October 24, 2016

Statement by the Aquaponic and Hydroponic Organic Coalition Regarding the National Organic Standards Board's Recommendation to Ban Organic Aquaponics and Hydroponics

Members of the National Organic Standards Board:

The Aquaponic and Hydroponic Organic Coalition recommends that the National Organic Program (NOP) continue to allow organic certification of aquaponic and hydroponic farms that are compliant with USDA organic standards. These farming methods align with the organic mission so strongly that the integrity of the organic label stands much to gain by including them, and much to lose by excluding them. Furthermore, aquaponics and hydroponics are critical to improving the sustainability of our agricultural system, but revoking organic eligibility would move these industries backwards at a time we must foster their growth.

Aquaponics and Hydroponics Fit the Organic Mission

The organic label is ultimately about empowering consumers to identify products that match their values. Consumers do not prefer organic because it is grown in soil; they prefer it because it is pesticide-free, environmentally sustainable, and relies on natural ecosystems for plant growth. So the question is: do aquaponics and hydroponics (AP/HP) align with what the consumer expects when they purchase organic? The answer is a resounding *Yes.*

There are several core values that embody "organic" for the consumer, and AP/HP have proven they can align with each. "Organic" is perceived by consumers to mean:

- **Production without synthetic chemicals**. AP/HP do not require synthetic pesticides or fertilizers. Biological control and other organic methods work extremely well in AP/HP.
- **Production that fosters the cycling of resources, ecological balance, and biodiversity conservation.** AP/HP can be constructed as closed-loop ecosystems in which only the minimum required water and nutrients are added and with minimal or no discharge. AP/HP have also proven they can produce more food than soil culture per land area, thus saving more of the natural environment from the toll of agriculture and biodiversity loss. Aquaponics uses a biological nutrient source - fish waste – to grow plants. Organic hydroponics uses natural nutrient sources commonly used in all types of organic farming such as fish emulsion, compost tea, or seaweed.
- **Production that relies on biological ecosystems to support plant health.** Organic AP/HP production relies on a robust microflora in the root zone—made of the same types and numbers of bacteria and fungi that thrive in soil. This flora converts nutrients into forms available to plants and maintains plant health by reinforcing naturally-occurring mechanisms of disease resistance—just as in a healthy soil. (For a full discussion of AP/HP root biology and ecosystem, see Appendix 3, *7 Facts that Will Make You Rethink the Sterility of Hydroponics.*)
- **Production that responds to site-specific conditions by integrating cultural, biological, and mechanical practices.** Consumers expect that organic produce has been grown with

a healthy human element, where local customs, expertise, and ingenuity can overcome droughts, concrete jungles, and climate changes. AP/HP allow environmentally-sensitive agriculture where growing in soil isn't possible.

The Organic Label is Critical to the Growth of Sustainable Farming

Not only can AP/HP align with all the criteria of the organic ideal, but they have also proven to be extremely efficient and sustainable. AP/HP can produce more food per land area and with less resources than soil growth. The benefits of AP/HP include: water savings, reduced nutrient use and fertilizer runoff, shorter supply chains, food safety, and space efficiency. (See Appendix 1, *Aquaponic and Hydroponic Efficiency* for a discussion of AP/HP sustainability.)

In an era of climate change, resource depletion, and rapid population growth, the organic price premium is a critical incentive to draw more entrants into this market. If the NOP revokes AP/HP organic eligibility, these industries will not grow as quickly and our environment, health, and economy will suffer. (See Appendix 2, *Aquanomics*, for a discussion of the economic effect of organic prices on the AP/HP industries.)

Conclusion

Aquaponics and hydroponics align with the values of organic that consumers expect, and they are highly sustainable. Rather than placing a greater toll on our environment and health, the NOP should retain the organic eligibility of aquaponics and hydroponics.

Thank you for your attention to this matter,
The Aquaponic and Hydroponic Organic Coalition

Members of the Coalition:

Anacostia Aquaponics
The Aquaponics Association
Aquaberry Gardens
Archi's Institute
Association for Vertical Farming
Austin Aquaponics
Bigelow Brook Farm
Blue Mojo Farm, LLC
Bright Agrotech
Cali Summer Clubs
Center Valley Organics LLC
Edenworks
Evergreens
Fazenda Urbana, Inc
Fresh Farm Aquaponics, Inc
Friendly Aquaponics, Inc
Gateshead Consulting Corporation

Great Lakes Growers, LLC
Jenoe Group – Hydroponics
Joli Farms
Kabcao Aquaponics
Making Seeds 2 Cell
Marine Science Faculty, Autonomous University of Sinaloa
Minot, North Dakota
Northeast Brooklyn Housing Development Corporation
Oko Farms, LLC
Profound Microfarms
Rainsmith Agritech/Aquaponics
Smallhold
Solar Spice and Tea Trading Company
Springworks Farm
Terra Firma Aquaponixx
The Family Fish Farms Network, Inc
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Appendix 1

Aquaponic and Hydroponic Efficiency

Not only can AP/HP align with all the criteria of the organic ideal, but they have also proven to be extremely efficient and sustainable. The NOP should retain AP/HP organic eligibility in order to incentivize more entrants into this market, rather than eliminating eligibility and pushing prospective growers away. Below is a list of the benefits of AP/HP.

Water Savings

According to the USDA, agriculture accounts for up to 90% of fresh water use in some states.[1] AP/HP use less than 80% of the water as soil-grown crops; with some estimates of over 90% less water. The water saving potential of AP/HP are extremely important given the current rate of planetary water depletion. The Western U.S. is in the midst of a multi-year drought that is forecast to continue. And underneath the surface, NASA documented the shocking depletion of global groundwater resources, finding that 21 of the world's 37 largest aquifers are experiencing unsustainable depletion as of 2015. The Atlantic and Gulf Coastal Plains aquifer, supporting over 120 million Americans, is among those where use far outstrips natural rates of recharge.[2]

Nutrient Savings, Reduced Runoff

Most AP/HP systems are closed-loop and self-contained, meaning the grower needs to add only the minimum nutrients necessary for a given area or crop. Unlike soil, no nutrients will be lost to runoff or weeds. This can decrease the problem of aquatic dead zones – such as in the Chesapeake Bay and the Gulf of Mexico – which are largely caused by fertilizer runoff from farms.

Shorter Supply Chains

AP/HP can produce food in arid or urban areas, allowing residents of these locales to grow their own food without the carbon use, nutrient loss, and quality loss associated with long food transport. This is extremely important given current national and global population projections. Over 80% of U.S. residents currently reside in urban areas and that proportion is increasing. Worldwide, continuing population growth and urbanization are projected to add 2.5 billion people to the world's urban population by 2050.[3] Meeting the demand for these residents' organic produce without local AP/HP will be impossible.

Local produce will also help change the food culture and reduce healthcare costs. There is a direct link between diet, health problems, and healthcare costs. If we want everyone to eat more fruits and vegetables, we should give ourselves the option of a veggie from down the street rather than one that has sat in a truck for hours.

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[1] "Irrigation & Water Use", USDA Economic Research Service, Last updated October 8, 2015. http://www.ers.usda.gov/topics/farm-practices-management/irrigation-water-use.aspx

[2] "Third of Big Groundwater Basins in Distress". NASA. June 16, 2015. http://www.nasa.gov/jpl/grace/study-third-of-big-groundwater-basins-in-distress

[3] United Nations, Department of Economic and Social Affairs, Population Division (2014). World Urbanization Prospects: The 2014 Revision, Highlights (ST/ESA/SER.A/352).

Food Safety

AP/HP produce is usually grown indoors in a closed-loop water system, minimizing the risk of contamination from outside risks like ground-source animal feces or bird droppings. The closed-loop nature of AP/HP systems also give growers the ability to easily test for pathogens, or to fine-tune inputs to foster a balanced food web ecology that suppresses disease.

Growing More with Less Space

AP/HP can save land by growing more food with less space, thus decreasing the need for further land development to feed the growing population. Because the roots of AP/HP plants hang directly into water, they don't have to spread out and expend energy searching for water and nutrients. Therefore, plants can be grown in closer proximity. And, the plants can use more of their energy growing upward where the edible portion of most plants reside, rather than downward into the roots. Furthermore, AP/HP systems can be constructed vertically to dramatically increase the production per area potential. And because large tracts of soil aren't required, AP/HP systems can be operated in climate-controlled greenhouses to produce year-round rather than seasonally to fully optimize land area.

Economically Positive for Urban AND Rural Farmers

AP/HP provide agricultural jobs that are year-round; pay well; and do not involve repeated stooping to the ground, exposure to extreme weather conditions, or injuries and death from tractors and other heavy equipment. AP and HP bring accessible high-quality jobs to both urban and rural areas.

Organic AP/HP production clearly benefits urban areas by opening the door to a new industry. But AP/HP organic eligibility also benefits rural growers. With a "soil-only" organic rule, a rural organic farmer's growth potential is constrained by how much land they own. This leads to farm consolidation, increased land prices, and a limit on the number of jobs available per square area. Organic AP/HP allows rural farmers to expand their business by growing more densely, or even vertically.

Appendix 2

Aquanomics

The Organic Price Incentive

The AP/HP industries will not grow as quickly if their organic eligibility is revoked. That is bad news for our environment and our health.

The startup costs of an aquaponic or hydroponic system can be high. The organic price premium is one incentive that will bring more people into the industry. On average, organic produce fetches a whopping FORTY-SEVEN percent higher price than standard produce.[4] This price premium is large, and for some growers or investors will be the difference between going into aquaponics and hydroponics or digging up more of our dwindling arable land.

Some AP/HP farms will surely be able to succeed without the organic price premium. Organic certification may not be right for everyone. Some AP/HP growers that have close relationships with conscientious customers can already charge prices at or higher than organic. However, all situations are different. AP/HP growers should not be required to spend valuable time and resources educating their customers about sustainability when a soil grower can gain the same price premium simply by sticking on the organic label. We know for a fact that certification has proven valuable to some of these growers because in 2016 there are already 52 organic certified aquaponic or hydroponic operations nationwide. What would happen to these operations if the NOP revokes their eligibility? The industry would move backward.

True Cost Accounting Reveals a Structural Economic Disadvantage

True cost accounting is a method that fully captures all the costs and benefits of a production system, not just the costs that show up on the supermarket price tag. True costs accounting reveals that AP/HP are already at an economic disadvantage because soil crops benefit from large implied subsidies that are hiding right in front of our very eyes. Even though they are difficult to quantify, the costs attributed to industrial soil-based agriculture are very large and very real, including: carbon emissions, drought, soil erosion, aquatic deadzones from fertilizer runoff, pesticide use, and antibiotic resistance. In an ideal economy, these costs would be built into retail prices so that the market would adapt and produce less of these inefficient goods. If we fully built in these costs, producers and consumers would be financially incentivized to transition to methods that pose a lower cost to the environment. But in today's economy, AP/HP operate much more efficiently but without a corresponding economic benefit.

So where do these hidden costs show up? Usually the government pays for these hidden costs with our tax dollars. These large hidden costs manifest through the billions spent by governments on measures to adapt to climate change, drought, erosion, aquatic dead zones, and health care. But because we do not build these hidden costs into the price of our food, we are incentivizing a system in which we ship lettuce 1,500 miles that has been grown in a sterile monoculture field and tarnished with synthetic chemicals.

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[4] The Cost of Organic Food. Consumer Reports. March 19, 2015. http://www.consumerreports.org/cro/news/2015/03/cost-of-organic-food/index.htm

Appendix 3

7 Facts that Will Make You Rethink the Sterility of Hydroponics

Sarah Taber, DPM. May 13, 2016. Bright Agrotech Blog. http://blog.brightagrotech.com/7-facts-that-will-make-you-rethink-the-sterility-of-hydroponics

Here are a few terms to help you out if you're new to the hydroponics scene:

***Sterility** is a lack of micro-organisms. This is considered a negative trait in agriculture, where micro-organisms like bacteria support not only plant health but ecosystem health.*
***Bacteria** play a crucial role in nutrient processing and uptake by plants. Without them, plants are more vulnerable to disease, and have difficulty taking up nutrients.*

The reputation for sterility

Hydroponics has a reputation for being sterile.
This may include real consequences for farmers who use these techniques to make a living. The danger is that a failed bid for organic certification could set a dangerous precedent, leading to a large scale devaluation of the industry**.** Ultimately, the skewed reputation of the hydroponic growing method affects the livelihood of farmers.
Let me stop you there if you're thinking of large scale commodity crop farmers. That's not who we're talking about here. More and more small farmers are choosing hydroponics as the method with which to serve their communities on a local scale.
Hydroponics offers a variety of benefits, and opposition to the technique affects these small farmers. That's something we want to avoid, since small farmers are bringing back transparent local food to strengthen their communities, physically, socially, and economically.
Of course, **if** the reputation for sterility of hydroponics **is** true to the facts, then it is a valid and real concern. Sterile growing environments fail to meet the goals of the Organic program. (Like preserving natural resources and biodiversity.)
Soil plays host to a robust community of microbes, bacteria, and fungi. These ecosystems support the Organic programs goal of preserving natural resources and biodiversity. The question is,
"*Do hydroponic growing environments boast the same number and variety of microbes, or are they truly more sterile than soil environments*?"
Studies show that they are not more sterile, when treated with proper management. Let's look at the facts.

<u>7 facts to dispel the sterility rumor</u>

1) There aren't fewer bacteria and fungi and hydroponics.

Studies that look at the microbiology in hydroponics systems find about 10,000,000 bacteria per milliliter of nutrient solution (*1*, *29*).
Those are big bacteria numbers, but how do they stack up to soil?
Soil microbiology varies quite a bit, but compost consistently comes in at 100,000 to 1,000,000,000 colony forming units - or cfu- a measure of the viable bacterial and fungal cells -

per milliliter of dry compost (*2*, *3*, *10*, *30*). (It's a weird comparison since water vs dry dirt is apples to oranges, but it's the best we've got. Unfortunately, there are no studies with a direct comparison to soil.)

In other words, **the bacterial populations in conventional hydroponic systems are right in the normal range for compost. Not soil. *Compost***.

These systems are also rich in fungi-- a study that looked at both fungi and bacteria in hydroponic systems found 1,000,000 cfu/ml bacteria and 10 to 1000 fungi cfu/ml in the system (*29*).

2) The rate at which those bacteria populate the system is high.

A hydroponic system gains that microbial flora very quickly. A study watching the growth of bacteria in a hydroponic system started with a nutrient solution that had 500-900 cfu/ml bacteria in it. Within 20 hours of running the solution through tomatoes in rockwool, the bacterial population rose to 1,000,000 cfu/ml. Analysis showed most of these bacteria were plant root symbionts like *Pseudomonas fluorescens* (a bacteria which aids the plant in defense and nutrient uptake).

Meanwhile, the control solution stayed at the original 500-900 cfu/ml.

3) Microbe populations in hydroponics aren't just high—they're also diverse.

Microbe populations in hydroponics aren't just high—they're also diverse. There aren't a ton of studies looking at the diversity of microbes in hydroponics, but what we have shows a diversity in hydroponics equivalent to what is found in soil (*4*).

4) Mycorrhizae - the fungi assistants for plant defense and nutrient uptake - thrive in hydroponic and aquaponic systems.

What about mycorrhizae? Mycorrhizae are the equivalent of a root for fungi, and they play a key role in plant growth by a strong symbiotic (mutually beneficial) relationship with the plant roots. Hydroponic plants with mycorrhizae tend to be healthier and yield better than those without, just as in soil (*17*).

Mycorrhizae thrive in hydroponics. In fact, they do so well that when people need to raise mycorrhizae to make spores for inoculum (for example, the inocula used by organic farmers), they raise those mycorrhizae on plants in hydroponic systems (*12*, *14*).

True, you don't get as many mycorrhizae with high nutrient concentrations (*25*). The good news is you don't need high nutrient concentrations for hydroponics—in fact you can get away with a lot lower nutrient levels than you could in soil.

5) It's about the root surfaces, not the media-- and root surfaces can be abundant in any growing system.

Root surfaces are a "hot spot" of microbial activity (*11*) both in soil and hydroponics. The microbe populations immediately surrounding the roots are much higher than the surrounding area.

root zone bacteria in hydroponics were found at 10,000,000,000 cfu per gram of roots (*4*)—a thousandfold increase over the 10,000,000 cfu milliliter populations in the solution (*1*, *29*). This pattern of relatively low microbial populations in the surrounding environment, but high populations immediately around the roots, is similar to what is found in soil.

It’s these root-zone microbes, or PGPR (plant growth promoting rhizobacteria) that are most responsible for disease suppression, signaling plants to create more secondary metabolites (like flavonoids and other antioxidants), etc.

This difference in population is because plant roots exude mucilage—a complex mix of carbohydrates, amino acids, and organic acids—into the environment. This is a key food source for microbes and a major driver of soil ecology.

In other words, a lot of the “soil flora” that organic agriculture relies on is actually root flora. Microbes will live anywhere there are roots-- not just in soil.

6) The fact that it’s possible to grow plants in hydroponics at all without them killing themselves by allelopathy is pretty good evidence that there are very active root flora in the systems.

Allelopathy is when one plant species inhibits the growth of the other to compete for resources. Allelopathic compounds inhibit the growth of the other species by negatively impacting their function.

The root exudates of most crops include allelopathic compounds to help plants compete with their neighbors. Without a surrounding microflora, these compounds can build up to levels that are toxic to the plants that create them (*6*, *18*, *29*)—in both soil and hydroponic systems. Plant health depends on a strong microflora around the roots to break these compounds down (*24*,*32*). The fact that it’s possible to grow plants in hydroponics at all without them killing themselves by allelopathy is pretty good evidence that there are very active root flora in most systems, even conventional ones.

7) A substantial body of research shows suppression of plant disease by root flora and other microflora in hydroponics.

A review of these studies in 2011 found suppressive flora in rockwool, NFT, peat, and other hydroponic methods (5, 9, 15, 16, 20, 21, 22, 26, 27, 28, 31). It should be noted that compared to soil, there haven’t been many studies on suppressive flora in hydroponics. The fact that of these few studies, so many have found strong evidence of suppressive flora in hydroponics is important.

So why has the sterility rumor taken root?

One possible explanation for the sterility rumor is the fact that new and poorly-managed hydroponic systems can have very little microflora, leading to disease susceptibility (*19*). However, since this also occurs in poorly-managed soil farms, this isn’t a reason to consider hydroponics different from soil farms.

Another myth that supports the sterility rumor is that hydroponics is more prone to disease than other techniques. Hydroponics isn’t “more prone to disease” than soil. It’s more prone to *one* disease—Pythium root rot. Pythium has a spore that swims. So the reason it’s more prominent in hydroponics isn’t because hydroponics has no microbiota—it’s just because it’s easier for the spores to get around in an aquatic environment than in soil. (Even then you can still manage hydroponic systems for disease suppression, so hydroponics aren’t doomed to always have Pythium.)

Soil-based organic agriculture has had nearly 15 years of R&D since the USDA put out the organic regulations in 2002. The proficiency of organic farming has come a long way since then.

Having an organic market meant there was incentive to learn how to do organic management methods, and for crop care companies to develop products and tools that are compatible with organic philosophies. Hydroponics and aquaponics haven't had this benefit of 15 years of R&D investment. Hydroponic and aquaponic growers in 2016 lag behind soil growers in using organic techniques because they haven't been developed yet. And if hydroponics and aquaponics are banned from organic certification, *they never will be*.

Healthy farming systems depend as much on the individual farmer as on growing technique.

As we've seen, the well managed hydroponic system can be just as diverse and rich in microbial communities as a well managed soil system. Poorly managed systems of either hydroponic or soil techniques will suffer, but farmers have a plethora of management principles and information from invested parties (such as the USDA) to help improve that diversity and quantity of microbes.

Here are some easy ways to manage hydroponic and aquaponic systems for healthy root flora:

- Incorporate compost in rooting media wherever possible (27).

- Use sand filters to clean water before recirculating it through the system. Sand filters can develop a suppressive flora against plant disease, acting as a "scrubber" to catch any pathogens that may have escaped the root flora (7, 28).

- Add organic materials such as chitosan to hydroponic media and/or solutions (8, 23, 27).

- Inoculate hydroponic and aquaponic systems with beneficial microorganisms. Many hydroponic growers report success controlling Pythium with Trichoderma harzianum (13). An early history of poor performance came from using "beneficial microbes" that were easy to grow in the lab, not ones that were effective (Vallance et al 2011). Advanced techniques & investment (motivated by a premium for organic products) would fix this. Without an organic premium, it is unlikely that these products would ever be developed for hydroponics and aquaponics.

- Manage for balanced nutrients (13, 25). Lower phosphorous concentrations let plants establish mycorrhizal symbionts (25); high N levels can lead to more Pythium infection (13) as well as plants going overboard on succulent green growth nitrate content; and high K and Ca levels help maintain plant health (13).

Our understanding of microbial communities in hydroponics could impact the survival of more than hydroponic growing techniques.

The urban farming movement and other sustainable socio-economic trends depend on alternative growing techniques like hydroponics.

Hydroponics and aquaponics can support social sustainability in ways that no other technique can, but portions of that sustainability may rely on organic certification. For instance, urban agriculture is often forced to be soilless (because of space and/or contaminated soil). Organic certification allows a premium price, which can be critical for urban operations' survival because of high land prices. In other words: a "soil-only" organic rule may eliminate urban agriculture, an important source of urban employment and upward mobility.

Hydroponics and aquaponics, when employed as high-density production techniques, conserve soil and habitat.

Hydroponics and aquaponics, due to both higher yields and more space-conservative equipment, can produce significantly more food for a given area than soil-based agriculture. A "soil-only" organic philosophy requires habitat destruction to make room for organic agriculture.

An additional problem with land use in soil-based organic agriculture: it's an important and under-discussed driver of habitat loss. The three-year period to transition current farmland to organic is costly, so a popular organic farming technique is to plow up land that had previously been designated as wildlife habitat (source). Unlike farmland, land that used to be wildlife habitat can be certified organic immediately.

Allowance of organic certification for hydroponics and aquaponics will not cause the standards to suffer; instead, they will lead to faster and more thorough adoption of those standards.

The science is clear that hydroponic and aquaponic systems can be managed organically (e.g. by fostering a beneficial root flora). However, translating that knowledge to tools & practices lags far behind-- just like it did for soil-based organic growers prior to 2002. The establishment of USDA organic regulations in 2002 created an important marketplace and set of incentives to develop and implement sustainable technologies in soil.

Hydroponics and aquaponics have developed to where they're ready for the same growth in sustainable practice. Organic certification is an important driver of adopting sustainability practices. Without a price premium to aim for, aquaponics and hydroponics are unlikely to ever achieve their full potential as sustainable technologies.

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