Specialized Bulb Propagation of *Gethyllis multifolia* and *Gethyllis villosa* ©

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Gethyllis multifolia **L.Bolus and** ***G. villosa*** **Thunb. (Family: Amaryllidaceae) are indigenous (to South Africa), winter-growing, summer-blooming, deciduous, and bulbous geophytes.** ***Gethyllis multifolia*** **is threatened in its natural habitat and falls in the "Vulnerable" category of the Red Data List of Southern African Plants. The genus** ***Gethyllis*** **is more commonly known as kukumakranka in South Africa and is one of the most extraordinary and poorly researched of all southern African amaryllids. The medicinal uses of this genus includes cures for colic, digestive disturbances, teething troubles, fatigue, and as an application on boils, bruises, and insect bites. Apart from its medicinal properties, many members of this genus (including** ***G. multifolia***) **have a highly fragrant fruit that is good to eat.**

The main aim of this study was to find reasons behind the "Vulnerable" conservation status of ***G. multifolia*****, to look at ways of re-introducing it into its natural habitat and to investigate why** ***G. villosa*** **is not threatened while growing in the same area.**

Comparative specialized bulb propagation techniques were tested over one growing season on these two species. ***Gethyllis mutifolia*** **was successfully propagated using these techniques compared with poor results from** ***G. villosa.*** **However, both species were successfully propagated by division of bulblets. This research formed part of a complete environmental impact, propagation, and cultivation study, which was an attempt to establish proven propagation and cultivation techniques to ensure the existence of the species and to create platforms for future research.**

INTRODUCTION

This paper forms part of a Masters Degree in Horticulture, which is a comprehensive study on the propagation and cultivation of *Gethyllis multifolia* L.Bolus and *G. villosa* Thunb. This study was conducted to investigate why there is a decline in numbers of *G. multifolia* in its natural habitat and not *G. villosa* in the same habitat and to look at alternative methods of propagating the species.

Gethyllis multifolia is threatened in its natural habitat and falls in the "Vulnerable" category of the Red Data List of Southern African Plants (Hilton-Taylor, 1996), which is the list of endangered plants in southern Africa. *Gethyllis villosa* occurs more frequently throughout South Africa and is not threatened at all compared to *G. multifolia*, which grows in the same areas. Both species are winter-growing, summer-blooming, deciduous, bulbous geophytes (Du Plessis and Delpierre, 1973). The genus *Gethyllis* (family: Amaryllidaceae) consists of 37 currently accepted species and subspecies (Müller-Doblies, 1986). *Gethyllis* is more commonly known as kukumakranka in South Africa and is one of the most extraordinary and poorly researched of all Southern African amaryllids (Liltved, 1992).

Gethyllis multifolia bulbs are 200 mm in height, with twisted, lightly hairy leaves and the flowers are large and coloured white to cream. *Gethyllis villosa* bulbs are 30–150 mm in height. Leaves are 40–120 mm long, flat and loosely spiralled towards the apex, and covered with soft, white, T-shaped hairs and the flowers are white or pink (Hortsmann, 1999).

The medicinal uses of this genus includes cures for colic, digestive disturbances, teething troubles, fatigue, and as an application on boils, bruises, and insect bites (Du Plessis and Delpierre, 1973). In the past it was used by the Khoisan people of southern Africa as an aphrodisiac. Many members of this genus have a highly fragrant fruit which is good to eat and was used in the past to perfume linen and rooms. Later studies by Elgorashi and Van Staden (2003) found that some of the species contains anti-inflammatory and antibacterial activities. The genus has four distinctive growth phases: a winter (cold and wet) growing phase, leaf senescence towards spring, flowering during the hot and dry summer (when no leaves are present), and fruit formation in autumn, which is the start of the new growing season (Du Plessis and Duncan, 1989). Specialized bulb propagation techniques such as twin scaling, bulb cuttings, scooping, scoring, and division were tested on the above two species.

MATERIALS AND METHODS

Gethyllis multifolia bulbs were obtained from their natural habitat (Worcester, Western Cape, South Africa) where a new road was planned through part of an existing population. *Gethyllis villosa* bulbs were obtained from the natural habitat, a farm in the same area, where permission from the farm owner was granted to remove the bulbs. The availability of the threatened *G. multifolia* bulbs limited the number of repetitions per experiment. Propagation of both species was done at the onset of the new growing season, which is from mid-March to mid-April (Van Reenen, 1975). The healthiest and most mature bulbs were selected for the propagation experiments. Mature bulbs of *G. multifolia* have an average diameter of 30 mm and mature bulbs of *G. villosa* have an average diameter of 18 mm. All seed trays and tools used were dipped in a 1% Sporekill solution for sterilization. All working surfaces and hands were sterilized with the same Sporekill solution. All bulbs were washed under running tap water to remove all soil and old bulb scales. Bulbs were then soaked in a 0.4% Captab (fungicide) solution for 10 min. The rooting media were watered with the same 0.4% Captab solution to kill soil-borne fungal spores. The containers used were black plastic seed trays size $150 \times 30 \times 65$ mm.

All experiments were conducted at the greenhouse facility of the Cape Peninsula University of Technology (CPUT). The cuttings of all experiments (except division) were placed in a mini-tunnel (size 1 m × 2 m × 30 cm) covered with greenhouse plastic. The mini-tunnel was placed inside a polycarbonate greenhouse for more effective control over the relative humidity and temperature. The temperatures inside the mini-tunnel varied from 20–28 °C and average relative humidity from 52%–65% (measured with a Majortech CE Digital relative humidity meter). The light intensity reading (measured with a Toptronic T630 digital lightmeter) was 16,400 lux at midday. All cuttings were irrigated by hand when the medium showed signs of drying out. The duration of all experiments was 16 weeks.

Twin Scaling. Each bulb was cut longitudinally into five sections with a budding knife. Each section was then cut up longitudinally to form twin scales. Eight to 10 twin scales (15–20 mm long) could be cut from one bulb. Each twin scale consisted of two to three scales and part of the basal plate. Twin scales were allowed to dry for 10 min after which they were dusted with dry Captab powder to prevent rotting and planted upright into the propagation media. As an alternative propagation technique, twin scales were dusted with Cabtab powder and placed in clear self-seal plastic bags with fine moist vermiculite for 3 to 4 weeks (Hartmann et al., 1997). Twin scales and bulb cuttings are normally allowed to callus for 2 weeks in a dark, dry cupboard at a temperature of 21 °C and a relative humidity of 60% (Hartmann et al., 2002). This method of callusing, however, did not work for these two species.

Bulb Cuttings. Five bulb cuttings could be cut from one bulb. Each cutting consisted of five to six scales 15–20 mm in length with part of the basal plate. The rooting media for the above experiments were vermiculite; river sand and perlite (1:1, v/v), or river sand and peat moss (2:1, v/v). The media were kept moist by applying the 0.4% Captab solution when the media started to show signs of drying out.

Scooping. The basal plate was scooped out with a budding knife and for scoring, two cuts were made with the same instrument across the basal plate, to damage the growing point (Browse, 1995, Hartmann et al., 1997). Bulbs were allowed to dry for 10 min. Dry Captab powder was forced into all cut surfaces to prevent rotting. The wounded bulbs were planted in a river sand and perlite (1:1, v/v) medium. The bulbs were planted upright, with only their necks exposed, in the propagating medium.

Division. Bulblets were detached from the mother bulbs and all the leaves and roots were trimmed by one-half of their length. Bulblets were planted in 16 cm plastic shrub pots to a depth twice the size of the bulb (Browse, 1995). Two different media were used which consisted of sifted compost, bark, and river sand (5:5:1, by vol) or clay loam and river sand (1:1, v/v). Bulblets in pots were placed under shade net (40%) mini-tunnels (1 m × 2 m × 30 cm) under outdoor conditions for 2 weeks after which they were moved to full sun conditions. The average temperature under the mini-tunnels varied from 15–23 °C.

RESULTS

Twin scaling is regarded as successful if one or more new bulblets are produced from a single twin scale. *Gethyllis multifolia* twin scales in the self-seal bags in vermiculite were the most productive with a success rate of 87% (Table 1). This technique proved to be unsuccessful for *G. villosa* with less than half of the twin scales producing new bulblets per twin scale across all the experiments. Statistically there was no significant difference between media and resultant number of bulblets formed for *G. multifolia* and *G. villosa*.

Bulb cuttings are regarded as successful if two or more new bulblets are produced from a single bulb cutting. *Gethyllis multifolia* bulbs responded best in the river sand and peat moss (2:1, v/v) medium with a success rate of 80%. This propagation technique proved to be unsuccessful for *G. villosa* bulbs where less than 50% of bulb cuttings across all the media produced new bulblets (Table 1 and Fig. 1). Statistically, however, there was no significant difference between media and resultant number of bulblets formed for *G. multifolia* and *G. villosa*.

The scooping and scoring is regarded as successful if four or more new bulblets are produced from a single scooped or scored bulb. *Gethyllis multifolia* bulbs were successfully propagated using both these techniques with a 100% success rate. These techniques appeared to be unsuccessful for *G. villosa* with a 10% success rate (Table 2, Figs. 2 and 3). Bigger and fleshier bulbs were more responsive to this method of propagation and produced new bulblets first.

Division of bulblets proved the most productive asexual propagation method for both species. There was no significant difference in the results with a success rate of between 95% and 100% for both species (Table 2). The growth of both species appeared to be more vigorous in the compost, bark, river sand (5:5:1, by vol.) medium.

CONCLUSION AND RECOMMENDATIONS

Asexual propagation by means of twin scaling and bulb cuttings was slow but proved to be successful with *G. multifolia* bulbs though less effective with *G. villosa* bulbs. Twin scales of *G. multifolia* were successfully propagated in the vermiculite medium in self-seal bags as well as bulb cuttings in the river sand and peat moss (1:1, v/v) medium (Table 1). Neither of these techniques, however, are recommended for *G. villosa* bulbs.

Fleshier and larger bulbs were responsive to scooping and scoring, as fleshier bulbs produced new bulblets faster and of a bigger size. Both techniques were successful for *G. multifolia* bulbs but not for *G. villosa* (Table 2). Scooping and scoring could be recommended as a propagation method for increasing *G. multifolia* bulbs. Though not rapid, this method proved to be effective.

This study revealed that division of bulblets is undoubtedly the fastest, most effective and consistent method of propagating these two *Gethyllis* species (Table 2). Divided bulblets matured faster and in some cases produced flowers within the first flowering season. The success of this propagation method could be due to the fact that both species reproduce naturally through division. By comparison with other methods, division of bulblets responded faster with more luscious growth, to the sifted compost, bark, and sand (5:5:1, by vol.) medium. This method of propagation along with this medium is recommended for rapid multiplication of both species.

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Figure 1. Bulb cuttings of *Gethyllis multifolia*

Figure 2. Scoring of *Gethyllis multifolia* bulbs

Figure 3. Scooping of *Gethyllis villosa* bulbs

Table 1. Rooting success and media of *Gethyllis multifolia* and *Gethyllis villosa* by twin scaling, bulb cuttings in plastic mini-tunnels inside a polycarbonate greenhouse at 10–28 °C.

Species	Technique	Media	Success (%)
G. multifolia	twin scaling	perlite : river sand (1 : 1, v/v)	50
G. villosa	twin scaling	perlite : river sand (1 : 1, v/v)	33
G. multifolia	twin scaling	river sand : peat moss (2 : 1, v/v)	53
G. villosa	twin scaling	river sand : peat moss (2 : 1, v/v)	26
G. multifolia	twin scaling (ziplocs)	vermiculite	87
G. villosa	twin scaling (ziplocs)	vermiculite	27
G. multifolia	bulb cuttings	perlite : river sand (1 : 1, v/v)	40
G. villosa	bulb cuttings	perlite : river sand (1 : 1, v/v)	10
G. multifolia	bulb cuttings	river sand : peat moss (2 : 1, v/v)	80
G. villosa	bulb cuttings	river sand : peat moss (2 : 1, v/v)	20
G. multifolia	bulb cuttings	vermiculite	50
G. villosa	bulb cuttings	vermiculite	40

Table 2. Rooting success and media of *Gethyllis multifolia* and *Gethyllis villosa* by scooping, scoring in plastic mini-tunnels inside a polycarbonate greenhouse at 10–28 °C and division under shade net mini-tunnels outdoors at 15–23 °C.

Species	Environment	Technique	Media	Success (%)
G. multifolia	plastic mini-tunnel in greenhouse	scooping	river sand : perlite (1 : 1, v/v)	100
G. villosa	plastic mini-tunnel in greenhouse	scooping	river sand : perlite (1 : 1, v/v)	20
G. multifolia	plastic mini-tunnel in greenhouse	scoring	river sand : perlite (1 : 1, v/v)	100
G. villosa	plastic mini-tunnel in greenhouse	scoring	river sand : perlite (1 : 1, v/v)	0
G. multifolia	shade net mini-tunnels outdoors	division	compost : bark : sand (5 : 5 : 1, by vol.)	100
G. villosa	shade net mini-tunnels outdoors	division	compost : bark : sand (5 : 5 : 1, by vol.)	100
G. multifolia	shade net mini-tunnels outdoors	division	clay loam : sand (1 : 1, v/v)	95
G. villosa	shade net mini-tunnels outdoors	division	clay loam : sand (1 : 1, v/v)	100