NORTHWEST HORTICULTURAL COUNCIL
105 S. 18th Street, Suite 105
YAKIMA, WASHINGTON 98901 USA
(509) 453-3193 FAX (509) 457-7615
www.nwhort.org

September 30, 2021

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

RE: Docket Number: AMS-NOP-21-0038; Notice of Meeting of the National Organic Standards Board

Dear Ms. Arsenault,

The Northwest Horticultural Council (NHC) appreciates the opportunity to comment on the National Organic Standards Board (NOSB) proposals and discussion documents pertaining to organic materials listed in the most recent NOSB meeting materials posted in the Federal Register on June 3, 2021. Many of the NOSB proposals, petitions, and discussion documents referenced in this letter are especially pertinent to the growers, packers, and shippers of organic apples, pears, and cherries in Idaho, Oregon, and Washington that the NHC represents.

In many ways, the Pacific Northwest region is the epicenter for organic pome fruit and cherry production in the United States. The Pacific Northwest is the national leader in the production of organic apples, pears, and cherries. Over 22 million boxes of organic apples are now harvested from more than 32,537 acres in Washington state, amounting to 94.6 percent of the value of sales of fresh organic apple crop grown in the United States (USDA NASS 2019). There is also a significant volume of organic pears and cherries grown in our region, with more than 7,500 acres planted across the Pacific Northwest.

Organic tree fruit production in the region is increasing, with additional acreage transitioning to organic each year. The total value of the organic tree fruit crop for the region topped $620 million in 2019, of which organic apples alone accounted for approximately $540 million. In fact, tree fruit accounted for 60 percent of farm gate sales for all Washington state organics that year.

Organic tree fruit production, handling, and shipping is very complex. Our farmers must routinely manage dozens of pests that have the potential to make fruit unfit for consumption, or that suppress tree growth and overall production. The Food and Agriculture Organization estimates that 20 to 40 percent of global crop production is lost each year due to pests, with plant diseases contributing significantly to food waste and costing the global economy $220 billion. In the Pacific Northwest, growers must protect fruit from injury by 33 direct insect pests (those that feed directly on the fruit), 47 indirect insect pests (those that feed on the tree), two common bacterial pathogens, eight fungal pathogens, ten viral pathogens, and five phytoplasmas and viroids. Another seven postharvest diseases can cause fruit decay, costing the fruit industry millions of dollars in losses each year after farmers have already invested in growing and harvesting the crop (Washington State University, 2020). Invasive or emerging pests are also a continual threat.

In addition to pests and diseases that affect the fruit or the tree, our growers and packers must also combat foodborne pathogens, such as *Listeria monocytogenes*, pathogenic *E. coli*, and *Salmonella*, that pose a serious threat to consumer health and are naturally occurring in the environment. As discussed further below, growers and packers must have access to the sanitizers necessary to prevent cross-contamination on food contact surfaces through the harvest and packing process. Access to different types of sanitizers with different modes of action is critical to sanitizing the different types of food contact surfaces and attacking the multitude of microorganisms that can be found in the growing and packing environments.

The Organic Food Production Act states that synthetic substances may be permitted if, among other things, the substance is deemed "necessary to the production or handling of the agricultural product because of the unavailability of wholly natural substitute products." We ask the NOSB Board members to be cognizant of the impacts to the practical abilities of organic growers and packers to produce organic food in a matter that allows for effective management of these diverse pest threats when considering whether a listed material truly has a wholly natural alternative. In particular, the evolution of insect, weed, and microbe resistance means that producers and packers need access to multiple tools to deploy season-long pest management programs that allow for the rotation of products with differing modes of action to manage the evolution of pest resistance and therefore to be able to continue growing and handling of organic food. One product often cannot and should not be considered as a full substitute for another.

Not all alternatives provide equal efficacy in controlling the target pest organism; nor, is it a given that an alternative product is compatible with all pest management or food safety programs in all regions of the country in vying to manage varying pest and pathogen complexes under a myriad of weather and soil conditions. Impacts to material supply chains is another consideration when considering delisting existing materials. Manufacturers and distributers may not have the capacity to facilely step-up production and distribution of alternative products to fill a void created by delisting, leaving end users without the materials they need to produce and pack organic produce.

The NHC appreciates the good work of the Board in its preparation of the Proposals and Discussion Documents for the NOSB Meeting. We have compiled a list of materials from those listed by the NOSB for review that are of particular importance to organic tree fruit growers and packers. Below, you will find this list – complete with NOSB citation, a brief description of the item's standard usage, and a statement as to why the product is needed.

EPA List 3 Inerts- Crops (§205.601(m)(2)) - Inerts of unknown toxicity - **Sunset Date:** 5/29/2023

List 3 Inerts are essential to the proper performance of mating disruption and other pheromone products that are used to monitor and manage tortricid moth pests that pose a significant threat to pome fruit production, including codling moth, Oriental fruit moth, and leafrollers. It is incumbent on the NOSB to understand the highly negative impacts that delisting of EPA List 3 Inerts would have on the ability of organic growers to continue to operate. Approximately 95 percent of all organic pome fruit is produced in the Pacific Northwest, and mating disruption is almost universally used by Pacific Northwest organic tree fruit growers to control these pests that threaten pome fruit production globally. There are no viable substitutes to mating disruption in controlling pests like codling moth, and the Board must allow List 3 inerts to remain on the National List until suitable alternatives are determined.

List 3 inerts are ultraviolet stabilizers critical to the formulation of all passive pheromone dispensers used for mating disruption of tortricid moth pests in organic tree fruit production. Sumisorb, a benzotriazole on List 3, is incorporated into at least four commercially available mating disruption passive dispensers. Reviewers of a study commissioned by the NOSB in 2003, "National Organic Standards Board Technical Advisory Panel Review compiled by University of California Sustainable Agriculture Research and Education Program (UC SAREP) for the USDA National Organic Program," were in general agreement that Sumisorb should be allowed on the National List for use in passive mating disruption end-use products, stating that the utility conferred by the substance, coupled with the unlikelihood of it interacting with the environment, were compelling reasons to warrant its addition to the National List. Ting (2009, CA EPA) determined that use of an Isomate® pheromone dispenser, "…is not likely to pose a health hazard to humans, including children," and that "These chemicals are not likely to accumulate in the body or persist in the environment." These statements all still hold true today.

Controlled-release dispensers were critical to the development of practical control programs. To be effective, codling moth mating disruption dispensers must last in the field for approximately 180 days. Early research in the development of passive pheromone dispensers before the addition of UV stabilizers showed that pheromone components in the dispensers lasted 40-60 days in the field before the components were fully released (Brown 1986 and 1992). Studies on the inclusion of antioxidants and UV stabilizers in a number of different pheromone dispensers showed that the addition of these inert ingredients slows degradation of pheromone components (Miller 1993 and 1995, McDonaugh *et al*.). The work of these scientists over the past three decades delivered controlled-release pheromone dispensers that are practical for use in tortricid moth management.

The NOSB Technical Advisory Panel report cited above found that Sumisorb is nonvolatile at field temperatures, has a low probability of escaping the dispenser when used appropriately, and that Sumisorb has a low potential for environmental contamination (even if misused). According to the EPA, ten years of field use of lepidopteran pheromones resulted in no adverse human effects (EPA 1991). The low risk of contamination prompted the EPA to exempt from tolerance all inert ingredients used in mating disruption formulations, including UV stabilizers (EPA 1993). The 2003 study commissioned by the NOSB concluded, "Given the chemical complexity of mating disruptant formulations, it appears unlikely that any *de facto* organic substance (i.e., a byproduct of a living organism, naturally-occurring in the form that it is used) will be a suitable substitute for Sumisorb."

Personal communications by NHC staff with personnel of three leading pheromone manufacturers/distributers – Isomate®, Trécé ® and Suterra® -= reveal that there are no natural alternative UV stabilizers available today that could be used to replace Sumisorb and other List 3 inert ingredients. In a letter to the NHC (enclosed), Trécé, Inc., a company that uses List 3 inerts to produce over 175 products used to monitor many different insect species, states that List 3 inert ingredients account for over 97 percent of total end products in their dispensers, that the inert ingredients do not diffuse out of the dispensers, and that there are no natural alternatives efficacious enough to provide protection against pheromone component degradation. Trécé, explains that the loss of List 3 inerts "…will essentially eliminate all semiochemical products (monitoring, mating disruption, and gustatory stimulants) that Trécé offers for organic production." Without the addition of the inerts, pheromone dispensers **will not** remain viable for use by organic growers. The loss of these materials would be catastrophic to the organic tree-fruit industry.

Pheromone-mediated mating disruption is not applied to the fruit. The pheromone is contained within devices and volatilizes into the orchard air to prevent males from locating and mating with females, leaving no residue on the fruit. One particularly damaging tortricid, Codling moth (*Cydia pomonella*), is a quarantine pest for important international export markets. Larvae chew their way into the center of the apple, making the fruit unfit for consumers.

Mating disruption is the cornerstone of IPM programs in both organic and conventional production. The WSU website for organic codling moth management, "How to Effectively Manage Codling Moth" states that "Organic programs should always use mating disruption, without it, codling moth control is extraordinarily difficult." Organic ovicides and larvicides targeting codling moth control become far less effective as stand-alone materials and efforts to improve biological control of codling moth since the year 2000 have not yielded significant control of codling moth (Mills 2005; and Lacey and Unruh 2005). Without mating disruption to keep populations of the pest at low levels, current organic tools will be insufficient for organic producers to achieve control of codling moth.

Prior to the introduction of mating disruption, organic growers relied on applications of ryania, a botanical insecticide made from the ground stems of *Ryania speciosa*, a native plant of tropical America. Codling moth injury to fruit in organic orchards before mating disruption typically ranged between 30 percent and 50 percent of the fruit damaged (Gut and Brunner, 1998). Gut reports from his mating disruption trials that, "In 1991, the organic comparison orchard at the site received 31 applications of ryania plus Bacillus thuringiensis var. kurstaki and fruit injury at harvest was 10.5%." Today's organic pome fruit producers target managing codling moth injury at below one percent to remain economically viable.

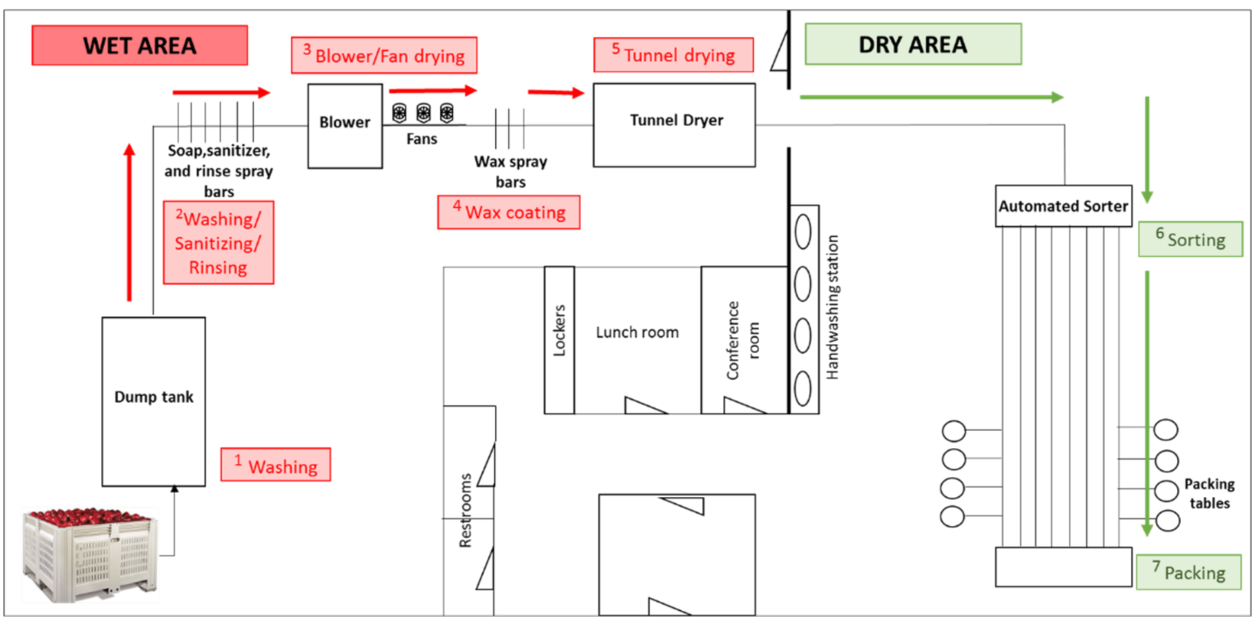
As outlined above, there are no current viable alternatives to List 3 Inerts to effectively stabilize pheromone products to work effectively for the control and monitoring of codling moth. If history is an indicator, a decision to delist these inerts could very well lead to a dramatic increase in food waste with the loss of 50 percent of organic pome fruit production from the Pacific Northwest within the next five years, and an even steeper decline in years five through ten. We strongly encourage the NOSB to follow the statute, which allows for the continuation of synthetic products on the National List when there is no “wholly natural” alternative and retain List 3 Inerts for organic pome fruit production.

Sanitizers and Disinfectants

Fresh produce is grown in the open environment where dangerous, and sometimes deadly, pathogens exist. It is impossible to eliminate the potential for these pathogens to reach the surface of produce in the field, and therefore it is critical for growers and packers to have the tools necessary to combat these pathogens before they reach the consumer. This includes cleaning the produce itself, as well as cleaning and sanitizing all food contact surfaces (including water) to reduce the potential for cross-contamination. Protecting public health is the top priority of the tree fruit growers and packers we represent, and we encourage the NOSB to not make it more difficult for them to deliver a safe and healthy product to consumers.

After harvest, some tree fruit (including apples) may be stored for up to 12 months in either refrigerated or controlled atmosphere cold storage. Following storage, fruit is run over a packing line to be graded and placed in various packages (see Figure). Packing lines consist of a wet area and a dry area. The wet area consists of a water flume system called a dump tank, various conveyor systems, an array of spray bars for soap, rinse, and sanitizer application; and a fan and heated tunnel system to dry the fruit. The main parts of the dry area are an optical sorter/grader and various packaging stations.

Figure: Depiction of a typical apple packing line (Source: Dr. Faith Critzer, University of Georgia)



Growers and packers need access to more than one type of sanitizer to be able to achieve the critical objective of delivering a safe and healthy product to consumers year-round. Each sanitizer and disinfectant listed below has specific benefits that make it the most effective and appropriate choice for a particular circumstance. It is also important to note that different products with different modes of action are regularly used in postharvest handling in order to manage the vast array of public health microorganisms, which include viral, protozoa, and bacterial targets. Therefore, growers and packers must have access to multiple products to combat the full plethora of pathogens of human health concern. Many packers rely on an environmental monitoring program to assess when to change products for a particular action – whether it be a sanitizer used on a particular food contact surface, or applied to water systems such as hydrocoolers, dump tanks, flumes, and spray bars.

For example, a grower may use peracetic acid (PAA) to sanitize food contact surfaces in the field. Once the fruit reaches the packinghouse, the packer may use calcium hypochlorite as a wash water sanitizer and PAA in the spray bars. At the end of the day, the lines may be sanitized using chlorine dioxide or ozone, while sodium hypochlorite may be used to sanitize the cold storage rooms. This regiment may change should environmental monitoring data show that the effectiveness of sanitation on a particular food contact surface is reduced.

In addition to the need to attack these pathogens from multiple directions, the maintenance of multiple sanitizers is also important because of concerns that reliance on a single type of sanitizer could lead to resistance evolution by the pathogens. This concern is being further explored by leading *Listeria* researcher Dr. Martin Wiedmann (Cornell University) and colleagues in a study funded by the Center for Produce Safety (Estrada 2020).

Lastly, it should be noted that in addition to protecting human health, these sanitizers are needed for growers and packers to comply with the requirements of the Food Safety Modernization Act's Produce Safety Rule and Preventive Controls for Human Food Rule.

§205.601 Sunsets:

1. **Ozone gas - Crops** - §205.601(a)(5) for irrigation cleaner - **Sunset Date:** 5/29/2023

The NHC supports the maintenance of this product on the National List. Ozone gas is an environmentally safe and effective irrigation cleaner to control a wide spectrum of pathogens of human health concern, including *E. coli* or *Listeria*. It has many benefits in comparison to other products, including the fact that it leaves no residue on food, food contact surfaces, or in water. Because there are no residues, it has no negative impact on soil. Worker safety concerns are negligible, as good ventilation is easy to maintain in the open environment. While cost currently prevents ozone from being widely used by organic tree fruit growers for this purpose, technological advances may bring the cost down in the future. Ozone has the potential to become a valuable tool should the cost be reduced. It is already widely used in the storage and packinghouse environments.

2. **Peracetic acid - Crops** §205.601(a)(6) & §205.601(i)(8) – **Sunset date:** 5/29/2023

The NHC supports maintaining peracetic acid on the National List. Peracetic acid (PAA) is widely used as a sanitizer and disinfectant by both organic tree fruit growers and packers. It has a high efficacy rate against pathogens of human health concern, including the biofilms that protect them. As one of the few non-chlorine-based sanitizers available for use in organics, PAA allows growers and packers to attack naturally occurring pathogens of human health concern with a product that utilizes both oxidation and pH modulation as its primary modes of action. This is essential to protect consumers against these naturally occurring organisms.

In the orchard, PAA is used to sanitize equipment including picking bags, pruning shears, ladders, and bins. It is the primary disinfectant and sanitizer utilized on this equipment for a number of reasons. First, it is more portable than most chlorine-based sanitizers (*i.e.*, there is no need for a generator or other equipment). It also dissipates quickly by resolving to water, which precludes the need to rinse a food contact surface following application – something that can be challenging to do in the field.

In the packinghouse, PAA is widely used as a sanitizer for packing line equipment, to treat wash water to prevent cross-contamination, and is applied through spray bars onto the fruit. As mentioned previously, packers often use chlorine-based sanitizers and PAA in different areas of the packinghouse to ensure efficacy against pathogens of human health concern – thereby achieving a higher degree of consumer health protection. The same characteristics that influence a decision to use PAA in the orchard, such as portability and the fact that a rinse is not required on food contact surfaces following application, also affect when and where it is used in the packinghouse.

PAA is also currently commercially available in several organically approved hydrogen peroxide materials for controlling the fire blight pathogen, including use on pruning shears in the orchard. Fire blight is a quarantine condition and economically significant threat for apple and pear growers – causing heavy damage to entire orchards in a single growing season under the right conditions. Since growers lost the use of streptomycin and oxytetracycline for controlling fire blight, PAA has become even more important to pome fruit growers.

Scientists at WSU have been investigating the use of PAA to control fire blight blossom infections since 2016 (DuPont 2020). Applications of a solution of PAA mixed with hydrogen peroxide, ranging from two percent to five percent, were applied in blocks of Red Delicious apples inoculated with fire blight in 2016, 2019, and 2020. Results of the PAA trials in 2016 and 2020 showed significantly reduced fire blight strikes per 100 flower clusters as compared to untreated, inoculated control blocks, though less effective as compared to a streptomycin treatment. In 2021 both PAA/hydrogen peroxide treatments (Jet Ag and Oxidate 5.0) provided reductions in blossom infections compared to the water-treated check, with suppression similar to organic and antibiotic standards (DuPont 2021). One challenge researchers continue to address with use of PAA for fire blight control is the potential for increased incidence of fruit russeting.

3. **Chlorine materials – Crops and Handling** §205.601(a) - As algicide, disinfectants, and sanitizer, including irrigation system cleaning systems; disinfecting and sanitizing food contact surfaces - **Sunset Date:** 10/30/2024

(i) **Calcium hypochlorite** citation 205.605(b): The NHC supports maintaining calcium hypochlorite on the National List. This chemistry is used as an algaecide, disinfectant, and sanitizer. It is commonly used to disinfect water in cherry hydrocoolers, which are used to cool fruit postharvest, extending its retail shelf life. Hydrocoolers can be transported to farming sites in order to hydrocool cherries within an hour of harvest. Calcium hypochlorite is favored in hydrocooler use because it is available in a stable tablet form that is safe and easy to handle, including during transport. It also is not as corrosive as PAA or ozone.

Calcium hypochlorite has several other uses. It is universally used on packing lines to sanitize food contact surfaces, as a disinfectant in wash water, and as a fruit wash. Once again, worker safety and ease of handling is a significant factor in the decision to use calcium hypochlorite. In addition, it is easier than other products to keep use levels at peak efficiency and prevent over-application, due to the availability of robust, accurate, and inexpensive monitoring and control systems. Unlike sodium hypochlorite, it does not easily get tied up by organic matter and create salts in water.

(ii) **Chlorine dioxide** (citation 205.605(b)) - The NHC supports maintaining chlorine dioxide on the National List. Chlorine dioxide is used for disinfecting and sanitizing food contact surfaces. It is equally effective as PAA in penetrating biofilms, without being as corrosive – making it a better option for certain food contact surfaces or in rotation on a limited basis for biofilm control. It is also often applied through spray bars as a fruit rinse since it gasses off during fruit application. The lack of a residue also means that it does not adversely affect a packinghouse's wastewater. Chlorine dioxide can also be used in dump tanks and is used to sanitize storage rooms prior to use. It is very commonly used in commercial organic tree-fruit handling facilities, and some packers are investigating expanding its use to other equipment in the dry end of the facility to limit cross-contamination caused by water-applied sanitizers.

(iii) **Hypochlorous acid** - generated from electrolyzed water (citation 205.605(b)) - The NHC supports maintaining hypochlorous acid on the National List. Electrolyzed water, which generates hypochlorous acid, is currently used by a small number of packinghouses and others are investigating adopting this technology. It is known to work well in large-scale applications, such as municipal disinfection, and has the benefit of leaving no residue. It is also being used in a small number of instances to help control fire blight in the orchard.

(iv) **Sodium hypochlorite** (citation 205.605(b)) - The NHC supports maintaining sodium hypochlorite on the National List. Sodium hypochlorite is widely used in packinghouses to disinfect and sanitize food contact surfaces. It is also commonly used in packinghouse dump tanks, and to disinfect and sanitize cold storage rooms. A volume of research has shown this product to be effective. Benefits include that it is more portable than calcium hypochlorite (i.e., no dilution system is required), and it does not require fresh potable water for use. It is also less corrosive than PAA or ozone. Like calcium hypochlorite, it is easier to keep use levels at peak efficiency and prevent over-application, due to the availability of robust, accurate, and inexpensive monitoring and control systems.

Non-synthetic substances prohibited for use in organic crop production

Calcium chloride §205.602 (citation 205.602(c)) **- Sunset Date:** 5/29/2023 – Calcium chloride is a common plant nutrient that provides calcium for plants, including pome and stone fruit trees, and helps prevent destructive postharvest physiological disorders such as cork spot, fruit cracking, internal browning disorder, and bitter pit of apple. Some popular apple cultivars, such as Honeycrisp, are highly prone to bitter pit, a physiological disorder that begins in the orchards, but for which symptoms may only begin to appear in storage. Without foliar applications of calcium chloride, high numbers of fruit will be lost every year to bitter pit. Foliar applications of calcium chloride also help prevent alfalfa greening on pears and fruit splitting on cherries. The NHC supports the continued exemption for the allowed use of calcium chloride for use as a foliar spray to treat organic fruit.

§205.601 (j)(5) Magnesium oxide (Cas # 1309-48-4) – for use only to control the viscosity of a clay suspension agent for humates: The NHC supports the re-listing of magnesium oxide as material that aides in the suspension of humates, which are used to improve the efficiency of nutrient uptake and absorption and to promote the growth of bacterial fungi.

Petitioned Material Proposal: Chitosan for Plant Disease Control: The NHC supports the petition for addition to the National List at §205.601(j)(4) for plant disease control. This is a material that also has potential as a soil amendment. As noted in the NOSB Discussion Document, the EPA states that "chitosan is not expected to harm people, pets, wildlife, or the environment when used according to label direction." The NHC's only objection to this petition is the petitioner's frivolous claim that, "…chitosan is an alternative to sulfur-based pesticides, which can be phytotoxic to plants." Sulfur-based pesticides are extremely important products in organic production of many crops for the management of several disease-causing pathogens. Far more research and practical use of chitosan in an array of crops against associated plant diseases would need to be performed before such any serious discussions about efficacy of chitosan as a replacement for any plant disease control product can be reasonably conducted.

Conclusion

The products referenced in these comments are important – and in some cases critical – to organic tree fruit production. The loss of these products would negatively impact the abilities of organic tree fruit growers and packers to protect against and manage injury from insect, disease and microbial pests and could have the unintended impact of forcing our local tree fruit growers and packers out of organic production. This is particularly true as regards the potential loss of List 3 Inert ingredients for pheromone mating disruption products, the loss of which directly jeopardizes almost all organic pome fruit production. We ask that members of the NOSB consider their decisions carefully while recognizing the importance of these materials for the role each plays in organic tree fruit production and in preserving management options necessary to respond to food safety concerns and operational needs in organic production and packing.

Thank you for your careful consideration of these comments.

Sincerely,
NORTHWEST HORTICULTURAL COUNCIL

David Epstein, Ph.D.
Vice President for Scientific Affairs

CC: NHC Science Advisory Committee's Organic Subcommittee

Literature Cited

Brown, D.F and L.M. McDonough. 1986. Insect Sex Pheromones: Formulations to Increase the Stability of Conjugated Dienes, J. Econ. Entomol. 79: 922-927.

Brown, D.F., A.L. Knight, J F. Howell, C.R. Sell, J.L. Krysan, and M. Weiss. 1992. Emission Characteristics of a Polyethylene Pheromone Dispenser for Mating Disruption of Codling Moth (Lepidoptera: Tortricidae), J. Econ. Entomol. 85(3): 910-917.

DuPont, S.T. and M. Munir. 2021. Biologicals, mineral based biopesticides, plant extracts, and peracetic acid treatments for control of fire blight of apple, 2021, Washington State University Agriculture and Natural Resources Extension.

DuPont, S.T. 2020. WSU Efficacy of New Products for Control of *Erwinia Amylovora* Blossom Infections – Summary report 2016 to 2020, Washington State University Agriculture and Natural Resources Extension.

Estrada E.M., A.M Hamilton, G.B Sullivan, M. Weidmann, F.J. Critzer, and L.K. Strawn. 2020. Prevalence, Persistence, and Diversity of *Listeria monocytogenes* and *Listeria* Species in Produce Packinghouses in Three U.S. States, J. Food Prot. 83(2): 277–286.

Gut, L.J. and J.F. Brunner. 1998. Pheromone-based management of codling moth (Lepidoptera: Tortricidae) in Washington apple orchards, J. Agricultural Entomology 15(4): 387-405.

McDonough, L.M., W.C. Aller, and A.L. Knight. 1992. Performance Characteristics of a Commercial Controlled-Release Dispenser of Sex Pheromone for Control of Codling Moth *(Cydia pomonella)* by Mating Disruption, Journal of Chemical Ecology 18(12).

Miller, J.G. 1995. Degradation and Stabilization of E8,EIO-Dodecadienol, the Major Component of the Sex Pheromone of the Codling Moth (Lepidoptera: Tortricidae), J. Econ. Entomol. 88(5): 1425-1432.

Pan, Y., F. Breidt Jr., and S Kathariou. 2006. Resistance of *Listeria monocytogenes* Biofilms to Sanitizing Agents in a Simulated Food Processing Environment, Appl. Environ. Microbiol., 72(12): 7711–7717, (https://www.ncbi.nlm.nih.gov/pmc/articles/PMC1694257/).

Ting, D. 2009. Human Health Risk Assessment of Isomate LBAM Plus, Pesticide and Environmental Toxicology Branch Office of Environmental Health Hazard Assessment California Environmental Protection Agency, https://oehha.ca.gov/media/downloads/pesticides/report/hhralbam2009.pdf

USDA NASS. 2019. Certified Organic Farm Data, Table 9: Certified Organic Apples Harvested and Value of Sales: https://www.nass.usda.gov/Publications/AgCensus/2017/Online_Resources/Organics/organics_1_009%20_009.pdf

Washington State University. 2020. Crop Protection Guide for Tree Fruits in Washington, Extension Bulletin 0419, http://cpg.treefruit.wsu.edu

Weidmann, M. 2020. Listeria develops reduced sanitizer sensitivity but not resistance at recommended sanitizer use levels, Center for Food Safety, https://www.centerforproducesafety.org/researchproject/454/awards/Listeria_develops_reduced_sanitizer_sensitivity_but_not_resistance_at_recommended_sanitizer_use_levels.html

Washington State University, How to Effectively Manage Codling Moth: (http://treefruit.wsu.edu/article/how-to-effectively-manage-codling-moth/),