Dossier for Potassium Bicarbonate in Crop Production

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Purpose

This dossier is presented as part of a request that DEFRA recognize the use of Potassium Bicarbonate on crop production under the United States National Organic Program (USDA NOP) as equivalent for import under article 11.6 of the European Union regulations for organic production.

Executive Summary

Potassium bicarbonate is a safe material for control of several important fungal diseases of grapes, strawberries, tomatoes, and cucurbits. It is allowed for use but the USDA NOP in organic production because it has meets all of the evaluation criteria satisfactorily.

Potassium bicarbonate is allowed for use in organic processed food products and is thus consumed by constituents of the UK. Use as a crop production aid is consistent with the nature and way of organic farming, with less impact on plant and animal communities that allowed inputs such as sulfur and horticultural oils. Use of potassium bicarbonate for crop production in the US will not result in any residue on products imported to the UK.

The International Federation of Agricultural Movements (IFOAM), Basic Standards allows the use of Potassium Bicarbonate. IFOAM's approval of the product represents a consensus of international organizations that the product is consistent with goals and principles of organic production.

This material is equivalent too, but superior in safety, to other approved materials such as copper, sulfur and suffocating oils. It enables producers to use less of those materials that have a greater ecological impact while having less effect on the environment from its use.

General Background Information

Potassium Bicarbonate is found throughout nature in living systems and in non-living environments. It is present in humans, animals, plants as well as in soils, water and rocks. It is allowed for use in food and cosmetic products. Because the natural form rarely occurs in large concentrations by itself, for agricultural and food processing purposes it is usually synthesized. The use as a pesticide active ingredient was first registered by the US Environmental Protection Agency in 1994.

In 1996, the USDA National Organic Standards Board recommended approval of its use in organic production. The USDA National Organic Program (NOP) adopted this recommendation in the October 2002 publication of the NOP Rule. We are seeking approval for US organic crops exported to the EU.

Identification

Common Name(s): Potassium Bicarbonate
Chemical Name: Carbonic acid, monopotassium salt.
Other Names: Potassium acid carbonate; potassium hydrogen carbonate
CAS Number: 298-14-6
Other Codes: OPP chemical code: 073508

Characterization

Composition: $KHCO_3$

Properties: White granules, crystals or powder. Melting point 100°C; specific gravity 2.17. Appreciable solubility.

How Made: Produced by carbonating potassium hydroxide to K_2CO_3 which is then carbonated to $KHCO_3$. Carbonation is accomplished by injecting carbon dioxide gas into an aqueous solution of potassium hydroxide. Potassium hydroxide is formed by the electrolysis of potassium chloride.

Specific Uses: Disease control of powdery mildew (Sphaerotheca fuliginea) on cucurbits and (Uncinula necator) on grapes, early blight (Alternaria cucumerina) on tomatoes, and mold (botrytis spp.) on strawberries. Potassium bicarbonate is used both as a protectant and as an eradicant for powdery mildew on grapes, and is also labeled for use in control of downey mildew (Plasmopara viticola).

Action: Bicarbonate ion has been identified as the probable cause of growth inhibition in some bacteria and fungi. The bicarbonate causes the collapse of hyphal walls and shrinkage of conidia (different parts of the fungus). In addition, pH elevation may also play a significant role. Bicarbonates can eliminate the disease after it has already appeared on the crop, unlike other conventional controls that are preventative only.

Combinations: Recommended to be used with a coating polymer to help provide uniform coverage of leaf surfaces. Oil and pinolene based coatings would be acceptable for organic growers and are much more effective than bicarbonate alone. Potassium bicarbonate is also sometimes mixed with sodium bicarbonate and inert ingredients in formulations.

Status

Codex/International Status: Not specifically mentioned in the EU or Codex. Approved by IFOAM for pest and disease control, IFOAM Norms for Organic Production and Processing, version 2005

Status among USDA NOP-accredited organic certifiers: Allowed by all NOP-accredited certifiers.

Historic Use: Baking soda has been used experimentally for control of plant diseases since at least 1933. In 1996 the US EPA ruled that sodium and potassium bicarbonates are exempt from residue tolerances, and that paved the way for commercial bicarbonate products to be developed. Before that there was no historic use in organic agriculture (or conventional agriculture either). After approval by the NOSB in 1996 and the NOP in the 2002 Federal Rule, it has been allowed by all US certifiers.

Evaluation Criteria

1. Necessity

Materials are often necessary to control fungus diseases of plants in areas or seasons with high levels of moisture in the air. In organic farming it then becomes desireable to use the safest material of the alternatives available before choosing a material with more consequences to the environment. This substance is an important alternative to more problematic fungicides that are available to organic farmers such as copper products or sulfur.

2. Nature and Way of Production

a) Nature

Potassium Bicarbonate is found throughout nature in living systems and in non-living environments. It is present in humans, animals, plants as well as in soils, water and rocks. It can be assimilated or degraded easily in nature.

b) Way of Production

There are some impurities created in the manufacture of potassium bicarbonate. The main ones are chlorine, sulfate and water, which are impurities primarily from the formation of potassium hydroxide from potassium chloride as the precursor material. The chlorine level is not exceeding 0.5% and the sulfate level is not exceeding 0.045%. Both of these impurities are common in nature and have biological processes which transform them into stable materials.

c) Collection

Since this material is synthetic it is not collected from the environment.

3. Environment

a) Environmental Safety

The US EPA fact sheet states, "Potassium bicarbonate and sodium bicarbonate are not associated with adverse effects to the environment."

b) Degradability

Decomposition products are potassium carbonate, water, and carbon dioxide. These materials readily dissipate in the environment.

c) Acute toxicity to non-target organisms

There has been a little study of the bicarbonate ion (mostly from ammonium bicarbonate) on soil-borne pathogens. A suppression effect was found (Ziv, 1992). Its use may result in pH elevation, which will have a myriad of effects on the soil.

d) Long-term chronic toxicity

None

e) Chemically synthesized products and heavy metals

Not Applicable.

4. Human Health and Quality

No carcinogenicity was found in various data searches. No effects of overexposure were documented.
--Mild alkaline irritant to respiratory system. Coughing, sneezing, possible breathing difficulty in acute cases.
--Mild eye irritant, possible reddening due to alkaline effect or abrasion.
--No LD50 information found relating to normal routes of occupational exposure.
"No adverse health effects are expected when potassium bicarbonate or sodium bicarbonate are used as pesticides. The compounds are ubiquitous in nature; considered to be "generally recognized as safe" (GRAS) by the US Food and Drug Administration; naturally present in human food; widely distributed in commerce; available to the general public for non-pesticidal uses; and required for normal function in human, animal, plant and environmental systems." (EPA Fact Sheet, 1999)

5. Ethical Aspects – Animal Welfare

There are no ethical aspects associated with potassium bicarbonate.

6. Socio-Economic Aspects

None noted.

7. Alternatives to using the Substance

Potential alternative cultural, biological, natural, and existing organic controls also include:

Selection and cultivation of disease resistant varieties.
Nutrient management, particularly correcting Nitrogen: Calcium and Nitrogen: Potassium ratios.
Water management, including humidity control and air management for crops grown in greenhouses.
Trellising and pruning for improved air movement.
Sanitation: pruning and removal of diseased tissue.
Foliar application of non-synthetic materials: Compost tea extracts or Microbial fungicides
Foliar application of synthetic materials on the National List: Copper based materials, Sulfur, or Suffocating oils.

Potassium bicarbonate is one of two viable materials for organic vineyards which have eradicative properties for powdery mildew, Stylet Oil (horticultural oil) being the other material. Stylet Oil is also used as a non-specific insecticide, and so has much greater impact on the ecology than the more fungal specific potassium bicarbonate

products. Potassium bicarbonates are labeled with a one day preharvest interval and one hour restricted entry period. Stylet oil appears to limit sugar accumulation in grapes, has a negative interaction with sulfur products, as well as having possible effects on growth of the crop plant the following year under certain circumstances.

Copper products are also not as desirable as potassium bicarbonate, because they have phytotoxic effects when used in high concentration or at certain times in the season, they can lead to copper build-up in soils, and are hard to handle and apply safely.

Natural source sodium bicarbonate has been investigated for disease control, but in pure form it just doesn't work very well. Some investigators have had success with a mixture of potassium and sodium bicarbonates, but no products are on the market with this combination.

Some specific microbial fungicides are still in development and not yet approved for organic production. The diseases targeted by potassium carbonate are difficult to control organically and the conventional chemicals are now running into resistant strains of the disease organisms. Potassium Bicarbonate may in many situations be more environmentally sound and safer for applicators and other farm workers than the other approved synthetic alternatives for organic production.

Conclusion

The fungus diseases which are controlled with potassium bicarbonate are very difficult to control with any acceptable organic practices or materials. In fact these diseases have influenced the ability to grow susceptible crops in certain environments at some seasons. Potassium bicarbonate is a synthetic material but is compatible with all the criteria posed for review in organic production. It should be allowed in US product to be exported to the European Union.

References

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