Aquatic Plant Q&A – Part of the larger usenet "Aquatic Plant FAQ" series of articles in Tank Talk Volume 19 No. 3 1996

FAQ: AQUATIC PLANT Q&A
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Answers to your questions are available on the following plant topics:

* General Questions
* Lighting
* Nutrients and Fertilizer
* Heating
* Fish
* Carbon Dioxide (CO2)
* The Substrate
* Long Term Success

General Questions

``What do you absolutely need to grow plants?"

Successful plant growth requires a balance of light, nutrients, trace elements, and carbon dioxide (CO2). The light should be provided in a spectrum the plants can absorb, must be of great enough intensity to keep the plant alive, and should be consistently on 10-14 hours a day. Most nutrients are supplied by fish waste. Trace elements _may_ also be supplied in your tap water, but can be supplied by commercial trace element mixtures. CO2 is supplied partly from the air and partly by your fish, but can be enhanced by injecting it from an external source (for example, a compressed bottle). If your plants have a deficiency of even one of these factors, their growth will be limited. (Don't panic about this; most of us don't need optimal plant growth.) Each will be discussed in detail in the following sections.

``My friend grows plants beautiful plants and doesn't do stuff like CO2 or fertilizers. Is it really necessary?"

The quick answer to this is _no_. It is completely possible to grow plants using basic tank equipment, either by chance or by patiently learning through trial-and-error. This is accomplished by slight modification of the basic equipment and usual fishkeeping practice. High-tech gadgetry, however, can remove much of the guesswork by allowing you to better control each of the four success factors.

We should also mention that the term _beautiful_ is a bit subjective here; Some hobbyists achieve great success with ``easy" plants and no special equipment, and this is perfectly fine. But beware comparing this to a high-tech monger and their ability to grow a wider variety of plants, because they're really two different categories!.

``How do I disinfect my plants?"

* A ten minute soak in potassium permangenate (pale purple) works well; it is available in dilute form from Jungle products as "Clear Water". Permangenate is particularly good for killing bacteria and pathogens.
* A 2-day soak in 1 tbsp/gallon of alum (buy it at drug stores) is good for killing snails and their eggs.
* If the plants are kept in a fish-free system for three weeks, parasites like ich and velvet will die without their fish hosts.
* Soak plants in a 1:19 diluted bleach solution; 2 minutes for stem plants, 3 minutes for tougher plants. Make sure to remove all traces of bleach afterwards by rinsing with water and dechlorinator. This method can kill your plants, so use only as a _last resort_ against hell algae.

(See the ALGAE SECTION of the DISEASE FAQ for more algae-prevention tips, and the SNAIL SECTION of that same FAQ for snail prophylaxis.)

``Do I leave my new plants in the pot?"

Many aquatic plants are now sold in potted rockwool. Plants with delicate roots, such as _Cryptocoryne_ and _Anubias_, are usually best left in the rockwool wadding, especially if you have to move them around in the tank. Leaving them potted also can reduce transplant shock; otherwise you must be patient and allow the plants time to recover in their new substrate. You can bury the pots in your gravel to conceal them. Some folks like to cut away the plastic pot, and just leave the plant in the wadding so it can grow out into the substrate.

Fish

``What kind of plants can I keep with fish X?"
``What kind of fish can I keep with plant X?"

These are essentially the same question, though asking the second one shows you are a serious plant person. You need to match the habits of the fish with the plant. Big cichlids that like to dig should not be kept in a tank with rooted plants, though floating (or ephiphytic) plants are fine. Vegetarian fish should not be kept in a tank with plants they like to eat, unless the plants grow faster than they destroy them! Some algae-eating fish also turn out to be plant-eaters too. In general, try and learn the habits of your fish before you buy them and your plants, and be prepared to find out what works by several trials.

Some fish that can be kept with virtually any plants: small tetras, danios, rasboras, gouramis, discus, bettas, angelfish (Pterophylum), rainbowfish, Corydorus catfish, livebearers, killifish, dwarf cichlids, and in general most small fish.

Lighting

``How much light do I need"

The ``classic" rule of thumb for lighting is 2-4 watts per gallon (0.5-1 watts/l) for a tank of normal depth, less than 24 inches (60cm). The actual requirements also depend on depth, so you could get away with 1-2 watts per gallon with a 12 inch deep tank, but would need more than 4 watts for a tank deeper than 24 inches. For plants that demand medium to high light, most people find they need at least two fluorescent fixtures of the length of normal tanks (20-gallon (80l), two 24 inch tubes; 55-gallon (200l), two 48 inch tubes). More detailed calculations can be found in the later LIGHTING section.

``Can I grow plants with my single strip light?"

Yes, you can, though you are limited to the lowest-light plants and will get very slow growth. Some of these include Java fern, Anubias, Cryptocoryne species, water sprite and Java moss. Some of these plants, notably _Cryptocorynes_, actually _prefer_ lower light. We should also mention that some people may have luck with plants that normally prefer higher light, but the odds are that they will grow slowly and stunted.

``What kind of bulb do I need?"

First and foremost, don't use incandescent lights; they generate far too much heat and not enough light. Full-spectrum fluorescent bulbs are ideal, since they duplicate the spectrum of the sun. These tubes (``Vitalite", ``Spectralite") cost between $8 and $20. Cheaper ``plant lights" are also good, and may actually bring out your fish's color better. Tri-phosphor bulbs (Triton, Tri-lux) are slightly more powerful, but also more expensive than full-spectrum bulbs, and high-end bulbs with internal reflectors (BioLume) are overpriced and unnecessary. Other bulbs to avoid are standard cool-white tubes, and ``aquarilux" tubes, designed to show off the fish and retard plant growth, though some folks have had success with a mixture of cool white and plant bulbs.

``What's MH? Is it better than fluorescent?"

Metal Halide (MH) lights are most commonly seen illuminating football fields, but are also used in our hobby by reefkeepers and die-hard plant enthusiasts, who demand very high light intensity. The fixtures cost significantly more than fluorescent (over $200 per fixture). The bulbs last longer and provide more efficient and brighter illumination than fluorescents (typically 175-250 watts per bulb), but generate an appropriately higher level of heat as well. Some aquarists like the sun-like shadow effects generated by MH bulbs.

Do not confuse MH with the tungsten halogen lights sold in hardware stores as utility floods or living room fixtures; Halogen lights are basically high-wattage incandescent lights, and generate an enormous amount of heat and are very inefficient in their light output.

``How do I add another light to my tank?"

If you can fit a second tube in your existing hood, many stores sell upgrade kits to add the second fixture. Otherwise, you might be able to add a second hood to the tank, or you can find a replacement two-bulb hood (mail-order places sell them). Another option for 4-foot (130cm) long tanks is to buy a ``shoplight" fixture and lay it across the top over he glass. You can also build your own hood or canopy and mount the shoplight or fixture inside. It's possible to omit the fixture by purchasing special end caps and clips for the tubes. These are available, with ballasts, from aquarium stores and are commonly used by marine aquarists.

``How long do I leave the light on each day?"

Plants want a definite daily light and dark cycle each day; 10-14 hours is fine; twelve hours is the duration on the equator, where many tropical plants are found. You should buy a timer ($5-10) to automatically turn the lights on and off for you, since the plants (and fish) prefer a regular cycle to an erratic one. If the plants need more light, you should _not_ extend the light period, as that will only help the algae. Rather, install another fixture and increase the _intensity_ of light.

Speaking of timers, many fluorescent fixtures don't self-start, i.e. you have to hold in a button for a few seconds to turn it on. You can quickly convert any fixture into a ``self-starting" one with a few new components from a hardware store or sold as a kit from mail-order houses. See the later LIGHTING section for a diagram.

``How often do I change the bulb?"

Most fluorescent bulbs lose a major portion of their intensity after six months, so they should be replaced every 6-12 months. If that seems expensive to you and you can live with the reduced light level, you can cheat and wait until the bulbs burn out after two years (that is, according to TAG editor Neil Frank, what ``many experienced plant enthusiasts" do). It is best to stagger the replacement on multi-bulb tanks in order to avoid dramatic intensity changes.

``Won't increased light fill my tank with algae?"

If you are adding that second light to your tank for the first time, you should be prepared for this. Increased light is welcomed by both algae and plants, so the plants must out-compete the algae. You can help tip the balance in the plants' favor by maintaining a low fish population, keeping algae eaters, and frequent water changes (see the ALGAE SECTION of the DISEASE FAQ).

## Carbon Dioxide (CO2)

``Is CO2 injection really necessary?"

CO2 injection is not required to grow plants. However, most people with CO2 feel that, aside from high-intensity lighting, CO2 is the most important step to getting _excellent_ growth. In fact, as light intensity is increased, plants will require more nutrients, including carbon which is derived from CO2. In conjunction with carbonate buffers (see the WATER CHEMISTRY section of the BEGINNER FAQ), CO2 injection will buffer your water to a neutral or low pH. Lower pH will help plants get access to certain nutrients. Some also report CO2 injection keeps algae down.

``Isn't CO2 expensive?"

The startup cost can be a bit steep; expect to pay around $500 for a fully-automated Dupla system, $350 for a manual injector. If you do it yoursel using welding or bar supplies, you can drop the price to $100-$200 for a tank, regulator, and needle valve. After your initial investment, CO2 refills (try fire extinguisher or beverage service outlets) are cheap: $5-10 a year for a 5 lb cylinder.

If this is still too much, try the ultra-cheap _Yeast Method_ of brewing CO2 (see below). *[Also look for the article on building your own CO2 infuser in the next issue of Tank Talk...Editor]*

``How much CO2 is normal?"

The optimum dissolved CO2 level in an aquarium is 15-20 ppm. Some references say that levels above 25ppm poison your fish, but general experience is that this doesn't happen. The amount found in the water from atmospheric concentrations varies by elevation and temperature, but is less than 1ppm.

``How does the compressed gas method work?"

A compressed gas cylinder supplies CO2 at a high pressure of 800-1200 PSI. This is dropped to 5-20 PSI through a regulator, and reduced to a few bubbles per second by a fine-control ``needle valve". This slow bubbling must be dissolved in your aquarium's water, through either a gas reactor (which lets water and gas mix in a chamber much like a trickle filter), an inverted jar (which just lets the gas diffuse into the water slowly), or by injecting the bubbles into the intake of a power or canister filter (the impeller ``chops" them up into smaller bubbles, many of which dissolve). The reactor is the most efficient method, while the power filter injection is the easiest to try.

It is important to have control over the rate of injection, as too much CO2 can kill your fish. Expensive ``automatic" systems use an electronic pH meter to regulate the amount of CO2 in the water by shutting off the gas when the pH drops too low. ``Manual" systems require you to start with very low injection and gradually increase over several days, all the time carefully monitoring pH drops and CO2 bubble rate in order to find the correct needle valve setting.

Construction and operational details can be found in the later CO2 SECTION.

``How does the yeast method work?"

CO2 is generated by fermentation of sugars in a bottle (just like when brewing beer!) and then injected into the tank using the same methods described above. The parts are _very_ cheap and easier to set up than the compressed tank. The main drawback is that CO2 generation rate can be erratic, and will quit on you if you do not change the solution (once every two weeks or so) or get the mixture right. The CO2 level generated is lower than that of compressed gas tanks, but is still enough to help plant

growth. Initially passed off as ``useless'' by much of the aquarium literature, this technique has enjoyed a certain vogue in the last year as a good way to try CO2 without draining your wallet.

Here is one quick construction method: Tap the cap of a 2-liter plastic soft drink bottle (the author uses drip-irrigation taps, which can be obtained cheaply at local hardware stores) so that an airline tube can feed the gas into your tank. Half fill the bottle with water, and add 1/2 tsp yeast and 1/2 cup sugar. The solution will last about two weeks, after which you can throw it out and start a new batch. Beware of water siphoning back from your tank... put a check valve in-line with the airline tube.

``Can I just dump carbonated water into my tank?''

No! Plants need a slow continuous source of CO2. If you dump carbonated water in, it will spike the pH (stressing your fish), and the CO2 will just dissipate back into the air within a few hours.

``Does injecting CO2 reduce the oxygen content?''

No. The level of dissolved CO2 and oxygen are actually _independent_ of each other; high levels of both can exist at the same time. Furthermore, if you have a set of healthy plants, they will be saturating the water with oxygen on their own. The problem is that many of the techniques used to increase oxygen content (airstones, trickle filters, keeping the water moving at the surface) also cause CO2 to diffuse out of the aquarium; i.e., if you turn off your airstone in order to keep the CO2 in, you might also reduce your oxygen content. The best solution is to keep the water moving at the surface of the tank, but inject CO2 faster than it can escape, giving you high levels of both CO2 and oxygen.

Nutrients and Fertilizer

``Is fish food enough to fertilize my plants?''

Fish food usually provides enough of the three _macro_nutrients, nitrogen, phosphate, and potassium (N-P-K), to keep your plants healthy. However, the trace elements such as iron are not all supplied in a form that the plants can use. Some trace elements may be in your tap water, so frequent water changes will replenish them. This may provide enough for some plant growth, but if you want the best growth you should consider adding a trace element fertilizer.

``Can I use normal plant fertilizer?''

Normal land plant fertilizer contains high amounts of N-P-K which is already supplied by the fish food. Adding more will cause algae outbrea and possible fish stress. You may be able to find a trace-element-only fertilizer at better garden shops, or even mix your own. Aquarium-specific mixes by Dupla (available world-wide) and Dennerle (not available yet in the U.S.) are expensive, but are proven to work very wel Beware some other brands that supply N-P-K (check the label for ingredients; some do not list their contents for this exact reason.) Fertilizer tabs, or even 1/4 inch pieces of ``plant sticks'' (without sulfate have been successfully used if placed deeply in the substrate and used sparingly.

``How do I know if I need fertilizer?''

Lack of fertilizer shows up in your plants, as sickly transparent or yellow leaves, as holes in the leaves, and as reduction in plant growth. Old leaves die off more quickly than they are supposed to, and the new leaves are small and stunted. Another symptom is the plants grow very well for a month or so after you buy them, but then stop as their internal supply of trace elements and macro nutrients run out. You also need to add fertilizer if you have high levels of CO2 and lighting, but no plant growth.

``How do I know which nutrient is limiting plant growth?''

This is always difficult to answer without actually _trying_ it yourself. If you have slow growth and it picks up shortly after you change your water, then your water is probably supplying some trace elements which get depleted later; consider adding a trace element mix or changing your water more often. If you have slow growth, but it picks up after adding trace element mix, problem solved! If you have slow growth but it picks up after feeding your fish a little bit more, problem solved! But watch out that you don't increase things too drastically, or you'll get algae blooms.

``How much is too much?''

If you like keeping zillions of test kits, then you can check some trace element levels with them (Dupla recommends an iron level of 0.1ppm). Ammonia and nitrate test kits will tell you if you are overfeeding. Alternatively, you need to watch your tank. Too much fertilizer and fish food may show up as excessive algae growth.

The Substrate

``What should I put in my substrate?''

Gravel or sand is a good start! Size is an issue; with small grainsthe roots might not be able to get a good hold and the sand tends tocompact, while larger gravel has a tendency to collect pockets ofrotting detritus. Most believe the ideal size is 2-3mm (#8) gravel,while a few others like 1-2mm coarse sand (though it may be harder tofind). Malaysian trumpet snails (see the ALGAE SECTION of the DISEASE FAQ) will burrow into the substrate and keep it aerated. The bottom 1/3 of the gravel can be supplemented with a fertilizer, of which popular choices are peat (softens water), laterite (a clay containing iron, usually used with undergravel heating systems), and soil. One word of warning: if you use an undergravel filter, it may suck your fertilizer back into the tank instead of keeping it with the bottom of the gravel. Dupla makes special laterite balls which can be used in an UGF (though expensive).

``How deep a substrate?''

In general, it's good to match the substrate with the types of plant (or types of roots). For instance big Amazon Sword plants like deep gravel of 4 inches (10cm), but _Lilaeopsis_ grass can do fine with an inch or less. This can be helped by terracing the back of your tank to be deeper and planting your deep-rooted plants there. You also can't go wrong with a uniform 3 inches (7cm) of gravel all-around.

``Can you grow plants with an undergravel filter (UGF)?''

Oh my yes! Make sure you have enough gravel for the plants to be happily rooted. It should also work best with a very slow flow rate. Pluses of UGF may be an increased circulation to the roots. However, you will probably get roots growing in the plates, it will be harder to vacuum everything, and will be a major pain to pull and replant. Many feel so strongly that you _shouldn't_ grow plants with an UGF that it has become a bit of a religious issue on Usenet. However, this does not mean it is not possible... like most religious issues, it is something for which you must make your own decision. :)

Heating

``What temperature do I keep a planted tank?"

This varies from plant-to-plant, but you can keep most aquatic plants from 72-80F (22-27C). For warm-water discus tanks, check a plant book for species that thrive in these special conditions.

``Do I need to have substrate heating?"

The exact benefits of substrate heating have not been proven yet, but it is believed they provide _long-term_ stability to a tank. If you are a beginner, it's hardly worth messing with before mastering the basics (fertilization, lighting, etc). If, though, you are a gadget freak or love to spend money, you may get a sense of pride from installing a cable heating system. (Some believe that a very slow UGF can provide the same benefits.)

Long Term Problems

This list is by no means exhaustive! Please feel free to suggest more long-term problems that can be addressed here.

``The leaves turned yellow and fell off."

``The leaves got holes & fell off"

Might be a trace-element deficiency, or in the latter case, fish and plants eating them.

``It grew for a while & then died/still grows, but slower."

This is by far the most common problem beginners experience, and has several different causes.

1. Plants can store some nutrients and trace elements, using them later. When they come from the greenhouse, they are fully stocked. But after a month or more, if you do not supply them with a balance of nutrients they take what's missing from their stock. When the stock's gone, the plant dies.
2. Most _potted_ plants are grown emersed (hydroponically) in greenhouses, and are used to growing in very high light (i.e. filtered sunlight) and with high levels of nutrients, and must acclimate to aquarium conditions. First, they'll lose the old leaves which were growing out of the water and produce new leaves that have a different shape and firmness. Secondly, as they acclimate to the lower light and nutrient levels their growth rate will temporarily slow down.

   While potted plants ship well, this may not be true for _non-potted_ plants. They may have been stressed by passing through many hands from grower or collector to wholesaler to retailer, so they may not be in optimum condition when you acquire them. The non-potted plants were most likely grown underwater, but also outdoors under filtered sunlight, so they also must acclimate to the aquarium conditions.
3. The plant might not be a true aquatic plant. Many stores pass off land plants as aquatics (see our BLACKLIST). These plants can manage to stay alive for a month or more, but eventually succumb.
4. Some plants go into hibernation. Aponogeton bulbs will lose all their leaves, at which point they should be removed from the tank and kept in cold water for a few months. Then they can be replanted and will send out new leaves.
5. Cryptocorynes will ``melt" all their leaves on a change in water chemistry. Don't despair, eventually they will send out new leaves.

``My ... grows great but everything else dies"

Some plants are hardier than others, and will grow in lower light, CO2, or worse water conditions than others. However, some plants will actually out-compete others for the available nutrients, and some plants will not do well in the presence of other species; try moving the other plants into a different tank if you can.

``My ... is covered with algae!"

Please read the ALGAE SECTION of the DISEASE FAQ for details on specific algaes and remedies. But to summarize, you can keep algae-eating fish to munch on it, starve it for nutrients by adding floating or fast-growing plants that consume nutrients faster than the algae, harvest some plants and remove dying leaves often to take nutrients out of the tank, reduce feeding (or increase water changes if you must overfeed), reduce the number of light hours per day, use root fertilization instead of liquid leaf fertilization, or physically remove it from the tank. There are also antibiotics for blue-green algae and other algicides, but the latter can kill your plants as well; use with caution!