More About Foliar Feeding

Pineapples (*Ananas comosu*) are distantly related to *Tillandsia* air plants, so a pineapple plant is something of an air plant on steroids. Note the purple flowers peeking out at the bottom of the inflorescence, whose colour is quite intense. This is the same plant that was pictured in the Useful Concepts chapter, in bloom 18 months after the pineapple top was planted. (July 2020)

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

Introduction

Foliar feeding is an excellent cultivation strategy for plants that are good at absorbing nutrients through leaves or stems, such as pineapple plants. Foliar feeding is also beneficial for cactus plants. In the following, we will look at some outcomes of foliar feeding experiments.

Nicknames for Scientific Names

PMag = *Parodia magnifica*
PClav = *Parodia claviceps*
GBald = *Gymnocalycium baldianum*
MGeo = *Myrtillocactus geometrizans*

This naming scheme is purely for convenience. Just think of them as webchat nicknames. Other nicknames and additional notes can be found in the appendix to the third chapter.

A Pineapple Plant

A wider view of the pot-grown pineapple plant. (July 2020)

Since many bromeliads are also epiphytes, pineapples can absorb a lot of nutrients via its leaves. Leaves also act as funnels, directing water and debris to the base of the leaves. Pineapples are CAM photosynthesis plants like cacti, with reduced water loss in order to better survive drought.

The above pineapple plant was grown in a pot. It was fed mainly by applying manure fertilizer powder (a product that is a 50% aged manure mix) to the base of the leaves. The plant was also fertigated with dilute fertilizer sprays. While the pot isn't very large, the root system is helped by nutrient absorbtion via the leaves. The plant is healthy and strong and is better-looking than practically all other pineapple plants in the neighborhood.

The pineapple plant with its fruit, about a week before harvest in mid-October 2020.

Foliar feeding works for pineapples. The fruit was harvested in late October 2020 – it weighed 1.9 kg. Pineapples are easy-to-grow CAM plants. So if you live in a tropical urban area and you don't want to grow your pineapple plants in the ground, you can grow them in pots[1]. Provide them with adequate nutrition and you will still get to enjoy fairly large fruits.

This can be translated to the cultivation of cacti. First, select the species of cacti that have the potential of becoming very productive. Then provide them with adequate nutrition. Foliar feeding is a good way of providing nutrition to cactus plants. I believe this strategy works in a tropical climate. After all, I have enjoyed hundreds of cactus flowers – it can't be 100% dumb luck.

1 When removed from its pot in November, the plant had a lot of roots in the pot – it was somewhat pot bound. But no matter, a fruit of nearly 2 kg is no slouch.

An Echeveria

An *Echeveria* in bloom in January 2021. Note the healthy colour of its succulent leaves. The other two pots contain rain lilies, *Zephyranthes*.

Regular fortified sprays improved some *Echeveria* specimens too (picture above), resulting in better leaf colour and a flower stalk appeared in January 2021. Normally these plants are not watered, and there is no soil in the two pots containing the succulents, only small stones and rubble. The roots survive on organic debris that get trapped among the stones and rubble.

While it's nice getting an *Echeveria* to flower in the tropics, I have since *reduced* the frequency of fortified water spraying for these succulents – because they tend to become lanky after blooming, and would bend over and look like a mess. This behaviour is similar to bolting[2] in regular plants. I prefer to keep the rosettes more compact, hence a reduction in nutrition is warranted. Still, it's good to know that *Echeveria*s are willing to flower in the tropics given adequate nutrition.

2 Bolting is the diversion of resources into a flowering stem in order to produce seeds. High temperatures are often the cause of bolting in leafy vegetables. Vegetables that have bolted results in a poor quality harvest.

Attempt to Push the GSteno Specimen

Left: The large GSteno in mid-April 2020, wet after spraying.
Right: The same specimen in late August 2020.

From the beginning of June 2020, I have switched to daily fortified water sprays, except on rainy days. On weekends, small amounts of additional fertilizer salts were added to provide NPK to plants. My suspicion is that larger plants are not getting enough nutrients and daily sprays of fortified water may help with stem growth and flower production.

For my solitary GSteno specimen (above pictures), this resulted in positive changes. The stem is slightly fatter. In particular, look at how the lower stem below the offsets have filled out and there is more green than brown. Newer growth at the top is also better-looking, with more dark green colour.

I also made sure to get the two offsets wet, so that they also get nutrients through foliar feeding. Such offsets often grow slowly – it's possible they don't have a strong connection to the main stem and are unable to draw nutrients efficiently. The offsets have grown significantly, a very positive outcome. I think foliar spraying is absolutely necessary if you want to make such offsets grow larger. Larger offsets will be stronger and easier to root, ensuring successful outcomes.

The top of the GSteno specimen with many failed flower buds, August 2020.

As for flower production, many flower buds were produced, but so far all were aborted. Foliar feeding leads to stronger growth, and new areoles on mature *Gymnocalycium* like this species often appear elongated and probably has the capability to produce flower buds.

While better feeding gave a positive push to the plant to produce buds, other issues caused flower production to fail prematurely. There are many factors that could have caused flower buds to be aborted. This specimen may have a poor root system, damaged due to past cultivation methods. Or the species may need a resting season. But this plant did flower twice, in April 2017 and July 2019, seemingly without any special prompting or pampering.

Some growers in online forums have reported that their GSteno specimens are prolific at producing flowers. So it may turn out that continuously growing a big green stem is bad for flower production in the case of GStenos. The challenge is to discover the conditions for reliable GSteno flower production in the hot and humid tropics – such knowledge may also be useful elsewhere.

In September 2020, I abandoned this experiment, electing to harvest the two offsets instead. The progress of the two offsets is covered in the Hooray for Healthy Roots chapter.

Response of PMags to Daily Spraying

The big PMag in early June 2020. The two rear stems are marked with arrows.

One of the main objectives of daily spraying of fortified water is to improve the performance of the big PMag. While the specimen flowers almost continuously, its two rear stems (see picture above) rarely flower. The stems appear to be growing well, and each has a somewhat dense apex. However, they have not been producing flowers for a long time.

The rationale is that if the stems are in competition for limited resources, then the two rear stems may be losing out and thus they are reluctant to flower. So this is a simple cause-and-effect experiment.

After about 1½ months (see pictures on the next page), both stems have more wool near the apex and each of the stems has at least one flower bud. All it took was some extra feeding. Foliar feeding worked. It's probably not luck, because in September 2020 after the initial flowers, both stems continued with new flower buds. The three stems at the front were still producing flowers as usual, so with adequate nutrition, all five stems are now productive. This specimen produced 38 flowers in 2019 and I hope to maintain that level of productivity[3].

3 If productivity stalls, it's probably pot bound and the specimen will need to be repotted.

The left rear stem in July 2020 with a flower bud.

The right rear stem in July 2020 with a flower bud.

By the end of July 2020, the flower buds on the rear stems are clearly visible.

After about 3 weeks, the left rear stem has a flower open. (August 2020)

After another 3 weeks, the right rear stem has a flower open. (September 2020)

The two rear stems in late September 2020. Both stems still have buds, so all five stems[4] of the specimens are steadily producing flowers.

That's not all. Another two PMag specimens also started to produce flower buds (see next page.) Since the two specimens are likely pot-bound, they will probably be reluctant to produce more flowers. But foliar feeding did push them to produce flower buds.

4 Actually, four are very large offsets and there is only one main stem. For PMags, offsets can grow very large, so it is easier to think of them as stems.

The arrows point to two specimens that ‘woke up’ and produced a flower bud each. Before this, the one on the left has never previously flowered, while the one on the right has flowered once or twice. Since they have been in their pots for a long time, there are plenty of roots in there and they are likely pot-bound. Both were originally stems (or offsets) of the big PMag specimen. (August 2020)

The two PMag specimens with flower buds in late August 2020.

Left: The smaller PMag with its first flower ever in early September 2020. The stem of the specimen is about 6 inch long. When the upper part of the stem grows to a mature size, PMags never seem to stay upright.

Right: The larger PMag with a single flower at the end of September 2020. This is the larger of the two PMag specimens that were used in flower forcing experiments. This particular specimen has flowered about twice before, but has not done so for a long time because it is probably pot-bound.

Response of PClavs to Daily Spraying

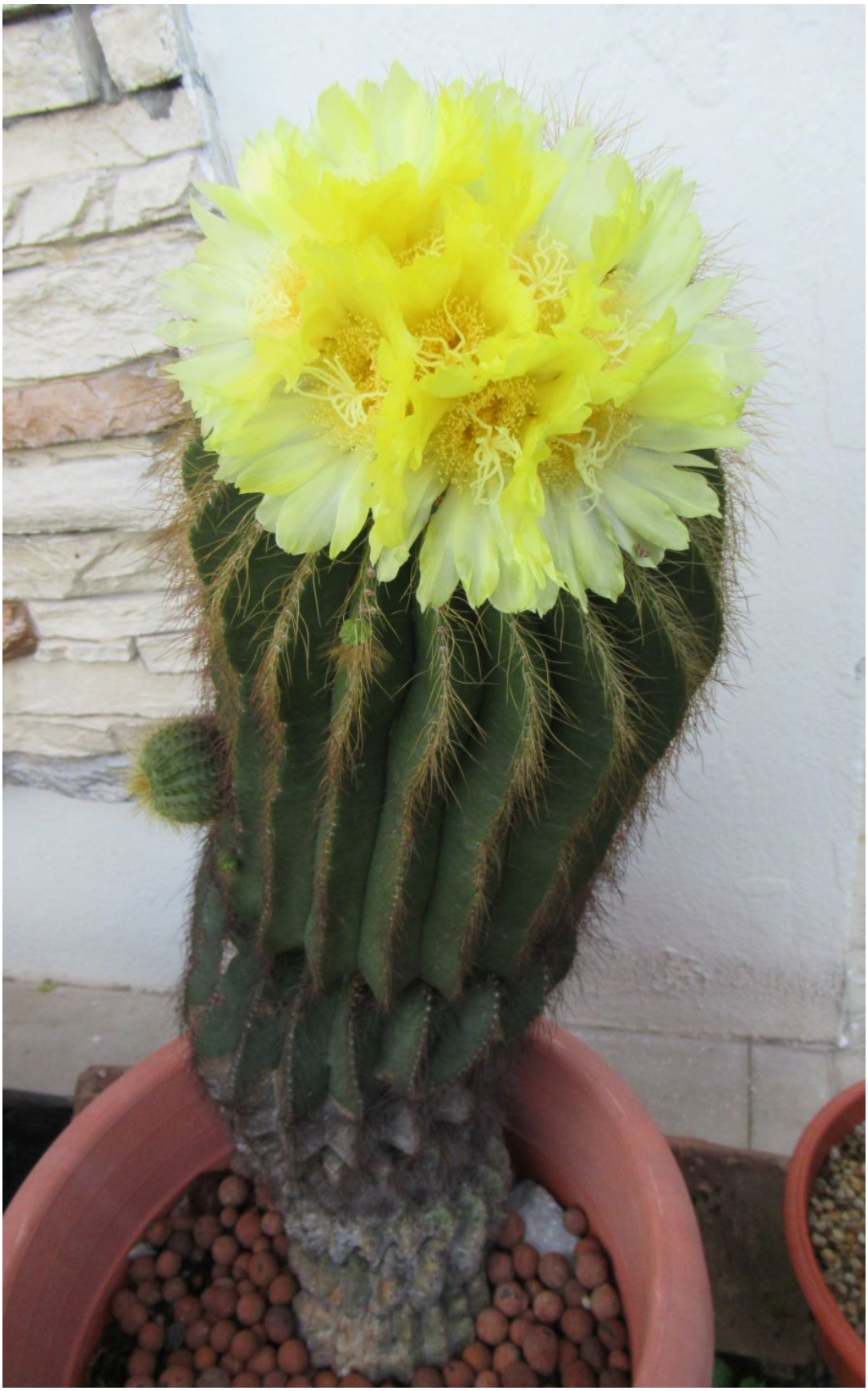
For the large PClav, growth and flower production appear to be sustained and vigorous. It took many months of spraying before something other than “vigorous flower production” could be observed.

Flower buds shown a week apart on the large PClav, late August 2020.

The day after the second picture, with 7 buds opening in the morning. Note that there are 2 more buds at maximum size, ready to open the next day. (August 2020)

With 7 flowers open later in the day. (August 2020)

Flower production was sustained throughout the year. Stronger growth – a probable direct result of better nutrition – led to the specimen producing ever-larger bursts of multiple flowers. The number of flowers produced by this specimen is reported in the Data and Charts chapter.



With 9 flowers open the next day. (August 2020)

In late December 2020, strong growth on the largest offset (arrow) was finally seen.
Those dried flowers were the aftermath of a show of 11 simultaneous flowers.

A different positive result of foliar feeding on the large PClav was finally seen in the renewed growth of its one large offset towards the end of 2020 (picture above). This offset has not been growing for a long time. Direct spraying of fortified water on the offset restarted its growth.

Towards the end of 2020 and into 2021, the large PClav appear to be sustaining more than 7 flowers for each burst of flower buds, but with more simultaneous flowers, they become slightly smaller. The higher number of buds also led to longer periods of time between each burst of flowers. By mid-2021, the time between each large burst of flowers is nearly two months. Other than the change in bursty flowering behaviour, the rate of flower production may be slowly increasing as the specimen grows taller. Another year or two of data gathering will prove or disprove this.

For PMags and PClavs, I think one has to watch for signs of growth stopping due to roots becoming pot-bound. PMags have the strongest root systems and are quickest to run into this problem. Other than becoming pot-bound, large and strong PMags and PClavs are quite trouble-free and are very productive with adequate feeding.

The large PClav five days before that, with 11 flowers open. (December 2020)

The flower buds did not open at the same time; it was two, two, and then seven.

Here is the PClav with 4 flowers open, and another 7 flower buds waiting to open the next day.
(December 2020)

A Very Productive PClav, Yay!

The specimen took a break after that display, producing a single flower in the next month. Then it started putting out a big clump of flower buds. There were 18 buds in this picture, and largest two would open the next day. (February 2021)

With 2 flowers open the next day. The other 16 buds were still a couple of days away from opening, so the PClav just missed displaying 18 flowers at once. (Feb 2021)

Two days later, the first two flowers have dried up. (February 2021)

The next day. 16 flower buds opening for the first time. (February 2021)

A little later, the 16 flowers were opening. (February 2021)

With 16 flowers almost fully open in full sunlight. (February 2021)

There were still 16 flowers open on the large PClav the next day. Pictures don’t fully do the display justice, because it’s hard to capture the entirety of the crown of flowers in a single camera shot. The flowers were noticeably smaller than usual, but still impressive to see. (February 2021)

The large PClav again took a break in the following month, producing a single flower. It then started putting out an even bigger clump of flower buds. The dried remains of the single flower that appeared in March 2021 can be seen at the bottom of the mass of flower buds. (April 2021)

A few days later, with 21 flower buds two days from opening. (April 2021)

The PClav with 21 flowers opening in the morning. (April 2021)

A few hours later, 21 flowers partially open in full sunlight. (April 2021)

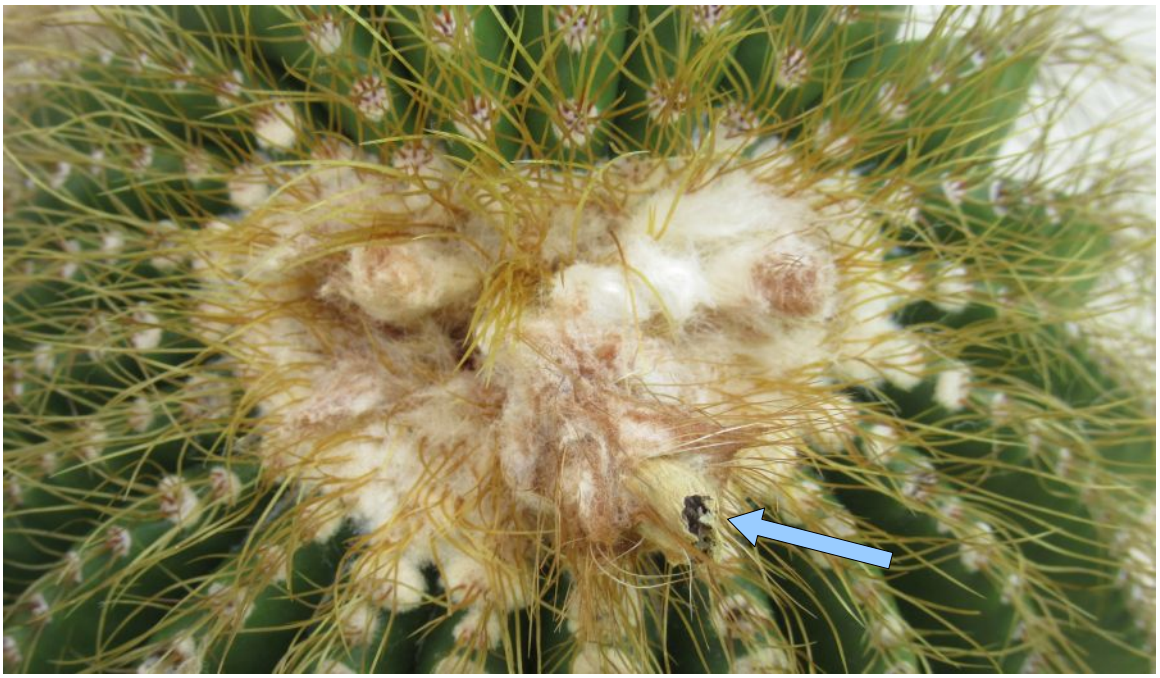
The 21 flowers were fully open in the afternoon. (April 2021)

Maintenance for Profusely Flowering PClavs

A word of caution, though. If you have too many PClav flowers packed together, drying flowers can cause problems. Be ready for a clean up. (April 2021)

Just *two days* later, wet weather caused the above mess. It has been *five days* since the flowers first opened. There's some kind of webbing all over... (April 2021)

Normally, dried flowers that failed to set viable pods will detach easily after a few days. But this was a wet mess that was packed together, decorated with some sort of insect or mite webbing. Clean it up or risk damage to the plant. (April 2021)



The apex of the PClav after the clean up. It's much better to keep the growing point clean of debris. The black bits (blue arrow) were attached to something that wouldn't come off yet. Oh look, more flower buds. (April 2021)

Long-Term Foliar Feeding Effects on a PClav Offset

The strong and sustained production of flowers on the large PClav means that nutrition is successfully getting to the apex or growing point of the specimen. In about 2 years (2020–2021) the PClav managed to produce almost 200 flowers. Most likely, foliar feeding is responsible for a big part of that. A few years ago, I thought getting 3 or 4 flowers on the PClav was great; now I want to experiment some more. On another note, the PClav's offset is also benefiting from foliar feeding.

Left: The offset with a split stem in early June 2021.
Right: Looking much bigger at the end of October 2021.

This offset is often 'fed' by directly spraying its growing point with fortified water. About half a year after it started to grow again, I noticed the scar of a split stem on the offset – it had not been growing for so long that it failed to cope with renewed growth. The growing point also looked dense, wooly and healthy.

By October 2021, the offset has obviously expanded beyond its original diameter. I plan to leave it on the plant, turning it into sort of a branch of the PClav. If the apex of the offset starts to shed wool, it may even mean that it is a mature stem and is capable of producing flowers. It's possible that a strong and large offset may be able to establish proper links to the vascular bundles of the main stem, thereby making the offset a fully-fledged stem of the PClav, much like PMag stems.

Perhaps in a couple of years, I'll end up with a PClav-with-a-stem. It may not look like a traditional PClav anymore, but at least we will learn more about what PClavs are really capable of.

Some Limitations of Foliar Feeding

Left: A commodity cacti grafted GBald sporting an offset near the 12 o'clock position. The MGeo stock of this specimen is hidden under the GBald in this overhead shot. **Right**: A "failed graft" GBald from the same batch of commodity cacti also sporting an offset, to the lower right of the apex. (October 2023)

Usually, an old GBald will produce offsets near the base of its stem. But these two specimens are sprouting offsets on areoles that are not very old.

Throughout this chapter, you have been shown all the good things that came about because of foliar feeding. So it's useful to also take a look at some limitations, lest we start to fantasize that we are working with magic potions that always result in magical plants.

In the above pictures, the most likely cause of the anomaly is excessive NPK fertilizer in my fortified sprays in 2023. I had added and sprayed NPK fertilizers too often in an effort to push them to a large mature size faster. So I was greedy and impatient; force-feeding GBalds to get them to flower backfired on me. You can provide the nutrition but the apex of the GBald appears to have a speed limiter that's most likely caused by CAM respiration. This is a timely reminder of the nature of cacti – slow growth, and cactus cultivation usually does not equate to fast results.

One cannot avoid NPK altogether because they are essential nutrients. So, in feeding C&S one has to find some kind of middle ground that works. Of course, if you *wanted* those offsets, then feed away! But remember, on PClavs nitrogen fertilizer tends promote offsets over flowers and the effect persists over a long period of time, so most likely for GBalds you'd also be sacrificing flowering potential and letting stem or offset growth rule the day. Personally, I won't sacrifice "willingness to flower" for growth speed, but then I am not in the business of mass-producing C&S.

Left: An MGeo stock sprouting a healthy offset. (March 2023)
Right: The box cutter points to another offset on an MGeo stock. (May 2023)

The above highlights another issue with over-feeding GBald grafts. A few of my GBald-on-MGeo grafts (I estimate about one-third) had their MGeo stock sprout offsets. These MGeo offsets are fast-growing and healthy. These specimens had been repotted not long ago so that they can grow new roots; thus the GBald scions are healthy and growing. The MGeo stems are also fat.

My current working theory is this: Fresh roots promoted growth after repotting so both scion and stock were fat and healthy. There are a lot of resources at hand in those stems, but these GBalds (in the case of the one on the left in the above picture, mongrel commodity cacti GBalds) can't grow too fast. A spillover effect then pushes the MGeo to produce offsets.

Like the grafted specimens on the previous page, again the problem is that more aggressive feeding does not always equate to increased GBald scion apex growth. I focus on *healthy apex growth* to get new areoles and the flowers that come with mature areoles in my microclimate. If it's impossible to make the apex grow arbitrarily fast, then we will always need to be patient when growing C&S.

In order to break this speed limiter, you'd need to think about applying hormones. But there is another possibility that is mentioned by some sources: At some point in their lives, some CAM plants (for example, seedlings of certain species) may be more willing to keep their stomata open so that they can grow fast while there is still moisture in the environment. In such conditions, the plant can break the CAM speed limit. It's all very interesting stuff, though I am very much focused on keeping my C&S healthy and productive and so breaking speed limits is not a priority. ♦

Version Information

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Colophon

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