TROUBLING WATERS:
How Hydroponic Agribusiness and the USDA Diluted Organics by Sanctioning Soil-less Growing

Profiling Illicit Produce Brands Grown in Liquid Fertilizer Rather Than Nutrient-Rich Soils

CORNUCOPIA INSTITUTE

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INTRODUCTION TO THE ORGANIC HYDROPONICS CONTROVERSY

HYDROPONICS REFERS TO A TECHNOLOGY for growing terrestrial plants with the roots in nutrient solutions rather than soil. Although interest in hydroponic methods began in the early 1900s, it was not widely adopted on a commercial scale until recently. The advent of cheap plastics in the 1970s and present-day availability of inexpensive oil for plastic containers, tubing, and greenhouse covers now allows hydroponics to be a financially viable production method.[1]

Hydroponic systems depend on the use of purchased soluble fertilizers, rather than naturally cycling nutrients in soil. USDA's advisory panel to the National Organic Program (NOP) on organic regulations, the National Organic Standards Board (NOSB), did not consider the concept of growing organic crops without soil when they first sought to define the term "organic," and hydroponic production is not mentioned in the Organic Foods Production Act (OFPA) of 1990. Rather, OFPA makes it clear that maintaining soil fertility is foundational to organic farming.[2]

THE BENEFITS OF GROWING IN SOIL VERSUS SOIL-LESS SYSTEMS

Most producers within the organic community agree that the most important aspect of organic farming is ensuring that organic matter and fertility in the soil is maintained or increased. Farming practices that improve the soil are often costly, but they benefit the environment on both a local and global scale. Some of these benefits include preventing nutrient run-off, properly balanced nutrition for plants and animals, capturing carbon in the soil, positive cycling of water in the biosphere, and integrating humane animal husbandry.

For example, excess nutrients in the form of animal waste can impact water quality, but planting specific cover crops, rotating smaller numbers of livestock, establishing buffer zones, and building soil organic matter are some methods organic farmers utilize to prevent nutrient pollution.[3] These practices not only minimize nutrient run-off, but also sequester carbon from the atmosphere that is stored in soils by the interactions between plant roots and soil microorganisms.[4] At the same time, livestock on well-managed pasture are often healthier than animals housed in confinement.[5] Adopted in this way, organic farming can provide solutions to the biggest environmental issues of our time: climate change, erosion, declining aquifers, and the creation of large dead zones in water systems through excessive fertilizer run-off.

The Organic Foods Production Act makes it clear that maintaining soil fertility is foundational to organic farming.

The economic survival of *authentic* organic farmers depends on the enforcement of organic law which requires improving soil fertility. Without this requirement, these environmentally responsible farms face unfair competition from agribusinesses using less expensive and unsustainable production practices under the same organic label. Rather than cycling nutrients on the farm, hydroponic operations use nutrient-free planting media and apply a continuous supply of liquid fertilizers, commonly

Hydroponic production relies on energy-expensive infrastructure, including inert growing media, plastic containers, and plastic tubes that deliver fertilizer to plants.

from hydrolyzed conventionally grown soybeans or fish emulsion (that may be wild caught, impacting native fisheries).[6]

Not unlike the marketing used by "livestock factories" to obscure how they confine thousands of animals in feedlots, the hydroponic industry likes to use small, urban and family farms as their poster children. In reality, the preponderance of "organic" hydroponic production comes from corporate-owned, industrial-scale facilities in the desert Southwest and Mexico or is imported from countries where it is illegal to market soil-less production as 'organic.'

Hydroponic produce is grown in substrates that are designed to remain inert while they provide structural support for plant roots. For most hydroponic production, the nutrient-free growing medium is coco coir, ground-up waste from predominantly conventional coconut shells. Coco coir is so resistant to decay that it remains "fluffy" and aerated for years. Peat moss, mined from wetland bogs and freeing carbon from the soil, is sometimes used instead. The plants are fed with a liquid fertilizer solution at every watering. Hydroponic growing media do not provide the multiple other benefits real soil does. Labels on these "organic" products do not differentiate hydroponic crops from soil-grown crops, despite the fact that nutrient-dense food grown in soil is in high demand by informed consumers.

THE NOSB WEIGHS IN ON HYDROPONICS UNDER THE ORGANIC LABEL

The question of whether hydroponics should qualify for USDA organic certification gets at the very heart of the legal and philosophical definition of organic agriculture. The NOSB has been embroiled in a heated debate on the issue for the last couple of years.

On August 14, 2017, the NOSB held an unprecedented two-hour conference call to discuss whether hydroponic systems should be considered under the organic label. The call was scheduled to help the Crops Subcommittee write proposals to define hydroponics and container growing for the fall NOSB meeting. Note that the term

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"container growing" is a euphemism widely adopted by the hydroponic industry in an effort to avoid negative publicity.

During the public conference call, NOSB members were strongly divided on the issue—so much so that a compromise could not be reached. Pro-hydroponic NOSB members articulated that the organic label is appropriate for any crop produced without the materials prohibited in organic production. Pro-soil NOSB members maintained that organic production is also defined by what farmers *are doing* (i.e., diversifying fields, rotating different species of animals on pasture, minimum or no tillage, etc.), rather than simply what they are *not doing* (i.e., using toxic agrichemicals).

At the subsequent fall 2017 NOSB meeting in Jacksonville, Florida, the board remained evenly divided on the issue of the organic certification of hydroponic production, and they were unable to pass a supermajority vote on this issue.

What remains is a state of confusion, where individual certifiers are allowed to decide for themselves whether or not hydroponic producers meet USDA organic standards. These decisions are based on the current regulations, previous NOSB recommendations, and conflicting messages from the NOP.

In the following report we review the history of NOSB and NOP actions that led up to this vote, summarize the organic community's concerns with soil-less organic production, and recommend actions the NOP and equivalency trade partners should take from here.

THE DEFINITION OF ORGANIC

The Federal Trade Commission (FTC) was the first government entity to officially define organic in 1978. Having banned the use of the word organic in 1974 (likely due

to pressure that it would condemn conventional agriculture), four years later the FTC reversed its stance due to overwhelming consumer demand. The agency defined organic as:

> *Organically grown food is produced on* ***humus-rich soil*** *whose fertility has been maintained with organic materials and natural mineral fertilizers. No pesticides, artificial fertilizers or synthetic additives are used in the production of organic foods.* [emphasis added][7]

In 1995, the USDA's newly created National Organic Standard Board (NOSB), an expert panel mandated by Congress, defined organic agriculture as:

> *...an ecological production management system that promotes and enhances biodiversity, biological cycles, and* ***soil biological activity****. It is based on* ***minimal use of off-farm inputs*** *and on management practices that restore, maintain, and enhance ecological harmony* [emphases added].[8]

In light of the above definitions, how can the term organic be applied to soil-less systems, such as hydroponic crop production?

The NOP has recently stated that "organic hydroponic production is allowed."[9] However, this statement directly contradicts the most recent recommendations issued by the NOSB. More important, the NOP's position conflicts with the organic label's enabling legislation, OFPA. The aforementioned definitions of organic would, in fact, exclude all production systems that do not involve soil, including hydroponics, aquaculture*, and aquaponics.

Adding organic matter to soil—like the straw groundcover pictured—supports both the biological activity and humus of the soil as it breaks down.

The USDA has redefined organic without the legally-mandated collaboration of the NOSB or the organic community.

Later definitions of organic created by the NOP removed the reference to soil. In 2002, the NOP defined organic agriculture in CFR §205.2:

> *Organic production [is] a production system that...respond[s] to site-specific conditions by integrating cultural, biological, and mechanical practices that* foster cycling of ***resources, promote ecological balance, and conserve biological diversity****.* [emphasis added]

Since hydroponic systems do not cycle nutrients, this requirement was also eventually removed from the definition of organic. In fact, hydroponic systems largely rely on nutrients derived from conventional agriculture (often soybeans), rather than cycling organic matter (like animal manure, cover crops, compost, etc.) back into the soil.

Organic is currently described as *"a labeling term that indicates that the food or other agricultural product has been produced through approved methods."*[10] The organic standards go on to detail the specific requirements that must be verified by a USDA-accredited certifying agent before products can be labeled USDA organic.

The USDA website currently states, "Overall, organic operations must demonstrate that they are protecting natural resources, conserving biodiversity, and using only approved substances."[11]

Whether organic agriculture is considered a "production system" or defined by the USDA merely as a "labeling term," it is clear in OFPA that organic agriculture is more than input substitution (the substitution of approved "organic" materials for prohibited synthetic chemicals). Organic agriculture was intended to work in concert with ecological cycles.

The USDA has redefined organic without the legally-mandated collaboration of the NOSB or the organic community.

* Aquaculture is the production of aquatic plants (algae) and animals (fish, crustaceans), whereas aquaponics involves the production of crop plants in nutrient solutions produced from aquaculture.

OVERVIEW OF "PONICS" PRODUCTION SYSTEMS

HYDROPONIC SYSTEMS

The term **hydroponics** encompasses a diversity of production systems that provide the plant's fertility needs through the irrigation system. On a basic level, the definition of hydroponics is "the cultivation of plants without soil."

Looks can be deceiving! Though some substrate can look like soil, it only serves to hold roots in place.

Terrestrial plants have evolved to obtain nutrients through complex interactions with soil microorganisms in their roots. In a hydroponic system, terrestrial plants have their roots in air, water, or an inert medium, rather than soil. The roots are either immersed in water or periodically sprayed with a nutrient solution.

There are several types of "ponics" technology. Various terms describe whether plant roots are in a solid substrate, whether the nutrient solution is recycled, and whether fish are part of the system.

"**Aggregate systems**," also called "medium culture," allow plants to be rooted in coco coir, peat, sand, gravel, vermiculite, rock wool, or other virtually nutrient-free substances, while continuously fertilizing the plant as it grows. These systems are increasingly referred to by the industry as "container systems" to boost their marketing success, though all hydroponic systems use containers.

"**Solution culture**" is when the plant roots are continuously immersed in a liquid nutrient solution, rather than in a more solid substrate. Plants may be grown on floating rafts of polystyrene or similar materials, with roots suspended in the nutrient solution. Alternatively, roots may be encased in plastic channels, in the nutrient film technique (NFT). Instead of being immersed in water, roots can also be suspended in air and misted with water, a technique called "**aeroponic production**."

Hydroponic systems are further categorized as "open systems," where the nutrient solution is not reused, or "closed systems," where surplus solution is recovered, replenished, and recycled.

AQUAPONIC SYSTEMS

When fish are added to the hydroponic system, it is called aquaponics—the integration of aquaculture (growing fish or algae) with hydroponics. An aquaponic system fosters the cycling of nutrients because the nutrient-rich water from fish tanks is used to fertilize (or "fertigate") the plants. Fertility is generated from biological cycles, rather than from off-farm inputs, although the feed fed to the fish or other aquatic species almost exclusively comes from off-farm sourcing. Plants act as biological filters, so that the water can be recirculated and reused.

Aquaponics facility at Berea College in Kentucky.

Aquaponic systems may be highly sustainable *if* the nutrients that are brought in for the fish food are obtained in a sustainable way.[12] However, the fish feed may come from unsustainable sources.[13]

Another hurdle faced by organic aquaponics is that applying fresh manure to plants is prohibited in organically managed systems.

In hydroponic production, all of a plant's nutrients are generated off-site.

HYDROPONIC PRODUCTION AND ECOLOGICAL SYSTEMS

Hydroponic producers claim they use less water than soil-based production, which is a wise use of resources in arid areas. However, it isn't sustainable to feed the nation and export throughout the world from operations located in the continent's deserts—and water preservation becomes a significant issue. Driscoll's and Wholesum Harvest, for example, have enormous hydroponic operations based in the desert southwest regions and Mexico.

Although many of these mammoth hydroponic operations tout their efficiency in terms of water usage, they use tremendous amounts of energy and petroleum-based plastics for pumping the fertilizer solutions, artificial lighting, and climate control.

Hydroponic production also minimizes on-farm biodiversity. Because hydroponic production is typically done indoors in a greenhouse, the crops are also isolated from the entire terrestrial ecosystem—including soil flora and fauna, as well as all insects, birds, and other plant life. Typical hydroponic greenhouses do not *"promote ecological balance, and conserve biological diversity,"* both of which are part of the definition of organic production systems.

"Organic" hydroponic production is merely "input substitution," the process of substituting organically approved inputs for conventional inputs without changing other production techniques. In contrast, organic production is premised on an ecological production system that fosters the cycling of nutrients. Crop production systems that require all nutrients to be generated off-site do not represent an ecological system or cycle nutrients; therefore, they should not be labeled organic.

Though hydroponic producers may use the same fertilizers as other organic farmers, hydroponic producers completely rely on these fertilizers for the entire life of the crop, whereas organic farmers use these fertilizers in limited quantities as amendments. When plants are grown in soil, the breakdown of organic matter by microbes and invertebrates releases most of the nutrients plants need slowly, as the plants need them. Organic farmers build fertile soil by adding organic matter from crop residues, animal manure, and cover crops, providing the conditions that allow the organic matter to decompose and form humus over time.

From the book, *Building Soils for Better Crops:*[14]

> *It's true that you can grow plants on soils with little organic matter.... However, as soil organic matter decreases, it becomes increasingly difficult to grow plants... But if attention is paid to proper organic matter management, the soil can support a good crop without the need for expensive fixes.*

Soil-based organic production relies on the health of the soil—including its natural microbiome—for the majority of plant nutrition.

Soil, even sandy or poor soil, is an ecological system. Soils are not sterile; they have bacteria, fungi, and soil-dwelling invertebrates that increase availability of nutrients by breaking down organic matter. More importantly, the ecological approach of organic farming can improve poor soils. The use of cover crops, compost, natural sources of minerals, or grazing animals can improve the organic matter content and biodiversity in the soil. This is the fundamental process of regeneration that makes organic agriculture truly sustainable, able to grow food over the long term. Soil-less systems such as hydroponics seek to diminish the ecological complexity of the system.

Crops grown in intensively managed greenhouse environments can require less acreage, therefore may be more suitable near urban environments. However, these systems still must be designed to operate in fertile soil to be considered organic.

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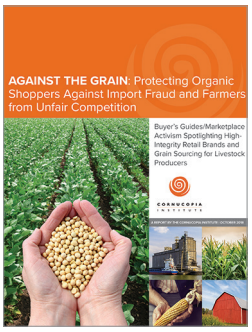

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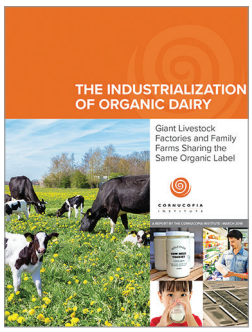

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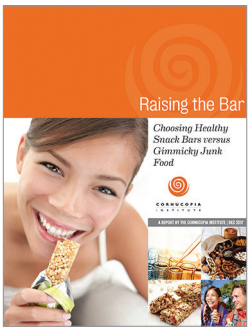

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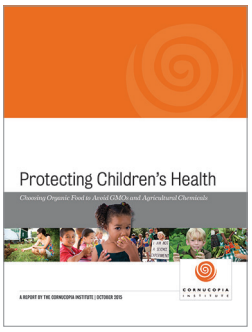

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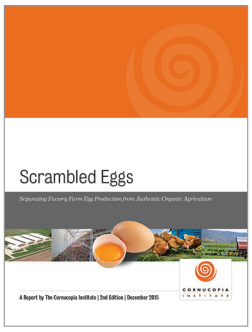

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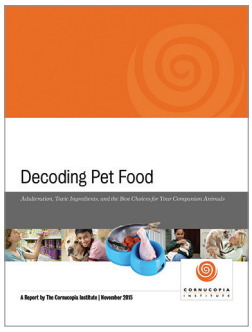

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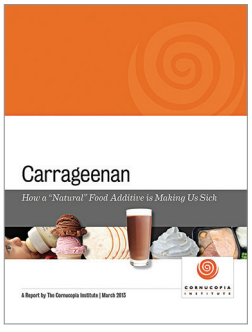

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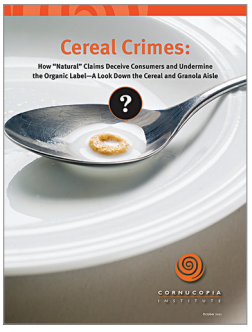

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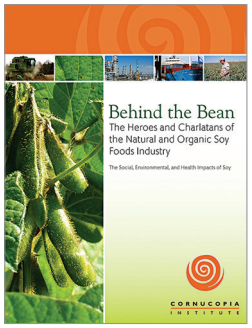

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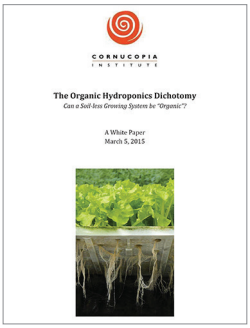

The Organic Hydroponics Dichotomy: Can a Soil-less Growing System be "Organic"?

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