CLIVIA

TWENTY

The Clivia Society www.cliviasociety.org

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The Clivia Society caters for Clivia enthusiasts throughout the world. It is the umbrella body for a number of constituent Clivia Clubs and interest Groups which meet regularly in South Africa and elsewhere around the world. In addition, the Society has individual members in many countries, some of which also have their own Clivia Clubs. An annual Yearbook and quarterly Newsletters are published by the Society. For information on becoming a member and / or for details of Clivia Clubs and Interest Groups contact the Clivia Society secretary or where appropriate, the International Contacts, at the addresses listed in the inside back cover.

The objectives of the Clivia Society

1. To coordinate the interests, activities and objectives of constituent Clivia Clubs and associate members;
2. To participate in activities for the protection and conservation of the genus Clivia in its natural habitat, thereby advance the protection of the natural habitats and naturally occurring populations of the genus Clivia in accordance with the laws and practices of conservation;
3. To promote the cultivation, conservation and improvement of the genus Clivia by:
   3.1 The exchange and mutual dissemination of information amongst Constituent Clivia Clubs and associate members;
   3.2 Where possible, the mutual exchange of plants, seed and pollen amongst Constituent Clivia Clubs and associate members; and
   3.3 The mutual distribution of specialised knowledge and expertise amongst Constituent Clivia Clubs and associate members;
4. To promote the progress of and increase in knowledge of the genus Clivia and to advance it by enabling research to be done and by the accumulation of data and dissemination thereof amongst constituent Clivia Clubs and associate members;
5. To promote interest in and knowledge of the genus Clivia amongst the general public; and
6. To do all such things as may be necessary and appropriate for the promotion of the above-mentioned objectives.

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TWENTY

Editor
Glynn Middlewick

EDITORIAL

Editorial

By Glynn Middlewick

This is my first attempt at producing a Yearbook. I am fortunate in having some articles available from the Quadrennial Conference in 2018. Some new articles have been provided. To balance the content of the Yearbook, I have some scientific articles, some less scientific articles and of course the entries for the photographic competition. Two 'show' articles have been included in the Yearbook, one from Toowoomba and the other from the Melbourne Expo. The other shows will be covered in the next Clivia News.

Felix Middleton has contributed two articles, the first is on the Ngome *gardenii,* detailing the uniqueness of this variation of gardenii. His second article gives us feedback from the past and reminds us that clivia flowers have been present for a long time and we hope they will not be more threatened than they are at present. Aart van Voorst updates us on his tetraploid clivia breeding programme. Doubling the number of chromosomes should provide our clivia with many more beneficial characteristics. We have an article by Calvin Becker on diseases in clivia. He wrote this article as part of his research thesis. Carrie Kruger presents an article on interspecific clivia breeding. An interesting article on Legionnaire's disease is included. The condition is rarely acquired from potting soils. This is a good informative article.

The photographic entries provided the judges with a pleasant challenge, to make an objective choice of the best images. A note was sent to me, notifying all, that the prettiest photograph would not necessarily win the competition. The decision would depend on the qualities of the image presented. Aspects such as: composition, lighting, clarity, focus and absence of noise would be considered. Thank you to all the entrants and congratulation to all the prize winners.

Regards,

Glynn Middlewick

FRONT COVER
Collage of photographs
Helen Marriott

TITLE PAGE
'Interspecific'
Pieter Saayman

BACK COVER
'Yellow Clivias'
Helen Marriott

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ARTICLES

Honorary Life Members

The Clivia Society is privileged to award an Honorary Life Membership to six Society members this year. Each candidate has, in their own unique way, made an exceptional contributed to the promotion of clivia.

The proposals and motivations follow:

Brian Tarr

Proposal for the award of Honorary Life Membership of the Clivia Society

Proposed by – A Everson – Chairman of the KwaZulu-Natal Clivia Club

Seconded by – G Middlewick – Chairman of the Joburg Clivia Club

I first met Brian Tarr at the Pietermaritzburg Botanical Gardens, where we held our first KZN Clivia Meeting in 1994. He was a founder member of the KZN Clivia Club and this year, 2019, he will help celebrate the twenty-fifth anniversary of the KZN Clivia Club. Brian has been involved with plants most of his life. He graduated with a Diploma in Horticulture and first worked in the Port Elizabeth Gardens Department. While he was in Port Elizabeth he won a scholarship to join the staff at Kirstenbosch Gardens. He followed this up with a grant to join the staff at Longwood Gardens in Pennsylvania, USA, for a year!

He returned to Kwa Zulu Natal n 1979 and accepted a post at the National Botanical Gardens in Pietermaritzburg and returned to Kwa Zulu Natal.

Brian is a happy, friendly and helpful person. The knowledge he has acquired over the years, has provide him with an exceptional botanical knowledge. He willingly shares his knowledge with fellow clivia enthusiasts. He has been involved with the education of members with regards to germination, pollination, pests and diseases and the advice on the choice of ideal potting mixtures for clivias.

Brian Tarr

Brian is involved in the conservation of all plant species, particularly the protected and vulnerable plants. He was responsible for collecting some of the material for the Clivia Heritage Collection, housed at the Pietermaritzburg Botanical Gardens. As the Curator of the gardens he was responsible for the management of the gardens and continued in this role until his retirement in 2009 at the age of 63 years.

He served as Vice-Chairman of the KZN Clivia Club from 2000 until 2008. He followed on as Chairman of the KZN Clivia Club in 2009 and 2010. His organizational skills were put to good use and he organized the first KZN clivia show at the Pietermaritzburg Botanical Gardens in 1995. At this show he won first place with his 'Watkins Golden Yellow' plant. Brian is a well - recognized breeder, show exhibitor and an experienced judge.

Brian was responsible for arranging and running numerous shows, workshops and outings to see clivia in their natural habitat. He enjoyed teaching fellow members about clivia and gave many talks on cultivation, show preparation, dividing offsets and on repotting plants. At no time did he ever expect compensation for his time spent educating enthusiasts. His reward was the enthusiasm generated in people his was instructing. He was acutely aware of the importance of conservation to ensure that the national heritage is retained for future generations. He was passionate about locating and recording the locations of

areas of natural habitat of clivia in South Africa.

Brian's commitment to the KZN Clivia Club has been continuous for the past 25 years. His commitment to all aspects of clivia cultivation makes him a worthy recipient of an Honorary Life Membership.

Alfred Everson

Izak Hendrik Johannes Nel

The Joburg Clivia Club wishes to propose Sakkie Nel to be awarded and Honorary Life Membership of the Clivia Society. This is to reward him for his invaluable work he has contributed to the Clivia Society.

Izak Hendrik Johannes Nel

Izak Hendrik Johannes Nel, popularly known as Sakkie Nel, was born on a farm in the dry Northern Cape. Sakkie's mother died when he was nineteen months old. Sakkie grew up with his father and step mother Chrissie, together with fourteen siblings. He spent his school years at a boarding school in Kenhardt, about 120 kilometres away from Upington.

After leaving school, Sakkie joined an insurance company. With the amalgamation of this company with others the final banking giant was Absa. Sakkie was promoted to manager and worked in various towns. His final position as manager was in Pretoria. Sakkie retired in 2003 after 39 years in the banking service.

Sakkie married Esme van Schoor in 1968 and they have been married for 51 years. His hobby of collecting clivias is probably part of his character. Not only does he collect clivia, but is also involved with the collection of knives, stamps, walking sticks and silver coins.

His first introduction to clivia was in 1996. His neighbour, Erna Pretorius, gave him his first orange clivia. At the clivia show in 1996 he purchased his first yellow clivia. This plant took nine years to flower, but luckily produced a lot of offsets. In 1998 he decided to join the Northern Clivia Club. In 2000 he started helping out at the annual clivia show and his first duty was to control the access to the show. He continued with this task for several years. The first Society Conference he attended was in Pietermaritzburg in 2002. At the Society Conference in 2006, together with Koos Geldenhuys and Danie Botha, Sakkie was instrumental in ensuring a very successful auction.

In 2009, Bossie de Kock, the Society treasurer passed away and Sakkie volunteered to take over this position. He was elected as treasurer at the AGM in May of 2009 and this position he holds to date. In addition to the responsibility of the financial affairs of the Society, Sakkie has been a valuable contributor of articles which have been published in the Clivia News and Yearbooks. To date he has written more than 42 published articles and will probably continue to contribute in the future.

Sakkie served in the role as the Society representative of the United Kingdom for 2015 and 2016.

'Griet'

Together with his wife and Eric, Sakkie has ensured the distribution of all the publications for the last few years.

Sakkie has a few favourite plants. One of these is 'Griet'. He bred this from 'Coba', an orange clivia as the pod parent and a yellow McNeil plant as pollen parent. 'Griet' has an unusual flower with yellow stripes along the length of tepal. Some of his other favourites are an interspecific plant 'Kalahari Moon' from Dave van den Burgh and a yellow Coromandel plant.

Modern inventions such as GPS and smart mobile telephones have not appealed to Sakkie. He has managed to master the function of a computer which allows him to keep up to date with his correspondence. Sakkie remains a loyal, committed member of the clivia fraternity. The interests of the Clivia Society have always been placed first in his responsibilities. He believes in a fair deal for all, irrespective of whom they are.

Proposed by the Joburg Clivia Club – Chairman – Glynn Middlewick.

Seconded by the Northern Clivia Club – Chairman – Joubert van Wyk

Ken Smith

The Clivia Society of NSW wishes to propose Ken Smith as an honorary life member of the Clivia Society.

Proposed by Peter Hey – President of the Clivia Society of New South Wales.

Seconded by Glynn Middlewick – Chairman of the Joburg Clivia Club.

Ken Smith

Ken Smith has been and continues to be instrumental in the promotion of the genus Clivia, not only in Australia, but world-wide. His involvement with clivia has been ongoing since 1990. He was a keen plant collector as a teenager and received his first clivia seeds from well- known clivia breeders which included, Bill Morris, Kevin Walters and later on, Yoshikazu Nakamura. Ken then increased the size of his collection by importing plants from South Africa, New Zealand, Japan and the USA.

Ken, a horticulturist, taught horticulture at the Western Sydney Institute of TAFE – Richmond campus for most of his adult life. He has addressed a variety of Garden Clubs and Horticultural Societies and the Royal Botanical Garden on several occasions. His knowledge of clivia has made him a popular person to invite when a speaker was needed at many gardening events.

Ken is a founding member of the Clivia Club, later to become the Clivia Society, and was the Australian representative of the Clivia Society from 1994 until 2016. He contributed several articles to both the Yearbook and the Clivia News. He has presented talks at various conferences and has participated in talks and tours of many countries.

In 2002 he was appointed as the Registrar for Cultivars of the genus Clivia, publishing Volume 1 of "A Checklist and Register of Clivia Cultivar Names" in 2009. Ken has judged clivia shows in Cape Town, Port Elizabeth, Pietermaritzburg, Pretoria, California and Philadelphia and a show at Clivia Classiques in Perth, Western Australia.

In recent years, Ken has been a founding member of the Clivia Society of NSW, serving as the foundation Secretary for two years, foundation Public Officer for the last five years and Vice-President from 2015 – 2019.

He has addressed numerous Society General Meetings as well as being a Key Speaker at the 'Rare Clivia Expo' featuring interspecific clivia plants in May 2018. He has been instrumental in co-ordinating the spectacular floral displays and layout of the Spring Shows, acted as the registrar for display plants and has co-ordinated the 'People's Choice' award and the 'Best First Flower' award at the NSW Shows. He arranges the distribution of various publications and promotional items to existing, new and prospective members.

Ken Smith has a wealth of knowledge and has spent close to thirty years promoting Clivia not only locally, but also world-wide.

Neil Nathan

Neil Nathan

The Free State Clivia Club would like to nominate Neil Nathan for an Honorary Life Membership of the Clivia Society. Neil is one of the founding members of the Free State Clivia Club, which was formed on the 5th February 2005. Prior to this, Neil was a member of the Bloemfontein Interest Group.

From the time of his appointment as treasurer in 2005, Neil has held the position of treasurer. Owing to his financial expertise, he has ensured that the club has remained on a sound financial footing. Neil does not limit his time with the club to the financial affairs. He enjoys mentoring the new members of the club. Neil readily shares his knowledge of clivias with his fellow members. Neil and his wife Dorrie are actively involved at every annual clivia show. There, the couple, sell books, answer visitors' questions and recruit new members.

Neil's greatest contribution to the Clivia Society and fellow members, is the digitalising of the Society publications. Complete records were not kept of early publications, the Yearbook and Clivia News and to date he has completed the conversion of 107 of these publications. This is a slow and complicated task. The process starts with the scanning of each page of a publication to ensure an exact copy is produced, checking that the fonts are correctly transcribed, that the images are as clear as the original document. Lastly the pages need to be compiled into the same order as the original. Neil has almost completed the transcribing of the publications and hopefully these will be completed by the end of 2019.

The preservation of these documents, some of which are available on the Clivia Society web site, provide a bank of knowledge to both new and current Clivia enthusiasts and can be retrieved at the click of a button. We all know that this is a challenge not many of us would be prepared to tackle. Neil has given up many hours to complete this task.

We would like to thank Neil for his invaluable and selfless contributions, not only to our club but also to the Clivia Society. The Free State Club feel that there could be no better way to thank Neil for his contributions than by awarding him

Honorary Life Membership of the Clivia Society.
Proposed by the Free State Clivia Club – Chairman – Hennie van der Mescht

Seconded by the Northern Free State Clivia Club – Chairman – Ben Nel
14th February 2019.

1st February 2019.
The Northern Clivia Club wishes to propose that both Peter Lambert and Christo Topham be awarded Honorary Life Memberships of the Clivia Society.

Both nominees have spent the last twenty years dedicating their time and efforts to the promotion and management of various aspects of *Clivia* plants.

Peter and Christo remain active members of the Northern Clivia Club.

Proposed by the Northern Clivia Club Chairman: Joubert van Wyk

Seconded by Joburg Clivia Club Chairman: Glynn Middlewick

Peter Lambert

Peter took over as chairman of the NCC in 2002 and continued in this role until the end of 2017. He served at Vice-Chairman of the Clivia Society from 2003 to 2007.

Peter Lambert

He successfully encouraged the Joburg Clivia Club to be established as an independent club in 2005. He served as a mentor to the Joburg Club in their infancy.

The Successful 2006 Quadrennial Clivia Conference hosted by the Northern Clivia Club was led by Peter as the Chairman. A highlight at the auction after the conference was the sale of 'Charl's Green', for the highest price paid for a clivia at the time, of R32 000.

Peter, a keen photographer, was active in photographing the show plants at the Northern Cliva Club for several years. He is an avid wildlife photographer and is happiest in the unspoilt open plains of a game reserve.

In addition to filling the role of club representative of the Northern Clivia Club, he headed the judging committee of the Northern Clivia Club for several years until his retirement in 2017.

Peter, a patient person by nature, an anaesthesiologist by profession – needing the patience of Job, would patiently listen to complaints, assess them and after careful consideration make an objective decision. This helped a lot in his role as chairman of the Northern Clivia Club for 15 years.

In his quiet way, he looked after the well-being of many members within the clivia community and made the time to visit several members during their hospitalisation.

Peter encouraged the practice of keeping habitat plants in South Africa and was a keen participant at the Society auctions. He has a good collection of plants which are grown mainly under trees in his garden.

Peter will be remembered as a peace maker in the clivia community and he often explained why collecting clivia was so popular. His often quoted line is: 'Flowers, Fun and if you are lucky Friends'.

Perhaps we can all take a leaf out of his book and remember this quote.

Christo Topham

Christo Topham

Christo joined the NCC in 1999. In 2001 he served on the management committee of the show and was responsible for running the show together with Lena van der Merwe. In 2002 he took over as the show manager. In 2003, Christo was elected as deputy Chairman of the NCC, a position he held until the end of 2017.

In 2008, Christo took over as vice-chairman of the Clivia Society. He served as vice-chairman for three years and was then appointed as chairman of the Clivia Society. He remained in this position for the next four years.

Christo started growing clivia in 1998 on a small scale. Prior to this he was more interested in growing trees. Once he had become an active member of the Northern Clivia Club, he started buying clivia seeds and plants. Like most clivia collectors, he soon ran out of space for his collection. In 2010 he had the opportunity of purchasing an extra piece of land. Here he erected shade houses and expanded his collection. At present he has a collection of more than 5000 plants. Some of the favourite plants in his collection are the 'Narcotic' seedlings, purchased from Sean Chubb.

Christo, a quiet person, is always prepared to help. All the materials for the show stalls are stored on his property. Christo is ably supported by his wife, Marlene. The two were long-standing organisers of the Northern Clivia Club show. Christo also has a hobby of bird collecting and has a special interest is parakeets.

He and his family will now have the opportunity to enjoy the clivia flowers, without the added responsibility of the show commitments.

Ngome *Clivia gardenii*: a new species or a subgroup?

2018 Conference contribution, Felix Middleton

Classification of Clivia Species according to flowering season:

Autumn-Flowering *Clivia*

C. gardenii	April – May
C. robusta	May – June

Spring-Flowering *Clivia*

C. nobilis	September – October
C. caulescens	October – November
C. mirabilis	November
C. miniata	August – October

What we know of *Clivia gardenii*

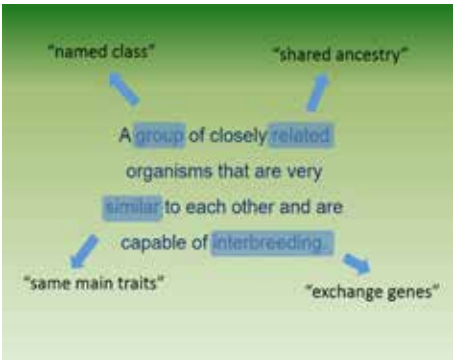
Clivia gardenii is named after Major Robert Garden, a soldier who was stationed in KwaZulu Natal between 1848 and 1853. The conservation status of *Clivia gardenii*, which is often referred to as the forest *Clivia*, was last assessed in 2008 and is currently described in the red list database as Vulnerable. This is disturbing as the species was documented as Not Threatened in a 1996 assessment. The disparity can partially be explained by the regrouping of the autumn flowering *Clivia* species in 2004. There are now two groups, the smaller *C. gardenii* found to the North of Durban and the more robust form, *C. robusta* which grows in isolated ravines to the South. The separation resulted in the overestimation of the previous range and population size of *C. gardenii*. Also, *C. gardenii* is one of the prevalent Clivia species sold on the traditional medicine market and overexploitation is nationally considered as a threat to this species. Plant numbers are estimated to have declined by at least 30% in the last 90 years and this decline is expected to continue. Although it is regarded as of little importance in horticulture, some populations are exploited for the landscaping market.

Yellow forms or mutations of the autumn flowering *Clivia* have been documented but are generally not common. The first yellow *C. gardenii* described was found in the Ngome forest in Northern KwaZulu Natal and was described in a paper by Swanevelder, van Wyk and Truter in 2005. They designated it as *C. gardenii* var. *citrina*. Unlike most other yellow forms of *Clivia* that occur as single clones in larger populations of orange or red flowering plants, these yellow *C. gardenii* grow in large stands of plants. The South African National Botanical Institute (SANBI) keeps records of the distribution of a species. The distribution of *C. gardenii* is depicted in Picture 1 but excludes the locality of the yellow form found in Northern KwaZulu Natal.

Picture 1: Distribution of *C. gardenii* as documented on the official SANBI website – (http://pza.sanbi.org/clivia-gardenii)

Defining a species

A species is defined as a group of closely related organisms that are very similar to each other and are capable of interbreeding. Although this definition is accepted by most biologists, variations in this wording are often found in the literature. Naming a new species is not an easy undertaking. The complexity of the decision-making process of naming a new species can only be appreciated when we start to examine



the main concepts in the definition of a species.

A species is a named class: The classification may in some instances not be obvious to the layman. If an academic institution says it is a species, it will be regarded as a species until further notice. There are two extremes when it comes to botanising, we find botanists who split and those who lump. Splitters attempt to create many groups, often for academic gain and the alleged 'respect' associated with naming of a new species. Lumpers on the other hand believe that simplifying the system by reducing the number of classes will facilitate the process of understanding the plant group involved. For instance, not recognising a subgroup will result in leniency when assessing the consequences of urban development in wilderness areas. The process of classification needs to be somewhere in between.

Individuals in a species share essential attributes: Traits that have evolutionary significance need to be used to describe and separate species. These main traits can be of the dominant or major type where for example differences in the severity of predation based on skin colour can result in the separation of groups into those that flourish in savannas and those who survive in dark forests. However, most adaptative traits are the result of the accumulation of many genes, each with minor effects. The result may not be discrete, but it may create a slight shift towards better survival or reproduction. For instance, the shape of leaves may provide plants with a small advantage regarding the utilisation of available moisture. It will take many generations of natural selection for such a trait to get fixed in a population, but in the end, it will separate a group into a species that can tolerate drought and a species that grows only in moist forests.

Individuals from a species interbreed: The lack of the production of offspring is a consequence of speciation and is not the precursor needed for a species to develop. Groups that diverged long ago into separate species have less chance of still being able to interbreed and produce viable offspring. One reason for this is the structural differences in chromosomes that may arise by chance in each group when groups are reproductively isolated. Chromosomal incompatibility is only one of these reproductive barriers but may be the easiest to explain. In some intergroup crosses, chromosomes do not pair up properly, cell division is abnormal, and the embryo is aborted. Either no progeny are formed, or sterile progeny are produced.

Several *Clivia* Breeders have remarked that the outcome of wide crosses between *Clivia* species do not always produce the expected results. It seems as if the F1 (first outcross) between species contains traits from both parents as expected but the variation in the more advanced crosses or through self-pollination of these F1s is limited and often biased towards one of the parents. We might be encountering a form of chromosomal incompatibility as described above. The chromosomes are inherited individually as large linkage blocks due to a lack of chromosomal crossover events and therefore individual genes are not segregating independently. But this is a topic for another day.

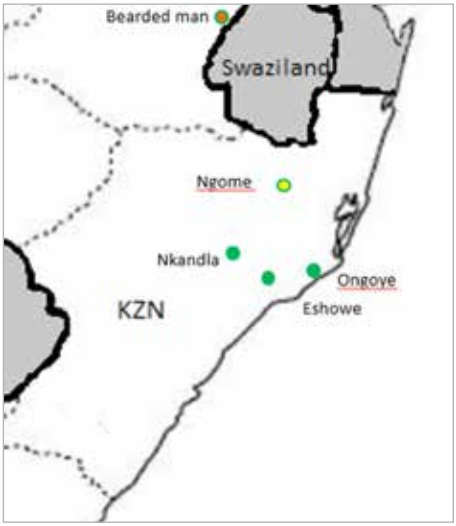
There are other ways that preclude interbreeding in *Clivia*. The most obvious is flowering time. The autumn flowering species generally cannot breed with the spring flowering species. A further barrier to restrict interbreeding, although not perfect, is the shape of the flower. The open-flowered species is typically pollinated by insects, whereas the pendulous species are mainly pollinated by birds. The differences in

flowering period, pollinator preference and distance isolation can all be used to classify *Clivia* into species.

Individuals in a species are closely related: Speciation is based on the premise that individuals with similar traits interbreed to form a new generation that is hopefully better adapted. These traits, which the individuals have in common, are either there due to their survival or reproductive value or because of inbreeding. In the absence of selection pressure, we find that in large populations traits are randomly distributed and inherited from generation to generation. However, the inheritance of such traits in a small population is affected by chance and genetic drift. This may lead to a trait being fixed in one population but not in another.

Ngome *C. gardenii* – Distribution

The yellow form of *C. gardenii* is described as *C. gardenii* var. *citrina* and was first observed in the Ngome forest in Northern Kwazulu Natal near the town of Vryheid. The area forms part of the Ntendeka Wilderness Area and has been protected for more than a hundred years. It is now managed by Ezemvelo Nature Conservation on behalf of the traditional healers of Ngoma. This forest is not a conventional Mist Belt forest but is regarded as a transitional forest between Mist Belt and Coastal Scarp forests. The actual forest, which is approximately 3000 ha in size, is isolated from other forests and consequently harbours unique insect, reptile, arachnid and plant species. Although some small pockets of natural forest are known to occur in kloofs and ravines around Vryheid, Paul Pietersburg to the north and even as far north as Piet Retief, the nearest forested area of significance is Nkandla forest to the south. *C. gardenii* do grow in the Nkandla forest and in the forests around Eshowe to the East but there are no documented sightings of *C. gardenii* to the North of the Ngome forest. Pendulous species of *Clivia* have been documented at the Bearded Man site which is situated on the Northern border of Swaziland. These are a subgroup of *C. caulescens*, a spring flowering species. Pendulous *Clivia* have also been documented within the borders of Swaziland, the identity of these still need to be verified.

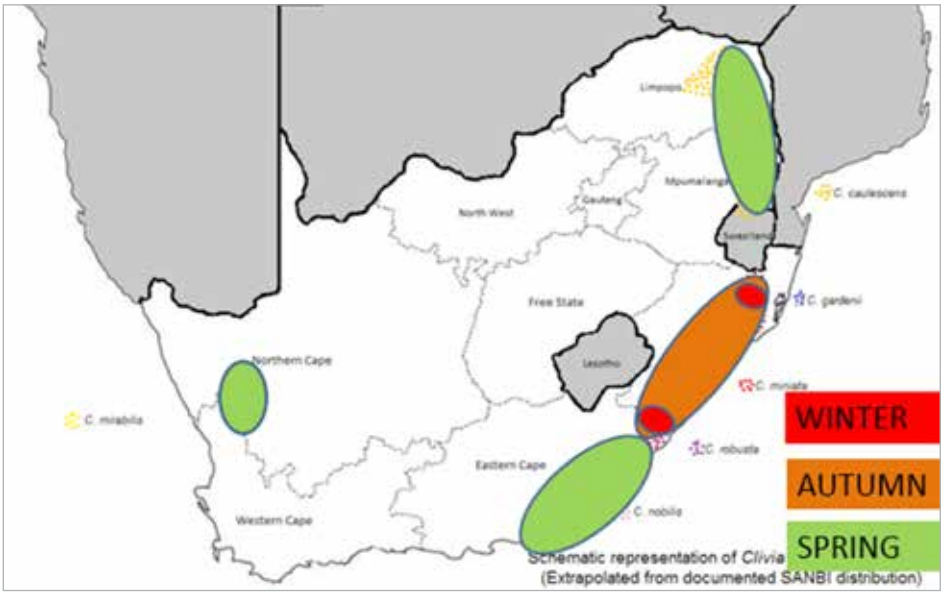


Picture 2: Location of the Ngome Forest in Kwazulu Natal

Ngome *C. gardenii* – Classification based on flowering time

The pendulous species of *Clivia* can be separated into autumn and spring-flowering types. Although *C. gardenii* and *C. robusta* flower in autumn, populations towards the southern and northern ends of the distribution range are known to flower in winter. These winter-flowering populations could be the result of an ancient hybridisation with spring flowering species or could simply be intermediate forms between the spring and autumn flowering types. The winter-flowering *C. robusta* to the south is morphologically distinguishable from the spring-flowering *C. nobilis* that grows further south. The differences between the winter-flowering *C. gardenii* and *C. caulescens* to the north of its range are unfortunately not so clear.

The yellow form of Ngome *C. gardenii* has in the past been mistaken for the rare yellow form of *C. caulescens* as it flowers closer to spring and many enthusiasts have unknowingly bought these plants as *C. caulescens* mutants.



Picture 3: Distribution and flowering periods of *Clivia* species

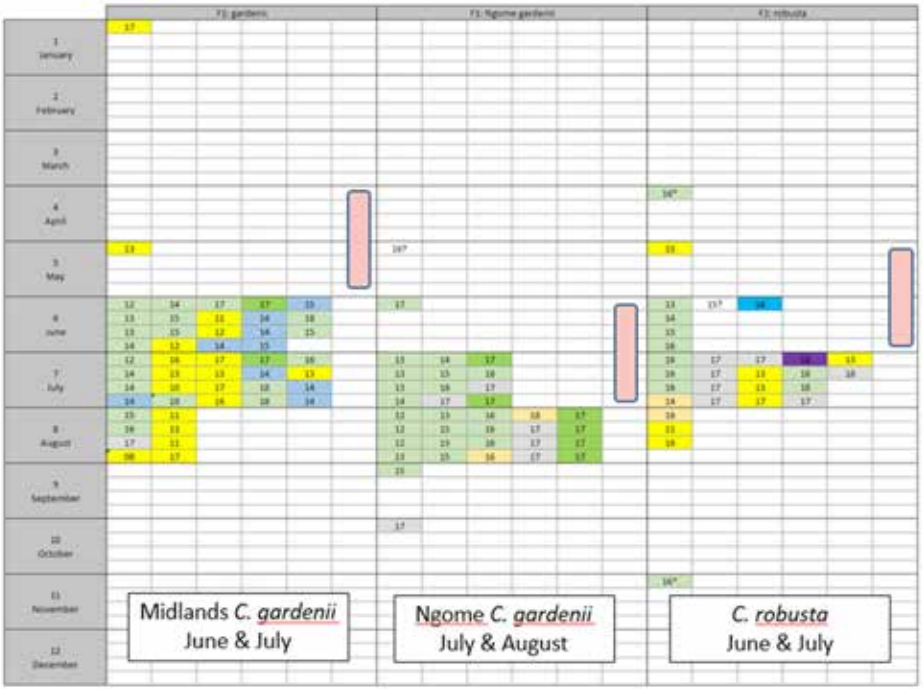


Table 1: Flowering time of *Clivia* species observed in different years at different habitat locations

Unfortunately, there are very few true yellow clones of Ngome *C. gardenii*. Many will flower yellow when procured but then in later years produce flowers that sport a pink hue.

The flowering season for the autumn-flowering pendulous species is short. Even though the onset of flowering is different between locations, the period of flowering within a population is generally less than 30 days. This is not true for Ngome *C. gardenii*. The population starts flowering in June but there are still some plants in habitat that flower during the first part of August.

Ngome ***C. gardenii*** – Classification based on DNA

Several scientists have attempted to differentiate the *Clivia* species with the use of molecular markers. Generally, DNA studies evaluate differences in the genetic makeup of individuals only after the Genus has already been separated into groups or species. The sampling of individuals for such a study attempts to weigh the sampling in order to have representative samples of groups instead of an unbiased sampling of all the variation in nature. These studies often result in splitting of a current species into two or more new groups. Unfortunately, starting from the beginning and reclassifying species in a genus with molecular markers is almost impossible. An unbiased representative sampling of all variation found in nature is needed for such a study to be meaningful. As the technique is expensive and the bureaucracy of obtaining permits to sample in nature is complex, scientists rely mainly on the *Clivia* enthusiast for plant material. The *Clivia* enthusiast has in his collection not only a very biased germ pool of the atypical types found in nature but also possesses many prised plants that have incorrect pedigree information. Given all these hurdles, there are still some very informative DNA studies on *Clivia*. For instance, Prof Spies, a retired professor from the University of the Free State, has in one of his studies found that some of the *C. gardenii* samples from Ngome forest are related to the *gardenii-robusta* group while others are related to *C. caulescens*. This, on its own, suggests that Ngome *C. gardenii* should be documented as a transitional form between the autumn flowering species and *C. caulescens*. However, in a later study where he used a different method of DNA analysis, the Ngome gardenii grouped separate from all the other species but showed a close relationship with *C. caulescens* species.

Ngome ***C. gardenii*** – Classification based on morphology

Using a single specimen to describe a species will lead to incorrect assumptions. This is especially true if the plant has been grown and nurtured by a *Clivia* enthusiast. In nature there are always the exceptions to the rule, and these are the plants that a collector will target. Pendulous species in most collections are therefore not always representative of the wild-type. The description or idiotype of the Ngome *C. gardenii* plant below is made from not only observing several plants in a shade house but mainly from observations in the Ngome forest over a 5-year period.

- The general plant type is more robust than that of the Midlands and Coastal form of *C. gardenii* but not as Robust as the *C. robusta* forms found in Pondoland.
- The shape of the leaf is not exceptional and cannot be used to differentiate it from that of *C. gardenii*. However, most plants have leaves with a somewhat leathery appearance which lack the ribbing of the typical *C. gardenii*.
- When grown in a greenhouse the plant develops a swollen base that gives the impression of an onion or leak plant. This characteristic is not always evident in nature, likely due to the lack of excessive feeding and nurturing. It should be noted that some *C. caulescens* plants, especially those robust forms from the Magoebaskloof area also develop this bulbous base when grown in a shade house.
- The seeds often occur singularly in a seedpod and are huge when compared to those of *C. gardenii*. The embryo is also exceptionally

large. Seeds germinate quickly after planting and seedling growth is rapid.

The main feature that sets it apart from the autumn flowering pendulous *Clivia* species is the flowers.

- There are many flowers on a Ngome *C. gardenii* umbel in contrast to the low flower count of midlands and coastal *C. gardenii. C. gardenii* has been described as having a flower count that averages in the order of 15 flowers per umbel. This is also the feature which precludes its utilisation as an ornamental garden plant. On the contrary, it is not uncommon to find a plant of Ngome *C. gardenii* with a flower count that exceeds 40.
- *C. gardenii* has been described as a pendulous species of clivia where the anthers and stigma protrude from the flower, but this is not true for all *C. gardenii*. Many have anthers that do not protrude. The general flower structure of Ngome *C. gardenii* includes anthers that protrude markedly.
- Although the flowers are tubular like the other pendulous *Clivia* species, the tepals of Ngome *C. gardenii* separate at the mouth into a flared shape accentuating the protruding anthers.

Flower colour is not necessarily an indicator of species divergence, except if it can be associated with modifications that affect pollination. There are several yellow and pink flowering mutations that have been observed among orange-flowered clivia plants in nature. Ngome *C. gardenii* is not one of these. We have not encountered a true orange-flowered plant to date. Furthermore, although there might be a few plants that produce flowers that are devoid of any orange pigment, the majority produce flowers that open yellow and then changes colour to pink as the flower matures. The colour is also not evenly distributed in the flower. Flowers are mostly pink at the base of the tepals near the ovary, but the pink lightens to yellow as we move to the tip of the tepals. The green colouring that is associated with the tips of tepals of all the pendulous *Clivia* species

Picture 4: True yellow *C. gardenii* of the midlands type. Picture taken in habitat near Greytown in the KZN Midlands. Note the low flower count.

is often spread over the whole flower in Ngome *C. gardenii*. The change in colour or blushing is associated with not only the maturity of the flower but also with light intensity. The colour of Ngome *C. gardenii* plants grown in a shade house is unstable as it changes from year to year. Some enthusiasts have attributed the changes to differences in growing media, but this observation still needs to be verified.

Picture 5: True yellow Ngome *C. gardenii.* Picture taken in Ngome forest. Note the high flower count, protruding anthers and flared tepal tips.

C. gardenii (Midlands form) Ngome *C. gardenii*
Picture 6: Difference in structure of flower between Ngome *C. gardenii* and *C. gardenii*

Picture 7: Ngome *C. gardenii* in habitat. Note the difference in shading of colour especially the infusion of green.

Ngome *C. gardenii* – Classification based on hybridisation results

Although not regarded as a parameter to use in species classification projects, results from crossing individuals of different origin is a well-known way of determining the magnitude of the difference between groups. The more diverse the individuals, the higher the chance for and the greater extent of hybrid vigour in the progeny. Furthermore, if plants from one group

Picture 8: The colours of Ngome *C. gardenii* flowers change as the flower matures

differ in the way they react in a hybridisation program when compared to another group, it may also demonstrate genetic differences between the two groups.

C. gardenii are not regarded as good breeding stock when used in a *Clivia* hybrid breeding program as the offspring are generally inferior with respect to colour as well as flower count. It is said that the *C. miniata* species developed from an ancient *C. gardenii* type and are thus more closely related to *C. gardenii* than to any of the other pendulous species. The lack of hybrid vigour in the progeny between a *C. gardenii* and a *C. miniata* supports this hypothesis. However, a cross between a Ngome *C. gardenii* and a *C. miniata* almost always leads to progeny that show hybrid vigour. The vigour is expressed in the size of the flowers, thickness of the leaves and the robustness of the progeny. Furthermore, a cross between a Ngome *C. gardenii* and a midlands *C. gardenii* also produces progeny with hybrid vigour. Unfortunately, I have not seen many of these as breeding programs with the pendulous species are generally aimed at crosses between species and not within a species.

The true yellow genes found in *C. miniata* are expressed as recessive traits. This is also true for the yellow *C. caulescens* as well as the yellow Midlands *C. gardenii.* Contrary to this uncomplicated, single gene type of inheritance of yellow, the light colour of Ngome *C. gardenii* is inherited as a dominant trait. If Ngome *C. gardenii* is crossed to an orange or even red *C. miniata*, the progeny produce light coloured flowers. These often show the colour change

over time (blushing) and a diffusion of green from the Ngome *C. gardenii* parent. The flower count of a Ngome *C. gardenii* hybrid is also superior to a midlands C. gardenii hybrid when crossed to a *C. miniata*.

The slight flare on the tips of the tepals of Ngome *C. gardenii* is preferentially transferred to the hybrid progeny. A hybrid between *C. miniata* and Ngome *C. gardenii* has a more open flower than the semi-tubular flower seen in the progeny from a *C. miniata* by *C. gardenii* cross. This, together with the higher flower count gives the impression of a full umbel when compared to the loose, flat-topped umbel seen in progeny from a midlands *C. gardenii* cross.

Ngome *C. gardenii* – Interspecies hybrids flower later

The actual flowering times of hybrids created from interspecies crosses between the autumn flowering species and *C. miniata* was established by inspecting actual pictures of F1 hybrids. Each data point in the table below relates to a picture that was taken of a flowering hybrid. The numbers and colours of each data point depict the year as well as the breeder who presented the picture. Several reputable *Clivia* breeders contributed to the dataset. Only F1 hybrids, where the pedigree is known to be correct, were used. Subsequent generations such as progeny from advanced self-pollinations or backcrossing of an interspecific hybrid were not taken into consideration. The study did not differentiate between reciprocal crosses and both types were used, i.e. where the *C. miniata* was used as pollen parent or as the pod parent. Furthermore, data from crosses with *C. miniata* that are in advanced stages of

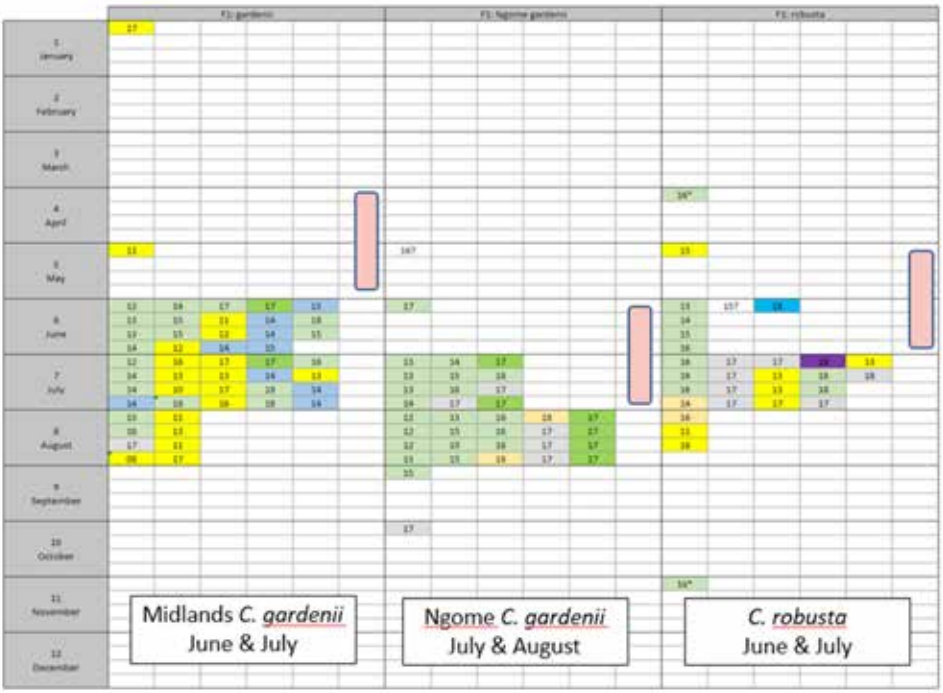


Table 2: Flowering time of F1 hybrids that were created between the autumn flowering pendulous species and *C. miniata*. Flowering time of parental species is noted as bars in pink to the right of the respective F1 data points.

Picture 9: Ngome *C. gardenii* interspecific hybrids

domestication, such as Florid White Lips and Daruma, were not included in this study. These varieties may already contain germplasm from pendulous species due to past introgressions or their natural flowering response may have

Picture 10: Midlands *C. gardenii* interspecific hybrids

been altered through selection in consecutive breeding cycles.

Although the main flowering month for the F1 hybrids is July, the Ngome *C. gardenii* tend to flower a month later. This flowering time overlaps with that of the *C. miniata* parent.

Ngome *C. gardenii* – Pollinating agent

Studies on natural pollinating agents of *Clivia* show that the main pollinators of the pendulous species are sunbirds, whereas butterflies are

Picture 11: Ngome *C. gardenii* showing the protruding anthers and tepals that are flared at the tips

said to be the main pollinators of *C. miniata*.

We set a Birdcam at two sites within the Ngome forest and obtained pictures of an Olive sunbird pollinating Ngome *C. gardenii*. A Birdcam is a category of trail camera that is sensitive enough to pick up small animals. It is triggered by a combination of heat and movement. The frequency of visits by the sunbird was very low. Only two visits were documented in the eight days that the camera was set. This is much lower than that which we found for the other pendulous species, where a flower was on average visited more than once a day. In addition to the two bird sightings, the camera did pick up several visits by honey bees. The frequency of these visits, although documented at twice per day by the camera is likely much higher as the camera is rather insensitive to insect activity.

The light colour of the flowers may be attracting the bees. The slight flare of the tepals as well as the protruding anthers seems to facilitate pollination by bees. However, the tube of the flower is narrow and the bee cannot reach the nectar. The colour change from yellow to light pink shows that the plant still attracts birds. In contrast to *C. miniata* it presents bees with pollen and sunbirds with nectar and therefore gains from pollination by two agents. We also observed several solitary or Allodapine bees which were also visiting the flowers only for pollen.

Should Ngome *C. gardenii* be classified as a species? - Summary

Classification of Ngome *C. gardenii* as a separate species is not just of academic importance.

Picture 12: Ngome *C. gardenii* showing the shading of pink and infusion of green

This population has adapted to incorporate insect as well as sunbird pollination in its strategy of reproduction. During the process of adaptation, the biochemical pathways for colour have changed to such an extent that the colour inheritance is unlike to be the straightforward monogenic inheritance that we find in other *Clivia* species.

Currently the Ngome type of *C. gardenii* is not managed with the conservation importance that it deserves. Until further localities are found, the population is for now known to be limited to the Ngome forest, where it is exploited as a medicinal plant. The population seems stable, but this may change in future as pressure is placed on this species due to over exploitation and shortages of suitable medicinal material in other areas. Reclassification is not only of importance for conservation purposes but will also classify this group as a type that should be managed differently in breeding programs aimed at the ornamental plant market.

Picture 13: Ngome *C. gardenii* interspecific hybrid

For future reading or reference:

Website on SA red list species:
http://redlist.sanbi.org

Paper on Ngome *C. gardenii*:
Swanevelder ZH, Wyk AEV, Truter JT (2005) AMARYLLIDACEAE. Bothalia 35: 67-68.

Paper on DNA analysis:
Clivia taxonomy revisited, using DNA barcode regions. Spies, J.J. Spies (2018), 10.17660/ActaHortic.2018.1201.67
(Abstract : https://www.actahort.org/members/showpdf?booknrarnr=1201_67)

Legionnaires' disease – what is it and what can gardeners do about it?

Nicole Wolter

Centre for Respiratory Diseases and Meningitis (CRDM)
National Institute for Communicable Diseases (NICD)

Recently an article appeared in an Australian newspaper documenting a death from Legionnaire's disease, which was acquired from potting soil. The incidence is rare. All clivia growers have close contact with soils, and we should be aware of this rare possibility.

What is Legionnaires' disease?

Legionnaires' disease is a lung infection (pneumonia) which is caused by the *Legionella* bacteria. If you become infected with the *Legionella* bacteria, you may have no symptoms, have a mild flu-like illness known as

Pontiac Fever or develop a severe pneumonia known as Legionnaires' disease. The symptoms can include a cough, shortness of breath, high fever, headache and muscle aches. Symptoms normally develop 2-10 days (up to 3 weeks) after a person is exposed to the bacteria. The disease was named after a large outbreak in 1976 that occurred at a meeting of the American Legion in Philadelphia, USA.

How do you get infected with *Legionella* bacteria?

Legionella bacteria grow in water and moist soil, and especially like conditions where the water is warm (20° - 50°C) and stagnant. Some common sources of infection include hot and cold water systems, cooling towers, jacuzzis, fountains, sprinklers, soil, potting mix and hospitals. A person can become infected by breathing in water droplets that contain the Legionella bacteria. You cannot get Legionnaires' disease from another person or an animal.

What should you do if you think you might have Legionnaires' disease?

Anyone can get Legionnaires' disease but it is normally people that are over the age of 50, smokers, people that have weakened immune systems or have chronic lung, heart or liver diseases that have a greater chance of getting the disease. It can be diagnosed by laboratory tests, and your doctor will ask you for a sputum (phlegm) or urine specimen to be tested. About 10-20% of individuals with Legionnaires' disease will die, and so it is important that a person diagnosed with the disease be treated early with an antibiotic that is effective against the Legionella bacteria.

How common is Legionnaires' disease?

Legionnaires' disease is quite rare. About 2-5% of all pneumonia cases around the world are caused by *Legionella* bacteria. In 2018 the National Institute for Communicable Diseases was made aware of 38 cases from South Africa. However, we know in South Africa that Legionnaires' disease is not often diagnosed and that the number of cases that we are aware of is much less than the true number of cases. Legionella pneumophila, the strain that is mostly found in water, causes most cases of disease in America and Europe whereas in Australia and New Zealand, *Legionella longbeachae*, the strain that is found mostly in compost and potting soil, is common. In South Africa we have found both pneumophila and longbeachae to cause disease.

How can we prevent Legionnaires' disease?

There is no vaccine for Legionnaires' disease. It is important that water systems must be properly designed and maintained so that water does not sit for long periods at any point in the system. Water pipes must be flushed regularly. Water must also be kept at the right temperatures where Legionella bacteria cannot grow, so cold water should be stored below 20°C and hot water above 60°C.

Advice for gardeners

It is rare to catch Legionnaires' disease from gardening. However, the use of potting mixes, composts and other soils puts a gardener at greater risk of getting the disease. Care should be taking when working with potting soil or compost including (i) wearing a mask and gloves when handling the soil, (ii) washing hands with soap and water after handling the soil, (iii) storing bags of potting mix in a cool, dry place, (iv) opening bags of soil slowly and away from the face, (v) wetting potting mix when working with it to prevent dust and (vi) avoiding breathing in droplets of water from dripping pot plants and when watering plants.

Polyploid Breeding in *Clivia*

Aart van Voorst

Abstract

Polyploids are important in many crops. Although there are a limited number of natural tetraploids found in *Clivia*, to be able to use the advantages of polyploidy in this genus, a project of converting diploid material into tetraploids has been ongoing since 1995. After the first artificial tetraploids flowered in 2000 a continually growing number of new clones are being created. To utilise the full possibilities of polyploidy in *Clivia* all existing types and species (with their hybrids) need to be available in polyploid form. The recessive mutations should also be made available in tetraploid form to speed up breeding in this slow growing crop. Extra possibilities for polyploidy breeding in *Clivia* can be found in using unreduced gametes from interspecific crosses and hybrids. Triploids in *Clivia* that can be grown from seeds can additionally make polyploidy breeding more successful.

'Sleeping Beauty' from Johan Conradie

'Big Boy' from John Craigie

'Mathias Monster' from Joubert van Wyk

'Gentle Giant' from Pierre De Coster

Introduction

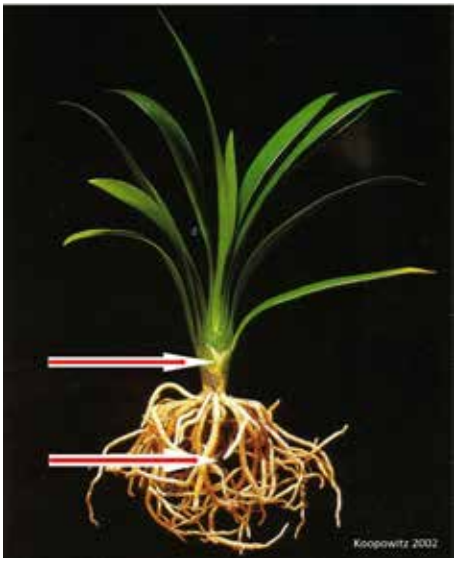
In many horticultural crops the advantages of polyploidy are widely recognised and appreciated. The larger flowers, firmer stems, darker and harder leaves can give something extra to a crop. Tetraploids also appear naturally in many crops, formed by what is generally accepted to be unreduced gametes (Harlan and DeWett, 1975, Ramanna, 1992) *Clivia* have naturally occurring tetraploids, such as the following four plants:

To be able to work on a polyploid level, one can make use of these plants, but there are not many and they are not freely available. A good polyploid breeding program needs sufficient genetic variation to be able to develop its benefits to the full.

This is why I started the Polyploid Project, converting many types of diploid material into tetraploids with the use of colchicine. Two methods are described in Clivia Five (page 33-39), Clivia 6 (page 43-46) and Clivia 8 (page 56-63). The Layman's method is still a good start for people who do not have access to laboratory facilities. My own method has been slightly changed over the years and uses dissected embryos in tissue culture.

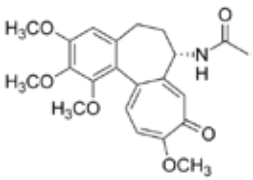
Ideally one would choose the best hybrids or plants that give the best progeny as starting material for treating diploid material with colchicine or another chemical that disturbs the spindle in the cell cycle. In that way cells with the double number of chromosomes are formed. If those cells grow out into a plant, it will be tetraploid. One needs fast dividing cells to treat with the chemical, they are found in the shoot meristem and the root meristem.

The problem in *Clivia* is that the stem- and leaf-forming meristem (shoot meristem) is hidden deep in the trunk (upper white arrow) and is very difficult to reach with a chemical. The other type of meristem in a growing *Clivia* plant is the root meristem (example at lower



Colchicum autumnale

Gloriosa superba



Colchicine

arrow).

It is not necessary to convert the latter into the tetraploid form, because if the shoot meristem is converted, tetraploid roots will eventually be formed when the plant grows on. The second difficulty is the need for many plants, because only a small number of plants exposed to the chemical will be turned into a tetraploid.

The only way to reach the apical (stem) meristem is to utilise germinating seeds (see the Layman's method) or use embryos.

I use embryos of a promising cross under sterile conditions after the seedpod has been dipped in ethanol and flamed three times. The seeds are taken out and the embryos dissected from these. The embryos are then put on a simple tissue culture medium (Murashige and Skoog,1962) comprising macro and micro nutrients, 3% sucrose and a gelling agent. After 10-20 days, depending on the cross, 0,1% filter-sterilized colchicine is added to the germinating embryos for 1 day at about 20° C. After this treatment they are placed on fresh medium without colchicine and grown till they have several leaves and roots before they are hardened off under a plastic cover in the soil.

Colchicine is a naturally occurring chemi-

Colchicine treatment of *Clivia* embryos *in vitro* results:

'4Tune'

'4Midable'

94001-13

94001-27

cal that is found in *Colchicum autumnale* and *Gloriosa superba*. In human medicine it is used to treat gout.

Results

After treating the first cross of fast-flowering Belgian-type plants in 1995, it took about 5 years before the first tetraploid flowered (its status checked using flow cytometry: A. van Voorst 2003), a couple of these have been named, others are just used as breeding parents.

RGT06 tetraploid showing different throat colouring at successive flowering seasons.

08009-06 is a tetraploid from a cross between a Nakamura variegated and 'Vico Yellow'. Seedpods were supplied by Helen Marriott. These gave unpigmented tetraploid variegated offspring.

After my first attendance at a Clivia Conference in 2002, some Clivia friends like Tino Ferero gave me seeds of their breeding stock and the tetraploid RGT06 ('Red Greengirl' cross of Tino) was bred.

'Vico Yellow' introduced via several different genetic blood lines to improve flower shape in my tetraploid material.

At the Clivia Conference in 2006 the late Bossie de Kock, at that time treasurer of the

03012-34 One of my first tetraploid yellow miniatas. It is a cross between yellow miniatas of Jaap Keijzer and Pat Gore. Yellow material from different origins is used to create a broad genetic base. In the newer crosses undergoing colchicine treatments, the darkest yellow material from Solomon is also used.

'4Yellow'. Again a cross between a Jaap Keijzer and Pat Gore yellow. This is a very big plant and has huge flowers.

05036-13 The first tetraploid Cameron Peach, derived from seeds I got from Peter Lambert in 2006.

08044-02 Another Peach tetraploid derived from colchicine treatment, but of group 1 this time, bred from 'Chubb's Peach' and 'Vico Gold' by Helen Marriott.


Two pictures from two different flowering seasons. 'Deklan' the mother of this plant has 'Vico Yellow' blood and in this way important genes are incorporated in the tetraploid lines.

Clivia Society, gave me two seedpods of a 'Deklan' cross. From these two seedpods with only few seeds in each, a couple of tetraploids were derived and one of the most appealing tetraploid miniata types thus far is probably '4Bossie'.

One of the best examples of the influence of tetraploidy on material of *Clivia* is found in *Clivia robusta*. SCU16 (Swamp Clivia Umtamvuna) named '4Security', with reference to the original code.

The most important tetraploid interspecific till now is '4Tissimo'. It came from a cross between a diploid *Clivia robusta* type and one of the first tetraploid miniatas: '4Tune'. So on the maternal side an unreduced gamete should have been involved.

The long search for a white *Clivia* can also be found on the tetraploid platform. The diploid SCU01 white crossed with a diploid 'Bing Wiese


In both pictures, on the left the normal sized C. robusta and on the right '4Security'. Fertility is quite good, so this tetraploid *C. robusta*, together with other tetras from the same background are good starting material for tetraploid interspecific crosses.

'4Tissimo'. Above on the right are two pictures, with '4Tissimo' at the top and a diploid hybrid of the same cross, at the bottom.

SCU01 (diploid)

Polyploid01 (diploid)

07002-08 (tetraploid)

Polyploid' that splits for yellow, could be the start of this quest.

Unfortunately the mutation in the white *C. robusta* only seems to be compatible with the mutation in the 'BW Polyploid' that is normally compatible with other Group 1 yellows. All other combinations with Group 1 and Group 2

yellows gives only coloured stems and flowers. This slows down the possible use of my white *C. robusta* form for breeding white tetraploid *Clivia. Whether this white form of* C. robusta has the same type of mutation as other white *C. robusta* forms, like 'Carolina's Pride' or 'Ice Giant', has not yet been tested.

One of the things to consider when raising the ploidy level of plants, is that the flower count usually goes down. Later in the breeding process, you can select and breed again for a higher flower count, but it is a good thing to start the colchicine treatment on crosses between material that initially has a good flower count. One of those crosses between *C. miniata* and *C. nobilis* gave, after treatment, a number of tetraploids and one of them, 04017-66 is a fine example of an excellent start.

The Future of Polyploid Breeding in *Clivia*

Although tetraploid breeding may be more difficult than breeding on a diploid level, this effect is mainly evident at the start, when the recessive mutations are incorporated. The Punnett squares show that a recessive character will only turn up 1 in 36 when a tetraploid plant with that character is selfed compared to 1 in 4 in a diploid. That is why I treat plants with that kind of characters (yellow, peach and green as example) with colchicine, to get tetraploids that are homozygous for that character. Crossing with other superior tetraploid plants, without that mutation and backcrossing on the homozygotic recessive tetraploid will get the mutation back at almost 17%

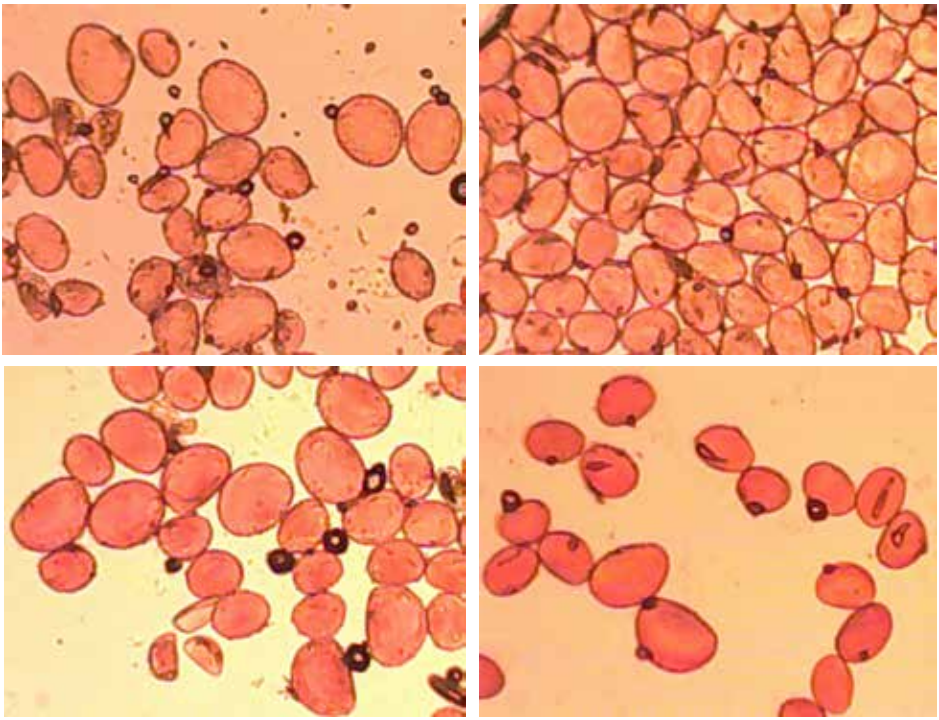
To make polyploidy breeding in *Clivia* a success, there should be a growing involvement of breeders that see the benefits of tetraploidy and they should have the opportunity to get material to work with. Not everybody can or wants to do their own colchicine treatments. It is not my intention to hold this material closely, e.g. to be able to sell material at high prices. In the beginning of 2018 more than 400 seeds of tetraploid crosses were distributed among Clivia friends, and hopefully this helps to get more people involved. In future years more seeds will become available.

An important speed-up system could come about through the occurrence of unreduced gametes in hybrid material. Distant and inter-specific crosses could cause problems with fertility. Problems with meiosis may result in pollen grains or eggs with the double number of chromosomes, known as unreduced gametes.

The bigger pollen grains in the pictures are unreduced gametes and they occur in many hybrids. In normal situations these unreduced gametes (on both female and male side) have little chance of success in the breeding process.

The unreduced pollen grains normally grow their pollen tubes a little bit slower, so in the race to reach the female egg, they may arrive rather late and even when they fertilize an egg, in most cases normal seed may not develop. But in cases where the receiving plant is a tetraploid it is just the other way around. Here the unreduced gametes have the advantage to

2x(2n gametes) X 2x(2n gametes)	———	2x (normal diploid): most of the time 3x (triploid): very rare 4x (tetraploid): extremely rare
4x(tetraploid) X 2x (2n gametes)	———	3x (triploid) rare 4x (tetraploid) possibly not rare.



give rise to a balanced chromosome number after fertilisation.

I have not made many crosses yet in this direction because the production of tetraploids is still the main goal of my crossings, but with the use of the newly produced tetraploids and the great possible source of unreduced gamete-producing (interspecific) hybrids, the number of tetraploids could rise quickly. In the pictures below the bigger pollen grains are the unreduced ones, containing the diploid number of chromosomes.

There are so many beautiful interspecific hybrids around nowadays and a great many of them may produce unreduced gametes. I have checked only a small percentage and I found several producing unreduced gametes. But even 'normal' *C.miniata* hybrids can produce unreduced gametes. For breeding purposes it is important to identify such plants.

It is a relative simple procedure to check the pollen size, to deduce whether on the male side, unreduced gametes are being produced. If they are produced on the female side, this is much more difficult to determine and I haven't done that so far.

With a simple microscope and the use of a digital eye-piece (e.g. Bresser) to make an image, with the use of a free measuring program from the internet (Micro-Measure) it is

possible to measure the size of the pollen grains after colouring with Acetocarmine.

A possibility for the development of new hybrids not yet mentioned specifically here, are the triploids. Crosses between tetraploids and diploids can result in triploids. Although in many cases triploid seeds are not viable due to poor embryo growth or bad endosperm development, sometimes normally-growing plants can be produced. These triploids are in most cases sterile, but in *Clivia* sometimes fertile plants occur. In many cases when used as a mother with the father being diploid, again diploid plants with no special characters may be found or there may be some triploids. In rare situations one can find triploids that produce unreduced gametes which when combined with diploid mothers may give rise to tetraploids (2x X 3x(2n) = 4x: 1set of chromosomes from the mother and 3 sets from the father). In the 2018 crossing season I made a lot of crossings in this manner, resulting in more than a dozen normal seeds. Later it will have to be checked if tetraploids have really been formed.

The future of polyploid Clivia may be bright when all the benefits are recognized and the growing number of tetraploid forms available and the potential of utilising unreduced gametes to produce hybrids are used together in the breeding programs of tomorrow.

Triploid cross between a diploid yellow *C. miniata* and a tetraploid orange *C. miniata*

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Investigating *Clivia* Diseases

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EXECUTIVE SUMMARY:
Investigating *Clivia* Diseases

Research to date: 2012 -2013

1. Isolate Pathogens:
   a. brown leaf spot
   b. soft rots
   c. leaf mosaic virus-like symptoms
2. Identify Pathogens
   a. Brown Leaf Spot: Causal agent – a fungus Genus: *Colletotrichum*; Species: this is not clear

Control – use of systemic fungicides and biocontrol is feasible but trials are needed.

   b. Soft Rot: causal agents – several bacteria so far: - *Pseudomonas*, *Pectobacterium*; not clear yet what species.

Control – difficult, but a management programme can be developed and tested. Use of beneficial viruses (bacteriophages) is feasible.

   c. Virus diseases: 2-3 viruses found so far. Identification – not sure but they are definitely not 3 virus families so far

Control – need to identify vectors before we can plan the control of the viruses.

CLIVIA SOCIETY REPORT 2
27/11/2013

Synopsis of research methods and outcomes since previous report:

This report serves to update the members of the Clivia Society on the results I have obtained in my research on three *Clivia* diseases (leaf spots/lesions, soft rots and virus-like diseases) detailed in my previous report.

I presented a sequence of steps for each of the diseases (Report 1: Tables 1, 2 and 3) that outlined my research plans. In all cases, I have

verified the presence of pathogenic organisms involved with each disease.

2.1) Fungal leaf spot

My investigation into this disease was with fresh samples of symptomatic leaves, as pictured in Figure 2.1.1 below.

Figure 2.1.1 Leaves of *Clivia miniata* showing symptoms of spots, lesions and necrosis.

I put these leaves in what is called a sporulation chamber to observe any changes that occurred as the leaves aged. A sporulation chamber keeps the environment warm and humid and encourages any fungi present to produce spores. I then viewed the yellowing and withered leaves with a dissecting microscope and what I observed is depicted on the following page.

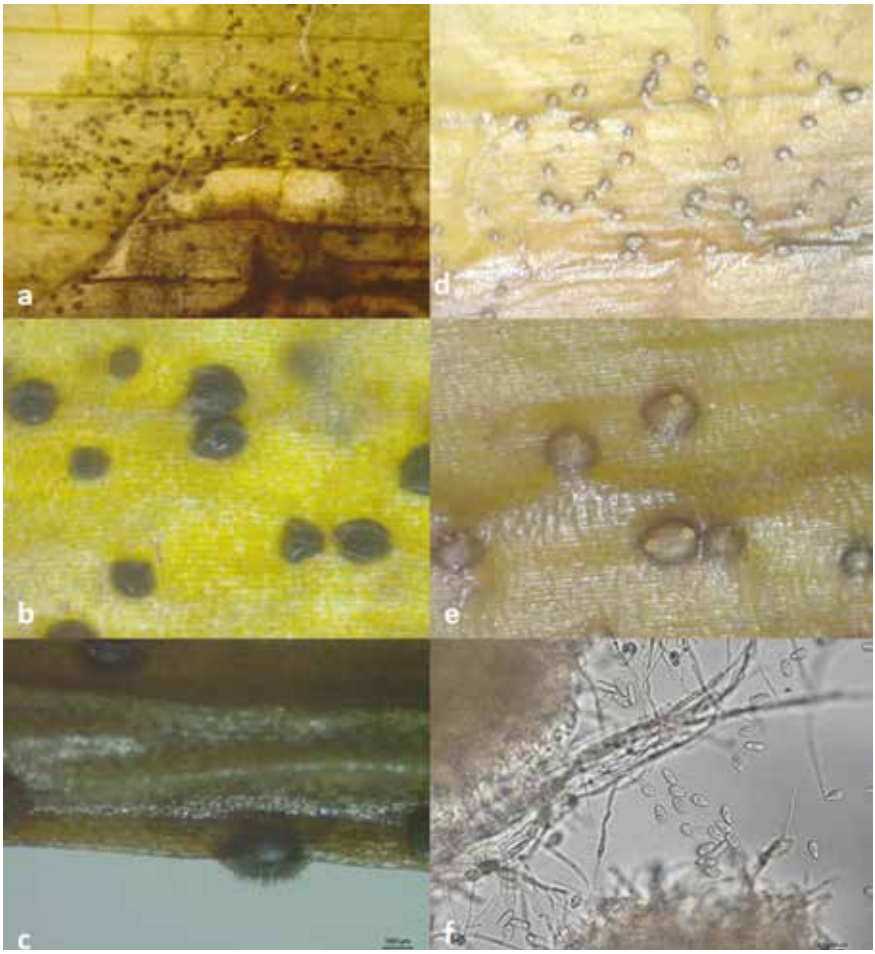

Figure 2.1.2 Development of fungal fruiting bodies (acervuli) and spores (conidia) from infected leaves: (a) acervuli appearing in a circular fashion towards the edge of the lesion; (b) some showed the presence of hair-like projections (setae); (c) acervulus and setae seen from the side; (d) extrusion of conidial masses from acervuli; (e) close up view of acervuli and orange conidial masses; (f) wet mount of fungal mycelium and conidia.

Figure 2.1.2f shows what I saw under a light microscope when I put one of the conidial masses on a slide. I used the key provided by Williams-Woodward (2001) to key them out as conidia (which are asexual spores that fungi produce and which are often dispersed by splashing water) belonging to the genus of fungus known as *Colletotrichum*. *Colletotrichum* fungi cause diseases on a wide range of plants (which are collectively known as anthracnose diseases). I refer you to Figure 1 by Cannon *et al*. (2012) - page 182 in Damm *et al*. (2012) – for a good pictoral overview of anthracnose symptoms and affected host plants. The fruiting bodies and spore masses shown in Figure 2.1.2d and 2.1.2e are very similar to those of a *Colletotrichum* species depicted in Figure 5 (page 247) by Yang et al. (2011).

Figure 2.1.3 (a) young culture showing white mycelium; (b) older cultures showing abundant orange spore masses.

In order to confirm that the *Colletotrichum* isolate that sporulated from the diseased leaves as being responsible for these symptoms. I grew some of the conidia on nutrient media under laboratory conditions. The conidia grew into a fungus that grows initially as white and cottony mycelium that then produces orange masses as it ages, illustrated in Figure 2.1.3 above.

The orange colour that can be seen on the cultures comes from the millions of conidia that the fungus produces as a method of asexual reproduction. I sprayed a suspension of these conidia onto the leaves of healthy *C. miniata* seedlings and observed that they developed the symptoms illustrated in Figure 2.1.4 following inoculation. Other seedlings that I inoculated with water did not develop any symptoms over the same duration.

I re-isolated a fungus from the lesions on these seedlings shown in Figure 2.1.4. It displayed the same initial morphology as what I put on (Figure 2.1.3a) and aged to produce orange masses like those in Figure 2.1.3b. I examined them microscopically and the conidia I observed are shown in Figure 2.1.5 below.

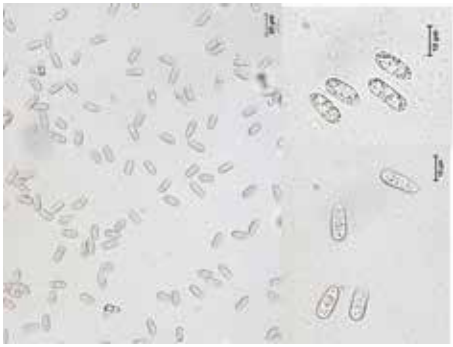

Figure 2.1.5 Bright field images of the conidia of the *Colletotrichum* species implicated in anthracnose of *Clivia miniata*.

Figure 2.1.4 Symptoms that developed on seedling *C. miniata* following inoculation with conidia of the *Colletotrichum* isolate.

Table 2.1.1 Reports of anthracnose of *Clivia miniata* caused by *Colletotrichum* species.

Colletotrichum species	Symptoms (as described in report)	Host	Country reported	Reference
C. boninense	Leaf spot	*Clivia miniata*	Japan	Moriwaki *et al*. (2003)
C. cliviae	Leaf spot	*Clivia miniata*	China	Hyde *et al*. (2009); Yang *et al*. (2009)
C. gloeosporiodes	Anthracnose	*Clivia miniata*	South Africa	Whitlock (1986)
C. trichellum	Anthracnose	*Clivia miniata*	Iran	Mirabolfathy (1989)

These are similar to the conidia I observed that developed from the initial leaves I started with (Figure 2.1.2f) and I therefore concluded that the pathogen responsible for some, if not all, of these foliar spots, lesions and dieback shown in Figure 2.1.1 is the *Colletotrichum* species I have isolated and worked with.

I have surveyed all the literature that pertains to anthracnose diseases and *Colletotrichum* infections of *Clivia*. I have found that similar disease symptoms have been described and studied on *C. miniata* and that at least three species of *Colletotrichum* have been reported to infect *C. miniata*. This information is summarised in Table 2.1.1 above.

Whitlock (1986) published the only prior, definitive record of a similar disease from South Africa. Although he did not provide pictures of the symptoms that he observed, what he described sounds very much like what we have been observing. Swart (2005) reported that he isolated a *Colletotrichum* species from leaves displaying very similar symptoms to what I have observed but that it did not cause disease when applied on healthy plants – in his words 'Koch's postulates was negative'. I think this is likely due to the environmental conditions not being conducive for infection at the time that he carried out his study.

Yang *et al*. (2009)'s paper entitled 'Colletotrichum anthracnose of Amaryllidaceae' shows symptoms that various *Colletotrichum* species cause on various amaryllid species. Although symptoms on *Clivia* are not shown, those depicted on various *Crinum* and *Hippeastrum* species (close relatives of *Clivia*) are very similar to those observed on infected plants in my study (Figure 6, page 140). I am confident that the range of foliar symptoms that various growers and I have observed is caused by infection of plants with a species of phytopathogenic *Colletotrichum*.

I have sequenced the ITS region of this isolate and assessed some of its morphological characters in an attempt to identify this *Colletotrichum* isolate at a species level. My preliminary opinion is that we are dealing with *C. boninense* but I need to conduct further studies to be confident. There exists the possibility that this isolate may represent an undescribed *Colletotrichum* species because Yang et al. (2009) stated that 'the Amaryllidaceae comprises 51 genera, with over 800 species and a worldwide distribution. A high diversity of *Colletotrichum* species, including many undocumented new species, could be expected if more hosts are studied'. I need to consult with an international *Colletotrichum* expert to verify my assessments, which I am in the process of arranging.

Another line of inquiry that strengthens the implication of a *Colletotrichum* species in this disease development is the fact that a member of the society who lives in Pretoria told me that he observed that application of the fungicide Switch (Syngenta: http://www.syngenta.com/global/corporate/en/products-and-innovation/product-brands/crop-protection/fungicides/pages/switch.aspx) appeared to stop the tips of the leaves of his plants from dying back. Sygenta

state on their website that Switch provides high level of control of a number of different fungal pathogens, including *Glomerella*. *Glomerella* is another name for *Colletotrichum* - they are different forms of the same fungus that were initially named as separate species but it has since been realised that *Glomerell*a represents the sexual form of the fungus and *Colletotrichum* the asexual form of the fungus [see Table 2 from Cannon *et al*. (2012) – pages 190 and 191 in Damm *et al*. (2012)].

The next step in this disease issue will be to study and develop recommendations for measures to control this disease. Cannon *et al*. (2012) stated that 'in common with many other fungal pathogens, the *Colletotrichum* asexual morph is most commonly associated with disease symptoms, with the sexual morph tending to develop on moribund or dead host tissues'. It is likely that plants become infected in spring, when environmental conditions are conducive to spore production and infection (humid and warm, like in the sporulation chamber where I incubated the diseased leaves). Splashing water (rain, irrigation etc.) may then splash the spores from the sites where they are produced (dead and dying leaves and other debris from infected plants) onto the new, fresh and susceptible leaves that the plants are producing around the same time. As the fungus grows through the infected leaves, it produces the symptoms we have observed.

Control measures of fungal diseases revolve around taking a multi-faceted approach towards decreasing diseases levels. Growers should try not rely solely on the use of fungicides for disease control but also on cultural and sanitation techniques in conjunction with spraying fungicides. I am not able to make further fungicidal recommendations at this point as there are currently no fungicides registered for anthracnose control on *Clivia* in South Africa and none of the studies cited in Table 2.1 looked at controlling the diseases they studied. Studies assessing the efficiency of various fungicides at controlling or reducing this disease are warranted before I can make any concrete recommendations to the Clivia Society. Growers may like to begin to look at testing the fungicides that are registered for the control on anthracnose of other crops (such as avocado for example) in South Africa.

In common with many fungi, the spores of *Colletotrichum* species require a layer of standing water (usually dew) to be present on a leaf surface before they can infect the leaf. Removing this layer of free water by supplying adequate ventilation in the growing area and moving away from overhead irrigation techniques may help reduce the dispersal and germination of the spores of this pathogen. The removal of dead and dying plant material in and around

Clivia growing areas may also help reduce disease incidence by decreasing the number of inoculum sources in the nursery. A third option for disease control is the use of biological control, which would entail the use of other microorganisms to stop disease development and spread. Studies to isolate and assess various biocontrol options may be warranted.

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2.2) Bacterial soft rots

In my previous report, I detailed two cases of *Clivia* plants suffering from soft rot symptoms. My research into the literature of *Clivia* diseases has indicated that only four studies on bacterial soft rot on *Clivia* sp. have been published worldwide with only one, Laing (2009), coming from South Africa. These reports are detailed in Table 2.2 below.

I can confirm that I have isolated bacteria from each locality that are capable of producing soft rot symptoms when previously healthy plants are inoculated with them. My research methodology is outlined in the figures below.

I isolated bacterial samples from some diseased tissue of the *C. miniata* seedlings from Howick and the mature plant from Nelspruit (Figures 6, 7 and 8 in the previous report). I then assessed whether any of these isolates had soft rot abilities by inoculating slices of potato with each isolate and observing any changes that occurred (Figure 2.2.1). I found that a single isolate from each locality was able to cause soft rot of the potato slices (Figure 2.2.1b and 2.2.1c). This indicated to me that these

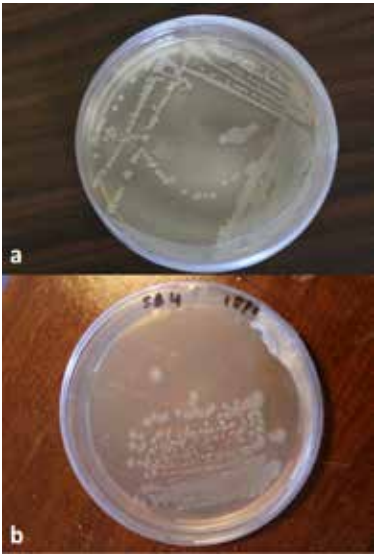
Figure 2.2.1 Rotting potato slices after inoculation with bacterial isolates: (a) evaluation of all bacterial isolates for their soft rot ability; (b) isolate obtained from Howick; (c) isolate obtained from Nelspruit.

Table 2.2.1 Reports of bacterial diseases of Clivia

Genus	Species	Common name of disease	Host organ affected	*Clivia* Host	Country of report	Reference(s)
Erwinia	*cypripedii*	Brown rot	Leaves and roots	*Clivia* spp.	Korea	Han & Choi (1994)
Pectobacterium carotovorum	subsp. *carotovorum*	Soft rot	Leaves and roots	*C. miniata*	Korea, South Africa	Choi & Lee (2000); Laing (2009)
Pseudomonas	*syringae* pv. *syringae*	Brown spot	Leaves	*C. miniata*	Germany	Khan & Rudolph (1997)

Left: Figure 2.2.2 Development of soft rot on *Clivia miniata* seedlings inoculated with each isolate: (a) seedling inoculated with the isolate from Howick; (b) seedling inoculated with the isolate from Nelspruit.

Below: Figure 2.2.3 Colonies of (a) Howick isolate and (b) Nelspruit isolate, on tryptone soy agar (TSA) incubated for 72 h at 25 ± 2 °C.



isolates possessed soft rot abilities and were potentially the pathogens responsible for the disease symptoms observed.

I confirmed their pathogenicity on *C. miniata* by inoculating healthy seedlings with a suspension of each isolate. Soft rot symptoms developed on the plants shortly after inoculation. These were similar to those that I initially observed (Figures 6, 7 and 8 in the previous report) and are depicted in Figure 2.2.2. The bacteria that I reisolated from the rotting seedlings were morphologically identical to my original isolates, which lead me to conclude that these isolates are the bacteria capable of causing soft rot diseases of *C. miniata*, and possibly other *Clivia species.* Colonies of each isolate are shown in Figure 2.2.3.

I initially thought that what I had isolated were *Pectobacterium* species, in line with that reported by Laing (2009). However, the results from my DNA sequencing investigationsindicate that the bacterial isolates currently being studied are not the same as those reported by Laing (2009), i.e., they are not a Pectobacterium species. The isolate from Nelspruit appears to be a Pseudomonas species but I have not yet had definitive results with the Howick isolate and am attempting DNA sequencing again.

My results seem to highlight that soft rot diseases of Clivia are actually caused by a wider range of bacteria than we initially thought and that the bacterial species assemblage associated with this disease complex requires further study.

I think that the bacteria that cause rots of *C. miniata* and other *Clivia* sp. are environmental inhabitants that do not normally cause diseases unless something in the environment is imbalanced in some way. As I mentioned in the

previous report, hot and humid environmental conditions encourage bacterial growth to higher levels than normal, combined with plants that are stressed (due to heat, lack of water, nutrient imbalances, infection with other diseases etc.) leads to outbreaks of these bacterial soft rots. Any physical damage to plant organs like leaves or roots (caused, for example, by insect pests or improper chemical applications or sunburn) provides sites of entry for bacteria to easily infect plants.

It is impractical to attempt to completely eradicate bacteria and the soft rot diseases they cause from the environment because bacteria are so widespread and multiply so rapidly. Antibiotics have been applied to control bacterial diseases in the past; the bacteria have shown their resilience by rapidly developing resistance. Healthy plants are better able to defend themselves against pathogens than stressed plants are and bacterial diseases are thus best controlled through the implementation of cultural practices that ensure the healthiest plants possible. There is an avenue for research focussing on the isolation of viruses that use bacteria as their hosts (bacteriophages) from the environment and assessment as to whether any will be able to control the bacterial strains I have isolated for a potential long term control strategy.

References:

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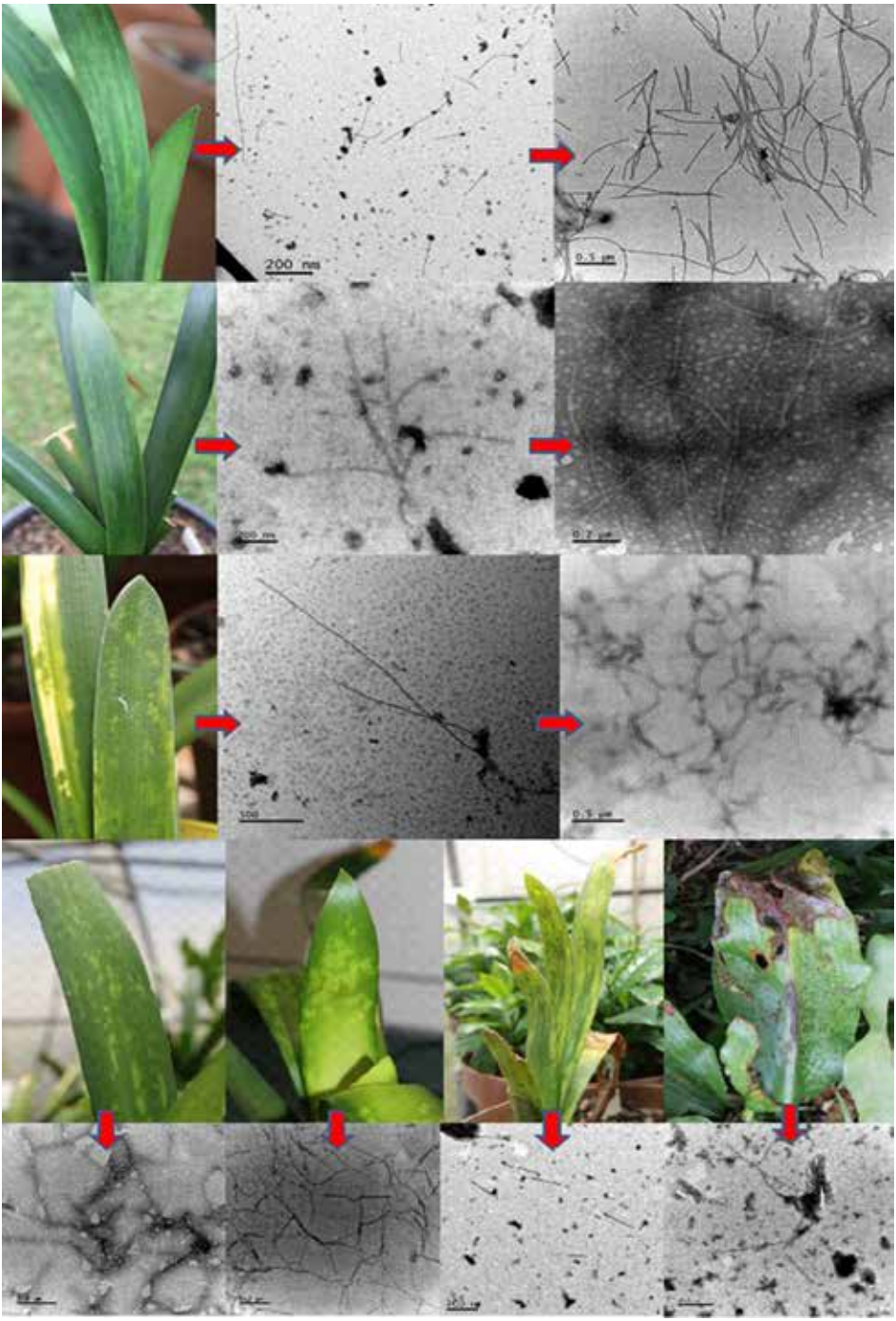
2.3) Virus diseases of *Clivia*

I reported previously the presence of virus particles in *Clivia* plants displaying symptoms of viral infection and a tentative identification of these viruses as a closterovirus. The hsp70 gene that I reported to have amplified is found in both plant and closterovirus genomes and the DNA sequencing results I obtained indicated that the DNA products I illustrated in Figure 14 are actually plant DNA and not from viruses. I realised that I did not manage to effectively exclude all plant DNA from the samples that I analysed. I thus need to retract their identification as a closterovirus species.

I needed to work with purer samples of each virus to ensure more accuracy with my results. I decided to attempt to purify virus particles from the leaves of plants showing symptoms of virus infection. I was unable to find any protocols that have described virus purifications from *Clivia* plant material. I based my attempt

Opposite page: Figure 2.3.1 A compilation of *Clivia* plants showing virus-like symptoms: a-j are from the plants I initially thought were infected with closteroviruses (CMB= *Clivia miniata* Benoni, CIH= *Clivia interspecific* Howick, CCM= *Clivia caulescens* Mariepskop); a,d and g are symptomatic leaves of each plant; b, e and h are transmission electron micrographs of virus- like particles isolated from the sap of infected leaves; c, f and i are transmission electron micrographs of virus-like particles purified from symptomatic leaves of each plant; i and j are plants (CEVZ = *Clivia* 'Elsa van Zyl', CUY = *Clivia* 'USA Yellow') I received for analysis from members of the Lowveld Clivia Club; n and o are virus-like particles purified from the leaves shown in i and j; l and p show symptoms and virus-like particles isolated from the sap of CIH (an interspecific from Nelspruit); l and p show symptoms and virus-like particles isolated from the sap of SPP (a *Scadoxus puniceus* from Pietermaritzburg that I thought was infected with a closterovirus).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on a protocol successfully used by some of my colleagues for purification of viruses similar in morphology to what I observed and reported in Figures 11, 12 and 13 of my previous report. I modified the protocol I was given and managed to successfully purify virus particles from the leaves of three plants with virus-like symptoms. My investigations into viral diseases of *Clivia* is summarised in Figure 2.3.1.

I have searched for literature pertaining to virus infection of clivias worldwide and was able to generate Table 2.3.1, which summarises all available reports of viral diseases affecting *Clivia*.

It is evident that research into the field of viral diseases of *Clivia* species and hybrids is still in its infancy, particularly in South Africa. Using the information in Table 2.3, I excluded tospoviruses as the cause, since the particles of tospoviruses are spherical. I then attempted to test for the presence of potexviruses, due to Hammet's report from New Zealand. I was unable to generate DNA products from these viruses using potexvirus-specific tests and I therefore exclude potexviruses as the cause too. There still exists the possibility that these viruses are new and unnamed viruses, therefore I need to investigate their identities further.

I have taken steps towards further study of these viruses by mechanically inoculating susceptible tobacco plants with ground up leaves and sap of CIH. This is standard for assessing the host range and transmissibility of viral isolates. The response of inoculated plants compared to control plants is shown below in Figure 2.3.2.

Plants inoculated with leaf material and sap of CIH appeared stunted compared to: plants inoculated with water instead of infected leaves/sap and plants not inoculated at all. Besides apparent stunting and slowed growth rates, the tobacco plants that I inoculated did not seem to show any other symptoms that are usually associated with viral infection (leaf distortion, mottling and streaking etc.). I thus found the results from this transmission study inconclusive.

I have attempted to use molecular methods to test for the presence of three virus genera; Closterovirus, Potyvirus and Potexvirus. These molecular tests were carried out through the use of reverse transcription (RT) to convert the RNA of these suspected viruses (isolated and purified from symptomatic *Clivia* leaves) to DNA and then PCR using primers reported in available literature to be specific to each virus group mentioned above. I have not been able to amplify definitive viral DNA products from any of my purified virus samples using the primer sets I have tested thus far. The implication

Table 2.3.1 Worldwide reports of viruses infecting the genus *Clivia*

Genus	Species	Symptoms of infected plants	Clivia species	Country reported	Reference
Potexvirus	Undetermined		*Clivia* hybrids	New Zealand	Hammet (2004)
Potyvirus	Narcissus late season yellows virus (NLSYV)	Streaking and mottling of leaves	*C. gardenii*, *C. miniata* 'Belgium hybrid', *C. miniata* var. *citrina*	Australia	Adcock (2007)
Tospovirus virus (IYSV)	Iris yellow spot *Clivia* spp. Tomato spotted wilt virus (TSWV)	Streaking and mottling of leaves	*Clivia* spp.	Japan Holland, USA	Jones (2005); Gent *et al*. (2006) McDonough *et al*. (1999)

is that these viruses may be novel and that further, detailed study is necessary for conclusive identification of the viruses observed.

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McDonough, M.J., Gerace, D. & Ascerno, M.E. (1999) Western flower thrips feeding scars and tospovirus lesions on petunia indicator plants. http://purl.umn.edu/51809. Accessed 05/07/2013.

Conclusions and future research:

The disease tables I present in this report (Tables 2.1.1, 2.2.1 and 2.3.1) summarise all the literature I could find that has been published on investigations into *Clivia* diseases. These are adapted from tables I have compiled on ornamental plant diseases and included in my literature review. I have been using these references as starting points for my research techniques and also to point me in the direction that I need to follow in order to confidently identify the pathogens that I have shown to be present in association with each disease. I am currently in the process of attempting to identify the fungal, bacterial and viral isolates I have been working with to the best of my ability.

As I have mentioned in previous reports, adequate control can be implemented only once the pathogens have been adequately identified. I feel that my brief foray into *Clivia* disease research (both identification and control) highlights how little-studied the field is and that much of the international literature has only recently been published or is not freely available, particularly

Figure 2.3.2 Plants of *Nicotiana tabacum* 'Xanthi' mechanically inoculated with symptomatic leaf material of an interspecific *Clivia* hybrid.

in South Africa. I feel that I have made good progress with the study of all three diseases I have been looking at but that all three issues require more study, particularly since there has been so little previously reported in South Africa.

I have made an application to the University for an upgrade of my MSc registration to PhD. I am still waiting to hear the outcome of my application. If I am successful, this will allow me the time I mention to study these and possibly other *Clivia* diseases further and to begin to look at testing various control measures for the diseases I have been studying, for example: testing various fungicides on the control of the Colletotrichum-induced leaf spots and lesions that so many growers experience.

I hope that this report serves to effectively communicate to the Clivia Society what I have being doing since my previous report, how and why I did it and what it means to the clivia grower. This report is a summarised version of my in-progress thesis chapters, which include detailed reports on the techniques I have mentioned that other researchers will be able to follow and build on.

Unlocking the potential of interspecific breeding

Carrie Kruger

Interspecific *Clivia* flowers hold the added appeal of extending the flowering season. With the forming of the first flower, on crosses made four or five years previously, excitement is in the air. The hope that the flower will bloom in a way anticipated from your crossing, holds you in suspense and hope.

With all *Clivia* breeding there are good and disappointing results. Occasionally there are some outstanding results, which justify the time and effort spent hybridising the plants.

The range of colours found in the interspecific crosses, provides a treasure trove of hidden genetics. Most of the new and unusual colours found in clivia today originate from

Fig. 1 Star Green Destiny – Carrie Kruger

Fig. 2 'Ember Spirit' – Carrie Kruger

Fig. 3 'Planet Earth' – Carrie Kruger

Fig. 4 'Lucid Dreams' – Carrie Kruger

Fig. 5 'Over the Moon'– Carrie Kruger

the interspecific breeding programmes. The inclusion of the interspecific plants in a breeding programme, may be considered a 'new age' of clivia breeding.

As with many breeding programmes, patience is needed. Some of the F1 hybrids of interspecific crosses, provide pleasing results, but the largest improvement takes place with the second generation. Many of the F1 hybrids are tubular with a slight flare, which is not that spectacular. Many breeders may be discouraged by the appearance of the F1 hybrid flower, but will be rewarded when the F2 hybrids flower.

The interspecific breeding popularity is a relatively recent development. When I started breeding interspecifics, several years ago, the choice of plants was limited. Most of the plants available were mainly the tubular F1 hybrids. Selecting from these hybrids, for the best flower shapes and colours, I started our breeding programme. I now use the best of our F2 hybrids, making either sibling crosses or self-pollination.

Working with the interspecific plants has made me aware of the large gene pool involved in these crosses. As a result, the offspring colours are not always guaranteed. Ideally, I would grow all these plants to a flowering stage and then select the best. Unfortunately, like most breeders, I do not have the space to keep the plants until they flower.

Advice I can offer from breeding with interspecific clivia plants:

Start with superior F1 and F2 plants from the start. By doing this you will save a good few years in your programme, instead of starting from scratch.

We have bred some superior versi-colours flower plants from non-versi- coloured parents, for example 'Ember Spirit' Fig. 2. Versi-colour traits are carried over in the pollen as well as pod parent plants.

Avoid using miniata pollen, too often, on the interspecific cross. The repeated use of miniata pollen may result in an inferior looking 'miniata' type flower.

Fig. 6 'Mirror Beauty' – Carrie Kruger

Results from self-pollinating F2 hybrids have often resulted in flowers that are superior to the parent. Consider self- pollination as an option when developing your interspecific plants. An example of this is 'Planet Earth' Fig. 3.

When you do decide to hybridise plants, know which groups your plants belong to, to avoid unwanted orange offspring.

To produce shorter leafed plants, use a compact plant as a parent. I have been working with a yellow Daruma plant as a parent, producing good results. 'Mirror Beauty' Fig.6 is a good example of this type of cross.

Crossing your interspecific plants with either variegated or LOB type plants have resulted in beautiful plants. "Light of Africa" is an example of this type of cross. This cross was made by Francois van Rooyen.

Plants I used in breeding the various hybrids

Fig 1: 'Star Green Destiny' - F1 of 'Star Green Original' ('Star Green Original' is a F2 bred by Nakamura)

Fig 2: 'Ember Spirit' – 'Carnival (*miniata* x *gardenii*) x 'Secret Wish' ('Stella Parish' *miniata* x *gardenii*) x Grp1 Yellow)

Fig. 7 'Carnival' – Carrie Kruger

Fig.3: 'Planet Earth' – 'Jupiter' (*gardenii* x *miniata*) x (*miniata* x *gardenii)* x Self

Fig 4: 'Lucid Dreams'- 'Dreaming' (Best Nakamura F1 x self) x sibling

Fig 5: 'Over the Moon'- 'Secret Whisper' ('Stella Parish' *miniata* x *gardenii* x Grp1 Yellow) x 'New Moon' (Yellow F2 interspecific)

Fig.8 'Jupiter' – Carrie Kruger

Fig 6: 'Mirror Beauty'- (Yellow Daruma x *mirabilis*) x Yellow Daruma

Fig 7: 'Carnival' = (*miniata* x *gardenii*)

Fig 8: 'Jupiter' = (*gardenii* x *miniata*) x (*miniata* x gardenii)

Fig 9: 'Dreaming' = (Best Nakamura F1 x self)

Developments and observations

The popularity of the interspecific hybrids has grown in the past few years and continues to attract many collectors and breeders. Many clubs now have exhibitions of the interspecific flowers. The advantage of the interspecific flowers is that they flower from the beginning of June up until the end of August in the Southern hemisphere. They often flower at odd times during the year, extending the flowering season of the *Clivia* plants.

Another advantage of interspecific flowers is that they are more disease resistant than the *Clivia miniata*. Interspecific plants grow faster and multiply well with some of the plants forming offsets before they have flowered.

The range of colours and flower forms are unlimited. These plants should be found in every collection.

I look forward to the next year's variety of interspecific colours!

Fig.9 'Dreaming' – Carrie Kruger

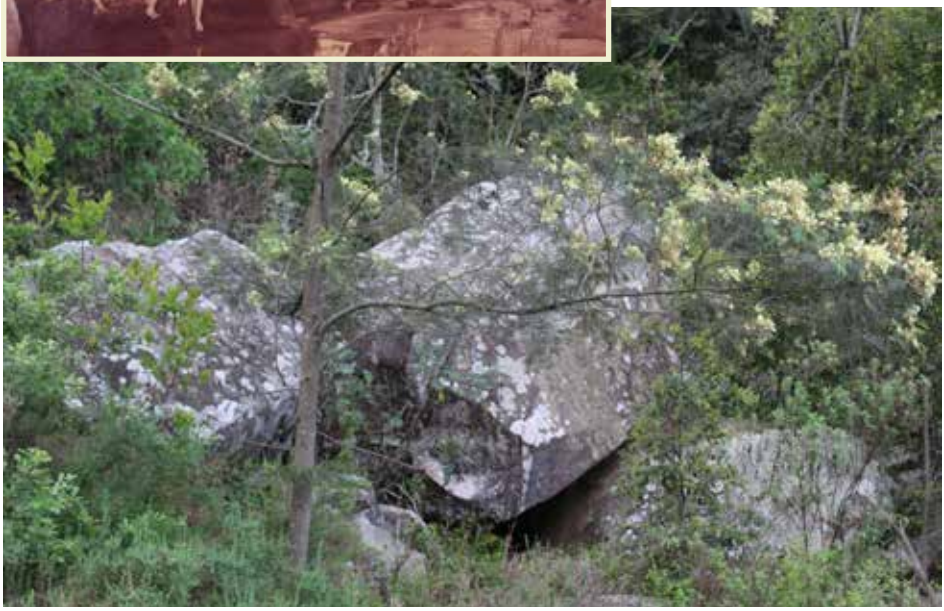
Site Description: "The Dassies" Greytown area

KZN club contribution, prepared by Felix Middleton

John van der Linde presented a talk at the 2018 International Clivia Conference which was titled "the great Chinese Clivia Bubble". In this presentation John described the boom and bust cycle of value growth and decay which is often associated with the marketing of ornamental plants. As introduction he provided a speculative but rather credible account on how *Clivia* might have migrated to the Orient via the German Missionary workers in South Africa. A total of 126 German missionary stations were established in Southern Africa during the eighteen hundreds, bringing not only the Scripture but also training indigenous peoples in farming techniques. The missionaries who were posted in Hermannsburg, Wartburg and Lunaburg were known to be ardent botanists and could have been the link for some of the Clivia introductions abroad.

By chance the Hermannsburg School Foundation asked me just the week prior to the conference if I knew of a botanist who would be willing to present a talk at their fundraising dinner. I asked John if he would be willing to address some of the German descendants of the missionaries who he was

Picture 1 –'Then'

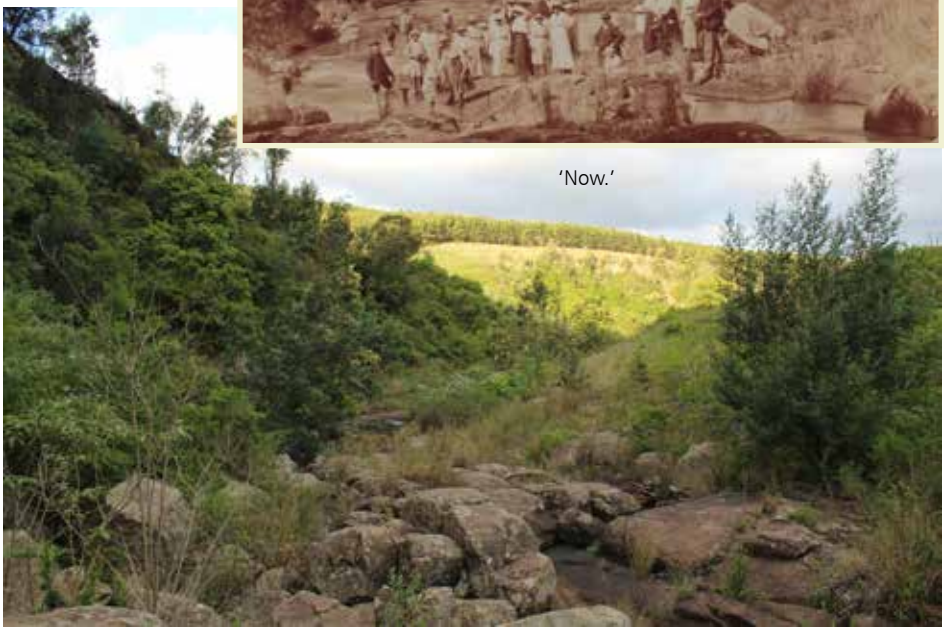


Picture 2 – same site now.

referring to in his talk and he accepted the challenge. We needed an old photograph of the missionaries to use in the advertisement for the dinner. My wife is the assistant curator at the Hermannsburg Museum, so instead of pestering John for a picture from his talk, I asked her if I can photocopy one from the museum archive. She presented me with the one shown in Picture 1.

The site where the subjects were photographed is well-known to me. It is situated about 10km from my house in a bend in the upper reaches of the Hlambitwa River. The Hlambitwa River is a tributary to the Umvoti River. For the past few years we have been documenting all the isolated forested areas where indigenous trees still grow within the vast plantations around Hermannsburg. This is one of the few sites where there are still some *Clivia miniata and C. gardenii* to be found. Most other indigenous forest patches have either been ruined to make way for subsistence farming or have been so infested with pine and wattle seedlings from the adjacent plantations that very little natural underbrush survive. I found this undisturbed site in 2014 and have been visiting it annually to follow the flowering cycle of *Clivia*. The colours of the flowers are mainly dark orange but there are a few with lighter shades. Variation is mainly in the colour of the flower throat. Most of the flowers are with yellow throats but a few have white and there are even some with green throats. An interesting phenomenon occurred in 2016 when very few plants produced flow-

'Then'



'Now.'

ers. They all pushed umbels but almost all were infested with worms during the bud stage. As a result no seed set that season but the flowering in 2017 was spectacular.

Let's get back to the photo in picture 1 which was taken around 1890. In the right bottom quadrant is a small boy holding a single flower. It is odd that he is the only boy in this picture who is holding a flower. He seemed to have dropped the others just before the picture was taken. Furthermore, the flowers are clearly *Clivia* and with a little imagination we may surmise that it is a yellow or light form of *C. miniata*. Al the other flowers that are held by the subjects seem to be *Clivia* but are dark in comparison to this one single umbel.

The scholars and teachers of the Hermannsburg missionary station often held picnics at this site. The site was then called "The Dassies" due to the large population of Rock Hyrax that were living among the rocks. There are still some rock rabbits living there but the population has decreased in recent years. We found over 30 pictures of these outings all dating back to the period between 1880 and 1920. Although the details in many of these pictures are blurred, others do show individuals holding bunches of *Clivia*. These picnics were organised to celebrate the onset of spring. They were mostly organised during September and October after the cold winters but before November which marks the onset of the rainy and misty season. The rain would have made travel on the muddy roads a nightmare and the mist would have damaged the photographing equipment.

Yellow *Clivia* from the area

When I moved to Hermannsburg in 2008, the garden was unkempt but contained many *Clivia* and *Agapanthus*. The original owners loved gardening and were enthusiastic plant collectors. There was one patch of *Clivia* that was special to me. This favourite patch of plants had 10 umbels of yellow flowers in 2009. I split the clump and gave many of these yellow flowering plants away as they did not have a great form. I labelled the offsets HMB Yellow. It later came to my attention that many gardens in the town contained this yellow clone. Unfortunately the origin to the HMB yellow clone is lost as no one could recall its source. One theory is that it could have originated from

Examples of *Clivia* flowering in the area.

the German trader who owned a shop on the road to Stanger in the mid nineteen hundreds as he sold flowering *Clivia* plants during spring. These plants were apparently collected from a farm near Hermannsburg. Another explanation could be that the original clone came from the Dassies site and spread through the small town over the years. The yellow clone has a thin leaf with a sharp point that is typical to the *Clivia* that grow on the Hlambitwa River. However, the form of the flower is more like the plants found to the South of the site on the Ersken Farm.

One other spectacular plant from near the area to the South is Vroegop Yellow, a yellow *C. gardenii* that was discovered on a privately owned farm in 2012. An offset of Vroegop Yellow was collected and documented with Ezemvelo Plant Collection Permit # OP49/2016 and has been presented to the Botanical gardens in Durban for preservation in their heritage collection. Unlike other natural yellow variants in nature, there were more than one clone of this yellow. To date thirteen different clones have been documented, all with slight differences in leaf, and flower characteristics.

The first documented yellow *C. miniata* was collected in Zululand in 1888. It was named Saunders yellow to honour the Saunders family who were instrumental in its discovery and documentation. It was later formally described as *C. miniata* var. *citrina*. Collectors now refer to this clone as Eshowe yellow as it was collected in the Eshowe area. If the *Clivia* in picture 1 was a yellow, it is likely the first yellow *C. minata* ever discovered as the date of the picture precedes the discovery of Saunders yellow. Unfortunately the identity of the boy in the picture is not known. But one thing is certain, he was an ardent *Clivia* enthusiast, not being ashamed to be seen by future generations as the only boy holding flowers in this picture!

Acknowledgements

- John van Der Linde for his efforts to connect the dots.
- The Hermannsburg Museum for allowing the reprinting of the photographs.

CLUB SHOWS 2018

Toowoomba Clivia Club show

The 2018 Toowoomba Clivia Society's Clivia Show held at the TAFE Horticultural Centre was again a great success over the 6 days of the Show. Over 140 plants were on display this year as well as seeds, seedlings and plants available for sale. This was the 13th show held at the TAFE College. We were privigiled to have Mr. Kev Larsen, our Patron and a founding Member of our Society officially open the show. Kev is also a Nursery owner and is well known in Toowoomba/Fernvale area for his very informative *Clivia* knowledge. We are very proud of the fact that we raise much needed funds for our nominated charity each year through our gold coin donation entry and our raffle. We presented a cheque to Beyond Blue, an organization assisting in the mental health area for $3,500. We were visited this year by the Premier of Queensland, Annastacia Palaszczuk who was awestruck by the beauty


Lionel Marten received the Kevin Walters Trophy for Best Plant on Display, as voted by the public. Plant, Grace Miller

of the displayed plants shown in the attached Show photos. Our congratulations went to Lionel Marten who won the Visitors Choice, Kevin Walters Trophy for 2017 as well as for 2018, this year with his Clivia named Grace Miller, hybridized and owned by L & J Marten.

Melbourne Clivia EXPO 2018

Lisa Fox

Despite the concerns of the members that there would not be enough blooms for the show, owing to the cold weather, the 2018 Clivia EXPO the best one to date. The quality of the plants surpassed all other years and the public complemented us on the huge variety of colours, sizes, shapes of the flowers. The variegated *Clivia* leaves held a strong attraction for several visitors.

There was a steady stream of visitors throughout the day. The busiest part of the day was the early morning, witheveryone looking for the best plants on the sales tables. Sales were well represented by four individual sellers plus the 'Trading Table'. Visitors enj oyed the display plants, the floral art, demonstrations, raffle, and took advantage of the relaxed atmosphere, enjoying coffee, tea, cake and sandwiches surrounded by a mass of coloured flowers.

Tanchoo

We were very pleased to see a good number of new members sign up with the club. We look forward to welcoming these new members at out next meeting.

This year, 2018, we held a live auction of 26 quality plants and a *Clivia* print. The auction was well attended, with bidding constant and at times, fierce. The auction is an opportunity for members of the public to bid on rare plants that are generally not available to them, and it was great to see the public bidding and winning plants, not just the enthusiasts. The winning prices varied between $55 and $320 with the highest price being paid for the well-known peach, Comet. Five green flowering plants were sold for prices between $150 and $280 proving that the plants remained popular with the public.

'People's choice'
The winning plants with their owners. Alan O'Leary, Peter Haeusler and Terry Edwards.the requisite permit from the local authorities.

A few well-bred red bronze flowering plants sold at prices ranging from $130 to $200 and offsets of Sir John Thouron, The Artist and a yellow *C. caulescens* reached into the $200s. A few lots did not sell during the auction but several were sold after the auction. Two lots were very kindly donated to the Melbourne Clivia Group by Hugh Williams and Helen Marriott.

The People's Choice Awards

The most popular flower, chosen by the public was Tanchoo 1 x Tanchoo 2 owned by Peter Haeusler. The second most popular flower was 'Best Kept Secret', owned by Alan O'Leary and the third place was awarded to 'Terry's Green', bred and owned by Terry Edwards. These are three very beautiful plants and worthy winners of the show.

We look forward to the challenge of making the 2019 show bigger and better than our 2018 show.

PHOTOGRAPHIC ENTRIES

HABITAT ENTRIES

Winner – 'Habitat' – category – Chris Holtzhausen

Second – 'Habitat' – category – Felicity Weeden

Third place – 'Habitat' – category – Alfred (snr) Everson

SINGLE FLOWER ENTRIES

Winner – 'Single flower' – category – Andrew Kajewski

Second – 'Single flower' – category – Pieter Saayman

Third – 'Single flower' – category – Helen Marriott

'OTHER CLIVIA PHOTOS' - CATEGORY

First place – 'Other clivia photos' – category – Helen Marriott

Third place – 'Other clivia photos' – category – Helen Marriott

Second place – 'Other clivia photos' – category – Helen Marriott

INTERSPECIFIC CATEGORY

Winner – 'Interspecific' – category – Carrie Kruger

Second place – 'Interspecific' – category – Andrew Kajewsky

Third place – 'Interspecific' – category – Pieter Saayman

PENDULOUS CATEGORY

Winner – 'Pendulous' – category – Carrie Kruger

Second place – 'Pendulous' – category – Andrew Kajewsky

Third place – 'Pendulous' – category – Pieter Saayman

'CLIVIA MINIATA' - CATEGORY

Winner – '*C. miniata*' – category – Dawie van Heerden

Second place – '*C. miniata*' category – Carrie Kruger

Third place – '*C. miniata*' category – Dawie van Heerden

OTHER PHOTOS OF INTEREST

'Pendulous species' – Henry Howard

Pendulous species – Carrie Kruger

'Single flower' – category – Andre du Toit

'Single flower' – category – Andrew Kajewski

'Single flower' – category – Carrie Kruger

'Interspecific flower' – category – Pieter Saayman

'*C. miniata*' – category – Carrie Kruger

'*C. miniata*' – category – Frikkie Potgieter

'*C. miniata*' – category – Felicity Weeden

'*C. miniata*' – category – Frikkie Potgieter

'C. miniata'
– category –
Henry Howard

bELOW:
'C. miniata'
– category –
Mike Riska

'*C. miniata*' – category – Pieter Saayman

'*C. miniata*' – category – Andrew Kajewski

'*C. miniata*' – category – Marilyn Paskert

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