

A cost analysis of fertilizers for hydroponic/soilless growing in 2022

Why fertilizer costs matter

Fertilizer can be one of the largest expenses of a hydroponic growing facility. This is especially true when boutique fertilizers are used, instead of large scale commodity fertilizers. The use of non-recirculating systems with high nutrient concentrations also contributes heavily to high cost fertilizer usage. A medium scale growing facility working with boutique fertilizers can in some cases spend 2000-4000 USD per day. Even when using some of the most cost effective solutions, a facility can still spend 4000 USD per day if they use 20,000 gal/day with a nutrient line costing 0.2 USD/gal.



The above is a common combination of raw inputs and a standard blended input

In 2022, the high cost of energy and high inflation have increased raw fertilizer input costs to the highest point of the past decade, making the problem of fertilizer costs even more pressing. This has been specially the case for soluble phosphate fertilizers which have, in some cases, seen costs triple from the start of 2019. This is because soluble phosphates were largely produced in Russia and alternative sources of soluble phosphates had a hard time ramping up capacity at the same cost level as could be previously achieved.

To help people who are growing better assess their costs, I seek to paint a clear picture of the current cost level of commodity and boutique fertilizers as well as the cost levels that can be achieved with preparation of custom solutions.

Price sources

The cost analysis focuses on the US market. The prices I obtained for boutique fertilizers are from google searches

where I found the cheapest costs at the highest scale I could find. For commodity fertilizers I used the price points of [customhydro.com](https://www.customhydro.com), which is a trust-worthy website for the purchase of fertilizer inputs. These prices are also accessible from small to large scales, so they do not require large scales to be accessible. Boutique fertilizer companies might offer larger discounts to people who contact them directly to buy large amounts, but I did not use these prices as they are not publicly available.

To make comparisons easier, I will express all costs as costs per final gallon of nutrient solution, when prepared per the directions of the manufacturer or to arrive at formulations with a reasonable composition (formulations that can grow healthy, high yield crops). Please also note that I only considered fertilizers that could be used to prepare concentrated solutions to be used for injection, as these are fundamental to large scale growing operations. I also only considered powdered fertilizers as these offer the lowest cost. Liquid concentrated fertilizers – which are often substantially more expensive – were not considered.

For purposes of keeping the costs as low as possible I also only considered the base products from boutique fertilizer companies and did not consider the costs of any of their additives (line cleaners, boosters, hormones, etc). Shipping costs are also *not* considered here.

Blended fertilizers

The easiest, most accessible fertilizers for most people will be pre-blended fertilizers. Due to the proliferation of the cannabis industry, most of the pre-blended fertilizers that are sold to retail growers will be cannabis-centric and will have a considerably higher price than the blends currently used by the wider hydroponic industry.

	Cost (USD)	Weight (lb)	Cost/gal (USD)
Flora Pro Bloom	56	25	0.029
Flora Pro Grow	56	25	
Flora Pro Micro	56	25	
Athena pro core	180	25	0.183
Athena Pro Gro	180	25	
Athena Pro Bloom	180	25	
Masterblend 5-11-26	59	25	0.024
Calcium Nitrate	37	50	

Table comparing a couple of boutique lines with a standard 5-11-26 preparation using a Masterblend product and Calcium nitrate.

The table above shows three representative fertilizer programs for comparison. The Flora Pro series from General Hydroponics was the lowest cost boutique fertilizer I could find, with a total cost of 0.029 USD per gallon at the recommended dosing rates by General Hydroponics. I also put the Athena line for comparison, as they often portray themselves as a low cost option for cannabis companies. Their cost is almost an order of magnitude higher, at 0.183 USD/gal. From this analysis it seems clear that their margins are much higher than those of General Hydroponics although they can be substantially more cost effective than other companies with even more expensive products.

After seeing the above table, it is clear that boutique companies are not price competitive against formulations using traditional blended fertilizers from the agricultural industry. A formulation using Masterblend 5-11-26 and Calcium nitrate, which could be perfectly adequate for the growth of flowering plants during their vegetative stage or purely vegetative plants like basil, has a cost of 0.024 USD/gal. Similar simple approaches using other blended products can be used to achieve a variety of compositions at a similar price tag.

Raw input fertilizers

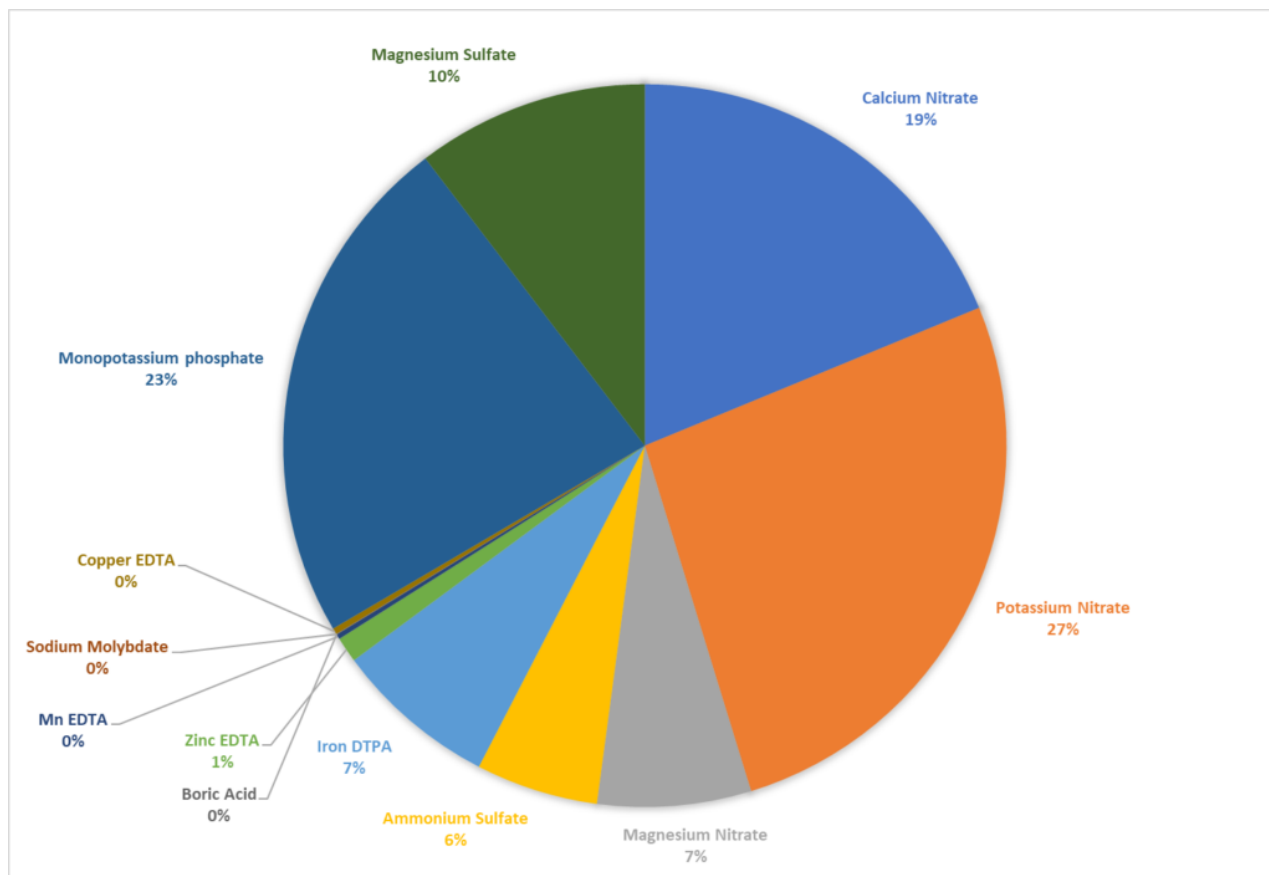
It is also interesting to consider the case of raw fertilizer inputs as this allows us to better think about formulations to reduce cost and also calculate whether making custom fertilizers is worth the expense. The table below shows you some commonly used bulk fertilizer inputs, their cost in USD and the cost per pound of each one of the products.

Chemical	Cost	Amount (lb)	Cost/lb
AgSil 16H	321.84	50.00	6.44
Ammonium Sulfate	45.98	50.00	0.92
Boric Acid	9.54	1.00	9.54
Calcium Nitrate	37.86	50.00	0.76
Copper EDTA	185.46	20.00	9.27
Iron DTPA	490.08	55.00	8.91
Magnesium Nitrate	69.27	50.00	1.39
Magnesium Sulfate	29.92	50.00	0.60
Mn EDTA	28.08	7.00	4.01
Monoammonium phosphate	75.13	20	3.76
Monopotassium phosphate	155.04	50.00	3.10
Phosphoric Acid (75%)	1575.00	86.90	18.12
Potassium Hydroxide	106.80	50.00	2.14
Potassium Nitrate	66.75	55.00	1.21
Potassium Sulfate	76.28	55.00	1.39
Sodium Molybdate	23.70	1.00	23.70
Sulfuric Acid (40%)	259.53	71.50	3.63
Zinc EDTA	384.09	55.00	6.98

Cost and cost per pound of each fertilizer input

Micronutrients are the most expensive per pound, but since they are used at very low amounts, their total cost contribution to fertilizer solutions is often less than 0.002 USD/gal (not counting the iron). The cost of the bulk fertilizers is much more important from a cost impact perspective. From these fertilizers, potassium inputs are often the most expensive. Both potassium nitrate, potassium sulfate and monopotassium phosphate are usually large contributors to the total price of a hydroponic formulation. Soluble silicon amendments, like AgSil16H, are also often large contributors to the overall price of these formulations. The above analysis also shows that Phosphoric acid is a very

expensive option for pH adjustments in hydroponics. For this reason – and a few other reasons out of the scope of this post – sulfuric acid should almost always be used.



Cost contribution of bulk fertilizers to a custom hydroponic formulation.

The image above shows you the bulk contributions of all the raw inputs used in a sample custom formulation. The total cost of this formulation is around 0.016 USD/gal. If we supplemented Silicon from AgSil16H, the cost of this formulation would likely increase to close to 0.025-0.03g/gal depending on how much Si we would like to add. You can see here that the highest bulk costs are indeed the monopotassium phosphate and the potassium nitrate, it is unlikely that we would be able to diminish this cost contribution substantially, as this is the true bottom line of the fertilizer industry.

For most of my clients, formulation costs in real life will usually be between 0.01-0.03 USD/gal. The final cost will depend on which bulk discounts are available at scale, which

plants the client is growing, what the cost of shipping the fertilizer is and which additional amendments beyond simple raw fertilization we choose to use. Sometimes, by using the nutrients already present in the water, substantial additional savings are possible with custom formulations.

Note that the above raw input analysis does not include the cost of labor to prepare the concentrated nutrients needed for injection. If a worker needs to spend a couple of hours per week mixing 25 gallons of each fertilizer then this, at 20 USD/hour, would likely increase the cost of the fertilizer by around 2-5%. Since workers can often mix batches of concentrated solutions that end up creating thousands of gallons of solution, the labor cost needed to mix fertilizers is often not meaningful relative to the overall cost of the inputs.

Balance between complexity and cost

From the above, it is clear that making your own fertilizer has the lowest cost, even at a small scale. However, it does add a substantial level of complexity to an operation and exposes the operation to a variety of potential mistakes dealing with preparation. A careful consideration of the advantages and disadvantages of mixing your fertilizer needs to be made. For large facilities, I believe this to be a no-brainer. At scale, it almost certainly makes sense to mix your own fertilizers.

However, it is true that at a medium scale, a grower might benefit from not doing their own mixing, as this simplifies their operation and allows them to focus on growing great plants while they grow. In this case, you can certainly – regardless of the plant you’re growing – create a formulation based on a widely available agricultural industry blend with perhaps one or two raw inputs, to achieve a highly cost effective formulation.

Of course, there is also an additional cost to fertilizer formulation, which – per the prices charged by myself and other colleagues – might cost you from hundreds to thousands of dollars depending on complexity. If you do not want to incur this cost, then you should bear in mind you will pay a perpetually higher price in your fertilizers, to a company that has done the formulation work for you.

At a large scale, you definitely do not want to go with a formulation that reduces the yield or quality of your plant product, so – if you lack the experience to do these formulations yourself – always make sure to hire someone who knows what they are doing.

In the simplest case, a formulation schedule of an agricultural preblended product – using for example the Masterblend 5-11-26 mentioned above – adjusted to your situation might lower your costs by an order of magnitude from an expensive boutique shop at a minimal increase in complexity and low formulation costs. Of course you can always [make your own Masterblend proxy](#) as a first step when you move to fully custom formulations. If it is not possible to use these types of blends – due to for example your water composition – a fully custom formulation will be required.

There is no reason to pay even higher prices

People in the traditional large scale hydroponic industry have been growing at very cost effective fertilizer prices for decades. If you are a small, medium or even large scale grower, there is no reason why your fertilizer costs should be astronomically high. There are no reasons to perpetually pay high margins to fertilizer companies and there is no reason why you shouldn't take advantage of the easiest cost savings that can be achieved with products that are already available to the bulk agricultural industry. Now that the raw fertilizer

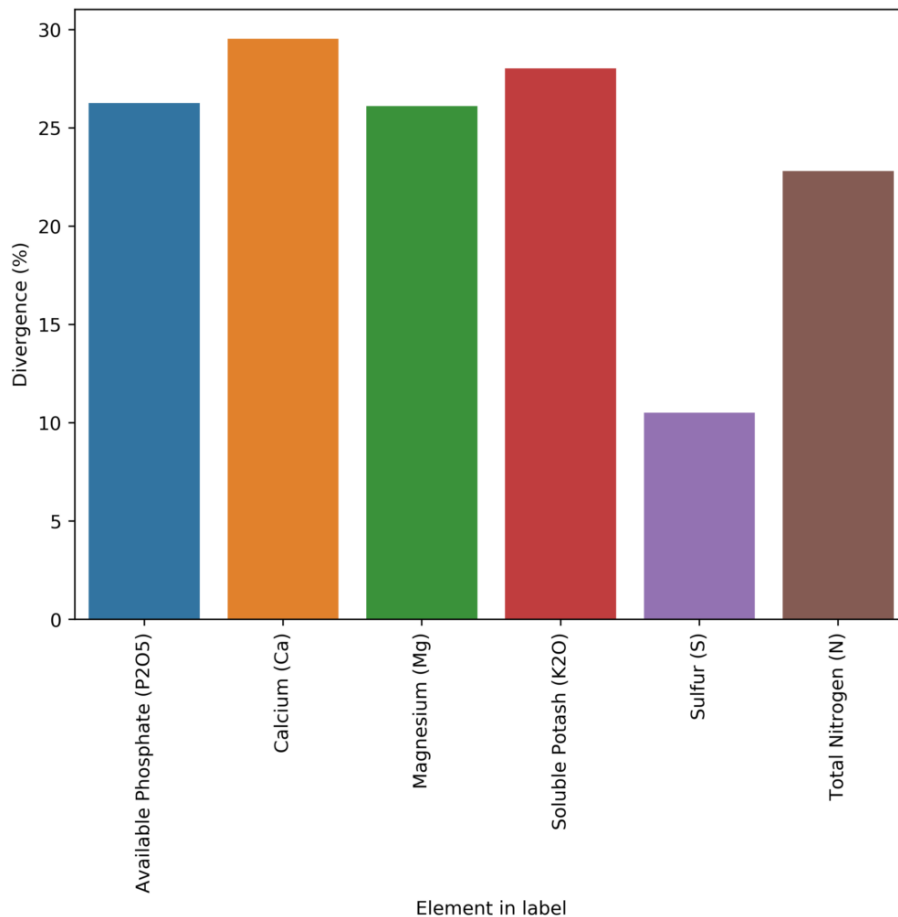
input costs are even higher, it is more important than ever to go to lower cost methods to achieve your desired hydroponic formulations.

If you want to learn how to make your own fertilizers, then I advice you visit [my youtube channel](#) or read [my blog articles](#) on making your own fertilizers from raw inputs.

Are you using boutique fertilizers? Are you mixing your own? Please let us know about your experience in the comments below!

Differences between labels and actual composition values in commercial hydroponic fertilizers

Whenever I am hired to duplicate a company's fertilizer regime based on commercial products, I always emphasize that I cannot use the labels of the products as a reference because of how misleading these labels can be. A fertilizer company only needs to tell you the minimum amount of each element it guarantees there is in the product, but it does not have to tell you the exact amount. For example, a company might tell you their fertilizer is 2% N, while it is in reality 3%. If you tried to reproduce the formulation by what's on the label you would end up with substantially less N, which would make your mix perform very differently. This is why lab analysis of the actual bottles is necessary to determine what needs to be done to reproduce the formulations.

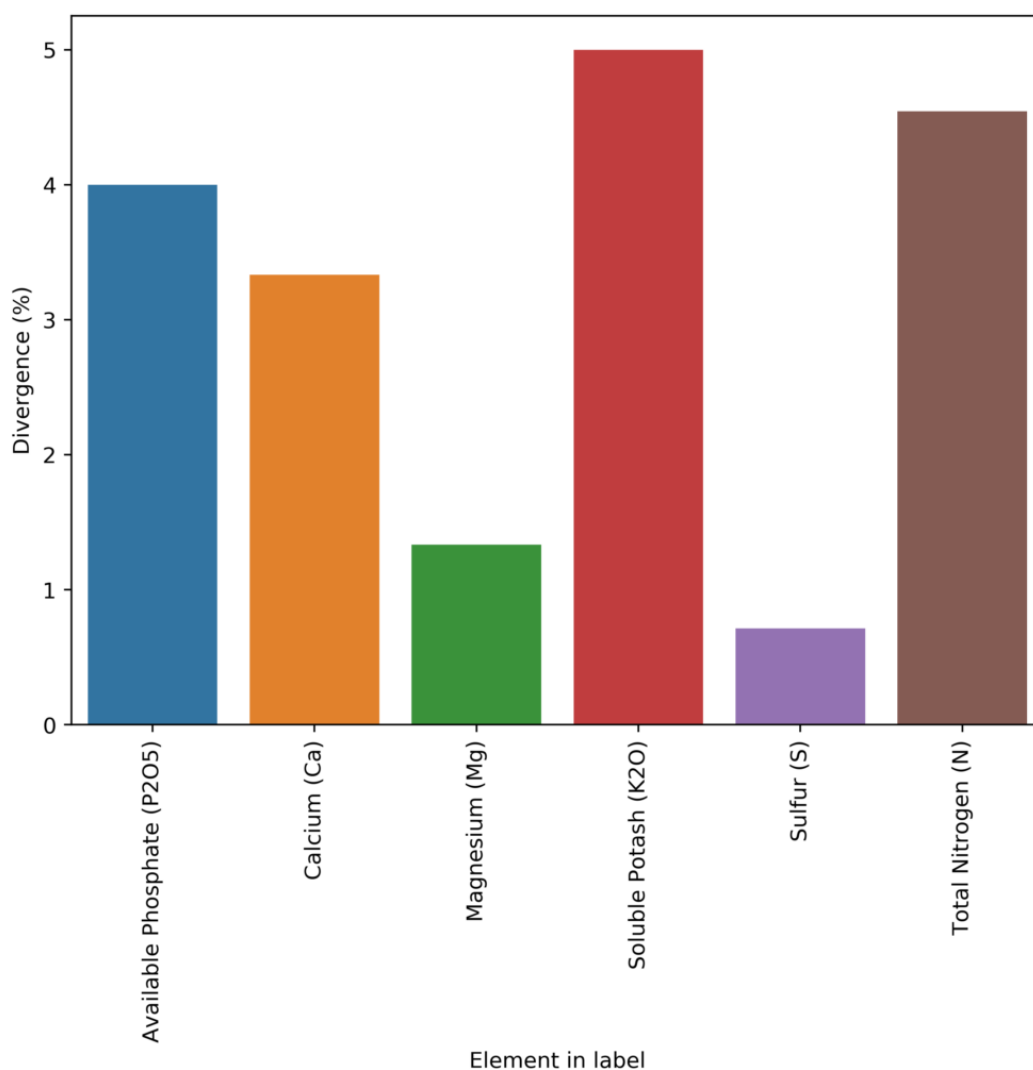


Average deviation from the reported composition on the label compared with lab analysis.

How bad is this problem though? Are companies just under-reporting by 1-5% in order to ensure they are always compliant with the minimum guaranteed amount accounting for manufacturing errors or are they underreporting substantially in order to ensure all reverse engineering attempts based on the labels fail miserably? I have a lot of information about this from my experience with customers – which is why I know the problem is pretty bad – but I am not able to publicly share any of it, as these lab tests are under non-disclosure agreements with them. However, I recently found a website from the Oregon government (see [here](#)), where they share all the chemical analysis of fertilizers they have done in the past as well as whatever is claimed on labels.

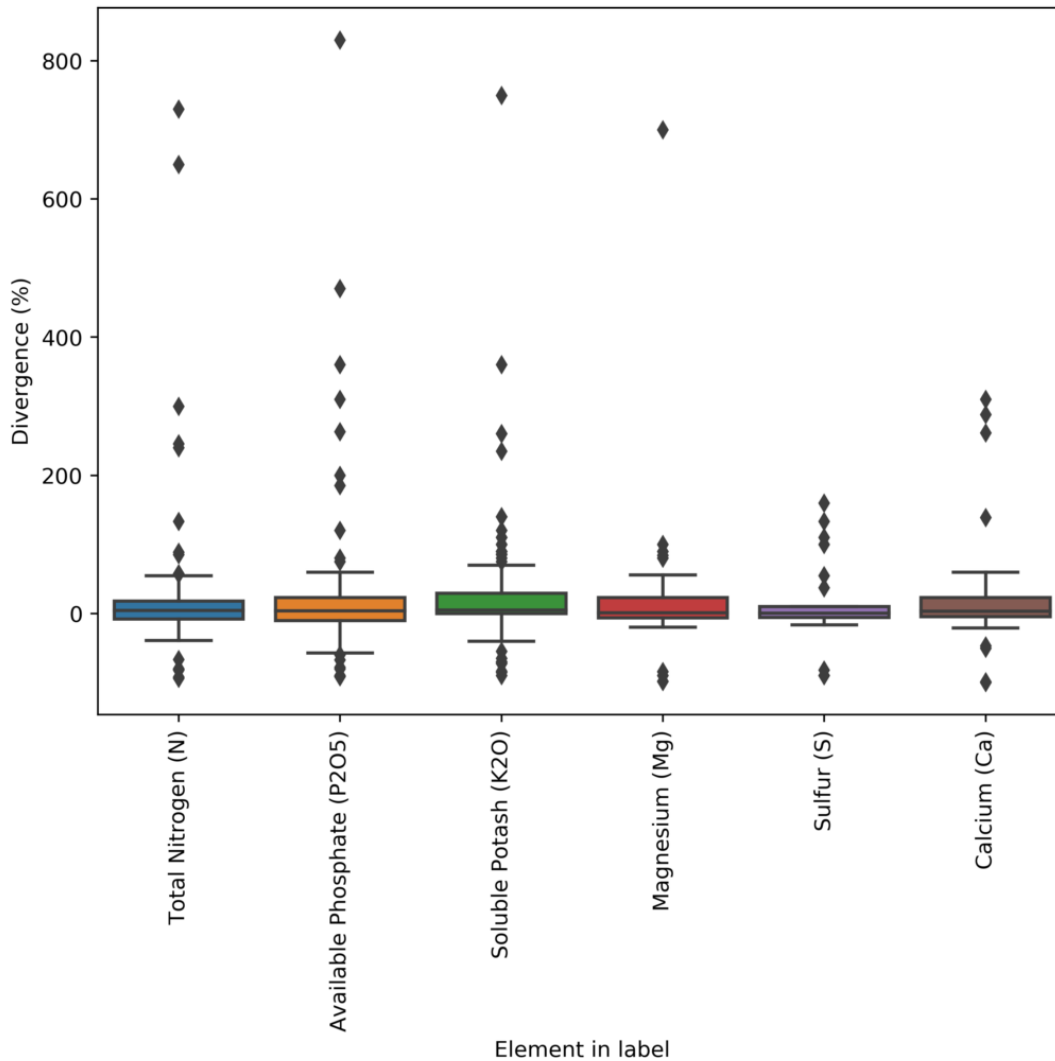
The Oregon database is available in pdf form, reason why I had to develop a couple of custom programming tools to process all the information and put it into a readable database. So far I

have only processed the fertilizers that were registered in 2015, but I am going to process all the fertilizers available in their database up until 2018 (the last year when this report was uploaded). However, you can already see patterns emerging for just the 2015 data. That year there were 245 fertilizers tested, from which 213 contained N, P, K, Ca, S or Mg. If we compare the lab results for these elements with the results from the lab analysis, we can calculate the average deviation for them, which you can see above. As you can see, companies will include, on average, 20%+ of what the labels say they contain. This is way more of a deviation than what you would expect to cover manufacturing variations (which are expected to be <10% in a well-designed process) so this is definitely an effort to prevent reverse engineering.



Median divergence between compositions derived from labels and

lab analyses.



Boxplot of the divergences between compositions derived from labels and lab analyses.

Furthermore, the deviations are by no means homogeneous in the database. The above graphs showing the box plot and median deviation values, show us that most people will actually be deviated by less than 5% from their label requirements, but others will be very largely deviated, with errors that can be in the 100%+ deviation from their reported concentration. In many cases, companies also have negative deviations, which implies that the variance of their manufacturing process was either unaccounted for or there was a big issue in the manufacturing process (for example they forgot to add the chemical containing the element). These people would be in violation of the guaranteed analysis rules and would be fined and their product registrations could be removed.

With this information, we can say that most people try to report things within what would be considered reasonable if the label is to remain accurate (deviations in the 1-5% range) to account for their manufacturing issues but many companies will choose to drift heavily for this and report values that are completely misleading relative to the labels. These companies are often the ones that are most widely used as they are the ones who want to protect themselves from reverse engineering most aggressively.

Take for example General Hydroponics (GH). *Their FloraGro product is registered with an available phosphate of 1%, while the actual value in the product is 1.3%, this is a 30% deviation, far above the median of the industry.* They will also not just underreport everything by the same amount – because then your formulation would perfectly match when you matched their target EC – but they will heavily underreport some elements and be accurate for others. In this same Floragro product, the K₂O is labeled as 6% and the lab analysis is 5.9%, meaning that they reported the value of K pretty accurately. However, by underreporting some but not others, they guarantee that you will skew your elemental ratios by a big margin if you try to reverse engineer the label, which will make your nutrients work very differently compared to their bottles.

As you can see, you just cannot trust fertilizer labels. Although most of the smaller companies will seek to provide accurate labels within what is possible due to manufacturing differences, big companies will often engineer their reporting to make it as hard as possible for reverse engineering of the labels to be an effective tactic to copy them. *If you want to ever copy a commercial nutrient formulation, make sure you perform a lab analysis so that you know what you will be copying and never, ever, rely solely on the labels.* I will continue working on this dataset, adding the remaining fertilizers, and I will expand my analyses to include

micronutrients, which are covered by Oregon government tests.