National Organic Standards Board
Crops Subcommittee Petitioned Material Discussion Document
Ammonia Extract
February 16, 2021

Ammonia extract (AE) petition

The petitioner seeks to prohibit non-synthetic ammonia extract for use in organic crop production. Specifically, the petition claims that both synthetic and naturally derived forms of ammonia can be synthesized or derived and applied to soils to meet the nitrogen demand of plants. Since non-synthetic sources of ammonia are not currently permitted by Certifiers or Material Review Organizations (but also not explicitly prohibited) in organic production and because such use of ammonia is claimed to be caustic, increases soil pH, is known to decrease soil biotic activity, and bypasses other soil based sources of nitrogen, the petitioner seeks to list ammonia extract at § 205.602 of the National List as a prohibited non-synthetic substance.

Public comments received for the Fall 2020 NOSB public meeting discussion document on the ammonia extract petition provided conflicting data as to whether the use of ammonia extracts promotes or degrades soil health. The question of the effects of ammonia extract on soil health directly relates to the OFPA criteria:

> **§ 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…

In general, comments in favor of prohibiting the use of natural ammonia extract indicated that these extracts would degrade soil health by reducing the biological condition of the soil. Ammonia fertilizer degrades the quality of organic soils by bypassing or reducing soil microbes which are imperative to the health of the soil and they would not be in line with improving soil organic matter content.

Comments opposed to the prohibition noted that the addition of ammonia extract does not degrade soil health and that they would not have a negative impact on biological activity and organic matter changes. In fact, they would increase the ability of soils to cycle nutrients and would lead to increased soil organic matter.

Soil Health:
Further details and quotes from the comments in favor of the prohibition include (some comments included references not included here):

Addition of organic fertilizers primarily feeds and activates the soil food web through the supply of abundant amounts of C[arbon] and engaging a large array of soil organisms involved in N[itrogen] mineralization. Expectedly, organic fertilization, as shown by numerous studies, enhances activity, diversity, and abundance of both microbial and non-microbial communities in soils. Improved soil biological status is one of the key advantages of organic crop production. In contrast, any N fertilization practice (i.e. ammonium extracts) that does not benefit or require soil organisms, although it may be technically "organic" or non-synthetic, compromises the "sustainability" benefits of organic farming. Ammonia is a chemical that when applied as a fertilizer, directly feeds the plant, bypassing the soil food web. The core issue at hand is the equivalency of nitrogen products independent of the pathway.

Whether synthetic or non-synthetic, ammonia extracts are incompatible with organic production because they cause harm to the soil and do not "foster soil fertility, primarily through the management of the organic content of the soil through proper tillage, crop rotation, and manuring…" as OFPA requires (7 USC § 6513).

Ammonia extract is chemically identical to the ammonia fertilizers commonly used in conventional growing systems: ammonia extract provides plant-available nitrogen directly to the crop without enhancing soil biology; ammonia extract creates detrimental chemical and biochemical effects on soil structure; and ammonia extract fosters nitrogen leaching.

The organic regulations limit substances of high solubility. In the preamble to the publication of the NOP Final Rule on December 21, 2000, NOP discusses how it decided to agree with the NOSB recommendation and to put specific regulation of substances of high solubility into the annotations for each of these materials where they appear on the National List of Allowed and Prohibited Substances. NOP goes on to say, "Based on the recommendation of the NOSB, the final rule would prohibit use of these materials [substances of high solubility], unless the NOSB developed recommendations on conditions for their use and the Secretary added them to the National List."

The Law of Return. In an organic system, residues are returned to the soil by tillage, composting, or mulching. 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 (including the microorganisms) of the soil-plant-animal ecological community… Feed the soil, not the plant. 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. Biodiversity. 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. Ultimately, holistically healthy, truly organic farms produce healthy plants that require far fewer applications of insecticides and fungicides (even if approved for organic

production). In the case of ammonia extracts, we are particularly interested in the principle of feeding the soil rather than the crop.

Further details and quotes from the comments against the prohibition include (some comments included references not included here):

> Bio-based fertilizers have been shown to increase the characteristics related to soil health, e.g., organic matter, soil aggregates, enhanced biological activity, increased nutrient cycling because they stimulate biological activity through a balanced carbon - nitrogen (C:N) ratio. The ideal C:N ratio is 8:1 and ammonia-based extracts are in the range of 2:1 which would provide a balance for biological activity. Much has been written about soil biological fertility and is summarized in the book by Abbott and Murphy (2007). The aspect of soil-biological fertility is beginning to recognize that bio-based fertilizers that are organic concentrates high in ammonium have a large impact on the release of nutrients from organic materials in the soil and offer the potential to increase our ability to supply nutrient dense foods to feed the world. There is no evidence to suggest that adding organic concentrates high in ammonium from natural sources would have a negative impact on soil biological activity, organic matter changes, or soil health and would suggest that these additions would enhance the soil's ability to cycle nutrients and would lead to increases in organic matter contents and soil functionality.
>
> Mineral nitrogen fertilizers, including ammonia-based fertilizer products, increase crop productivity and drive long-term increases in soil organic carbon, soil microbial biomass, and soil bacteria and fungi when compared to nonfertilized controls. Any potentially negative effects of ammoniacal fertilizers in soil (e.g., reduced fungal growth or stunted crop seedlings) are ephemeral and quickly subside after ammonium is either taken up by the plant or oxidized to nitrate. Moreover, ammonium is a product of mineralization of any organic nitrogen source (e.g., compost, animal manure, and green manure) and has the same temporary negative effects of ammonium toxicity that can be observed for at least three weeks after application as well. Compared to mineral nitrogen fertilizer alone, organic soil amendments usually lead to greater increases in soil health metrics. However, the research is clear that the same soil health benefits of organic soil amendments can be realized when used in combination with mineral nitrogen fertilizer – an approach called integrated nitrogen management. This is important because nonsynthetic ammonia-based fertilizer products cannot replace organic soil amendments as part of a USDA NOP Organic System Plan. Animal manure, compost, green manures, or other organic fertilizers will still be necessary for meeting other essential crop nutrient needs, including phosphorus. Phosphorus-rich organic soil amendments like manure also contain significant amounts of organic nitrogen and will continue to displace a portion of the crop demand for mineral forms of nitrogen. However, the reduced dependence on manure to meet the entirety of crop nitrogen demand (as has been historically practiced to the detriment of surface water quality) will allow growers to apply manure to meet crop phosphorus needs without over-applying phosphorous or other key nutrients, thus minimizing negative soil health and environmental impacts.
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> I foresee a grower using a product such as an ammonia extract as a supplement to their fertility program, possibly lowering the overall application of nitrogen on the front end of the crop, thus reducing the potential for residual nitrogen at the end of the crop where leaching and runoff of nitrate and phosphate could occur. For a grower to have access to a naturally derived available

nitrogen source that is low in phosphorus greatly increases the options available to myself and other organic growers to safely and effectively produce a high yielding crop.

The Petition wildly overstates and claims, without any basis in actual testing or ground truthing of the different materials, that all ammonium extracts will have a negative impact on soils, soil biology, and on organic farming systems. While some of the products included in the Petition may indeed cause similar damage as conventional ammonium fertilizers, our product does not share these same characteristics. Replicated research by third-party research firms and field trials by independent farmers involving our materials over the past two years have shown the materials to be stimulants to the biological systems the petition claims they should be damaging and repressing

The process by which [our] products are concentrated results in products which have a distinctive odor, color, C:N ratio, and isotopic ratio. This means that the products can easily be distinguished from synthetic ammonium fertilizers in the field and that this field assessment can be back checked with an in-lab isotope test.

Potential for Fraud:

In addition to soil health issues, the NOSB also received comments about the ability to distinguish between natural and synthetic ammonia extract in a product and the potential for fraud. Some commenters felt that a nitrogen mass balance approach from producers and formulators of products including ammonia extract would be adequate to prevent fraud. Others commented that a nitrogen isotopic assay would be needed to determine the source of the ammonia. Still others noted that the blending of synthetic and non-synthetic ammonias could be done in such a way that the resulting isotopic analyses would not be conclusive.

The proposed technology for ammonia extraction from natural sources is particularly suited for fraud by those in the organic fertilizer sector who are susceptible to the lures of making a lot of money quickly. If this technology is accepted for use in organic production, it would be a 'gift from heaven' to those who want to make easy money fast, and an absolute nightmare to those of us who compete honestly, and want to protect the "Certified Organic" seal and the integrity of the whole Certified Organic Food Movement and all its integral parts

A nitrogen mass balance approach could be used to routinely inspect, verify, and certify the manure-based origins of nonsynthetic ammonia-based fertilizer products. The mass balance approach to manure nitrogen management is already widely used among farmers and nutrient management regulators and could be easily deployed to ensure compliance with the NOP guidelines for allowable inputs. For the fertilizers in question, a portion of ammonia is removed from raw manure or anaerobic digestate during production. The relative amount of ammonia removed from manure or digestate – defined as the production efficiency – is specific to each production process and is routinely monitored through independent lab analyses. Production efficiency is calculated as the mass of ammonium-N in the fertilizer product divided by the mass of ammonia-N in the manure or digestate feedstock, and may be as high as 85% (the remaining 15% – ammonia-N not removed during production – is lost to the atmosphere or remains in the spent manure or digestate). If manufacturers document and disclose their production efficiencies (via third parties), the nonsynthetic origins of ammonia-based fertilizer products could be easily verified by comparing the mass of ammonium-N in the product to the mass of ammonia-N in the feedstock. If the mass of ammonium-N in the fertilizer product exceeded that

in the feedstock (or even if the production efficiency was significantly greater than expected), then there would be cause to suspect inclusion of synthetic ammonium in the product. Additional investigation or verification of the product could include isotopic analyses2, but this would not be necessary for routine inspection or certification of the nonsynthetic origins of ammonia in a fertilizer product.

Practicality of use of these products is dependent on an isotope analysis to determine the source of nitrogen contained. These products, through testing by the manufacturer will have a specific profiled of organic material, nutrient concentration, and other chemical and physical properties specific to these materials. Care must be taken to ensure no contamination takes place from source of manufacturing to end use

Though the ratio of N15 to N14 isotopes can provide some indication of the possibility of adulteration, OMRI considers it to be an unreliable indicator, particularly for fertilizer blends. The principle behind this testing protocol is to quantify nitrogen that has been derived from the air, as in the synthetic Haber-Bosch process used in ammonia production, and nitrogen derived from organic plant or animal materials. There are, however, some plant materials that can fix atmospheric nitrogen directly, such as some seaweeds and soy, so the isotope ratios may resemble those of synthetic nitrogen sources (Mukome et al., 2013). Further blending of fertilizer materials complicates the situation. At one point in its history, OMRI requested nitrogen isotope analyses for high nitrogen liquid fertilizer products but currently rarely uses the practice due to interpretation difficulties and unreliability. It can be assumed that other material review organizations would have equivalent difficulties in evaluating synthetic ammonia content using these laboratory methods, particularly for facilities that may produce conventional and organic lines of products. This situation may require testing of all fertilizer ingredients at a site for comparison rather than final product blends as a whole… While OMRI does not advocate for the allowance or prohibition of any specific material, it understands the risks of adulteration by synthetic substances to organic integrity. In the case of nonsynthetic ammonia sources, OMRI believes that the risk of adulteration by synthetic forms is significant due to the difficulties in identifying the sources of the material. The risk of adulteration is also higher for soluble nitrogen products given the potential economic gains from producing an input product with cheaper, synthetically derived nitrogen.

Given the range of public comments (not all are included in this document), the NOSB seeks additional input from stakeholders regarding this petition.

Questions/Information Requests:

1. Given the conflicting comments on the effects of ammonia on soil health, please provide further information that would help to resolve this conflict. Provide scientific citations so that the NOSB can have primary references as to the effect of ammonia extract on soil health.
2. Is there a range of concentrations in the soil solution in which ammonia is beneficial, while outside that range it is not?
3. Please provide additional information as to how the fraudulent use of synthetic ammonia could be prevented while at the same time allowing for the use of natural ammonia extract.
4. Should the use of natural ammonia extract be limited to a certain percent of nitrogen use in crops (similar to the Chilean nitrate restriction)?

5. If natural ammonia extract is limited to a certain percentage of nitrogen use, how can that amount be verified and separated from synthetic ammonia?
6. In mixed organic and conventional operations, how can the use of natural ammonia extract used in the organic crops be verified as opposed to synthetic ammonia used in the conventional crops?
7. Is there additional information about the effects of highly soluble organic fertilizers on soil health that the NOSB should be aware of?

Subcommittee vote
Motion to approve the discussion document on ammonia extract.
Motion by: Steve Ela
Seconded by: Rick Greenwood
Yes: 6 No: 0 Abstain: 0 Recuse: 0 Absent: 2

Approved by Rick Greenwood, Crop Subcommittee Chair, to transmit to NOP February 17, 2021.