DISAS IN CULTIVATION: AN UPDATE

WALTER ORCHARD

Introduction

THE GENUS DISA CONSISTS of over 150 species of terrestrial orchids occurring in sub-Saharan Africa and, in a few cases, on two islands (Madagascar and Reunion) and the Arabian peninsula (Linder and Kurzweil, 1999). This range encompasses many different types of climate and soil; consequently there can be no single description of the cultural requirements for the entire genus. The majority of *Disa* species are found in the Western Cape, South Africa, a temperate, often mountainous, winter-rainfall region. Yet even here, disas that are found growing in close proximity to each other may require fundamentally different cultural practices. The best-known *Disa* species are evergreen and are found growing on stream banks, waterfalls and damp cliffs where there is water all year round. They are also the easiest to cultivate. This article will focus on these species and their hybrids.

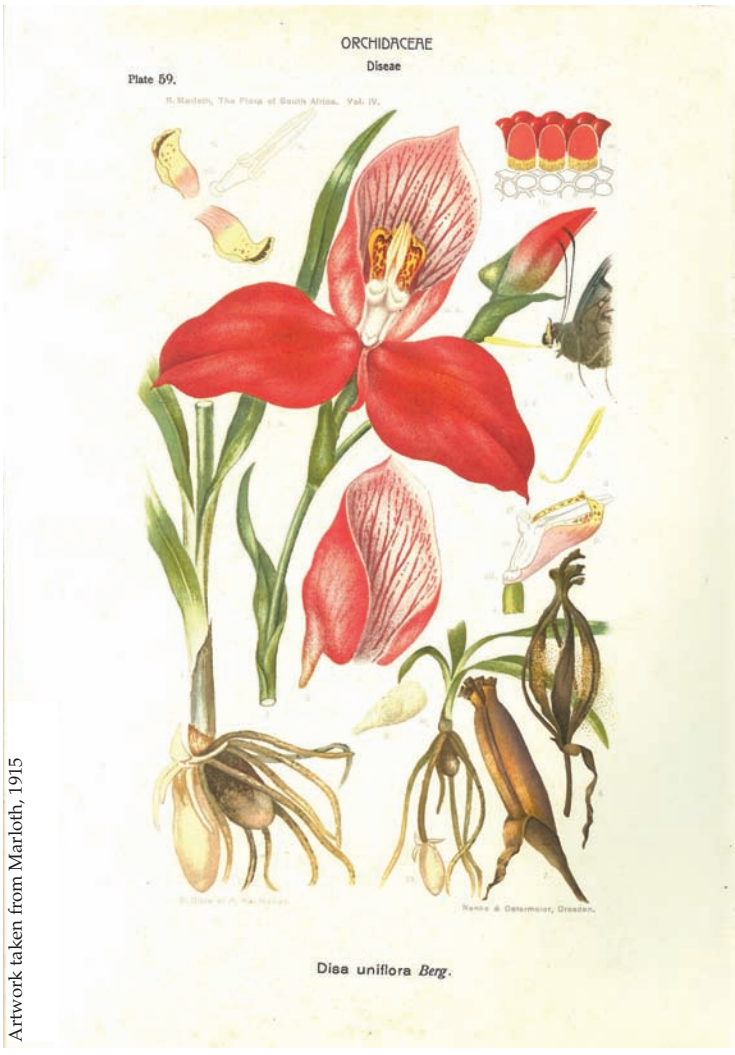
The Swedish botanist Bergius was responsible for naming the genus, apparently inspired by the legendary woman called Disa who arrived at the Swedish royal court draped in nothing more than a fishing net (Wikipedia, 2013). In present-day Scandinavia, Disa is still used as a female name.

The earliest records of successful disa cultivation come from England, where the first *Disa* hybrid was registered in 1891. Several more hybrids followed in the years up to about 1920, after which there was a major hiatus in the registration of new hybrids. Then, in the 1950s, disa cultivation resumed in the Western Cape. Some of the old hybrids were remade and eventually new, more complex hybrids began to appear. Between 1980 and 2001, Dr. Louis Vogelpoel, an accomplished orchidist and photographer, documented many of the advances in disa cultivation. His publications culminated in a pair of articles in *Orchid Digest*, where he summarized and analyzed much of the earlier work (Vogelpoel 2001a and b). These two articles remain the definitive works on *Disa* species and their hybrids.

Floral Pigments

Vogelpoel (2001a) described in some detail the origin of floral colors, and particularly the inheritance of these colors. In the case of disas, two distinct types of pigment are particularly important. Anthocyanins are a water-soluble class of compounds whose colors are markedly dependent on pH. They are found in the epidermal (surface) cells of flower parts and range in color from red to purple and blue. The pattern of anthocyanin distribution results in the characteristic veins or spots of deeper color that occur in the dorsal sepals of many *Disa* flowers. Carotenoid pigments are fat-soluble and are generally responsible for yellow coloration. They occur in chromoplasts, small structures lying in the mesophyll (subsurface tissue) of the flower. Thus, to the observer, the color of a *Disa* flower can be thought of as the combined effect of the anthocyanins (if any) in the surface cells, and the underlying carotenoids. Where anthocyanins are absent, any carotenoid pigments will show up as yellow; where carotenoids are absent, the color will be purely due to anthocyanins; where both are present the color will normally be dominated by the overlying anthocyanin; and when neither pigment is present, the flower parts will appear white.

Anthocyanins and carotenoids, being unrelated classes of compounds, are independently produced via biosynthetic pathways involving many separate steps. Genes control each step in these pathways, through the production of enzymes and co-factors which facilitate the individual reactions that occur. A faulty gene may result in reduced pigment production. However, since



Artwork taken from Marloth, 1915

Disa uniflora. The dorsal sepal shows the characteristic net-like veins of anthocyanin color that may have inspired Bergius when he named the genus.

chromosomes occur in pairs, it would require that both copies of a particular gene be non-operational in order to completely block the synthesis of a given pigment. Mutants that exhibit such abnormal coloring, while relatively uncommon, are well-known in the plant world, and disas are no exception.

The foregoing constitutes an admittedly simplistic description of the colors seen in *Disa* flowers. For a more detailed description of the biosynthetic pathways for anthocyanin and carotenoid pigments, albeit in *Clivias*, the book by Koopowitz (2002, Ch. 5) is recommended.

Important Evergreen *Disa* Species

Disa uniflora

This is easily the most important of the *Disa* species. Its flowers are the biggest, reaching to over 4 inches (100 mm) across, and they show more color variability than the other species. Additionally, there is considerable variation in stem length, from shorter stems found on waterfall faces, to much longer stems where the plants grow in competition with tall grasses and reeds on river banks. A characteristic of *uniflora* is the veining pattern in the dorsal sepal that is carried over to many of its hybrids. *Uniflora* is a rather misleading epithet – inflorescences with three or four flowers are found in nature, while in cultivation the number can be even higher. The flowers have a tendency to bunch together, especially as their number increases. *Disa uniflora* grows on several different mountain ranges in the Cape, and these populations have evolved in relative isolation from each other. Thus, while one population may be red, another will be pink, another one orange, and so forth. Table Mountain, the backdrop to the city of Cape Town, is known for having *uniflora* flowers ("The Pride of Table Mountain") of excellent size, form and color. Many plants were destroyed in earlier times during the construction of water reservoirs on top of the mountain, but the species has demonstrated its adaptability by colonizing a now-disused aqueduct in the same general area. Mutant plants displaying anthocyanin albinism have occasionally been discovered in the wild. Two such plants were successfully crossed and the seed germinated at Kirstenbosch Botanical Garden, providing many viable plants displaying pure yellow flowers (Crous, 1997). Lighton (1960) tells of a pure white albino *D. uniflora* flower that was seen in Cape Town, around 1920, but that report was never confirmed. Both anthocyanin and carotenoid pigments would need to be absent in such a mutant.

Disa racemosa

Disa racemosa grows in seepages and swampy areas, where it is easily shaded out by other taller plants in the "fynbos", the shrubby vegetation typical of the Western Cape. As a result its flowering is extremely fire-dependent. Populations may lie unnoticed for 20 or more years, until a fire in the hot, dry summer leads to a display of the flowers of *racemosa* the following spring. The inflorescences have lilac-colored flowers, well-spaced on upright stems. The flowers are smaller than those of *uniflora*, but the good shape and greater spacing of the flowers make this a valuable species in hybridization programs, especially where big flowers are sought. Pure white albino forms of *racemosa* are occasionally seen in wild populations. This species has proven more difficult to cultivate than the other important evergreen species listed here. As a result, growers have mostly used wild-collected *racemosa* pollen in making their hybrids.

Disa tripetaloides

This species has the widest range of all the evergreen disas. While common along stream banks in the Cape mountains, it also occurs much further eastward along the coast and into the summer rainfall area of Southern Africa. The small flowers, occasionally as many as fifty on one inflorescence, range from almost pure white to deep magenta/pink, with darker colored spots in the dorsal sepal. Hybrids of this species tend to inherit this spotting pattern, as do those of the *aurata*, the following species.

Disa aurata

Disa aurata is found in very similar habitat to *Disa tripetaloides*, but is restricted to one small mountainous area at Swellendam. The flowers are bright yellow, with red spotting, and are much like those of *tripetaloides* in

The pure yellow (alba) form of *uniflora* is a mutant that displays only the color due to carotenoid pigments.

Disa racemosa, flowering in the Spring after a recent fire.

Disa tripetaloides has the biggest range of the evergreen *Disa* species.

Disa graminifolia is a deciduous species displaying striking colors and form. It grows on sandy soil, away from water, and is rarely if ever seen in cultivation.

size and form. Aside from the coloring, the two species are so similar that *aurata* was for many years considered to be a sub-species of *tripetaloides*, until DNA studies by Parker and Koopowitz (1993) suggested that it be considered a distinct species.

Disa cardinalis

Disa cardinalis is a streamside species found in a small region near Barrydale, further inland than the previous two species. The flowers tend to have relatively long lateral sepals, but their intense red color make this species much sought after for use in hybridization programs.

Other *Disa* species

Several other parent species, including *atricapilla, bivalvata, caulescens, glandulosa, longicornu, lugens, sagittalis* and *venosa*, have also been hybridized and occasionally cultivated. However their breeding lines have been very limited. Perhaps the most notable hybrid produced from this group has been *Disa* Yvening Shadows (*tripetaloides* x *longicornu*) in which some of the grey-blue color of the *longicornu* parent was evident.

Other *Disa* species may display attractive features such as striking colors (including blue) and spectacular lips. Attempts to cultivate or hybridize them have generally met with failure. One such species is *D. graminifolia*.

The Current Status of Disas in Cultivation

In his two major articles in this journal, Vogelpoel (2001a and b) presented a detailed account of *Disa* hybridization up to that time, with diagrams showing the line breeding of the best-known hybrids. He also held out much hope for the future of disa growing worldwide. Recent history has shown that his optimism was somewhat misplaced. Attempts to commercialize disas as either cut flowers or pot plants in the U.S.A., South Africa, and New Zealand have so far met with very limited success. Disa cultivation by hobbyists has declined even on their home territory, and DOSA (the *Disa* Orchid Society of South Africa) is no longer active (Haasbroek, 2013). Much of the collection at Kirstenbosch, formerly a valuable repository of local forms of several *Disa* species, has been lost (Crous 2013). In recent years, no new major species of *Disa* have been introduced into hybridization programs, so it is unrealistic to expect new hybrids to show significant improvements in

Disa aurata has sulfur yellow flowers with red spots in the dorsal sepal.

flower size or form. However, some success has been achieved in producing new and more intense colors. *Disa* Caspar (Kewfoam x *cardinalis*) a medium sized hybrid with deep red coloring has received several AOS awards. *Disa* Korean Tiger JO (Auratkew x Diablo Lightning) displayed attractive splash petals inherited from its parent Diablo Lightning.

A pure white *Disa* Veitchii (*uniflora* x *racemosa*), was reported from England several years ago, suggesting a possible route to obtaining large, white hybrids by line-breeding with pollen from pure yellow unifloras. However, I have heard nothing further about that plant or any of its possible progeny.

While the pure yellow mutant *uniflora* flowers, mentioned above, are attractive and sought after, the yellow color is rather subdued. Various growers have attempted to breed disas with big flowers and stronger yellow coloring than is displayed by the alba form of *uniflora*. Vogelpoel (2001a) had a picture of an attractive yellow specimen, but that was not a pure (mutant) yellow form. Haasbroek bred and flowered a *Disa* Unimeyer (*uniflora* x Helmut Meyer) with large, bright yellow flowers that was awarded a silver medal at the Miami WOC in 2008. However, it appears again that this plant was not an albinid form (Haasbroek, 2013). If one compares flowers of different clones of normal (non-mutant) *uniflora*, it is clear that the amount of carotenoid pigment displayed can be quite variable. Since the yellow carotenoid pigment is inherited purely from the pod parent (Vogelpoel, 2001a), it should theoretically be possible within two generations to breed alba unifloras with different levels of yellow by using pollen from an alba parent for each crossing, and so breeding in the mutation responsible for anthocyanin albinism. Yellow alba plants have been bred in this way, in an attempt to get more intense yellow, but the improvement in color was marginal. Using analogous arguments, if a *uniflora* can be found that has no carotenoid pigments in the sepals, it may be possible to breed a pure white-flowered form within two generations. Vogelpoel (2001a) argued that a pure white *uniflora* is unobtainable, because all *uniflora* plants have at least some yellow pigmentation in the sepals. However, the *uniflora* appears to have little or no yellow coloring in the dorsal sepal (the petals do show yellow), so starting from a pod parent like that one, a pure white *D. uniflora* may still be possible.

Disa hybrids with red, orange and pink coloration are relatively plentiful. Large, bright yellow or white *Disa* flowers, whether *D. uniflora* or hybrids, remain an intriguing challenge for the breeder. Successful incorporation of colors such as the blue or green of *D. graminifolia* into a vigorous hybrid would also be an exciting achievement.

Cultivating Disas

The evergreen disas and most of their mutual hybrids are not particularly difficult to grow. But their cultural needs are quite different from those of the more commonly grown orchid genera, and they are not for the casual grower. In nature disas grow on open, windswept mountains. Their roots are kept cool by the moist, often mossy, substrate. The soil is sandy with little organic matter and virtually no clay. The water, in the Cape mountains, is acidic and tea-colored, due to the presence of humic substances, and is very low in dissolved solids. In cultivation, water quality is critical–disas abhor high levels of dissolved solids or chlorine. A tester that measures the level of dissolved solids in parts per million (ppm) is a valuable adjunct for the serious grower. Rain water, distilled water or reverse osmosis water may be needed to grow disas successfully if the local water quality is inferior. Except possibly

Disa cardinalis, valued for its red color. Streamside disas have to deal with the threat of high water levels, even in the drier summer months.

Disa longicornu, the drip *Disa*, has unusual blue-grey coloring. It grows on shaded cliff faces that are intermittently moist.

Disa Korean Tiger JO, a recent hybrid with attractive splash petals.

Disa Unitrikew displays markings in the dorsal sepal that reflect both the spots of *tripetaloides* and the veins of *uniflora* in its pedigree.

for *racemosa*, the disas that are described individually above grow in a moist or wet substrate all year round. This then points to an obvious requirement for cultivating them successfully. Growers around the world have used various media for disas. What these have in common is good drainage, good aeration, no clay particles, and a neutral or mildly acidic pH. Media based on coarse quartz gravel have often been used in South Africa, though elsewhere in the world this does not seem to have been very successful. The mostly widely-used media consist of sphagnum moss mixed with medium sized perlite, bark or similar material to prevent compaction of the moss and maintain aeration and drainage. Long fibered sphagnum causes problems at repotting time (an annual requirement in the fall) since it is a tedious process to disentangle it from the brittle roots without causing damage. Supersphag (finely divided sphagnum) or sphagnum that has been chopped into short lengths are recommended.

Various methods of watering have been used. One is to stand the pots in shallow water that flows along a table and circulates by means of a pump. Another is to intermittently flood the pots and allow them to drain. This uses plenty of water unless the water can be stored in a reservoir for reuse. Perhaps the best results can be obtained by regular watering from above, as the flushing action helps prevent the buildup of unwanted salts at the surface of the growing medium. Excellent results are obtained using microjet irrigation, with a timer-controlled pump and a reservoir. Excess water drains back into the reservoir. This method delivers regular, low concentrations of soluble fertilizer. Disas need more watering in summer in order to ensure constant moisture. Watering frequency should be curtailed in winter; water just often enough to ensure that the medium does not dry out.

Disas multiply vegetatively through tubers, stolons (the thinner, white runners) and keikis. The main tuber and some small plants developing from stolons are clearly visible. Healthy roots are thicker than the stolons and creamy in color. The darker roots at the base are old and dying.

Fertilizer is best supplied as a weak solution in the water. A complete, balanced and fully soluble urea-free fertilizer is recommended. Fertilizer levels can be monitored using a dissolved solids tester. Concentrations of 100 to 200 ppm are quite adequate. Fertilizer is best applied in the spring and early summer when Disas are growing most vigorously. Discontinue fertilizer in the winter months.

Disas are susceptible to a virulent rot that seems to strike most often in the colder months. Regular application of fungicide, good air movement, a hygienic growing environment and bright lighting will all help keep the plants healthy. The most commonly encountered insect pests are thrips, aphids and fungus gnats. Thrips are the worst of these–they do their work unseen and can easily ruin an entire blooming season before the grower is even aware that anything is wrong. Prevention is far better than cure when dealing with these pests. Slugs may also be a problem. Great care should be taken to test any pesticides on a few plants before applying them to the whole collection. Disas have thin, soft leaves and will often react badly to oily and solvent-based chemicals.

For more details on disa cultivation, the reader is referred to the publications of Crous and Duncan (2006) and Orchard (2000a and b).

Koopowitz (2002) has pointed out the importance of speaking to one's plants (in that case, clivias) on a regular basis. That is sound advice indeed, though I would add that in the case of disas, listening to them is even more important. If the plants look feeble

and no vigorous new growths are appearing, that is their way of telling you that something is wrong. A good first step is to check the condition of the roots. This is usually easy to do by inverting the pot and carefully lifting it off. Healthy roots and tubers are cream colored and firm; dead or dying roots are brown and soggy. If your disas are unhappy, try changing the cultural conditions, be it lighting, air movement, media, water quality, temperature or the presence of pathogens.

A Year in the Life of a *Disa*

Disas begin to show vigorous growth in early spring. Flower spikes elongate rapidly and by early summer mature plants should be in bloom. Flowers open successively over several weeks, and an inflorescence may remain attractive for two months or more. Mature disas will form a new tuber each year; after blooming, the old plant, roots and tuber die, but the new tuber will put up a new growth in the fall. Disas can also multiply vegetatively through underground runners (stolons) and through keikis, small plantlets that sprout next to the main stem at ground level. In nature, vegetative multiplication is the norm; disas are often found growing in clumps that all originated from a single original parent.

When a *Disa* flower is pollinated, the seed capsule will normally ripen within about six to eight weeks. The seed is relatively big by orchid standards, and will germinate readily on a bed of damp sphagnum moss. However, the plantlets will develop much faster when the seed is flasked on sterile, dilute nutrient media. After six to nine months *in vitro*, the seedlings can be deflasked. A disa will normally produce a tuber in its second year from seed, and flower after three years.

Conclusion

Disas, with their clean lines and range of bright colors, are among the most attractive of all terrestrial orchids. Given the right conditions (suitable media, mild temperature, moderate humidity, good water, bright light), disas are very rewarding. However, anyone choosing to grow them should recognize their particular and unusual cultural requirements. Outside of the Western Cape, they have been successfully grown in New Zealand, Australia, Europe, Japan, and the Western United States. Determined growers have also managed to grow disas in less favorable environments where the water quality is poor or summer temperatures are high. By all means give these orchids a try if you are prepared to pay close attention to their needs. But please do not squeeze them in between your Phals and Paphs and expect them to thrive!✾

Acknowledgements

Thanks are due to Jim Rassmann for generously providing me with greenhouse space to pursue my disamania. I would also like to thank the photographers for allowing me to use their pictures in this article, as well as Jan Conradie, Hildegard Crous, Floris Haasbroek, Ron Maunder, and Pietie le Roux for providing me with information about the status of *Disa* cultivation in South Africa and New Zealand.

References

Crous, H. 1997. "Cultivating the coveted yellow *Disa uniflora*." *South African Orchid Journal* 28: 70-72.

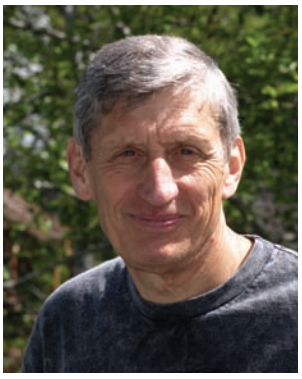
Crous, H., and G. Duncan. 2006. *Grow Disas.* South African National Biodiversity Institute, Kirstenbosch,

Two *uniflora* specimens showing contrasting amounts of yellow pigment in the dorsal sepals.

Cape Town, South Africa.
Crous, H. 2013. Personal communication.
Haasbroek, F. 2013. Personal communication.
Koopowitz, H. 2002. *Clivias*. Timber Press, Portland, Oregon, U.S.A.
Lighton, N. 1960. *Cape Floral Kingdom*, p.166. Juta, Cape Town, South Africa.
Linder, H. P., and H. Kurzweil. 1999. *The Orchids of Southern Africa.* A. A. Balkema, Rotterdam, Netherlands.
Marloth, R. 1915. *The Flora of South Africa,* Volume 4, plate 59. Darter Bros. & Co., Cape Town, South Africa.
Orchard, S. W. 2000a. "Disas." *Orchids* 69: 634-644.
Orchard, S. W. 2000b. "Growing Disas Using Hydroponics." *Orchids* 69: 645-647.
Parker, L., and H. Koopowitz. 1993. Chloroplast DNA and the determination of species status in *Disa tripetaloides* complex (Orchidaceae), and its relationship to three *Racemosae* species within the *Disa* section. *Biochem. Syst. & Ecol.* 21: 799-808.
Vogelpoel, L. 2001a. "*Disa* Breeding in the Western Cape, South Africa, Part I." *Orchid Digest* 65: 52-62.
Vogelpoel, L. 2001b. "*Disa* Breeding in the Western Cape, South Africa, Part II." *Orchid Digest* 65: 122-131.
Wikipedia. 2013. *Disa*. http://en.wikipedia.org/wiki/Disa.

About the Author

Walter Orchard hails originally from South Africa. He taught Chemistry at the University of the Witwatersrand, Johannesburg, until 1992. He then moved to the state of Washington where he continued teaching Chemistry. In 2007 he and his wife Christine moved to Yachats on the central Oregon coast where the local climate and water supply are ideal for disa growing. His disa collection is hosted by Jim Rassman, in nearby Florence. When not tending to his orchids he can be found pulling invasive weeds, playing bridge or baking artisan bread.



Walter Orchard
E-mail: worchard@peak.org
worchard.home.comcast.net

ORCHID DIGEST
Show Trophy Winners
Spring 2013

"Orchids On The Bayou"
Houston Orchid Show
Sandra Higham & Tom Pickens

"Orchids By The Sea"
San Diego County Orchid Show
Newport Harbor Orchid Society

"18th Annual Central Coast
Orchid Show"
Five Cities Orchid Show
Five Cities Orchid Society

South Eastern Pennsylvania
Orchid Show
South Eastern Pennsylvania
Orchid Society

"In The Mood For Orchids"
Sacramento Orchid Show
Sacramento Orchid Society Garden

"Orchid Reflections"
Alamo Orchid Show
Alamo Orchid Society

"Orchid Safari"
Galveston Orchid Show
Houston Orchid Society

"Orchids Around the World"
Memphis Orchid Show
Memphis Orchid Society

Oklahoma Orchid Show
Brian Truong