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Ms. Michelle Arsenault
National Organic Standards Board
USDA-AMS-NOP
1400 Independence Ave., SW
Room 2648-S, Mail Stop 0268
Washington, DC 20250-0268

Re. CS: Hydroponics/Bioponics/Aquaponics

These comments to the National Organic Standards Board (NOSB) on its Fall 2016 agenda are submitted on behalf of Beyond Pesticides. Founded in 1981 as a national, grassroots, membership organization that represents community-based organizations and a range of people seeking to bridge the interests of consumers, farmers and farmworkers, Beyond Pesticides advances improved protections from pesticides and alternative pest management strategies that reduce or eliminate a reliance on pesticides. Our membership and network span the 50 states and the world.

Beyond Pesticides supports the view of the majority of the Crops Subcommittee that hydroponic operations should not be considered eligible for organic certification.

The reports of the Hydroponics Task Force (HTF) provide good evidence that hydroponics is not, and cannot be, organic. It may not be clear to all readers that the task force "report" is actually two reports under one cover –two reports written by subcommittees with very different viewpoints –the 2010 NOSB Recommendation Subcommittee (2010 SC) and the Hydroponic and Aquaponic Subcommittee (HASC). The former represents the viewpoint that organic production must be in the soil, and the second promotes certification of "organic" hydroponics. The confusion is heightened by a table near the end with columns labelled "NOSB 2010 Recommendation Summary" and "Task Force Analysis." Since the analysis in the second column is that of the HASC, not the entire HTF, it delivers an extremely misleading impression that the whole HTF supports the certification of "bioponics" as organic. The NOP should never have allowed the document to be published in that format.

Nevertheless, if one can see through the misleading and obfuscating rhetoric of the HASC, the overall implications are clear.

Foundations of Organic Production

Historically, perhaps the most important principle of organic production is the "Law of Return," which together with the rule "Feed the soil, not the plant" and the promotion of biodiversity, provide the ecological basis for organic production. Together these three principles describe a production system that mimics natural systems. The Law of Return says that we must return to the soil what we take from the soil. Non-crop organic matter is returned directly or through composting plant materials or manures. To the extent that the cash crop removes nutrients, they must be replaced by cover crops, crop rotation, or additions of off-site materials when necessary.

The dictum to "Feed the soil, not the plant" reminds us that the soil is a living superorganism that supports plant life as part of an ecological community. We do not feed soil organisms in isolation, to have them process nutrients for crop plants; we feed the soil to support a healthy soil ecology, which is the basis of terrestrial life.

Finally, biological diversity is important to the health of natural ecosystems and agroecosystems. Biodiversity promotes balance, which protects farms from outbreaks of damaging insects and disease. It supports the health of the soil through the progression of the seasons and stresses associated with weather and farming. It supports our health by offering a diversity of foods.

The report of the 2010 SC reminds us of these foundations, but also contrasts organic production and "conventional" agriculture. At the time of the passage of the Organic Foods Production Act, the organic community's characterization of soil as alive was viewed with amusement by the "conventional" agriculture experts, who saw soil as a structure for supporting plants while farmers poured on nutrients –and the poisons necessary to protect the plants growing outside of the protection of their ecological community. Interestingly, organic producers at that time compared conventional agriculture to hydroponics.

Conventional agriculture has now learned something about soil life –enough to promote some use of cover crops. On a parallel track, practitioners of hydroponics have learned the value of biology in their nutrient solutions. However, in both cases, the lessons have not been completely understood. This is made very clear from the attempts of the HASC to explain that "bioponics" (non-sterile hydroponics) depends on biological activity.

Yes, bioponics relies on biological activity in the nutrient solution to break down complex molecules and make them available to the plants. And yes, the nutrient solution in bioponics has an ecology –as all biological systems do. But the HASC repeatedly calls this a "soil ecology," although it is merely a toxic mimic of soil ecology.

The ecological system of a bioponic nutrient system is revealed in the HASC report to be more like a fermentation chamber –a means of processing plant nutrients– than the soil ecosystem of an organic farm. To see this, we can look at the three principles mentioned above.

The Law of Return. In a soil-based system, residues are returned to the soil by tillage, composting, or mulching. In a bioponics system, the residues may be composted, but none of the case studies describes how the residues are returned to the bioponic system, closing the loop. We note that the HASC identifies some inputs used in bioponics.[1] They include many agricultural products –animal-based compost, soy protein, molasses, bone meal, alfalfa meal, plant-based compost, hydrolyzed plant and animal protein, composted poultry manure, dairy manure, blood meal, cottonseed meal, and neem seed meal– and these are produced off-site, with no return to their production system. While most organic growers depend on some off-site inputs, most of the fertility in a soil-based system comes from practices that recycle organic matter produced on-site. The cycling of organic matter and on-site production of nutrients –as from nitrogen-fixing bacteria and microorganisms that make nutrients in native mineral soil fractions available to plants– is essential to organic production. The Law of Return is not about feeding plants, but about conserving the biodiversity of the soil-plant-animal ecological community.

Feed the soil, not the plant. The description of the bioponics system and case studies reveal how much bioponics relies on added plant nutrients. These nutrients may be made available through biological processes, but they are added to feed the plants, not the ecosystem. The case study of bioponic tomatoes in the Hydroponics Task Force Report, for example, says,

> After planting the seedlings in this growing media, it is necessary to add supplemental nutrition throughout the growing cycle (approximately one year). About once per week, solid and liquid nutrients are added to the growing media. Some fertilizer can be applied through the irrigation lines because they are soluble enough and will not clog the lines. The use of soluble nitrogen fertilizers is limited because of their high costs, for instance for plant-based amino acids. As long as the sodium nitrate rule continues to apply, it will be used as a lower cost nitrogen source. Soluble organic-compliant inorganic minerals are also added through the irrigation system, such as potassium and magnesium sulfate.

Biodiversity. The definition of "organic production" in the organic regulations requires the conservation of biodiversity. As stated in the NOP Guidance on Natural Resources and Biodiversity Conservation (NOP 5020),

> The preamble to the final rule establishing the NOP explained, "[t]he use of 'conserve' [in the definition of organic production] establishes that the producer must *initiate practices to support biodiversity* ***and*** *avoid, to the extent practicable, any activities that would diminish it.* Compliance with the requirement to conserve biodiversity requires that a producer incorporate practices in his or her organic system plan that are beneficial to biodiversity on his or her operation." (76 FR 80563) [Emphasis added.]

Thus, it is not enough for a bioponics producer to say it is not diminishing soil and plant biodiversity –the operation must take active steps to support biodiversity. On a soil-based

[1] See table on p. 23 of HASC report.

organic farm, many practices support biodiversity –from crop rotations to interplanting to devoting space to hedgerows and other non-productive uses. Many of these practices can and should be used by farmers producing food in greenhouses. However, the case studies provided by the HASC are evidence that bioponics is a monocultural environment that does not support biodiversity.

Aquaponics. Aquaponics differs from bioponics in several respects. Animal wastes produced by the system are used to feed plants. There is more biodiversity because there are both plants and animals. However, the system is strongly dependent on fish feed coming from outside the system. As with bioponics, the Law of Return is violated for the production of the animal feed. If fish feed were produced on-site using recycled water and nutrients from fish waste, then we would be more inclined to see possibilities for organic aquaponics. There is also more possibility of a system with biodiversity and soil ecology, but that is not reflected in the case history presented.

Exceptions

Both reports discuss exceptions to organic production as a purely soil-based system. These exceptions prove the rule that organic production is soil-based. Sprouts are not required to be grown in soil because sprout production is a way of processing seeds, just as pickling is a way of processing vegetables. Transplants are not truly an exception because the crop is produced by plants grown in the soil. Mushrooms are not required to be grown in the soil because the mushrooms grown for food or medicinal uses are saprophytes that decompose organic matter. They are thus grown on ecologically-appropriate substrate –manure for *Agaricus bisporus* and wood for shitake (*Lentinula edodes*), hen of the woods (*Grifola frondosa*), reishi (*Ganoderma lucidum*), and others.

A Continuum of Greenhouse Production Methods

The discussion of greenhouse culture demonstrates that there is a continuum from in-ground production to hydroponic/bioponic production. As an example, we agree with the 2010 SC that microgreens are debatable as an exception –they are almost processed seeds and all of the nutrients can be provided by the compost medium. This is an area that needs more attention. If microgreens are to be treated the same as sprouts, then the seeds must be organic, and soluble fertilizers must not be allowed.

However, we do not intend to address the complexities of containerized production in these comments. Somewhere along the continuum between in-ground production and bioponics is a line separating those methods of production that can be certified organic from those that cannot. For the purpose of these comments, we can say that the line is somewhere along that continuum –in-ground production can be certified organic, while hydroponics/bioponics/aquaponics cannot.

These extremes appear to be uniformly accepted by other countries, none of which allows hydroponics/bioponics/aquaponics to be certified organic, though there is some difference of opinion about methods intermediate on the continuum.

Other Issues

Advocates of hydroponics/bioponics point to its greater water use efficiency as beneficial to the environment. However, many hydroponics operations are situated in deserts where in-ground cultivation of vegetables is impractical and water resources are scarce. In these situations, hydroponic growing operations may use limited water resources that are needed for other uses.

One factor leading consumers to purchase organic produce is its perceived greater nutrient value. Research supports that perception. On the other hand, research has shown that nitrate concentrations in leafy vegetables are significantly different for hydroponic, conventional, and in-ground organic systems, with hydroponic>conventional>organic.[2] Desired nutrients are generally more concentrated in organic vegetables, with organic>conventional>hydroponic.[3] To some extent the nutrient levels of the produce can be manipulated by manipulating the nutrient solution in hydroponics –once again reflecting the "feed the plant" philosophy inherent in hydroponics. While hydroponics may reduce stress on plants, some phytonutrients are produced by plants in response to stress.[4]

Conclusion

Beyond Pesticides opposes the organic certification of products grown by hydroponic, bioponic, or aquaponic methods.

Thank you for your consideration of these comments.

Sincerely,

Terry Shistar, Ph.D.
Board of Directors

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[2] Guadagnin, S.G., Rath, S. and Reyes, F.G.R., 2005. Evaluation of the nitrate content in leaf vegetables produced through different agricultural systems. *Food additives and contaminants*, *22*(12), pp.1203-1208.

[3] Kimura, M. and Rodriguez-Amaya, D.B., 2003. Carotenoid composition of hydroponic leafy vegetables. *Journal of Agricultural and Food Chemistry*, *51*(9), pp.2603-2607. Virginia Worthington. The Journal of Alternative and Complementary Medicine. July 2004, 7(2): 161-173. doi:10.1089/107555301750164244. Caris-Veyrat, C., Amiot, M.J., Tyssandier, V., Grasselly, D., Buret, M., Mikolajczak, M., Guilland, J.C., Bouteloup-Demange, C. and Borel, P., 2004. Influence of organic versus conventional agricultural practice on the antioxidant microconstituent content of tomatoes and derived purees; consequences on antioxidant plasma status in humans. *Journal of agricultural and food chemistry*, *52*(21), pp.6503-6509. Toor, R.K., Savage, G.P. and Heeb, A., 2006. Influence of different types of fertilisers on the major antioxidant components of tomatoes. *Journal of Food Composition and Analysis*, *19*(1), pp.20-27.

[4] Kubota, C., Thomson, C.A., Wu, M. and Javanmardi, J., 2006. Controlled environments for production of value-added food crops with high phytochemical concentrations: lycopene in tomato as an example. *HortScience*, *41*(3), pp.522-525. Moreno, D.A., López-Berenguer, C., Martínez-Ballesta, M.C., Carvajal, M. and García-Viguera, C., 2008. Basis for the new challenges of growing broccoli for health in hydroponics. *Journal of the Science of Food and Agriculture*, *88*(8), pp.1472-1481.