National Organic Standards Board
Crops Subcommittee
Discussion Document
Container and greenhouse production: further clarifications
September 6, 2016

Introduction

Regardless of how a recommendation on bioponic comes out, the NOP has said that they do not have enough clarity to write rules for crops grown in greenhouses or containers with solid substrate. This Discussion Document will look at the gaps and inconsistencies in the 2010 NOSB recommendation on Production Standards for Terrestrial Plants in Containers and Enclosures (Greenhouses) to fill in those gaps and justify the unresolved points.

The goal is to examine what is needed for growing plants to maturity in containers in order to be consistent with the organic regulations, to create definitions and standards for terms that were not precisely spelled out in the 2010 recommendation, and to create a stage for further rulemaking efforts if needed.

Each point below has a discussion section in which options and opinions from the Task Force report are mentioned. The Discussion Questions posed request public comment on which policy option or standards are preferred and why.

Background

The NOSB has made several past recommendations on the subject of greenhouse production which have relevance to this discussion. In a 1995 Standards for Greenhouses recommendation, the following statement is made:

> Hydroponic production in soilless media to be labeled organically produced shall be allowed if all provisions of the OFPA have been met.

This was before there was an NOP rule so the NOSB only had OFPA to guide them.

In 2010 the NOSB issued a recommendation titled Production Standards for Terrestrial Plants in Containers and Enclosures (Greenhouses). While this mostly focused on greenhouse production in containers with solid growing media, the following statement is made:

> Observing the framework of organic farming based on its foundation of sound management of soil biology and ecology, it becomes clear that systems of crop production that eliminate soil from the system, such as hydroponics or aeroponics, cannot be considered as examples of acceptable organic farming practices. Hydroponics" "...cannot be classified as certified organic growing methods due to their exclusion of the soil-plant ecology intrinsic to organic farming systems and USDA/NOP regulations governing them.

Furthermore, in 2009 a document titled Soil-less Growing Systems Discussion Item contains the following statement:

> In previous Crops Committee discussion documents, the question has been asked: “Should container culture-based growing media (typically utilized in greenhouse systems) that are predominately compost and compostable plant materials be considered ‘soil’?" As highlighted in earlier portions of this document, a foundational principle of organic farming is the practice of maintaining and nurturing soil health so as to foster the proliferation of the proper soil biology

with their accompanying ecologies. Since all typical soil dwelling organisms, such as earthworms, insects, arachnids, protozoa, fungi, bacteria, and actinomycetes can thrive in a properly designed compost-based growing media, producing the beneficial symbiotic ecological relationships found in soil, such growing media should be rightfully considered soil.

At the first meeting of the Hydroponic/Aquaponic Task Force in January 2016, the NOP presented information on where they thought there were gaps and inconsistencies in the past NOSB recommendations, both for hydroponics and for greenhouse growing systems in general. Their presentation included the following statement, "Further analysis and clarification is necessary because regardless of what position the NOSB ultimately takes on the issue of hydroponics and aquaponics, the NOP will likely need to undertake rulemaking. Rulemaking requires a comprehensive recommendation from the NOSB that addresses grey *(sic)* areas left by past recommendations."

The gray areas and gaps include the following (paraphrased from original):

- A clear explanation of the basis for each recommendation made.
- Acknowledging the continuum of production methods from field/soil to hydroponic and the role of compost or other biological growing media. Recommendations on each type of production and reasons for allowing or prohibiting.
- Guidelines are needed on exactly how different production types comply with provisions in regulations for soil fertility, rotation, and cover cropping.
- Definitions of vague terms including container, hydroponics, soil-less media, "compost-based", and soil ecology.
- How are OFPA and the NOP rule able to be consistent on other soilless production such as mushrooms, sprouts, aquatic plants and greenhouse in-ground systems?
- What is the justification for requiring soil (as opposed to cycling of resources, promoting ecological balance, and conserving biodiversity) but making an exception for cover crops, crop rotation, etc. when soil is not explicitly required in the regulations, but crop rotation is mandatory?
- Aquaponic systems are not specifically addressed in previous NOSB recommendations.

The lengthy report from the Task Force contains a lot more background information which is too extensive to cover here. Selected portions will be referenced below in the discussion section.

Relevant areas in the Rule

<u>Organic Food Production Act (OFPA)</u>

§6504. National standards for organic production

To be sold or labeled as an organically produced agricultural product under this chapter, an agricultural product shall—

(1) have been produced and handled without the use of synthetic chemicals, except as otherwise provided in this chapter;

(2) except as otherwise provided in this chapter and excluding livestock, not be produced on land to which any prohibited substances, including synthetic chemicals, have been applied during the 3 years immediately preceding the harvest of the agricultural products; and

(3) be produced and handled in compliance with an organic plan agreed to by the producer and handler of such product and the certifying agent.

§6512. Other production and handling practices

If a production or handling practice is not prohibited or otherwise restricted under this chapter, such practice shall be permitted unless it is determined that such practice would be inconsistent with the applicable organic certification program.

§6513. Organic plan

... (b) Crop production farm plan

(1) Soil fertility

An organic plan shall contain provisions designed to foster soil fertility, primarily through the management of the organic content of the soil through proper tillage, crop rotation, and manuring. ...

.... (g) Limitation on content of plan

An organic plan shall not include any production or handling practices that are inconsistent with this chapter.

§6519. Recordkeeping, investigations, and enforcement

(c) Violations of chapter

(1) Misuse of label .... (2) False statement .... (3) Ineligibility

National Organic Program Rule

§205.2 Terms defined.

Crop rotation. The practice of alternating the annual crops grown on a specific field in a planned pattern or sequence in successive crop years so that crops of the same species or family are not grown repeatedly without interruption on the same field. Perennial cropping systems employ means such as alley cropping, intercropping, and hedgerows to introduce biological diversity in lieu of crop rotation.

Field. An area of land identified as a discrete unit within a production operation.

Organic production. A production system that is managed in accordance with the Act and regulations in this part to respond to site-specific conditions by integrating cultural, biological, and mechanical practices that foster cycling of resources, promote ecological balance, and conserve biodiversity.

§205.202 Land requirements.

Any field or farm parcel from which harvested crops are intended to be sold, labeled, or represented as "organic," must: (a) Have been managed in accordance with the provisions of §205.203 through 205.206;

§ 205.203 Soil fertility and crop nutrient management practice standard.

(a) The producer must select and implement tillage and cultivation practices that maintain or improve the physical, chemical, and biological condition of soil and minimize soil erosion.

(b) The producer must manage crop nutrients and soil fertility through rotations, cover crops, and the application of plant and animal materials.

(c) The producer must manage plant and animal materials to maintain or improve soil organic matter

content in a manner that does not contribute to contamination of crops, soil, or water by plant nutrients, pathogenic organisms, heavy metals, or residues of prohibited substances....

§205.205 Crop rotation practice standard.

The producer must implement a crop rotation including but not limited to sod, cover crops, green manure crops, and catch crops that provide the following functions that are applicable to the operation:

(a) Maintain or improve soil organic matter content;

(b) Provide for pest management in annual and perennial crops;

.....

§205.208 - 205.235 [Reserved]

Discussion
First and foremost, a standardized set of definitions must be adopted in order to have a successful discussion. Therefore a glossary is appended here of some of the most common definitions taken from the NOSB 2010 Recommendation and the Task Force Report. Definitions taken from these two documents may be slightly amended for this discussion.

1. Consistency with mushrooms, aquatic plants, seedlings, and other "soilless" culture.
The Task Force report points out the following:

> From this subcommittee's perspective, the recommendation could be bettered, and more easily accepted by the NOP, if it explained how each of these exceptions to the premise that crops be grown in soil; 1) are linked to soil, or 2) are not naturally living or growing in soil so there is no reason for farming them in soil. Furthermore, how each meets the Principles of Organic Production and Handling (NOSB, 2001) should be made clear.

They continue by pointing out that sprouts and wild harvest aquatic plants are addressed in the current organic regulations, and that the preamble to the final rule specifically states that additional standards would be needed for mushrooms and greenhouses.

The CS concurs with this analysis. Sprouting seeds is similar to a processing step for an organic product. Therefore the ingredient (seeds) must be certified organic. There are no inputs to the seeds to make them grow besides water which is an exempt handling ingredient. . The essential elements otherwise needed for plants to complete their lifecycle are not added because all the nutrition they need to the point of harvest is provided by the seed.

Wild Aquatic plants are covered under the wild crop section of the rules and the preamble specifically points out that the term "site" was used to replace "from land" in the proposed rule. This clarifies that wild aquatic plant certification was intended. However, there is now a large amount of aquatic plant farming occurring that would not be considered wild, and this is not covered in the current rules.

Seedlings, or transplants, are also specifically mentioned in the organic rules and must be certified organically grown, but are considered acceptable if raised in soil-less media. These are future crops that will spend most of their time growing in soil and the time to produce the transplant is short compared to the time in the ground.

Mushrooms are fungi, not plants, and that justifies that they don't have a direct link to soil. They are more similar to yeasts and microorganisms that may be grown on substrate that does not depend on minerals from soil. The parameters of their production may eventually need additional rulemaking but so far many mushrooms are able to be certified organic under the existing rules.

Cultivated plants in aquatic systems do not appear to be specifically allowed in the existing rules. This is true for both bioponic systems and cultivated aquatic plants in bodies of water.

2. Land Considerations and Natural Resources

Regardless of where the container production is occurring, the land underneath the containers and the surrounding environment must be considered. The land underneath an outdoor operation must comply with the same provisions of the rule regarding land history and transition as other land. It must also be maintained or improved with respect to avoiding contamination. Land that has a building on top of it with an impermeable floor must comply with whatever practices are adopted for greenhouse or enclosure production.

The Task Force asked the NOSB to consider limiting the use of land where crops could be grown in the soil from being converted to container production. It also recommended limiting the conversion of non-organic container plants to organic by re-potting them in organic growing media.

Natural Resource conservation includes the resources of soil and water and wildlife. This must be addressed in an Organic System plan for a container growing system. This includes maintaining the condition of land underneath the container production, fate of any water or nutrient run-off from container production, and any positive actions taken to encourage biodiversity such as installing hedgerows, planting insectary plants amongst the containerized crop plants, and other similar techniques.

3. Rotation

The NOSB 2010 recommendation noted that the intent of the rotation and cover cropping clauses in the rule could be met by similar practices with the same functions or goals as the crop rotation that are applicable to the operation. Such techniques might include mulching, replacing growing media (thus replenishing the soil system), planting hedgerows, adding microbial inoculants to stimulate existing populations, and recycling and composting used growing media. It was noted by the Task Force that the crop rotation requirement is already not enforced by some certifiers on greenhouse crops grown in soil and on perennial crops with limited water.

Canadian standards 7.5.12: “Soil regeneration and recycling procedures shall be practiced. The following alternatives to crop rotation are permitted: grafting of plants onto disease-resistant rootstock, freezing the soil in winter, regeneration by incorporating biodegradable plant mulch (for example, straw or hay), and partial or complete replacement of greenhouse soil or container soil, provided it is re-used outside the greenhouse for another crop.”

4. Containers & Growing Media

The 2010 NOSB recommendation on Terrestrial Plants in Containers does partially address production in containers. It specifies that the substrate in the container be based on compost and re-iterates the previous NOSB opinion that compost was equivalent to soil (see Background section from Bioponics proposal).

The weakness of the 2010 recommendation was that it didn't quantify "compost-based", nor did it put any limits on the volume of solid material that would be sufficient in a container in order for there to be an equivalent amount of biological activity occurring to the activity occurring in the ground. There was also no recognition of whether non-synthetic, carbon-based materials such as coir or peat moss could serve the same functions as soil in a container, especially over time and if inoculated with a diverse biological microbial population.

The statement from OFPA that fertility come "primarily through the management of the organic content of the soil" has been interpreted to mean that soluble fertilizers should not be the primary source of nutrients, but only a supplement to an overall program focused on crop rotations and amending with compost or manure. This is reflected consistently throughout NOSB recommendations from the past, from limitations on sodium nitrate or potassium chloride, to many rejected petitions that were requesting the addition of more soluble forms of nutrients to the National List.

In order to specify an appropriate size of container or characteristics of the growing media that are appropriate for organic production, there needs to be a comparison of the characteristics of container system vs. the soil system. The Task Force uses Bulk Density as a viable comparison factor. Mineral soils have a bulk density of 1.3 grams per cubic centimeter (g/cm^3), while peat or coir-based media have a bulk density of only 0.13 g/cm^3, or one-tenth the bulk density of mineral soils. As compost or other high organic matter materials are added to peat or coir, the bulk density of the media will typically increase, along with the nutrient holding capacity.

A raised bed which has a liner between it and the ground is considered a container, even if the growing media is a foot deep. However, containers as referred to in this discussion are limited to those containing a solid substrate only. Liquid substrate containers are covered by the overall bioponics proposal/recommendation.

By making the containers large enough, the nutrients in the organic matter fraction will be able to supply the majority of nutrition for the plant. What is large enough? And how can it be explained in a way that is appropriate for different plants? The Task Force cites the work of Dr. Martine Dorais of Laval University and the Agassiz Research and Development Centre. At a volume of 100 to 180 liters of soil per m^2, Dr. Dorais has demonstrated that no liquid feeding is necessary, and fertility can be provided by the biological activity of the growing medium in the beds.

Both Canada and Sweden permit container growing while requiring minimum soil volumes based on growing area. Canada requires a minimum soil volume of 70 liters[1] per m^2 of growing area. For staked crops like tomatoes and peppers they require at least 10% compost at the start of production and containers must be at least 30 cm (12 inches) high. They state in section 7.5.4: “Soil used in a container system, with the exception of transplants, shall provide nutrients to plants continuously. The soil (growth media) shall contain a mineral fraction (sand, silt or clay) and an organic fraction; it shall support life and ecosystem diversity.”

The Canadian standards do not specify an amount of compost or soil for other crops such as lettuce or blueberries. They do not account for breakdown and settling of soil volume, it is unclear how certifiers can measure the soil volume, and the term "growing area" is not well defined.

In Sweden they require at least 30 liters of soil per m^2 for annual crops with long seasons and 0.2 liters per pot for other plants such as herbs, lettuce and strawberries.

[1] For reference a 5-gallon pot holds 25 liters and a 10-gallon pot holds 40 liters.

The Task Force report states, "(t)ransplant and container growing methods would have more clarity if container growing media had a defined initial and temporal water and nutrient holding capacity and biology carrying capacity." It is possible to have a compost- or soil-based growing media with adequate aeration and water holding capacity that can provide enough fertility for production of annual plant crops or a season in the growth of perennial plants.

The Task Force Subcommittee that reviewed the 2010 NOSB recommendation is recommending that organic growing media must have a minimum of 20% compost.

In presentations given to the Task Force, it was mentioned that coir-based media amended with compost or compost tea can partially decompose into substrate with a high nutrient holding capacity similar to compost. No research on this has been presented, but over time, the bulk density of the media could increase along with microbial diversity. It might be appropriate to require only 5 or 10% compost in a coir-based media for perennial plants, which would more closely mimic a soil system that rarely has as much as 10% organic matter.

5. Nutrition

The Task Force Report states, "(t)he key distinction between organic fertility management and conventional fertility management is that in organic the source of the bulk of the crop nutrients are from the biological activity decomposing complex organic molecules (compost, manures, seed meals, etc.) and the mineral fractions." Soil is important due to the interactions of the physical, chemical and biological properties together.

While the bioponics systems are sustainable in regards to nutrient recycling and water conservation, they do not have the complex interactions found in an organic soil-based system. The backbone of organic production is the complex interactions between soils, plants, animals and humans.

It would seem logical to assess the continuum between grown in the ground and fully liquid based systems by determining where the plant nutrition is coming from. If the nutrients are primarily coming from the "soil" or approved growing media and solid amendments, then they would be considered equivalent to in-ground production. Whereas a container production system that relies primarily on liquid fertilizers would not be within the requirement for soil-based systems.

The NOSB recognizes that some soils contain very little inherent fertility and crops are being grown and certified organic which rely in large part on liquid fertilizers. While this is an area that should perhaps be enforced more vigorously, this is outside the scope of this attempt to set standards for crops grown in containers. In order for container production to be certified organic, there may have to be greater efforts made than for growing crops in soil.

If there is a minimum soil volume requirement created to provide most nutrition from the soil, there may still need to be a limit set to how much of the plant's needs can be supplied by soluble liquid nutrients. For instance, the Soil Association in Britain limits the amount of nutrients that can be added after planting to no more than 50% of the total nutrients required. This applies to crops grown in the ground. Other standards for greenhouses limit liquid nutrients to 25% of the total nutrients supplied. A brand new revision to the Canadian standards[2] also proposes limits on liquid fertilizers by stating that

[2] 2016 amended draft of Canada Organic Standards, pp 44-45: General Principles and Management Standards

for small soil volumes there must be 70% of the nitrogen and phosphorus supplied by solid organic soil amendments that require an active soil ecosystem.

The Task Force Subcommittee that reviewed the 2010 recommendation is recommending that liquid nutrients be limited to 20% of the total nutrients supplied. No reasoning is given for being lower than the international standards in use.

The bioponics proponents claim that the mineralization of nutrients into forms that plants can take up is performed by microbial digestion in a bioponic system and that the microbial population and dynamics are equivalent to a "diverse soil ecology". The Crops Subcommittee questions this statement because no solid information was provided about the specific microbes and their roles, and because saying that "soil biology" can happen without soil is not substantiated by definition or data.

6. Other issues
The Task Force report included information about production in controlled indoor environments and electric vs. natural lighting. Some of the other international standards take up issues such as the use of energy and the sustainability of peat moss. At other times the issue of supplementing carbon dioxide in greenhouses through heating or adding an input have been brought up. We are not going to take up these topics until the others are worked out.

Discussion Questions
1. For container production of crop plants which of the suggestions made in the discussion above should be recommended as standards? Why?
   For example, container size, amount of compost or soil in growing media, stipulation about liquid vs. solid nutrition sources, and varying requirements for different crop types.

2. Do you have other suggestions about certified organic container production?

Motion to accept the discussion document on container-based growing.
Motion by: Zea Sonnabend
Seconded by: Harold Austin
Yes: 7 No: 0 Abstain: 0 Absent: 0 Recuse: 0

Glossary of terms
Source in (Parentheses)

Aquaponics – A system in which plants are grown in waste water from aquatic organisms, which in turn purifies the water. (*Task Force Report)*

Aeroponics – A variation of hydroponics in which plant roots are suspended in air and misted with nutrient solution. *(2010 NOSB Recommendation)*

Bioponics – A contained and controlled growing system in which plants in growing media derive nutrients from natural animal, plant and mineral substances that are released by the biological activity of microorganisms and delivered in water. *(Task Force Report with slight modification by CS)*

Compost – The product of a managed process through which microorganisms break down plant and

animal materials, including allowed feedstock materials (either nonsynthetic substances not prohibited at § 205.602, or synthetics approved for use as plant or soil amendments), into more available forms suitable for application to the soil. Compost must be produced through a process that combines plant and animal materials with an initial C:N ratio of between 25:1 and 40:1 and processes it to a low final C:N ratio (in the range of 5:1 to 20:1). Producers using an in-vessel or static aerated pile system must maintain the composting materials at a temperature between 131 °F and 170 °F for 3 days. Producers using a windrow system must maintain the composting materials at a temperature between 131 °F and 170 °F for 15 days, during which time, the materials must be turned a minimum of five times. (*USDA organic rule)*

Compost Tea – A water extract of compost produced to transfer microbial biomass, fine particulate organic matter, and soluble chemical components into an aqueous phase, intending to maintain or increase (it may be brewed) the living, beneficial microorganisms extracted from the compost. (*Task Force Report)*

Container – Any vessel and associated equipment used to house growing media and the complete root structure of terrestrial plants and to prevent the roots from contacting the soil or surface beneath the vessel, such as, but not limited to, pots, troughs, plastic bags, floor mats, etc. (*Task Force Report)*

Greenhouse – Permanent enclosed structure that allows for an actively controlled environment used to grow crops, annual seedlings or planting stock. *(2010 NOSB Recommendation)*

Hydroponics – The growing of normally terrestrial vascular plants in mineral nutrient solutions with or without an inert growing media to provide mechanical support. *(Hybrid definition adopted by CS from Task Force report)*

Growing media – Material which provides sufficient support for the plant root system and enables the plant to extract water and nutrients. Used interchangeably with the term "substrate". (Adopted by CS from Task Force and internet sources)

Microbial solution – Growing solution used in bioponic production which is commonly composed of organic substances and a diverse ecosystem of beneficial microorganisms in water. (*Task Force Report)*

Nutrient solution – Growing solution used in traditional hydroponic production which is commonly composed of immediately plant-available soluble synthetic mineral salts in water (*Task Force Report)*

Soil – The outermost layer of the earth comprised of minerals, water, air, organic matter, and living organisms, in which plants grow. (Modified from *Task Force Report)*

Soil Ecology – A term used to describe the incredible diversity of organisms that live in the soil and the complex interactions between them that contribute to plant nutrition and plant and soil health. They range in size from the tiniest one-celled bacteria, algae, fungi, and protozoa, to the more complex nematodes and microarthropods, to the visible earthworms, insects, small vertebrates, and plants. *(Hybrid definition adopted by CS from Task Force report)*