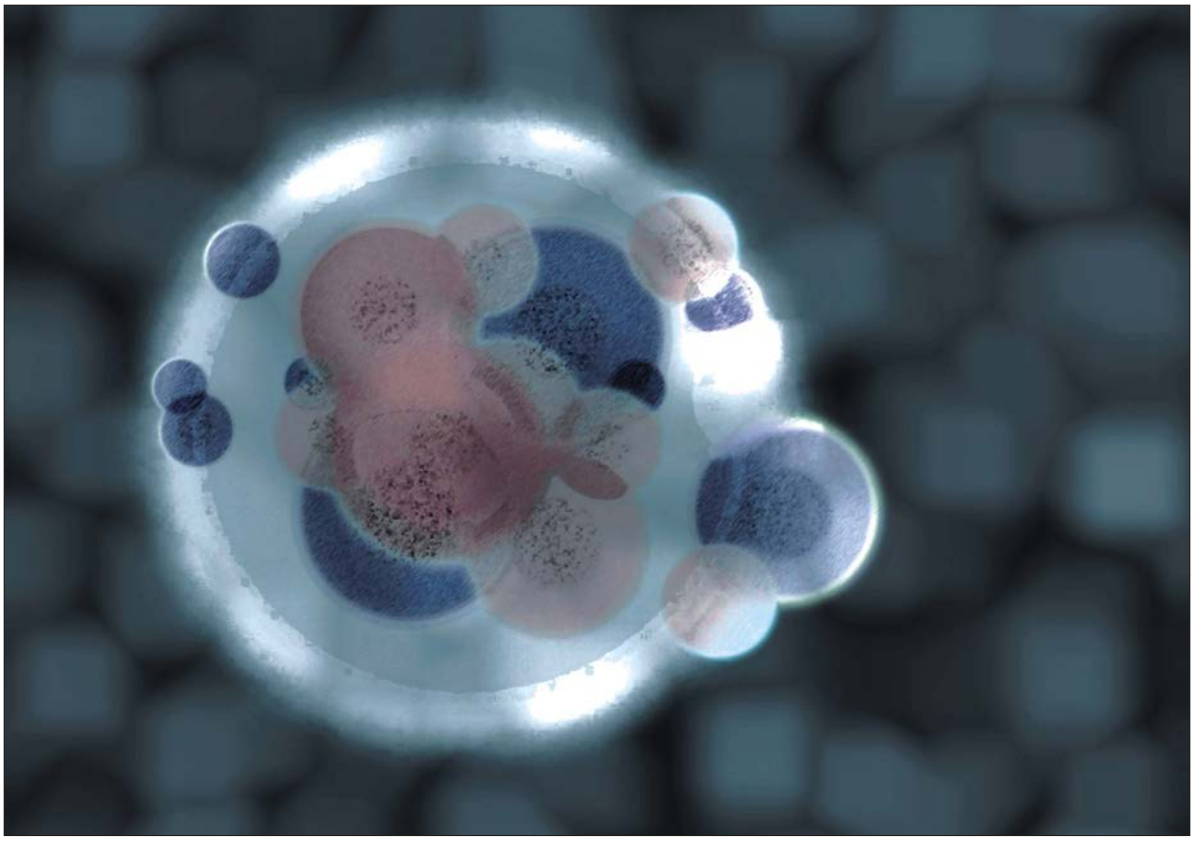

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Vegetative Propagation of *Sternbergia lutea* (L.) Ker-Gawl. Ex Sprengel (Winter Daffodil) by Chipping Techniques

[1]Nilüfer Seyidoglu and [2]Murat Zencirkiran
[1]Department of Landscape Architecture, Faculty of Forestry, Istanbul University, Istanbul, Turkey
[2]Department of Landscape Architecture, Faculty of Agriculture, Uludag University, Görükle Campus, 16059, Bursa, Turkey

Abstract: This study was to determine of bulbils formation for the possibility of sustainable bulb production in *Sternbergia lutea* (L.) Ker-Gawl. Ex Sprengel using the chipping technique. The bulb circumferences were determined to be effective on bulbils formation/bulb, length and weight. The highest bulbils formation was obtained from the bulbs having a circumference 11-12 cm.

Key words: Chipping, bulb production bulbils formation, bulb circumference

INTRODUCTION

Sternbergia is mainly a Mediterranean genus and extends to the Caucasus, North Persia and the mountains of Central Asia in the East and to Hungary and Rumania in the North (Davis *et al*., 1984; Ünal *et al*., 1997; Zencirkiran, 2002; Mirici *et al*., 2005).

The genus *Sternbergia* is known by seven species. Two of them are vernal (*S. fischeriana* (Herbert) Rupr. and *S. candida* Mathew and T. Baytop) and five are autumnal (*S. lutea* (L.) Ker-Gawl. Ex Sprengel, *S. sicula* Tineo ex Guss., *S. greuteriana* Kamari and Artelari, *S. clusiana* (Ker-Gawl.) Ker-Gawl. and *S. colchiciflora* Waldst. and Kit.) (Ünal *et al*., 1997).

All species in this family contain Amaryllidacea-type alkaloids (tazettin, lycorin, belladin, galanthamin, etc.) which are known to have antimicrobial, antiviral, antitumor, antileukaemial, anticholinesterase and immune-stimulant activities (Gabrielsen *et al*., 1992; Weniger *et al*., 1995; Hudson *et al*., 2000; Barthelmes *et al*., 2001; Baxandale *et al*., 2002).

This genus also has great potential as an ornamental plant (Arslan *et al*., 2002; Zencirkıran, 2002; Mirici *et al*., 2005) because of its attractive golden-yellow (Fig. 1) and white (only in *S. candida*) flowers which open in early spring and autumn (Zencirkiran and Tumsavas, 2006).

Sternbergia lutea (L.) can be propagated from seed and bulblets. However, propagation of seed takes five or more years from seed to develop plant capable of flower production. On the other side, the bulblet formation capacity of bulbs is low (Ekim *et al*., 1991; Arslan *et al*., 2002; Zencirkıran, 2002; Zencirkiran and Tumsavas, 2006).

Fig. 1: General appearance of *Sternbergia lutea* (L.) Ker-Gawl. Ex Sprengel

Multiplication rate is not satisfactory as 1-2 offset-bulblets per year are formed. This low multiplication rate and as the use of bulb in pharmacy industry and garden plant resulted in a destruction of nature.

It became necessary to search for different means of production with the aim of inhibiting this destruction and to achieve using the sustainable bulb material. Therefore, vegetative propagation techniques such as scaling or chipping may be applicable for this species but there is not enough research about this subject.

Corresponding Author: Murat Zencirkiran, Department of Landscape Architecture, Faculty of Agriculture, Görükle Campus, 16059, Uludag University, Bursa, Turkey

The chipping method is applicable for the bulbous ornamental plants such as *Albuca, Chasmanthe*, *Chinodoxia*, *Narcissus*, *Galanthus*, *Iris*, *Haemanthus*, *Hippeastrum*, *Hymenocallis*, *Lycoris*, *Leucojum*, *Nerine*, *Muscari*, *Fritillaria*, *Scilla* and *Hyacinthus* (Rees, 1992; Mengüç *et al*., 1993; Zencirkiran and Mengüç, 1996; Van Leeuwen and Van Weijden, 1997; Zencirkıran and Mengüç, 2002; Zencirkıran, 2002; Aksu and Çelikel, 2003; Li *et al*., 2005; Zhu *et al*., 2005). The chips prepared depending on the bulb size and the incubation temperatures changes between 15-25°C, depending on the species. The increase in incubation temperature reduces the bulbils formation in some cultivars though slightly. The incubation duration of 12 weeks is enough in most cultivars (Alkema, 1975; Alkema and Van Leeuwen, 1977; Hanks and Rees, 1979; Hanks and Phillips, 1982; Hanks and Jones, 1986; Mengüç *et al*., 1993; Sandler-Zıv *et al*., 1997; Zencirkıran, 2002; Zhu and Liu, 2003; Park *et al*., 2003).

The aim of this study was to determine the effect of different bulb circumference and number of chip on the bulbils formation for the possibility of commercial bulb production using the chipping technique.

MATERIALS AND METHODS

Bulbs of *Sternbergia lutea* (L.) Ker-Gawl. Ex Sprengel were provided from a private company dealing with exportation of flower bulbs (Fig. 1). *Sternbergia lutea* (L.) bulbs with two different circumferences (9-10 and 11-12 cm) were used as plant material. This experiment was settled up on June.

The bulbs were held in 1% formaldehyde for 1 min, for surface sterilization after the outer scales were removed, thereafter, the surfaces of bulbs were cleaned with 96% ethanol. Bulbs were divided longitudinally by hand into four and eight equal-sized segments (chip). Dividing as soon as possible after lifting bulbs (i.e., mid June). The chips were half-filled into polyethylene bags after mixing with perlite wetted with Benlate and water (1 part per liter/1 part water) and the bags were sealed leaving air spaces inside (Hanks and Phillips, 1982; Mengüç *et al*., 1993).

The bags were incubated in an incubator at 20±1°C and 80% relative humidity for 12 weeks.

The experiment was established according to randomised factorial experimental design with 3 replicates composed of 10 chips each. At the end of the experiment, bulbils formation/bulb, bulbils length (mm) and diameter (mm) and bulbils weights (g) were determined.

The data were analysed statistically by analysis of variance (Minitab 13). Separation of means was by the Duncan's Multiple Range Test at p = 0.05.

RESULTS

Bulbils formation/bulb: Although bulbils are obtained in both bulb sizes, the best results are obtained by using bulbs of 11-12 cm. It is observed that the number of bulbils increase together with the increase in the number of chips made of mother bulb (Table 1, 2)

Bulbils length: Obtained from the chips made of bulbs with different radiuses, the lengths of the bulbils have ranged between average 17.65 and 23.55 mm. On the other hand, number of chips made of mother bulb has been found to be effective in the length of the bulb and caused occurrence of longer bulbils which occurred by division of mother bulbs into 4 parts (Table 1, 2).

Bulbils diameter: It has been found that the sizes of mother bulbs do not affect the diameter of bulbils; however, diameter of the bulbils reduces in line with the increase in the number of particles prepared (Table 1, 2).

Table 1: The effects of bulb circumferences on bulbils formation, length, diameter and weight

Circumference of mother bulb (cm)	Bulbils/Bulb (No.)	Bulbils length (mm)	Bulbils diameter (mm)	Bulbils weight (g)
9-10	4.38a*	17.65a	4.18a	0.11a
11-12	6.52b	23.55b	4.65a	0.64b

*Means followed by the same letter are not significantly different according to Duncan's Multiple range test (p = 0.05)

Table 2: The effects of number of chip on bulbils formation, length, diameter and weight

No. of Chip/Bulb	Bulbils/Bulb (No.)	Bulbils length (mm)	Bulbils diameter (mm)	Bulbils weight (g)
4	3.98a*	23.52a	5.43a	0.53a
8	6.92b	17.68b	3.40b	0.23b

*Means followed by the same letter are not significantly different according to Duncan's Multiple range test (p = 0.05)

Bulblet weight: While the weight of bulbils obtained have increased depending on the sizes of the mother bulbs used, the increase in the number of chips made of mother bulb have caused decrease in bulbils (Table 1, 2).

DISCUSSION

The results showed that initial bulb circumference is critical for rapid propagation of *Sternbergia lutea* (L.) Ker-Gawl. Ex Sprengel by the chipping technique. The bulb circumferences were determined to be effective on bulbils formation/bulb, length and weight. Initial bulb circumference significantly affected the bulbils formation/bulb, bulbils length and weight.

This is in accordance with the findings of researchers such as Hanks and Jones (1986), Hanks (1991), Zencirkıran and Mengüç (1996) and Aksu and Çelikel (2003).

Hanks (1991), Zencirkıran and Mengüç (1996) and Aksu and Çelikel (2003) have determined in *Narcissus*, *Leucojum aestivum* L. and *Galanthus elwesii* Hook., respectively that formation of bulbils increases in parallel with the increase in size of mother bulb in the beginning.

Cutting mother bulbs into segments encouraged adventitious bulbils formation. Increase in the number of chips made of mother bulb has caused increases in the number of bulbils obtained. However, decreases in lengths, weights and diameters of these bulbils have occurred as the number of chips increased. These results agree with earlier findings for various bulbous plant species (*Narcissus* and *Hippeastrum*) (Hanks and Jones, 1986; Sandler Zir *et al*., 1997; Zhu *et al*., 2005).

Division of mother bulb into many particles causes decrease in the scale leaves and basal plate in the chips obtained. This is thought to be the reason of the decrease in lengths, weights and diameters of the bulbils obtained.

These results have shown that chipping technique can successfully be used for bulbils production in *Sternbergia lutea*. On the other hand, importance of the size of bulb used in the beginning of the application and number of chips to be prepared must be taken into consideration.

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