

**National Organic Standards Board**  
**Crops Subcommittee Petitioned Material Proposal**  
**Allyl Isothiocyanate (AITC)**  
**June 19, 2018**

**Summary of AITC [2016 Petition](#); [2013 Petition](#):**

Two petitions for allyl isothiocyanate (AITC) have been submitted to the National Organic Program by Isagro USA, Inc. Both petitions propose to add AITC as an allowed synthetic substance in organic crop production (§ 205.601) as a pre-plant fumigant. The original petition, dated December 20, 2013, was received by the NOSB on January 24, 2014. After review and discussion by the Crops Subcommittee, the request to add AITC to the National List at 205.601 was not recommended. The second petition, submitted July 2016, further asserted that AITC offers organic growers the only effective management tool for soil-borne diseases and pathogenic nematodes at levels that are commercially relevant and supports the phytosanitary certification process for organic fruit and vegetable nursery stock production.

**Summary of Review:**

Based on information from the 2018 technical report (TR), AITC is a naturally occurring compound found in plants such as broccoli, brussel sprouts, mustard, wasabi, and horseradish. AITC, commonly referred to as “oil of mustard” was first registered by the U.S. EPA in 1962 for use in pesticides and rodent control products; however, oil of mustard is a common food ingredient and has been listed on the U.S. Food and Drug Administration’s Generally Regarded As Safe (GRAS) list since 1975 (2018 TR, lines 78-79, 132).

To facilitate review of the petition dated July 2016, the Crops Subcommittee requested a limited scope technical report (TR) to address outstanding issues. These issues were addressed in the TR dated February 12, 2018, as follows:

- Provide a review of allyl isothiocyanate as it pertains to the newly listed additional uses that were not listed in the original petition.
- Review the proposed phytosanitary use for nursery stock and plants which deals with Nursery Stock certification, including potential benefits, all applicable rules and regulations on both a State and Federal level, as well as how that applies to USDA APHIS requirements. Would allyl isothiocyanate work and would it be allowed for this mandatory process as required by law?
  - o Clarification: The 2018 petition mentions the use of AITC as a phytosanitary tool for use on organic nursery stock and plants when there is a requirement to meet phytosanitary restrictions. There is currently an exemption that allows treatment of organic nursery stock and plants if that is the only alternative to meet phytosanitary certification processes. This may occur during the intra- and inter-state movement of plant materials (e.g., seed and nursery stock) through inspection and certification programs (e.g., USDA APHIS). Specific soil-borne pathogens and nematodes are targeted pests of the nursery stock registration and certification program and must be treated for presence of such in stock or seeds. Eradication treatments of thermotherapy, fumigation using methyl bromide or Telone II™, other synthetic fumigants, and/or hot water treatments are mandatory. Would this material work, and would it be allowed for this mandatory process, as required by law.
- Provide a comprehensive look at both the short and long-term impacts on soil beneficial life forms compared to existing practices and/or materials being used.

## Category 1: Classification

1. For CROP use: Is the substance \_\_\_ Non-synthetic or \_X\_ Synthetic?  
Is the substance formulated or manufactured by a process that chemically changes a substance extracted from naturally occurring plant, animal, or mineral sources?

AITC may be considered synthetic or natural depending on the method utilized for its production. The petitioned substance is produced using chemical synthetic methods (2018 TR lines 337).

2. For CROPS: Reference to appropriate OFPA category:  
Is the substance used in production, and does it contain an active synthetic ingredient in the following categories: copper and sulfur compounds; toxins derived from bacteria; pheromones, soaps, horticultural oils, fish emulsions, treated seed, vitamins and minerals; livestock parasiticides and medicines and production aids including netting, tree wraps and seals, insect traps, sticky barriers, row covers, and equipment cleansers; or (ii) is used in production and contains synthetic inert ingredients that are not classified by the Administrator of the Environmental Protection Agency as inerts of toxicological concern?

AITC contains a singular sulfur atom; therefore, AITC may be considered a sulfur compound.

## Category 2: Adverse Impacts

1. What is the potential for the substance to have detrimental chemical interactions with other materials used in organic farming systems?

One possible interaction between the petitioned substance and other materials used in organic crop production involves the reaction of AITC with free amino acids, peptides and proteins contained in organic composts and fertilizers. Specifically, electron deficient AITC can react with the electron rich amino groups of the free amino acids alanine and glycine as well as cysteine, lysine and arginine residues of intact proteins. Diminished enzymatic digestibility was documented for some of the resulting protein-AITC adducts; however, it is uncertain how these chemical transformation products might affect the absorption and metabolism of amino acid building blocks in plants (2018 TR lines 563-569) 2018).

2. What is the toxicity and mode of action of the substance and of its breakdown products or any containments, and their persistence and areas of concentration in the environment?

Overall, as noted in the TR, it can be concluded that the toxicity rating of AITC ranges from toxic to practically non-toxic to the few non-target taxa evaluated in the TR (2018 TR lines 669-670). The risk of toxicity associated with mammalian exposure to AITC is variable depending on the source and concentration of AITC used in toxicity testing. According to US EPA, oil of mustard containing AITC at a concentration of 4.43% is practically non-toxic via the acute oral and inhalation routes of exposure. In addition, oil of mustard is not an acute dermal irritant or sensitizing agent.

3. Describe the probability of environmental contamination during manufacture, use, misuse or disposal of such substance.

Considering its moderately high volatility (3.7 mm Hg at 25°C), high application rates (85–340 lbs/acre), and agricultural use as a soil biofumigant, releases of AITC to the environment are inevitable. AITC is both flammable and potentially toxic to nontarget organisms such as mammals and fish. Aquatic wildlife may be exposed to AITC through spills and/or irrigation runoff. As with conventional fumigants, measures such as the use of plastic tarps on treated fields or application of AITC through a drip system could be taken to further protect humans (bystanders and workers) and nontarget terrestrial organisms from exposure to AITC following soil biofumigation. The rapid breakdown and dissipation of AITC in the environment reduces the probability of contamination of groundwater and surface water due to agricultural applications of the substance (2018 TR lines 523-531).

4. Discuss the effect of the substance on human health.

The TR specifies that natural sources of AITC contained in natural vegetable oils (e.g., mustard oil) are generally non-toxic to humans via oral exposure. This observation is not surprising considering the high concentrations of AITC (3 mg/kg to 15 g/kg) generally found in popular food items such as kale, broccoli, mustard and horseradish. However, moderate doses of concentrated AITC are considered toxic to mammals based on laboratory studies in animals.

5. Discuss any effects the substance may have on biological and chemical interactions in the agroecosystem, including the physiological effects of the substance on soil organisms.

AITC can have a short-term harmful effect on beneficial soil microorganisms and mutualistic fungal interactions. However, long term soil effects for other fumigation agents is relatively non-existent, as they have not been as widely utilized as methyl bromide and have only received considerable attention since the ban on methyl bromide in 2005.

In a short-term study (28 days) of the effect of AITC on soil bacterial and fungal communities, the application of AITC significantly decreased soil fungal populations but had negligible impact on soil bacterial numbers. However, AITC did have an influence on certain microbial community composition changes. The results showed increased proportions in bacterial taxa, which include bacteria associated with fungal disease suppression. The increase in these bacteria and decrease in overall fungal populations following application of AITC suggests that the observed efficacy of AITC on fungal suppression was not only due to direct toxicity of AITC to soil fungi, but also to biological interactions and competition with the altered microbial community that existed following fumigation. (2018 TR lines 640-650).

6. Are there any adverse impacts on biodiversity?

AITC may have an impact on certain fungi that produce mutualistic relationships with plants and prey on insects. Exposure to livestock, birds, freshwater fish, freshwater invertebrates, non-target plants, and non-target insects is not expected based on the application methods proposed and the rapid environmental degradation of AITC (2018 TR lines 605-608, 610-611).

### Category 3: Alternatives/Compatibility

1. Are there alternatives to using the substance? Evaluate alternative practices as well as non-synthetic and synthetic available materials.

Mustard seed meals, mustard green manures (plowed cover crop), and Regalia (OMRI approved material) are biopesticides that are available. SoilGard, a fungal biocontrol material, Serenade, and Bionematicide Melocon are also feasible alternative materials available for use in organic crop production systems.

Crop rotation and soil nutrient management are alternative practices, as well as cultural practices that enhance crop health. For pest problems, introduction of predators or parasites of a pest species, lures, traps and/or repellants also can be used. For weed control, mulching, flaming, mowing, hand or mechanical weeding are some examples of practices currently in use. Also, the tilling in of mustard plant cover crops to create a green manure is currently being used and is a viable alternative practice.

2. In balancing the responses to the criteria above, is the substance compatible with a system of sustainable agriculture?

No, the substance is not compatible with the system of sustainable agriculture.

#### Classification Motion:

Motion to classify allyl isothiocyanate (AITC) as synthetic

Motion by: Jesse Buie

Seconded by: Emily Oakley

Yes: 6 No: 0 Abstain: 0 Absent: 2 Recuse: 0

#### National List Motion:

Motion to add allyl isothiocyanate (AITC) at §205.601

Motion by: Jesse Buie

Seconded by: Emily Oakley

Yes: 0 No: 6 Abstain: 0 Absent: 2 Recuse: 0

Approved by Steve Ela, Subcommittee Chair to transmit to NOSB, August 24, 2018