CLIVIA

6

Photo: Keith Barlow

Clivia miniata from the Metro Show

Front cover: C. *miniata* "Deklan" Breeder and grower Bossie de Kock. Photo: Chris Vlok
Back Cover: Winner Photographic Competition Photo: Tony Barnes, New Zealand

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Photo: Peter Lambert

C. miniata of the "Roly's Chiffon" strain. Breeder and grower Roly Strachan

Editors

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Editorial

'Art is exploration,
To breed a flower is Art'

The words of this haiku, written by Keith Hammett, provide an ideal theme for Clivia 6.

Clivia growing, in all its aspects, affords one of the most satisfying of gardening interests, not least because it is a perfect outlet for our artistic and creative instincts. We become partners with nature in the design of new plant forms and colours. We access her paint box and so become close to the very miracle of creation. Nature may reward us with the most beautiful of plants and flowers - or it may not!

As with any worthwhile interest, serious *Clivia* growing and breeding is a learning experience that can be both challenging and frustrating. Achievements do not come easily, and they certainly don't come quickly. Time is not on our side, so it is all the more important that we save time by building on foundations that have already been laid down for us. Clivia Society yearbooks not only provide the opportunity to learn from the experience of others but also are a forum for *Clivia* enthusiasts to share their knowledge and skills with everyone. As growers and breeders we can use their input to point us in directions that hold the promise of pleasant surprises - and to steer us away from pitfalls, blind alleys and disappointments. Time is far too precious to be wasted.

We trust that CLIVIA 6 will add to the library of *Clivia* knowledge that is steadily being accumulated for the benefit of all. It contains articles by authors from Australia, England, Netherlands, Japan, New Zealand, South Africa and the United States. The topics covered range over most of the *Clivia* A to Z, from Akebono and Anshan, China through to Peach, Perceptions and Polyploids.

The quality and range of photos available to us improves year by year. This issue features the winning pictures in the Clivia Society Photographic Competition and it is our hope that these will encourage novices and experts alike to submit entries for the next Competition.

The editors wish to thank our contributors and hope that readers will be encouraged to share their knowledge, experience and photographs with us. We welcome contributions, not only from Clivia Society members, but also from a far wider field, including members of the new Clubs and Societies in Australia, New Zealand and USA. Our members would also like to know more about all aspects of *Clivia* in China and Japan.

This new editorial team pays tribute to our predecessors, who produced five Yearbooks, each an improvement on the last. They are enjoying their break - working with their clivias, you can be sure!

Finally, a gentle warning: it can be tempting to convert prices of seeds and plants quoted by authors into one's own currency. Interpret price conversions with caution, for exchange rates at the time of reading may have changed significantly from those ruling when transactions referred to in articles actually took place.

The Editors
July 2004

Photo: Claude Felbert

C. gardenii "Ngome Yellow"

Perceptions

Keith Hammett, New Zealand

The period 2002 - 2003 was an important one for people with a common interest in the genus *Clivia.* I specifically stopped myself from using the term "Clivia Movement" as I think it important to remind ourselves that we form clubs and societies because we have a common interest in something, whether it be domestic cats, salt and pepper pots or model trains. It is nothing more and nothing less, yet there is an inherent tendency to start to think that we have been chosen to look after the subject of our interest. In reality, the *Clivia* has got on really well without mankind's help for millions of years and if it is in trouble in the wild now, it is because of man's activities.

As soon as we see ourselves as guardians of an interest we become evangelical and the interest runs the risk of becoming a quasi religion or doctrine. The organisation of religions and major political movements is by nature hierarchical, where edicts are handed down from on high and people are expected to adhere to such edicts. This system works quite well for small groups operating in local areas. The problems arise when efforts are made to get agreement between groups working in different areas. This is especially so with a plant interest where people operate within different social structures and climates.

Currently I see a clear dichotomy of thought amongst those interested in *Clivia*. On one hand efforts are being made to establish a grand coalition of clubs and societies worldwide. This is the hierarchical approach. At the same time a highly successful Clivia e-group is operating. This is the best e-group that I know. A tremendous amount of good information and images are posted daily and the needs of both newcomers and the more experienced are met. This is an example of the grassroots approach where individuals making their own observations in their own specific climates contribute to our collective knowledge.

I intimated in my article, "A Clean Slate", published in CLIVIA 5, that as a young interest we have the luxury of being able to chart our future without the inherited baggage of a traditional way of doing things. With established interests newcomers are taught how things are done and once people are so programmed it is much more difficult to stand back and be able to see the "wood for the trees".

Communication

The current era is often referred to as the information age. With the Internet, communication can be virtually instantaneous and available twenty-four hours a day. It is important that *Clivia* enthusiasts working in different places are able to communicate accurately. Currently an internationally based group is drawing up a classification scheme so that we can categorize and have a common understanding of the different flower shapes, colours and plant habits already found in the genus plus those being created by hybridization. It is essential that by defining categories of plants with certain characteristics in common we create something which is both robust and useful. In reality we are simply attempting to erect fences at points along a continuum of variation. If a classification is seen to be useful it will be adopted widely. However, like respect, such usage will need to be earned.

Aesthetics

I guess that people are drawn to a particular interest by circumstance and some interaction between their personality and the topic. I make the assumption, rightly or wrongly, that those of us interested in flowering plants are primarily drawn to a particular plant because of its beauty. I am therefore constantly bemused by the almost total lack of discussion of aesthetics in connection with ornamental plants. In other comparable areas of endeavour whether they be music, visual arts or dance one expects and receives discussion on the inherent merits of a work and the interpretation by the performers. Such discussion is almost totally lacking in ornamental horticulture. Quite apart from the problem of the divide between garden or landscape design, where plants are seen simply as components of a bigger picture and plantsmanship, information on individual cultivars seldom gets past being told the colour of the flowers and the height of the plant.

In other areas of connoisseurship such as appreciation of wine, there is discussion of how the components contribute to the whole experience and how well a particular wine might complement a particular food. I would really value discussion on the relationship between flower size, flower shape and leaf width in a particular cultivar and the number of flowers in an inflorescence and their presentation. This latter consideration is especially pertinent to some of the elegant interspecific hybrids now being produced.

Art is exploration,
To breed a flower is art.

Judging

I acknowledge that fundamentally the concept of establishing judging criteria is an attempt to define aesthetic appeal. Basically we are trying to determine which is the most beautiful exhibit. However, in practice they are a very blunt instrument and equate more closely to the rules governing a sport or game than aesthetic appreciation.

At best, judging rules help us simplify the exercise by considering component elements in turn. However, in my experience, when there is a truly beautiful or champion exhibit, it tells you. One does not need to go and look for it. In practice, judging rules come into play most obviously when a judge is attempting to determine the relative position of exhibits, all of which have differing faults.

Some time ago a judging panel was nominated by the Clivia Society based in South Africa to frame judging criteria. This panel consists of people in various countries. It is interesting to note that at this time, while it is only Clivia Clubs in South Africa that hold competitive shows, to date almost all the active responses have been made from outside South Africa. Life is full of little ironies.

Photo: Sharon Booth

C. miniata “Lemon Glow” from New Zealand

Ownership/Custodianship

During the last couple of months there has been much lively debate concerning the recently named C. *mirabilis* and its availability or otherwise to *Clivia* enthusiasts for breeding. I have specifically not engaged in this debate and do not intend to do so. However, I do have some observations to make from the sidelines concerning the alternate paradigms of ownership and custodianship.

I am a full-time professional plant breeder. My personal belief is that in our very short lifetimes we have the privilege to run a leg in a relay race. We may pick up the baton in the form of elaborated hybrids from earlier breeders or we may run the first leg with wild species not previously used. In either case we only have a pitiful fragment of genetic diversity available to us for a short time.

With wild plants we are dealing with what seems to us to be the end point of millions of years of evolution in essentially the areas where they now occur. As mankind has evolved definable groups have constantly migrated. Even the oldest recognizable groups have probably not been associated with an area for more than 10,000 years and most groups have been associated with an area for no longer than a few centuries. No individual human has been associated with an area for longer than their lifetime. It is therefore very difficult to understand how any group can claim to have contributed to the development of wild plants that they happen to live alongside right now, let alone have ownership.

For several decades I have been involved in Plant Variety/Plant Breeders' Rights, Plant Patents and Industrial Patents. The essence of Patent and Copyright Laws is that if someone invents something or writes something, in return for full disclosure, they may be granted monopoly rights of exploitation for a finite period. Such legislation was intended to encourage creative activity.

The alternative to patenting is to have a secret formula such as the recipe for Coca Cola or Colonel Sanders Kentucky Fried Chicken. In such cases disclosure of the formula is not made, you just have to protect your secret.

Inherent in Plant Variety/Breeders' Rights and Copyright Law is the concept that it is the juxtaposition of the genes, words or musical notes that is protected, not the individual genes, words or notes themselves. An important feature of Plant Variety Rights has been that other plant breeders may use a protected cultivar for further breeding. It is only propagation and selling of the protected cultivar that is controllable. Any new cultivar bred from a protected cultivar must have sufficient distance. In other words it is the effort and creativity of arranging genes, words or notes that is rewarded and then only for a specified time.

Photo: Sharon Booth

C. miniata from NewZealand

Photo: Sharon Booth

C. miniata "Cup of Fire" from New Zealand

With the advent of genetic manipulation and the employment of industrial patent law, especially in the USA, large corporations and some universities are claiming ownership of specific genes. This is comparable to an individual claiming ownership of a C-sharp note so that they may demand a royalty payment from anyone else who may wish to use that note when writing a piece of music.

In parallel with this concept is the idea that ethnic groups, organisations or countries can claim ownership of fauna and flora. It would be far healthier if we were to realise that we live on a very isolated planet with a fragile biosphere and that none of us has long-term ownership of anything.

At best we have the privilege of short-term custodianship. Wild species are our inheritance; they must also be our legacy.

Opposite: A delicate Pink

Below: “Hirao” bred by Toshio Koike

Photo: Courtisy Shigetaka Sasaki

Horticultural Significance of Clivia miniata

Dirk Swanevelder, South Africa

This article has been abridged from a chapter in the author's MSc thesis; "Diversity and population structure of Clivia miniata *Lindl. (Amaryllidaceae): Evidence from molecular genetics and ecology.'' He has given copious references in the original work but these have been omitted here for brevity.* **Eds.**

Introduction

The horticultural history of this genus started when the first specimen, namely *Clivia nobilis*, arrived in Britain for identification during the early 19th century. The subsequent introduction of *Clivia miniata* launched this genus into the horticultural markets of Europe. Today *Clivia* can truly be regarded as a cosmopolitan genus, far removed from its humble origins in its native countries, South Africa and Swaziland.

The variety found in flower form and colour is one of the reasons for the horticultural success of the species. The ease with which *Clivia* is grown and hybridised, together with the big showy flowers and a high tolerance for abuse, makes it an ideal plant for amateur botanists, landscape designers and gardening hobbyists. The long 'seedling stage' and lengthy waiting period for sucker production, in conjunction with human impatience, facilitates the trade of this species.

The *Clivia* industry is dominated by *Clivia miniata*. With no international monitoring institutions there are no official estimates available to determine the extent of the industry. No comprehensive worldwide studies on the *Clivia miniata* industry, covering such aspects as annual production, monetary value and breeding aims, are known. This type of study is complicated by the fact that a large part of the industry is owned by the private sector. The present study has shown that private growers are responsible for a significant share of the total income generated by the industry.

Clivia are grown world-wide, and information presented here covers the larger markets and was gathered through an extensive survey of the literature, the World Wide Web—including a related news group http://groups.yahoo.com/group/clivia-enthusiast/ and websites of mail-order nurseries — and personal communications with various *Clivia* growers. Where possible, estimates are supplied to highlight the horticultural significance of C. *miniata* internationally.

Photo: Reinhardt Hartzenberg

Clivia miniata. Grower Jack Walters NCC

South Africa

South Africa is the chief producer of commercial *Clivia* hybrids in Africa. Surprisingly, South Africa only became a role player in *Clivia* cultivation in and around 1998. The growth of the *Clivia* industry in the region is largely due to the formation of the Clivia Club in 1992. Rare clones that were in the hands of a select few were now being actively promoted and marketed to a wider audience. The increase in public awareness and knowledge, promoted largely by the Clivia Clubs and their shows, led to a boom in the local *Clivia* industry, with plants being actively propagated to satisfy the increasing demand. Shows, newsletters and discussion sessions organized by these

Clubs and Groups, as well as the Society's annual publication (Clivia Yearbook), are contributing to the success of the industry in South Africa.

The South African market focuses on a broad range of plant characters, which include flower form, flower colour, leaf width, leaf variegation and interspecific hybrids. With material becoming readily available and a large natural genetic pool, new hybrids are actively being produced. Weather conditions that prevail virtually throughout the country are ideal for the promotion of *Clivia miniata* as a garden shade plant. The other species of *Clivia*, however, enjoy limited interest in South Africa. In recent years, the local demand for rare hybrid lines, produced in other countries like Japan and China, has increased considerably.

Private growers dominate the South African market, which makes it difficult to obtain reliable estimates of the actual number of plants being produced annually. Income generated by seed and plant sales is virtually impossible to calculate without production figures. Annual production is estimated to be anything from one to five million plants. Supposing plant production figures are around one million, with plants sold for an average of R30 per plant; the revenue generated at the producer level would be in the vicinity of R30 million.

The demand for South African material is strong. Seeds and plants are exported to, amongst others, the USA, Australia, Canada, UK, Sweden, Netherlands, Japan, France, New Zealand, Denmark, Malta, Peoples Republic of China, Finland, Spain, Belgium, Portugal, Israel, Germany, Puerto Rico (USA), South Korea, Costa Rica, Brazil and Mexico.

The market still appears to be unsaturated—even though prices have decreased over recent years for certain varieties. High prices are still being paid for top quality and rare specimens—clearly evident from the auction held by the KwaZulu-Natal Clivia Club in September 2002, in conjunction with the 3rd International Clivia Conference. At the auction 81 plants were sold for a staggering R91 695. A C. *miniata* plant was sold for R13 600 and a yellow *Clivia caulescens* for R8 600, implying an average price per plant of R880 for the remainder.

Photo: Coen Calitz

Brush pollenation at the nusery where Dirk Lootens works in Belgium

Europe

The debut of *Clivia miniata* into Europe's horticultural markets during the 1850s launched the genus into instant stardom. Increasing popularity made C. *miniata* a very successful indoor plant during the Victorian era when it was one of the most highly prized plant varieties. The popularity of *Clivia miniata* has been maintained, largely due to numerous new cultivars being produced, the most popular being broad-leaved, compact types—though types with high flower counts are also popular. The market briefly lost interest in this pot plant after World War II (1960s), mainly because of its long production period (less profitable in a market looking for inexpensive plants) and an old image sentiment.

Clivia miniata is currently being grown throughout Europe, especially in Belgium, Denmark, Finland, France, Germany, Italy, Netherlands, Portugal, Spain, Sweden and the United Kingdom. Compact plants flowering within three years, with umbels above the foliage, have been the latest market trend in the northern European countries. Southern European countries appear to prefer the larger varieties.

Belgium's annual production for 1997 is estimated at 700 000 flowering plants, making it the largest producer in Europe at that time. A large portion of Belgian plants (278 000 plants) was sold during 1997 at the Dutch auctions for a then average price of US$3.90 per plant. The Netherlands produced around 200 000 plants for the corresponding period. Production figures for Italy, Germany and France were substantial. Europe therefore produced more than 1 million plants in the 1997 season. In 2003 at Dutch auctions, orange-flowered cultivars were sold for €4 a plant and the yellow-flowered cultivars for €6. Retail prices are usually two to three times the auction price for the same cultivar.

If the 1997 production figures are used, the wholesale income is estimated to be €4-6 million for the 2002 season. The retail income is therefore in the vicinity of €4-12 million per annum, depending on the number of yellow-flowered cultivars sold. With these estimates, the gross revenue generated by the industry is calculated at between €8-18 million for 2002.

Japan

Clivia was introduced into Japan during 1854, probably C. *nobilis*. *Clivia miniata* was most probably introduced to Japan from Europe in the 1870s. The general trend in Japanese horticulture to produce dwarf hybrids, with broad leaves or

Photo: Courtesy Shigetaka Sasaki

Shima-fu variegated Daruma and a Japanese decorative pot with a dragon design

variegated foliage, stems from the Edo Period in Japanese history (1603-1867). During this period various wild mutations of highly prized plants were collected and the Japanese model for *Clivia* is based on two such plants, the Nippon lily or omoto, *Rohdea japonica* (Thunb.) Roth (Convallariaceae or Liliaceae s.1.) and the Japanese wind orchid, *Neofinetia falcata* (Thunb.) Hu (Orchidaceae). The Daruma cultivar-group corresponds to these species in leaf shape and variegation form—commercial Daruma names even correspond to these species' cultivar names.

Clivia miniata is highly commercialised in Japan. The other species are not well known. In Japan, the emphasis is placed on the plant rather than its flowers. *Clivia miniata* plants with symmetric, fanlike appearance, half round leaf apexes, visible contrasts between leaf veins and blades as well as the overall shape of the leaves, are all highly desirable. Japanese horticulturists focus their breeding programs on the production of short and broad-leaved plants. Selections with the correct leaf width to leaf length ratio have the cultivar-group name Daruma. Subtle differences in leaf shape and variegation are used to distinguish between the various commercial cultivars. The Daruma cultivar-group name is generally accepted to have its origin in Buddhism—either from a small doll named Daruma sold at temples (as a symbol of happy fortunes), or from a monk named Daruma.

Clivia purchase prices in Japan range from US $10-30 for orange-flowered plants, to US $80 for a yellow or selected hybrid. Precise statistics regarding the Japanese *Clivia* industry are unavailable, but production and sales are estimated to be considerable.

China

The main introduction of *Clivia* into China only occurred in the 20th century when Japan invaded China, although legends in the southern region of Liaoning Province claim that a German brought some plants from the Drakensberg in South Africa to Qing Dao after the Opium War (1840). A Danish missionary is said to have brought plants to Liaonan around the same time. These plants were called "German-lan" and "Danish-lan", respectively. Denmark is pronounced in this region as 'Darma, therefore, the Chinese term "Darma-lan" is sometimes used for *Clivia.*

A glasshouse in Anshan with 10 cm broad-leafed seedlings. Note the clay pots used.

It has been said that the Japanese policy of 'opening the country and learning from books' was largely responsible for the introduction of *Clivia* into China during the Japanese occupation of Manchuria in the 1930s. A Japanese named Tamura brought plants to the Manzhou Royal Palace in Changchun, the capital of the Japanese puppet state. The Japanese emperor also gave rare *Clivias* to the last Chinese emperor of the Qing Dynasty, Aixin Jue Luo Pu-yi, whom they had set up as "ruler" in Changchun. At this time, *Clivia* was regarded as a noble plant and was only publicly displayed at state functions. Just a small number of Japanese, royals, courtiers and high-ranking government officials could enjoy them, with the ordinary people not even knowing of their existence.

In 1942, Pu-yi, while mourning the death of his wife, the Empress Tan Yu Ling, ordered a pot of *Clivia* to be displayed "before her spirit" at the temple Hu Quo Bo Ye Ji (Guardian Wisdom Temple). The *Clivia* was not returned to the palace after the 49-day funeral. P'u Ming, a monk at the temple, kept the plant and started to cultivate it. This plant eventually gave rise to the cultivar Monk ("He Shong") when it reappeared in 1963. It was the end of World War II in 1945 that was responsible for the release of *Clivia* to the general populace. It is reported that there were only "two *Clivia* pots" preserved after the collapse of the government. An old florist (gardener) of the court, Chang Yu T'i, preserved a specimen that was subsequently presented to Changchun Park (Zhang Chun Sheng Li Park). In celebration of the victory of “Peoples’ Liberation” against Japan; this specimen was named “Sheng Li”, i.e. “Great Victory’” The other specimen was taken by the royal chef and presented to the manager of the Changchun Tung Hsing Dyeing Factory (Dong Xing Dyeing Factory), Chen Kuo Hsing—a cultivar today named “Dyer” or “Dyeing Factory”.

In the 1960s it was realised that *Clivia* could be produced from seed. This led to intensive breeding programs and the development of various new, highly desirable cultivars, i.e. “Engineer Huang” and “Painter”. Then the Cultural Revolution came about (1966 to 1976). With *Clivia* regarded as a mark of distinction, i.e. elitist, many prominent growers faced prosecution and even death in Changchun. During this time many rare *Clivia* were destroyed.

The current Chinese name used for *Clivia*, “Junzi-lan” (noble orchid), originates from a Japanese publication in “Horticulture Illustrated 1931” in which *Clivia* was referred to as “Kunshi-ron Orchid”, which refers to the original Latin meaning of *Clivia*, namely noble, good and strong, but was later modified to “Kunshi-ran”. The Chinese later adopted these ideographs, but pronounced them as “Jun-zi-lan”. In Chinese, “Jun-zi” means noble or “those with ability & morality” and “lan” means orchid. “Kun” in Japanese, similarly as “Jun” in Chinese, would be added to the end of a persons name to express respect .

Flower cultivation became a fashionable trend after the Cultural Revolution—breathing new life into *Clivia* cultivation. This eventually caused an outbreak of “Clivia-fever” all over the country in the mid 1980s. In October 1984 *Clivia* was named the official flower of the city of Changchun by the “Changchun People’s Congress”. Large-scale cultivation projects by nationalised companies, private groups and individuals—all coming together in the search of commercialised companies and *Clivia* enhancing activities, were started. This was probably the beginning of Chinese institutions like the Clivia Business Association (Changchun, Anshan), the Clivia Union (Beijing), the Clivia Study Society (Shenyang), the Clivia Project Association (Harbin) and the China Clivia Association (Jilin, Liaoyang, Daliang).

The Chinese *Clivia* industry is essentially situated in the northeastern part of China, in the Jilin Province. Changchun, the capital, is regarded as the cradle of the Chinese *Clivia* industry. A 5-day competition held in 2003 in Changchun, attracted 50 000 Clivia entries from more than 3 000 participants and was visited by 100 000 people. Only ten plants regarded as “superior” won the title “the king of flowers”.

In the mid 1980s the *Clivia* industry reached its peak. Prior to this a 5-leaved sucker from the Monk cultivar-group sold for 100 yuan—approximately 3 months wages of an ordinary worker. In the mid 1980s, top quality plants were sold for anything from 60 000 to 200 000 yuan per plant (60 000 yuan equalled about US $20 000 at that time). The prices dropped dramatically during the latter part of 1985, some by as much as 99%. Today ordinary mature *Clivia* plants can be bought for as little as 30-100 yuan, but rare cultivars still demand high prices, i.e. a top quality plant can reach anything from 10 000-200 000 yuan (US $2500-50000).

Annual production of mature Chinese C*. miniata* cultivars is estimated to exceed a million, excluding one to two year old seedlings. This assessment is a rough figure of the total volume traded. The Chinese market is believed to be one of the largest, if not the largest, market for *Clivia* cultivars. The true value of this market is probably in the vicinity of US $200 million annually.


Photo: Ken Smith

A pale "Cowlishaw" (See pg 24 for the dark strain)

Australia

The first introduction of *Clivia* into Australia occurred in 1844 when J.C. Bidwill, an early director of the Sydney Botanical Gardens, brought some C. *nobilis* on board the Arachne to Sydney. More introductions followed, with imports of new hybrids and C. *miniata* occurring regularly.

Clivia miniata are very popular in Australia. The similarity between the Australian and South African climates makes it possible for *Clivia* growers to grow plants in shade houses or in shady spots in the garden. Hence, the plants are a favourite of landscapers and gardeners alike. *Clivia miniata* is the most widely cultivated *Clivia* species.

The *Clivia* industry in Australia focuses on the broad-leaved cultivars. In Queensland nurseries, these are produced in their thousands. Red, variegated and peach cultivars are currently in demand. *Clivia miniata* plants are sold as pot plants during the flowering season, but unlike in Europe, these plants are planted in the garden.

Market prices for *Clivia* in Australia have dropped in recent years. Mature yellow-flowered plants that were sold in the past for AUS $100-150 are now difficult to sell at retail stores, even though prices are reduced. Plants over AUS $50 are hard to sell. The price drop could be attributed to an increase in producers: during 1995 there were only 2 or 3 mail order nurseries offering *Clivia*, but in 2002 this number more than doubled to 7 or 8. Growing imports (from USA, South Africa, Europe, China, Japan and especially from New Zealand), an increase in maturing plants produced from previously imported/produced seeds and higher local production, all contribute to this drop in prices.

Collectors, however, are still prepared to pay high prices (>AUS $150) for guaranteed cultivars. Variegated plants are priced from AUS $150 to AUS $1500. It is therefore the known producers and collectors in select sectors of the market that are profiting. The exact production figures and total income of the industry in Australia are unknown.


Photo: Di Smith

A New Zealand Peach. Grower Di Smith

New Zealand

New Zealand is one of the emerging markets of the *Clivia* industry. Seed and plants are currently being produced for both the local and the Australian market, with focus on yellow-, cream-, red- and orange-flowered plants. Internal production of seed/plants and a growing interest among the local population, is currently driving the market. Seeds have for several years been imported from countries such as Japan, South Africa and Europe, raised and sold to the local market.


Photo: Jim Comstock

A collectors dream from the USA

The Americas

Clivia have increased in importance on commercial markets during the last few years. *Clivia miniata* is grown from Canada to Brazil, including several states in the United States of America, Mexico and Puerto Rico.

Clivia material is being imported from South Africa, Japan and China. Californian growers specialize in flower varieties that seem to be more colourful than those in South Africa and China. American customers seek *C. miniata* plants with both attractive foliage and flowers, with no special preference for either. *Clivia* prices are still relatively high due to sustained demand. A mature orange-flowered variegated plant sells for US $100-150 and a yellow-flowered variegated plant for US $400-450.

Various companies sell plants in the USA, with prices ranging from US $50 for mature orange-flowered plants to hundreds of US $ for mature yellow-flowered plants. In 1998, yellow *C. miniata* plants were on offer for US $950 by White Flower Farms (Pennsylvania). Seed prices range from US $0.60-20.00 a seed, depending on the demand. There are no figures available for any of the American markets to date. Considering initial tendencies of other countries that grow *Clivia*, prospects for the US market look very promising.

Conclusion

Clivia miniata is currently grown worldwide and the *Clivia* industry has reached a considerable size. The number of mature *C. miniata* hybrids produced annually is estimated to be around 6-10 million plants. Income generated by the trade in these plants, excluding seedling sales, is conservatively estimated to be US $200 million to US $400 million annually. The Chinese *Clivia* market is the largest in the world. However, figures obtained from USA growers indicate that there is a substantial market in the USA waiting to be developed. In Table 1 estimates are given for the different regions where C. *miniata* is grown on a substantial

Production Area	Breeding Trends & Markets	Estimated Annual Production & Revenue
South Africa	Broad & variegated leaves, intra- & interspecific hybrids, flower forms & colours, pot- & bedding plants	1 - 5 million plants US$ 1- 5 million
Europe	Compact, small, broad-leafed plants, fast flowering, greenhouse & pot plants	>1 million plants US$ 8 - 15 million
The Far East (China, Japan, Korea, etc.)	Foliage: broad-leafed, variegated plants with symmetrical fan-like appearance, greenhouse & pot plants	2 million plants >US$200 million
Australia & New Zealand	Broad &variegated leaves, intra- & interspecific hybrids, flower colour variations, pot- & bedding plants.	<1 million plants US$ 1 - 5 million
USA	Broad &variegated leaves, intra- & interspecific hybrids, flower form & colours, greenhouse & pot plants	1 - 5 million plants US$ 50 - 100 million

Table 1. Horticulturally important production regions for Clivia miniata: estimated production figures and revenues, including breeding trends and markets.

scale. These estimates are calculated from a small percentage of the market and could be distorted, most likely towards the conservative side.

Clivia economics is firmly based on supply and demand. The possibility of high returns on investment stimulates production to meet demand. The market may become saturated and prices may decline. In trying to counter this trend, producers develop new cultivars or hybrids. This forces the buyers to become knowledgeable about cultivars and their monetary value, resulting in an educated clientele with specific needs and demands.

Another way of countering the drop in price of cultivars is through exports. The local clients' demand for new and improved cultivars is the driving-force behind imports. This puts pressure on local producers to have the latest cultivars on offer. Only those producers with good reputations and products are able to stay in business.

Better communication between growers stimulates the market. That is, with new hybrids becoming more rapidly known, the demand for them increases. The market is therefore driven by the latest cultivars. Older cultivars rapidly become outdated as new cultivars are produced. The serious collector is prepared to pay high prices, usually for the new and improved cultivars. What is important is that the market has become knowledgeable, demanding breeding records, genetically identical material and improved cultivars of known origin.

The development of a sustainable and stable industry depends on growers identifying their target markets, for example pot plant market, collectors, general public, landscapers, etc. In Europe, for example, *Clivia* is mainly grown as a pot plant. It is enjoyed for a season and a new plant is bought the next year. This market is limited in size, with too high a production forcing prices down and making it commercially non-viable. This markets' profitability is directly linked to quality and the markets' trends—both contributing to the sustainability of the market. In China, where Clivia is part of the people's culture and enjoyed by both serious collectors and the general public an opportunity exists for producers to exploit both of these market sectors. The future of the C. *miniata* industry is very promising. There are still substantial new markets to develop such as the Americas. Also, Clivia growers have not yet explored the cut flower markets of the world. This sector could be highly profitable for those who are first to venture into it. To date it is still more profitable to produce and sell seed than to produce cut flowers. Intraspecific and interspecific hybrids have yet to reach their full potential. Biotechnological manipulation of floral colour holds considerable potential. The industry is still growing, and with new hybrids being produced worldwide, the future looks prosperous indeed.

Acknowledgements

I would like to thank all those who responded to my request for information which has been most helpful. Special thanks to Pen Henry, who is not only a well know Clivia breeder but is also one of the moderators of the Clivia e-group.

C. miniata "Show Stopper".
Breeder & Grower: Sean Chubb. Best yellow KZNCC Pietermaritzburg Show

Photo: Courtesy Sean Chubb

Design Your Own Clivia

John van der Linde, South Africa

This article has primarily been written for the "clivia man in the street". This is the enthusiastic but random pollinator, one might say, who crosses two good-looking plants and hopes for a winner. (I am a dedicated random pollinator by the way, so I am writing this article for myself too!) Our chances of success are probably a lot less than the chances of winning the First Prize *Clivia* in a raffle at our local Clivia Show. What is more, we will have to wait in suspense for years for the results of our breeding efforts. "It is then that hopes and aspirations are either fulfilled or shattered."

Would you like to know about another way to achieve success in your *Clivia* breeding? A methodical way, which can give you a lot of satisfaction? A method by which you can design your own *Clivia* to meet your own requirements?

You need to begin with an objective you wish to achieve. Then you need to know your plants, and have a basic understanding of some simple genetic principles - "the rules of the game". You also need those scarce commodities, time and space. Let me describe my own real-life application of the method. This "case study" illustrates the general principles you can apply - to design the *Clivia* that until now you have only dreamed about.

The objective:

I want to have plants that will bloom from April or May onwards, thus bringing forward the start of my flowering season - I am of course talking Southern Hemisphere here. My reason already extends in the other direction. I have plants based on breeding with Group 2 yellows, which regularly flower late, from October through to November. I have decided to begin my project by breeding an early-blooming yellow *Clivia miniata.* Why a yellow? Well, firstly, I have not yet come across such a plant. Secondly, I am halfway there already, as will become clearer later.

The benefits to me would include: (i) the pleasure of achieving what I had set out to do,
(ii) beauty to be enjoyed and shared, at a time when there are no other yellows in flower, and
(iii) maybe some pocket money from seed and plant sales to feed my insatiable clivia habits! The costs would largely be my investment in time, and the opportunity cost of devoting scarce space to this particular project at the expense of others.

The plants needed to achieve my objective:

Fortunately I already have one early blooming plant, even though it is not a yellow. It is a very attractive light apricot, as measured on the Cape Clivia Club colour chart. It is an offshoot of "Gladys Blackbeard", a plant named by the late Gordon McNeil for Miss Blackbeard, a pioneering South African *Clivia* breeder (see CLIVIA 2 page 44, for Charl Malan's article about her). This plant may flower at any time from April onwards.

Mick Dower, the owner of the mother-plant, who gave me the offshoot, made a cross between "Gladys" and a Lötter C1C2 Group 1 yellow and put some of the seedlings on sale in 2000. I bought two of them, both with heavily pigmented stems. One of these plants bloomed in September 2003, as did one of Mick's plants, and also a sibling owned by another grower. In all three cases the flower colour was light apricot, very similar to the colour of the mother plant.

The Lötter yellow, the pollen-parent of these seedlings, is a handsome plant that meets my colour requirement but not my requirement for early flowering, since it does not bloom until Spring.

My plan is to use these two plants, with their different colours and flowering habits, to produce the plant that meets my objectives set out above. But I am not going to start from scratch, which might take ten years or more. Rather, I plan to work with the first generation plant that I already have, to build on what Mick Dower has begun. This will cut development time in half. But first I need to make sure that my plan will work.

The next step: Knowing my plants

I know, from the light apricot colour of the first generation (F1) crosses that have already flowered, that "Gladys" colour characteristic is dominant over that of the yellow. Also, that "Gladys" does not itself have any hidden yellow in its makeup. How do I know that? Because if it did carry this recessive characteristic, then the cross with a yellow would have yielded some seedlings with green stems and possibly also yellow flowers. Mick Dower has however said that all the seedlings from this cross had heavily pigmented stems.

Another useful observation is that the two parents did not combine to "fix up" whatever genetic mutation had given rise to each plant's unique colour, by producing orange-flowering seedlings, as is the case when Group 1 and Group 2 yellows are crossed.

Thirdly, because the three seedlings all bloomed at the "normal" September flowering time, and not months earlier like the mother plant, I can deduce that "Gladys' " early-flowering habit is a recessive trait, which is "overridden" by the dominant September-flowering trait of the yellow pollen parent.

Also - and this is a key conclusion, vital to me in my breeding plan - I can deduce that "light apricot colour" and "early flowering" are characteristics which are inherited independently. This is because the seedlings that flowered in September 2003 were all light apricot, like their "mother", yet they flowered at the usual time when their "father" flowered.

Stage three: September 2003

First, I isolated my first-generation (F1) "Gladys x yellow" plant to prevent any accidental unwanted pollination by stray pollen. Next, I self-pollinated it, in order to bring to light, in the next (F2) generation, those hidden recessive characteristics which I know are there in the genetic mix. By the way, there are other hidden traits I don't even know about, and they could surprise me when they are brought to light at the same time.

I have drawn up a "checkerboard" to show all sixteen possible combinations of the two independent characteristics, colour and flowering time, that will be generated and displayed in the next (F2) generation of plants. Of course, there are many more than just two traits that could be taken into account. However, the number of possible combinations increase rapidly if more than two characters at a time are considered.

A convenient shorthand, in drawing up a checkerboard like this, is to use capital letters for dominant observable characteristics, and lower case for recessive hidden ones:

A = Dominant Apricot

a = Recessive Yellow Colour

S = Dominant Spring Flowering

s = Recessive Early Flowering

		A S	**A s**	**a S**	**a s**
Dominant apricot Dominant spring flowering	**A** **S**	1 **A S** **A S**	2 **A s** **A S**	3 **a S** **A S**	4 **a s** **A S**
Dominant apricot Recessive early flowering	**A** **s**	5 **A S** **A s**	6 **A s** **A s**	7 **a S** **A s**	8 **a s** **A s**
Recessive yellow colour Dominant spring flowering	**a** **S**	9 **A S** **a S**	10 **A s** **a S**	11 **a S** **a S**	12 **a s** **a S**
Recessive yellow colour Recessive early flowering	**a** **s**	13 **A S** **a s**	14 **A s** **a s**	15 **a S** **a s**	16 **a s** **a s**

Possible Combinations of Desired Genetic Characteristics

In this shorthand, and with respect only to the two traits I am working on, my plant can be coded as AaSs. The capital letters show what is dominant and thus observable, the apricot colour (A) and normal flowering time (S). These dominant characteristics mask the hidden traits (a) and (s) also carried in the genetic makeup of the plant, the "s" having come from the mother and the "a" from the father.

Self-pollination (or cross-pollination with a sibling, had one been available to me at the time) gives rise in the next (F2) generation, to the above sixteen possible combinations of the two characteristics (colour and flowering time) that I am working on.

Across the top, in heavy type, I have set out the four possible mixes of my two chosen characteristics: AS, As, aS, and as. These represent the contributions from the F1 pollen parent ("self" in this case). Down the side, also in heavy type, are the corresponding contributions from the F1 mother plant (again "self").

So what is in heavy type relates to the genetic traits brought to the party by each parent, from "pollen parent (father)"in one case, and from "pod parent (mother)"in the other. Now we look at what is inside the checkerboard, all in normal type. This all relates to the next (F2) generation, the one I am really concerned with.

The squares are all numbered in sequence for easy identification. Look at square 1 for a start, containing A and S from the pollen parent, which are the two characteristics shown immediately above, in heavy type along the top of the checkerboard. The square also contains another A and S, contributed by the mother plant alongside. The combination AASS in the square tells us that the seedling produced from this particular combination of pollen and egg will have a light apricot flower (as shown by the dominant A), and will bloom in September (because of the presence of the dominant S).

Now look at square 2; there we have A and s from the pollen parent, from what is immediately above, in heavy type along the top of the checkerboard. The square also contains A and S from the mother, from what is to the left, also in heavy type. The seedling from this mix AASs will also flower light apricot, also in September, because of the presence of both A and S. It will look just like the first seedling, but genetically it will be subtly different, because it will carry the hidden trait for early flowering - the (s) in the mix.

You should have the idea by now, but let us look at another one, say square 10. This has the combination A and s from pollen (above), and a and S from egg (to the left). The F2 plant with this genetic mix (AaSs) will look just like the first two we have examined, because of the presence of dominant A and dominant S, but will differ from each of the first two because it carries the hidden recessive traits for both yellow colour (a) and early flowering (s).

However, let's not go into too much detail at this stage. Now that you have the hang of it let us look at the big picture. The nine squares with the numbers 1, 2, 3, 4, 5, 7, 9, 10 and 13 are those combinations with both dominant characteristics, A and S. This result implies that 9 out of every 16 seedlings will be light apricot coloured, like "grandmother Gladys", but will flower in Spring like "grandfather Lötter yellow".

The combination that I am looking for, however, is in the one remaining square, which has neither the dominant A nor the dominant S, but only the double recessive aass. So I can expect one in every sixteen seedlings to be my precious early-flowering yellow. I will have achieved my objective: to unmask both hidden characteristics in the same plant.

Action plan for 2004:

Having self-pollinated my "Gladys x yellow" F1 plant in September 2003, I will harvest and then sow the resultant seeds in 2004. For every 16 seeds I plant I can expect just one early-flowering yellow (the "double recessive"). In fact, I plan to plant 48, from which I can expect - if all survive to maturity:

3 early-flowering yellows
(my target plants)
9 Spring flowering yellows
9 early-flowering light apricots
27 Spring flowering light apricots.

Note that 12 out of 48 (25%) seedlings will be yellows, the result one would expect from the self-pollination of a (non-yellow x yellow), according to one of the basic laws of genetics.

You can now see why I have said that space can be a limiting factor! However, the problem is not as big as it may seem because in 2005, if I want to, I will be able to substantially reduce the number of plants that I grow on from there.

Action plan for 2005

Around April 2005, or when most of the seedlings have at least two leaves and are strong enough, I will be able to separate out the twelve yellows, which of course will all have clearly visible unpigmented stems. I have to keep them all, since at this stage, I will not know which of the twelve are the three early-blooming ones.

At this point, depending on how much space I have available, I will have to decide what to do with the thirty-six seedlings with pigmented stems, all of which will eventually bloom with light apricot flowers. They will be a by-product of my plan to breed an early-blooming yellow, and so can be discarded as being surplus to my immediate requirements. However, they could be a useful input, were I (or a successor) to take my breeding plan further, as discussed below.

Fast-forward........2008:

My F2 plants have all flowered!?

This is when I should be able to observe the flowering times of my 12 yellows, the ones selected in 2004 because of their unpigmented stems. I should at long last, when they bloom, be able to isolate my 3 early-flowering yellows, the plants I set out to design, back in 2003. A long time to wait? Yes, but no longer than the waiting time for the results of a "random pollination" in 2003. Think about that....

Note that, apart from the uniform yellow colour, these three early-flowering plants could differ considerably from each other with regard to other features, like form, flower shape, petal width, etc. Such variation is to be expected in the F2 (second) generation.

End of the story - or the start of the next phase?

Yes, I can choose to end my project at this point, since I will have achieved what I had set out to do. But look at the options available to me, or to a successor, for using the plants I have now reared to maturity, to further develop a range of early-blooming *Clivia* by breeding within the line that I have now begun to establish.

I can sibling-cross between my three early-flowering yellows, I will be able to guarantee that the seeds will all yield yellows, all early blooming, because of their parents' double-recessive traits. These two traits are now "fixed", with the advantage that the plants will breed true for these traits from generation to generation. I can now concentrate on selecting the most desirable F3 plants with regard to other features, like flower shape, petal width, vigorous growth, etc.


Photo: Shawn Benjamin

C. *miniata "Cl C2"* grower Riel Lötter

I can back cross my three yellows with "Gladys", and will be able to guarantee all early-blooming light apricot flowers in the next generation, though the plants will have the hidden yellow in their genetic mix. Back crosses can be repeated several times - here I am talking about a really long-term breeding program- and variations will decrease accordingly. By using at each stage the seedling parent with the most desirable features (which means, in effect, selecting out the less attractive) such back crosses will, in the long run, perpetuate the features I prefer and eliminate those I don't.

Let us assume that I also grew some of the F2 seedlings with pigmented stems on to maturity and was able, at the flowering stage, to select out one or more of the nine that were early flowering - refer back to squares 6, 8 and 14. I could use them in my breeding programme as well, for example, by sibling-crossing between them, or with their three yellow siblings, or indeed again back to "Gladys". I will still be able to guarantee that the resultant seeds will produce early-blooming F3 plants, though some will be yellow and some light apricot.

I would probably not self-cross any of my

F2 plants on a large scale, since they themselves were the product of a selfing, because I suspect that this could lead to a loss of vigour in subsequent generations. To find out if this was in fact the case I could always experiment with one or two flowers, and then keep records of what happens.

I could also out cross with a plant outside the early blooming line that I have worked so hard to establish. I would be reluctant to do this, unless such a plant also came from a known line of early flowering plants. I might consider, as an experiment, for example, pollinating a few flowers with pollen from a winter flowering interspecific hybrid, say a C. *miniata* x C. *gardenii,* with characteristics I liked. The purpose would be to bring desirable characteristics into my early flowering line, but there would also be a risk of bringing in unwanted features. Normally, in line breeding like this, outcrossing is used only when really necessary, to bring in new vigour and fertility.

Of course, there is nothing to stop me from using pollen from my plants to out-cross to plants outside the line I am establishing.

Conclusion:

I have gone somewhat beyond my original purpose when I began this article, in order to illustrate the range of possibilities opened up to the enthusiastic amateur, once one has learned "the rules of the game" and begun to apply them. The process is made so much easier if you can begin with F1 plants, building on work already done.

This is certainly a practical and exciting working method, well worth the effort for the amateur wanting to achieve planned results. I say 'exciting' because remember that, by controlling for only two characteristics, you will not be removing all uncertainty, for the plants resulting from the self-pollination of an F1

C. miniata "Gladys Blackbeard,"grower Toy Jennings

plant may still vary in every other conceivable characteristic.

The general principles can be applied to breed a dark red with a large flat open flower. Such plants are rare and are highly desirable. You could begin by crossing a plant with dark red funnel-shaped flowers, which are not as rare, with one with large open, flat but orange flowers. Or, better still, you may already have an F1 seedling from such a cross, or be able to acquire one. Provided the traits "dark red" and "flat open flower" are independently inheritable - you can check this by asking experienced breeders or by learning from your own experience as you go along - you can follow the steps outlined above to design your own *Clivia*.

The unlocking of hidden variation in ones plants remains one of the most fascinating - and most rewarding - aspects of Clivia breeding. The article "Multitepal breeding" by Shigetaka Sasaki on page 57 gives further breeding possibilities that you may care to try, using the method set out above. Eds.

More on mirabilis

John van der Linde, South Africa

The story of the discovery of the new species, *Clivia mirabilis*, was told in CLIVIA FOUR. Several of the plants collected under permit at the Oorlogskloof Nature Reserve flowered at Kirstenbosch Botanical Gardens in November 2003, unseen by the public.

The terms of the memorandum of agreement with the Northern Cape Nature Conservation Department (NCNCD) governing this permit state that no material or any progeny or derivatives thereof may be transferred to any third party without the written consent of the Director of the NCN CD, so the tight security surrounding these plants is understandable.

We are therefore privileged to publish these "behind the scenes" pictures, showing two of the plants in flower. The third picture shows John Winter at work at Kirstenbosch, surrounded by plants he is potting up.

In terms of the agreement, the NBI will market C. *mirabilis* seedlings to the public, on behalf of the NCNCD. By early 2005 most of the seedlings should be ready for sale, once permission to release the plants is received.

The NCNCD has been asked to consider making seeds available to growers in countries where plant importation procedures could be fatal to young plants.

The "candy-stripe" effect is thought to be caused by the lack of direct sunlight

Photo: Claude Felbert

Photo: Claude Felbert

John Winter working amongst *C. mirabilis* seedlings

Photo: Graham Duncan

C. mirabilis flowering at Kirstenbosch in November 2003

The Photographic

Competition Winners

Above Left: Winner Best Photograph
Also shown on back cover
A selection of *C. miniata,*
Grower & Photo: Tony Barnes,
New Zealand. Sigma 35mm
on slide

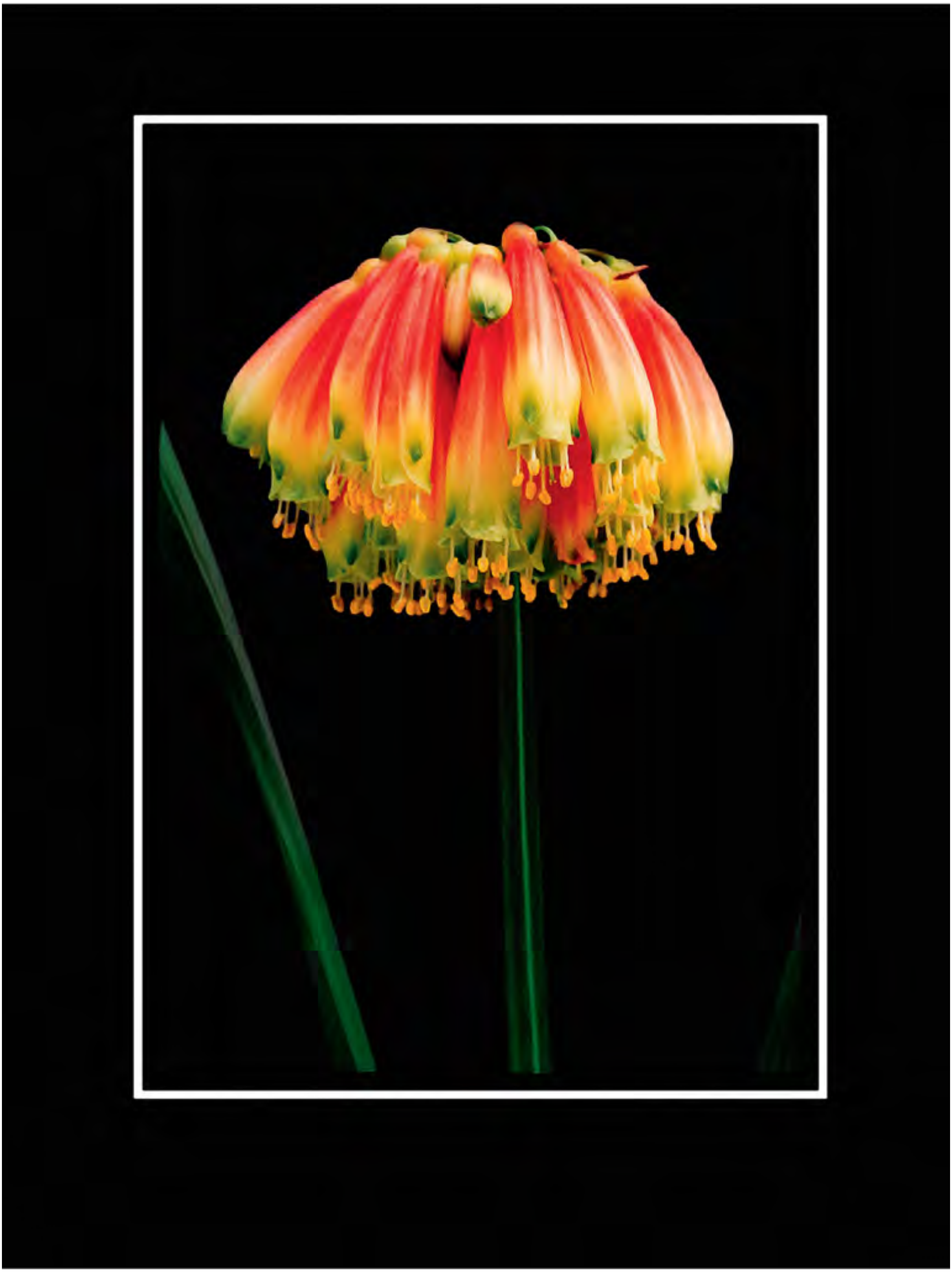
Above: Runner-up to best Photograph
C. miniata, Breeder G Cowlishaw
Grower & Photo: Ken Smith,
Australia. Canon Power Shot A30

Below Left: Winner Best *C. miniata*
Grower & Photo: Tony Barnes

Right: An Ian Coates Interspecific entry

Winner *C. Caulescens*, Grower & Photo: Ken Smith, Australia

Winner Interspecific,
Grower & Photo:
Ian Coates, UK



Winner *C. Gardenii,* Grower & Photo: Ian Coates, UK

Location, Location, Location

Jerry Charpentier, U.S.A.

I reside in Orlando, Florida, U.S.A. and no, I'm not in property sales. I am a *Clivia* collector and have all of my *Clivia* growing outdoors exclusively. The land is basically white 'sugar' sand rich in phosphate and not much else. It is further enriched by live oak leaves which I utilize as a year-round mulch. Earthworms play a major role in further breaking down the leaves and turning the sand into an appropriate organically rich 'soil' for the Clivia. The sand is of course very free-draining and apparently allows for enough air to reach the roots providing optimum growth. The Live Oak trees *(Quercus virginiana)* are ideal to grow *Clivia* under since they provide the necessary shade and protection from the settling frost. The trees are essentially evergreen, losing their leaves in a flush during very early Spring and immediately replacing them in a flash with the new ones.

Orlando is located in lower USDA and is in Zone 9*. Subtropicals are at home here and the *Clivia* thrive. The winter months are cool to occasionally cold and dry and the summers are hot and very humid with daily afternoon thunderstorms prevailing from early July through early September. These hot and humid conditions don't especially appeal to *Clivia* which leads me to the first 'Location' reference.

Firstly, locate your *Clivia* where they will receive adequate air circulation, especially if they subjected to the heat and humidity prevalent here and along the U.S. eastern and gulf coasts, among innumerable other locales in this great big world. Generally if I'm going to lose any *Clivia* plants, it will be in August when they run this test gauntlet. I don't spray any fungicides or pesticides since I only want to to be associated with cultivars which have the genetic propensity to be utilized as landscape plants requiring no pampering, only reasonable care. Surprisingly, without spraying I have lost very few to soft rot in the last 16+ years and most of those were from a seed lot of indigenous types from South Africa. I also lost a few named cultivars bred on the U.S. west coast to various vulnerabilities to this Florida climate, although a high percentage of seedlings from these same cultivars actually show no ill effects from the climate.

Secondly, locate *Clivia* where they receive adequate light. Experience has shown me that if you want blooming, give them all the light they can take, short of sun-bleached leaves and scorching. I have clivia clones which produced immense heads of flowers in one bright south-facing location which even subjected the plants to many hours of winter sun. I broke the clump into segments and put some of them in a shadier spot which received just a couple of hours of morning sun and dappled shade for the rest of the day. ..those haven't bloomed in the three years they've been there. Out of curiosity I set my hand-held photographic exposure meter for 100 speed film and used a 30 shutter speed exclusively, allowing for the lens opening reading as the only variable. The reading in the more desirable south-facing area called for a lens opening of f-16 whereas the lens opening reading for the least desirable shaded area was f-8. (A reduction of two full stops.) The reading was taken October 26 at 3:00 p.m., I hope this quasi-scientific effort will be of assistance to others.

Thirdly, locate your *Clivia* so that they can get the chilling they need to set blooms. I leave my plants in the ground throughout the year but I know not everyone has that luxury. My plants have survived temperatures below freezing without trauma and they actually seem to luxuriate in the very cool temperatures. What has been most damaging to the plants is frost settling on the leaves and burning them to a crisp. The plants are generally unscathed but the appearance is unsightly for the whole of the next year. To avoid this burning, place the plants inside or under the eaves of the house, under evergreen trees or a frost cover of any contrivance and they'll reward you handsomely.

I hope this mini-treatise will help some of you with your *Clivia* growing problems.

Additional comments

**Climatic Regions of the USA are split into 10 Zones. Each zone may be categorised by the average range of minimum annual temperature, which each zone receives. Parts of Zone 6 and Zones 7, 8 and 9 are the areas where* Clivia *may be grown in shaded ground without protection from ambient temperatures.*

If you do not live where it is convenient to keep your Clivia *in the ground then like most* Clivia *enthusiasts you will probably grow your* Clivia *in pots. This portability means that they can be grown anywhere as long as they receive protection from extremes.* Clivia *are hardy plants and adapt to many climate, temperature and moisture extremes. They will grow best in temperatures that range from between 8° to 28° C. By placing* Clivia *in shade houses to protect from sunlight or glasshouses to protect from cold we are creating a controlled microclimate.*

Factors to consider when creating a protected environment for* Clivia*;

1. Solar Radiation, Sunlight / Shade; The degree to which your plants receive light and heat radiation from the sun is largely a function of the angle at which solar rays strike the earth's surface. This depends on the time of year and the latitude at which you are situated as well as the time of day. The amount of sunlight and heat that your plants receive at various times will determine whether you need to protect them from heat or cold. In some climates only one protection is required while in others you need to protect from both.

2. Temperature; The temperature to which plants are exposed determines the protection required. With high temperatures a greater amount of moisture will be needed. Air circulation will also help to reduce the temperature and remember that evaporation causes cooling. Lower temperatures are required to initiate scape elongation, but frost and ice with their below freezing temperatures have the potential to cause the most damage. Combat with warmth or continuous water sprayed on leaves until the temperature rises above freezing and any ice or frost has melted.

3. Moisture; The amount of water that your Clivia *need will depend on the drainage characteristics of your potting medium and the ambient temperature.*

4. Air Circulation; This helps to reduce fungal growth and keep temperatures from rising too high. Pests like mealy bug do not thrive in good air circulation.

5. Feeding; This depends on the time of year and the stage of development at which the plant is.

Seedling	*-Nitrogen for vegetative growth & Phosphorus for rooting*
Pre-Flowering	*-High Potassium*
Post-Flowering	*-Phosphorus*

(see Clivia *4 pgs 52 & 53)*

6. Control of Insects and Fungal Diseases; Air circulation is an important factor. Fungicides and insecticides can play a role. Eds

Maternal Inheritance: Some Observations About Variegated Clivia

Kenneth R Smith, Australia

When I first started to research *Clivia*, it was the knowledge that yellow-flowered and variegated foliage forms of *Clivia* existed that prompted my selection of the genus. Now a lot more is known of the breeding of the yellow flower forms, but the variegated types continue to amaze us. As a long-time collector of all variegated plants I have learned that plant variegation has many aspects. I am still learning new things.

The term maternal inheritance, or cytoplasmic inheritance, or extrachromosomal inheritance, is used to describe the mechanism by which foliage variegation is transmitted. The material contained in the plasma that surrounds the egg cell holds the genetic material that influences the phenotype, or appearance, of the resulting seedlings. More and more, we are learning about the role that the mother plant, or seed-bearing plant, plays in the transmission of the variegated foliage character in *Clivia*.

Photo: Hein Grebe

Variegated seedlings from China

Whilst it is said that an evenly-striped plant, that has good form and flowers, gives the best chance of producing striped offspring, it must also be remembered that chance plays a role.

Variegation in *Clivia*, as well as in other plants, can be a very personal choice. What looks good to one grower may be considered unworthy of cultivation by another grower. I gave up trying to explain my fascination with plant variegation to others a long time ago. I like all types of variegation and that is all that matters. The striata type of variegation can have many combinations of stripes. *Clivias* that appear totally green may have just a few fine stripes, and, of course, can produce variegated seedlings. *Clivias* with evenly spaced stripes of green and white or green and yellow tend to be showier and can produce seedlings of variable stripe patterns, some weaker and some better than the mother plant. *Clivia* that have very bold stripes of white or yellow on the green leaves certainly stand out in a collection. These plants can also produce striped seedlings. But here's the catch — these bold plants have a greater tendency to produce albino seedlings, which of course will ultimately die due to lack of chlorophyll.

I found it very interesting to read an account of the propagation of the beautiful margin variegated form of *Clivia* called 'Demeteri'. It was stated that the plant originated as a seedling and that it grew well and was shown to the public for the first time at the Ghent Floralies of 1905! That it originated as a chance seedling, I can believe, but the article then goes on to say: "Offsets were rarely formed and although seed from self pollinated plants produced practically 100 per cent variegated plants, only one or two seedlings raised during the last sixty years have approached the parent plant in beauty"

That was written in 1971, and although a few seeds would have resulted from the self pollinating, the comment that 100% variegated offspring resulted is surprising to me. The margin variegation is chimeral in origin and it has been my experience that all seedlings from the margined form turn out to be albino. I don't spend any of my time pollinating the flowers of the margined form. I must note here that I have raised some seedlings that turned out variegated where the margined form was the pollen parent. They are very weakly striped plants and I am not sure what to make of that.

I think we have had the spotlight put on the variegated *Clivias* lately with all the attention that the Chinese forms have received. The images we are shown show exceptional plants that have been cultivated for precise stripe patterns. The variegated Sparrow *Clivia* is one of the most elegant variegated plants I have seen, and the nature of variegation means that anyone growing *Clivias* from seed of the Chinese variegated forms can end up with a plant like that. The breeding recommendations in the translation of Zhu Jifu's book, "Appreciation of Chinese *Clivias"* page 5, state:

1. green pollen + green female = green seedlings
2. variegated pollen* + green female = green seedlings *
3. green pollen + variegated female = the 3 colours (green, variegated and white offspring)
4. variegated pollen + variegated female = the 3 colours."

The asterisk in point 2, states:

"The pollen from a variegated pollen X green female can be used in your (sic) crosses with a variegated mother plant. The pollen contains the recessive gene."

Another form of the striata type of variegation that commands attention is the half-green half-yellow leaf. Several forms have been named, such as 'Miss Perfect' and 'Hamboon Hamboon'. The Chinese refer to this form as Mandarin Duck variegation. The elusive nature of variegation means that this form is difficult to propagate both vegetatively and by seed. Offsets can be either all green, all yellow or variously striped, and I imagine, rarely as a half-green half-yellow offset. One of my variegated Belgian Hybrid *Clivia* has decided to make one side of the plant a half-and-half variegated leaf, whilst the other side is typical striata. I am watching it with interest and await the first flowers.

Photo: Claude Felbert

Narrow-leafed centre variegation from Mike Christie

Like the margin-variegated types, the centre-variegation forms cannot be reproduced from seed. This chimeral type of variegation will produce all green seedlings, or at least that has been my experience so far. Yet, on occasion, a centre-variegated seedling will crop up unexpectedly in a batch of seedlings. Well, I suppose they have to start somewhere. When variegation appears in a plant, either as a new growth or as a seedling, the pattern can change in time as the cells sort themselves out. The centre stripe and the margin tend to be stable, whilst the striata type is variable. Mr Nakamura has sent me a photo showing a striata form *Clivia* that developed the prized margin variegated leaf as the new leaves were produced. I have had this happen on one of my variegated *Clivia*. As I previously mentioned the nature of variegation is unpredictable.

Akebono variegation is another form that has caught our attention recently. Here we have cross banding on the *Clivia* foliage. The good thing about this mutation is that it is able to be reproduced by seed, that is, it is maternally inherited. Add the fact that the pattern appearance is influenced by temperature as the seasons change and you have a very interesting *Clivia*. This is proving to be a very variable character, as some seedlings will display the banding very early, yet others will start with typical green foliage, only developing the banded leaves as the plant matures. Crossing a striata form with an akebono form will produce some very interesting checkerboard pattern plants. But wait a minute, how will you get the seedlings to show both variegation characters if each type is only maternally inherited?

There are many types of variegated plants that can be grown from seed. As the research states, there are many ways that different variegations are reproduced. The more you research variegation the more detailed it becomes. In *Clivia* we have striped leaves and banded leaves that can be grown from seed. The margin and the centre variegations have to be grown by offsets. I feel that the more you deal with variegated *Clivia* the more you will understand how it works. It is necessary to keep an open mind about it, as anything can happen. Yes, there are clear indications that certain types reproduce from seed. The trouble is that the percentages vary unless you are growing lots of seedlings. The one seed that you buy could hold the genes to produce the best patterned plant in your collection. On the other hand you could grow hundreds of seedlings and only get mediocre patterned plants. It really is the luck of the draw. I would encourage all *Clivia* growers to try different crosses because there is always a chance of creating a new pattern.

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Photo's: Hein Grebe & Claude Felbert

Different forms of variegation — courtesy Mike Christie's "The Clivia Collection" and Hein Grebe

Breeding Broad Leaf Clivia

Theoretical Genetic Considerations

Johan Spies, South Africa

Introduction

Although the genus *Clivia* is endemic to South Africa, this phenomenal plant has been exported to many countries, where breeding programmes were subsequently initiated. 'Beauty is in the eye of the beholder'. This expression is especially applicable to various breeding programmes. I do not know whether cultural differences or fashion preferences in different countries were responsible for the extremely diverse breeding aims in the different countries.

Breeding for broad leaves started in Belgium and has been carried to the extreme in the Far East. When comparing these products of human intervention with *Clivia* in nature, they appear to represent almost different species (See Fig. 5 *for selection of leaf shapes and widths*). Many breeders are now trying to combine plants selected for beautiful flower production with plants selected for extremely broad leaves. The ultimate aim is to combine the beautiful flowers with yearlong beautiful foliage. During this process the inheritance of certain traits should be known, for example, how does the inheritance of broad leaves work. Are the ultra broad leaf *Clivia* plants the product of combining the correct combination of genes during breeding or the result of a new mutation (change of a gene) that occurred?

One of the major problems with *Clivia* breeding is the lack of knowledge of the inheritance of many characters, such as broad leaves. This process is being studied and the final results will, hopefully, be available in about 15 year's time. Some people are anxious to see the results and are not willing to wait. Therefore I decided to write this purely academic exercise and present a totally theoretical putative explanation of how this phenomenon may have occurred.

Photo: Hein Grebe

You have to play your cards right to get the perfect fan shaped broad leaf.

Polygenic inheritance

When a pure breeding yellow and pure breeding orange *Clivia* are crossed, the offspring will all be orange. When an offspring is self-pollinated, a ratio of 3 to 1 (orange to yellow) will be observed. This type of inheritance is called Mendelian inheritance.

Many variations of Mendelian inheritance exist. Some characters in plants and animals are controlled by more than one gene pair. Usually quantitative traits (height, length, weight, etc.) are controlled by various gene pairs. This phenomenon, where more than one gene pair determines the inheritance of a single character, is called polygenic ("many genes") inheritance. With polygenic inheritance the genes work additively; the more genes present the more or greater the effect will be. For example, with no dominant gene for leaf width present, the leaves may be extra narrow, with one gene the leaves may be narrow, with two genes they may be semi broad, and so on till six dominant genes may produce an ultra broad leaf plant. Let us assume that the genes responsible for broad leaves are present in nature and we name these the "broad leaf genes" (abbreviated as BL1, BL2, BL3, etc.). This assumption immediately gets the response "but why are there no plants with very broad leaves observed in nature"?

Population 1

We start with a theoretical *Clivia* population with a bit of variance in the width of their leaves. The majority of the population have narrow leaves (N) and occasionally an extra narrow (EN) or semi broad leaf (SB) is observed. This normal variation is caused by a single gene pair, Broad Leaf 1 gene (BL1). Genetically the majority of the population will be BL1bl1 (in other words heterozygous[1] for the broad leaf (BL1) gene - or they can be described as splitting for EN and SB as often described in the *Clivia* literature). If this narrow leaf *Clivia* is self pollinated, a quarter of the offspring will be EN, another quarter will be SB and half the offspring will be N (Fig. 1). This form of inheritance differs from the normal inheritance where we will get a 3:1 ratio in the offspring (for example when you self-pollinate an orange *Clivia* plant which had a yellow parent). The reason for this is that the dominant genes (written with capital letters) act additively to the width. This theoretical situation corresponds with observations in nature where a bit of variation in leaf width is observed.

	BL1	bl1
BL1	**BL1 BL1 SB**	**BL1 bl1 N**
bl1	**BL1 bl1 N**	**bl1 bl1 EN**

Fig. 1 Genotypes and Phenotypes following the self-pollination from an N plant in population 1

Population 2

Assume that a second *Clivia* population exists with a similar variance in leaf width. However, this second population contains a different broad

[1]*The term heterozygous implies that the individual will have the appearance (or in genetic terms the phenotype) of the dominant gene but it will also carry a recessive gene. The genotype (the genetic constitution of the plant) of this plant consists consequently of a dominant and a recessive gene (eg. Aa). In* Clivia *literature this phenomenon (heterozygosity) is often described as a plant that will split for a certain character. A heterozygous orange will, if self-pollinated, split to form three orange and one yellow plant.*

	BL1BL2	BL1bl2	bl1BL2	bl1bl2
BL1BL2	BL1BL1BL2BL2 VB	BL1BL1BL2bl2 B	BL1bl1BL2BL2 B	BL1bl1BL2bl2 SB
BL1bl2	BL1BL1BL2bl2 B	BL1BL1bl2bl2 SB	BL1bl1BL2bl2 SB	BL1bl1bl2bl2 N
bl1BL2	BL1bl1BL2BL2 B	BL1bl1BL2bl2 SB	bl1bl1BL2BL2 SB	bl1bl1BL2bl2 N
b1bl2	BL1bl1BL2bl2 SB	BL1bl1bl2bl2 N	bl1bl1BL2bl2 N	bl1bl1bl2bl2 EN

Figure 2 : Genotypes and phenotypes following the crossing of two SB plants from populations 1 and 2.

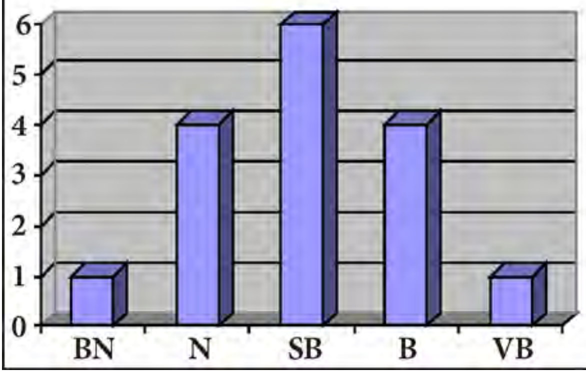

Fig. 3. Ratios of different leaf widths following the crossing of two SB plants from populations 1 and 2.

leaf gene, BL2. This second population may be bllbll or the bl1 gene may be absent, especially if this population is from a different locality or is a different species from the first population. In nature these populations will usually be geographically isolated. Our keen *Clivia* breeder collects SB plants from both these populations and crosses them. To his/her dismay all the offspring (Fl) are still classified as SB.

He/she self-pollinates these inter-population hybrids and observes quite a variation in the offspring (Fig. 2) where leaf width varies from EN to VB with the majority of F2 plants being SB (Fig. 3).

BL1BL1bl2bl2 (SB - Pop. 1)
X
bl1bl1BL2BL2 (SB - Pop. 2)
results in
BL1bl1BL2bl2 (SB - hybrid)

With no dominant genes a certain basic width will still exist (EN). Each dominant gene will add to the total width (in this case approximately 20-30 mm). The number of classes involved is directly correlated with the number of genes playing a role in this whole process.

These results indicate an important breeding principle: self-pollination of the F1. People often hear about the negative effects of inbreeding and they try to avoid it at all times. Self-pollination is needed to determine whether genes like these putative broad leaf genes are present. If self-pollination was skipped the whole breeding effort would have been stopped when the F1 did not show any response.

Population 3

In an attempt to get even broader leaves, a population with a third broad leaf gene (BL3) should be found. The success of the next cross is dependent on the genetic composition of the parent containing the BL1 and BL2 genes.

The parent should contain both dominant genes. If the VB plant is selected from the cross between populations 1 and 2, you will ensure the presence of both dominant genes. So in your next cross you use the VB plant (BL1BL1BL2BL2bl3bl3) and cross it with the plant from the third theoretical population (bl1bl1bl2bl2BL3BL3):

BL1BL1BL2BL2bl3bl3 (VB)
X
bl1bl1bl2bl2BL3BL3 (SB)
results in
BL1bl1BL2bl2BL3bl3 (B)

Self-pollination of this hybrid will result in the ratios presented in Fig. 4.

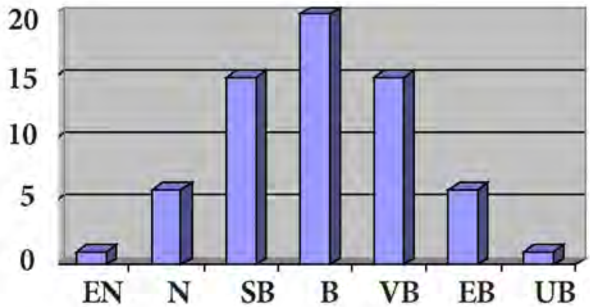

Fig. 4. Ratios of different leaf widths following the crossing of a VB hybrid from populations 1 and 2 and a SB plant from population 3.

In summary it can be said that each dominant gene adds a certain width to a basic width.

# Dominant Genes	0	1	2	3	4	5	6
Width	EN	N	SB	B	VB	EB	UB

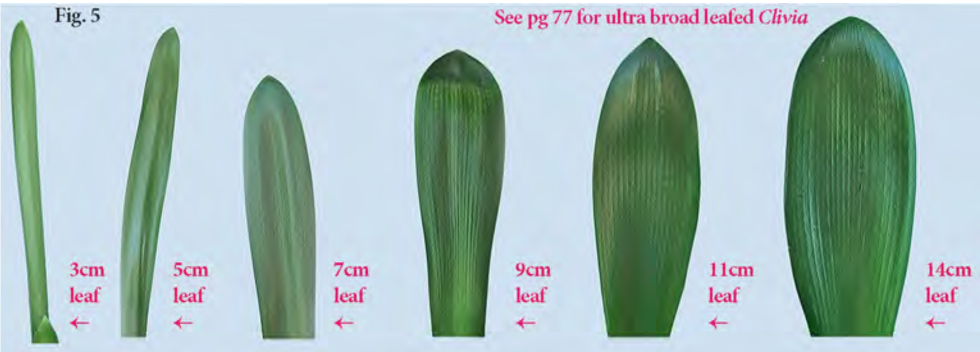

Fig. 5

Discussion

These results indicate that it is theoretically possible to breed an ultra broad leaf *Clivia* if plants containing different broad leaf genes are used. Any of these theoretical natural populations can be substituted by a mutated population in a breeding programme. The major problem remains our lack of genetic knowledge regarding our breeding material.

A lot of factors complicate this simple demonstration of the inheritance of broad leaves in *Clivia*. The width of a leaf is not only the product of the genes present, but the interaction between these genes and the environment will play a role. If we compare this situation with humans, you may inherit the potential to develop an IQ of 120 but if all stimulation is withdrawn from you during your childhood, your IQ will be much lower than 120. Similarly a *Clivia* may inherit the potential to reach a leaf width of 150 mm, but stress at any stage of development will decrease that figure.

All genes may not contribute to the same extent. BL1 may contribute more, the same as, or less than either BL2 or BL3. These genes may influence one another so that BL1 and BL2 in combination produce a different width than would be predicted from crosses involving only one of them. Any one of these genes may be linked to another gene that will almost always be inherited together with it, that may influence the outcome. If a short leaf gene is inherited with a broad leaf gene, the leaf may, for example, be broader than predicted to compensate for photosynthesis.

Breeding broad leaf yellow *Clivia*

An example of this complexity may be the extreme rarity of broad leaved yellows. Two possible explanations exist; either (i) the yellow mutation suppresses the formation of broad leaves on a physiological/bio chemical level, or (ii) the yellow mutation gene is linked to a recessive bl gene or to a broad leaf suppressor gene. The fact that broad leaved yellows have been obtained in the USA and in the East suggests that hypothesis (ii) is likely to be correct.

Linked genes indicated that these genes are situated close to one another on a chromosome and that they will be inherited together. The closer these genes are together the more often they will be transferred together to the next generation. Since two yellow genes are needed to form a yellow plant, gene linkage will ensure that two "narrow leaf genes" are inherited with them. Consequently the broadest leaf possible will be very broad (VB) and the extra (EB) and ultra broad (UB) leaves will not be obtained by conventional breeding. However, with linked genes a cross-over occurs occasionally between the genes involved. These very rare events may have occurred in the American and Asian cases.

It may also be possible that the yellow mutation is linked to a "broad leaf suppressor" gene. If such a gene is inherited it suppresses the working of the BL genes and they cannot be expressed. In the case of humans this can be illustrated by the inheritance of albinism. Two black people (having many expressed 'colour' genes and both being carriers for the albino gene) may produce an albino child. This child may have inherited many 'colour' genes but these genes cannot be expressed because the albino genes stop the production of melanin (the colour forming substance).

To test this hypothesis the following should be done: try to breed a broad leaf yellow group 2 *Clivia*. If this aim is achieved we know that we are dealing with linked genes. The chance of both yellow mutations being linked to the same "broad leaf controlling gene" is very low.

Clivia breeding

The strategy for the development of broader leaves should be to try crossing as many populations of *Clivia* as possible in an attempt to find new BL genes. In *Clivia* this is a very difficult process because breeders continuously cross different populations and almost no 'pure' population exists. If the populations were pure, a cross between a Belgian broad leaf and a Chinese broad leaf should be an excellent source to increase the width. However, it appears as if these populations contain the same broad leaf genes and no additional width is obtained. This 'contamination' of the different gene pools (populations) of *Clivia* makes it very difficult to make progress with the breeding process. Breeding becomes a haphazard event - where you are looking for a needle in the haystack - rather than the predictive science it should be.

In a previous Clivia Newsletter Keith Hammett and Ken Smith pleaded for the preservation of the natural variation in *Clivia,* or in other words, for the preservation of as large a gene pool as possible. I want to end this in the same way. That insignificant *Clivia* that started your *Clivia* obsession may look worthless to you now that you have obtained some hybrids and have improved your own material, but it may contain some novel genes that you are unaware of. It may contain an, as yet, unknown broad leaf gene that will, in the right cross, give you the ultimate broad leaf plant. Take care not to destroy an ugly looking genius. If you selected humans, would you have kept Einstein as a child?

A fan-shaped short broad leaf *C. miniata* from China

C. miniata "Ella van Zyl". Grower: Toy Jennings

Miniata : In Favour of Seed Grown Strains

Michael Jeans, United Kingdom

For the majority of popular plants, those most desired are the named cultivars or hybrids, and divisions or cuttings from the award winning clones. There is considerable current discussion on possible commercial methods of propagating the most desirable clones of *Clivia miniata* and *Clivia* Cyrtanthiflora. In this article, I am setting out my reasons for suggesting that, in general, seed grown strains of C. *miniata* are the way forward, both for large scale commercial production and for amateur growers. Cyrtanthiflora, being a hybrid between two species, may well have problems in maintaining the quality of plants if grown from seed - it is outside my experience as I restrict my efforts to C. *miniata*.

Photo: Michael Jeans

Fig. 1 - Attractive fruits setting the tone

Seed grown plants avoid the very real genetic pitfalls of propagation by tissue culture, and also the long term problems resulting from continued vegetative propagation. In Europe, where the latter has been carried out over many successive generations of some bulbs and corms, it is now impossible to find them un-infected by virus. Continued vegetative propagation will, in any case, lead to a slow but gradual decline in the quality of the genetic make-up of the plant. However, a division from an early generation of an exceptional plant makes a worthwhile addition to any gene pool. Its good qualities are still there to be passed on, and any genetic deterioration is subsequently lost in the seed process. Virus is seldom transferred by seed, and the genetic make-up is totally renewed in a seed grown plant.

Absolute uniformity, usually the desired end point in line-breeding, is best avoided. There are several reasons for this - not least because the added interest of variation would encourage growers to produce ever better plants. However, a degree of uniformity in the size and appearance of the plant is essential for commercial production. In my strains, I am aiming for moderately broad leaves, 5 - 7 cm across, and very roughly 45 - 60 cm long. In my experience, broad-leaved plants produce flowers with broad petals and a good degree of petal overlap. Narrow-leaved plants tend to produce flowers with narrow petals and very little, if any overlap, which I feel should be avoided. Again, my experience suggests that well shaped plants usually have broad leaves while narrow-leaved plants are more likely to have the leaves sticking out at all angles and look untidy.

My own seed grown strains of C. *miniata* are divided into 4 groups:

Clear orange, dark orange and red

Pale oranges, sometimes suffused with other colours and sometimes pure, are put in the pastel group, leaving this group with strong, vivid colours. Fig.2 shows a seedling, flowering for the first time, which will be incorporated into my gene pool for this group. Amongst other core plants, I am also using an Ixopo C. *miniata* which has a 25cm head and flowers with 9cm long petals, which are larger than flowers usually found on Ixopo C. *miniata.*


Photo: Michael Jeans

Fig. 2


Photo: Michael Jeans

Fig. 3

Yellow flowers, including peach

The yellow in this group is limited to strong, medium saturation yellow, and the cream coloured flower with a faint yellow stripe down the centre, which is described (commercially) as yellow is moved to the pastel group. Again it is intended that the group has only flowers with strong, vivid colours. Fig. 3 shows a yellow seedling which I feel has many of the characteristics for which I am looking. Its only real weakness is that the flowers are only 7 - 9 cm across. I feel that, ideally the flowers should be about 10 cm across, and that they would then look in balance with a large round head carried on a strong stem well clear of the leaves.

Pastel flowers

This group is intended to have the full range of pastel colours, amongst which the (commercial) yellow and pale orange can earn their keep in extending the range. Photographs taken at *Clivia* Shows, capturing different classes and a range of colours in the same picture, illustrate how much more impact is made than with a display of a single colour. One has only to see a large display of orange C. *miniata* in a garden centre to realise the difference; they may look attractive, but are hardly likely to stop every passer-by in their tracks! The pastel group is probably the most exciting commercially, and also that most likely to appeal to enthusiastic growers. Figs. 4, 5, 6, 7 and 8 show various pastels that are typical of my gene pool at its current stage of development.


Photo: Michael Jeans

Fig. 4

Fig. 5

Fig. 6

Fig. 7

Variegated leaves

For me this is by far the most difficult group, and consequently I have had to lower my sights and settle for a strain that produces seed with a good chance that the seedlings will have attractively variegated leaves. Parent plants with spectacular variegation can easily produce seedlings that suffer sufficiently severe chlorosis as to be unable to survive. It is also desirable that the plants should have flower heads that are the equal of other C. *miniata*. Figs. 1 and 7 show a plant with attractive variegation, a good flower head and a spectacular seed head which adds considerable interest to the plant. My target is that 50% of seed should produce variegated leaf seedlings, mostly with orange flowers, but some with yellow flowers.

In order to aim for top quality, it is essential that the plants are hand pollinated to a carefully controlled plan and the seed from the various crosses kept separate and labelled. Cross-pollination tends to produce very much larger seed heads than self-pollination, and consequently yields a much larger crop. Typically, I would expect 10 - 12 seeds a berry from cross pollination. Whilst in the course of writing this article, I have harvested and sown two berries from the plant shown in Fig. 3, one contained 13 seeds and the other 17 seeds. One exception to this is any cross with considerable Vico Yellow blood in it, where one would be lucky to see even half that number of seeds in a berry. The small green and white berry at the bottom of the head in the photo on the first page of this article is likely to be a self-pollinated berry, and the other much larger berries to be cross-pollinated.

Hand-pollinated seed that is labelled so that it can be traced to its parents is far more time-consuming and expensive to produce than “bulk” unlabelled seed, but the production cost per seed is minimised if nearly every flower in the head produces a large berry filled with a good quantity of seed. It also means that the number of stock plants needed to produce a given quantity of seed is much reduced. High seed yield, all other things being equal, is an extremely valuable characteristic for those retained as stock plants.

My aversion to keeping records manifests itself in the labels which I tie to flower heads once I have cross-pollinated them. Each label records the parent plants and the date of the cross. The latter is of interest as it tells me the earliest time that I can sow the seed and expect it to be viable. Sowing the seed as early as possible is important since the few months between the seed becoming viable and the berry changing colour can, in some instances allow the plant to flower a year earlier than would otherwise be the case.

In England, C. *miniata* flowers in the period mid-Febuary to the end of May. If a plant has not flowered during that period, it will wait until the following year, and that particular program will be delayed by a year. Typically, a complete cycle for my C. *miniata* is usually 4 years, one year for the seed to ripen followed by 3 years for the seedlings to flower. Only very occasionally, does a seedling manage to flower in two years from seed. To reduce the complete cycle to 3 years would pay great dividends as it would mean that a 12-year period contains a total of 4 cycles rather than 3.

As I mentioned earlier, I am keen that all the plants should be relatively broad-leaved and tidily shaped. Such plants can be selected when they are about 18 months old, and grown on to flowering in the hope that they will at least match, if not improve, on the previous generation. Without doubt my greatest disadvantage in growing *Clivia* in England is the cold winter that demands that the plants are grown under glass, thus limiting the space available and the quantity of seedlings that I can grow on to flowering. However, I also have a great advantage in the availability of broad leaved orange flowered plants. Some of these plants are the product of selective breeding through many decades in the late nineteenth and early twentieth centuries, and combine good flower form with a well shaped plant. Fig. 9 shows a seedling with excellent shape and only average or below average flower form. It is still worth adding to the gene pool as few plants are that well-shaped, and the shape is all that there is to see for those of the 52 weeks in the year when the plant is not in flower.

Seed sown strains should only be the starting point for enthusiastic growers who, having bought a packet of mixed pastel shades, can then add their own favourite plants into that gene pool, giving a unique but completely up-to-date gene pool. Not only would the availability of seed enable all growers to maintain high-quality gene pools, but also, hopefully ensure that much better quality plants find their way onto the general marketplace.

Photo: Michael Jeans

Fig. 8

Photo: Michael Jeans

Fig. 9

Polyploidy in *Clivia* : A Laymans Guide

Aart van Voorst, Netherlands

Introduction

After my first research on polyploidy in *Clivia* and the successful production of polyploid *Clivia* plants using the in-vitro method (see CLIVIA 5), the question arose: how to continue? If polyploidy should be a success in *Clivia*, working alone on this subject will not speed up polyploid breeding very much. Among the many *Clivia* enthusiasts around the world, working on the improvement of all kinds of characteristics, there must be others who would also like to work on this subject. The hobby breeder doesn't normally have a laboratory at his or her disposal, so the method to induce polyploids should be simple and easy to apply at home "at the kitchen table".

Preliminary results with germinating seeds immersed in a colchicine solution, presented at the 2002 Clivia Conference, showed great loss of material due to the toxicity of the colchicine to the root meristem. Normally you also get losses because in many cases the shoot meristem dies, but loss because of a destroyed root meristem reduces the effectiveness of the method without any possible advantage. The first root(s) of a colchicine treated *Clivia* seedling may be diploid even when the shoot is converted to tetraploid. Roots that appear later from the tetraploid shoot will also be tetraploid. A method that will save the root meristem would be welcome. Harold Koopowitz suggested putting the germinating seed upside down in the liquid with the root meristem above the colchicine solution. In this case the chemical is not in direct contact with the root meristem and will reach it only when transported within the plant. With this in mind I returned to Europe and at home I started experimenting with seeds people at the conference had donated to me and with some material collected from the wild.

Material and Methods

Two of the chemicals most widely used to double chromosome numbers are oryzalin and colchicine. Although oryzalin is more effective in several plant species (van Tuyl *et al.*, 1992; Vainola, 2000), colchicine is easy to use and maybe more easy to purchase in different parts of the world. I use colchicine in all my experiments. Colchicine can be purchased at several chemical firms. A website illustrating the use of colchicine where Wouter Addink uses *Fuschia* as an example is: www.geocities.com/RainForest/Vines/2259/colchicine.htm.

To be effective colchicine should be in contact with an active meristem. Why germinating seeds are the best starting material for chromosome doubling in *Clivia* has been explained before (van Voorst, 2003). It is important to state that colchicine is highly toxic and should be used with great care, especially the pure powder form. Inhaling the powder should be completely avoided. When diluted with water to the working concentration of 0.05 - 0.1% (0.5 - 1 g/l; some firms sell solutions) the risk of getting poisoned is very small. Take the same precautions you would when using any other household chemicals like bleach or poisonous substances.

Starting off with dormant seeds and a clean method of germination should increase your success rate. Putting the seeds in soil would complicate the procedure due to the substrate particles sticking onto the developing plantlet. Place the seeds on moist tissue paper in a small container which is then kept in a warm spot. Treating the seeds with a diluted solution of household bleach (one to one hundred) for one hour should prevent fungal infection.

Within the seeds of a cross there is normally a variation in germination speed. For convenience it would be preferable to treat all within a batch simultaneously. This can be achieved by "chipping" the seeds: taking the seed coat away above the embryo with a sharp sterilized knife or razor. Extra care should be taken so as not to damage the embryo.

Colchicine application method

After the seeds have been chipped they can be placed in moist rather warm surroundings (a little above 20° C). For example in a petri-dish on a piece of moist paper towel (Fig. 1.)

Colchicine can be applied when the seeds have germinated and the radicle is about 1-1.5 cm long. Terminology of reproductive parts of *Clivia* is explained by Robbertse (2001).

The meristem of the primary root should be visible and just above the meristem the first circle of root hairs can be seen. The sheath from which the first leaf will emerge should also be visible. It is around this sheath from which the first leaf emerges that the colchicine solution should be applied in order to reach the shoot meristem. To make the procedure easy, it is best to mount the seed on a piece of clay (Fig. 2).

You can use ordinary children's playing clay that comes in different colours. Using the different colours of clay will help in keeping the seeds from different crossings within an experiment separated (Fig. 5).

A small oblong piece of (Kleenex) tissue is then wrapped around the radicle containing the sheath and shoot meristem, (Fig. 3). This piece of tissue can be pre-wetted with a small amount of colchicine solution to make it easier to manipulate. From this stage the tissue should not be touched, so working with sterilized tweezers is recommended.

When the tissue is placed in several layers on the shoot meristem, as much extra colchicine solution as possible should be added (Fig. 4). I use a standard 0.05% solution.

The seeds, still mounted on clay, are then kept in the dark in a humid container (colchicine breaks down in light) at a temperature above 20° C for 1-2 days (Fig. 5). If a period of two days is chosen (recommended), after one day an additional drop of colchicine solution should be applied to the piece of tissue on the shoot meristem. After the induction period of the colchicine, the seeds are then rinsed in tap-water and planted in soil or other medium.

Fig.1

Fig-2

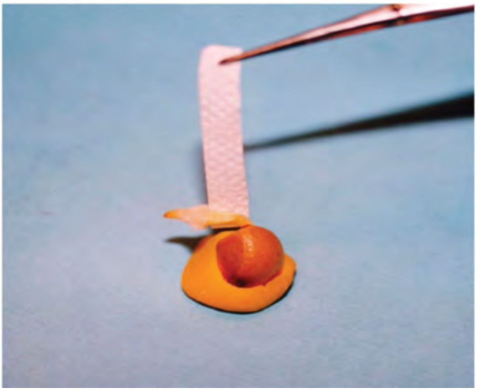

Fig. 3

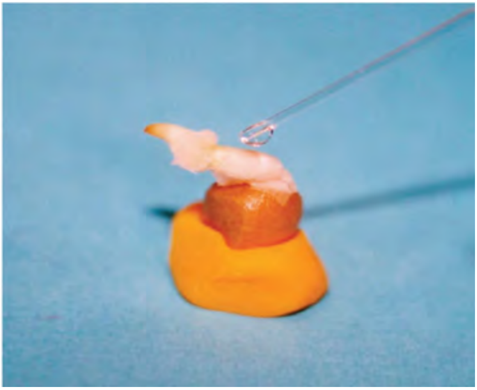

Fig. 4

Fig. 5

Fig. 6

To minimise chances of fungal infection, I remove the outer seed coat (the thin transparent outer layer of the seed) and dust the seed with a fungicide. Unfortunately in Western Europe seeds are at their best for germination in winter, which is not the best growing season for seedlings. I put my seeds in test tubes on vermiculite in a growing cabinet with artificial light. Fig. 6 shows a number of test tubes with seedlings that show a positive reaction to the colchicine treatment.

Discussion

The effectiveness of the abovementioned method has yet to be checked. What can be seen at present is that the results of the colchicine treatment vary from distorted growth to complete death of the plantlet. The reason for developing this new approach was the high death rate of the root meristem after immersion in a colchicine solution. The procedure described in this article results in a reduced number of plant deaths. It is not possible to give exact figures on this because of the great difference in treated seeds. I have used seeds from (very) different crosses and sources, which are of interest to my tetraploid breeding program. I did not intend to get scientific proven results.

The described procedure is very time consuming and therefore rough methods like immersing great numbers of germinating seeds in colchicine can also be successful, and used in cases when many seeds are available. My approach is specially designed for relatively small numbers of seed from precious crosses. Every seedling is individually treated with colchicine and receives special after-care.

To determine whether an experiment is a success, you have to wait until the treated seedling flowers. Indications of success are a thicker leaf and flower structure than normal. Pollen grains of tetraploids are bigger than those from normal diploids. Also measuring the DNA level of the individual cells with flow cytometry is a good method or counting the chromosome numbers. In CLIVIA 5 these methods are discussed more thoroughly.

It is maybe a good idea to recap on the possible benefits of polyploidy in *Clivia*. Polyploids can give bigger flowers, broader leaves and more intense colours. Disadvantages could be slower growth and lower flower count per umbel and reduced fertility. These disadvantages can be overcome by selective breeding. An interesting possibility would be the incorporation of genes from several species in a polyploid plant. Developing triploid hybrids was one of the reasons I started colchicine treatments in *Clivia*. First attempts to get triploids between tetraploid C. *miniata* and diploid species like C. *gardenii* and C. *caulescens* in a cooperative project with several *Clivia* lovers in South Africa and Australia failed. This year I've made my own crosses between tetraploid C. *miniata* and diploid C. *caulescens* and they look successful. I've germinated some seeds from the cross with C. *caulescens* as a mother in-vitro and found two of the plantlets to be different from "caulescens-type" seedlings. Triploids between tetra C. *miniata* and diploid (yellow) C. *miniata* are now two years old and need at least one more growing season to flower.

In many plant species crosses between different ploidy levels require embryo culture to be successful: there is no or insufficient endosperm development. In *Clivia* normal triploid seeds do arise, but also many shrivelled seeds are found in ripe berries. Embryo culture in an early stage could give more triploid plants from a cross, but this has not yet been tried. The number of triploids from a cross seems to depend very much on the combination of parent material used. Till now the most successful combination was a cross between tetra C. *miniata* as a father and a yellow C. *miniata* as a mother. More than ten plants have been grown from seven developed berries. In most other combinations till now, only one or two triploid plantlets have been found.

The number of tetraploids produced from seed is low. I only have a couple of tetraploid or cytochimeric plants that are old enough to flower. As a result of reduced fertility in the colchicine treated material and the resulting slow growth (a flower is not always produced every year), I only have five proven tetraploids from seed in my collection. It will take many years of patience to see if the fertility in future generations of these treated plants will increase as the theory dictates.

I hope the above results will not scare people from trying to produce polyploids of their own. To make tetraploid breeding a success it is important that every type of *Clivia* is available in a tetraploid form. Peach, Akebono or variegated types, broad leaf Chinese plants and interspecifics, there is still a lot of work to be done!

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2003 Show Sellection

Photo: Peter Lambert

Above: *C. miniata,* Best on Show KZNCC, Grower Gem Wild Flowers

Below: *C. miniata*, Runner-up to Best on Show KZNCC, Grower Gem Wild Flowers

Photo: Peter Lambert

Photo: Reinhardt Hartzenberg

Above: *C. miniata,* Best on Show NCC, Grower Pine Pienaar

Below: *C. miniata,* Best on Show PECC, Grower Ian Vermaak

Photo: Pine Pienaar

Photo: Reinhardt Hartzenberg

Above: *C. miniata,* Runner-up to Best on Show NCC, Growers Pikkie & Elize Strumpher

Below: *C. miniata,* Runner-up to Best on Show CCC, Grower Felicity Weeden

Photo: Claude Felbert

Photo: Pine Pienaar

Photo: Claude Felbert

Above: Runner-up to Best on Show PECC, miniature with variegated leaf, Grower Charl Coetzee
Right: *C. miniata*, Best on Show CCC, Grower Eric Heine
Below: *C. miniata*, Winner Yellow / Cream narrow tepal, NCC, Grower Gert Esterhuizen

Photo: Reinhardt Hartzenberg

Photo: Keith Barlow

Above: *C. miniata,* Best on Show Metro Group, Grower Johannes Smith

Below: *C. miniata*, Third Placed on Show Metro Group, Grower Bertie Guillaume

Photo: Keith Barlow

Clivia: Food and Drink

Ian Coates, United Kingdom

It is not possible to give advice on the upkeep of any plants without some qualification, as there are so many variables. There are now five accepted species of *Clivia* and each resides naturally in a different environment. Some by a stony water's edge, some deep in forests or a dry gorge and some are partially epiphytic. Each location has its own characteristics and each species has developed to suit. Darwin would be proud of them! Some people live in areas where they are able to grow *Clivia* in their natural habitat, others around the world can grow them in their garden beds if temperatures are compatible, but, mostly, it is *C. miniata* which are grown and kept in pots. I will therefore concentrate on this scenario.

I am located in central England where winter day temperatures are around 4⁰C and nights can drop to -10⁰C so plants are kept indoors. In summer, temperatures rise to around 20 - 25⁰C and plants are outside in their pots. In hotter climes, more water will be required than I give — but only slightly more food to compensate for the extra growth.

In the ever warm Canary Islands where the plants grow mostly in free draining volcanic rock, they are watered daily. In cooler climes, less water will be necessary.

In the Northern Hemisphere, January is part way through the plant's rest period. Watering is very minimal according to its retention in your potting medium. The number one problem with *Clivia* in pots appears to be rotting of their roots. However little they are watered, they must have excellent drainage. Coarse sand, granules or bark allow for this whereas a fine water retentive compost does not.

The only change in February is a slight increase in temperature. By March one would hope that flower scapes are starting to grow, so watering is slowly increased. I usually wait until the stems are about 9" (22 cm) high before I begin to add feed. By the time the majority have reached this height I feed them all, as some may not be going to flower this year anyway.

In April I pot on any plants which are too heavily pot bound. If you do this into a ready-made commercial medium, be sure to add extra drainage. Such mediums probably already contain nutrients so your fertilising should be delayed a month or so as it should

Photo: Ian Coates

A well cared for *C. miniata*

not be overdone. I water heavily and let the medium dry out before repeating. With good drainage in the British climate, this usually means about once a week during the summer. To keep things simple, I feed at every watering. Since this would give too much fertiliser, I double the recommended rate of dilution. It is never good to over fertilise, as some of the chemicals are retained in the potting medium and can become toxic.

The three main constituents of proprietary fertilisers are Nitrogen (N), Phosphorus (P) and Potassium (K). Each has a different function and the proportion of each in a fertiliser mix will vary. Nitrogen is responsible for leaf growth. A shortage of it will see older leaves yellowing. Phosphorus looks after the roots and therefore the overall growth of the plant including the seeds. Potassium particularly affects the flowers. The proportion of each will vary but this should be shown on the package. This could typically read: Nitrogen - 4%; Phosphorus (pentoxide*) - 4%; and Potassium (oxide*) - 2%. This is usually shown as a ratio - N:P:K. 4:4:2*. It shows that there is twice as much Nitrogen and Phosphorus as there is Potassium. It is therefore most suitable for leaf and root growth and is used on younger plants. It may be notated differently according to your country but you should still be given the percentages. If the figures are higher i.e. N:P:K 8:8:4, this would indicate that it is twice as strong and will need more dilution. This will be shown on the mixing instructions.

Since most *C. miniata* in the Western world are grown for their flowers, a higher proportion of Potassium is desirable once the plant has matured. I consider my *Clivia* have reached maturity when they have a total of twelve leaves. They are then mature enough to bear flowers so a fertiliser richer in Potassium is used. A readily available mix for this is a specialist tomato fertiliser where the fruit is more important than the foliage. This mix is nearer 1:1:2 (or 4:4:8 etc) and is just right for flowering plants.

In May my plants are moved outdoors and, during the hotter months of June, July and August I will also spray the leaves occasionally with water to increase humidity. Annually in July I give the plants one special feed. This contains elements including Magnesium, Calcium, Iron, Manganese, etc. which are vital for healthy growth but only required in small quantities. Commercially, this is known as a ‘trace’ element fertiliser. Some basic fertilisers will also contain these trace elements so this special mix will not be needed. In summer, I will also test the growing medium for acidity. *Clivia* generally seem to prefer a pH level around 5.5 and simple test kits are available in most areas. Levels of pH 4 to 7 have been reported but I aim between 5 and 6.

Watering with feed is carried on until September. Most seeds will now be ripe and are sown immediately onto a water retentive gel. The plants are brought indoors and plain watering without fertiliser is continued for a month through October. *C. gardenii* and *C. nobilis* and interspecific crosses mostly flower at this time. In November, resting begins with minimal watering again and the temperature is kept down to between 5C and 15C to trigger the dormant flower spikes for the next year. Resting continues through December and so to January again............

** In South Africa and a few other countries, NPK content in fertilisers is specified in elemental form. It is given on the container in terms of the ratio of NPK to each other with the total percent NPK in brackets. For example, South African 4:3:4 (33) has 12% N, 9% P and 12% K. For approximate conversion from the oxides multiply the P by 0.43 and the K by 0.84. The 4:4:2 that the author uses as an example will be approximately 4:1.7:1.7 NPK elemental*. Eds

Observations on Akebono

Connie & James Abel, South Africa

Variegation in *Clivia* leaves fascinates many enthusiasts. As we have added different types to our collection we have gained a little (perhaps dangerously so) understanding of the types and their origin, from observation and available literature. A highlight was the realisation that Akebono variegation is seasonal - something that we have seen no reference to elsewhere. This seasonality is short term in effect and not overall, as with autumn (fall) colours for example.

Plants with variegated leaves are slower growing, proportionately to the amount of non-green leaf surface, since that area does not contain chlorophyll and does not contribute to the energy needs of the plant that are derived from photosynthesis. Variegation is the result of dysfunctional chloroplasts. According to Ben Zonneveld of Leiden University, about 1000 genes are involved with the formation of the chloroplast of which 900 are located in the nucleus.

Variegated leaf *Clivia* have had their greatest development in Asia, particularly Japan and China, where *Clivia* enthusiasm has been concentrated on leaf forms and patterns, based on the principle that they can be enjoyed all year round, while flowers offer only short term pleasure. A few basic aspects will first be discussed. The three best known forms of variegation in clivias are:

1) Regular or longitudinal stripes (Fig. 1), further subdivided into a number of recognised patterns such as Fukurin (green centre with broad lateral white stripes).
2) Akebono or transverse banding (Fig. 2)
3) Light of Buddha (LOB, Fig. 3 with blotchy patches of lighter colour. We have little experience with LOB and will not discuss them further.

Fig. 1. Longitudinal variegation

Most plant characteristics, with the genes on the chromosomes, are inherited in predictable Mendelian ratios. Regular variegation, with attractive and even startling colour contrasts,results from the presence of a mix of normal and dysfunctional chloroplasts in varying proportions in the cells in the apical meristem. The genes controlling regular variegation are in the chloroplasts in the cytoplasm and, since the cytoplasm separates at random as the cells divide (for growth or for reproduction), variegation

Fig. 2. Akebono variegation

gene distribution between the new cells is unpredictable. As the meristem divides and grows upwards, it leaves vertical bands of less or more highly striped stem and leaf below it, around the circumference of the plant. The leaf meristems continue this division, so that individual stripes can be traced down the full length of the plant. But since the cytoplasm split between the cells in the meristem is unpredictable the patterns do change and are seldom the same between seedling siblings, between parent and offsets and between leaves on the same plant.

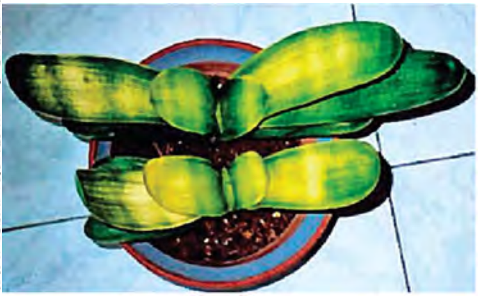

Photo: Courtesy Connie & James Abel

Fig. 3 — Light of Buddha

Pollen, necessarily very light so as to enable distribution by wind or insect, brings no or very little cytoplasm to the new seedling. Therefore variegation is inherited from the fruit parent. For this reason, green leaf pollen parents can be used on variegated plants to improve flower or leaf characteristics, without affecting the variegation of the seedlings.

Photo: Courtesy Connie & James Able

Fig. 4 — Akebono with yellow flowers

Akebono variegation

Our interest in Akebono started from the first Clivia Conference and Show in Pretoria in September 1994 with the visit of the well known *Clivia* breeder Yoshikazu Nakamura, who stayed with us. We obtained some seed from him — seed which was not only Akebono and rare,

Photo: Courtesy Connie & James Abel

Fig. 5 — Akebono radiation (see a & b next page)

but which had been bred for yellow flowers, a combination which had not previously flowered. Ours flowered in September 2000 (Fig. 4) and again in 2001, to the good natured frustration of Yoshikazu who flowered his first yellow Akebono in January 2002. He has used his yellow Vico strains to give the excellent flower quality.

Apart from their flower and leaf beauty, our interest in the Akebono has been increased with our observation that the pattern is seasonally determined. We have seen no record of this from elsewhere, but there can be no doubts about the correlation and our hypothesis follows.

The genes for Akebono variegation are also carried in the chloroplasts and inherited from the berry parent. These plants do not have a mix of functional or dysfunctional chloroplasts in their cells - for most of the year ALL new chloroplasts in the new cells dividing off the meristem are able to form chlorophyll. However, for perhaps 6 - 8 weeks in late winter/spring a seasonal trigger, which may be increasing light and/or temperature, causes all new cells to be chlorophyll-incapable.

After this period the effect is cancelled out and new cells are again chlorophyll-capable. As the new leaves emerge from the centre of the plant the emerging cream bands are clearly visible at a uniform height above the centre of the plant, as can be seen in the photo. The leaves grow about 8 - 10 cm during this period and that is the width of the band. There are several interesting observations that follow:

a) The band appears in a chevron shape, which is the pattern of the intercalary meristem between the leaf sheath and the leaf blade, from which the leaf elongates.

b) The growing leaves are at different stages of elongation when the Akebono tissue is formed, and as they elongate to their final length through the summer and autumn, so the bands in older leaves remain close to the centre of the plant while younger ones are pushed out to the periphery of the plant. In the photo the three new leaves show this season's greenish/yellow recent stripes while the previous years have off-white bands having lost the green colour.

c) Since leaves develop fully in less than a year, normally there will be a maximum of one stripe per leaf.

Photo: Courtesy Connie & James Abel

Fig. 6 — Akebono plant flowering

d) The peduncle elongates fully in about three weeks, and since this occurs fully within the Akebono period it is cream for as compared to 8 - 10 cm for slower growing leaves.

Photo: Courtesy Connie & James Abel

Fig. 7 — Akebono seedling

e) Seeds are also subject to the Akebono effect. The original seed was germinated late, in December '94, and the new leaves were green. We germinated our first seedlings in September '01 and the leaves emerged without chlorophyll. We assumed that they were all albino and would soon die. There was much relief when the Akebono period was over and the new leaf tissue started to emerge green.

f) As with regular variegation, Akebono plants can be pollinated from green leaf plants to improve flowers or leaf form, without affecting the inheritance of Akebono in the seedlings.

Multitepal Breeding

Shigetaka Sasaki, Japan

In recent years the breeding of *Clivia* has advanced thanks to the efforts of enthusiastic breeders, and it is now evident that there are a number of characteristics of *Clivia* species that will be important in future breeding. In particular, the following characteristics should be of interest:

- Flowers with green striped petals that are found in interspecific hybrids subsequent to the F2 generation (e.g., Nakamura hybrid shown in CLIVIA 3, p.29)
- Hybrids based on *C. nobilis,* such as Rudo Lötter's interspecific "Chanel"
- Bicolour flowers with contrasting sepals and petals, such as the *C. miniata* bred by Yoshikazu Nakamura (CLIVIA 5, p.71)
- *Haemanthus*-like flowers with about 20 stamens;
- Flowers like Connie Abel's "Frats Odd Petal", without any petals or with deformed petals but with stamens and pistils
- Flowers with keeled petals
- Flowers with bleached petals like "Kabuki", bred by Yoshikazu Nakamura using cobalt 60
- Flowers with peach, pink or green petals

be able to see a special hybrid in the future that incorporates a number of the above interesting characteristics.

What will be the most important factor to dramatically influence *Clivia* breeding? I think the answer lies in the breeding of multitepals. We can see two kinds of multitepals: a double flower type, and a type that bears many tepals. Since we have not produced many beautiful flowers of a double flower type to date, I think it is desirable to concentrate our breeding on this objective. If we can breed *Clivia* with some of the above-listed characteristics in conjunction with a combination of green-tipped tepals, such as *C. nobilis, C. gardenii* and *C. caulescens,* and, with double flowers, we will certainly change the impression of a *Clivia* flower. It should even be possible for us to breed *Clivia* even more rose-like in the future.

Here I would like to introduce two tips for breeding multitepals. These are not based on my own breeding results, but I think these points will be useful and of interest to *Clivia* enthusiasts.

In relation to breeding developments with regards to the leaves of *Clivia*, Chinese and Japanese breeders have had a long interest in breeding beautiful variegated and broad-leafed *Clivia*. Future breeders could try crossing *C. nobilis* with *C. miniata* to breed broad-leafed and variegated *Clivia* incorporating the rigid leaf of *C. nobilis.*

In comparison with other garden plants, it appears that *Clivia* breeding is still in its development stage. However, I believe that we will

Rose-like *Clivia* multitepal

***Hippeastrum* Multitepal**

The following comments are extracts from a letter from my friend, Nobuyuki Katsuyama. He has used the methods described below to breed *Hippeastrum* double flowers.

"If you want to breed double flowers, you have to select good plants with the potential for breeding this feature. For example, use a flower with eight petals or a flower of which the stamens and stigma are partly changed into petals. Of course the plants should be fertile. If you cannot find such plants, you have to at least select plants that show such signs.

Nerine and *Hippeastrum* which have eight petals have a tendency to produce eight-petalled flowers in the next generation. However, I have been unable to breed double flowers from crossing eight petals x eight petals. Therefore, I selected only those plants with flowers where the stamens and stigma were partly changed into petals as the parent plants for my double flower breeding.

In the case of *Hippeastrum*, I was able to create a high percentage of double flowers from crossing plants with flowers where the stamens and stigma were partly changed into petals. It seems that the changing of stamens and stigmas into petals can be inherited through either the mother plant or pollen plant.

Plants where the stamens and stigmas are changed into petals in alternate years (rather than every year) will be more fertile and are recommended for use in breeding double flowers. This feature will be masked through a reduction of water and fertilizer but the plant will become more fertile. Accordingly, it's better to select good fertile plants showing even a slight disposition rather than selection based on the number of the petals themselves.

In order to build up my stock for breeding *Hippeastrum* with double-flowers or different colours, I tried pollinating double-flowered plants with pollen from regular flowers with six petals, or else pollinating plants possessing regular flowers with pollen from double-flowers. The result was that almost 100% of the F1 plants had regular flowers. However, the F2 plants that were bred from crossing these F1 plants together showed a high percentage of double-flowers. I then selected the most fertile plants from the F2 generation and crossed them with each other. An even higher percentage of double-flowers resulted. This is the method that I have used to breed *Hippeastrum* cultivars with double flowers up until now.

If you want to create double-flowers based on your favorite flower shapes, you will need to select good parent plants carefully before crossing the F1 plants together."

When I consider Nobuyuki Katsuyama's results in breeding doubled-flower *Hippeastrum* cultivars, the most important thing is that the characteristic for showing double flowers will be inherited from the pollen as well as from the mother plant.

Photo: Courtesy Shigetaka Sasaki

Another fine multitepal. Breeder Yoshikazu Nakamura

A good multitepal bred by Yoshikazu Nakamura

There are not many common features between *Clivia* and *Hippeastrum,* apart from the fact that both belong to the *Amaryllidaceae* family. However, I think that it is worthwhile applying Nobuyuki Katsuyamas breeding results to the creation of double flowers in *Clivia.* I have already tried using this breeding method, but I will have to wait for some years before I can see the result.

My goal for breeding *Clivia* is to create double flowers with the unique characteristics that are found in interspecific hybrids. My idea is based on the fact that Nobuyuki Katsuyama was able to get *Hippeastrum* with a high percentage of double flowers in the F2 generation and also because I can find very unique interspecific hybrids in the F2 generation of *Clivia.*

Crossing F1 hybrids is a kind of self-breeding in genetic science. This fact reminds me that we can bring out hidden inferior (recessive) genes as a result of crossing F1 hybrids with each other.

Clivia Multitepal Breeding

Another tip for multitepal breeding comes from a story that I heard from a Japanese *Clivia* breeder of daruma. Once he found a regular flower (six tetals) with its stigma split into four on the top, and he placed pollen from a normal daruma *Clivia* on top of this stigma.

As a result, he was able to obtain plants with eight-tetalled flowers in the F1 hybrids of this cross. He also pollinated other flowers on the same plant at the time, but the seedlings grew to show regular flowers. When I reflect upon his breeding results, I wonder whether the genetic information might vary within each flower of the same plant. Multitepal flowers can be seen as an abnormality compared with regular *Clivia* flowers, but we do not care about this because the flowers are beautiful. Nobuyuki Katsuyama has succeeded in creating beautiful double flowers in *Hippeastrum.* I think that *Clivia* display signs to us for creating something new. We should recognize these signs and engage in continuous breeding in order to create the *Clivia* of our dreams.

I would like to thank Masashi Yamaguchi for translating this article into English, and Helen Marriott for her assistance in producing the final version.

Multipetal is a layman's term and is used by Clivia *enthusiasts to describe flower forms that have more than the normal six segments. The correct descriptive word is multitepal as used in this article. In some cases the term polytepal should be used.* Clivia *flowers are often incorrectly called florets. When a flower is in multitepal form the tepals are normal in size, shape and position in the flower, but there are more of them. They vary in their consistency and will usually produce some six tepal flowers among the eight tepal or even double flowers within the crown.*

Polytepal *— this term is used where the flower has as many extra stamens as there are extra tepals.*

Double *— Stamens have been converted to petaloids and the centre of the flower can sometimes be filled with them. Doubles in the other sense have extra tepals (petals) and petaloids. The picture at the beginning of this article is a good example.* Eds.

Photo: Courtesy Shigetaka Sasaki

Radiation type multitepal bred by James Comstock

Photo: Courtesy Shigetaka Sasaki

Chrysanthemum-like — bred by Yoshikazu Nakamura

Photo: Johan Schoombee

An attractive green throat with the centre flower wide open with overlapping tepals. Grower Gerrit van Wyk

Diagnosing Plant Disease: What the grower needs to know

Wijnand J. Swart, South Africa

Introduction

When growers of any agricultural crop or ornamental plant observe physical abnormalities on their plants, the typical reaction is usually one of immediate concern followed by the rapid application of a chemical pesticide obtained from the local hardware store. Very few growers resort to the logical route which is, firstly to determine the exact cause of the specific abnormality and then to treat it accordingly with a therapeutic compound.

Often, the observed "abnormality" may not be an abnormality at all but simply a normal expression of the plant's growth habit or reproduction. In other instances the cause may be insect-related or a soil nutrient deficiency, in which case a fungicide will not help at all.

It is also possible that there is more than one problem present, and in some cases there may be more than one pathogen infecting a plant. Symptoms associated with these infected plants may be significantly different from the symptoms expressed in response to each of the different pathogens acting separately.

These scenarios illustrate the importance of correctly diagnosing the cause of a plant abnormality before attempting to rectify it by chemical application or other means. Incorrect diagnosis can lead to control failure and it is therefore important that an expert is consulted before control measures are applied.

The main objective of this article will therefore be to inform growers of the correct procedure to follow when encountering sick plant/s.

Plant disease: Understanding the causes

It is important to have a basic concept of what plant disease is and how it occurs as a background to understanding the procedures involved in plant disease diagnosis. Plant disease occurs when there is the slightest alteration or deviation in the physiology and/or structure of a plant due to interference by living entities (biotic factors) or the environment (abiotic factors).

As seen from this definition, a plant's health is subject to factors that influence its growth and development, either positively or negatively (Table 1). It is important to understand that although a single biotic or abiotic factor can lead to stress which will eventually affect the plant's health, it is usually an interaction between one or more biotic and abiotic agents that results in plant disease.

Abiotic factors may be physical, mechanical or chemical and whereas the first two are usually easily observed and identified, chemical factors may require extensive laboratory analysis (e.g. soil testing) to identify the exact qualitative and quantitative nature thereof.

Biotic agents are divided into infectious and non-infectious agents. Infectious agents are mostly microorganisms that have the capacity to grow and reproduce very quickly and to be spread from one host plant to another over wide areas and even entire continents. Of these, the fungi are particularly important in that they cause most plant diseases.

Non-infectious disease occurs when abiotic factors (chemical and physical) occur at levels above or below a certain range tolerated by plants, for example, temperatures that are too low or too high, air pollution, lack of oxygen, nutrient deficiencies, drought or waterlogging (drowning). The organisms which cause infectious diseases are called parasites or

pathogens and are spread by means of **inoculum.** A parasite is an organism that lives on or in some other organism (e.g. plant) and obtains its food from the latter (i.e. parasitism). **Parasitism** is not always detrimental to the host, for example the root nodule bacteria of legumes and my corrhizal fungi of most flowering plants, a phenomenon known as **symbiosis.** Parasites that are detrimental to the plant's health are termed pathogens. This phenomenon is referred to as **pathogenicity**.

Fruits eaten by rodents or insects

TABLE 1: Factors that can negatively affect plant health:		
BIOTIC	ABIOTIC (non-infectious) (non-infectious)	
BIOLOGICAL	**CHEMICAL**	**PHYSICAL**
Infectious agents:	Soil acidity / alkalinity	Compacted soil
Fungi	Air pollution	Day length
Bacteria	Mineral toxicities	Drought
Viruses / viroids	Growth hormones	Waterlogging
Phytoplasmas	Nutrient deficiencies	Fire
Parasitic plants	Pesticides	Frost
Nematodes	Soil salinity	Heat stress
Protozoa		Lightning
		Light intensity
Non-infectious agents:		UV radiation
Insects		Wind
Mammals		
Mites		
Birds		
Slugs and Snails		
Weeds		

Determining the causes of plant disease

To determine what factors caused plant abnormality or disease requires an inquisitive, investigative approach combined with careful observation and the ability to put all the pieces together to reconstruct the event(s) that produced the disease. In diagnosing plant damage a series of deductive steps can be followed to gather information and clues from the big, general situation down to the specific, individual plant or plant part. Through this systematic, diagnostic process of deduction and elimination, the most probable cause of the plant abnormality can be determined (Fig. 1). When samples of diseased plants are taken to a diagnostic plant pathology laboratory it is crucial that as much information as possible is supplied by the grower. The diagnostitian will then have as much information as possible on which to base his / her diagnosis and thereby recommend the correct control measures. This information usually includes the soil media used, watering and fertilization regime and light availability, etc. However, by having a through knowledge of the particular type of plant involved and its normal appearance it is often possible for a grower to circumvent the cost and effort of consulting a plant disease diagnostician. The bottom line is that that there are many instances of plant disease where no plant diagnostician, no matter how experienced, can accurately diagnose the true cause of the disease without the aid of additional information which only the grower with an experienced eye can provide..

Photo: Courtesy NBI

Photos : Claude Felbert

Top of page - sun damage.
Above - fungal disease.

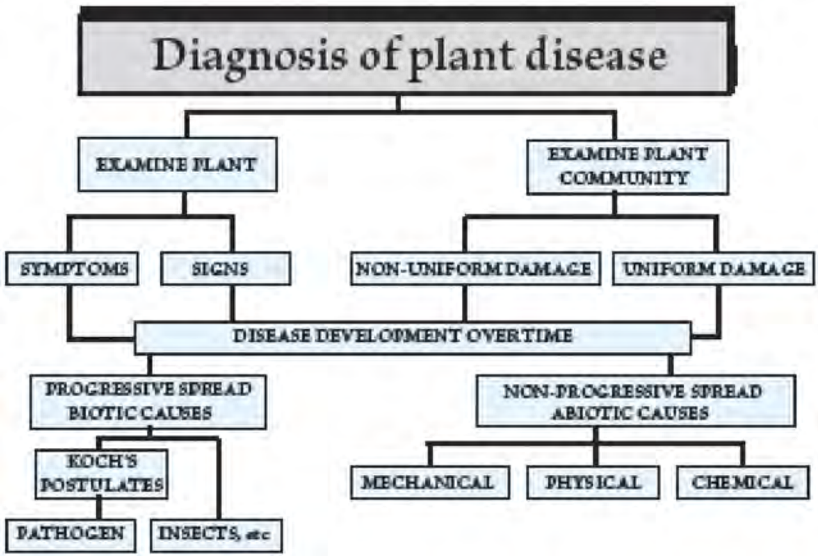

Fig. 1. A flow model for diagnosing plant disease

A. Defining the problem

The first stage in diagnosis is ascertaining that a "real" problem exists. It is important to note that the plant species must firstly be identified and then examined in isolation as well as within the context of its community. Secondly, it is important to know the normal appearance of the plant species under observation. Each species of plant has special growth habits, colours and growth rates and if the grower does not know what to expect of the plant he/she cannot recognize when something is wrong. It is also important to know that appearance can vary between hybrids or cultivars. Some plant cultivars have naturally pale to yellow leaves, or sparse foliage which at first glance appear to have symptoms of under-fertilization, root stress or soil pH problems.

Once the "normal" appearance of the specific plant is determined, several comparisons can be made between the problem plants and healthy plants. Compare characteristics such as overall size, shape and colouration; leaf shape, size, colouration and distribution; and root distribution and colouration. It is also important to take note of events such as leaf drop or senescence (ageing), which may occur in a healthy plant. The affected parts of the plant should also be noted. Are there symptoms on the leaves, stems, roots, flowers or fruit?

Examination of a single plant must take note of abnormalities such as "signs" and "symptoms" which are the physical effects of disease and the most important clues as to the presence of a possible pathogen. Not all signs and symptoms are visible to the unaided eye and finding all symptoms of a disease may require microscopic examination, possibly with a scanning electron microscope.

Signs are an indication of the actual pathogen, or part of the pathogen, or the products of the pathogen on a diseased plant. They are usually the best indication of the presence of a pathogen except when they belong to a micro-organism that may be of secondary concern (e.g. a saprophytic fungus or bacteria). Typical signs of plant disease are usually:

- Bacterial ooze. Sticky liquid produced by some bacteria.
- Mycelium. The mass of interwoven strands of a fungus (hyphae).
- Fruiting bodies. Structures which produce spores (in fungi) and can appear as anything from small black specks to large mushrooms for others.
- Cysts. Nematode body tissue protruding from roots.

Symptoms are more difficult to describe and in most cases require an expert that has a knowledge of plant anatomy and physiology in order to accurately describe the plant parts affected and how they are affected using the correct terminology. Variation in symptoms expressed by diseased plants may lead to an incorrect diagnosis by an untrained eye and it is important to know exactly what kinds of symptoms are usually associated with plant disease. Symptoms are usually grouped as follows:

Underdevelopment of tissues or organs.

Examples include such symptoms as stunting of plants, shortened internodes, inadequate development of roots, malformation of leaves, inadequate production of chlorophyll and other pigments, and failure of fruits and flowers to develop.

Overdevelopment of tissues or organs.

Examples include: galls on roots, stems or leaves, witches' brooms, and profuse flowering.

Necrosis or death of plant parts.

These may be some of the most noticeable symptoms, especially when they affect the entire plant, such as wilts or diebacks. Other examples include shoot or leaf blights, leaf spots, and fruit rots. (Figs. 2 & 3)

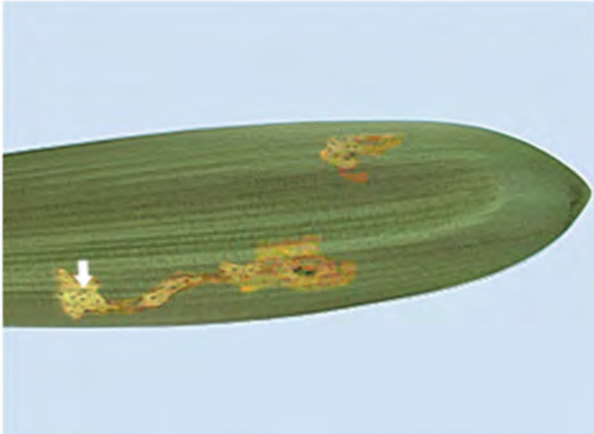

Fig. 2. *Clivia* leaf with necrotic tissue (symptoms) and small black fungal fruiting structures (signs)(see arrow).

Alteration of normal appearance. Examples include mosaic patterns of light and dark green on leaves, and altered colouration in leaves and flowers.

B. ***Look for patterns in distribution***

Diseases, whether caused by biotic or abiotic factors, are usually characterized by trends in terms of the distribution of sick plants within a specific location. This information is critical in making a correct diagnosis but more often than not growers cannot supply a diagnostician with any specific details in this regard. It is therefore important to note whether sick plants are distributed uniformly across an area or localized in one or more parts. For example, do the sick plants occur only along the edges of a greenhouse near open windows or lights, next to roadways or driveways, in low spots of a field or garden, along a planted row, or are they randomly spread.

Distribution patterns can be especially important in looking at the possibility of non-infectious problems, such as improper herbicide use or various soil factors. A non-uniform damage pattern on individual plants or in a community of related plants (e.g. a bed of *Clivia*) is usually indicative of biotic causal factors whereas a uniform pattern over a large area and on individual plants indicates abiotic factors.

C. Determine the development of damage over time

Progressive spread of symptoms on a single plant or over an area of plants, indicates damage caused by living organisms. When damage does not spread to other plants or parts of the affected plant over time and when there is a clear distinction between damaged and undamaged tissues, abiotic factors are usually indicated. Such factors may be related to an episodic event such as a change in temperature, lighting, hail damage, or possibly improper chemical usage.

Fig. 3. Basal stem rot of *Clivia* caused by *Fusarium oxysporum*

D. Review cultural practices and growing environment

As was previously mentioned, it is vital that a diagnostician be made aware of all the activities that have been conducted around the affected plants. Information pertaining to the growing environment of the affected plants is often a vital piece of the puzzle and can usually only be supplied by the grower. Changes in the environment are especially important, for example, extreme temperatures, rainfall, hail, temperature inversions (important in possible air pollutant damage and pesticide drift) and prevailing winds. All these abiotic factors can be related either directly or indirectly to the problem. Site factors such a soil type, drainage and soil pH should also be evaluated.

E. Analysis and understanding of the problem

After having systematically worked through the steps shown in Fig. 1, the diagnostician will know whether the primary cause is abiotic or biotic. If biotic, and the organisms are phytophagous (plant-eating) insects, they may be linked directly to the observed damage by virtue of their presence and actual activities (e.g. feeding or oviposition) on the plant. If they are micro-organisms (e.g. bacteria or fungi) then rules developed by the microbiologist, Robert Koch, in 1876 and known as "Koch's Postulates" have to be followed in order to determine whether they are the true cause of the problem. Although not always necessary in routine diagnosis, Koch's Postulates must be followed when the disease symptoms have not previously been reported on a specific host.


Photo: Courtesy of NBI

Snout beetle damage to C. *miniata* flowers.

These rules involve five steps and are outlined in the table below:

1. A suspected pathogen must be consistently associated with same symptoms.
2. Suspected pathogen must then be isolated and grown in pure culture on nutrient agar away from host and its characteristics described.
3. Organism from pure culture must be re-inoculated into a healthy host plant of same species.
4. Symptoms identical to original disease should then develop.
5. Organism should be re-isolated from test host to pure culture and must be identical to the organism initially isolated.

Once a diagnostician is certain that a specific pathogen is the cause of a plant disease, the organism must be identified to species level. There are estimated to be some 1.6 million fungal species, most of which are not infectious pathogens. Many fungi and bacteria have never been isolated and identified and the characteristics upon which their identification is based are very complex and require specialized training.

Conclusion

As is evident from the foregoing, correct identification of a pathogen is crucial for effective plant disease control. For this reason, growers should always resort to consulting an experienced plant disease diagnostician before attempting to rid their plants of disease. As long as the grower can provide the diagnostician with as much background information as possible, an accurate diagnosis and sound recommendation for controlling the disease will follow.

A Call for a Peach Standard

James Comstock, U.S.A.

I have heard that "a rose is a rose is a rose". But over the years, I have realized that a "peach" *Clivia* is a creature of many colours. Or more precisely, they are creatures of many colours, all given the same name. I have found it both amusing and frustrating to visit other *Clivia* growers, both in the U.S. and South Africa, and find *Clivia* flowers of admittedly similar yet distinctly different colours all referred to as "peach". I think the time has come when these differences are recognized and standardized for accurate and internationally consistent reference. Certainly, I don't claim to be an "expert" on *Clivia* or peach *Clivia* in particular. And I am not going to propose a standard here. But I will share my observations and call for further discussion.

Back in 1984, I discovered at a local nursery, the first "peach" *Clivia* I had ever seen or heard of. It was growing on the edge of a shade house where it and its companions were getting far too much sun. Their leaves and their flowers were burned and faded. At first, I considered that the colour of this peach *Clivia* was due to sun bleaching. But I kept returning to this flower and kept comparing it to the other normally-coloured, but also sun bleached flowers around it. I just knew something was different about it. I bought it and took it home. As all the buds had opened already, there was no way to find out what its true colour was. I would have to wait until it bloomed again. Hopefully, that would be the following year. And sure enough, the following March, I was delighted by a *Clivia* flower with a colour unlike any I had seen before. And the additional year of kinder growing conditions resulted in a much improved umbel as well. I named it "Morning Light" and, at the time, described it as apricot coloured, not peach. But back then, that description was a term I only used for myself. I knew no one else who cared for *Clivia* or would appreciate its uniqueness. With the discovery that same year of a huge, magnificent orange that I named "Grandmere" I decided I finally had something worth breeding with. After obtaining a yellow to throw in the mix, I began my breeding program that today is light years beyond that simple beginning.

In the late 1980's, I heard rumours of another *Clivia* breeder in Santa Barbara, California. Up until then, I had never heard of anyone else breeding *Clivia*. I tracked down this "Dave Conway" and was graciously invited

Photo: James Comstock

Clivia miniata "Morning Light"

to visit him and his plants. Among a glorious and impressive array of yellows, reds, and his first "parti-colours", I was introduced to "Tessa". It had the same glowing, warm colour as my "Morning Light". This was probably my first exposure to the term "peach".

In the late 1990's, while traveling with Harold Koopowitz in South Africa and attending the International Clivia Conference, I had the pleasure of meeting Sean Chubb and getting to see, first hand, his famous "Chubb's Peach". The mind often convinces us to see what we expect to see; and my first impression of "Chubb's Peach" was that it was the same colour as "Morning Light" and "Tessa". That's what I expected to see; that's what I saw. But with subsequent visits, I decided it was distinctly different. Its colour, to me, is much lighter and paler with the colour concentrated in the center of the petal.


Photo: Sean Chubb

Clivia miniata "Chubb Peach", Breeder: Sean Chubb.
Best on Show at the KZNCC show at Kloof in 2004.

This was when I sensed we might have a problem. Here were two different colour forms being called by the same name. Then I became aware of a growing group of *Clivia* called "pastels". These are pale forms of orange, some nearing pink. My preference is to reserve the term pink for flowers with no yellow in them. I find the standards for pastel descriptions very difficult and I won't approach them here, but I have seen many plants I would classify as pastel being called peach. One way I differentiate between peaches and pastels is that peaches seem to breed true when crossed with other peaches, and produce green-based seedlings. Pastels give a wide range of results when selfed or crossed to other pastels. I have done much breeding with many different peaches over the years and I have hundreds of seedlings of various F1, F2, and F3 generations. Unfortunately, few have bloomed. So I cannot give detailed results or percentages for particular breeding scenarios. But so far, the deep peaches like "Morning Light" and "Tessa" seem to breed true. I have read similar reports of peach breeding in South Africa giving the same results. My question is, "what peach are they using?" I've assumed it is "Chubb's Peach".

As a photographer, I have realized a major factor contributing to the confusion over peaches is that this colour is extremely difficult to photograph. The slightest inaccuracy in the ratio of orange, pink and yellow results in either a pink-looking *Clivia* or one that just looks like a pale orange. In doing the photography for Harold Koopowitz's book "Clivias", I was further frustrated by the additional inaccuracies of the printing process. Trying to compare supposed peach clones through pictures shot by different people, with different equipment, under different lighting conditions, and then reproduced in different formats is, shall we say, challenging. That is why I reserve judgment until I see a plant in flower personally. Being of particular interest to me and my breeding, I have searched out these peaches here in California and in South Africa. I can't think of anyone else who has seen as many peach clones in person.

In my opinion, the deep peach colour that is represented by my "Morning Light" and Conway's "Tessa" is a particular colour variation that is a simple genetic mutation, like the yellow mutation is, and breeds like a recessive trait as yellow does. They also produce green-based seedlings. I also think it is a mutation that occurs much more frequently than the yellow mutation does. In addition to "Morning Light". I myself have found three or four other peach sports occurring in various, unrelated, normal-orange populations. I know of at least six other peach clones that have been discovered by other collectors in California. By contrast, I can't think of anyone here that has found a yellow sport that couldn't be traced back to an original yellow from Africa. On my last trip to South Africa in September 2003, I saw a peach of the same colour as "Tessa". I think its name is "Cameron Peach".

Photo: Courtesy of Mike Christie's "The Clivia Collection"

Clivia miniata "Cameron Peach"

There have been determined to be at least two types of yellow, Type A and Type B. A third type is suspected. I have a feeling there are probably several types of true breeding peaches. "Tessa" might be an example of one type, while "Chubb's Peach" might be an example of another. Both types appear to breed true. Both types produce green based seedlings. The colour of "Tessa" is a rich, warm peachy-apricot colour with pink highlights and a yellow throat. "Chubb's Peach" is paler in colour with less yellow, and the peachy-to-almost-caramel colour concentrated in the throat. Only time and careful breeding records will identify and verify the existence of different peach types.

One of the problems with the pastels is that many of them are what people would call peach, partly because we don't have enough names to describe colours. As an art student, I became aware of the small vocabulary most people have for describing colours. And until the specific peach mutations, that I am hoping people will recognize as distinct, are widely known or given a completely new name, we will continue to see any *Clivia* that is between yellow and pale orange being called peach.

Considerably more of my seedlings need to bloom before I can make any theories about how peaches breed, especially when crossed with yellows. Of course, I have my suspicions and these guide my breeding program. But I won't discuss them until I have numbers to back them up. I have read many reports from the Lötters of South Africa regarding peach breeding and, again, I assume they are using "Chubb's Peach". One example I do have regarding peach and yellow breeding is the work of Victor Murillo who has brought us the "Victorian Peach"' strain. There is a considerable range of colours displayed under the name "Victorian Peach". I have seen plants that appear close to "Tessa" in colour, yet others are nearly yellow with just the slightest pink revealed. Some are nearly pale cream, while others are darker than "Tessa". I have seen the original peach plant that Victor started with. It appears to me to be "Tessa"-like in colour. It was crossed with a yellow that I did not see. The resulting F1 progeny are the parents of the plants sold as "Victorian Peach" (F2 and F3). The resulting colours segregate into 3 or 4 ranges. Victor is able to predict which colour range a particular plant will exhibit depending on its parents.

I am sure there are what I call peach in Australia. Unfortunately, I have only seen what look like pastels that, for lack of another term, get the peach name. Again, pictures are just so frustratingly deceptive. Until I go there myself and see them personally, I probably won't be satisfied.

There is a warmth and a glow to this peach colour that impresses everyone who sees it. One of my goals in my breeding program is to expand the range of flower forms and plant shapes available with a peach colour. It is important to me that the different types of peach colours are recognized as distinct within themselves and especially from the pastels. This to facilitate communication and the exchange of knowledge and appreciation among *Clivia* lovers worldwide. There are several directions we could take. We could find a way to categorize the different types of peach such as "type A peach" and "type B peach". Or we could drop the term "peach" altogether, find some other term, and let "peach" be used in a more vague sense which would allow its use for some pastels. Horticulturally, I know that a name can be a powerful thing. The right name can enchant the mind to see the virtues of a flower that a more pedestrian title might discourage.

But ultimately I know, what's in a name. A peach *Clivia* by any other name is still a glorious sight!


Photo: James Comstock

Seedlings "split" for peach - 4 of 9 are green stem

Addendum, April 2004

This article was written in August, 2003. As we in California wrap up our Spring 2004 bloom season, I quickly compiled some results related to peach and yellow crosses. Of approximately 280 plants that bloomed for the first time this season, 42 were peach X yellow crosses, or yellow X peach crosses. All 42 produced orange coloured flowers. These 42 crosses represent 15 different combinations. They also involve 5 different peaches and 12 different yellows. Of approximately 10 other crosses that involved a peach X a peach, all produced peaches. All these crosses were done, of course, several years ago. I rarely do a straight peach X peach


Photo: James Comstock

Clivia miniata "Being Peach"

cross now. Or a peach X yellow cross. Most of my work involves using an orange that is "split" for peach (meaning it is an orange X peach cross, thus having a recessive peach trait.) When the orange/split peach is crossed with a peach, the results are typically 50% orange, 50% peach.

I have done very little work with "Chubb's Peach". Those crosses I have done have yet to bloom. The breeding habits of "Chubb's Peach" have been well documented and obviously demonstrate a difference between that form of peach, and the peach forms I have discussed here in California. The exception being "Victorian Peach" which, according to its breeder, Victor Murillo, reportedly breeds more like, if not identically to, "Chubb's Peach". Although breeding techniques, I'm sure, are common knowledge, perhaps for clarity I should briefly explain my breeding strategy. When I crossed an orange X a peach which gave me orange flowering progeny, or I crossed an orange X a yellow which also produced orange flowered progeny, that was exactly what I expected and wanted to happen. This F1 generation would be the parent, when crossed with siblings or back crossed to a peach or yellow, of an F2 generation producing the yellow or peach colors but, hopefully, with the desirable traits of the original orange. That is why when I started my breeding program in 1986, when I was given my first yellow and then found a peach and an orange of exceptional form, I knew I had something substantial worth breeding with. If, for example, I wanted to "improve" my yellow (and by "improve" I mean simply to produce an alternate form), the strategy is to cross it with an orange that has the desirable traits, and eventually the F2 and F3 generations will yield something approaching the goal. To simply cross 2 yellows and hope something better will be produced, and doing that over and over, will only move one towards one's goal in small, incremental steps. In the short term, it might seem more emotionally satisfying to look at a bed of yellow-blooming seedlings and say,"yes, I'm breeding for yellows", than it is to look at a bed of oranges/split for yellow and say, "look at the potential!" But this is how I've worked since my very first three crosses. The third cross being peach X yellow because I did not know what would happen. This kind of experiment is also very important. Please remember that when I started in 1986, I didn't know anyone else in the world was breeding *Clivia,* and had no way of benefitting from their experience as we all are so fortunate to do now.

The purpose of this whole article is to bring an awareness to the different forms of peaches. And one of the important differences is in their breeding habits.

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Clivia miniata A peach owned by Gert Wiese

Single






Flowers

Opposite Page: Flowers from the Metro Show
Photos: Keith Barlow

Above: A double headed multitepal from Ken Smith

Above Right: An almost white flower from Ken Fargher

Right: A cream flower. Photo by Johan Schoombee

Below: Olive striped pink flower. Breeder Ken Fargher

Below Right: A delicate pink flower.
Breeder Yoshikazu Nakamura

In Search of a "Light of Buddha"

Hein Grebe, South Africa

About 2 years ago I saw pictures, on the Clivia Enthusiasts e-mail group, of a *Clivia* grower in Anshan, China, photographed with what looked like a Light of Buddha (LOB) *Clivia*. These broad leafed plants fascinated me so much that I immediately started to make plans to visit Anshan. My first step was to locate this city on a map. I was glad to see that it did not look too far to the north-east of Beijing, as I have a very good friend, Tracy Qi, living in Beijing. I showed the photos to *Clivia* friends and they also became excited about these new - to us anyway - plants. Wu Jin, who has posted many LOB photos on the e-mail group, satisfied our hunger for more photos and information on these plants. In early 2003 I ordered LOB seed from Wu Jin for friends and myself. It was the very first time that I held LOB material in my hands.

I asked my friend Tracy to look out for LOB plants at flower markets in Beijing, but she had no success. The story she was told was that these plants do not exist, but that growers fastened aluminium foil around the leaves of ordinary plants so that they become yellow over a period of time.

October 2003 was my first chance to travel to Anshan. This was after I had spent nearly 6 weeks traveling in China and Tibet, covering a distance of almost 10 000 kms. During that time I had visited many Buddhist temples in the West of China. I found *Clivia* growing in pots at all of them, including the temple above the Grand Buddha in Leshan, Sichuan, which at 71m, is the largest Buddha in the world. Here I found a type of cyrtanthiflora, similar to that in Australia, in flower. At all the other temples I saw ordinary *C. miniata.*

I learned from my tour in China and around Tibet that Buddha and *Clivia* have something in common. Where there is a Buddhist temple you are sure to find some clivias growing in the beautiful landscaped gardens. Another plant that you will find at the temples is *Gingko biloba* - trees that are hundreds of years old and some that are even more than a thousand years old.

In the back of my head Anshan was a magic place where the most beautiful plants were to be found. In Beijing's flower markets and on the internet, I made contact with a number of growers, including the secretary of the China Clivia Association (CCA), Mr Meng Zhou, who invited me to visit their glasshouses, which they call 'sheds', in Anshan.

My friends' father, Mr Yonghe Qi, is well known in plant circles in China and he even arranged for us to be accompanied by Yuanhau Liu, the daughter of a well known *Clivia* growing family in Anshan. Her job is to

Photo: Hein Grebe

The view of Mr Meng Zhou's plants from his home sell the family's plants in Beijing at the flower markets. When Yuanhau told me that they had LOBs in their glasshouse, I became even more excited. Our departure day from Beijing was a rainy one. After a long shopping spree, we ate a meal together as a family in a restaurant, an old Chinese tradition before a family member goes away on a long trip. As a result, we left quite late that afternoon and got lost along the way. Luckily lone taxi drivers here and there put us on the right track again. We arrived between 02:00 and 03:00 in the morning in Anshan. Members of Yuanhau's family were waiting for us. We got to bed after an hour's chat, very tired indeed after the 10 hour drive of more than 650 kms in pouring rain.

Later that morning we were woken up by what sounded like machine guns. Our host, Qingxiang Guo, informed us it was a bride and bridegroom coming home from a wedding ceremony and that it is a tradition to shoot crackers and fireworks. It was Saturday and many Chinese couples get married on weekends. A big surprise was waiting for me at the breakfast table. The main dish was the one in the centre of the table, fat silkworm larvae grilled in garlic. My host said I must try some as they are very tasty and nutritious.

Not to disappoint him I began eating, pretending that I liked them. This was a big mistake, as when he saw my 'enjoyment, he said he would arrange more for the next day! After breakfast we all set off to the family's glasshouses.

They do not work at weekends, unless there is urgent work to be done, like repotting in the glasshouse.

After all the rain, the dirt road to the commercial *Clivia* growers was not in good condition. I saw discarded *Clivia* lying along the road between heaps of leaf litter used as growing medium. Some nice broad leaf plants as well. I was thinking that you could pick up a fortune of *Clivia* by just checking out what the growers throw away!

Anshan growers repot their *Clivia* twice a year. This is hard work as all the growing medium must be removed and replaced with new rotted oak leaves, which must be made fine at the same time. It looks like this keeps them busy for the whole month and the whole family helps with this operation.

When we finally arrived at the family's home we had to look for dry ground. A big iron gate was opened to let us into the courtyard with two glasshouses of approximately 650m^2 each. Yuanhua's parents still live in the house area attached to the glasshouse. As you enter their house you look through a window into where the *Clivia* are housed. What a wonderful sight and what an excellent idea! I had never thought of having my *Clivia* shade house next to my home so that I could watch them from my kitchen or bedroom!

Photo: Hein Grebe

All plants face north / south to facilitate short broad leaves

The *Clivia* all stood like soldiers on guard. Not a single one out of line, with their arms stretched out in a north-south direction. I had never seen anything like this and could not take my eyes off them. We were invited in for tea. Despite the cold outside, it was warm and cosy inside the two roomed house. The first room serves as the kitchen and entrance and the second one as a dining room, lounge and TV room during day time and doubles as a bedroom at night. There is a raised section along the wall of the lounge. I was invited to sit there. It is warm there, they say. The stove in the kitchen is connected with pipes that transfer the heat underneath the raised area. This is so that they can sleep warmly during the icy winters.

Broad leafed "Light of Buddha"

Finally, I was invited into the glasshouse. For the first time I saw full grown LOBs. They are even more beautiful than on the photos. I also saw variegated LOBs - something I never thought existed.

Later we were taken to our host's glasshouse or shed just opposite his parents. Each year he grows a few plants with 15cm broad leaves. He said he gets several thousand rands for each. His plants are of a higher quality and I can see why he can live in a big modern apartment.

We were then taken to other glasshouses. It was ice cold outside and our shoes and socks were wet. We were tired as well, after only 4 hours sleep. After a family meal, with lots of wonderful spicy dishes, we returned to our host's apartment and slept. In the evening we chatted and watched TV.

The next morning we were woken up again by what sounded like machine gun shots. I did not worry to get up as I knew it was a happy occasion being celebrated - someone getting married. So many dishes for breakfast, including my new-found 'favourite, silkworm larvae, which I had actually begun to enjoy. Tracy noticed it was snowing and everyone got excited, except me. I had recently had a bad experience driving back from George to Cape Town on snowy, slippery roads. They say the snow is a good omen, as it never snows in October.

Today we were to visit the Anshan growers we had met in Beijing. To find a place in a big city in China is not that easy. You can easily get lost even if you know the place well. I thought back to our experience in Beijing, when we were looking for a clivia grower there that Tracy and her brother, Biao, had visited in 2002. After a long search we had to give up. I hoped that we would be luckier this time in Anshan. To me the snow looked like a bad, rather than a good, omen. It forced everyone inside and to close their gates. We found a house with an open gate and asked if they knew the CCA Secretary. Yes, we were lucky. We saw some stunning *Clivia* through the entrance window and asked if we could look. The lady was a tough negotiator and her prices were high. I explained that I was not an American but an African and that, relatively, we are not as well-off and cannot afford American prices. She did not believe that I came from Africa.

Above: Rare “Starlight Light of Buddha”

Left: Anshan grower with 15cm broad-leafed plants — note leaves wrapped to maintain alignment

All Photos: Hein Grebe

Above: The unusual markings of the "X-Ray Light of Buddha"

Right: 12cm variegated leaves in one of Mr Zhu's heated glasshouses.

Below: Seedlings reminiscent of hungry fledglings — their leaves like open beaks

All Photos: Hein Grebe

Maybe my skin was not dark enough for her!

After a long fight I bought a couple of plants, one with leaves almost 15cm wide. It is the first time I had seen a plant with leaves this wide and I had to get it. I had with me my picture of the LOB grower I had seen on the e-mail group. Maybe she knew of him as she looked almost 70 years old and must have known most growers. No success, but she did refer us to someone that grows LOBs.

We visited the house of the secretary of the 23000 member strong CCA, Mr Meng Zhou, whose plants have won several awards including a gold medal at the Kunming International Horticultural Exposition in 1999. He invited us into the glasshouse to look at the *Clivia* growing there. Everyone was so friendly. It looked like they specialized in 'crinkle face' plants. These plants are the most expensive in China at the moment. He showed me a plant with a price tag of R800 000. A sucker of this plant would set you back a mere R30 000. The surface of the leaves looks like a honeycomb. He explains that the idea of this plant comes from the civil building industry. The ridged areas represent the reinforcement, the areas in between the concrete or bricks. I would love to have plants like this.... but not this year! I was shown a very thick hard cover book with beautiful photos, priced at the equivalent of R450. I decided to rather buy a book.

At long last we were taken to the house of the LOB grower. I thought that maybe this would be the man in the photo. Only his wife was present. From the size of the house, and the luxuries inside, I could see that he was successful and made a good living, like the previous grower we had visited.

I have never imagined so many LOBs - thousands of them. All the different types, even "painted face" LOBs.. We took photos and shots with the digital video camera. After a few minutes the owner arrived. No more shooting and no more pictures. I showed him the photo I had been carrying all this time. He recognized the person and showed me the place where the photo was taken. He explained that the person in the photo, although pictured with LOB plants, was not a *Clivia* grower but a publisher, who did not even have any *Clivia*! He showed me his second glasshouse, also full of LOBs. He told me that in the past he got R50 a seed, exporting to the USA. Now prices had reduced, and though for very good quality plants he still got R50 a seed, he now got only R20 a seed for the rest.


Photo: Courtesy Hein Grebe

Mr Zhu & the author

During the following days we visited as many growers as we could, all with magnificent plants. To everyone I visited I gave a couple of hundred special *Agapanthus* seeds. This South African plant is as yet not well-known in China. They liked the blue flowers and said that they wanted to create blue flowering *Clivia*. I wondered how wide their *Agapanthus* leaves would be in 10 years time! At least I have a running start - back home I have an *Agapanthus* with 9cm wide leaves.

We visited growers with *Clivia*

with leaves 15, 16 and 17cm wide, and a grower with X-ray LOBs and a new type of LOB called Starlight. The dots on the leaves look like stars in the sky. He explained that Japanese *Clivia* lovers bought most of his plants, paying up to R10 000 for a good Starlight LOB. I bought two 12cm broad leaf LOBs from him, the widest leaves I could find. We also visited a grower who specializes in variegated LOBs. I was stunned. Later this grower entertained us with some songs, while playing his guitar. I bought another 12cm BL LOB from him.

I asked around if anyone had an 18cm or wider BL (broad leaf) *Clivia*, as I had read a message on the e-mail group of someone who has a plant with such broad leaves. One evening we were taken to a grower who has such a plant. I was warned not to touch his plants as he is very precise; also that his plants start at R10 000 each. If I were to offer a lower price I might insult him. This grower told me that he had a friend with a 19cm BL and showed us a hundred or so plants resulting from a crossing between the 18cm BL and the 19cm BL plants. They looked around 2 years old and should flower early next year, in April 2005. We also admired beautiful variegated BLs of 12 cm and wider. Then suddenly I was given a beautiful gift - a variegated double whale, i.e. a *Clivia* with white or yellow rimmed leaves with green in the middle.

After Anshan we traveled about 150kms north to our last stop in Shenyang to visit China's most famous *Clivia* grower, Mr Jifu Zhu, who is the Deputy President of the China Clivia Association as well as the author of 2 *Clivia* books. After a short meeting at his home, where we discussed photos, we were taken to his glasshouses. He has the biggest collection of variegated plants I have seen. In China they are called "coloured leaf" *Clivia* and I can see why. The range of colours on the leaves is amazing. The leaves of the adult plants are thick and wide, many of them 12cm and wider.

Mr Zhu let me choose a plant and later on he gave me another seedling and some seed heads. His wife gave me an offshoot of a beautiful plant, another 'coloured leaf' *Clivia*. The gifts did not end there as I was also given copies of his books. Photos were taken. Mr Zhu had arranged his own photographer, one of the top ones in the country. I could see that Mr Zhu is a professional, and a perfectionist. He explained that he was planning his third book, which will be in English and Chinese, and that he wanted to visit South Africa to see Clivia in their natural habitat. Finally Mr Zhu showed us a beautiful poster of one of his very best plants and then took us for lunch at a top restaurant. The food was excellent, as in the restaurants we had visited in Anshan and Beijing, food that I miss now that I am home in South Africa.

Back in Beijing, we prepared for inspection the almost 200 plants I had collected. Two permits were necessary, a phytosanitary certificate and a CITES certificate to say that *Clivia* were not protected indigenous Chinese plants. I left with a sad heart as I had fallen in love with China and its friendly people. Also, there is so much I still have to see and enjoy. I had been showered with so many gifts —something I had never imagined — by my new *Clivia* friends, and I had found, not one Light of Buddha, but many.


Photo: Hein Grebe

Variegated & "Light of Buddha" plants together

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