

# Battling Bugs



A new commodity cacti PCLav being cleaned, Sep 2018. There were a few white root mealybugs on the roots. The underside of the plant is depressed (concave), so this is likely a rooted offset. There were also some root mealybugs in the depression.

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

## **Fight Bugs, Win Some Battles**

The wind will blow bugs all over the place. Or they might arrive in your new plant. The war against bugs is never-ending. We have to choose: which battles to focus on, which battles we must win, and what weapons to use. To maintain a healthy collection, *these battles must be fought.*

## Nicknames for Scientific Names

PMag = *Parodia magnifica*

PClav = *Parodia claviceps*

GStella = *Gymnocalycium stellatum*

GBald = *Gymnocalycium baldianum*

MGeo = *Myrtillocactus geometrizans*

GSteno = *Gymnocalycium stenopleurum*

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

## What We Mean By “Bugs” Here

In the following, I am going to casually use the word “bugs” for a wide range of cactus threats. The primary threats are insects or mites, so most of the discussion will be about them. Two other problems that will be discussed are: centipedes trying to nest in cactus stems, and cactus rotting. Usually, fungi is blamed for cases of rotting. Losses due to rot in my collection are minimal; healthy plants rarely rot.

A varmit ate parts of some GBald flowers in February 2020 (see below), but this has happened only once ever. The culprit was probably a squirrel or a rat. Then there are also microscopic bugs such as virus and bacteria that may harm your plants, but testing for virus and bacteria is not something that typical urban growers do. There may be cases of rot that we blame on fungi but are really due to bacteria. For us urban growers, sometimes we have to live with guesswork with these things. But the battles will usually be with bugs in the form of insects or mites.



Some half-eaten GBald flower buds, February 2020. The specimen was found toppled over in the morning. So far this has not happened again.



**Left:** The new PClav after cleaning to remove root mealybugs, Sep 2018. This means soaking the plant in a dilute solution of liquid soap and household insecticide. The bottom is concave because of the way it grows while attached to the mother plant. So this was not grown from seed. As far as commodity cacti go, this isn't a particularly great specimen. Propagation via rooting of offsets means that size and quality standards are harder to enforce. Later, all the roots were removed so that the specimen can grow new roots. No point keeping all the damaged roots.

**Right:** After almost exactly one year, Sep 2019. The label on the pot says 'new' because it is the only new PClav specimen that I have bought in recent years. If the giant nurseries do not mass-produce commodity cacti PClav from seed, they will be harder to find and buy at retail compared to the more common species. Availability of PClav at retail in Malaysia is best characterized as "intermittent".

Other things that threaten cactus plants will be covered elsewhere, because some of these things may be specific to certain settings or conditions. For example, in an outdoor setting, algae will quickly grow on a very moist soil mix. If you are growing cactus seedlings, they will have trouble with the quickly spreading algae. Those problems are cultivation issues, not bug issues.

Luckily for us cactus growers, there are no caterpillars that you might prefer to save so that they turn into beautiful butterflies. I have rarely read anything that said something positive about the four principal cactus bugs in a tropical setting: scale insects, spider mites, fungus gnats<sup>1</sup> and root mealybugs. As far as I am concerned, these bugs fully deserve to die. Do not be merciful.

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1 Fungus gnats has its uses in an ecosystem, but I prefer not to let their larvae "recycle" my cactus plants.

## Living in a Tropical Bug Paradise

In Malaysia, the weather is hot and humid all year round. Even when patches of grass turn brown during an extended dry spell in the Klang Valley urban microclimate, the larger trees do just fine. It's a great place for insects to live – a tropical bug paradise. In North America, monarch butterflies migrate south during autumn to overwintering sites. But there is no winter in Malaysia, thus there is no need for winter survival tactics among insects. Once the bugs find a nice spot, such as your cactus plant, they can feed and multiply all year round.

Bugs may also find plants that are not cacti, but yummy (to them) all the same. Then they will have a nice spot from which they can spread, perhaps to your cactus plants. For example, in my experience scale insects love young pomelo<sup>2</sup> branches. Such an infestation is extremely difficult to control without resorting to systemic insecticides. I no longer keep any pomelo plant. For the average urban gardener in Malaysia, it is not possible to perfectly isolate your plants. Expect to do battle.



A Christmas cactus, or *Schlumbergera bridgesii* at a plant nursery close to Christmas time (Nov 2007.) The whitish stains on the pads of the plant is most likely due to a fungicide that comes in powder form. Most retail specimens are not this large. In order to maintain their stock with a minimum of manpower, plant nurseries may be spraying a variety of pesticides and fungicides. What are your options in this battle?

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2 Or pummelo. Commercial pomelos are cultivars of *Citrus maxima*.

## Your Battle, Your Choice of Weapon

In the old days, if you asked an online forum which insecticide to use for cacti, many will say “imidacloprid”. Imidacloprid is a systemic insecticide. Systemic insecticides are water-soluble; they are absorbed by the plant and the entire plant becomes poisonous to insects – imidacloprid is an insect neurotoxin. Although neonicotinoids such as imidacloprid is classed as “moderately toxic” to humans according to its Wikipedia page, their use have been greatly restricted in recent years because of the effects of neonicotinoids on bees and many other insects in an ecosystem<sup>3</sup>. *If you wish to use such insecticides, I won't be able to help because I have next to zero experience with those stuff*. Our focus here will be on fighting battles without having to use such chemicals.

However, I do have a container of Captan, a fungicide. This is used on *rare occasions* when cactus seedlings may be under threat of rot and I don't want to throw away a whole container of seedlings. Interestingly, while you can buy Captan for agricultural purposes in a container, huge amounts of it are used each year in non-agricultural applications such as antifungal paint. So, like it or not, you have already been exposed to low levels of Captan, year in year out.

Here are two useful online fact sheets on Captan:

- <http://www.npic.orst.edu/factsheets/captangen.html>
- <http://pmep.cce.cornell.edu/profiles/extoxnet/24d-captan/captan-ext.html>

The one insecticide I use is a pyrethroid household insecticide that comes in a spray can<sup>4</sup>. This has to be a water-soluble type. It is recommended for use on mosquitos; I recall long ago there were advertisements showing rooms being sprayed and plants being sprayed. It's not even strong enough to kill cockroaches<sup>5</sup>. If such a product is not officially registered for use on plants, it usually means that no one has done the tests and paperwork for it. Officially, I suppose it's a household insecticide.

Anyway, in this litigious age when folks are too ready to sue each other, let me just add here that when I describe things I have done, it doesn't mean that you should immediately repeat what I claimed to have done without thinking for a bit. **Evaluate my claims, understand the options that we are faced with when battling bugs, then decide for yourself what you want to do.**

Nobody has a magic wand for eradicating bugs, that much is clear if you have ever seen rice weevils in a bag of rice. It's amazing that weevils still manage to outwit all the spraying of chemicals by rice farmers. Growers who want perfection will probably be forced to consider systemic insecticides or contact insecticides. You may want to “go nuclear” on bugs, but in a typical urban housing estate in Malaysia, bugs are everywhere, and they will always be able to visit your cactus plants when helped along by high winds. Remember the bug-laden old unwanted plants that you saw in plant nurseries? There is no way to bug-nuke the entire housing estate or the entire Klang Valley!

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3 Neonicotinoids are based on nicotine. Nicotine can be used as an insecticide. If you think it's a great idea to buy some tobacco and extract nicotine to make an organic insecticide to spray your cactus plants with, think again. *Concentrated nicotine can be deadly*. A lethal dose may be as little as 1 mg/kg. I prefer to stick to less deadly stuff.

4 The brand name of this product plays up its water-based formulation.

5 From first-hand experience. I've mistakenly used it on cockroaches. It just slows them down.

## Stuff I Spray on Cacti

First, I use that water-soluble spray can insecticide. The objective of this mild insecticide is to attack young or juvenile insects, to stop spreading. Don't waste it on armored scale insects<sup>6</sup> that you can see – those must be removed manually. Pyrethroids are broad-spectrum insecticides, so bear in mind that some poor itty-bitsy beneficial insects will be hurt in the process of you protecting your cactus plants. Well, nothing's perfect... but at least I never have to worry about securely storing a bottle of imidacloprid or malathion. Also, synthetic pyrethroids are designed to break down quickly, especially in the presence of sunlight, so it's one of the “least bad” options that we have.

You can buy pyrethrin-based insecticides in a spray can from every supermarket, so the act of spraying it on your cactus plants – something that you are not going to eat – is not a very dangerous thing to do. Light sprays should not damage your cactus plants. If you have not used it before, it is customary to try it on one or two plants first as a precaution. The supposedly water-soluble insecticide really looks more like a kind of emulsion, so sometimes I mix some in a liquid soap solution, dilute it, then spray it on my plants.

I only use pyrethroids about once a month (but more often if there is an invasion) – I am trying to see how little of spraying I can get away with and still be able to suppress scale insect invasions. At other times, I may use neem oil emulsified using liquid soap, or a pinch of thymol crystals in magnesium sulfate sprays. But I am not a very disciplined user of insect repellents, so spraying of insect repellent is done only two or three times a month.

Neem oil is a natural insecticide and insect repellent. In Malaysia, you can buy it cheaply at any Indian sundry shop – just look (or ask) for margosa oil. Dilute sprays of emulsified neem oil should not damage your cactus plants; test it first on one or two plants.

As for thymol, there has been research on this chemical for insect repellent purposes. Thymol comes from the herb thyme. You can buy synthetic thymol cheaply from online suppliers<sup>7</sup>. Is it really an effective insect repellent? Thyme plants keep producing thymol, so it must be good for something...

Other popular natural insect repellents are citronella and rosemary. I have used citronella in the past, in the form of a natural floor wash product. Unfortunately this company changed the formulation of its product, thickening the liquid. I didn't like to use the thick liquid. So I stick to thymol these days. As for products using rosemary, I've read about them online<sup>8</sup> but as of 2019 I haven't seen any such product actively promoted in Malaysia.

In the future, expect to see the introduction of more natural insecticides and natural insect repellents based on compounds in various herbs and other plants. Of course, you can also try countless other solutions in gardening books and websites – some may work. As far as I am concerned, what I am doing works well enough for now, so I am not desperate for new solutions.

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6 Not the UK english “armour” which Malaysians are supposed to use. Most websites use US spelling for this bug.

7 Originally I bought some intending to use it in plant propagation for its antibacterial and antifungal properties.

8 For example, search for: “SNS 209 All Natural Systemic Pesticide”. Rosemary extract and rosemary oil appear to be both an insecticide and an insect repellent, much like neem. Many such rosemary products are now on the market. The company producing SNS 209 also produces a natural fungicide formulation that uses thyme oil – interesting.

Such products are not magical solutions. Armored scale insects for example are protected from contact insecticides by their shells, so if you see any non-moving bug, it is best to simply remove them manually using some kind of tool, for example, the one pictured below.

So pick your chemicals. Prepare to do battle. Bugs *will* appear. Only you can defend your plants.



For any scale insects that you can see, just manually remove them. Bamboo toothpicks are usually not sharp enough easily to lever them off. Sewing needles may be better, but I use a large MGeo spine mounted on the plastic shaft of a cheap brush using a two-part acrylic glue. It is a very sharp tool<sup>9</sup>; I have a paper cap for it.

## Scale Insects: Armored Airborne Invasions

In Malaysia, this is one bug that you must manually eradicate if and when they appear. And *they will appear*, unless you happen to operate a perfect regimen of chemical bug control. They are better described as *armored* scale insects – they look like little brown shells stuck to cactus stems. My solution is to spray the insect repellents, then prepare to do battle when scale insects drop by.

For my collection, in the 2019 outbreak there may have been more than one species of scale insects involved – their shapes look rather different. In that outbreak, they appeared on many GBalds at roughly the same time; this included plants sheltered by the side of the house, and rooted offsets in trays sited near a single open window *with intact mosquito netting in a first floor room*.

Thus anecdotal data strongly points to *wind-blown spreading* in my locality. In short, even with quarantine procedures for new plants to keep your collection free of scale insects, you will get attacked. It's not your fault – the scale insect threat lies beyond your garden.

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<sup>9</sup> A long spine on a cactus stem may encounter a part of you at an angle, and so the spine may bend at the base or the stem may move. But a securely mounted spine is quite sturdy, and the tool may well stab straight into you. Beware!

Now, don't take this discussion as "all doom and gloom" talk and be discouraged. Compared to the challenges of growing leafy green vegetables without pesticides in urban Klang Valley, Malaysia, scale insects attacking your cacti is merely *an occasional annoyance* that can be managed without too much trouble. In my case, putting in some effort is easy because of the payoff:



If you have a bunch of PMag, PClav and GBald specimens, it's easy to put in some elbow grease to keep bugs under control, because you know these cacti are willing to flower<sup>10</sup>. A few scars on a specimen is no big deal. PMags and PClavs often become woody at the base, while GBalds do the shrinking thing. So maintaining them as perfect-looking specimens is next to impossible anyway. (Dec 2019)

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<sup>10</sup> No bugs = healthier plants = more flowers. In January 2020, there were flowers *every day* of the month.



There is plenty of information about scale insects on the Internet. Some articles have a lot of things in common with what I will discuss. For instance, look at:

Patrick Grubbs of Sublime Succulents, **How to Treat Scale on your Succulents and Cacti.**

URL: <https://www.sublimesucculents.com/how-to-treat-scale-on-your-succulents-and-cacti/>

My suggestion is this: Read the discussion here and read some online articles, then compare notes and draw up your own plan of action. It pays to have a clear idea of what to do. If you are well prepared, you can minimize damage to your plants when an attack occurs.

Many online publications on scale insects for professionals can be found on the Internet. The following are three that I have read, they are freely downloadable in PDF form.

Eileen A. Buss & Adam Dale, **Managing Scale Insects on Ornamental Plants.**

Publication #ENY-323, University of Florida IFAS Extension.

URL: <https://edis.ifas.ufl.edu/mg005>

Eric Day, **Scale Insects.**

Publication 2808-1012 (ENTO-106NP), Virginia Tech Virginia Cooperative Extension.

URL: <https://www.pubs.ext.vt.edu/2808/2808-1012/2808-1012.html>

J. N. Kabashima *et al.*, **Scales.**

UC ANR Publication 7408, University of California Statewide IPM Program.

URL: <http://ipm.ucanr.edu/PMG/PESTNOTES/pn7408.html>

Not everything in those publications is suitable for a small-scale hobby gardener of cacti in the tropics. Remember, my arsenal of chemical weapons is limited, by choice. While some plants discussed in those publications – such as big trees – can tolerate a chronic infestation of scale insects, a slow-growing cactus plant such as a GBald cannot shrug off scale infestations. The GBald may survive for a long time in a weakened state, just limping along with no new growth. Therefore, for a cactus collection, it's best to keep the population of scale insects at **zero**.

What I will discuss next is how I control armored scale insects from getting a foothold in a cactus and succulent collection that consist primarily of PMag, PClav and GBald specimens, in a tropical urban garden. Everything in your garden should be free of armored scale insects. If you have trouble controlling an infestation on a plant, consider eliminating that plant – I no longer have a pomelo specimen for this reason.

**Keep a bug-free collection and fight a few battles, rather than keep a collection with chronic infestations and be discouraged at the prospect of fighting never-ending battles.**

There are two aspects of the enemy to be considered. The first: crawlers and male insects, both of which are mobile. The second: female insects, which do not move once they settle on their final feeding spot. Armored scale insects tend to attack stressed plants or plants that are “fat but weak”, for example, plants that got extra nitrogenous fertilizer.

For the mobile crawlers and male scale insects, I regularly use an insect repellent. On occasion I use the water-based pyrethroid insecticide. The objective is to keep the mobile population in check. From 2020 onwards, I use a repellent more often, so in theory fewer beneficial insects are killed. If it does not result in more scale insect attacks over the next few years, I will stick to this scheme.

For **prevention**:

- (a) Start with a clean collection having zero infestations.
- (b) Keep your cacti healthy but don't lavish so much fertilizers that they become fat and weak.
- (c) Spray some stuff regularly. My average rate of spraying is about twice a month.

Of course, this prevention strategy is not 100% effective. Outbreaks will occur – the winds will bring in the bugs and sometimes they will succeed in gaining a foothold. At my locality, there was one big outbreak in 2017, one big outbreak in 2019, and a minor one in 2020. To the grower, any outbreak sucks, but one big outbreak a year is certainly manageable, a small price to pay for the many cactus flowers I enjoy.



An indoor outbreak, September 2019. A few scale insects can be seen on the GBald stem. The blue arrow points to the biggest one. At the upper right in the background is the single open window with mosquito netting. The outbreak was worse on specimens directly facing the open window<sup>11</sup>.

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11 I wanted to maintain a few totally bug-free GBalds in a soilless mix, but I guess the experiment failed.

By 'outbreak' I mean some armored scale insects have managed to stick fast onto one or more specimens. For armored scale insects that do not move, my only solution is to remove them manually using some kind of tool. Anything more than 0.5 mm in size can be removed by a very sharp MGeo spine tool. After removal, I usually give affected plants a spray of the water-based pyrethroid insecticide. But before any sort of **removal** happens, there has to be regular **inspections**.

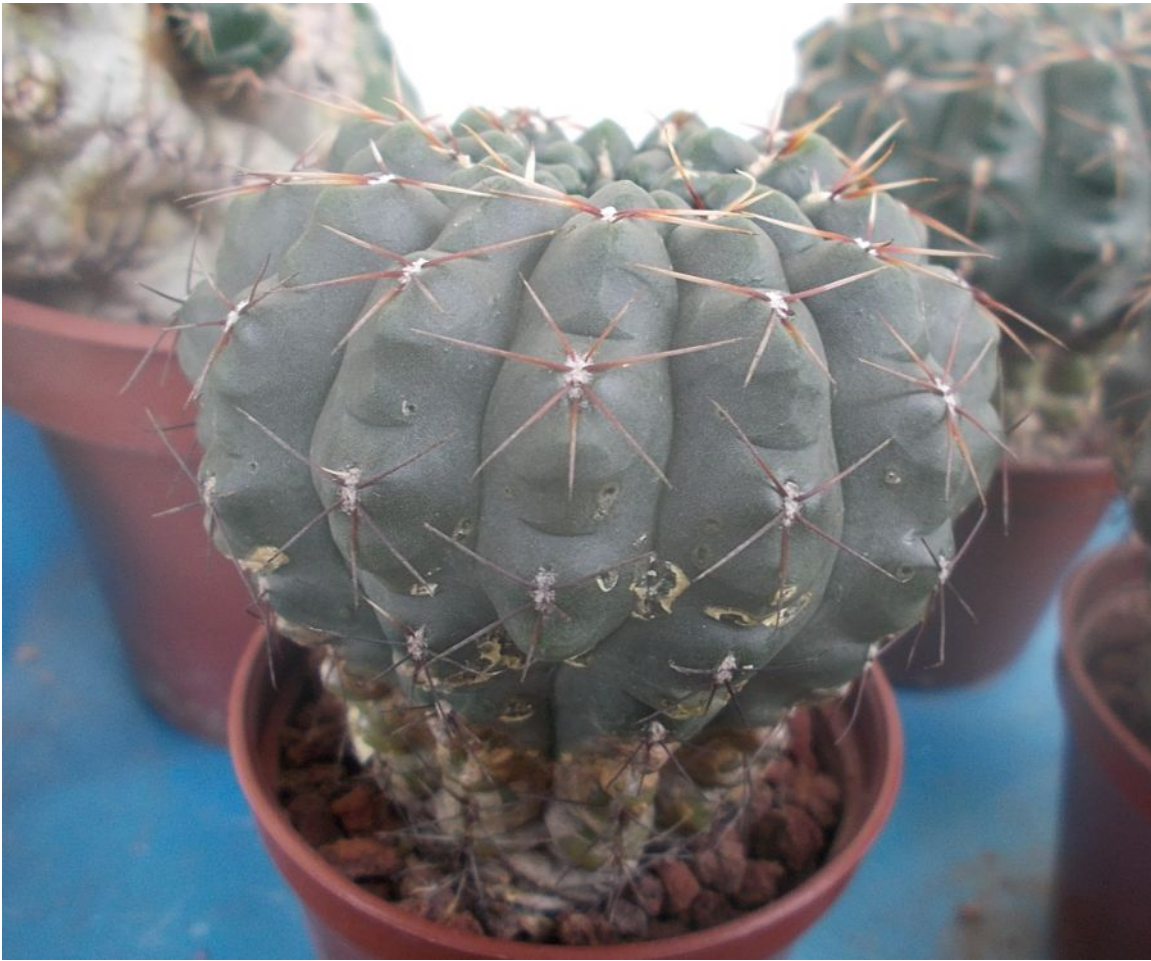
First up is the *casual inspection*. I casually inspect the GBalds every time I spray my plants with fortified water. This is done once or twice a week. Casual inspections are not foolproof; you must have a more thorough check or else you will miss detecting the beginning of an outbreak. As for a *full inspection*, that is done about once a month on average<sup>12</sup>. Full inspections means lifting up each of the small pots and checking the entire stem for both scale insects and signs of spider mites. For larger pots such as the older PMags and PClavs, I turn the pots without lifting them.



Some scale insects can be seen on this GBald, October 2019. This was outdoors by the side of the house. Time to break out the MGeo spine tool to scrape them off.

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12 Since I get an outbreak about once a year, I am too lazy to do twice-a-month full inspections.



After scale removal, October 2019. The scars will not be very noticeable if the specimen keeps growing strongly. Many scars look deep because for some reason, this particular species of armored scale looked like tiny inverted cones under the scale. This inverted cone shape is definitely different from the more conventional-looking scales in the previous 2017 outbreak. So, I do believe that multiple species of armored scale insects are out there somewhere, in Klang Valley, Malaysia.

Scale removal and some spraying will stop the outbreak for me. I also do a second round of removal, but usually I find just a couple more stragglers – nothing too difficult to deal with. No systemic or contact insecticides are needed. And in the months after that there was no fresh infestation, so my strategy of dealing with the outbreak appears to work. I suspect that at my locality, outbreaks occur when there is a population boom of scale insects. Perhaps there is a heavily infested plant nearby, who knows. But will this strategy work for say, species with soft stems? I don't know.

**Prevention – inspection – removal.** That's the formula.

A scale infestation can be a pretty discouraging experience for inexperienced growers of cacti. They might not detect the infestation early and may not immediately think that the immobile scales are insects. Often, realization sets in when the infestation is at an advanced stage. So be sure to learn about the threat of armored scale insects and how to deal with them. **Be prepared.**



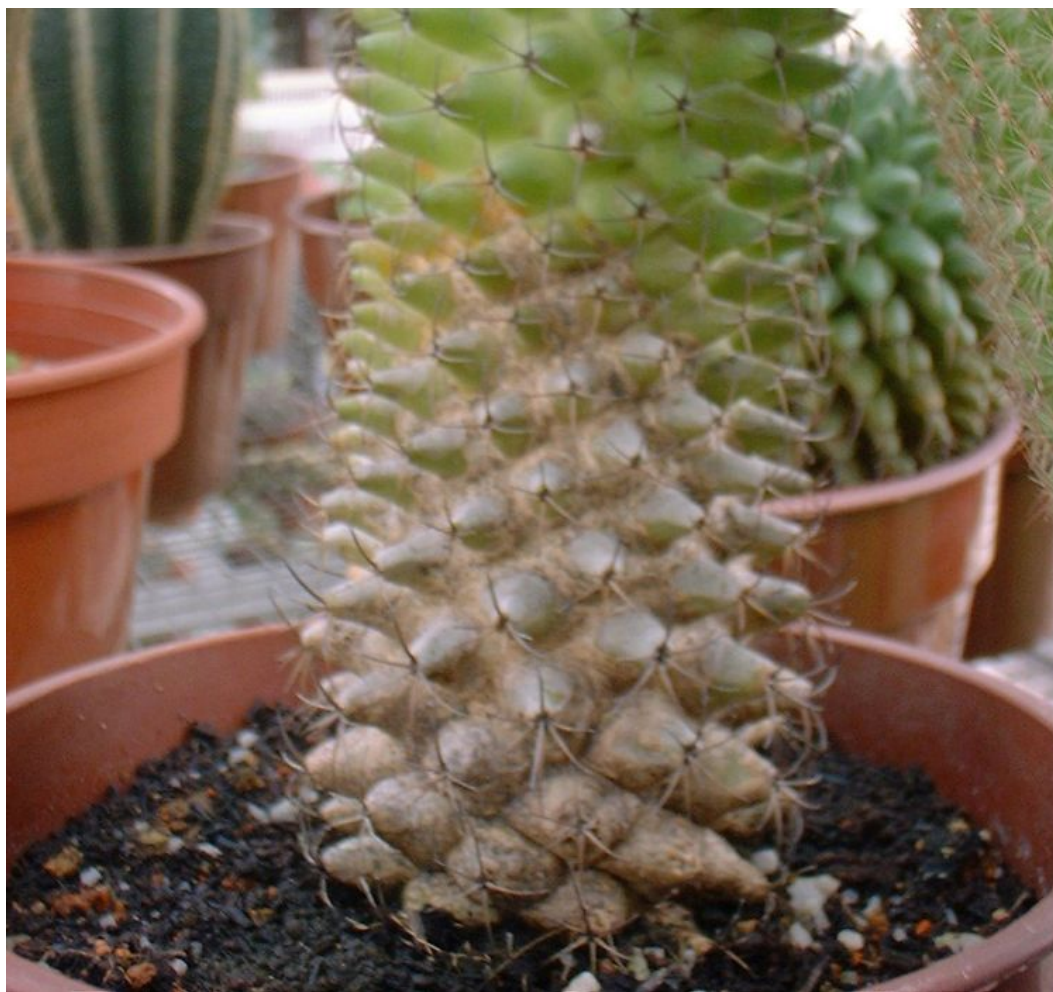
A succulent suffering from a scale insect infestation, July 2000.



A *Melocactus* specimen suffering from a particularly bad infestation, April 2001. The larger scales are nestled between the ribs of the plant. The tiny points lower down (arrow) appear to be the next generation of scale insects, happy to be out and about. Very ugly, but this has to be shown. This is what happens when an inexperienced grower has limited knowledge and lacks a concrete plan to tackle the infestation.

## Spider Mites: Lords of Dust

A long time ago, spider mites were a serious problem for me. I was thinking “desert plants” back then, so one tries to apply the obvious principles: Don’t water too much or it will rot. Don’t get the stem wet or it will rot. Unfortunately, there is a lot of dust in a hot tropical urban climate, and it turns out spider mites love dusty (or undisturbed) conditions. In retrospect, the “desert plants” paradigm turned out to be rather disastrous.



*A Mammillaria with extensive spider mite damage, February 2001. Well, in this case many Mammillarias are actually desert plants, but this one can’t handle spider mites for long in a dusty tropical urban climate.*

When an infestation has gone on for a while, expect to find some wispy webs on the affected or damaged areas. Spider mite damage often appear first on the lower portions of a stem (see picture), because those parts are less likely to be disturbed and hence, more dusty<sup>13</sup>. Damage is in the form of scarring due to spider mites puncturing the cell walls of the stem to feed. A weakened plant is usually reluctant to produce new growth and will often succumb to rot.

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<sup>13</sup> Spider mites like undisturbed conditions or dusty conditions, or both. I like to think in terms of dust, because urban areas are often really dusty. So be aware that the discussion about dust may not be scientifically sound.



A *Frailea* with scarring all over due to spider mites, July 2000. This is what happens when you try to treat your cactus plants as desert plants in a hot and dusty climate.

The method of controlling spider mites is deceptively simple: just spray your plants with water to get rid of the dust<sup>14</sup>. No chemical control is necessary! Do it correctly and it's almost 100% effective in a hot tropical climate. Spraying water is not a problem at all: I already feed all my plants by spraying them with fortified water or dilute fertilizer water. Remember, there are also regular insect repellent sprays to deter scale insects – those sprays might help deter spider mites too.

Healthy PMag, PClav and GBald specimens simply do not rot<sup>15</sup>. All the other cacti and succulents specimens in my collection are also sprayed with water and they do not rot. Here my perspective is biased because my current collection of plants are those that survived my treatment over the years.

So, grow cacti and succulents with somewhat tough skin and hard stems and you can control spider mites by regularly spraying your plants with water. However, cacti with soft stems might not survive this kind of treatment; your mileage may vary.

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<sup>14</sup> It has occurred to me that I can spray compressed air instead of water. But I haven't tried it yet.

<sup>15</sup> Also recall the discussion on nutrition. With supplemental micronutrients or minerals in the fortified water, all the plants (and their skin) are healthier. Perhaps this too make the plants less likely to be damaged by spider mites.



Wispy spider mite webs (blue arrows) on a PMag, March 2020. The scarring at the base of the specimen is probably also due to spider mites.

While the act of spraying water appears to be simple, it is possible to miss some areas in our haste to get things done, leading to spider mites gaining a foothold and causing some damage. See the picture above. This is a small PMag specimen. New growth is much wider than old growth, so the former acts as an overhang that shields the latter. The areas with spider mite webs or damage are the areas that I missed because I used a pump sprayer to spray water from above.

This mistake was caught during an inspection session when the spider mite damage became obvious. PMag skins are tough, so the damage took many months to accumulate. These days I spend a little more time in order to get all my plants completely wet. So inspections are not just to look for scale insects; you can also look for any damaged areas likely due to spider mites, and any other issues.

For spider mites, the formula is **prevention – inspection**. They are tiny, too small to hunt down individually. Since we cannot undo the damage inflicted on the stem of cactus plants, the priority is to prevent damage and regularly check for newly damaged areas so that we can improve our water spraying technique. Finally, although one can eliminate almost all spider mite damage, the threat never disappears. A tropical urban environment is perpetually dusty. Spider mites are always out there, spread all over the place by winds.



## Fungus Gnats: Larvae of Doom

You may have noticed small flies that buzz around and generally annoy you. Sometimes you will see small flies in your kitchen or bathroom. Those indoor flies may have been born in organic matter inside drain plumbings. Many people refer to all of these flies as “fungus gnats” even though there are many species of them. Sciarid flies is another commonly-used name. Basic information can be found at Wikipedia if you look for “fungus gnats”. According to Wikipedia, indoor flies are drain flies – they are shorter. Here, I will lump all of them into one label, fungus gnats.

The actual problem with fungus gnats is their larvae, which usually feed on decomposing matter. If the soil in your pot is wet for too long or is saturated with water, the wet organics in the soil will attract fungus gnats. The flies will lay eggs there. After the eggs hatch, the larvae will proceed to eat organic stuff – including any soft, juicy cactus stems.

Fungus gnat larvae is not a problem for cactus plants with tough skin. The larvae can only inflict significant damage on specimens with softer skins. Once the larvae eat their way in, the damage will allow fungi to attack and turn a plant into mush. Since I no longer grow soft-stemmed cacti, my regular specimens are reasonably safe from fungus gnats.



Rooted PMag offsets in black garden soil, May 2019. Young offsets are soft and have thin skins. The one on the left (arrow) has turned into mush because the soil has been kept wet for too long and fungus gnat larvae have snacked on the lower stem.



The two small rooted GBald offsets (arrows) in the middle are turning into mush due to over-watering of the coco peat and perlite mix. Fungus gnats were seen at the scene of the devastation. If you see fungus gnats roaming about on the surface of the soil mix, your plants are in great danger. These are rooted GBald offsets grown indoors near a window, hence the weak spines. (July 2018)

The specimens most at risk are small or young plants because they have thinner or softer skins. Small or young offsets that you are trying to root are also at risk. Any time you over-water these specimens or keep them too moist for too long, they will be in great danger.

An attack of fungus gnats often means a specimen is already turning into a pile of gooey mush. The flies like soft and juicy stems. A secondary fungi infection will spread like wildfire in a soft and juicy stem, so such scenarios are almost always fatal<sup>16</sup>. You can cut and cut again, but usually the fungi infection is ahead of you. So the only realistic strategy is **prevention**.

For your cactus collection in general, there are a number of preventive measures that you can take. Reducing the amount of organics in the soil will help. From about 2019 onwards, I use a soil and scoria mix in the middle layer of a pot, sandwiched between layers of scoria and pumice. With this kind of free-draining layered soil mix, I water reasonably and I don't see any fungus gnats roaming about the scoria surface. The regular insect repellent sprays and the occasional pyrethroid sprays may help to control the flies too. With tough-skinned cacti, the risk of getting destroyed by fungus gnat larvae is very low. But remember, the lower yellowed stem of GBalds are weak, so depending on the condition of the specimen, the risk may be higher.

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16 Almost. I recall saving only one, a long and thin seedling, by cutting it 1 inch above visible signs of rot.



Another one bites the dust, May 2019. This is another dead rooted PMag offset. Fungus gnats were seen on the surface of the soil. On occasion, I have dug around the remains and noticed tiny larvae. The root system appears to be almost intact while the lowest part of the stem looks well-punctured – I guess fungus gnat larvae like juicy stems more than fibrous roots. Lesson learned: If you want to risk using black garden soil to get offsets to root, then you need to carefully water the pot.

During inspections, look at the surface of the soil in pots and see if there are fungus gnats roaming about. If you see any flies, you should eradicate them with an insecticide. Drench the soil with the insecticide to kill the larvae too. Eliminate the flies and their larvae and your specimen might survive, if it is not too damaged and there is not yet any fungi infection.

Battles to eliminate fungus gnats are not something you should be doing very often. If you are fighting such battles all the time, then something is very wrong with your cultivation methods.

Our strategy for fungus gnat control is **prevention – eradication**. Eradication should be rare events. When a fungus gnat problem appears, it is almost always due to something that could have been avoided. Even with fragile seedlings, the priority must be with prevention rather than eradication. Simply put, don't entice them to your pots of cacti. Wet organic matter is a nice welcome mat for fungus gnats. For seedlings, use covers for seedling containers and spray occasionally with a pyrethrin-based spray. Focus on prevention, take extra care to avoid putting your young, small, soft, or thin-skinned specimens in danger and you should be able to minimize losses due to fungus gnats.

## Root Mealybugs: Out-of-Sight Unstoppable

Root mealybugs is the primary underground threat to plants in your collection. Fungus gnat attacks are quite rare, if you have got your preventive measures right. Root mealybugs are firmly entrenched in gardens in Klang Valley, Malaysia, and in many other places all over the world. Often, specimens that you buy from plant nurseries will have them in the soil too. Total isolation from root mealybugs appears to be impossible.

Luckily for us, *mild* root mealybug infestations are rarely fatal. According to Wikipedia, they are a type of unarmored scale insect. They will attach themselves to the roots of a plant and feed on sap. Roots will be damaged, but since cacti live in habitats where the ground can be dry for months on end, damaged roots or roots dying off will not kill cactus plants outright. However, damage to the root system and sap-sucking by the mealybugs do harm the health of your plants.

Our objective is to keep the overall population of root mealybugs low.



An old *Astrophytum*<sup>17</sup> with some root mealybugs (see arrow) clinging to roots. The layer of scoria was at the bottom – the pot was intentionally under-filled. The roots of the *Astrophytum* love the scoria. Most of the mealybugs were found at the very bottom; thus they may have arrived via the drainage holes of the pot. (February 2019)

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17 It doesn't look too healthy. What works on GBalds etc. does not work that well with *Astrophytums*.

The issue of root mealybugs as a pest is sometimes like Marmite: some growers have had bad experiences with them, while some think they are mostly harmless. Even experienced growers may claim that root mealybugs do not harm their plants much – I have seen such discussions in online forums. Such opinions may be valid, depending on the species and size of the cactus plants.

Because light to mild infestations of root mealybugs are not fatal, large or tough specimens may not be seriously harmed and their growth rate may not suffer at all. However, for smaller specimens their growth may turn sluggish or they may not grow at all. If your once-vigorous cactus plant stops growing, it may be time to look inside the pot.

It is easy to find excellent articles about root mealybugs on the Internet. Here are two articles that are in general agreement with what I do to control these pests:

Larry Hodgson (Laidback Gardener), **Root Mealybugs: Death From Below.**

URL: <https://laidbackgardener.blog/2017/02/10/root-mealybugs-death-from-below/>

Stanton Gill *et al.*, **Root Mealybug: What You Don't See is Hurting Your Plants.**

URL: <https://www.growertalks.com/Article/?articleid=24086>

These days, I see small numbers of root mealybugs when I repot a specimen, or none at all. While I don't think mealybugs are harmless, keeping their population low appears to work well enough for most species of cactus. It's an attainable goal. Root mealybugs are so common here in tropical Malaysia that I fear it is impossible to completely eradicate them from a garden.

Controlling root mealybugs involve **prevention – inspection – eradication**. In my case, eradication is more “population control” because I do not use any strong insecticides. Since mealybugs are everywhere, I do not think that zero mealybug population is a practical target.

First, avoid bringing in suspect soil. These days I rarely buy new cacti, but when I do buy them I really hate seeing root mealybugs inside pots of newly-bought plants. So I will *always* repot new cactus plants. I also clean off all the soil from the roots, then dunk the entire plant into a solution of the water-based pyrethroid insecticide and let it soak. Next the plant is washed and dried, and finally it is repotted. Such procedures are easy to implement for small pots of cacti. But remember, if you buy other types of houseplants from a plant nursery, *those pots may have mealybugs in them too.*

The second step is to implement some kind of barrier. I do not have any kind of isolation for large PMag, PClav and MGeo specimens, but many smaller plants are placed on separate trays. These trays are raised above ground level using bricks. Since root mealybugs are somewhat mobile, barriers are needed to stop the mealybugs from spreading too easily. And if you see ants roaming about your cactus collection all the time, you should consider controlling the ant population. Some ants farm mealybugs, and these ants will spread the mealybugs to all your plants!

The regular sprays of the pyrethroid insecticide used to control scale insects, spider mites and fungus gnats may also discourage spreading of mealybugs. About twice a year, I prepare a large container of the water-based pyrethroid insecticide and soak all my small specimens – more population control.



A root mealybug barrier is added during repotting. Cheap nappy liner at the bottom, followed by burnt soil. (September 2019)

The above picture shows a recent step I added when repotting cactus plants. This procedure is still experimental, so for now I cannot say if it works well or not at all. The objective is to add a barrier to the bottom of the pot.

Recall the picture of the *Astrophytum* – those root mealybugs were happy at the bottom of the pot. When you water your cactus plants, one spot that is damp for a long time is the bottom of the pot, both inside the pot and outside the pot. While root mealybugs are rarely found on the surface of the soil, they can sometimes be seen if you pick up a pot and look underneath it.

From 2019 onwards, I have often opted to add a “bug barrier” at the bottom of the pot instead of the customary rocks. The barrier is really a layer of burnt soil held in place using a piece of cheap nappy liner. “Burnt soil” is a soil amendment product that can be easily found at any plant nursery in Malaysia. It’s really a kind of fired clay that absorbs water well and passes water well, like very poor quality broken bricks. There are fines and there are lumps of various sizes. I am relying on the fines to block root mealybugs from easily getting into the pot.

Of course, it will not stop the bugs from getting in via the top side. Success or failure depends on the mobility of the bugs, so it’s experimental for now. I do not use this barrier for large PMag or PClav specimens. When repotting those large specimens, there was either a very small number of root mealybugs or none at all. Perhaps the bugs don’t like large *Parodias* all that much.

When trying to clean root mealybugs from the roots of a specimen during repotting, sometimes I wonder if I am also helping to spread the bugs around. Often I will lightly spray the root system with the water-based insecticide, hopefully to kill the bugs still hanging on to the roots.

Inspections with respect to root mealybugs is problematic, because these bugs are hidden inside your pots of cacti. The usual method I use is to check the underside of the pots. If you can find some mealybugs there, then you can either try to eradicate them with an insecticide dunking or you can repot the plant. You should also check nearby pots.

If you can see signs of root mealybugs on the top side of a pot, it means that you have a bad infestation and it's best to repot the specimen after a full cleaning and dunking. Sometimes though, the whitish stuff is not a root mealybug problem, see the picture below. Another option discussed in articles about root mealybug control for horticulture in general is to destroy the plant, but well, if you have a GBald that flowers, you are not going to destroy it just because of a few bugs.

In the longer term, the health of your collection may provide hints. If your plants are growing strongly, they probably do not have a heavy load of pests or bugs. But if your plants never seem to grow, then you should pull out one or two from their pots and check the soil mix.

The other long-term gauge is when you repot your specimens. If recent repottings show little or no root mealybugs in the soil mix, I would regard that as good news. It means the steps that you have taken to control the population of root mealybugs is working to some extent.



A GBald in a tray of pebbles (with no soil and no drainage) with a serious infestation of bugs. These bugs are not root mealybugs, but white flies – you can see the triangular shape of the two near the centre of the picture. This white fly infestation initially looked like a root mealybug problem. White flies usually attack leaves. This is a rare problem, perhaps caused by overly-damp conditions. (December 2018)



Smaller specimens on elevated trays, January 2020. Regularly applying various preventive measures to control bugs leads to healthier specimens. One may not have eliminated every pesky bug, but enough such that the growth and development of the plants are not hindered. The plastic pot saucers are to avoid rivulets of water when watering the plants. I don't know if they are any good as a root mealybug barrier.

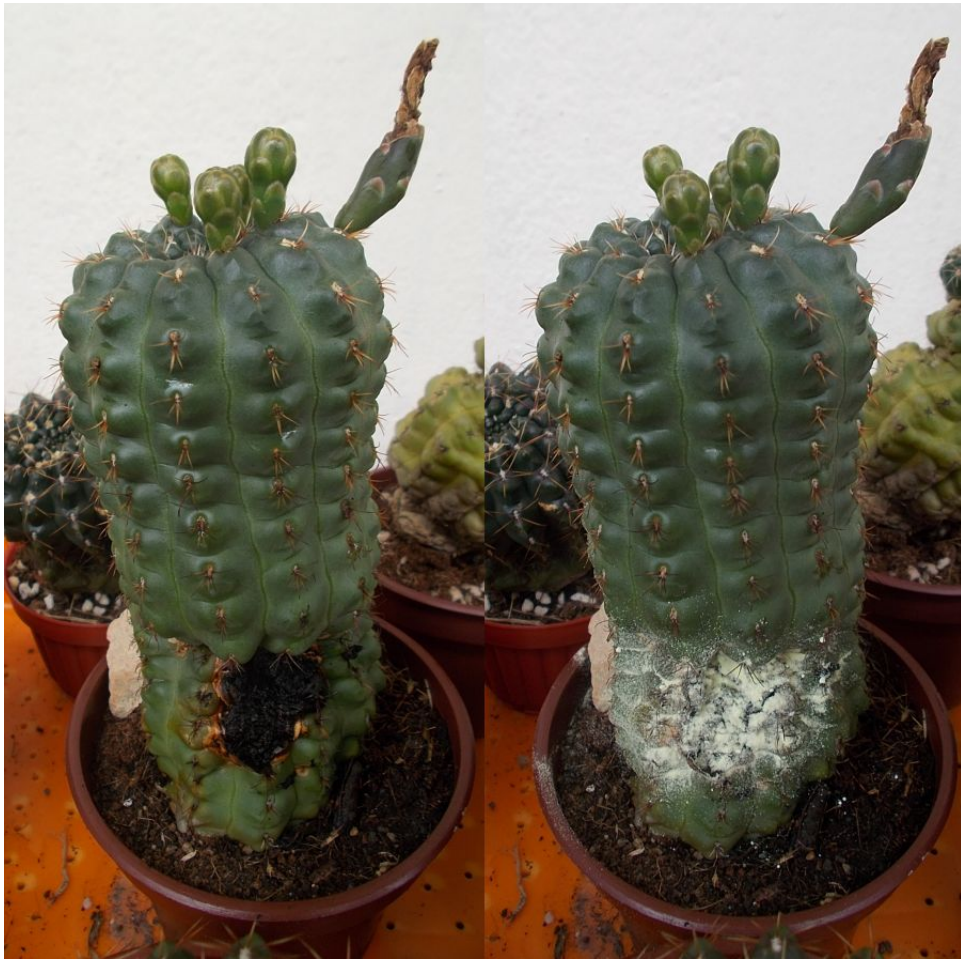
Once you manage to control the four main bug threats – scale insects, spider mites, fungus gnats and root mealybugs – the cactus plants in your collection will be largely free of damage and sap-sucking parasites. Cacti are slow growers and small specimens have little reserves, so every little bit counts.

Healthy specimens that are largely bug-free can therefore direct their resources into growth. A healthy cactus collection means that bugs are well under control. For growers in a tropical climate, if you grow healthy PMags, PClavs and GBalds, your bug-control efforts will not go unrewarded – it will help you achieve the big payoff: a non-stop display of brightly-coloured flowers.

## Centipedes and Weak GBald Stems

Centipedes are an unusual threat to cactus plants, but it has happened to me twice over the years. This may be kind of a tropical climate thing. Specifically it involves GBalds because of their weak lower stem. Insects and other organisms naturally see the lower stem as a weak point, and some organisms – such as centipedes – have uses for this weak point. The problem occurs when there is a weak point that can be easily attacked, for example, a damaged area such as a scar.





Centipedes attacked a big scar on a GBald (left). The area was cleaned and doused with sulfur<sup>18</sup> powder (right). This was the top half of a long GBald, the result of fertigation experiments. The shiny stem is due to insecticide spray. April 2017.

In the picture above, the black patch is an old scar that was originally near the top of the specimen. Sometimes such patches can appear out of the blue on a GBald, I don't know what causes it but the area dries up quickly and turns into a black patch. The rest of the specimen behaves normally. The original plant was cut into two a while back (this specimen is the top half, rooted) so the scar is now near to the soil, on the portion of the stem that is slowly turning yellow and shrinking.

What happened was some centipede decided to burrow into that scar area and make itself a nest. I realized there was a problem when I saw tiny baby centipedes crawling out of the damaged scar area. I suppose the mother centipede thought that area was a decomposing part of a plant.

The scar area was sprayed thickly with the pyrethroid insecticide, washed, then doused with some sulfur powder that I had lying around. The sulfur powder didn't appear to hurt the plant. The GBald survived, only to die of rot a few months later, in October 2017. In retrospect, the specimen was too big and too juicy – very dangerous when combined with the propensity of GBalds to shrink their lower stem.

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18 Or 'sulphur' (UK spelling) but I use 'sulfur' to match the more popular spelling of magnesium sulfate.



Oh well, game over. October 2017. As is common in such cases, this is utterly and totally fatal. Compare this picture to the picture in the previous page. In about 6 months, most of the long stem has turned yellow-green. Only the top 1 inch looks truly healthy. It was trying to do the shrinking thing, but the stem was perhaps too big and too juicy to shrink properly. The rot may not have started at the scar area. But it doesn't really matter, because the entire lower stem was ripe for a disaster.

## All Kinds of Rot

I don't have many useful things to say about rot in cactus plants, because as urban gardeners we actually know very little about what caused the rot. Was it fungi, bacteria or virus? We simply don't know for sure. Most of the time we make a guess and call it for fungi.

The first thing is to control those fungus gnats. Avoid attracting fungus gnats, and you will stop many avoidable cases of rot. If you grow tough species of cacti and succulents and grow them well, I believe cases of rot not caused by fungus gnats are generally few and far in between.

The second thing is to maintain a healthy collection. Apart from dealing with bugs, you will also need to provide proper care and nutrition. Strong and healthy cacti can be surprisingly trouble-free if they are well cared for.

The third thing is to be aware of the complication of GBalds shrinking their lower stem. In a hot and humid tropical climate, some of your GBalds may die while trying to do the shrinking thing, because the lower stem is so weakened. I think this is unavoidable, so any serious grower of GBalds in the tropics need to prepare for losses. Don't be too attached to individual plants. The trick is to see a group of GBald specimens as a local population of GBalds that you need to manage.



This GBald died in a different way. It was not juicy enough to melt into a gooey mess. Instead, the outer skin was still largely intact while the insides rotted and the remains dried up. The brown stem was the shrunken lower portion of the plant, so it had less moisture than a normal juicy stem. The specimen was not completely dead yet because the topmost part of the stem is still green on the outside. Anyway the green part did not survive because its internal damage was too extensive. (November 2016)

Losing a fat and juicy GBald that provided many, many flowers may appear to be a terrible loss, but under such circumstances we must review what we have learned about the lifestyle of GBalds and affirm that this species of cactus is somewhat short-lived but productive; fleeting but marvellous; kind of like a butterfly. I have plenty of offsets to replace this specimen. It's the population in its entirety that counts – and it's a healthy population of GBalds in an artificial setting.

## Fungi Risk for GBald Areoles



The long and fat GBald stem with some fungi trouble (blue arrow) in May 2015. This was how the large black patch that you've already seen many times began.

This is a fungi issue<sup>19</sup> that I have seen only on GBalds. In particular, it starts from an areole. A black patch of necrotic (or dead) tissue will form. Later, the patch will turn into a hard black scar patch. So far, I believe all my specimens survived such attacks – the GBalds managed to contain and close off the problem area.

From a study of my picture archives, the probable issue is a weakness of GBald areoles. All cases started at an areole that had just dropped off the remains of a dried flower.

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<sup>19</sup> I'll blame fungi for now. But it is so localized that I can't help but suspect bacterial action as well.



Closeup of the beginning of a black patch (blue arrow) on a GBald, June 2020.

The picture above shows the most recent case of this black patch problem (as of June 2020.) This is a relatively small patch, and it is centred right in the middle of an areole that only recently held a flower. That flower had opened, closed, dried up and dropped off. Then this problem began.

The simplest guess is that such areoles are weak points because it has a detached point with exposed surface where microorganisms can get into the plant. Since older areoles that once held flowers do not have this problem, the weakness is temporary. Once the detachment point heals, I suppose that will stop microorganisms. But before it heals, that's when this black patch problem might strike.

While the problem is not fatal (so far) and it is not common (so far), it disfigures the plant to various degrees. One solution is to stop spraying specimens with water when flowers are starting to dry up. Another solution is to spray less. The third solution is to spray a substance to ward off microorganisms. Currently I am trying to use thymol more often in water sprays because it has antifungal and antibacterial properties. I will also try to avoid spraying areoles with drying flowers, but modifying one's cultivation habits is going to take some getting used to.

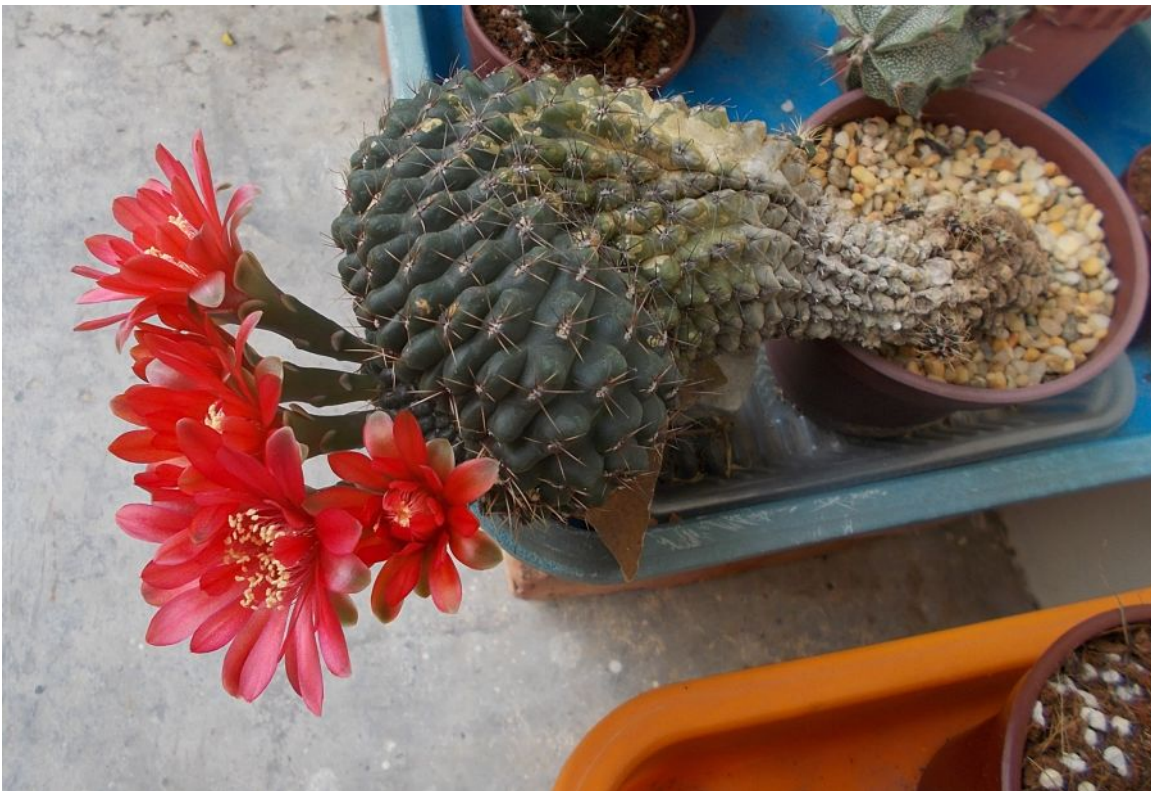
Generally, I see this as an uncommon issue and I'm not overly concerned about scars on my GBalds. So it's not a huge problem for me. I have never seen this on PMags or PClavs.

## Defending Your Cacti is Not Difficult

We have reviewed the major threats to a collection of cacti in a tropical urban setting. With a suitable selection of plant species and by making sure your efforts count, it is indeed possible to defend a collection from bugs over a period of many years. If you work smart, the use of contact insecticides or systemic insecticides is not necessary.

A lot of material was covered, and while all of this may appear daunting to a newcomer to growing cacti, fear not. For example, there are many bugs that threaten your plants, but when you do an inspection, you are checking for all signs of bugs or trouble at the same time. After some practice, sensing trouble will become easier, like second nature. Spider-man has got his spider sense; we just need to develop a cactus sense. Regular inspections are also a form of familiarization – you will remember how your plants are doing and this will help you to gauge their progress or state of health. And when trouble appears, the material here will have prepared you to do battle.

Sometimes when things are not going right, do not despair. We can learn things even with our failures. Aim for healthy plants rather than perfect plants. After all, shrinking GBald stems are not all that pretty. I once messed up a GBald and it was awful-looking for a long time. Then it got better, grew a bit, and produced a bunch of flowers. ♦



This GBald specimen was a mess that recovered. The growing point was probably damaged and this made the specimen grow a crest. March 2017.

## Version Information

This is the June 2020 Edition of this document.

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## Colophon

Written on LibreOffice. Most images were produced using GIMP and IrfanView. PDF tested using SumatraPDF. Fonts used include Liberation Serif, Arimo and Liberation Mono. The document is sized for A4 or Letter printing with enough whitespace for comfortable reading.

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