Cyrtanthus Multiplication and Breeding at UCI

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The genus *Cyrtanthus* is a group of African amaryllids that have great garden and cut flower potential but, with the exception of the Vallota (*Cyrtanthus elatus*), have been under-utilized by American horticulturists. In part this is because many of the species are rare and not in cultivation, few hybrids have been made, and methods for rapid propagation are not well known.

The Arboretum at the University of California at Irvine has one of the most complete collections of these species in existence, and we have used the germplasm to breed a new series of large flowered hybrids. This report describes our experiments to work out optimum ways of propagating selected materials asexually and discusses production and selection of new and novel clonal materials to introduce into the horticultural trade.

***Cyrtanthus sanguineus* (ex Natal) x *C. sanguineus* (E. Africa)**

Asexual Multiplication of Bulbs

One of the problems in dealing with hybrid plants is the propagation of large numbers of individuals from desirable clones that have been selected from a specific breeding program. While tissue culture can be very effective, many bulbous materials require unknown and specific growing media for tissue culture. In addition, the resulting plantlets can be slow growing, taking more than four years to reach maturity. Bulb cuttage is a way of producing bulblets from sections of bulbs that are sliced into segments of different sizes. While not as productive as tissue culture, cuttage is far cheaper and in the Netherlands is still the preferred method of propagating bulbs. These cuttage techniques also lend themselves readily to amateur use.

One method of cuttage used by the bulb industry in Holland is "twin scaling." Bulbs are cut into segments with each containing two leaf bases and a portion of the basal plate. The resulting segments are called twin scales. When incubated in bags with barely moist vermiculite, twin scales can produce one or more plantlets, which can then be grown to mature flowering size bulbs identical to their original parent bulb.

We experimented with two different *Cyrtanthus*: one was the species *C. sanguineus* and the other a hybrid, *C. sanguineus* x *C. smithiae*. To determine if there was an optimum time of the year to carry out the operation, each month we reduced three bulbs from each of the two stocks to twin scales. Each scale weighed approximately 0.7 grams. Average bulblet production varied from a low of 8 to a high of 35 bulblets per bulb. There was no consistent trend in the relationship between the number of bulblets produced and the time of the year that the bulbs were treated. Bulblets have been found to take approximately 28 days to make their initial appearance as a swelling on the tissue between the two leaf bases. Many of the bulblets started to sprout as they developed, and after approximately two months most had produced both leaves and roots. They were then planted out with 8 to 10 bulblets in four-inch plastic pots. It took approximately 30 months for the bulblets to reach flowering size, a time lag that could probably be reduced with additional feeding and optimum treatment growing conditions.

In order to reduce losses from rot during incubation the twin scales or segments were soaked in a fungicide solution after cuttage. It is important to avoid spread of virus by using new sterile cutting implements for each bulb.

Producing twin scales is a tedious job, and an alternative method is to cut individual bulbs into six or eight longitudinal sections. Fewer bulblets per bulb are produced, but the process is easier and less time-consuming, and there is less loss from fungal and bacterial infections.

Ring Sections

In some members of the Hyacinthaceae, the basal plate is not essential for the production of bulblets.

Cyrtanthus montanus* x *C. eucallis

***Cyrtanthus* "x Irvine"**

Cyrtanthus, however, belongs to the Amaryllidaceae, and we set up a series of experiments to test if basal plate tissue was necessary for bulblet production. Bulbs of both *C. sanguineus* and the hybrid *C. sanguineus* x *C. smithiae* were used. The bulbs were cut into rings of three widths—5, 10 and 15 millimeters—which resembled onion rings. We found that these could produce bulblets, but total production appears to be unreliable at this point. Bulblet production from rings is much slower than from twin scales, with bulblets first appearing 57 to 80 days following cuttage compared to 28 days for twin scales. Ten millimeters appeared to be the optimal width for bulblet production but it is moot whether or not one can produce more bulblets from rings versus twin scales. With rings, as compared to twin scales, there were severe losses from rot, despite the fact that the rings had been soaked in a fungicide prior to being placed in the incubating bags.

No members of the Amaryllidaceae have been propagated from bulb tissue without basal plate before, and we have demonstrated that it is possible to produce bulblets by this and other cuttage methods. It does seem, however, to be more effective to use twin scales.

Effects of Growth Regulators on Bulblet Production

In an effort to improve upon the number of bulblets formed after a bulb is cut, we soaked the newly cut segments in a variety of growth regulators. Those segments were soaked in one of three solutions—kinetin, zeatin or 6-BAP, in concentrations of .01, 0.1 or 1.0 milligrams per liter—for either one or three hours. The growth regulator solutions also contained Captan-Benomyl-Sevin which is an effective anti-fungicide. Controls were soaked for either one or three hours in only the fungicide. Of the three regulators we used, only kinetin produced a significant increase in bulb production. Production after a one-hour soak was 158 percent of the control value when the concentration was 1.0 milligram per liter, and after a three-hour soak also at the high concentration, the yield was 172 percent of the 3-hour controls.

Production of Newly Cloned Cyrtanthus Species

The best clones from the breeding program are listed below and will eventually be released to the trade. One clone is already in production in Holland, and interest in the hybrids has been shown at an international level. While many of the hybrids can remain evergreen they can be forced into dormancy. Nearly all of the species are tender bulbs, but because they can be forced into winter dormancy they could be developed as summer bedding bulbs stored dry during the winter and planted out in the late spring. Most of these hybrids normally flower in the months of July and August. Additional spikes can be produced at other times.

***Cyrtanthus elatus* "Charles Ford":** This species is commonly known in the trade as the Vallota and is one of the few that are commonly grown. It is a pot plant usually sold as dry bulbs. The color is usually an orange-red, but a pink form is known and was recently brought into the trade from Japan. For over a century descriptions of a white Vallota have been written, but until recently this has not been known to be extant in living collections. One of the Vallotas in our germplasm collection flowered with a

white blossom, and the clone has been called "Charles Ford." Material has been taken to Holland where it is currently in production and is expected to be on the market within five years.

***Cyrtanthus* "x Irvine" (*C. sanguineus* x *C. smithiae*):** Several hundred different clones of this cross were brought to flower, and those were then intercrossed to produce second generation hybrids. The original parent species are short plants, about 30 centimeters tall. *C. sanguineus* is an evergreen species which carries several bell-shaped florets of bright orange-red. *C. smithiae* is a rare species from the eastern Cape province of South Africa. It has pendant bell-shaped flowers, which are white with a pink stripe on the outer midline of each petal.

The flowers of the hybrids are primarily shades of pink and have large open bells on 30-centimeter spikes. In the second generation there was no reassortment of color, and the pink shades remained. One second-generation clone has been selected as superior in terms of both its flower quality and reliability. This clone is to be called *Cyrtanthus* "*x*Irvine." Unlike many of its siblings, the flowers tend to face up and outwards rather than pendant. We have counted five florets on a spike, and the flowers have held in good condition for at least four days. A single bulb of this clone can produce three spikes simultaneously and up to five spikes during a season.

What lifts this clone up above the rest is its performance. The *C. smithiae* parent is a xeric species that does not tolerate winter watering, and many of the first generation hybrids are also susceptible to overwatering. The selected second-generation clone is evergreen like its *C. sanguineus* parent and is able to tolerate considerable water during the winter without adverse affects to its flowering. The clone also offsets readily, and its rate of asexual multiplication could be enhanced using the cuttage methods we have developed. We have a small stock of it but have not attempted to introduce it to the trade. As there is nothing like it on the market, this clone promises to be an exciting introduction. Its main market may be Japan.

***Cyrtanthus elatus* x *C. fergusoniae*:** Here the usual orange form of the Vallota was crossed with an endangered species, *C. fergusoniae*, which has large, narrow, tubular scarlet flowers. A uniform and floriferous group of hybrids with heads of up to eight semi-pendant orange tubular flowers that flare at their tips resulted. These have potential as cut flowers. No single clone has been selected out at this point, as all appear to be uniformly productive. The group has inherited the vigorous offsetting capabilities of the *C. elatus* parent. The flowering season is earlier than that of most of the other hybrids with flower production occurring from mid-June to early July. As with other *Cyrtanthus*, a single bulb will produce several spikes during each season. Visitors to the garden always seem to notice and comment on these when they are in flower.

***Cyrtanthus elatus* x *C. montanus*:** The Vallota used was orange and this was crossed with *C. montanus*, a shy flowering plant that produces a head of starry, flat, open-faced florets resembling a Nerine. Of all of the hybrids produced during the course of this project, this group has some of the most spectacular flowers. Each spike carries a large head of up to 10 brilliant orange-red flowers. Plants flower in mid-summer, with spikes lasting as long as 10 days and several spikes produced per bulb. Vigorous offsets are generated readily. With their broad evergreen foliage, the plants from this group are ideal as potted plants similar in some respects to Clivia but tolerating considerably more sunlight. While they are fertile and readily make seed with a number of other species, their maturation appears to be very slow, and none of the next generation have flowered yet. Three clones have been selected from this group, one of which is dwarf and the other two quite large.

***Cyrtanthus sanguineus* x *C. eucallis*:** This is a cross between two closely related species from eastern South Africa. *C. eucallis* is a small, orange bell-shaped flowered species while *C. sanguineus* is a much larger flower with longer pointed petals of a crimson-orange. The hybrids are a uniform group, intermediate in size and with starry, paler orange flowers. Usually only one or two florets are on each spike. As with other hybrids there may be several spikes per bulb. No clones have been selected out from this mix as it is fairly uniform.

***C. montanus* x *C. eucallis*:** Both of these parent species have been described above. The first of the hybrid group has flowered and appears to be a brighter and improved form of *C. montanus* with bright, starry-shaped heads of flowers. They will need to be assessed over the next few years to see if any clones are better than others. It would be important to select clones that are free-flowering and more reliable than the parent species. At present, however, this cross appears to be very promising.

***C. sanguineus* (ex Natal) x *C. sanguineus* (ex E. Africa):** This species has featured frequently in the breeding program because it has several good points. The flowers are large and brightly colored on small plants that offset

readily. There are clones from several different parts of Africa in the UCI gene bank. The Natal series tends to have narrow, pointed petals but is floriferous. The East African form has more rounded petals and heavier substance. Hybrids between the two forms seem to show the best characteristics of each parent. There is an apparent heterosis resulting in enlarged flowers of a brilliant orange-crimson color. This is another plant which appears to be an attention grabber. Many visitors to the Arboretum have requested divisions, but it has not yet been released. The cross is relatively uniform, but as several clones appear to be even better than the average, they are still being assessed.

To Market?

It is sometimes difficult to introduce new plant materials to the market no matter how promising they may appear. In part this is due to saturation of the nursery trade and competition for attention, but it is also due to the ephemeral nature of flower fashions. In the case of *Cyrtanthus*, the problem involves the production of sufficient dry bulb material for the trade. The United States has few producers of dry bulb material, and one may have to look to other countries for production. Nevertheless, *Cyrtanthus* should eventually come into the trade, although the route may prove to be rather circuitous.

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