Grafting Part 1

The 2014 GBald on MGeo graft in February 2019.

The following piece is part of a collection of writings published on the Practical Small Cacti Malaysia site.

Introduction

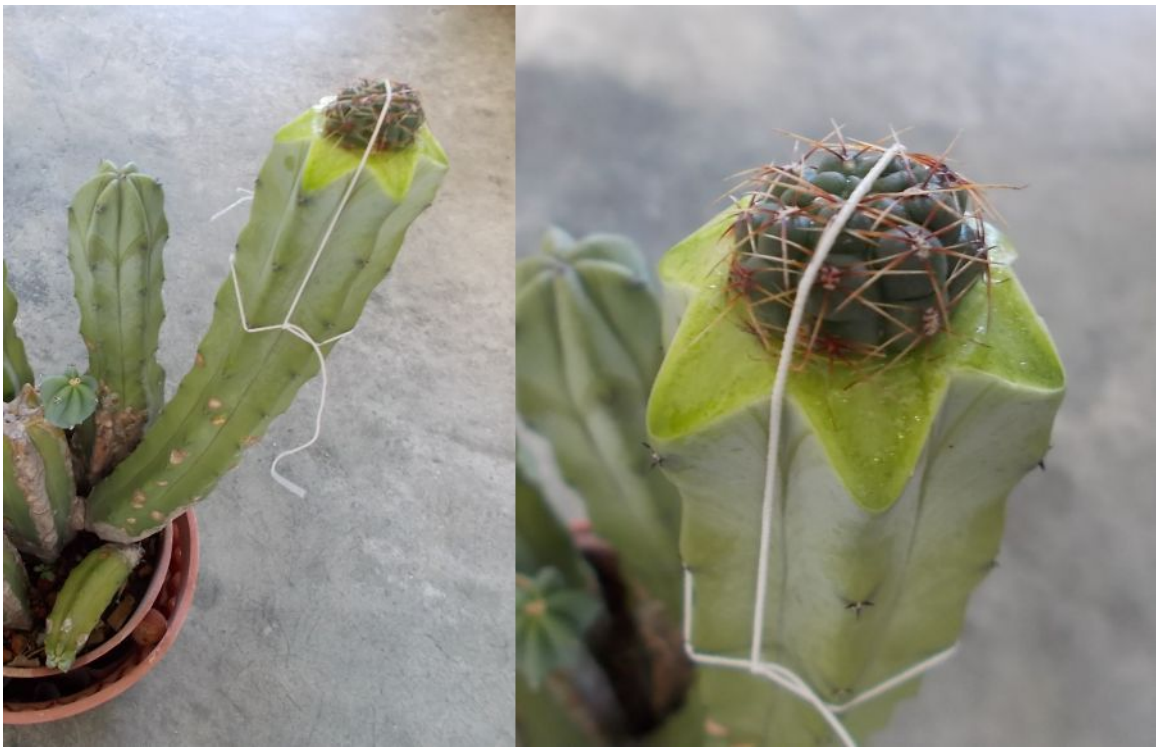
This chapter discusses the lifecycle of a single specimen, a GBald-on-MGeo graft done in March 2014. It has exhibited a number of interesting behaviours.

Nicknames for Scientific Names

PMag = *Parodia magnifica*	GBald = *Gymnocalycium baldianum*
PClav = *Parodia claviceps*	MGeo = *Myrtillocactus geometrizans*
GStella = *Gymnocalycium stellatum*	GSteno = *Gymnocalycium stenopleurum*

This naming scheme is purely for convenience. Just think of them as webchat nicknames.

In the Beginning



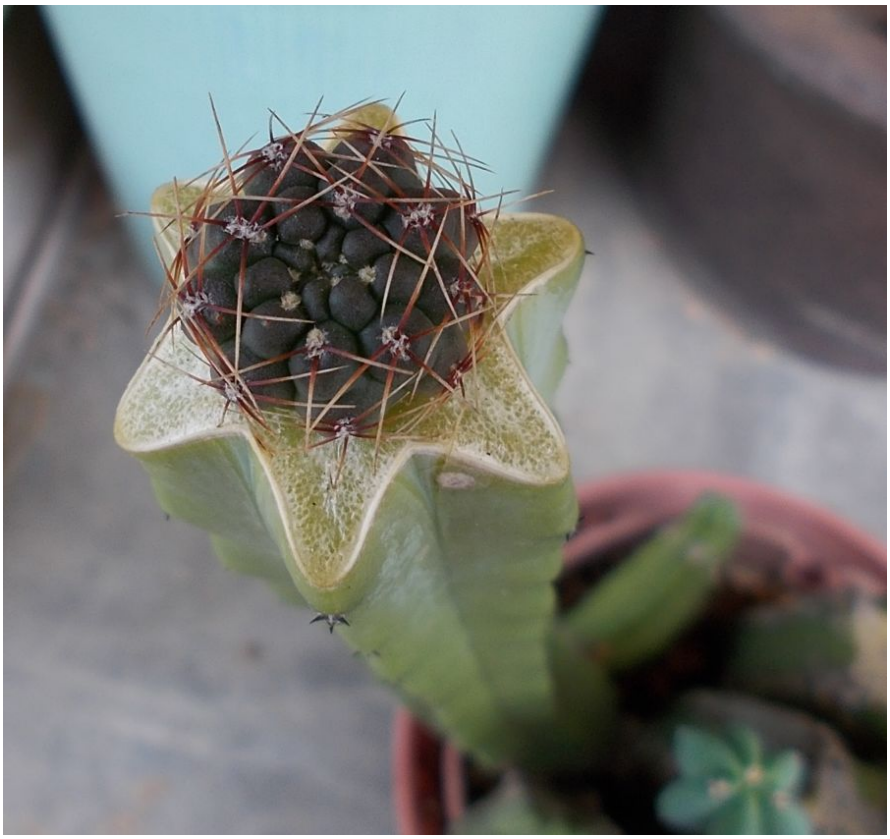
Just after the grafting operation was performed, March 2014.

I follow standard techniques without any extreme cleanliness measures. The GBald part is normally called the scion (*sai-uhn*), while the MGeo bottom part is the stock[1]. The GBald was about half an inch in diameter. This 2014 graft was the first one for which I have a good picture record.

My standard tools are: box cutter, denatured alcohol[2], and elastic thread or rubber bands. Elastic thread is easier to use than rubber bands; you can find it from a place selling tailoring supplies. A fat MGeo stem will shrink a lot, so it must be cut at an angle otherwise shrinkage will cause the scion to become detached. For fat juicy MGeo stems, do not use the shrink wrap method as the exposed tissue shrinks too much. Align the vascular bundles of both parts, then tie them up. I also use a long MGeo spine to pin the scion onto the stock plant. Poorly aligned grafts grow slowly. After about a week, the elastic thread can be removed.

1 Actually, ‘rootstock’ is the proper term, but ‘stock’ is really popular. I’m not interested in being a language police.
2 Make sure the alcohol dries before applying the blade onto your plants.

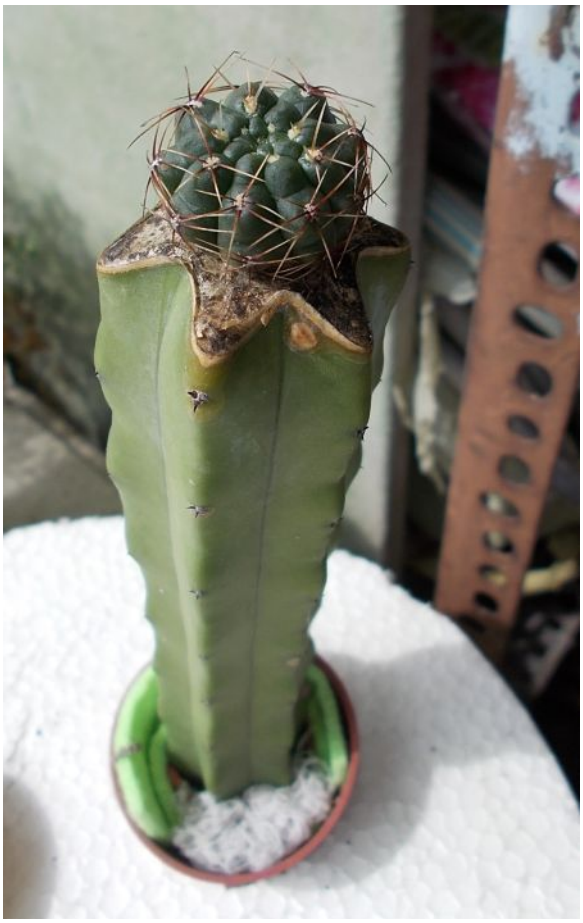
The day after the graft was performed, March 2014. Without the sloping cut, contact between the two parts will be lost because the exposed MGeo tissue shrinks a lot.



Ten days after the graft was performed, April 2014.

Twenty days after the graft was performed, the MGeo stem was detached. April 2014.

In order to maximize growth speed, deep water culture (DWC) was attempted (picture below.) Looking at the performance of my 2019 grafts, steady feeding compares *very well* to DWC and so at this time (2020) the use of DWC or cactus hydroponics is not currently a priority for me.



After the cut area was well-callused, the specimen was put in deep water culture (DWC) as an experiment to maximize growth speed. (May 2019)

The setup uses a pail (painted on the outside to block sunlight) and a styrofoam cover. The hydroponic AB solution was intended for hobby vegetable growing, and it was a local product that came in 2 bottles of concentrate. At a standard mixing ratio of 1:200, the AB solution mix had an EC of around 2000 µS/cm.

Generally, I think there is no problem with MGeos in DWC. However, GBalds in DWC is a riskier proposition, as the fine roots of GBalds have trouble surviving in water. So, a GBald-on-MGeo graft in DWC is a fairly low risk thing.

Growth and First Flower

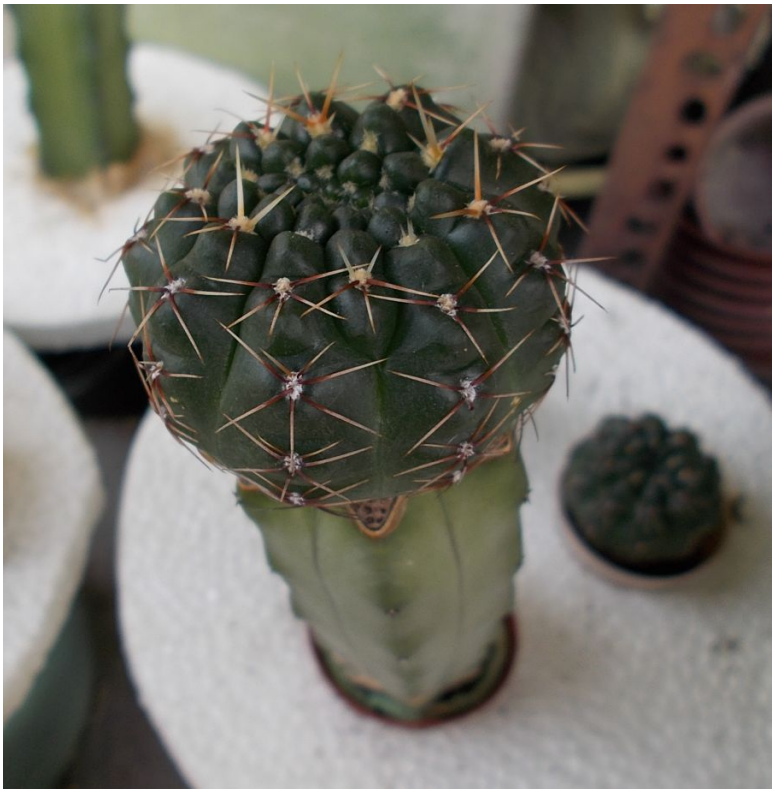
Looking much larger after nearly 3 months in DWC. (August 2014)

Signs of growth should be visible within a month. If growth is strong, then the graft is a good one. For my 2019 batch, I have two grafts that grow poorly but otherwise look fine. For poor grafts, you might want to re-graft and perhaps replace the scion.

Interestingly, the grafted specimen did not put out offsets, even though it is in DWC with a hydroponic solution that is meant for leafy greens. Two GBalds in the same pail did not put out offsets either. GBalds are not voracious feeders – I did some casual checking of the solution and the EC reading reduced rather slowly. I would put the blame on weak transpiration pumping.

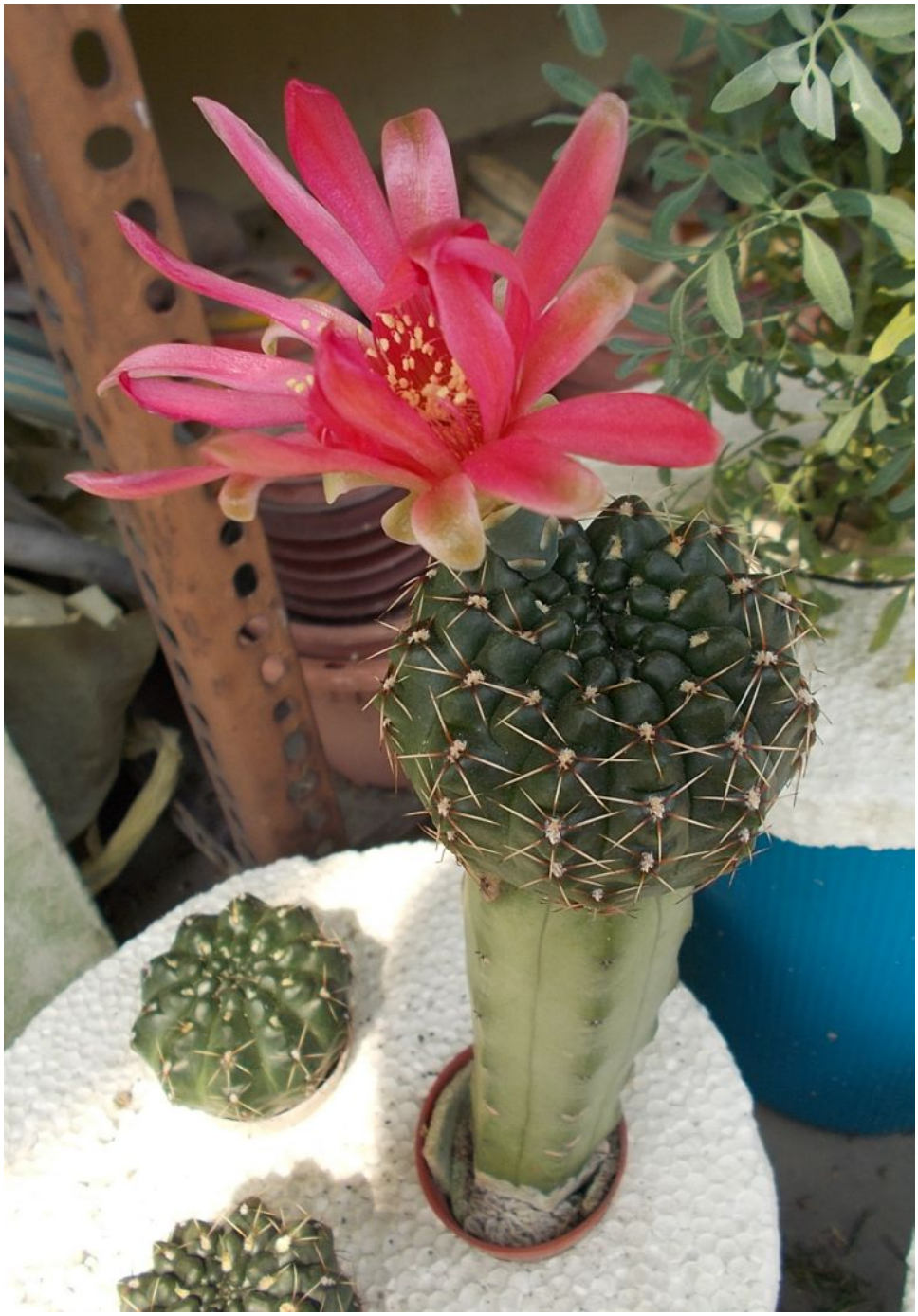
Since 2019, I had a batch of another six GBald-on-MGeo grafts to compare to this one. Those were grown in a mix with scoria and pumice and they got steady feeding. The performance of the 2019 grafts were comparable to this 2014 specimen – there is no significant advantage from using DWC.

GBalds are weak feeders probably because of their weak transpiration pumping, so they will never feed as fast as leafy greens in hydroponics, or grow significantly faster than well-grown GBalds in pots. Also, the fibrous or fine roots of GBalds do not last very long in DWC. So GBalds in DWC is not a super cool trick.



At 11 months, the GBald graft is now looking like a fine specimen. At right is a GBald in the same pail. The sizes are comparable at this point. (February 2015)

Its first flower bud is visible in mid-June 2015, 15 months after grafting.



The first flower of the GBald-on-MGeo specimen at the end of June 2015. The two GBalds in the same pail started as larger specimens than the GBald scion, but the grafted scion has overtaken the two GBalds in terms of size, and it has better spines.

For this 2014 specimen, the GBald went from graft to first flower in about 15½ months. This is comparable to the performance of my six 2019 specimens. Two 2019 grafts flowered in just under 1 year, while another two flowered after about 17 months. The final two of the 2019 specimens were growing less strongly, but both flowered in late September 2020, after about 17½ months.

Growth and Flowers

With 2 flowers at 2 years old, in April 2016.

A GBald on MGeo graft is a great way of growing GBalds without worrying about how their root systems will fare. But such a specimen will still do the shrinking thing – if this behaviour is controlled by the GBald scion (specifically the apex or growing point) via chemical signals, then this kind of GBald graft will always shrink.

According to my picture archives, it produced 22 flowers in 2017, 19 flowers in 2018, 40 flowers in 2019, 52 flowers in 2020, and 18 flowers in 2021 (Jan–May). It produced a maximum of 7 flowers in one month in May 2019 but has since exceeded that number in February 2020 (10 flowers) after it fell off from the MGeo stock. Complete charts can be found in the chapter on Data and Charts.

The specimen’s first 5-flower display, August 2016. The graft is 28 months old.

As the GBald scion grew larger and stronger, it produced more flowers, and also more simultaneous flowers. As such, we should aim to grow GBalds as large as possible in order to maximize the number of flowers. Of course, the shrinking complication may mess up our grand plans.

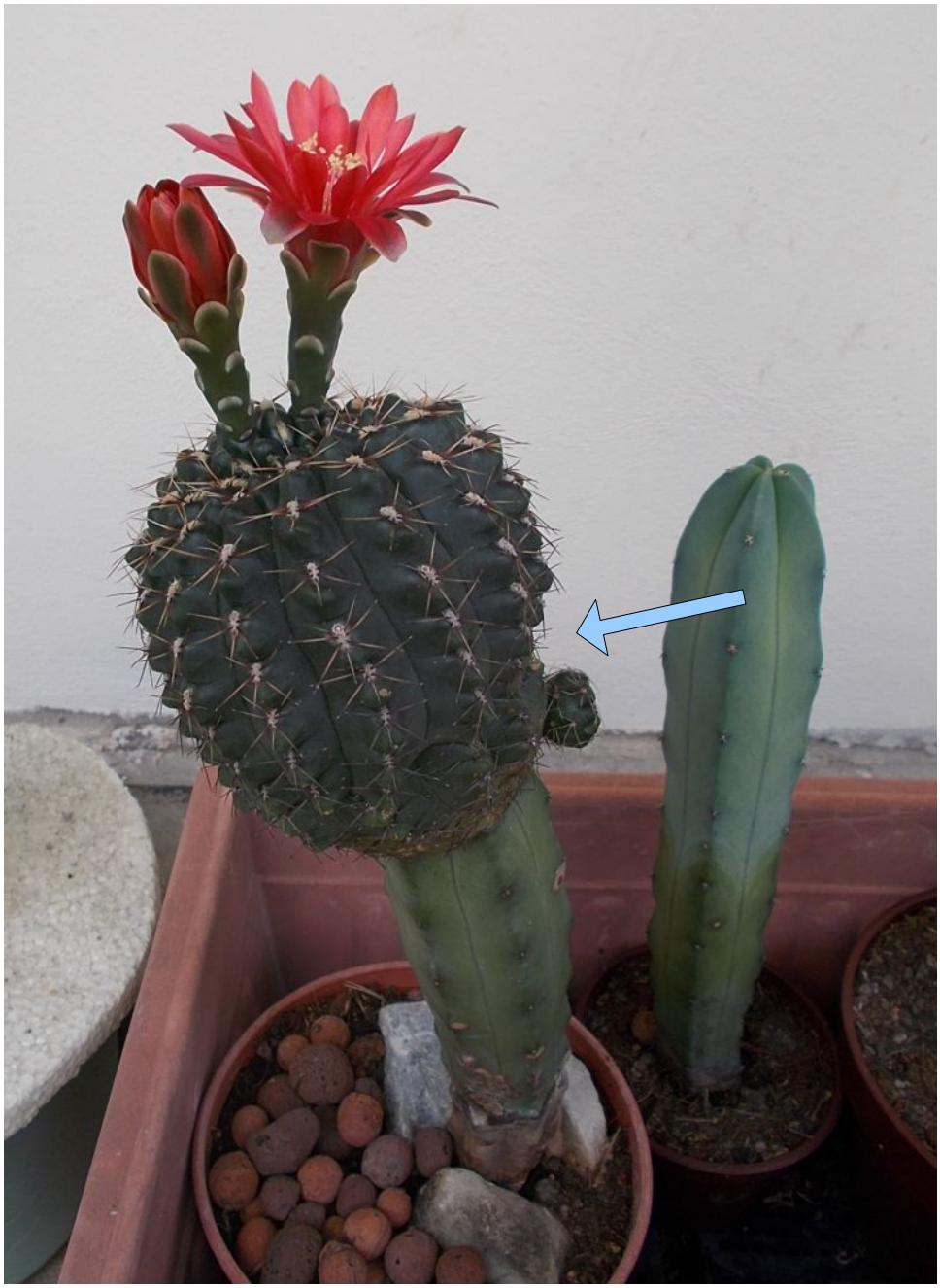
The two other GBalds in the same DWC pail also produced flowers, but the numbers of flowers were few compared to this grafted GBald specimen. There were a lot of problems with roots of GBalds in DWC; more than once, all the fine roots would slough right off, leaving a few bare anchor roots.

The specimen produced a 6-flower display with its next bunch of flower buds almost exactly one month later, in September 2016.

This is an example of what you can get from grafting: A total of over 100 flowers from a single grafted specimen in less than 6 years, starting from a scion that is only half an inch in diameter.

After September 2016, the specimen was potted up into a pot with a regular soil mix. Part of the reason was because the specimen was not only heavy, it was also top-heavy. The styrofoam cover of the pail was beginning to bend due to the weight, so the specimen was starting to outgrow the simple DWC pail contraption. Initially, it appeared the specimen didn't skip a beat; it produced a 4-flower display in November 2016.

Signs of Shrinking



In December 2016, a first offset, and the beginning of shrinking (arrow).

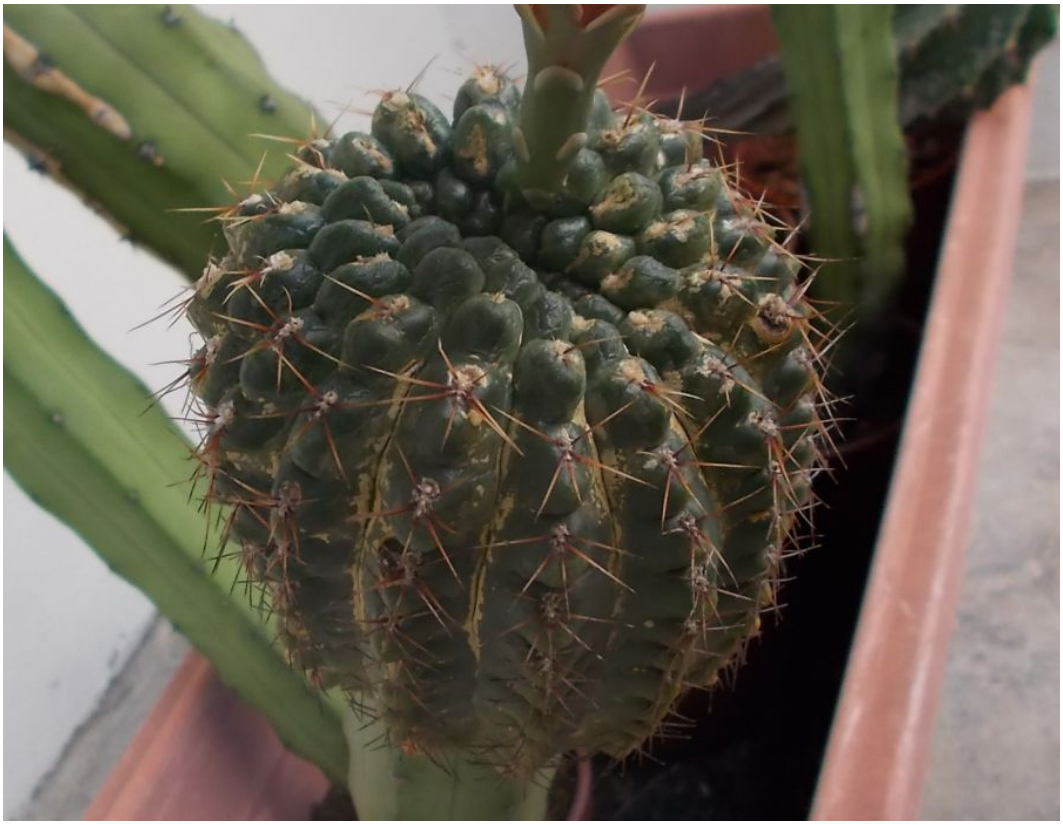
Also in November 2016, the first sign of shrinking appeared. In the picture above, shrinking can be clearly seen on the side where the first offset appeared. Rocks were used to brace the MGeo stem, as the specimen was very top-heavy. During that time, I ascribed such GBald behaviour to old age. Now, it seems to me there is a possibility that shock or stress of the move from DWC to pot may have triggered the shrinking action.

Left: With 3 flowers open in early March 2017. **Right**: The graft is now 3 years old. This was taken a couple of weeks later, still in March 2017. The measured diameter of the GBald scion is 3.2 inch. Note the tilt of the picture with respect to the planter box.

From this point onwards, one had to keep an eye on the ever-worsening tilt, to avoid having the top-heavy specimen fall over. The stem of the MGeo stock is still rather thin compared to the big globular GBald attached at the top. Surprisingly, my 2019 grafts did not have this problem; those MGeo stems increased in diameter along with the growing GBald scions. For cactus grafts, it appears that different cultivation methods may give rise to different behaviours.

From the above right picture, it appears that the maximum diameter of a GBald is just over 3 inch, assuming the grafted specimen has enabled the GBald scion to be as big as it could be. Since the GBald scion has started to shrink, it is no longer possible to create a columar grafted specimen.

Dormancy-Like Behaviour



It looks more like corking (suberization) rather than scarring. June 2017.

This bout of dormancy-like behaviour is discussed in more detail in the chapter on Complications of Shrinking. From March 2017, over the course of nearly a year, my GBald and GSteno specimens reacted badly to something, or a combination of things.

This behaviour started with small waxy patches appearing on GBald specimens, including this grafted specimen. Then, corky deposits followed, appearing mostly between ribs. Some specimens had it worse than others. Growth appeared to grind to a halt. However, for strong specimens, growth restarted soon after. New ‘post-dormancy’ growth was green and normal.

This grafted specimen is quite strong, so it produced quite a lot of corky stuff, then restarted growth soon after. It was removed from its pot from November 2017 to February 2018, but since growth was steady after restarting, I could just as well have left this specimen in its pot. Four months without soil must have caused the specimen to use up a lot of its reserves, because by the time it was potted up, the lower stem looked markedly shrunken and yellowed.

Two months later, in August 2017. Corky deposits were produced seemingly in one burst. New growth is green and normal. Flowers appeared with new growth, but fewer, since growth is still weaker than in the past. Note the lack of healthy new spines at the top. So it may be recovering from *something*.

In November 2017, the grafted specimen was removed from its pot. It didn't stop producing a flower or two and continued with new growth. By now new spines have grown on areoles in the newer 'post-dormancy' part of the stem.

By January 2018, most GBald specimens were recovering or getting back to normal. For this specimen, older growth is shrinking and turning yellow, no doubt the result of sustaining growth while it is unable to gain any nutrients via its root system.

Cutting the Stock Lower

The grafted GBald specimen ready to be cut lower. (February 2018)

Prior to potting up the specimen, a decision was made to cut it lower. Specifically, the lower part of the MGeo stock is to be cut. This will make the top-heavy specimen easier to brace with rocks.

As you can see in the picture above, the MGeo stock is rather narrow near the base. The lowest part of the stem is also corky, as if the MGeo stock was also trying to shrink. The upper part of the MGeo stock looks more normal. The root system of the MGeo stock is abnormal[3] – this may be due to its time in DWC. Or, the GBald scion may have directed the lower part of the MGeo stock to shrink like a GBald. It sure looks a bit like how GBalds shrink. Normal MGeos do not look like this. Cutting the stock lower also gives the specimen an opportunity to grow out new roots.

Note the yellowing and shrinking of the lower, older portion of the GBald scion. While dormancy-like behaviour has affected the scion, I suspect a big reason for the change is because a lot of reserves was used up during the four months the specimen was out of its pot.

The cut surfaces of the MGeo stock looked normal. The GBald scion with its shortened MGeo stock was left lying about for another 2 weeks to let the cut surface heal before it was potted up. The lower part of the MGeo stock with roots was also potted up so that it can produce new MGeo stems for future grafts.

3 This is shown in detail in a later section in this document.

The specimen after the MGeo stock was cut. (February 2018)

With one flower open a week later. Note the two flower buds. (February 2018)

About two weeks later, the grafted specimen was potted up. As you can see, the two flower buds did not abort during the two weeks. However, the pod later aborted. This is a temporary pot partially filled with soil because I was planning to pull it up to look at the new roots of the MGeo stock. (March 2018)

The two buds from the previous page grew into normal flowers. (March 2018)

Worsening Tilt, then Repotting

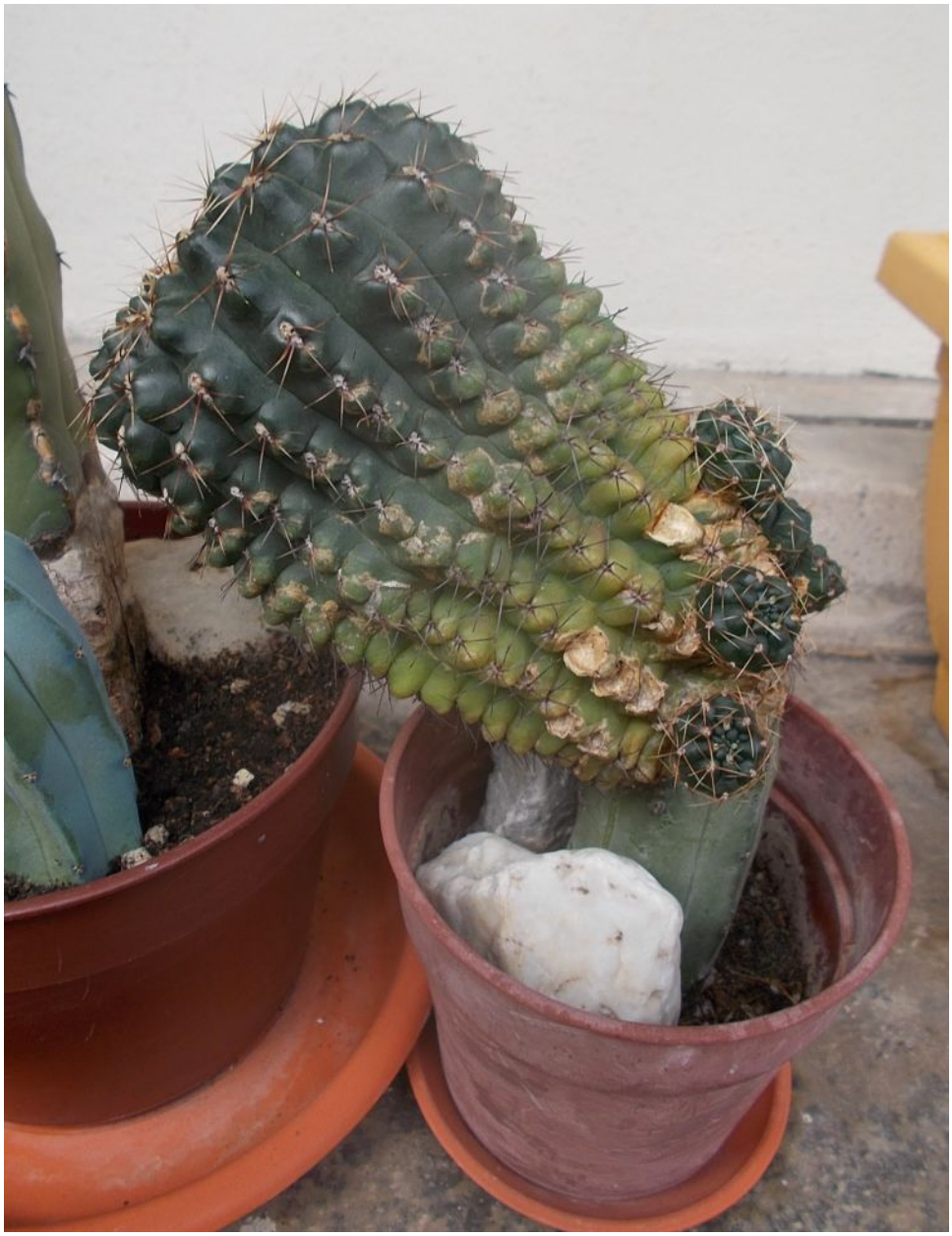
In the months after potting up, the upper part of the GBald scion continued growing steadily. There were still 1–3 flowers almost every month. The lower part of the stem continued to shrink and the yellow hue grew stronger.

As the lower stem of the GBald scion continued to shrink, the tilt of the scion with respect to the stock grew worse (see pictures on the next page.) By September 2018, the one side of the yellowed stem looked like it has partially collapsed onto itself, due to the heavy weight of the upper stem. Offsets were also popping out on the lower stem of the GBald scion. These offsets grew steadily and many were harvested.

I had the option of cutting off the healthy upper stem and planting it, as a way of renewing the specimen before it goes into terminal decline. However, since I have many GBalds at hand, I decided to leave this grafted specimen to run out its lifecycle because I wanted more data on the behaviour of GBalds in old age.

The specimen in mid-July 2018. The lower part of the GBald scion has shrunk some more. Now new growth looks wider in comparison.

In the left picture, the shrinking yellowed portion of the stem looked like it has partially collapsed onto itself. (September 2018)



Four months later, in late January 2019. The GBald scion has tilted past 45°. Note the many healthy offsets at the base of the GBald scion.

After about 10 months, the specimen was repotted at the end of January 2019 (see pictures on the next page.) While there were healthy roots, normal MGeos have much stronger root systems. It appears that the root system of this grafted specimen did not get enough nutrition. Perhaps the GBald scion was too focused on producing new growth, and the most of the specimen’s resources ended up in the new growth at the top.

Repotting the specimen in January 2019. There is perlite in the soil mix, and a piece of nappy liner at the bottom. Note the now-familiar look of an old GBald – the top 1 inch is a healthy green, while the lower part is shrinking and turning yellowish.

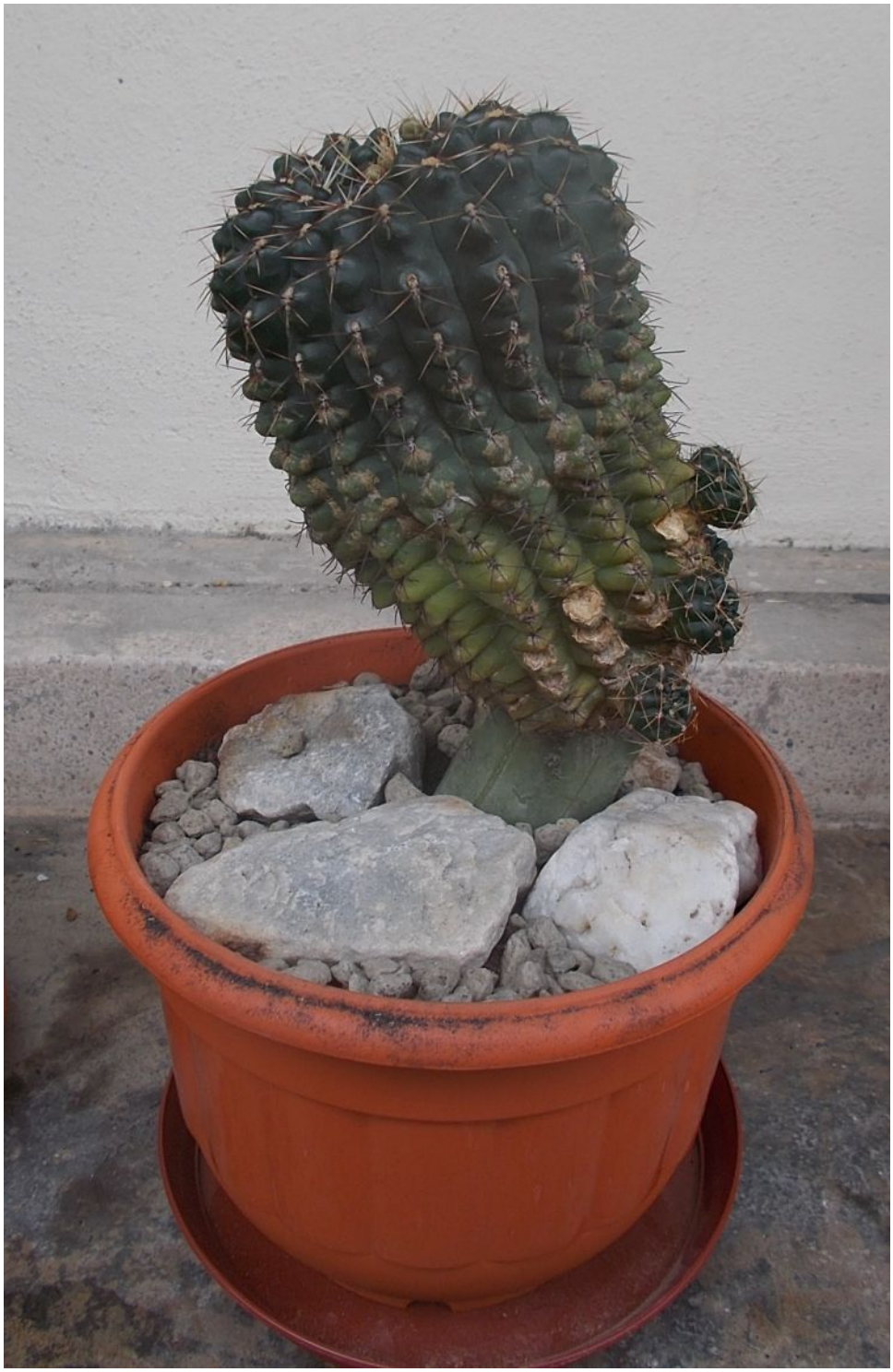
A closeup of the root ball with some soil removed. There are not a lot of roots to look at. It looks weak for an MGeo root system, so the roots may not have got a lot of nutrition from the GBald scion. (January 2019)

Repotting the specimen into a larger pot. (January 2019)

In the picture above, you can see that the lower part of the MGeo stock has shrunk a bit, and is generally discoloured. So again, it looked like the GBald scion is signalling to the MGeo stock to shrink, and the latter is responding to the signals.

The six GBald-on-MGeo grafts that I added in 2019 do not have this issue. Those MGeo stems still look fine, fat and green. Since I have only one old graft as of 2020, I do not have enough data on the behaviour of MGeo stocks when grafted to GBalds. For now, I can only say that these grafts are capable of exhibiting a variety of interesting behaviours.

The specimen was put into a larger pot with a better soil mix. The bottom of the pot was lined with a piece of nappy liner, then a layer of burnt soil aggregate was added to block bugs from entering the pot from below. In the middle, soil was added mixed with coco peat and red scoria. Finally a top layer of pumice was added as a mulch. Since pumice is light with rounded edges, it cannot hold the unbalanced specimen in place. So a few large rocks were added and jammed into position to hold the stem in place (see picture on the next page.)



After repotting, January 2019. The MGeo stock has been tilted so that the GBald scion is largely vertical. However, this is only temporary since the lower stem of the GBald scion will continue to collapse. Rocks were added to stop the stem of the MGeo stock from moving.

A Really Messed-up MGeo Stock

In the meantime, let's take a look at the lower stem of the MGeo stock that was cut off. Thanks to the GBald scion signalling the MGeo stock to shrink, the latter turned into the *ugliest-looking* MGeo stem on the planet (picture below.)

It shrunk a bit more. Corky patches increased somewhat. Shrinking and corky patches appears to be irreversible. Eventually its condition stabilized. Luckily it did not end up going into terminal decline like shrinking GBald stems. Different genetics, I guess. Instead, it survived and started producing a new normal-looking stem.

The MGeo stock in January 2019. It was cut in February 2018. The height of the stem had also shrunk a bit, and so the tougher vascular bundles ended up poking out of the cut surface. There is not a lot of green on the stem for photosynthesis, but the new stem still manages to grow steadily.

Closeup of the cut surface, with the vascular bundles poking out of the stem in a circular pattern. (January 2019)

This is how the cut surface of a normal MGeo looks like. (January 2019)

In July 2019, just before it was moved into another pot.

The roots of the MGeo stock specimen (left) compared to the roots of a normal MGeo (right). (July 2019)

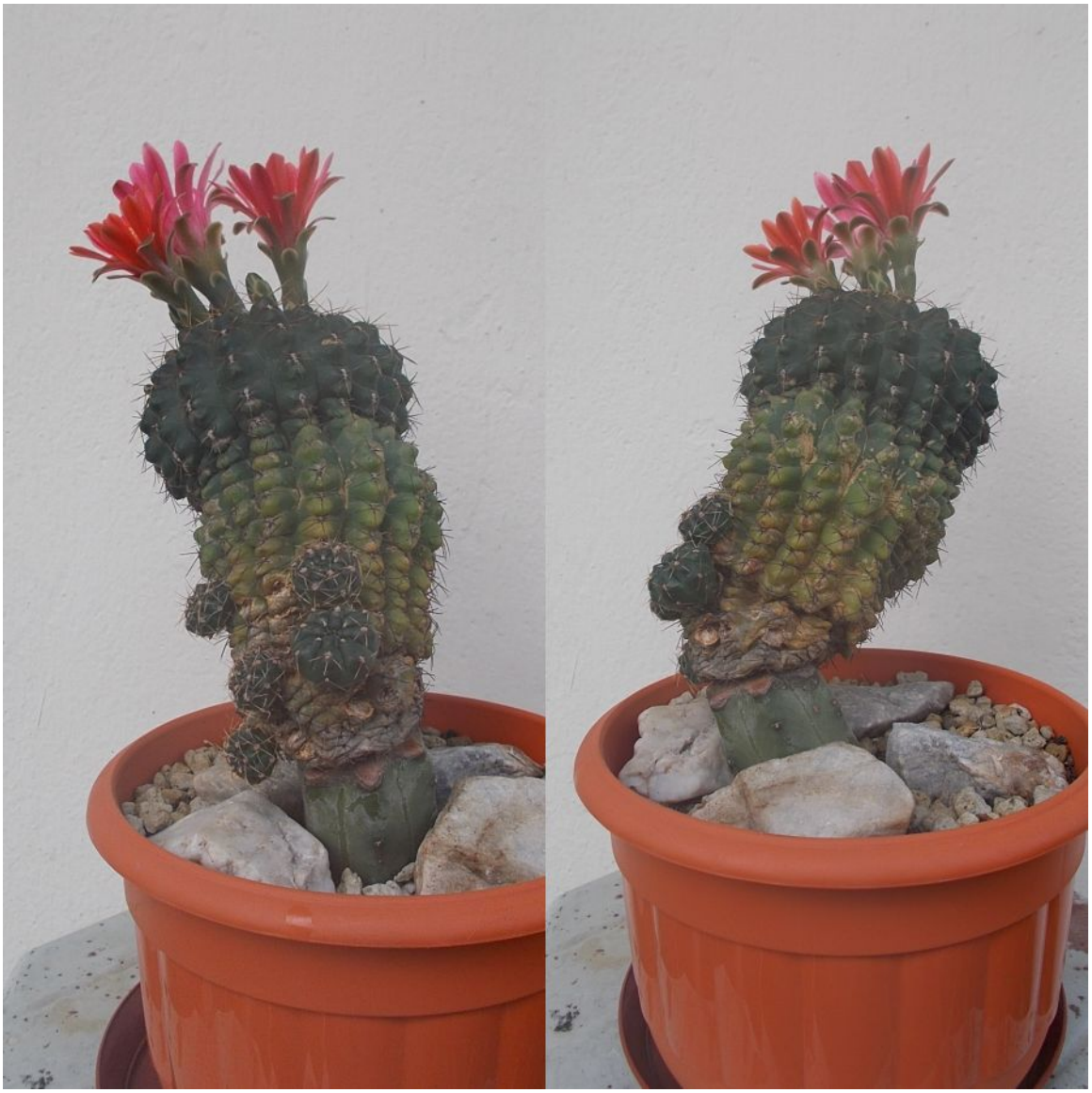
Shrinking and Bending Over

With three flowers open in April 2019.

After moving into its new pot, the condition of the grafted specimen improved after a few months. It started growing more strongly, and more flowers arrived with new growth.

The lower stem of the GBald scion continued to shrink while healthy new growth at the top increased. The net result is a top-heavy specimen. So the lower stem continued to collapse onto itself, and the scion as a whole continued to tilt or bend over. At this point, I was quite concerned about the joint between the GBald scion and the MGeo stock, but given the shrinking behaviour of GBalds, there was no viable fix or permanent solution.

Some cacti growers who do grafting sometimes bury the stock completely inside the soil mix, so the stock is no longer seen and the scion appears as an individual plant by itself. It’s an intriguing technique that I might use in the future – it’s easier to keep a tall and shrinking GBald or grafted GBald upright if the lower parts are buried.



A month later, in May 2019. Shrinking and yellowing was progressing steadily.

The pictures above nicely illustrates the usual appearance of shrinking GBalds. The top 1 inch of the GBald stem is a healthy dark green. Below that, the stem becomes more and more constricted. The older shrinking stem goes from light green to yellow-green to brown at the base. Collapse of the stem is most clearly evident at the base of the scion.

The vascular bundles connecting the healthy parts of the GBald scion to the MGeo stock is probably still functional – the specimen produced a total of 40 flowers in 2019. If the connection between the stems was not functional, then it is unlikely that the specimen would be able to produce displays of many simultaneous flowers, such as a 5-flower display in May 2019 (see picture on the next page.)

With 5 flowers open in May 2019. The specimen produced 7 flowers in that month.

When a GBald specimen (or in this case, a GBald graft) is weakened, sometimes anomalies appear. In July 2019, this is a display of 3 flowers with some abnormal characteristics. First, the lower left flower has petals that were prematurely drying. I have seen this happen on rare occasions when there is a heat wave. Second, a lot of stamens were immature, and a few were even blackened. Compare this to the picture of normal flowers on the same specimen on the previous page.

Totally Bent Over

Totally bent over. The lowest part of the GBald stem is now more or less below the level of the top of the MGeo stock. (July 2019)

By July 2019, the GBald scion has all but collapsed onto a horizontal position. Impressively, it is still attached to its MGeo stock, so the shrinking lower stem is quite flexible.

A rock was added to the edge of the pot to brace the GBald stem and to push it up a bit (see picture on the next page.) Later, different rocks were used to push the GBald stem back up. This allows the stem to be more easily cleaned, because spider mites will love the shade under a large and horizontal GBald stem. Since the shrinking lower stem was somewhat flexible, the stem accommodated these adjustments without any apparent tearing of the skin.

Of course, the big question mark is this: For how long can the joint between the scion and the stock hold up? The MGeo stock is fine; its upper stem is green and strong. It is the GBald scion part of the joint that is the weak point.

A rock was added to the top edge of the pot to hold the stem up. (July 2019)

Another view of the flowers on the same day. (July 2019)

Propping up the GBald stem some more. (August 2019)

This arrangement was manageable for a few months. This is the specimen with 3 flowers in early December 2019.

In mid-December 2019, I was trying to push the GBald scion into a more vertical position. Then it may be possible to construct some kind of frame to hold the stem securely in a somewhat vertical orientation.

If you compare this picture to pictures of the specimen from mid-2019 or early-2019 from the previous pages, you can see that the upper healthy stem of the GBald scion has grown *a lot*. So the weak joint of the graft was pretty badly stressed.

A Look at the MGeo Stock

Like the previously cut bottom MGeo stem, this second MGeo stem also exhibited some GBald-like shrinking characteristics (see the pictures below and on the next page.)

The roots of this messed-up MGeo look very similar to the fibrous root systems of GBald offsets grown in a soil-based potting mix pictured in the Cactus Cultivation in the Tropics chapter. The strong root system of a normal MGeo does not look like this. The lower part of the MGeo stem in the picture below is also significantly shrunken and discoloured. On a normal MGeo, the lower or older part of a stem will often turn woody or corky (suberization), but as you can see by comparing the pictures on the following page, the ex-stock MGeo stems look rather abnormal.

The ex-stock MGeo stem trying to imitate a rooted GBald. (January 2020)

Both ex-stock MGeo stem pieces shown together before they were moved to a common pot. (January 2020)

The root systems of two normal MGeos grown in what is probably recycled garden soil. These two specimens were repotted on the same day. (January 2020)

A closeup view of the upper surfaces of the two MGeo stems. (January 2020)

It remains to be seen whether this is the ultimate fate of all MGeo stocks for such grafts, or the unique behaviour of one specimen. More data is needed – I am currently keeping track of my six GBald-on-MGeo grafts done in 2019, all of which have flowered by September 2020. These later grafted specimens did not undergo DWC (deep water culture) or dormancy-like behaviour, so they may not behave in the same way as the 2014 grafted specimen.

Falling Down

In late January 2020, its luck ran out. The joint gave way and the GBald scion fell off. So this GBald-on-MGeo grafted lasted from March 2014 to January 2020, or approximately 5 years and 10 months. As a grafted specimen, the GBald scion produced 81 flowers during 2017–2019.

Side view of the detached GBald scion. (January 2020)

Underside of the GBald scion showing the broken joint. Some of the oldest shrunken tissue had pancaked thanks to the weight of the stem. (January 2020)

The now ex-graft GBald stem was then potted up. (January 2020)

The next chapter will continue to follow the progress of the detached scion. For convenience, I will use ‘ex-graft’ to describe this GBald specimen. The development of the ex-graft is a useful example of how a large GBald specimen behaves in a hot and humid tropical climate. It is shrinking, and shrinking is not a risk-free lifestyle for GBalds. Since it is very difficult to avoid shrinking among GBald specimens in a tropical climate, it is useful to collect more data on such behaviour. ♦

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Colophon

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