Sunset 2015 Review
Meeting 2 - October, 2014
Crops Subcommittee
Aqueous Potassium Silicate

August 19, 2014

As part of the National List Sunset Review process, the NOSB Crops Subcommittee has evaluated the need for the continued allowance for or prohibition of the following substances for use in organic crop production.

Aqueous Potassium Silicate — *Synthetic*
205.601(e)), 205.601(i)

Use: As insecticides (including acaricides or mite control). As plant disease control.

Listing: Aqueous potassium silicate (CAS #-1312-76-1)—the silica, used in the manufacture of potassium silicate, must be sourced from naturally occurring sand.

Technical Reports: 2003 (PDF); 2014 (PDF)

Petition(s): Aqueous potassium silicate; Aqueous potassium silicate supplemental

Past NOSB Actions: NOSB review and recommendation for addition to the National List 11/30/07.

Regulatory Background: Proposed rule (including justification) 6/3/2009 (74 FR 26591). Added to National List 12/13/2010 (75 FR 77521).

Sunset Date: 12/14/2015
Reference: 7 CFR 205.601(e)(2)

Subcommittee Review

The Crops Subcommittee believes that the full Board should have the opportunity to complete the review of each sunset material by voting. The NOP has stated that to do this a motion to remove should be brought from the Subcommittee for each substance. If the Subcommittee motion to remove fails to receive a majority, the motion will still be put forward to the full board for review. The motion to remove is voted by the full Board and needs to receive a 2/3 majority to recommend removal.

Summary:

In 2007, the Crops Subcommittee recommended against listing Aqueous Potassium Silicate[1] (APS) because "multiple substitutes are available" and it is a "synthetic soil applied fertilizer not compatible with organic farming regulations." The rationale given for NOSB approval was, "Public comment at Nov. 2007 NOSB meeting well supported listing the substance as plant disease control by providing historical 2003 NOSB consideration of the material as well as more information from petitioner and other interested stakeholders."

New information has been provided in a new Technical Review. That information supports the conclusions below. (Citations are line numbers in January 6, 2014 TR.)

- Dermal exposure can lead to low to medium systemic toxicity and skin irritation (577-579);

[1] Aqueous Potassium Silicate is the active ingredient in products such as the brand Sil-Matrix Fungicide/Miticide.

- Silicon reduces the availability of elements such as manganese, iron, and aluminum to roots (471-473);
- Treatment with potassium silicate may not be appropriate when crops are used for feeding or as forage for livestock because it makes some forages less digestible (477-481);
- The addition of potassium silicate as a foliar nutrient may result in the production of less tender fruits and vegetables or forage for grazing animals (479-481);
- Silica supplementation can result in elongation and thickening of stems, delayed antithesis and flower deformation in some species (487-490);
- In addition to morphological changes, changes in micronutrient in plants may occur as a result of silica supplementation (490-491);
- New alternative materials suggested include other forms of silica that are available as approved supplements for the soil that can provide the same protection over a longer term against plant disease and compost made with silica-rich plants (592-594);
- The TR suggests the following alternative practices: soilscaping, choice of variety and planting time, balancing silica accumulators and nonaccumulators, moisture management, choice of mulch and ground cover, and scouting (661-706); and
- Internationally (Japan, Canada, EEC, CODEX, or IFOAM), natural sources of silica, not APS, are allowed (258-296).

The Crops Subcommittee invited comment on these conclusions, as well as well as on two major issues of concern at the Spring 2014 meeting:

1. Potassium silicate makes plants more resistant to disease and herbivory, at least in part by concentrating silica. Humans and livestock are herbivores who might be consuming the treated plants. Does the foliar application of potassium silicate might have impacts on the nutritive value of treated foods that would exceed the impacts of silica obtained by the plant from natural soils? The TR addressed this to some extent (See #3, 4, and 6 above.) How should the NOSB weigh this impact on the nutritive value of treated plants?
2. The central issue in the essentiality question is whether organic management systems that conserve and build available silicon in the soil are alternatives to potassium silicate. Thus, the subcommittee received some information on this issue (see #7 and 8 above) and is interested in comments concerning nonsynthetic materials and practices (involving soil management as well as foliar treatments) that would build comparable resistance to insects and fungi, while precluding the need for synthetic potassium silicate.

The NOSB received two comments supporting renewed listing and eight comments opposing renewal. Some specific comments that were received are:

- When APS enters the soil from plant treatment it is indistinguishable from silicates already present in the ground.
- APS is used as a foliar application not for roots.
- “Management systems can be used to build the Si in the soil to improve the plant’s resistance to disease and reducing the likelihood of needing a pesticide treatment. However, when an infestation occurs and a treatment is required, APS should be an available option for organic farmers.”
- Information is needed on accumulation of silica in plants.
- International standards do not allow aqueous potassium silicate in crop production.
- Organic methods of soil conservation make its use unnecessary.

Conclusion

In reviewing the 2014 Technical Review and materials submitted by commenters, the Crops Subcommittee finds new evidence relating to OFPA criteria. There are concerns about impacts on human health and the environment, essentiality given alternative materials and practices, and the fact that APS is not allowed in organic production in other countries. There is also information that APS fills a need when a problem occurs. The subcommittee supports research to gather additional information needed to address the issues identified in the attached checklist.

Motion to Remove:
This proposal to remove will be considered by the NOSB at its public meeting.

Based on the Subcommittee's review, the Subcommittee proposes removal of this substance from the National List based on the following criteria in the Organic Foods Production Act (OFPA): **[OFPA criteria at 7 U.S.C. 6158(m),** (7) its compatibility with a system of sustainable agriculture.

Motion to remove Aqueous Potassium Silicate from the National List

Motion by: Harold Austin

Seconded by: Carmela Beck

Yes: 4 No: 3 Abstain: 0 Recuse: 0 Absent: 0

Minority Statement on Motion to Remove

While the minority of the CS agrees with the majority that the full NOSB should vote on sunset materials, in voting against this motion it is following what we believe are required procedure of AMS/USDA as established by the September 16, 2013 Federal Register notice (78 FR 56811), which states that motions to remove be justified by criteria established by the Organic Foods Production Act. Because of concern that a change in NOSB procedures should be disclosed to the public before taking effect, the minority does not accept the compatibility criteria from 7 U.S.C. 6158(m) (7) that was provided in this case. Furthermore, AMS/NOP has said that no action by the NOSB maintains a sunset material on the National List.

Evaluation Criteria (see attached checklist for criteria in each category)

	Criteria Satisfied?		
1. Impact on Humans and Environment	☐ Yes	☒ No	☐ N/A
2. Essential & Availability Criteria	☐ Yes	☒ No	☐ N/A
3. Compatibility & Consistency	☐ Yes	☒ No	☐ N/A

Substance Fails Criteria Category: 1, 2, 3

NOSB Evaluation Criteria for Substances Added To the National List (Optional Checklist)

Category 1. Adverse impacts on humans or the environment? Substance: Aqueous Potassium Silicate

Question	Yes	No	N/A	Comments/Documentation (TAP; petition; regulatory agency; other)
1. Is there a probability of environmental contamination during use or misuse? [§6518(m)(3)]	X			Since potassium silicate is sprayed onto plants, there is a probability of contamination.
2. Is there a probability of environmental contamination during, manufacture or disposal? [§6518(m)(3)]	X			CO2 produced by manufacture. High energy cost, use of fossil fuels. Strong alkaline solution produced in manufacture. TAP, pp. 2, 4, 9-12.
3. Are there any adverse impacts on biodiversity? (§205.200)	X			Potassium silicate has not been tested for ecotoxicity. It is not persistent in aquatic systems, but is highly alkaline in solution form and can be harmful to aquatic life if not diluted and disposed of properly. TAP, p. 4.
4. Does the substance contain inerts classified by EPA as 'inerts of toxicological concern'? [§6517 (c)(1)(B)(ii)]	X			It is/was a List 3 "inert." TAP, p. 3.
5. Is there potential for detrimental chemical interaction with other materials used in organic farming systems? [§6518(m)(1)]	X			The substance may react in storage with ammonium salts to form hydrogen gas, and care should be taken to avoid contact with raw manure in closed storage. Potassium silicate solutions have a high pH, and applications may have adverse effects if used on alkali sensitive crops. TAP, p. 3. During storage of the compound, care must be taken to avoid wetting the material. Spills are slippery. Reacts with acids, ammonium salts, reactive metals and some organics. TAP, p. 9 Potassium silicate gels and generates heat when mixed with acid and may react with ammonium salts resulting in the evolution of ammonia gas. Flammable hydrogen gas may be produced on contact with aluminum, tin, lead, and zinc. TR lines 451-453.[2]
6. Is there a toxic or other adverse action of the		X		No carcinogenicity, mutagenicity, or

[2] Line numbers for TR refer to January 6, 2014 final.

	material or its breakdown products? [§6518(m)(2)]				developmental toxicity data are available for potassium silicate. TAP, p. 5. Potassium silicate has no chronic hazards, does not bio-concentrate in the food chain, nor make volatile or toxic organic compounds when used as recommended. TAP, p. 11.
7.	Is there persistence or concentration of the material or breakdown products in the environment? [§6518(m)(2)]		X		"little to no potential to contaminate or persist in the environment." TAP, p. 9. Use will not result in hazardous of environmentally persistent byproducts. TAP, p. 11. When dissolved in water, the active ingredient potassium silicate dissociates into potassium cations, hydroxide anions, and mono- and polysilicic acids. When used as a pesticide, potassium silicate residues are low relative to naturally present concentrations and other uses in the environment. TR lines 522-523; 398-399.
8.	Would the use of the substance be harmful to human health or the environment? [§6517 (c)(1)(A)(i); §6517 (c)(2)(A)(i); §6518(m)(4)]	X			Acute overexposure may cause skin and respiratory tract irritation. The substance has not been tested for primary eye irritation, but is regarded as an eye irritant on the basis of its high alkalinity and its similarity to sodium silicate (Blumberg 2001). Respiratory problems in the agricultural sector due to inhaled dust are a proven concern (Schenker 2000). TAP, p. 4 Potassium silicate has not been tested for ecotoxicity. It is not persistent in aquatic systems, but is highly alkaline in solution form and can be harmful to aquatic life if not diluted and disposed of properly. TAP, p. 4. Not buffered, and a buffered natural system is not likely to be affected. TR 387-391. Agricultural use of potassium silicate is subject to the Worker Protection Standards (WPS), requiring Personal Protective Equipment (PPE) a long-sleeved shirt, long pants, socks, shoes and gloves, plus a 4 hour Restricted Entry Interval (REI). TR lines 568-569. "Results of the acute dermal toxicity study indicated moderate to low toxicity at the maximum dose tested, although dermal irritation was observed." TR lines 577-579.
9.	Are there adverse biological and chemical interactions in the agro-ecosystem? [§6518(m)(5)]	?			Potassium silicate effects on metabolic interactions are not well characterized if at all. TAP, p. 9. Protective effects would apply to weeds as well as crop plants. If used on pastures, could affect the pattern of grazing, thus affecting species composition. TR lines 494-497.

10. Are there detrimental physiological effects on soil organisms, crops, or livestock? [§6518(m)(5)]	X			Successive silicate fertilizer applications have been shown to increase soil pH to levels that adversely affect plant growth (Miayke and Takahashi 1983), but soils with high organic matter content tend to buffer this effect, and additions of organic material were effective in correcting soil pH. TAP, p. 5. Most impacts on soil are positive. TAP, pp. 2, 5, others. . Silicon reduces the availability of elements such as manganese (Mn), iron (Fe), and aluminum (Al) to roots of plants such as rice and sugarcane. TR lines 471-473. Treatment with potassium silicate may not be appropriate when crops are used for feeding or as forage for livestock since its addition hardens some plants, making them both more difficult to chew and digest. Furthermore, monosilicic acid naturally strengthens the phyto-skeleton, thus the addition of potassium silicate as a foliar nutrient may result in the production of less tender fruits and vegetables or forage for grazing animals. TR lines 477-481. Silica supplementation can result in elongation and thickening of stems, delayed antithesis and flower deformation in some species depending on the level of accumulation of silica by the plant species, the type of silica supplement used and the method by which it was applied. In addition to morphological changes, changes in micronutrient in plants may occur as a result of silica supplementation. TR lines 487-491 Makes certain forage grasses less digestible. TR lines 494-497.

Category 2. Is the Substance Essential for Organic Production? Substance: Aqueous Potassium Silicate

Question	Yes	No	N/A	Comments/Documentation (TAP; petition; regulatory agency; other)
1. Is the substance agricultural? [§6502(1)]		X		
2. Is the substance formulated or manufactured by a chemical process? [§6502(21)]	X			Potassium silicates are manufactured using a calcination process that combines silica sand (SiO_2) and potassium carbonate (K_2CO_3) at 1100-2300°F for up to 15 minutes (NOP Petition; Rawlyk and McDonald 2001). The two substances fuse into glass, which can be dissolved with high-pressure steam to form a clear, slightly viscous fluid, or cooled and

				ground into a powder. Carbon dioxide is evolved from this reaction. The solution can be dried to form hydrous powder crystals of potassium silicate. TAP, p. 2
3. Is the substance formulated or manufactured by a process that chemically changes a substance extracted from naturally occurring plant, animal, or mineral sources? [§6502(21)]	X			Potassium silicates are manufactured using a calcination process that combines silica sand (SiO2) and potassium carbonate (K2CO3) at 1100-2300°F for up to 15 minutes (NOP Petition; Rawlyk and McDonald 2001). The two substances fuse into glass, which can be dissolved with high-pressure steam to form a clear, slightly viscous fluid, or cooled and ground into a powder. Carbon dioxide is evolved from this reaction. The solution can be dried to form hydrous powder crystals of potassium silicate. TAP, p. 2
4. Is the substance created by naturally occurring biological processes? [§6502(21)]		X		Petitioned material is synthetic, but some natural aqueous potassium silicate is present in volcanic soils. TR, line 72.
5. Is there a natural source of the substance? [§ 205.600(b)(1)]			X	
6. Is there an organic substitute? [§205.600(b)(1)]			X	
7. Is there a wholly natural substitute product? [§6517(c)(1)(A)(ii)]	X			Fertilizer: glauconite, TAP p. 6. Azomite, p. 8. Disease: A number of foliar treatments to control fungal disease are currently used in organic agriculture, with research ongoing; some of these are agricultural products. In one study, an aqueous solution of burnt rice husks (400 q/ha) was shown to be as effective and economically viable as a 1% commercial sodium silicate solution for treatment of rice blast (*Pyricularia oryzae*) (Hsieh and Hsieh 1989). Sulfur is by far the most widespread treatment for powdery mildew and botrytis bunch rot on grapes. Others…TAP p. 6. More studies are required to definitively state that silica is useful to prevent fungal infections in other crops. The necessity of potassium silicate for organic production has not been demonstrated. P. 10. There is no known natural substance producing the same short term effect on plant health as aqueous potassium silicate in a foliar spray. However, other forms of silica and application methods for these substances are available as approved supplements for the soil that can provide the same protection over a longer term against plant disease. TR lines 591-594. Compost made with silica-rich plants. TR lines 596-605. Biopesticides. TR lines 609-633.

8. Are there any alternative substances? [§6518(m)(6)]	X			See #7.
9. Are there other practices that would make the substance unnecessary? [§6518(m)(6)]	X			Organic practices including rotation, green manures, compost. TAP p. 8, 10. In addition, soilscaping, choice of variety and planting time, balancing silica accumulators and nonaccumulators, moisture management, choice of mulch and ground cover, and scouting. TR lines 661-706.

Category 3. Is the substance compatible with organic production practices? Substance: Aqueous Potassium Silicate

Question	Yes	No	N/A	Comments/Documentation (TAP; petition; regulatory agency; other)
1. Is the substance consistent with organic farming and handling? [§6517(c)(1)(A)(iii); 6517(c)(2)(A)(ii)]		X		Unnecessary synthetic input. Synthetic fertilizer. Internationally (Japan, Canada, EEC, CODEX, or IFOAM), natural sources of silica, not APS, are allowed. TR lines 258-296.
2. Is the substance compatible with a system of sustainable agriculture? [§6518(m)(7)]		X		Unnecessary synthetic input. Synthetic fertilizer. High energy requirement for manufacture.
3. If used in livestock feed or pet food, Is the nutritional quality of the food maintained with the substance? [§205.600(b)(3)]			X	
4. If used in livestock feed or pet food, Is the primary use as a preservative? [§205.600(b)(4)]			X	
5. If used in livestock feed or pet food, Is the primary use to recreate or improve flavors, colors, textures, or nutritive value lost in processing (except when required by law)? [§205.600(b)(4)]			X	
6. Is the substance used in production, and does it contain an active synthetic ingredient in the following categories: [§6517(c)(1)(B)(i); copper and sulfur compounds		X		
toxins derived from bacteria		X		
pheromones, soaps, horticultural oils, fish emulsions, treated seed, vitamins and minerals	X			Minerals.
livestock parasiticides and medicines		X		
production aids including netting, tree wraps and seals, insect traps, sticky barriers, row covers, and equipment cleansers		X		