

Analysis of Liquid Fertilizers: the ADA Brighty Series™



Plants grown on ADA Amazonia and EI dosing

Introduction:

This month's Barr Report test and measures the concentrations of various nutrients in Aqua Design Amano's product line. Nutrient concentrations are not reported for the ADA line of fertilizers. By testing the concentration levels for each nutrient, aquarist can design and make nutrient solutions that are similar. If you presently use or are thinking about using ADA's liquid fertilizers, this will save considerable amounts of money making your own standard solutions based on these concentrations, as well as a known chemical concentration standard to compare dosing with other methods. Green Brighty Step 1, 2 and 3, Brighty "K", Green Brighty "Shade" and Green Brighty "Lights" were tested. Specific nutrients are not measured due to the involvement of independent analysis, time and cost. It is better to do the analysis right than fast. At high levels, fertilizers ions can interfere with test methods yielding inaccurate results. This was taken into consideration and therefore dilution and EPA water test methods were used throughout the analysis. The remaining plant nutrients may be tested in the future. For now, the main plant nutrients, NO_3 , NH_4 , K^+ , PO_4 , Fe were measured for the liquid fertilizer line. The ADA liquid volume dispenser was also measured to address the actual volume of the dosing mechanism and its accuracy as this corresponds to dosing directly. The following month's Barr Report will entail sediment analysis and we can synthesize each component and source (both water column and the sediment) for fertilization.



Methods:

A Hach Spectrophotometer (model DR 2800) was used for colorimetric measurements. Each parameter was calibrated based on a three point reference. Samples were diluted by a factor of 0, 5, 200, 1000, and 5000 using serial dilution methods. Example: 1 milliliter (1000 micro liter micropipette) was used and added to 9.000 mls of DI water for each type of fertilizer, then a 1.000 milliliter sub sample of that solution was added to another 9.000ml DI water sample and then this procedure was performed once more. Reference samples where made in a similar manner for the nutrients (e.g., 100ppm NO₃ was diluted to 10ppm and finally to 1 ppm). Secondary independent analysis for confirmation of the result by an independent lab as is the protocol for environmental monitoring and testing services. CLS laboratories in Rancho Cordova, California perform the analysis using APHA/EPA methods for conventional parameters and EPA 200 series methods for Metals. This adds a strong layer of redundancy and confidence to these results. Additionally, a Hanna potassium colorimeter was used to verify K⁺ for Brighty K. For volume measurements for the ADA liquid dispenser pumps, a micropipette was used to measure the volume dispensed and taking the average of ten readings with standard error.

Results:

Volume measurement of ADA bottle pumps: 990 micro liters per full pump (SE: 20 micro liters).

Results from CLS laboratory (Rancho Cordova, CA)

Fertilizer brand name	Green Brighty "lights"	Green Brighty "Shade"	Green Brighty Step 1	Green Brighty Step 2	Green Brighty Step 3	Bright K
K+	2400	3100	84	81	970	68000
NO3	4340	4385	N/D	N/D	N/D	
NH4	865	108				
PO4	3900	2400				
Fe			190	310	340	

Table 1 (all concentration units are mg/liter)

Results from Hach DR 2800

Fertilizer brand name	Green Brighty "lights"	Green Brighty "Shade"	Green Brighty Step 1	Green Brighty Step 2	Green Brighty Step 3	Brighty K
K+	2400	3000	80	80	4900	68000
NO3	4385	4385	N/D	N/D	N/D	
NH4	855	110				
PO4	4000	2450				
Fe			190	308	341	

Table 2 (all concentration units are mg/liter)

The dilution in the aquarium is 1 pump per 20 liters of aquarium volume. This translates to a conversion of 1 milliliter dose to 20,000 milliliters of aquarium water. So these dosing rates are to be diluted by 20,000 times in the planted aquarium since the concentrations in table's 1 and 2 are mg/liter, the volume from the ADA bottle is **about** 1 mls and we are diluting each pumped dose it by 20 liters of suggested aquarium volume x 1000mls = 20,000 milliliters. So 1 dose of Green brighty lights into a 20 liter planted tank would yield a PO4 ppm of 4000 ppm/20,000 = 0.2ppm of PO4 dosed per day. For Brighty K+, this is about 3.4ppm per day, or 23.8ppm of K+ per week. With the suggested weekly 50% water change, we know from serial dilutions and using the Estimative Index, that K+ can only possibly build up to about 47 ppm K+. PO4, to 2.8 ppm, NO3 to 3ppm. Nitrogen is pretty lean in this method with Green Brighty "Lights".

Results per dose in the suggested at the aquarium concentration:

Fertilizer brand name	Green Brighty "lights"	Green Brighty "Shade"	Green Brighty Step 1	Green Brighty Step 2	Green Brighty Step 3	Brighty K
K+	0.12	0.15	4 x10 ⁻³	4 x10 ⁻³	0.245	3.4

NO3	0.05	0.05	N/D	N/D	N/D	
NH4	0.045	4.5x 10 ⁻³				
PO4	0.2	0.1225				
Fe			9.5x10 ⁻³	0.0154	0.01705	

(All concentrations are in mg/l)



Sago pondweed (*Stuckenia pectinatus*), Crispy or curly leaf pondweed (*Potamogeton crispus*) and *Egeria densa* lab test with different sediment types.

Discussion:

This month's issue has a simple goal: to save consumers money much like PMDD methods where used to find methods to avoid paying for high cost imported fertilizers. This will allow aquarist to compare "brand name" products to simple chemicals that are widely available and very cheap to make their own stock solutions for 1000X less cost. It also adds a reference point for scientific research studies for comparative purposes. ADA is quite popular among aquascapers and those seeking inspiration, yet few of these same aquarist, even if they are top artists and aquascapers, are inclined to test, isolate and measure the components that make up plant growth. If aquarists desire to know what is in a commercial product line or any other product line, they can test and measure the amounts required and the constituents. In this manner, they know what is in the fertilizers and can make their own blends. No two aquariums will ever use the same amounts of

fertilizer at the same rates. If an aquarist seeks to tweak and hone their fertilizing further, it would be advantageous to be able to modify their fertilizer ratios and concentrations. Without knowing what those concentrations are, it is impossible to speculate with any confidence.



Potamogeton lucens, Marin County, CA, USA.

These rates are “lean” or considered low for aquatic plant growth in aquariums. However, aquatic plants also can access nutrients from the sediments as well as the water column. ADA incorporates rich nutrient levels in the sediment thereby allowing leaner water column levels. So this is only part of the source of nutrients. These water column dosing rates are also done daily and it is suggested to add more or less depending on their effects. Basically no precision here (none is needed), just watch the plants and dose according to them rather than a pre set concentration target goal. Tropica suggest this same approach and makes their liquid fertilizers fairly dilute for the same reason: aquarists often over dose their nutrients and some do not use CO₂ or higher light intensities. K⁺ is almost exclusively taken in from the water column in lab studies as well as natural aquatic macrophyte systems (Barko and Smart, 1981; Barko, 1982; Barko and Smart, 1986). The most dramatic difference appears to be the PO₄ in the Green brighty series “Shade” and “Lights”. Relative to Nitrogen, is very rich. However, adding PO₄ can dramatically improve growth if N is available from the sediment as well. Adding fish waste is often mostly Nitrogen relative to Phosphorus in many planted aquarium systems. Therefore this approach works fairly well for meeting the growth needs without much fiddling with test kits and concentrations, and without making them so

concentrated that aquarists make huge mistakes other than not adding enough. And even if they do not add enough Green Brightly Lights, Shade of step's 1 through 3, they still have a back up of nutrients in the sediments as well. This means the system is synergistic, ADA places nutrients everywhere for the plants, not just the water column only and not just the sediment only.

Adding a richer level of nutrients to the water column can be done as well, and given the suggestions to do weekly 50% water changes by ADA, EI style of dosing can be very effective here. The aquarist can approach the leaner side and add progressively more and more until the plants no longer show more improvement. Or the aquarist can dose a richer non limiting concentration and reduce it down until the plants respond negatively. Aquatic plants can and do hold nutrient reserves and adapt to a wide range of nutrients also, so care must be made in assuming a “dose-response” effect. The time frame often is much longer than many assume it to be.



Fontinalis antipyretica Marin County, Ca, USA

ADA likely went with what the aquarist wanted and marketed accordingly, well after dosing of the water column for NO₃ and PO₄ became common and accepted (but who really knows? Amano never gave a straight answer when I asked, “It adds plant nutrients that are required” is about all anyone could get out of him). Fe and K⁺ have long been accepted and the line of fertilizers reflect that progression and that series has been around for a longer time than the “lights” and “shade” series. In conclusion: the ADA line appears to work well with lean and richer water column dosing routines due mainly to the sediment source as a back up. Adding richer water column fertilizer(ADA's or other

chemical based salts such as KNO_3 , KH_2PO_4 etc) reduced the sediment's influence and prolong the life and source of nutrients there, while leaner routines will accelerate the depletion. There is a trade off there. Still, with 50% weekly water changes suggested by ADA, you can get away with most any richer routine without any need for testing also.

I will perform a sediment analysis next month for the ADA Aqua Soil Amazonia and the power sand series of sediments from ADA. I will test the following: Organic matter content, N, P, and Fe. These will also have independent lab verification. This way we will have a fairly complete picture of the ADA line of fertilizers and nutrient sources.

“ADA”, “Green Brighty series” fertilizer, ADA “Aqua soil Amazonia” and “powersand” are trade marks of Aqua Design Amano, Inc. Japan.

References:

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