

# How to Make Plants Flourish

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The sheer number of factors involved in plant growth and health may seem daunting at first, however, if we broadly classify these factors into three categories the task of deciding what is needed becomes more manageable. These categories are: Substrates, pH/Hardness, and Supplements. Each category builds upon the one before, using the groundwork laid to ensure a flourishing environment at every stage.

Substrates are the “root” and foundation of the system. Starting with a quality gravel (such as Seachem’s all natural and mineral rich gravels: Flourite™, Flourite Red™, or Onyx Sand™) lays the foundation for further success. Although a low cost gravel may save money in the short term this will be more than offset by a necessitated increase in use of supplements to make up for the shortcomings of such gravels. If a quality gravel is employed one could actually just add a few fish and have a successful planted aquarium. It likely will not win any awards for growth rates but it will be a good, solid aquarium whose overall simplicity of maintenance will appeal to the beginning hobbyist. At this point there will be a divergence of hobbyists; some will be happy with the aquarium as is and some will desire to take the aquarium to the next level, i.e. faster growth, richer greens, etc.

This next level begins with pH/Hardness (KH and GH) optimization with buffers and mineral salts. Although these terms are used quite frequently it would be worthwhile to define them here for those new to this hobby. In broad terms, pH is a measure of the acid content of the water (acid meaning Hydronium ion:  $H_3O^+$ ); because pH is the negative logarithm of this acid concentration, smaller pH numbers translate into higher acidity levels. KH is a measure of the carbonate (bicarbonate & carbonate) content of the water. Because carbonates act as pH buffers you will find that KH and pH are intrinsically linked in the planted aquarium (in general KH and pH rise and fall together). GH is a measure of the calcium and magnesium content (it also encompasses other divalent

metal cations, e.g. iron, copper, etc, but these typically contribute less than 1% to total GH) of the water. For both KH and GH low values correspond to “soft” and high values to “hard. The native environment of some plants (*Cryptocoryne*, *Aponogeton*, etc.) is soft whereas others (*Sagittaria subulata*, *Riccia fluitans*, etc.) are more acclimated to hard water. Husbandry goals will dictate the approach taken to adjusting pH and hardness. If keeping soft water plants and the source water is hard one will need to soften it either by using a RO (Reverse Osmosis) system (such as Seachem’s Pinnacle™ or Pinnacle+™ Series) or by purchasing already demineralized/deionized water. Once the water is softened one would then adjust pH, KH (Acid Buffer™ and Alkaline Buffer™ (Liquid or Powder versions)) and GH (Equilibrium™) as needed. If keeping hard water plants then the task is a bit easier since only minor adjustments to the presumably soft source water would be needed. If the source water is already hard then pH may be the only parameter needing adjustment. For those desiring to maintain soft water plants it is important to note that many soft water plants grow quite well in a hard water environment (*Cryptocoryne*, *Aponogeton*, etc.), thus if the source water is hard it may be worthwhile to first employ the source water to see how they fare. If they do well then demineralization would not be necessary.

The final category in environmental optimization is Supplementation. Supplementation encompasses organic nutrients (vitamins, amino acids, carbon, etc.) as well as micro and trace elements (iron, manganese, nickel, cobalt, etc.). Within this category there is also a hierarchy of parameters that addresses progressively more specific and advanced requirements. The best method to determine what a system requires is to start with a few products and use them for a few months. If they have a positive effect then they are essential. If, however, they seem to have no effect, then it is likely that they are not necessary. If unsure, halt a particular product’s use and see if



there is a negative effect. If a negative effect is seen then the product in question is required by your system.

From our (Seachem) product line we normally recommend one start with Flourish™ and/or Flourish Tabs™. These provide a broad range of micro-nutrients (vitamins, amino acids) and micro and trace elements (iron, manganese, nickel, cobalt, etc) that will enhance plant health and growth. If the growth rate is substantial the trace elements are often utilized more rapidly than the other components in Flourish™, thus in this case it would be beneficial to also employ Flourish Trace™ along with Flourish™ and/or Flourish Tabs™.

Once that foundation is set one can then explore the use of parameter specific supplementation. Because plant nutrient requirements, usage rates and source water can vary drastically we have determined that the ideal approach to supplementation is to separate each component so that each can be dosed individually as needed. Sometimes these requirements can be determined by testing (MultiTest: Iron™, MultiTest: Phosphate™, MultiTest: Nitrite & Nitrate™) and sometimes through simple observation of plant response. The five main parameters that need direct control are: Nitrogen (Flourish Nitrogen™), Phosphorus (Flourish Phosphorus™), Potassium (Flourish Potassium™), Carbon (Flourish Excel™), and Iron (Flourish Iron™). Nitrogen is a component of proteins and nucleic acids, phosphorus is a component of ATP, NADP, nucleic acids and membrane phospholipids and potassium is an enzyme activator and is involved in charge balance. Carbon is the backbone of all life and is thus essential for plant growth. Iron is necessary for the formation of chlorophyll and is involved in enzymatic electron transport and other oxidation-reduction processes.

Although planted aquariums are often considered to be too difficult for the beginning hobbyist, we believe that planted aquaria are actually ideal for the beginner. With the right substrate the beginner can have a successful aquarium with a minimum of maintenance. As the beginner become more comfortable in the hobby they will feel inclined to experiment a bit and thus build on the solid foundation they have already established.