CLIVIA

YEARBOOK

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Clivia Yearbook 2

Nakamura hybrid 1

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Writing in about 1990 on his breeding of *Clivia miniata x kewensis* ' Vico Yellow' Sir Peter Smithers remarked :

> *"Clivia* have suffered from being distributed commercially in a very indifferent form and also because of one of their great merits. They are amongst the most long-suffering pot plants which, like the *Aspidistra*, will put up with almost anything except over-attention. Just so! They are bracketed with the *Aspidistra* as inhabitants of lodging-house parlours".

Fortunately, however, in Australia and California and particularly in Japan and more recently in China over the past 50 years *Clivia* enthusiasts have been developing the potential of the other outstanding attributes of this most versatile plant.

This, the second Clivia Year Book, covers the astonishing results which are being achieved in Australia and Japan and more recently in South Africa in improving the form and colour of the *Clivia miniata* flower and umbel, not only in the better known orange form but also in the yellow form which is the product of a recessive gene. Pure breeding yellows have been developed and with them pastel colour forms, including pinks, but the pure white remains elusive. The four species of *Clivia* have also been hybridised to produce different flower forms and colours and to extend the flowering period, but this is still in its infancy. However, Sir Peter has also pointed out that:

"The modern improved clivias are spectacular plants when in flower, but it must be admitted that when out of flower they are inconspicuous to the point of boredom".

Yoshikazu Nakamura of the Clivia Breeding Foundation, Chiba Prefecture, Japan, a good friend of Sir Peter and an honorary member and benefactor of the Clivia Club, has made available to us publications on *Clivia* in Japan and China, revealing the extraordinary extent to which the potential of improving the "inconspicuous" leaf form of the *Clivia miniata* has been recognised in forms

McNeil interspecific hybrid

Nakamura hybrid

which are shorter, broader, thicker and more symmetrical, with enhanced vein patterns and variegated colour. Attention has also been drawn to the ornamental value of the development of the seed pods and of their change in colour as they ripen.

Thus in Japan and China in particular, *Clivia* has been rescued from its "condition of neglect" and "divorced at last from the *Aspidistra"* to become treasured for its ornamental value throughout the year with its "four season leaf, three season fruit and one season flower".

One publication by the China Clivia Association has been reviewed in this Yearbook and we look forward to publication in English also of other outstanding books being published in China on *Clivia.*

The publication of the first 1998 Clivia Year Book was facilitated by the papers read at the International Conference on Clivia held at Kirstenbosch National Botanical Garden in Cape Town 1998, but it also featured the improvement of the flower in Japan and more recently in South Africa, and the development of the variegated leaf in Japan. For this the second Clivia Year Book, we have had to rely on the willingness of *Clivia* enthusiasts to prepare articles suitable for publication. These have included in particular improvement of the *Clivia* flower in Australia and in England. It includes also an important overview of the distribution of *Clivia* in its natural habitat, where mutations of flower colour and form have been discovered which challenge man's own achievements in that regard. We are most grateful for their assistance and trust that this publication will inspire others also to produce articles for publication in the next Clivia Yearbook, especially those in California, whose rumoured outstanding achievements remain unpublished!

Cape Town, July 2000

Clivia miniata 'Spider'

The Natural Distribution and Ecology of Clivia

by John Winter

John Winter is the Deputy Director of Gardens and Horticultural Services of the National Botanical Institute in South Africa, and the Chairman of the Clivia Club

The genus *Clivia* is indigenous to South Africa, but has been grown extensively for more than 150 years in Australia, United States of America, Japan, China, the United Kingdom and Europe, where the commercial production of *Clivia* as a pot plant has been well developed.

There are four *Clivia* species of which *C miniata is* the most well known and spectacular. The other three species, *C. nobilis, C gardenii* and *C. caulescens,* all produce pendulous flowers and do not flower at the same time as *C miniata,* which flowers in spring.

Where do all these magnificent plants come from? Although *Clivia* have been improved through selection and breeding, all plants originate from the natural habitat. Unfortunately very few records exist which show the original location of these plants. A good example of this is *Clivia miniata* var. *citrina,* of which Kirstenbosch National Botanical Garden has approximately nine clones. These all originate from other growers of *Clivia,* none of whom can provide exact details of from where their plants originate.

They occur in Southern Africa from the Eastern Cape in the south, stretching up through the Transkei and Kwazulu-Natal into Swaziland, Mpumalanga and the Northern Province. Verbal reports have been made of *Clivia* occurring in Kenya and Uganda, but no herbarium records exist to confirm this.

However, not sufficient is known about the natural distribution of *Clivia* in South Africa, their taxonomy and ecology They are poorly represented in herbarium records and living plant collections of *Clivia* in the botanic gardens of the National Botanical Institute are most inadequate.

As a result in1996 I launched a project to establish a living collection of *Clivia* representative of the species and forms which occur in nature to be used for display, selection and breeding and to improve the living collections in the botanic gardens as well as the herbarium records. No taxonomic revision has ever been done of the genus *Clivia* and any species that has been described has been done on an *ad hoc* basis. Once sufficient field work has been undertaken a taxonomic revision of the genus may well follow.

Ecology

All *Clivia* are essentially shade loving. The wide variety of the conditions in which they thrive is remarkable. During the last

four years I have observed *Clivia* occurring on secondary coastal dunes (*C. nobilis),* in coastal forests (G *miniata, C nobilis),* on river banks and in swamps *(C gardenii),* rock screes, leaf litter and on tree trunks (C *miniata, C caulescens).* *Clivia* occur in isolated pockets which are difficult to locate. The populations that have survived are extremely old and in most instances very little seed is produced. Having the ability to multiply vegetatively ensures their survival in situations where pollination is poor.

Their roots are thick and succulent, obviously functioning as a storage organ, and they spread out on, or just below, the surface, anchoring the plant and making it secure. These growing conditions indicate that *Clivia* require little water and in cultivation they require a very sharply drained growing medium and cool conditions.

In nature *Clivia* occur in varying degrees of shade. Heavy shade limits flowering of all four species and the leaves tend to lengthen excessively. For example, *C nobilis* in heavy shade, produces leaves a metre in length, while the same species growing on coastal sand dunes in light shade produces a very stunted plant with leaves of approximately 300 mm in length, all with the characteristic notched tip and serrated edges. Populations exposed to sufficient light with a high canopy produce a delightful display of colour and the leaves maintain a dark green appearance. In cases where there has been a deterioration of the tree canopy, the foliage yellows due to over exposure and the plants become very stressed. Very few flowers are produced and growth is stunted.

Forest environments are cool and moist. However *C miniata* also occurs at sea level in the Eastern Cape, in Kwazulu-Natal which is sub-tropical, and in the northern Drakensberg where they also grow even at an altitude of 1500m. The latter populations are subject to mist, snow and extreme cold at times, which I could not endure for more than 10 minutes! In the mountainous regions of Mpumalanga *C caulescens* is common, despite being subjected to snow occasionally.

C. miniata pastel form growing in the habitat

Distribution

C. miniata

Known populations of *C. miniata* occur in isolated pockets from west of the Kei river, eastwards through the Transkei.

C. miniata, red form, growing in the habitat

Some of these populations are large, while others are mere remnants of clivia populations which have been decimated by man for medicinal purposes, and as a result of the removal of tree cover for fuel or agricultural purposes. Distribution continues north east through Kwazulu-Natal into Swaziland and Mpumalanga on the Sondeza range of mountains (northern boundary of Swaziland), growing on dolerite and sandstone geological formations.

While the predominant flower colour is orange and is uniform in most populations, in some populations the flower colour is almost red and in others there are pastel colour variants within the population, including yellow and pink.

In some populations the floret size is substantially bigger than usual with wider petals and in others, narrower petal forms are seen.

Leaf forms also vary from population to population, some populations having considerably longer leaves than others in the same light conditions, and others having narrower or broader leaves.

The size of the seed in the most western populations is also considerably larger than the usual size.

C. nobilis

Clivia nobilis occurs mainly on the coast from Alexandria Forest northwards to the Nqabara River. Occasional populations occur inland as far as Grahamstown. I have seen *C. nobilis* growing and flowering in populations of *C. miniata* but have not come across any hybrids, possibly because they have different pollinators. Coastal populations occur on

C. nobilis

dune sand while forest and inland populations are found on river banks, on shale and on rocky outcrops. Both on the coast and in inland populations they have been found growing both in low bush cover and with a high forest canopy which, as stated above, affects the leaf length. While the flower tips are always green there is a wide variety of the flower colour from deep red, pastel pinks and oranges to yellow.

C. gardenii growing in the habitat

C. garden ii

The most southerly record of this species is at Port St Johns with scattered populations occurring northwards as far as the northern boundary of Kwazulu-Natal. Some of the populations I have observed grow in wet seepage areas and swamps and on flooded riverbanks, while others are relatively dry. It is felt that the swamp variety may be a different species and this is being investigated. *C. gardenii* seems to have the ability to adapt to wet or dry conditions. I have noted *C. miniata* and *C. gardenii* growing in close proximity to one another but because the flowering times are September and June respectively, there is little likelihood of natural hybrids being produced. A wide variety of umbels was also noted with florets ranging from about 15 to about 35 per umbel. The basic colour range does not vary to the same extent as *C. nobilis* but there are pastel forms (also with yellow predominant).

C. caulescens

This species is apparently fairly common in the Mpumalanga and Northern Provinces. However, to date I have only had the opportunity of visiting a couple of populations, namely the Sodenza range of mountains on the northern border of Swaziland where it grows amongst *C. miniata* at an altitude of 1500m and at Elandshoogte where the mountains were covered in snow at an altitude of over 1770m.

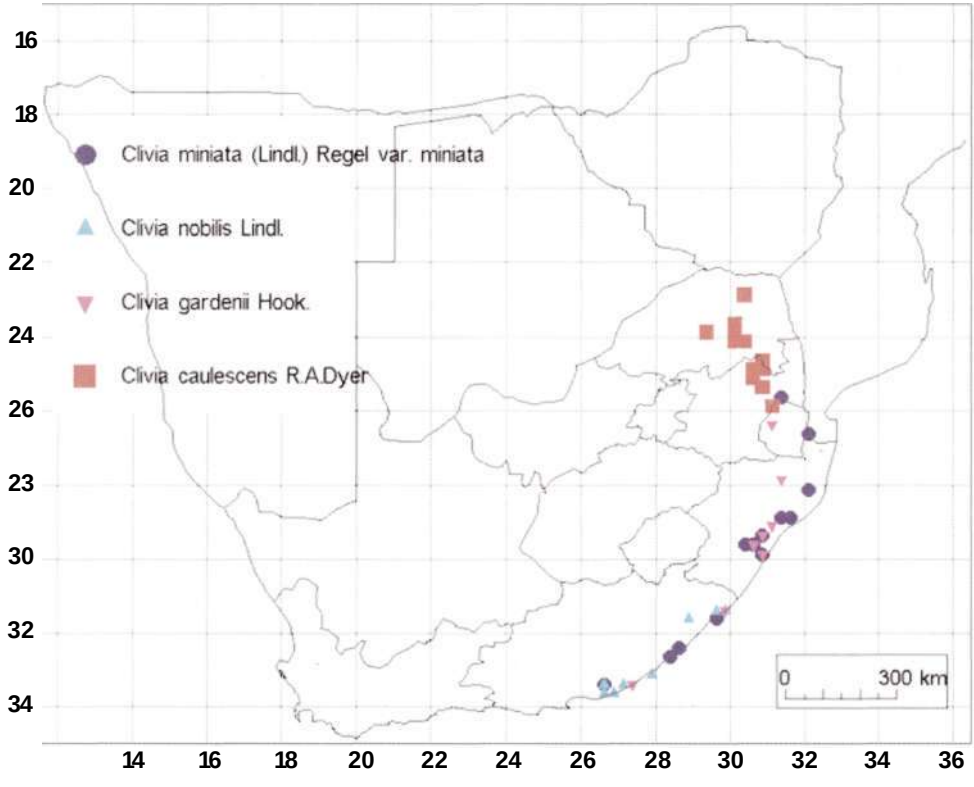
C. caulescens growing in the habitat

According to reports, populations occur at Sabie, Mount Sheba, God's Window and as far north as the Soutpansberg. The populations which I visited were all growing in association with sandstone.

Thus *C. miniata* is the most widely distributed species with growing conditions varying from coastal to subtropical and populations growing at 1500m in the northern extreme of their range. The pendulous species of *C. caulescens, C. gardenii* and *C. nobilis* are all found growing with *C. miniata* in the various areas where they occur. However, *C. miniata* has obviously had a greater attraction to the specific birds which have through the years been responsible for distributing this very attractive species.

The fact that *Clivia* occur in isolated communities which are not easily accessible makes it likely that new distribution records will be established in the future.

The following map of the distribution of clivia represents the existing records of the National Botanical Institute. I question the accuracy of some of the localities indicated of *C. miniata*, *C. gardenii* and *C. nobilis* in the southern section of the map. These need to be confirmed.



The Great Yellow Clivia Jigsaw Puzzle

by Brian Tarr

Brian Tarr is the curator of the Natal National Botanical Garden

C. miniata 'Golden Glow'

The yellow *Clivia* has, since its introduction into horticulture in the 1880's been a sought after addition to the plant collectors garden.

Over the years plants have been given, sold and acquired by people all over the world. As a result, the Yellow *Clivia* picture has become a bit of a jigsaw puzzle, the pieces being various clones and peoples names! (Who got what from whom with a bit of misinformation thrown in to complicate the picture). From literature it appears that to begin with two yellow clones were known to have originated in Zululand and one in the Natal Midlands. One of the Zululand plants was named *Clivia miniata van citrina.* This clone is, by all accounts, a recessive yellow while the other, which has become known as 'Noyce's Yellow' is a true breeding yellow *Clivia.* The third clone is known as''Mare's Yellow' and seems to be recessive when selfed.

C. miniata 'Natal Yellow'. Note the pronounced green colour on opening flowers

The story of *Clivia miniata var. citrina* is well known, how the plant was discovered in the Entumeni Forest in Eshowe and grown by Sir Melmoth Osborne. Plants were given to Sir Charles Saunders who in turn sent a

flower and bulb to his mother, Mrs J.H. Saunders, who did a water colour painting which was sent, with a plant, to Kew. This plant was described and published as *Clivia miniata var. citrina*. Sir Charles Saunder's daughter, Mrs M.M.K. Robinson, inherited his plants and grew them in Pietermaritzburg until at least the mid 1960's. Information about anyone who has plants from Mrs Robinson would help add some more pieces to the jigsaw.

Plants from Sir Melmoth's plant were grown by Mrs Essie Osborne, whose husband was a nephew of Sir Melmoth. A plant was given to Mrs J de Villiers of Manderston outside Pietermaritzburg. When she self pollinated this plant, the results were orange plants.
Mrs Robinson's plants gave the same results. The fate of Mrs de Villier's plants, kept in a clump of bamboo's behind her house, is unknown. It is also recorded that she received a plant from Mr Vernon Crookes which was different to hers, and gave a plant to the Natal Botanical Garden in 1986. It flowered in 1990 and was selfed. The resulting plants were all yellow flowered. The history of these plants is unknown and information would be welcome.

The second Zululand clone was bought by Michael Noyce from Mr & Mrs Faircliff of Hilton in 1980. Mrs Faircliff said that they had bought the plants from the wife of an Eshowe doctor (name unknown) who had received the plants from a grateful patient. When the doctor's wife moved into an old age home, she advertised her plants in the Farmer's Weekly as 'Rare plants for sale'! Mr & Mrs Faircliff bought the last clump in a half drum in 1955. This magnificent robust plant, with well proportioned flowers on a tight umbel has the added characteristic of breeding true yellow when selfed thus distinguishing it from the described clone.

This trio of yellows is completed by the well documented 'Mare's Yellow' which was grown and sold by Miss Grace Mare from her home, 'Silver Oak' in Mare Street, Howick. The original plant was collected at the foot of the Howick waterfall in 1891. When Miss Mare left Howick, she gave her plants to Mrs A.D. Tanner who grew them at her house in Blackridge, Pietermaritzburg. She describes this plant as having dark green narrow leaves and the flowers a clear, deep, butter yellow with no trace of orange (or green)! She tried self pollinating these plants but the resulting plants were all orange with more yellow in the throat than her orange plants. Plants of this clone are found in many gardens in Howick and the Karkloof. At present they are being sold by Mr Gavin Westbrook.

To complete this section of our great Yellow Clivia puzzle, it is necessary to introduce the hybrid known as 'Watkins Yellow'. It was developed by Mr Hal Watkins of Hilton, a keen plantsman and trained horticulturist. He had in his collection of plants, clones of

both the 'Mare's Yellow' and what is now known as 'Noyce's Yellow' (possibly bought from the Eshowe doctor's wife?). Just before he died earlier this year, he told me that the yellows which he sold from his nursery, 'Leprechaun Leap', were the result of crossing these two clones. 'Watkin's Yellow' is a robust free flowering plant which has a compact head of well formed flowers carried well above the leaves. When selfed it produces yellow flowered plants. The plant *C. miniata* 'Golden Glow', which has twice been awarded best on show at the KwaZulu Natal Clivia Show, is the result of selfing 'Watkin's Yellow'.

In view of the fact that both these clones have been available for a century, it is probable that this cross has been made in the past both here in South Africa as well as overseas. It will be interesting to see whether gene 'finger printing' will show this to be the case.

In the collection at the Natal Botanical Garden, we have two plants which as yet do not fit neatly into the puzzle as a result of insufficient information about their origins. The first is the popular plant 'Natal Yellow', said to have been collected somewhere in the KwaZulu Natal midlands. With Cynthia Giddy's untimely death, the true origin of this plant will probably never be known.

The second plant was given to me by Mrs B. Smith who lived in the Transkei. This plant is also without a locality apart from the comment that it was collected in the Transkei. It is an attractive compact plant bearing an umbel of well shaped campanulate flowers of a medium to light yellow. When selfed, the seedlings are orange. If any old residents of the Transkei have any information about this plant and its origins, I would welcome a call.

In recent years, further clones of yellow *Clivia* have been discovered in Zululand and the Transkei, and in one unfortunate case the area was completely stripped of plants by persons unknown, thus destroying a very valuable genetic resource.

These, however, are pieces which belong to another section of the Great Yellow *Clivia* Puzzle, which will be dealt with in the future, when more information is available.

'Noyce's Sunburst' a cultivar of 'Noyce's Yellow'

Clivia miniata x kewensis 'Vico Yellow'.

This plant finds a place here not because it is of my own raising, but because of the curious and instructive story of its origin. This, in addition to its undoubted beauty

Clivia have suffered from being distributed commercially in a very indifferent form and also because of one of their great merits. They are amongst the most long-suffering of pot plants which, like the *Aspidistra*, will put up with almost anything except over-attention. Just so! They are bracketed with the *Aspidistra* as inhabitants of lodging-house parlours.

I did not feel any of these inhibitions with a very handsome plant. From Mr Russell at Castle Howard I obtained three forms of *C. miniata* under the name of *'Kewensis'*. One was yellow, though called *'Cream'*. All had been bred by Charles Raffill at Kew, selecting back to recover a lost South African yellow.

'Vico Yellow ' Breeder Sir Peter Smithers.
Top flower – original clone. Bottom flower – tissue culture plant

In one of my few idle moments in the early days of planting this garden I crossed the orange and yellow clones. After the necessary five or six years there were flowers: no yellows, though some worthy orange plants. However, I had had too many seedlings to be able to keep them all and had discarded a number under the greenhouse stage. Then '*Kewensis* Cream' died, mysteriously, just as the South African

yellow had done at Kew many years before.

It was some years later that to my astonishment a yellow Clivia bloomed under the stage. It seemed to me good, perhaps an improvement on 'Kewensis Cream'. I rescued it, potted it, and in due course sent an offset to my friend Dr Shuichi Hirao in Japan. I thought no more about it. After a couple of years Shu sent me *Japan Horticulture* No. 89 for 1985. My yellow *Clivia* was the cover picture and there was an article about it inside. Inexcusably, for the Japanese are consummate plantsmen, I did not take this event too seriously. Then 'Shu' Hirao died, sadly and prematurely.

It was a couple of years after his death that I had a letter from Yoshikazu Nakamura, at Clivia Breeding Plantation, Mobara, Japan, to say that Shu's widow had sent the yellow *Clivia* to him. He would like permission to breed from 'Smithers Yellow', 'world's best yellow Clivia, the one to beat'. I was astonished! Of course he was perfectly free to make any use of the plant which he liked, but might it be called 'Vico Yellow'? Perhaps it was too late: 'Smithers Yellow' was already in the trade in Japan.

Subsequently another yellow flowered amongst my seedlings. It was very similar to the first but in my opinion slightly superior in form. Only time would tell. It was of course a separate clone. No 'Smithers Gold' this time: it is named *Clivia x kewensis* 'Vico Gold'.

The latest development in this story of entirely unmerited success, is that the C. *miniata x kewensis* ' Vico Yellow' is now to be registered in Japan and will be micro-propagated by Miyoshi & Co. of Yamanashi, for mass distribution.

Clivia miniata var. citrina seedhead

Nakamura hybrid

The Eastern Cape – of its People and Plants

by Charl Malan

Introduction

The Eastern Cape province of South Africa has a rich mosaic of people and plants. This is where *Clivia* was first discovered by early explorers, and also where Ms Gladys Blackbeard started and grew her *Clivia* collection. This article aims to give the reader some information on *Clivia nobilis* in its natural habitat, and a window into the world of Gladys Blackbeard.

***Clivia nobilis* in the Eastern Cape**

At the dawn of the new millenium the Eastern Cape still has vast areas of natural, undisturbed vegetation which is protected by a large number of formal and informal nature reserves.

The vegetation of the Eastern Cape is complex and is transitional between the Cape and sub-tropical floras, and many taxa of diverse phytogeographical affinities reach the limits of their distribution in this region. All the major biomes of South Africa can be found within a 150 km radius of Grahamstown, with the exception of the desert. These biomes include :

Cape Fynbos - a shrubby complex of Cape species found on nutrient poor soils. Cape Fynbos includes Dune, Mountain and Grassy Fynbos.

Karoo - composed of succulents, some grasses and many small bushes.

Sub-tropical thicket - dense, woody vegetation type composed of shrubs and small trees. Dune thicket exists along the coastal strip, the climax vegetation type which appears as true coastal forest. The more succulent thickets, which extend from the river valleys inland and invade savannah and grasslands, are often referred to as Valley Bushveld.

Savannah - grasslands with small trees (often *Acacia)* scattered throughout.

Grassland - either Sourveld, Sweetveld or Mixed Grassland.

C. Nobilis

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C. nobilis habitat at Kei River mouth

Afromontaine Forest - the large forest trees of this region have affinities with those of the montaine forests of central Africa.

Clivia nobilis is most commonly found in the Sub-tropical thicket or Valley Bushveld and its climax types, i.e. coastal and inland forests. The Eastern Cape is subjected to major movements of air masses extending over hundreds of kilometres. Altitude, mountains and distance from the Indian Ocean are important variables acting on the prevailing conditions, and as a result, there are major variations in temperature, rainfall and windiness.

With its tough, leathery leaves and extensive root system, *C. nobilis* is particularly well adapted to a habitat with an unpredictable and variable climate. Populations occur from West of Grahamstown through the Albany and Bathurst districts and from there along the Eastern Cape coastal belt well east of the mouth of the Kei River.

These populations are found in a number of diverse localities, ranging from primary coastal dunes to wooded kloofs further inland, where plants normally occur on river banks and along forest margins. Within this range marked differences in growth habit can be distinguished.

The coastal varieties very often are found under a low (2 - 5m) canopy on coastal dunes, where plants may be exposed to the sun for a large part of the day. Under such conditions the tendency is for plants to form large clumps with leaves that are no longer than 70 cm long. As the plants occur in alkaline marine sand, they mostly depend on falling leaves from surrounding vegetation for the supply of nutrients.

At Kei Mouth, on the other hand, plants occur right up to the high water mark under a canopy of ± 20 metres high. During severe storms in 1998, large areas of the primary dunes were damaged, and countless numbers of plants were washed away by the sea.

The plants under a high forest canopy do not form the large clumps normally associated with more exposed positions under a low canopy.

Mature plants tend to have leaves exceeding one metre in length, and plants tend to be solitary. This is also the

case under forest canopies at inland localities such as Grahamstown.

In habitat, *C. nobilis* grows on the surface of the sand or soil. The roots of a mature plant can spread up to 80 centimetres around the plant and quite clearly obtain the majority of their nutrients from the detritus collecting on the forest floor.

Mature *C. nobilis* plants in cultivation in containers (bags/pots) tend to produce astonishing numbers of offspring around the base of the plant. This is especially noticeable when the basal plate is damaged, whether naturally or artificially.

Flower colour in *C. nobilis* varies from one population to the other and even within fairly localized populations.

At Grahamstown within a radius of five kilometers one finds flowers that range in colour from pale apricot/pink with light yellow and green tips to a dark red form with tips which are dark green.

C. nobilis is a rewarding plant in cultivation, whether in containers or planted in the garden. It prefers a well drained soil and dappled shade, preferably under an evergreen canopy, but can tolerate sunlight for part of the day.

Interspecific hybridization using *C. nobilis* took place in Europe as early as the late 19th century, giving rise to the so-called C. Cyrtanthiflora hybrids.

From her writings we know that for her first interspecific hybridization attempts, Ms Blackbeard used *C. miniata* and *C. nobilis.* Where *C. miniata* is used as the pollen parent, the progeny grow at the same rate or even faster! This 'hybrid vigour' accounts for some plants first flowering under Grahamstown conditions in 42 months.

As reported by Ms Blackbeard, you also find such hybrids flowering at odd times during the year, and mature plants will produce flowers twice a year at different times.

Already in the F1 generation the leaves have lost the blunt tip feature of *C. nobilis.* The flower has a large number of florets (up to 50) and makes for a very attractive show.

C. nobilis habitat near Grahamstown

Karyotype analysis of the Genus Clivia by Giemsa and Fluorochrome Banding and in situ Hybridization

by Y. Ran[1], B.G. Murray[1*], & K.R.W. Hammett[2]

Key words : *Clivia*, fluorochrome banding, Giemsa banding, *in situ* hybridization, karyotype analysis, silver nitrate staining.

Abstract

The karyotypes of species in the genus *Clivia* were analyzed by using Giemsa C-banding, fluorochrome staining, silver impregnation and *in situ* hybridization. Banded ideograms were established with computer aided image analysis.

A chromosome number of 2n = 22 and a similar basic karyotype, based on relative chromosome length and arm ratio, was found in all the four species. There were clear differences in banding pattern between the species which allowed their karyotypes, and consequently the species, to be unambiguously identified. Apart from at the centromere, heterochromatin was mainly distributed on the short arms of the smaller chromosomes. Amounts of heterochromatin in *C miniata* and *C gardenii* were greater than in the other two species. The number of pairs of rDNA sites, identified by *in situ* hybridization, ranged from one to three.

Introduction

The genus *Clivia* Lindl. (Amaryllidaceae) is recognised as consisting of four species, *C nobilis* Lindl., *C. miniata* Regel, *C. caulescens* R.A. Dyer and *C gardenii* Hook. f. The species are all native to South Africa. Although *Clivia* has been cultivated as an ornamental for more than a hundred years (Weathers, 1911; Vorster, 1994), and several groups of hybrids have been reported (Bryan, 1995; Nakamura, 1995), very little information is available on the karyotypes, relationships and evolution of the genus.

Previous chromosome studies have concentrated on obtaining chromosome numbers and karyotypes from conventionally stained material (Inariyama, 1937; Sato, 1938; Gouws, 1949; He & Deng, 1989). In general the results confirm chromosome numbers as 2n = 22, although Sato (1938) found 2n = 44 in *C nobilis*, with some apparent variation in karyotype between the four species. Confusion has arisen from Inariyama (1937) having quoted Van Camp (1924) as reporting n = 9 for *C miniata* but giving no reference. Although being further quoted (Gouws, 1949), no subsequent author claims to have found the Van Camp reference.

The development and application of differential banding techniques for plants (Vosa, 1970; Schweizer, 1976a) has resulted in many more characters or

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markers being available for karyotype analysis. For example, base pair-specific fluorochromes such as DAPI (4' - 6-diamidino-2-phenylindole) and CMA (chromomycin A3), which preferentially bind to AT- or GC-rich regions of the genome respectively, allow the cytochemical characterization of heterochromatin (Schweizer, 1976a, 1976b; Deumling & Greilhuber, 1982; Ebert et al., 1996). The number and location of nucleolar organizer regions (NORs) also provide valuable chromosome landmarks and these can readily be identified by their selective staining with aqueous silver nitrate (Kodoma et al., 1980) and by *in situ* hybridization (ISH) with rRNA gene probes (Mukai et al., 1991; Murray et al., 1992).

In this study, a variety of banding techniques together with silver staining with ISH have been used to characterize the chromosomes of the four *Clivia* species.

Materials and methods

The plants of the four different species analyzed in the present investigation were a mixture of commercial cultivars and plants originally obtained from wild populations in South Africa (Table 1). They were grown in pots in a shade house. For karyotype studies, root tips were pretreated with a saturated solution of paradichlorobenzene for 18 - 24 h at 4°C, fixed in 3:1 (v/v) ethanol:acetic acid for at least 24 h and stored in 70% ethanol at 4°C. Chromosome spreads were made as described in Murray & Davies (1996). The technique for C-banding followed that described by Schwarzacher et al. (1980) modified by increasing the incubation time in barium hydroxide at 25°C to 15 min. Triple staining with CMA, distamycin A and DAPI for consecutive observation of CMA and DAPI fluorescence (Schweizer, 1981) used the modifications of Jacobs et al. (1999) where chromosome denaturation with barium hydroxide was carried out at 24°C for 10-13 min. Silver staining for NORs was done in two steps: first using 50% AgN03 in distilled water and a nylon net coverslip and incubating the slides at 60°C for 1 h (Kodoma et al., 1980); and then impregnating with 100% AgN03 in sodium citrate (pH3) under a glass coverslip at 60°C for 15 min to 1 h. Staining intensity was monitored under the microscope. For ISH, the plasmid pTIP6, which contains the 26S rDNA of Asparagus officinalis L. (King & Davies, 1992), was used as probe. Probe DNA was digoxigenin labelled by nick translation (Boehringer Mannheim). ISH was performed following the procedures outlined in Leitch et al. (1994). Hybridization was carried out overnight at 37°C in a thermal cycler (Hybaid Omnislide). Hybridization sites were detected using the HNPP/Fast Red TR fluorescence detection kit (Boehringer Mannheim), the chromosomes were counter stained with 0.5 mg/ml DAPI in phosphate-buffered saline (pH 7) and mounted with 1.8%

DABCO (Sigma D-2522) in 90% glycerol v/v 20mM Tris, pH 7.5. Selected chromosome spreads were observed with a Zeiss Universal microscope with epi-fluorescence and photographed with PanF or Ektachrome 400 film, the images digitized with a Nikon LS1000 film scanner and merged using Adobe Photoshop 3.0.5.

Chromosome measurements of five well-spread metaphases per species were made using the public domain Macintosh software NIH Image (developed at the US National Institutes of Health and available on the Internet at http://rsb.info.nih.gov/nih-image/)

This software allows the analysis of the following chromosome parameters: total chromosome length (T), short arm length (S), long arm length (L), arm ratio (AR), relative length of individual chromosomes (RL), the mean total karyotype length (TKL), the width of differentially stained bands (w) including bands on short arm (Sb), long arm(Lb) and centromere (Cb), the distance of the centre of a band from the centromere (p), and the total heterochromatin amount (HC). The banding patterns were validated from more than 30 cells. Chromosomes were classified according to Levan et al. (1964).

Results

Chromosome number and basic karyotype

The same chromosome number (2n = 22) was found in all plants of the four different species. The basic orcein-stained karyotope was also similar in all species (Figures 1a-d, 2a) with four pairs of metacentrics (1, 2, 8 & 10) and seven pairs of submetacentrics. Within a karyotype, there were large differences in chromosome length, three pairs (1, 2 & 3) were obviously larger than the others and three pairs (9, 10 & 11) were smaller than the others. Many of the chromosomes can be recognised from the length measurements, the exceptions being the medium sized submetacentric pairs 4, 5 and 6 and the two small submetacentric pairs 9 and 11.

Banding patterns

Giesma C-banding allowed the species to be divided into two groups. The most obvious difference was that C. *miniata* and *C. gardenii* had small, dot-like bands at the centromeres of all chromosomes whereas *C. nobilis* and *C. caulescens* did not (Figure 2b). All the species showed an interstitial band in the short arm of chromosome 8 and with the exception of *C. gardenii* also had a terminal band on the same arm. *C. miniata* and *C. gardenii* also had a terminal band on the long arm of chromosome 2 that was absent in the other two species. Terminal bands were present on the short arm of chromosome 9 in *C. caulescens* and *C. nobilis* which, in addition, had a terminal band on the short arm of chromosome 10 (Figure 3). There was a range in variation in the amounts of heterochromatin present in the species, viz. *C. miniata* (9.77%), *C. gardenii* (7.86%), *C. nobilis* (4.87%) and C. *caulescens (1.55%).*

With DAPI, the banding patterns in the four species were very similar to the C-banded ones (Figure 2c); the exception being that the terminal bands on the short arms of chromosomes 8 and 9 in *C. caulescens* were missing. Many fewer CMA bands than DAPI bands were observed. All the species could be identified by their CMA banding pattern (Figure2d; Figure 3); *C. caulescens* along with *C. miniata* and *C. nobilis* had a terminal band and an intercalary band on the short arm of chromosome 8, *C. miniata* and *C. gardenii* had an additional terminal band on chromosome 3. *C. caulescens* and *C. nobilis* had a terminal band on chromosome 9 and C. *nobilis* had an additional terminal band on chromosome 10. A faint interstitial band was observed on the short arm of chromosome 8 in all species.

Silver positive bands consistent with CMA ones were seen in *C. miniata* (four bands) and *C. gardenii* (two bands) but not in the other species (Figure 2e). In *C. caulescens* and *C. nobilis* a silver band was observed at the end of the short arm of chromosome 9 and of chromosome 10 respectively, and in *C. caulescens* silver positive bands were found at the centromeres of all chromosomes (Figure 3).

Intraspecific variation in banding pattern

The three populations of *C. caulescens* could be placed into two groups based on their banding pattern. The six plants from population 8288 all had an interstitial band on the short arm of chromosome 8 and a terminal one on the short arm of chromosome 9 when DAPI and Giemsa staining were used. Only one terminal CMA band on the short arm of chromosome 9 was found.

There was another example of band polymorphism in *C. nobilis.* In some plants chromosome 9 showed a CMA band on both homologues, but only one of the chromosomes had a DAPI band at the same site; the intensity of the C-band at this site also varied between homologues.

In situ hybridization with a rRNA gene probe

The chromosomal locations of rRNA genes in all species of the genus *Clivia* were determined by ISH. Two pairs of hybridization sites were seen in both *C. miniata* and *C. caulescens* with three pairs in *C. nobilis* but only one pair in C. *gardenii* (Figure 2f). The locations of the sites in all species coincided with the bright terminal CMA bands described above (Figure 3).

Discussion

Our study has found that the chromosome number of all four species of *Clivia* from a variety of different sources is 2n = 22. This confirms the previous reports of Inariyama (1937), Gouws (1949) and He & Deng (1989) but not the tetraploid number for *C. nobilis* (Sato, 1938). The species all had similar karyotypes consisting of

three large, five intermediate and three small chromosome pairs including four pairs of metacentric chromosomes. Thus, there appear to be some differences from the previous karyotype analyses. Gouws (1949) reported that in *C caulescens* there were two large pairs, five medium and five small pairs of chromosomes. In *C miniata*, he found two large pairs and three small pairs and six medium sized pairs. He & Deng (1989) reported only one pair of large metacentric chromosomes (the longest one) in *C nobilis.* Some of these karyotype differences may result from using sectioned material, the variability in contraction of the large *Clivia* chromosomes and the use of different arm ratio criteria, which were not clearly defined.

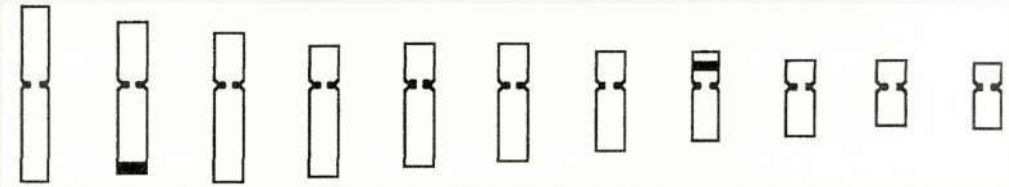
Vorster (1994) has suggested that the similarity in morphology, particularly in their vegetative characters, makes it difficult to justify the separation of *Clivia* species into different species. However, our karyotype studies, in particular the observations on the number, position and size of bands produced by the different staining schedules, along with the differences in chromosome length, allow the karyotypes of the species to be readily distinguished. In fact the species can be identified from their karyotypes by using all of the chromosome banding techniques. This is particularly useful in *Clivia* as plants can take several years to flower, when they are most readily identifiable. Thus, both seedlings and hybrids can be readily identified at an early stage. Within a species, a combination of length measurements and the ratios of chromosome arms together with banding pattern or ISH sites allows the identification of many chromosome pairs; five in *C miniata* and *C gardenii* (1, 2, 3, 8 & 10) and seven in *C caulescens* and in C. *nobilis* (1, 2, 3, 8, 9, 10 & 11). It will be necessary to find other molecular markers, such as the 5S rDNA (Fominaya et al., 1997) or microsatellites (Pedersen & Langridge, 1997), if all the chromosomes are to be unambiguously identified.

The overall similarity of the orcein stained chromosomes of the four *Clivia* species suggests that they have similar genomes. This is reinforced by similarities in the banding patterns of several of the chromosomes. Amongst the more conspicuous is pair 8 in all species, except *C gardenii*, where there are similar intercalary and terminal bands. The NOR-bearing pair number 2 of *C miniata* is similar to pair 2 of *C gardenii* with matching band patterns and arm ratios. Pair 9 of *C nobilis* is similar to pair 9 of *C caulescens*, again with similar banding patterns and *in situ* hybridization sites. There are other possible chromosome similarities based on banding patterns and arm ratio between *C miniata* and *C gardenii*, and between *C. nobilis* and *C caulescens* but more markers are needed. However, clear differences also exist between the complements; this is particularly clear from the ISH results where from two to

Table 1. Origin of plant material used in this study

Species	Population code/name	Origin	No. of individuals
C. miniata	886	Wild population, Howick, South Africa	10
	8312	Yellow Clone, Australia	4
	Daruma	Dwarf broad leaf clone, Japan	4
C. nobilis	871	Kirstenbosch, South Africa	4
	8317	Clone, Japan	4
	8659	Wild population, Kei River Mouth, South Africa	11
	8660	Wild population, Featherstones Kloof, South Africa	9
	8661	Wild population, Riet River, South Africa	7
C. gardenii	875	Cultivated population, South Africa	6
	812	Cultivated population, New Zealand	8
	827	South Africa, via UK	4
	8305	Clone, Japan	1
	8310	Clone, Japan	1
C. caulescens	880	Wild population, Venus plantation, South Africa	5
	840	Wild population, South Africa (obtained via Australia)	6
	8304	Wild population, South Africa (obtained in NZ)	5
	879	Wild population, God's Window, South Africa	2
	881	Cultivated population, South Africa	2
	8333	Wild population, God's Window, South Africa	1

a

	1	2	3	4	5	6	7	8	9	10	11
											
S	7.45±0.41	6.56±0.39	4.97±0.45	4.23±0.35	4.27±0.16	3.62±0.14	3.58±0.24	3.55±0.22	2.68±0.19	2.72±0.19	2.29±0.12
L	10.36±0.64	9.31±0.48	10.14±0.54	9.69±0.48	8.69±0.51	8.24±0.39	6.90±0.48	5.85±0.44	5.31±0.42	4.30±0.34	4.39±0.28
T	18.05±0.72	15.86±0.95	15.16±0.92	13.99±0.71	12.94±0.47	11.75±0.54	10.32±0.60	9.42±0.62	7.95±0.36	7.05±0.39	6.63±0.38
AR	1.42±0.05	1.42±0.10	2.13±0.13	2.38±0.07	2.04±0.07	2.28±0.06	1.94±0.07	1.65±0.06	2.04±0.12	1.60±0.11	1.92±0.14
RL	14.04±0.21	12.24±0.28	11.68±0.16	10.84±0.14	10.11±0.27	9.11±0.12	7.96±0.12	7.25±0.18	6.17±0.08	5.47±0.16	5.13±0.12
C-band											
Cb	-0.73	-0.73	-0.73	-0.73	-0.73	-0.73	-0.73	-0.73	-0.73	-0.73	-0.73
Sb1-w											
-p											
Sb2-w								0.79±0.07			
-p								2.87±0.67			
Lb1-w		1.33±0.22									
-p		8.65±0.36									
TKL=258.26±4.46				HC=7.86%							

b

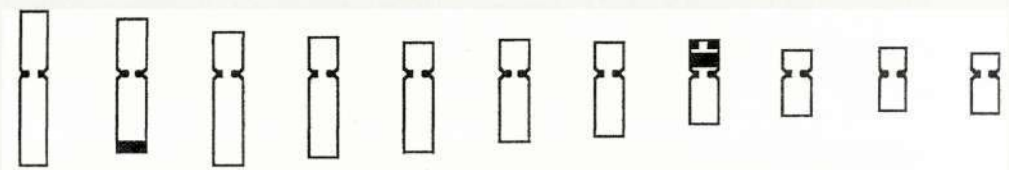
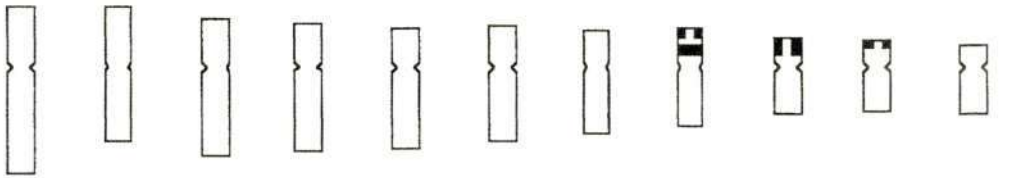
	1	2	3	4	5	6	7	8	9	10	11
											
S	6.76±0.34	5.84±0.30	4.25±0.20	3.78±0.18	3.43±0.12	3.61±0.12	3.45±0.12	3.54±0.11	2.35±0.09	2.78±0.13	2.18±0.08
L	9.75±0.21	8.36±0.31	9.87±0.28	9.07±0.36	8.29±0.31	7.14±0.23	6.55±0.19	5.45±0.19	4.50±0.12	3.92±0.09	4.23±0.13
T	16.56±0.40	14.20±0.46	14.13±0.46	12.79±0.23	11.68±0.26	10.91±0.33	10.02±0.21	9.00±0.30	6.94±0.17	6.73±0.22	6.40±0.19
AR	1.47±0.07	1.42±0.06	2.34±0.07	2.46±0.16	2.45±0.16	1.98±0.05	1.92±0.10	1.54±0.03	1.93±0.07	1.43±0.07	1.95±0.06
RL	13.96±0.23	11.92±0.24	11.76±0.26	10.73±0.17	9.78±0.10	9.13±0.17	8.39±0.09	7.53±0.14	5.81±0.11	5.62±0.08	5.35±0.06
C-bands											
Cb	-0.73	-0.73	-0.73	-0.73	-0.73	-0.73	-0.73	-0.73	-0.73	-0.73	-0.73
Sb1-w								1.10±0.08			
-p								2.99±0.10			
Sb2-w								1.52±0.09			
-p								2.85±0.09			
Lb1-w		1.02±0.10									
-p		7.85±0.43									
TKL=238.82±2.87				HC=9.77%							

Figure 1a-b **Karyotype ideograms and chromosome measurements in (a) *C. gardenii* and *C. miniata***

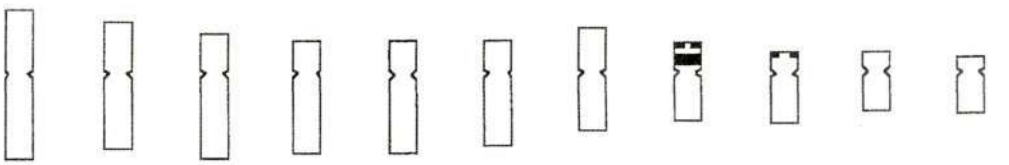
c



	1	2	3	4	5	6	7	8	9	10	11
S	7.91±0.30	7.06±0.50	5.45±0.53	4.83±0.29	4.42±0.26	4.61±0.25	4.02±0.30	4.49±0.26	3.20±0.26	3.00±0.19	2.75±0.37
L	11.69±0.64	8.30±0.48	10.01±0.54	9.48±0.48	9.29±0.51	8.31±0.39	7.58±0.48	6.75±0.44	5.98±0.42	5.05±0.34	5.32±0.28
T	19.53±0.82	15.59±0.83	15.41±0.86	14.25±0.75	13.75±0.73	12.98±0.66	11.59±0.76	11.28±0.66	9.16±0.54	8.12±0.46	8.09±0.59
AR	1.48±0.05	1.21±0.10	1.90±0.13	2.02±0.07	2.12±0.07	1.82±0.06	1.91±0.07	1.51±0.06	1.92±0.12	1.72±0.11	1.96±0.14
RL	13.96±0.34	11.08±0.16	10.94±0.08	10.09±0.06	9.78±0.10	9.24±0.14	8.20±0.15	8.00±0.11	6.50±0.10	5.77±0.12	5.68±0.15
C-bands											
Cb											
Sb1-w									1.26±0.16	1.18±0.10	1.27±0.15
-p									3.86±0.17	2.61±0.10	2.37±0.53
Sb2-w									2.16±0.18		
-p									2.90±0.21		
Lb1-w											
-p											

TKL=281.40±4.82 HC=4.87%

d



	1	2	3	4	5	6	7	8	9	10	11
S	6.93±0.35	6.23±0.34	4.54±0.29	3.87±0.26	3.77±0.22	3.97±0.23	3.51±0.26	3.16±0.16	2.31±0.19	2.56±0.21	2.04±0.10
L	10.04±0.59	8.20±0.49	9.42±0.53	8.93±0.51	8.49±0.48	7.94±0.52	6.43±0.41	5.39±0.30	5.03±0.28	4.33±0.34	4.41±0.25
T	16.95±0.90	14.33±0.80	13.96±0.76	12.80±0.63	12.26±0.67	11.91±0.71	10.44±0.65	8.54±0.44	7.34±0.39	7.21±0.45	6.39±0.39
AR	1.45±0.05	1.32±0.03	2.10±0.10	2.38±0.16	2.27±0.10	2.00±0.08	1.83±0.06	1.71±0.06	2.27±0.20	1.70±0.08	2.18±0.11
RL	13.88±0.18	11.72±0.22	11.42±0.15	10.51±0.22	10.03±0.14	9.71±0.16	8.51±0.15	7.02±0.18	6.02±0.10	5.95±0.33	5.21±0.11
C-bands											
Cb											
Sb1-w								0.63±0.08	0.45±0.04		
-p								2.94±0.20	2.09±0.13		
Sb2-w								0.82±0.05	-		
-p								2.34±0.15			
Lb1-w											
-p											

TKL=244.28±4.46 HC=1.55%

Figure 1c-d **Karyotype ideograms and chromosome measurements in (c) *C. nobilis* and (d) *c. caulescens* (bar represents 10 µm).**

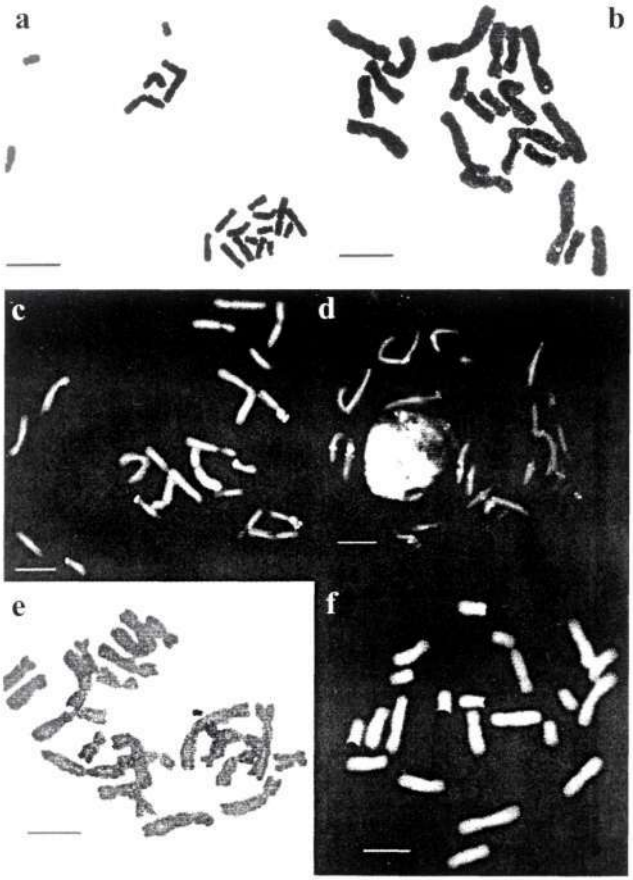


Figure 2. Mitotic metaphase chromosomes of *Clivia* species.

(a) *C. nobilis* stained with orcein.

(b) *C. miniata* C-banded with Giemsa.

(c) *C. nobilis* DAPI–banded.

(d) *C. miniata* CMA-banded

(e) *C. gardenii* stained with silver nitrate.

(f) *C. caulescens* showing rDNA hybridization sites. Bar represents 10µm.

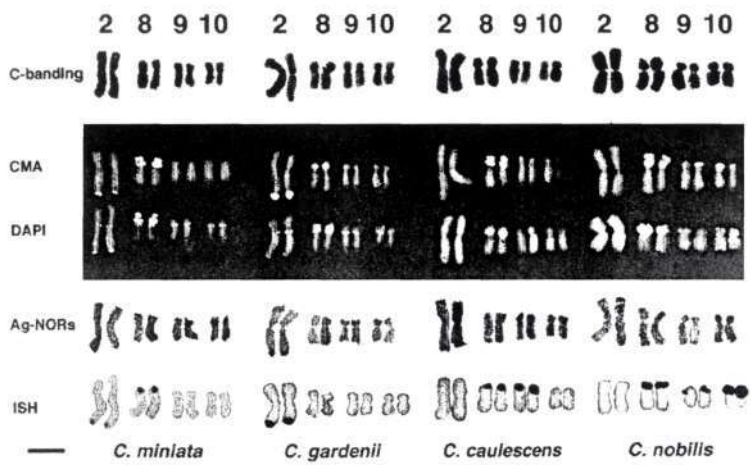


Figure 3.
A comparison of the different banding patterns and ISH sites in the four *Clivia* species.

six sites were seen in the different species.

There is good correspondence in banding pattern between fluorochrome-stained and C-banded chromosomes of the same species and both DAPI and CMA bands were heterochromatic. Generally, because CMA and DAPI fluorochromes perferentially bind to GC- and AT-rich DNA sequence (Schweizer, 1976b; Lin & Comings, 1977), the CMA positive regions are usually DAPI negative in most plants and animals (Schwarzacher & Schweizer, 1982; Sumner, 1990; Moscone et al., 1996). However, in *Clivia,* most of the CMA positive bands are also DAPI positive; the exception being the two pairs of terminal bands on chromosomes 8 and 9 in *C. caulescens* and that on one of the homologues of pair 9 in *C. nobilis.* There are two possible explanations for this. First, there may be AT-rich and the GC-rich clusters in closely adjacent regions in the heterochromatin that are large enough to produce distinct bands with either fluorochrome. Alternatively, although DAPI has a preference for AT-rich regions, the DAPI fluroescence bands might arise for reasons other than the presence of AT-rich clusters, because other flurochromes such as quinacrine, which also preferentially binds to AT-rich regions, give different banding patterns to the DAPI one in other species of plants (Leeman & Ruch, 1978; Schwarzacher & Schweizer, 1982; Sumner et al., 1973). It is possible that factors other than base sequence composition of the DNA may also play a role in fluorochrome banding of chromosomes (Comings & Drets, 1976; Sumner, 1990).

All rRNA gene sites on *Clivia* chromosomes in all species coincide with CMA positive bands, a common feature in a wide variety of plants (Ebert et al., 1996; Sumner, 1990). All these sites in *C. miniata* and *C. gardenii* were also stained with AgNO3, indicating they are active NORs (Sumner, 1990). Only one pair of sites, on chromosome 9 in C. *caulescens* and on chromosome 10 in C. *nobilis,* were silver positive.

The intraspecific polymorphism in banding pattern in *C. caulescens* is interesting as it has been found between plants within a single population. Our samples of this species are fairly extensive, though not exhaustive, and it would be interesting to make more population studies of this species.

Karyotype analysis appears to divide the genus into two groups; *C. miniata* and *C. gardenii* with centromeric C-bands and *C. caulescens* and *C. nobilis,* which do not. We plan to use DNA sequence information to construct a phylogeny of the genus and this will then provide an evolutionary framework that should allow the direction of evolution of karyotype characteristics, such as genome size, amount of heterochromatin, number of rDNA sites, to be determined.

Acknowledgements

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Clivia Names
by Harold Koopowitz

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C. Cyrtanthifiora

There appears to be much confusion concerning the names given to clivia plants. Here we will try and sort out and elucidate some of the problems. Currently there are several different kinds of names in use that are applied to various *Clivia* plants and people have not clearly distinguished between them. As more people become involved with breeding these plants it will become increasingly important to keep the record straight. In this article I will distinguish between the different categories of name and also make some suggestions on how to standardize name usage. This report is the result of discussions held with various *Clivia* enthusiasts both in South Africa and California.

Species Names:

These are the names conferred upon different types of *Clivia* found in wild populations. Fortunately *Clivia* belong to a small genus with only four currently recognized species (at least at the time of writing this account). There has been relatively little confusion between these names compared to the situation in many other much larger genera. Currently, the four *Clivia* species recognized are *Clivia caulescens, C. gardenii, C. miniata* and *C. nobilis.*

Grex **Names:**

Grex names can be given to all of the progeny of a cross and any time that that cross is repeated, the same grex name applies. This is also true if different individuals of the same grex are mated. For example, *Clivia* Cyrtanthifiora is the grex name, applied to the offspring of

C. gardenii (swamp form) x C. *miniata*

C. miniata x *C. nobilis*. Any *C. miniata* crossed with any C. *nobilis* has offspring that can be referred to as C. Cyrtanthiflora. It does not matter which is the pollen or pod parent. Crossing any C. Cyrtanthiflora with itself or with any other C. Cyrtanthiflora still results in C. Cyrtanthiflora. However, if C. Cyrtanthiflora is back-crossed to either *C. miniata* or *C. nobilis*, a new grex name would be required. Note that when the grex results from an artificial cross the name is always capitalized and is not written in italics. If the grex is the result of a naturally occurring hybrid it would be written as C. x *cyrtanthiflora* with an 'x' before the epithet and the name is italicized. (Naturally occurring C. x *cyrtanthiflora* does not appear to have been described.

In order to be valid, grex names must have been published together with the names of the parents. Up until this point the only valid grex name for the genus is C. Cyrtanthiflora published as *Imantophyllum* Cyrtanthiflorum in 1877.

The use of C. Cyrtanthiflora for *Clivia* crosses involving any of the other species is invalid and new grex names are needed. Grex names could be any short descriptor and may be a single word or name. In orchids where grex names are commonly used the length of the grex name is usually limited to three words. For modern grex names, latinized words are usually not allowed. It is useful for breeders, if they make up grex names that reflect the parentage of the plant, but that is not necessary.

Primary hybrids are the results of crosses between two different species. Crosses between primary hybrids and other parents are often called advanced hybrids. One such advanced hybrid, between C. Cyrtanthiflora and *C. miniata* appears to have been made several times and that deserves its own grex name. Below is a list of both new and the old grex names for some of these clivia combinations.

Des Andersson *C. miniata var. citrina x C. gardenii*

GREX NAME	PARENTAGE
Clivia Caulgard	*C. gardenii x C. caulescens*
Clivia Cyrtanthiflora	*C. miniata x C. nobilis*
Clivia Minicyrt	C. Cyrtanthiflora x *C. miniata*
Clivia Minigard	*C. gardenii x C. miniata*
Clivia Minilescent	*C. miniata x C. caulescens*
Clivia Nobilescent	*C. nobilis x C.* caulescens
Clivia Noble Guard	*C. gardenii x C. nobilis*

With this publication the above grex names have precedence unless one can show a previously published name for a cross. As an aside, the plural of grex is strictly greges, but the RHS now uses grexes and I would suggest we follow their example.

Cultivar Names:

Within a grex or a species, desirable individuals may need to be singled out for special recognition. In that case they can be given cultivar names. Asexually propagated divisions, or the result of tissue culture multiplication of the same individual, then obviously will all share the same cultivar name. Cultivars are genetically identical. If sports or mutations appear then they should be given new cultivar names. Cultivar names are written in Roman script and can also contain numerals or codes. The first letter of each word is capitalized and the epithet embraced by single quotes such as 'Wittig's Peach' or 'Orange Belle' or even 'Bill #87'. In orchids, only three words are allowed in the cultivar name and the entire name is a combination containing both the species or grex name plus the cultivar name, e.g. *Clivia miniata* 'Vico Yellow' or C. Cyrtanthiflora 'First Love.'

In many plant groups, grex names are not used and registries only contain cultivar names. This is true of daffodils where the register now contains tens of thousands of names. Roses are another case where cultivar names are used and grex names usually ignored. If grex names are used then one can reuse cultivar names e.g,. C. Cyrtanthiflora 'Imperial' and C. Minicyrt 'Imperial'.

Cultivar-group names:

The siblings of a cross can sometimes appear to be very similar to each other and one may not want to bother to differentiate between them; in those cases they can be given group names. This is what appears to have happened with some of the yellow clivias. Those names should be written in Roman letters and ending with Group. These names are not set off in quotation marks. Perhaps the most famous clivia example is Watkin's Yellow, which should be written or identified as C. Watkin's Yellow Group. Here is an assemblage of flowers that are genetically related and relatively uniform in appearance, but see the next category.

Strains:

Line breeding towards a certain end point often also leads to relative genetic uniformity and similar looking plants. The term, strain, could also be used to identify these plants. The naming would be similar to cultivar-group names. One might then write about C. New Dawn Strain, which is the name that Jim Holmes has given to his yellow clivias where he has consistantly weeded out any orange colors and now has an almost pure yellow breeding strain. Two other commonly used names are C. Belgian Strain and *C.* Sahin's Twin Strain. I suggest that the *Clivia* fraternity find some consensus about whether to call these assemblages groups or strains. Either word could be used. Strains and groups are seed grown and hence not genetically identical and it is possible to derive new strains from older ones, by further line breeding.

Within a group or strain an exceptional clone can still be singled out for a cultivar name. One such plant, bred by Jim Holmes from his C. New Dawn Strain, is very pale and he has named it, *C. miniata'* Cape Snowflake' One does not refer to the group or strain from which the particular cultivar was derived.

This may seem very complicated but it really is not. We are also fortunate in that we have many options in how to proceed with naming *Clivia.* For breeding purposes cultivar names are most important. For commercial trade seed-grown sales groups or strains are most important until tissue culture becomes commonplace and the cultivar names will assume more prominence. Our major decision is whether or not to call plants groups or strains and how much importance is to be placed on grex names. Grex names are helpful in understanding the species contributions to breeding but after several generations they tend to lose their value. Irrespective of how we decide to proceed, one important point is that a register of names needs to be initiated. This is another function the Clivia Club can play in the world. A registry is useful for avoiding future confusion but it will also act as an historic document for the evolution of this beautiful and horticulturally important plant.

Nakamura hybrid

Advanced Hybridising of Clivias a sacrifice but rewarding

by W J Lötter

The interspecific hybrid of *Clivia miniata* and *C.nobilis* has been known since 1850 and was described as *Clivia* Cyrtanthiflora. No doubt this cross has been repeated over and over as well as C. *miniata x C. gardenii* and *C. miniata x C. caulescens.* I myself have produced many of these crosses and fortunately always used *C. miniata var. citrina* as one parent.

As far as I am aware, intergeneric hybrids with *Clivia* do not exist and claims to this effect should be disregarded until substantial proof is submitted. I myself attempted a few with closely related genera within the *Amaryllidaceae* such as *Crinum* and *Amaryllis belladonna,* as well as the more remote *Hippeastrum,* without success. 1 doubt whether the recent attempt to cross Clivia with *Cryptostephanus* will succeed as the latter, although superficially resembling a *Clivia,* belongs to the *Liliaceae* and is more closely related to the *Alliums.*

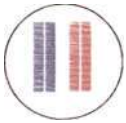
'Chanel'

Although not identical, little variation exists in the F1 hybrids produced from C. *miniata x C. nobilis, gardenii* or *C. caulescens* as these offspring receive 50% of their genetic material for open erect flowers from one parent, and 50% for tubular pendulous flowers from the other. In the F2 hybrids this situation changes dramatically. The F1 hybrids possess two sets of chromosomes, one set from each parent. In *meiosis* when sex cells are formed, the chromosomes 'split' lengthwise to produce exact duplicates of themselves. That means that there are now four sets of chromosomes, i.e. two from each parent. In the next step homologous chromosomes, one from each parent, form *chiasmatas* (crosswise arrangements) whereby genetic material is exchanged by breaking off very precisely at exactly the same loci on the chromosome and connecting again crosswise to its partner. Although one *chiasmata* is illustrated in diagram 1, as many as four may occur in any one pair. Now the cell is ready for its first division whereby chromosomes are reduced to two sets again. In this process Mendel's

rule of independent assortment comes into operation. Although the *Clivia* possesses 22 chromosomes (11 pairs) only two pairs are used to illustrate this process in diagram 2. While there are only four possible arrangements for the two pairs, this figure escalates to 2048 for all 11 pairs. Believe it or not, for the human being with our 23 pairs of chromosomes, this figure soars to an incredible 8388608! In the second division when four daughter cells or sex cells are produced, the chromosome pairs are once again split to provide each sex cell with half the number of chromosomes of the parent. Each of these sex cells contain different genetic information due to the exchanging of chromosome segments and independent assortment. When sex cells unite again (fertilization) the original number of chromosomes is restored.

Diagram 1;

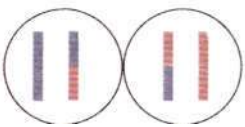
Pair of homologous chromosomes: blue from parent 1: red from parent 2.



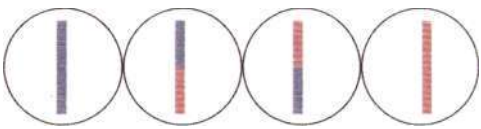
Chromosomes doubled

Chiasmata formed

Genetic material exchanged



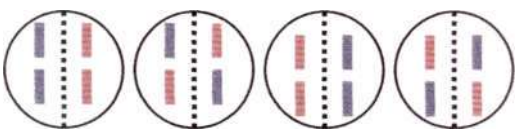
First division



Second division - four daughter cells, each containing different genetic information.

Diagram 2:

Blue - parent 1, red - parent 2.



Four different possible arrangements adopted by two pairs of chromosomes, prior to division - to illustrate Mendel's rule of independent assortment.

Clivia from the habitat in the

living collection at Kirstenbosch

The reason for these two ways of mixing genetic material is to provide an organism of as much variation as possible in its natural population. This enables it to adapt to changes in the environment and to cope successfully with competitors.

Now that the genetic material is thoroughly mixed, the sex cells may contain the following combinations:

Open erect flowers (O E)	Tubular pendulous flowers (T P)
Open pendulous flowers (O P)	Tubular erect flowers (T E)

As each F_1 hybrid produces these sex cells the following combinations are possible in the F_2 hybrids

	OE	OP	TP	TE
OE	OOEE	OOPE	TOPE	TOEE
OP	OOPE	OOPP	TOPP	TOPE
TP	TOPE	TOPP	TTPP	TTPE
TE	TOEE	TOPE	TTPE	TTEE

				ratio
1.	OOEE	-	open, erect	1
2.	OOPE	-	open, semi erect	2
3.	OOPP	-	open, pendulous	1
4.	TOEE	-	semi open, erect	2
5.	TOPE	-	semi open, semi erect	4
6.	TOPP	-	semi open, pendulous	2
7.	TTEE	-	tubular, erect	1
8.	TTPE	-	tubular, semi erect	2
9.	TTPP	-	tubular, pendulous	1

1, 2 and 4 resemble inferior *C miniata*.

3 may be mistaken for a wilted flower.

5 and 6 produce some very fine specimens.

7, 8 and 9 - none more attractive than the tubular species.

Although all these phenotypes have been observed, they may not necessarily appear in accordance with the ratios as set out above. Some of these, like nos. 3 and 7, are rarely seen. Furthermore the phenotypes are not precisely demarcated as a considerable degree of integration is rife. The reasons for this may be attributed to the following:

1) The examples as set out above cover only the basic differences, namely, open erect and tubular pendulous. Other aspects such as colour, shape (curvature of the flowers), size, length and width of the petals and sepals also play a role. These may be controlled by modifying genes which are responsible for the variation in a natural population, let alone the tremendous variation in modern day C. *miniata*. This no doubt has a significant effect on the phenotype of a hybrid or mutant. Modifying genes may inherit, just like mutant genes, dominantly or recessively.

2) The exchanging of genetic material as illustrated in diagram 1, takes place at random as anything from 0-4 *chiasmatas* may be formed in any one pair of chromosomes. Inheritance of characteristics as set out in 1) above cannot therefore be as predictable as in the case of the yellow colour mutant *Clivia* where a single recessive gene is involved and which is not affected by the exchanging of genetic material. No matter on which chromosome this mutant gene is located it will appear in 50% of the sex cells produced by an orange split for yellow plant, and in 100% of the sex cells produced by the mutant yellow phenotype.

3) Genetic information is also transmitted by the mitochondrions and plastids which are present in the cytoplasm of the egg cell. In the male sex cell (pollen), very little or no cytoplasmic genetic information is transmitted. Apparently the cytoplasm is utilised t6 form the pollen tube down the style to the egg cell. The progeny, therefore, receive a little more genetic information from the seed parent than from the pollen parent.

'Moondrops'

Bestel Interspecific hybrid

4) Some characteristics may be linked, i.e. the genes concerned lie so close to each other on the chromosome that they act as a unit, inheriting together. They are seldom separated by a *chiasmata* (crossing over) for a transfer of one of them to the other chromosome of the pair. It is only when this happens that unusual combinations can be formed. When genes are far apart on the chromosome, they cross over freely.

It will still be many years before the genetics at play will be fully understood. Without delving too deeply into the secrets of genetics, it is tempting to believe that the following may be examples of linked genes which were separated by crossing over to form new rare combinations. The inside of the tubular species are very pale pink, greenish-yellow or greenish-white. Although the hybrids are more or less uniformly coloured on the outside as well as the inside of the flower, specimens are sometimes seen with an inside colour which is much paler than the outside, featuring a somewhat bi-coloured effect. Such an extreme example as illustrated by 'Chanel' is very rare indeed. There is also a tendency to develop a yellow centre in the more open phenotypes. 'High Noon', without this yellow centre, is therefore also one of those rarities.

Not all F2 hybrids are desirable. The flowers of the majority are either too narrow, too open, too straight, too pendulous or too erect, to create the impression of a proper hybrid with its semi-pendulous, semi-open, gracefully curving flowers. I would say that not more than 10% will have the desired requirements.

But all this effort is not in vain. An extended flowering time may be a bonus. With C. *miniata* flowering in Spring,

'High Noon'

C. gardenii in Autumn, *C. nobilis* in Spring - early Summer and *C. caulescens* mainly in early Summer (November - December), a deviation from the normal flowering time may be expected in the hybrids. C. *miniata* x C. *gardenii* flowers late Winter and *C. miniata x C. nobilis* in Spring, but also at other times of the year. *C. miniata x C. caulescens* has not yet been properly observed, but such a hybrid flowered this year in February - March and two others in April. If these hybrids are intercrossed, i.e. *C. miniata x C. nobilis x C. miniata x C. gardenii* etc. flowers may be expected to appear at any time of the year.

In my opinion the *modus operandi* will now be to select from the best F2 hybrids, matching the phenotypes with a view to developing proper strains. To cross extremes such as 'Chanel' and 'High Noon' may again result in a vast number of unwanted forms.

As mentioned above, yellow *C. miniata* were used in producing the F1 hybrids with the result that 25% of the F2 progeny are the yellow phenotypes. As they lack anthocyanin, many more of them resemble a very poor quality *C. miniata* as shape alone determines the desirability. A phenotype like 'Moon Drops' which can appear in the F2 generation only, is also rare.

Hybridising *C. miniata. var citrina* with other species does not change the mutant gene in any way. The yellow hybrids inherit in exactly the same way as yellow C. *miniata* e.g.

(1) C. *miniata var. citrina x C. nobilis* = 100% F1 orange split yellow hybrids.

(2) F1 orange split yellow hybrid x F1 orange split yellow hybrid =

25% F2 yellow hybrids

25% F2 orange hybrids; and

50% F2 orange split yellow hybrids.

(3) F2 yellow hybrid x F2 yellow hybrid = 100% F2 yellow hybrids.

Note

1. 'Chanel', 'High Noon' and 'Moon Drops' are preliminary names for identification only and are not yet registered.

2. *Clivia x* C. Cyrtanthiflora refers to the original cross raised by Charles Raes of Belgium in 1850 and published by van Houtte in 1869. It is, therefore, incorrect to refer to any other interspecific hybrids, including subsequent *C. miniata x C. nobilis* crosses as C. Cyrtanthiflora.

Nakamura hybrid

Gladys Blackbeard ~ Clivia Pioneer

by Charl Malan

In an accompanying article I have described the incidence of *Clivia nobilis* in the Eastern Cape Province where it was first discovered in 1828. Like *Clivia miniata* which was discovered in the Natal Province some thirty years later, these plants were sent to Europe where they were improved and hybridised to become very popular house plants. Their popularity spread to Australia, California and Japan and more recently to China.

In their native land, however, *Clivia* received little attention from breeders. While interest has grown over the past ten years with the advent of the Clivia Club, in the Eastern Cape sub-branches have been formed at George, Port Elizabeth and East London only over the past year.

However, there has been one outstanding exception to this lack of interest in *Clivia,* namely Gladys Ivy Blackbeard who was born in Grahamstown on 19 May 1891 and died there on 11 September 1975. Her great grandfather, Francis Blackbeard, arrived in the Eastern Cape as a British settler in 1820 and the family established Blackbeard's Boot and Shoe Warehouse in Grahamstown. She had three sisters and a brother, but only her oldest sister Gertrude, married. When she was widowed all three sisters lived at Scotts Farm on the outskirts of Grahamstown where they established an animal and bird sanctuary and private nature reserve. There Gladys built up the only collection of *Clivia* of any consequence in South Africa and set about improving and hybridising them.

Her success and expertise are well illustrated in an article which she wrote in 1939. The copy which follows is from her manuscript which is kept in the Cory Library for Historical Research at Rhodes University, Grahamstown.

Unfortunately Scotts Farm was some distance from the Botanic Gardens at Grahamstown and the Grahamstown Municipality could not justify the expense of maintaining and continuing the nature reserve at Scotts Farm and with it, the *Clivia* collection.

It came to an end in any event as a result of the application of the apartheid laws and the planned demarcation of Scotts Farm as a racial group area.

Fortunately, Gladys found in Gordon McNeil an enthusiast willing to take over the whole of her *Clivia* collection in 1962, which was then transported to Ofcalaco in the Northern Transvaal. Many collections elsewhere, particularly in California, have benefitted from the *C.miniata van C citrina* and *C miniata var flava,* the yellow and cream forms of *C miniata,* which he supplied as offsets from plants acquired from Gladys Blackbeard.

Scotts Farm, Grahamstown, Cape Province. 26th May 1939

Of the many interesting flowering plants of South Africa, the *Clivia* is worthy of special mention. A handsome lily with dark green leaves, strong erect stems which carry a massive flower head, in brilliant shades of nasturtium red to copper and gold. A most desirable pot plant, even in winter, with its evergreen leaves and brilliant red fruit seeds. My early interest in the *Clivia* was awakened by my mother, who was deeply interested in South African flowers and gardening generally - an art almost despised in women folk at that time. Gardening, like freemasonery, brought her in contact with all flower lovers and gardeners of the old true type. She was fortunate in making the acquaintance of an old English gardener, who came to South Africa. He soon saw the possibilities of exporting bulbs etc. to England. He collected the very handsome Red *Clivia*[1] and presented my mother with one plant. As a child I well remember the joy of seeing that bloom each year. This increased and after many years, this true type has gone on almost as a family heirloom. I was fortunate in securing a plant from a friend, the origin of which she could not give. The shade being a pale apricot tint - the individual blooms having broader petals and not such depth of flower as the red one. This gave me light on the subject and soon I made a cross between these two Some five and a half to six years and longer saw the result of my crossing. The cross had considerably enhanced colour and form, from the palest to deep shades, with larger flower heads and broad petals. Truly a handsome crown. Year after year I made crosses from the best plants and today those early crosses represent a family of some 2000 plants, flowering to year old seedlings.

Branching out from this family and making a fresh cross, I took again as my pollen parent the pale apricot one and the seed parent a variety that is indigenous to this part *(Clivia nobilis).*

The blooms of this species are tube like and hang down in a massive cluster, being supported by a strong flower stem. This is a very hardy and robust family - growing under various conditions in shaded moist kloofs some 36 miles away from the sea, down to within a few hundred feet from the sea shore, on the slopes of the hillside, in part shade from the tall tree *Euphorbia.* (Locality Bushmens River). In this particular spot these *Clivia* have stood the test of time and remained, whereas the rest of the undergrowth has faded out with the advance of civilisation.

It must be remembered that all details given in this brief summary are purely my own personal experiments, unaided in any way. Therefore my experiments have not advanced as rapidly as I should

1 Probably the red form which grows in the most western part of the C.miniata habitat near the Kei River - Eds

Clivia miniata named 'Giadys Biackbeard' by Gordon McNeii

have wished. However many things are developed from small beginnings and the joy and keen interest shown in my collections has more than repaid me.

The flower head of the true *Clivia miniata* is erect whereas that of the *C nobilis* droops like flower bells. The hybrids in this cross are somewhat varied in shade and form.

The shades of these hybrids are from dark to light shades of apricot pink. These hybrids flower out of season, that is to say my general collection flower in the spring, late August to September, whereas the *C miniata x C nobilis* hybrids flower in May and a few in July, the flowering period having completely changed. If this will continue season after season, is yet to be proved. This will be of immense value for making crosses with other lilies that bloom at this time, such as I have ventured to try, using this late flowering *Clivia* (hybrid) as a seed parent and as a pollen parent the large pink *Nerine bowdenii* (locality : Queenstown, Cape Province). But at the moment of writing it is not possible to tell if this cross has taken.2

Cultivation

From the time the seeds start to form the pods or fruits gradually develop to the size of a large cherry, only pear shaped. As they ripen they turn to brilliant scarlet and have a handsome appearance. It takes from 10 to 12 months for them to ripen and they would remain much longer, only I prefer to remove seeds as soon as possible before other flower buds appear. It is possible to gather same as soon as the fruits show any colour. After removing pods I leave same for about 10 days to two weeks when I peel and remove seeds. Each fruit contains an average of 5 to 7 seeds. Do not leave your seeds in their fruit pods too long as they will start growing and shoots may be broken off when removing seeds.

For planting I use flat pans or boxes, moss as drainage and fill with a light mixture of one part each of sand, leaf mould to two of good light garden soil, well mixed. Place your seeds in rows 1 inch apart, cover with soil and give your seed pan a tap down, by lifting up and tap down at least twice. This settles the seed into position. This can be their home for some time. Eighteen months to two years.

When transplanting never give the seedlings much pot room and never transplant until the roots are pressing above and over the side of the pot. They

2 *The cross was not successful. Gordon McNeil persisted with these attempts to cross Clivia with other genera, particularly Agapanthus, also without any success. — Eds*

will flower well in 9 in. pots. Never over pot or spoil clivia plants as they will not flower, but only increase in leaf and root system. The secret of flowering is to rather starve your plants than overfeed. The general cry from most people is 'my *Clivia* will not flower and I keep potting it on'. I always reply 'starve them to enhance the bloom'.

When buds show, sprinkle round each plant a little well decayed horse or cow manure. This is all I have ever done for mine.

Conditions for cultivation is a bush house with flat roof, but before flowering it is advisable to put plants under more shelter such as a glass house or verandah to protect the blooms from damaging.

Plants can be broken up and sub-divided.

Gladys I Blackbeard

McNeil planting of *Clivia* hybrids

Crossing Clivia with other Amarylids?

by J G Niederwieser

Dr Niederwieser is a research scientist with the Vegetable & Ornamental Plant Institute, ARC, Private Bag X293, Pretoria 0001

Introduction

A number of years ago, attempts were made at the Institute to successfully cross *Clivia miniata* with other genera of the Amarylhdaceae, namely *Cyrtanthus, Nerine,* the purpose being to introduce variation in both *Clivia* and the other genera. However, few seedlings were obtained from combination *Crinum moorei* and *Amaryllis belladonna.* In the family a number of other intergeneric crossings do exist, for example, *Amaryllis belladonna x Nerine bowdenii* (Amarine); *Nerine bowdenii x Lycoris aurea* and *Amaryllis belladonna x Brunsvigia josephinae.*

Needless to say, many attempts have been made world-wide to cross *Clivia* with other genera of the family. Why is the success rate so low?

Incompatability

In the case where pollination of a flower leads to the formation of a viable seedling, a large number of processes are completed successfully within the flower.

recognition of the pollen on the stigma

hydration, activation and germination of the pollen

pollen tube growth through the stigma and style into the ovule

fertilisation and embryogenesis

germination of the embryo and development of a viable seedling.

In nature, plants tend to isolate themselves from other species. Man, on the other hand, is continuously trying to break down the natural barriers between plants to combine specific characteristics of one plant with another. The more distant one species is to another, the more difficult it is to overcome the natural reproductive barriers. The low rate of success with intergenera crossings in the Amaryllidaceae comes therefore as no surprise.

Overcoming incompatability

Many techniques have been used successfully to overcome natural isolation barriers in plants.
A few examples are :

Bud pollination. Removal or mutilating of the stigma. Delayed pollination.

Pollination and fertilisation *in vitro*. Irradiation of styles.

Embryo culture. Mentor pollen.

Genetic manipulation. Pistil grafting.

The application of these techniques depends on the site of incompatibility. At the Institute two relatively simple techniques are used to determine where incompatibility is manifested, namely staining and fluorescence of the pollen tube, and a clearing technique to determine whether fertilisation has taken place. (This method cannot be used on *Clivia* because of the storage tissue in the ovules). Once it is determined where the incompatibility reaction takes place, one can investigate techniques to try to overcome the barrier.

We did not investigate the problem of incompatibility in *Clivia* as it was decided to focus the breeding on interspecies crosses in the genus *Cyrtanthus*. Valuable information can, however, be obtained by fluorescence microscopy to determine where incompatibility takes place.

('Col Pitman' x Kevin Walters Yellow) Breeder Ken Smith

Named Cultivars of Clivia in Australia

by Kenneth R Smith

Winmalee, NSW Australia

When looking for named cultivars of *Clivia* in Australia it seems that they are few and far between. Many hundreds of seed grown plants are produced for the marketplace, but few, if any, named clones are sold. A search through my files and a few discussions with other enthusiasts brought forth about 50 named forms. Most are still cultivated, whilst a few have been lost.

'Relly Williams'. Breeder Kevin Walters

The excellent article by Kevin Walters in the Garden Journal, Vol 6/4 April/May 1987, described his breeding efforts to date. The photographs showed glorious blooms and would have been a source of encouragement for other collectors. The increased range of Kevin's named clones is described here. '**Relly Williams**' was produced from a cross between '**Aurea**' and a large

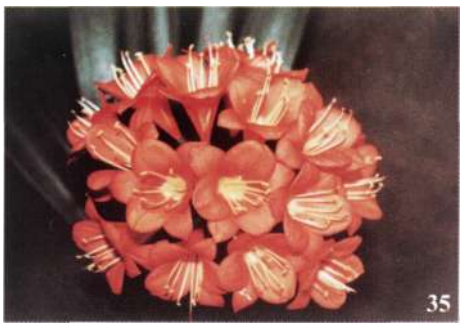
'Valerie Martin Supreme' Breeder Kevin Walters

flowered Belgian hybrid, the seed having been planted in the spring of 1977. This clone produces large flowerheads of broad petal, orange blooms. Two other selections from the same cross are **'Valerie Martin',** a large salmon flower and **'Valerie Martin Supreme',** a superior selection for bloom size. Kevin's aim was to produce large, hemi-spherical flowerheads, held on robust stems. Each floret had to be evenly spaced to give a good display of the individual broad petal blooms. I have found that **'Valerie Martin Supreme'** does not set seed, even when hand pollinated.

Daphne Lodington' is an orange flowered selection from Schenkel seed. This plant, from unknown parentage, produces large florets, each petal 45mm wide, arranged in a flowerhead approx. 23cm across. The foliage is broad. A second Schenkel seedling, named **'Dulcie Whittaker',** has been selected

for its large, white-throated orange blooms.

Three named selections from 'Aurea' crossed with a Kewensis orange C. *miniata* are **'Myrtle Park', Ruth McLennan'** and **'Monica Conquest'.** The first, **'Myrtle Park',** is a large



'May McPherson', Breeder Kevin Walters

flowered orange. **'Ruth McLennan'** and **'Monica Conquest'** are yellow selections, **'Ruth McLennan'** being sterile, with no pollen produced, and **'Monica Conquest'** showing some green in the throat. Other seedlings from this cross are being evaluated, one in particular, a taller growing, large flowered yellow.

'May McPherson' was selected from a batch of **'Valerie Martin'** seedlings. It is noteworthy for its prominent stamens. The colour is a darker, deep orange. **'Ivy Henderson'** is a self-coloured orange form grown from C. Cyrtanthiflora x *C. miniata* seed. The smaller, solid colour blooms without a throat colour are quite eye-catching. A second selection from this batch, **'August Delight',** was discarded as not outstanding even though the darker flower colour was initially noted. A possible sibling to these two is a selection called 'Sakura'. This beautiful clone has flowers the colour of cherry blossoms and was named by Mr Yoshikazu Nakamura, who had been sent a plant and photographs. The flowering of 'Sakura' seedlings is awaited with expectation to see what range of pastel colours might result. The last selection Kevin has made is a Midget strain seedling that produced a very neat, large flowerhead of orange blooms. It has been called **'Pomander'.**

An interesting form derived from Twins has been selected out by a friend of Kevin, Mr John Henderson, and named **'Green Walters'.** This plant is notable as it produces flowerheads of mostly green florets with no orange in

'Myrtie Park'. Breeder Kevin Walters

the petals. Some flowers are all green, at other times it has both all green and normal orange flowers. So far the plant has refused to make offsets but has been used in cross-pollination to determine if the green flower character will reproduce from seed.

Enthusiasts are cultivating two named

'James Dearing'

clones from an early Australian breeder of *Clivia*, Mr James Dearing of Melbourne. The more common **'Ailsa Dearing'** is described as a vivid, deep apricot bloom. It is reputedly a cross between *Clivia miniata* and **'Aurea'.** Perhaps one parent was our common narrow petal form of *C. miniata* and the improved petal shape of this clone came from the **'Aurea'** parent. It was named for Mr Dearing's daughter and was described in an article in Your Garden, December 1980, along with a description of **'Aurea'.** The clone **'James Dearing'** comes from the same breeder and named for himself. I am told it is a strong grower, with long, broad foliage, quite different to **'Ailsa Dearing'.** The flowers are described as a pale apricot with white and green throats. It is a late season flower. I am unsure whether the clone **'James Dearing'** carries the yellow parentage or is from another cross. To the best of my knowledge these two clones are not offered for sale in the marketplace.

An interesting outcome of a discussion with Mrs Irene Broadbent about these plants was the possibility that Mr Dearing brought **'Aurea'** from England in the early 1920's. Mr Dearing worked as the Head Gardener for Sir Benjamin Nathan, who owned 'Rippon Lea' during the period 1910- 1935. He was given an open cheque to purchase 'anything of merit for the garden'. It is quite possible that the choice clivias were brought back from a trip to England. Whilst there is no hard evidence amongst the books and papers that Mrs Broadbent received from Mr Dearing's niece, we certainly consider it worth looking into.

The cultivar name **'Aurea'** is applied to a cream flower form that is common in the marketplace. The origin of the stock is proving difficult to track down. It appears that nurseries in Victoria were propagating and selling offsets for many years. I have received plants from

'Col Pitman'. Chance seedling

Australia-wide sources and when they flower they are all the same. Contact with distributors indicates that only divisions are sold. The situation will be rapidly changing now as more and more seedling yellows reach the market. The name 'Aurea' is very likely to be used indiscriminately for any yellow *Clivia.*

The yellow form **'Col Pitman'** has

'Goiden Fanfare'. Breeder Cliff Grove

been described in the Clivia Club newsletter (Vol 2, No3 - July 1993). It was selected out of a batch of orange flowered plants grown from imported seed in the early 1980's. The principal of Civic Trees, the late Mr Colin Pitman, kept the plant aside as a treasured acquisition. Leaf width averages 50mm and a mound of foliage approx. 75cm high is produced. The cream bloom (RHS colour chart 12D) has broad petals. This form is not commercially available but is being propagated by a few collectors.

Larsens Warm Climate Bulbs were recently featured in an article in Australian Horticulture. The purpose was to highlight the Larsen Sunset Colours strain of *Clivia.* It was interesting to note two clones mentioned. **'Moonlight'** had a flower described as 'almost pure white with a green throat', and **'Almost Yellow'** was shown as a photograph of a cream flower with a darker yellow throat.

Cliff Grove was cultivating quite a few named clones at the time he sold his collection to Pen Henry of Clivia Gardens Nursery in Wanneroo, Western Australia. About 30 named accessions were listed by Pen when I requested information. The plants selected out are being developed as nursery stock. Seed, obtained from several sources, produced a selection of yellow flowered clones. Plants selected from Bill Morris seed are **'Golden Grove', 'Golden Beauty', 'Golden Shower', 'Golden Fanfare'** and **'Golden Heart'.** Warren Glover supplied seed that gave rise to **'Golden Delight', Golden Girl'** and **Golden West',** while Pam Elliot stock produced **'Golden Dream'** and **'Golden Time'.** Two yellow

Bill Morris seedling

'Hula Girl' a Twins seedling

selections out of a '**Relly Williams**' cross are **Golden Light**' and '**Limelight',** which is described as having a green tinge to the yellow-cream flower.

Some improved orange selections have been made from German and English seed, including seed from Albert Schenkel. Clones like '**Royal Show',** '**Western Ruby', 'Grand Prix', 'Royal Trumpet**' and **Grandifolia**' (sic) are being increased for stock and for use in continuing breeding programmes. Two Twins selections are '**Emerald Lady',** which shows the green flower

'Peach Glow'. Breeder Cliff Grove

characteristic, and '**Hula Girl',** a selection made for the interesting way the stamens are presented in each flower. A yellow cross orange breeding programme has so far resulted in **Apricot Splendour**' and '**Apricot Delight';** both selected out for improved pastel flower colour. An interesting green on green variegated clone is listed as '**Lime Dash'.** This orange flowered plant is described as having lime green stripes

'Orange Jade', Breeder Cliff Grove

on the foliage. A dark orange flowered seedling from a Grandiflora and '**Aurea**' cross has been named '**Kaye Dorothy',** in memory of one of Pen's relatives.

Two red flowered selections of unknown parentage are '**Burgundy Boy**' and '**Tropical Red'.** Presumably a sibling to this last named clone is '**Tropical Sunset**' a pinkish-orange flowered selection. '**Peach Glow**' is also a pale flower selection, possibly a Twins selection. No details on parentage are available. I have four photographs of

'Fireball'. Breeder Cliff Grove

Cliff Grove selections that remain as names only at this stage.
The **'Orange Jade'** shows the green colouration on the petals, **'Sunburst'** has a larger throat with the colour on the tips of the tepals. **'Sunrise'** and **'Fireball'** look similar to me and are possibly Twins selections also. The most recent selections that Pen has named are three broad leaf yellow clones, named **Connie', Elizabeth'** and **'Toy'.** As Pen put it 'special *Clivia* named after special people'. This extensive selection of *Clivia* forms is the result of more than a decade of growing and selecting Clivias. I know that many more will be coming from Clivia Gardens Nursery.

Bill Morris is also constantly selecting and improving his collection of Clivias. At this stage Bill is simply allocating numbers to selections that are to be used in further breeding work. An improved yellow from his collection (#96/1) is illustrated. When fully satisfied that a clone is worthy of naming, Bill will be releasing details. There are some in the pipeline.

It is pleasing to report that the clone ' **Vico Yellow'** is now in Australia. I imported it in September 1999, from Yoshikazu Nakamura of Japan. They are tissue-cultured plants so it will be interesting to compare the flowers of this type to the original material. The plants are a welcome addition to the named clones existing and being developed by the Australian *Clivia* enthusiasts.

I have in my collection plants bearing the names **'Giant No 3', 'Fireglow'** and a few clones that were labeled **['Salmon Queen'** X B308 Yellow]. I have since learned that the B308 yellow is the 'Aurea' from Flowerdale Nursery in Victoria, but the origin or details of **'Salmon Queen'** are waiting to be discovered. I will keep looking. I am

'Giant No 3'

referring to a gold median stripe form of the common *Clivia miniata* as **'Tao Stripe'.** The flower is the narrow petal type like the green foliage form. There is more to be said about the Clivia strains that are cultivated in Australia but that will be for another article.

If I have missed out any named clones it is because I haven't come

'Tao Stripe'

across them yet and it was not intentional. I welcome any feed-back from members on this matter. The clones listed in this article are not necessarily well known cultivars, indeed only a few would be. My intention was to list and highlight those forms that have been selected, named and disseminated as distinct cultivars. I know that continued development of *Clivia* is going on due to the increased exchange of information and plant material, worldwide, over the past decade or so. The ever-increasing number of named *Clivia* on the marketplace highlights the need for a Register of Cultivars.

I would like to thank the following people who gave details of the *Clivia* in their collections and sent photos to help illustrate the forms mentioned in the article. Kevin Walters for sharing information and photographs of his named forms, Irene Broadbent and Don Barrett for discussions about the Dearing cultivars, Cliff Grove and Pen Henry for the Western Australian connection. Also thanks to Bill Morris and Coral Larsen for the telephone discussions about aspects of the draft article.

'Salmon Queen' x B308 yellow

'Aurea'

Selection of orange Clivia miniata

by Michael Jeans

To me the most exciting moment in plant propagation is when a seedling flowers for the first time. It is then that hopes and aspirations are either fulfilled or shattered. The potential of any breeding program is limited by the gene pool available. I chose to try selective breeding of the orange *Clivia miniata* as I had a much larger gene pool than if I had favoured the yellow.

For about 150 years up to World War II, plants from all over the world were bred in Europe by very wealthy and knowledgeable patrons of horticulture. It is, therefore, likely that the orange *C. miniata* offered in garden centres today are the product of selective breeding over a century or more. Many named cultivars of C. *miniata* were recorded in Europe during that period. Sadly most of these are now lost without trace, but even so, they will have sired most of the European *C. miniata* of today.

I acquired my original stock from garden centres where I was able to choose plants that had good flower heads and flowers of reasonable size and shape. By selecting the seedlings with the best flowers and sowing their seed, I was able to secure second generation plants. Usually the seed had 'selfed' on its own but sometimes I had crossed it with another plant in flower at the time. In England, a generation in the life of *C. miniata* usually takes four years, almost a year for the seed to ripen, and a further three years for the seedlings to flower.

Nearly all C. *miniata* grown in Europe is of the board leafed form which appears to have rather shorter and wider leaves than those found in the wild in South Africa. The petals are also wider, and often overlap for much of their length. Fig. 1 shows a plant with a well formed head of flowers which are fairly flat and measure about

'Westonbirt Perfection'

Fig. 1

9cm across. I have plants with larger flowers; one with flowers 10cm across had 21 flowers but the head looked rather untidy as the flowers overlapped each other. I feel that the general impression given by the flower head and its stem is every bit as important as the colour and form of the actual flowers. I think that in Europe where clivia are grown under glass or on windowsills, the plant is cultivated as a formal plant. Hence the need for symmetry in a plant with a tidy and well proportioned head of flowers. Fig. 2 shows a deep orange or possibly, depending on definition, a red clone flowering in March. The individual flowers are of good form measuring 9cm in petal length and the same across. The flowers are well shaped, and the colour deep enough to make the plant look spectacular. Unfortunately there are only about a dozen flowers in the head and that is not enough to give the impression of a really solid round head, even though the individual flowers are substantial.

Fig. 3

Fig. 3 shows the same clone as Fig. 2 producing a second set of flowers in August. The flowers are fewer and smaller, and have a much more dominant yellow centre. Whereas *C. miniata* occasionally produces a second flower, *C.* Cyrtanthiflora flowers for a large part of the year. Fig. 4 shows C. Cyrtanthiflora in January with flowers that are pale salmon or peach on the outside and pale yellow on the inside. Fig. 5 shows the same clone in June when the flowers are deep orange on the outside and salmon or peach on the inside. I have yet to attempt to 'back cross' it with, say the *C. miniata* of Fig. 1. Such a cross might just produce a seedling

Fig. 2

Fig. 4 C. Cyrtanthiflora

with a widely flared flower that flowered several times a year and changed from yellow flowers in the winter to peach in the summer. Such are the hopes that dreams are made of.

I have not been too interested in multi-petalled flowers on *Clivia*. However Fig. 6 shows a sport that occurred last year. The plant produced a normal head of flowers, and then sent up a much shorter stem surmounted by one formal double flower 9cm across. Fig. 7 shows a close-up

Fig. 5 C. Cyrtanthiflora

of the comparatively flat ten petalled flower. The petals were arranged perfectly symmetrically in two neat rows, each petal

Fig. 6

Fig. 7

filling the gap between two petals in the other row, and the whole flower resembling that of a small water lily. With no other double flower available, the flower was self pollinated. A large seed pod followed and I now have five one year old seedlings, and more hopes than expectations!

Fig. 8

Fig. 9

Fig. 10

Fig. 8 shows flowers that are chalice shaped and offer something different from the usual form. Fig. 9 shows flowers with a pronounced green centre stripe. Unfortunately in my experience, the more dominant the green, the more dull or matt is the orange. Taken to its extreme Fig. 10 shows green flowers that are sterile, do not open fully but last for several months on the plant - if that is considered an advantage! Sometimes they share a flower head with the flowers shown in Fig. 9 and sometimes the entire head is composed of them.

This article has attempted to show that selective breeding from even a modest collection of *C. miniata*, be they orange or yellow, should produce some interesting seedlings. Seedlings from any good plant are always capable of surpassing the quality of the parent. My experience is that this is particularly true of the yellow *C. miniata*. I grew a batch of seedlings taken from a *C. miniata var. citrina* 'New Dawn' and all five seedlings that have flowered to date are superior to the parent in several respects. It should be remembered that a seedling will only produce its true flowers after its second or third year of flowering. Until then the grower is merely given a glimpse of what is to come.

Possibly'Bodnant Yellow'

Storage & Germination of *Clivia miniata* Seeds

by Neville Brown and Dianne Prosch

Dr Brown and Mrs Prosch are research scientists at Kirstenbosch Research Centre, National Botanical Institute, Cape Town

INTRODUCTION

In his new booklet 'Grow Clivias' Graham Duncan gives a description of the formation of fruits and seeds in *Clivia.* He writes: 'After successful pollination of the flowers, fruits containing the developing seeds begin to form at the base of the flower stalks (pedicels). The individual fruit containing the seeds is known as a berry, and consists of an outer fleshy, pulpy layer that encloses the seeds within. The number of seeds within each berry varies and may contain from one to as many as twenty-five or even more seeds. In general, it is the berries of *C miniata* that contain the most seeds. *C. gardenii* has the largest seeds (with a diameter of approximately 18 mm), followed by *C. miniata* (15 mm in diameter), *C. caulescens* (12 mm in diameter), while *C. nobilis* has the smallest seeds (9 mm in diameter)'. He continues later in the book: 'Propagation *of Clivia* by means of seed is an easy, inexpensive way of increasing stocks. The seeds are harvested once the ripe berries have turned bright orange-red or yellow'. (Duncan, 1999). These quotes form a useful introduction to the consideration of a number of questions concerning *Clivia* seeds and seed germination that are frequently asked by those interested in growing these plants. These questions include the following:

Can ripe seeds be stored successfully or must they be germinated as soon as they are ripe?

If storage is an option can seeds be stored successfully in the refrigerator?

Should seeds be cleaned before storage or can they be stored successfully enclosed in the ripe berries?

Can germination be improved by pre-soaking seeds in solutions of the commercially available germination stimulators such as Regulex (gibberellin GA4 + GA7) or Promalin (GA4 + GA7+ benzyladenine)?.

Can germination be improved by pre-soaking seeds in solutions of Kirstenbosch Smoke-Plus Seed Primer?. (This product is also a commercially available germination stimulator and contains extracts of plant-derived smoke and GA4 + GA7).

Will leaching of seeds to remove supposed germination inhibitors lead to improved germination results?

A series of experiments was conducted in the Seed Laboratory at the Kirstenbosch Research Centre in an attempt to provide answers to these questions.

LOW TEMPERATURE STORAGE OF *Clivia miniata* SEEDS AND ITS EFFECT ON GERMINATION

Seed storage conditions

A month after being harvested in June 1999, *Clivia miniata* seeds were placed in a cold room at 5°C. At regular intervals over a 12-month period seeds were removed from cold storage and germination tests were conducted to determine the effect of the storage conditions on subsequent germination.

In one set of treatments, seeds were stored within the fleshy fruits or berries. These berries were spread out in cardboard containers.

In the second set of treatments the seeds were removed from the berries and all traces of the fleshy fruit were removed. These cleaned seeds were stored in brown paper packets.

Seeds were removed from cold storage after: 0 days (Control); 30 days; 60 days ; 90 days; 180 days; and 360 days.

Seed germination conditions

Germination containers

Seeds were germinated in 9cm petri dishes on a thick filter paper (Whatman No. 3). The paper was kept moist by the addition of distilled water as required.

Germination temperatures

Two sets of germination temperature conditions were compared using controlled temperature germination cabinets.

Alternating temperatures of 10°C (14h) and 22°C(10h).

Alternating temperatures of 15°C (14h) and 28°C(10h).

In both cases light was provided to coincide with the higher temperature period.

Pre-germination seed treatments

At the end of each storage period a batch of seed from each group was removed from the 5°C conditions and each batch was divided up into five sub-groups. Each sub-group was given a different pre-germination treatment.

These treatments were:

Seeds were soaked for 24h in a 1% solution of Promalin (a commercially available growth regulator / germination stimulator containing gibberellins GA4 + GA7 plus a cytokinin, benzyladenine.

Seeds were soaked for 24 h in a 1% solution of Regulex (a commercially available growth regulator / germination stimulant, containing gibberellins GA4 + GA7.

Seeds were soaked for 24h in a solution of Kirstenbosch Smoke-Plus Seed Primer (a commercially available germination stimulator containing plant-derived smoke extract plus gibberellins GA4 + GA7.

Seeds were leached intermittently in running tap water for three days to remove any possible germination inhibitors.

Control treatment — no pre-treatment before germination.

EXPERIMENTAL RESULTS AND CONCLUSIONS

1. Pre-cleaned seeds stored at 5°C retained their viability in storage and gave a high percentage germination even after 360 days (12 months) storage. (See overleaf)

2. Seeds stored at 5°C in the fleshy fruits or berries initially gave a high percentage germination. However, after 90-180 days (3-6 months) of storage, seeds apparently lost viability and considerably lower germination percentages were obtained. (See overleaf.) The fruits became heavily infected with fungi and the seeds tended to rot during storage.

4. The leaching pre-treatment to remove possible inhibitors was detrimental to the seeds and gave reduced germination.

5. Pre-treatment with Regulex (Gibberellins GA4 and GA7) did not give any improvement in germination over the control.

6. Pre soaking in the growth regulator Promalin did give some improvement in germination particularly early in the storage period. It was, however, not able to reverse the effect of fungal infection on seeds stored in berries.

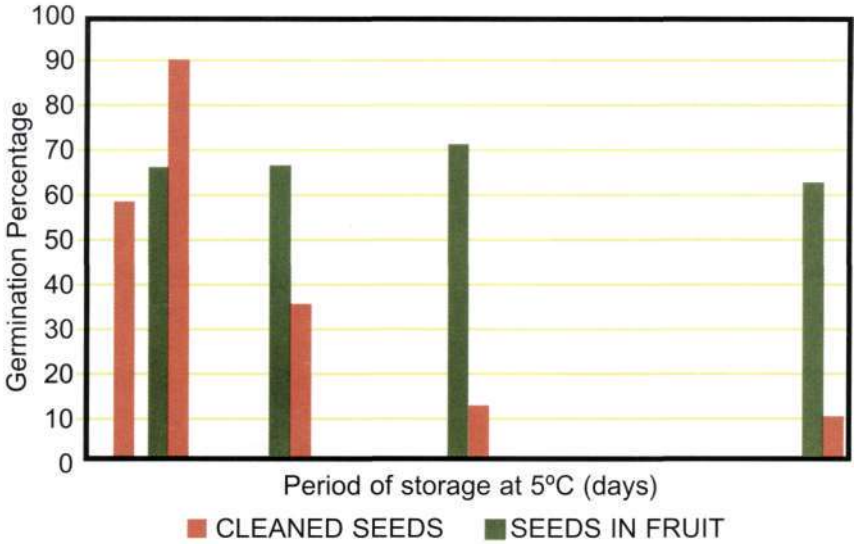
7. Pre-soaking in Kirstenbosch Smoke-Plus Seed Primer also gave some improvement in germination. In some cases this was superior to the Promalin treatment. In the berry-stored seeds the smoke primer solution, like Promalin, was unable to reverse the deleterious effects of storing the seeds within the fruits.

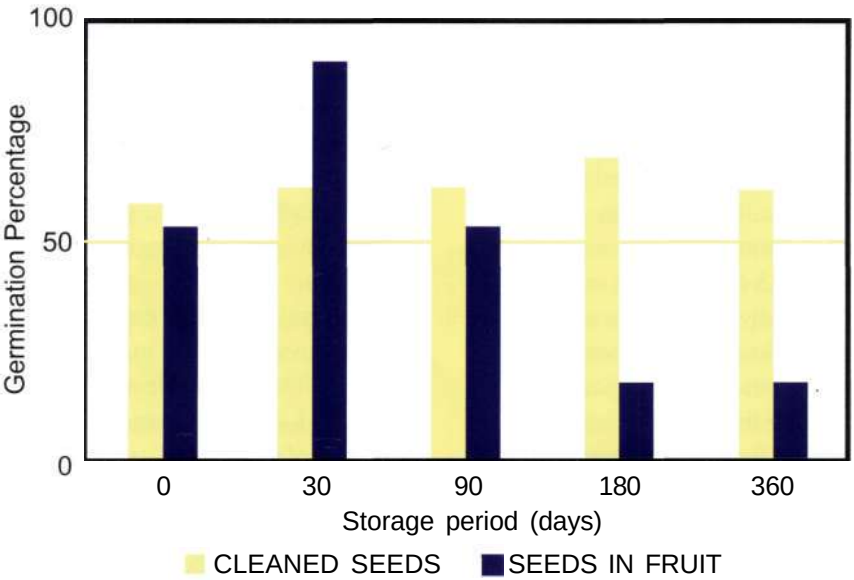
8. As far as germination temperature regimes were concerned, there was very little difference in the germination results between the two regimes.

9. In the control treatments germination of pre-cleaned seeds was in the region of 60%—70% and radicle emergence occurred 11—18 days from the beginning of incubation.

10. Seed size did not appear to influence germination. The very small seeds and the very large seeds both germinated.

Germination of Clivia miniata seeds following their storage at 5°C.





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Propagation of Clivia by Leaf Cuttings

from BULLETINS D'ARBORICULTURE

According to V. Teran (Bouturage de Glaiule et de Clivia; Bul. Cerele dArboric, de Belg. 1899, page 86), Clivia may be propagated by means of leaf cuttings. Apparently in a greenhouse a number of Clivia plants had been trimmed and the leaves left on ashes under a bench. Later it was observed that tiny plants had formed at the bases of the leaves.

Translation from an article in BULLETINS D'ARBORICULTURE
Good things can come from a chance observation.

Many of our colleagues have mentioned the multiplication procedures of *Gladiolus* and *Clivia* - ways that we had not expected.

A certain Mr Justin Rhein discovered by chance the procedure of making cuttings from *Gladiolus.* In previous attempts at propagation half the bulbs developed around the placents of the central bulb.

In the new procedure the 'mother bulbs' were planted early on a heated bed. After a few days, new shoots emerged, when they had reached a height of 1 Ocm, they were cut off next to the bulb and planted in heated soil. Two weeks later the cuttings rooted. The 'mother bulb' had produced, during the same time, two or three new shoots which could be used in the same way.

The rooted cuttings, after having been repotted into bigger pots, were distinguishable by their vigorous foliage. This procedure could be used for multiplication of new varieties, more or less, as said prudently by Wiener, which will continue to produce good results.

Regarding *Clivia,* one finds the same offering of leaves for multiplication. In a glasshouse there was a certain number of *Clivia* samples abandoned on the workbench - the leaves were more or less damaged at the top and detached from the base of the plant.

Comment from Pierre De Coster:
Ash was used in those times to cover greenhouse tables. It was obtained from Steam and Heating apparatus that used coal. This medium was inert, and obviously sterile. It was kept humid by water from the base of terra cotta pots. Today this medium would be hard to find as most heating is done by gas or paraffin.

Bacterial Soft Rot of Clivias

by Mark Laing

Professor Laing is the Professor of Plant Pathology at the University of Kwazulu-Natal, Pietermaritzburg

Causal Organism:

A bacterium called *Erwinia carotovora* pathovar *carotovora*

Hosts:

The bacterium has many hosts, attacking any fruit or vegetable with a juicy, sugary head or stem. Commonly, this bacterium attacks cabbage, cauliflower, broccoli, lettuce, chicory, Swiss chard, carrots, parsley and celery. Another strain attacks potatoes, causing potato blackleg. It also attacks the bulbs of many Amaryllidaceae, especially if another agent such as the Amaryllis worm, has already attacked the bulb and made a wound into which it can enter. This year (2000) was extremely wet in summer, and several of my *Clivia* which were in a dense growing medium, have succumbed to this bacterium. The symptoms are initially a yellowing of one or two of the bottom leaves. On investigation, one finds a dark, watersoaked lesion (wound) at the base of the plant. This may spread right up infected leaves. As the disease progresses, it often completely dissolves the base of the plant and the root crown, so that the plant falls over, leaving the bundle of leaves lying horizontal (see photos overleaf).

It is a very serious pathogen of Arum lilies *(Zantedeschia* species), being transmitted in bulbs, cuttings and even tissue cultured plantlets. This year I also isolated it from the heads of *Agapanthus* flowers, in the bud stage, just before and after the bud opened up

Epidemiology and Disease Cycle

Ideal Weather Conditions:

Hot :30-40°C, and wet : summer rainfall

Carryover: The bacterium lives in the soil or in plant debris in between attacking hosts. It may also be carried in the gut of insect and snail vectors.

Infection process: It usually infects hosts through wounds made by insects, nematodes (eelworms), snails, birds or people. However, under ideal weather conditions, it infects without the need of injuries.

Vectors: (agents of movement): It is moved from plant to plant by insects (especially houseflies), snails, birds and people. It is also commonly moved on pruning secateurs or a knife for harvesting vegetables. Houseflies are perhaps the most efficient of its vectors. When this bacterium rots a plant, it does so with external enzymes (extracellular cellulases and pectinases), creating a smelly, soft, watery rot, to which flies are very attracted: a rotting cabbage really stinks. The flies feed on the semi-digested

plant, then fly off and settle on a nearby plant. There they clean themselves, which involves a regurgitation process, depositing thousands of bacteria on that plant, and initiating another infection process.

When snails feed on infected plants, they ingest copious quantities of the bacterium, then having moved onto fresh plants, defecate there. Their faeces may contain thousands of bacterial cells, which again initiate another infectious process.

I would guess that the *Amaryllis* worm can vector this bacterium, carrying the bacterial cells in its gut from the stage of caterpillar to adult moth, to transmission at egg laying. However, it is unlikely that it carries through into eggs.

Raindrops also splash-disperse bacteria between plants. This form of disease spread is usually over a distance of 1 -2m, but in a heavy rainstorm, aerosols can form, carrying bacteria up to a one kilometre.

Control on Clivias

It can be difficult to control, if conditions suit the bacterium, i.e., under hot, wet conditions.

1. For outdoor plants, use a very porous growing medium so that no waterlogging ever occurs, even when heavy rains occur repeatedly. Waterlogging is probably the single biggest cause of this problem, creating a stressed plant, with roots dying from lack of oxygen. For indoor plants, make sure that one does not overwater the plants.
2. Have adequate shade levels, ideally under trees. Shade cloth does provide shade, but increases heating, especially black shade cloth, and this favours soft rot.
3. Control *Amaryllis* worm with weekly sprays of a pyrethroid insecticide such as alphamethrin or cypermethrin (Ripcord is available in South Africa in 100ml quantities for the home gardener). This spray will also control houseflies. Spray diseased plants with a pyrethroid to stop further disease transmission by houseflies. For example, this year I stopped the spread of soft rot of *Agapanthus* flowers by spraying cypermethrin onto *Agapanthus* flowers and buds, killing the flies that were moving the bacterium between plants.
4. Control snails with regular applications of snail bait.
5. Eliminate other diseased plants, and their debris from the garden (especially vegetables with soft rot). Compost the debris in a deep compost stack which gets hot. This will eliminate the harmful bacteria. Move compost heaps well away from *Clivia* plants.
6. This bacterium prefers plants with a high nitrogen fertilization, and high sugar content. Altering the fertilization regime is therefore an important part of controlling it in vegetable crops. The trick is to increase the ratio of calcium, magnesium and potassium to nitrogen

Close-up example of soft rot *(Erwinia)*

being applied. The first three elements make for stronger cell walls, making it harder for the bacterium to break them down. Dolomitic lime is a source of both calcium and magnesium, and potassium can be applied as potassium chloride or potassium nitrate, or by using a 3.1.5 fertilizer (3N : IP : 5K).

7. When using knives or secateurs to harvest, prune or cut plants, the cutting implements must be sterilized between plants. Use a 70% alcohol (use methylated spirits diluted 7:3 with water), or Jik (3% sodium hypochlorite) diluted 1:3 with water to sterilize cutting surfaces. This is clumsy, slow and difficult to do in practice. But it is worth it if the bacterium is present.
8. Where a *Clivia* plant becomes lightly infected, remove the infected leaf or leaves using a razor blade or scalpel. Sterilize the blade between cuts using one of the above sterilants. Doctor the wound site directly with sulphur dust or copper oxychloride dust.
9. Where the plant is severely infected and has fallen over, remove it from its pot. Remove any soft or dead tissue from the base of the plant. Dust with sulphur dust or copper oxychloride dust. Plant into sharp silica sand (swimming pool sand). Treat it like a plant cutting, giving it frequent light watering, and keeping it under 60-70% shade. *Clivias* are remarkably tough, and they recover quite well.

Soft rot in a potted *Clivia*

Amarylis worm

An Australian Peach Clone?

by Kenneth R Smith

Winmalee Australia

Over the past few years the peach clones have received increased focus. When I first came across the form, I was comparing it with the pale orange (apricot) types that I was familiar with in my collection. Further reading of some of the excellent articles on *Clivia* genetics has cleared up the picture for me.

Of particular interest is a plant that I flowered during the spring of 1999. I consider it to be a *miniata* type that conforms to the description of a 'Peach'. *Clivia miniata* forms were the basis of my collection when I first started growing *Clivias.* At that time (1989), one of the various batches that I had was the Sahin Twins strain. I remember selecting out one seedling because it had pigment free leaf bases, or so I thought. I knew that it was probably wishful thinking on my part. Anyway, I marked the pot with a label 'this plant might be a yellow?' The seedling was unremarkable in the early stages of development and soon became just one of the ever increasing collection of plants.

Not much thought was given to the plant until I noticed a flowerstalk

Green flowered twins owned by Ken Smith

developing in 1997. Only a few buds were forming, but a distinct yellow, a much darker yellow I thought. This of course was an exciting outcome, although short lived, as the stem rotted at the base before the flowers fully opened. The plant didn't flower the following season so I completely cleaned the plant up and repotted into new media. This action was rewarded with a much stronger plant this season. It had several suckers developing and produced a strong flowerstalk, topped with 19 blooms, which opened to reveal an intriguing shade of yellow. Certainly a dirty mustard yellow due to the orange overlay. The colour was near to RHS colour chart code 22C when I checked it. Trouble was, the depth of colour changed over the life of the flowerhead to a marked degree. The outside of the tepals was a darker shade and the blooms developed small red spots as they aged. I will be taking more detailed colour chart readings next flowering season. The flowers were of good form and I have cross-pollinated with a good yellow, both ways, as well as selfing a few flowers. Time will tell what the breeding behaviour is.

I have not seen a 'normal' cream-yellow flower in the Twins on the market in Australia, nor have I read about any being in the strain's background. I have, however, selected out some other interesting variants in this strain such as green, multi-petal, ridged-petal, large throat and self-coloured flowers. I find that the potential to grow and flower some extremely beautiful forms is a totally absorbing aspect of the hobby of *Clivia* cultivation. The fact that I found some interesting forms only makes me look more closely at every *Clivia* in my collection.

Whenever I read about or see a photograph of a new *Clivia* cultivar I am amazed at the diversity within the genus. A look at any batch of *Clivia* will generally show up some clear variants worthy of selection. I suppose the purpose of this short article is to let *Clivia* enthusiasts know that anything is possible. I was certainly surprised at the outcome of this Twins! Enjoy your plants.

Ken Smith, Twins 'Peach'

Clivia in China
by Yoshikazu Nakamura

It is well know that *Clivia* has won popularity in China. However, when one visits China, one is impressed by a lot of new experiences with *Clivia* plants and people there who have not been referred to in the related articles.

The places where *Clivia* is most remarkably popular in China are the three provinces of the North-Eastern region. In Changchun City of Jilin Province, people adore and enjoy *Clivia*, where it has secured a status as the flower of the city. People are involved in *Clivia* at various levels; aged people are seen to sell only a few *Clivia* seedlings on the street, while there are some who run a large glass greenhouse and a gardening supply store. Many kinds of cut flowers are seen to be sold at the gardening supply store, one after another - like hot cakes! When you look up at a tall apartment house building, *Clivia* are seen in the bay window of each household.

I occasionally visit a foreign country to observe local *Clivia.* Often I did not understand the local language or know my way around - of course in China too. Many of my Chinese friends, even on the occasion of our first meeting, warmly welcomed me and arranged my observation of *Clivia* in a vast glass greenhouse where visitors are not usually allowed to enter. Living facilities are built in a growing greenhouse. Although these friends usually entertained me at a splendid foreigners-only hotel or with local cuisine, I would have rather preferred to stay at such living facilities as in the greenhouses, so that I could have spent more time with *Clivia* and friends.

Pots for *Clivia* planting in China are all unglazed eathernware and the growing medium used is 100% leaf mold. To maintain foliage alignment, an aluminium foil is wound around a deformed leaf. We have to understand

'66

Bred in China

that the value of a small number of selected *Clivia* plants can be as much as a few hundred thousand rands! So you cannot take too much care of *Clivia!*

Breeding and growing techniques of Chinese *Clivia* are at the highest level and have almost reached the ultimate level. It seems, however, that they have had little experience in attempting interspecific crossing or crossing with yellows because, as in Japan, the emphasis is placed on leaves rather than on flowers. For my part, as I have given preference to hobby breeding rather than commercial breeding, my breeding objectives cover all ranges of *Clivia*, but in China, their breeding is concentrated only on foliage.

I know that an amazing *Clivia* plant was just bred in Changchun. It also makes me excited whenever I think of development potential of a new *Clivia* by the many enthusiastic *Clivia* breeders taking up the challenge, using the excellent genes available in South Africa. What impressed me most is the devotion to *Clivia* by Chinese people. I recommend you visit Changchun. Really, seeing is believing!

Clivia bred in China

PUBLICATION BY CHINA'S ASSOCIATION OF *CLIVIA* ON UNIFORM STANDARDS FOR APPRAISAL OF *CLIVIA* BRED IN CHINA

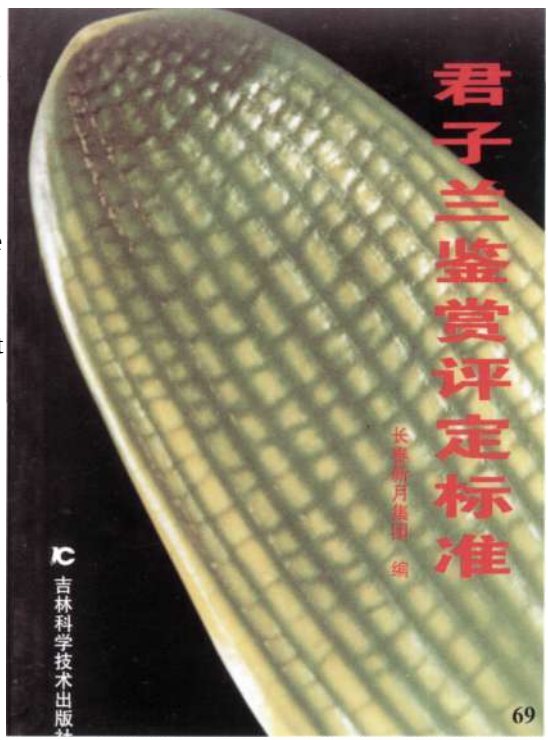
Published in December 1999
ISBN 7-5384-2206-4.

Dr John Rourke is the Curator of the Compton Herbarium, National Botanical Institute at Kirstenbosch, South Africa.

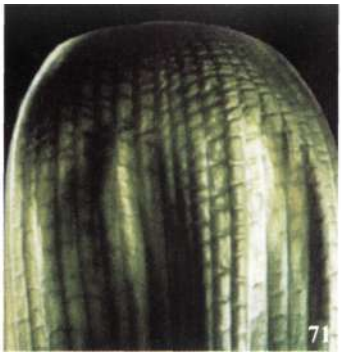
This is the title of a 63 page booklet issued by the 'China Association of Clivia'. The booklet is an extensively illustrated guide to the standards, ideals and judging criteria used by the above Society in assessing show plants in terms of Chinese horticultural aesthetics. And how different their standards are to those applied in this country. The main interest is centred on the leaves and growth form of plants rather than the scape of flowers. Of the 62 excellent colour photographs in the booklet only 8 show plants with flowers, the remainder concentrate exclusively on leaves. Some of these are reproduced with this review.

Dwarf squat plants with very short erect leaves having blunt rounded apices are greatly desired, as are leaves with raised tessellate surfaces of light green against a background of darker green veins. Striped, variegated leaves are also greatly coveted. Then detailed, illustrated criteria are set out for assessing these leaf characters, including what is described as 'the seat' which is the form and angle at which the distichous leaves emerge from the base of the plant. The *minutiae* into which Chinese growers have divided leaf characters in *Clivia miniata* are quite extraordinary in their detailed specifications.

The booklet tells us that *Clivia miniata* has been cultivated in China for half a century. This being so, it is



The worst apex shape, Not symmetrical, with a little sharp point

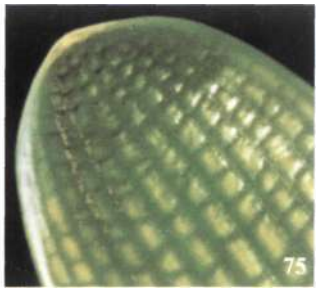


The better apex shape; nearly symmetrical

The best apex shape; symmetrical and half round

The worst vein; the vein is not convex

The best vein; th corttinous



The best colour; the vein and leaf *have* biggest contrast

The best shape of the base of the clivia

sobering to see the extent to which the wild type of this species has so recently been selected and virtually redesigned by breeders to suit a very specific horticultural taste. Clearly *Clivia miniata* is a species greatly treasured in China. This extraordinary veneration is delightfully expressed in the publication's concluding remarks:

'The Clivia is unfathomable. Many people can not observe the marvelous of it.'

In short, it provides a fascinating insight into the achievements of Chinese *Clivia* growers in their striving towards their concept of perfection in clivias as container plants with year-long rather than seasonal appeal.

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'Kirstenbosch Supreme'

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