National Organic Standards Board
Crops Committee
2013 Sunset Recommendation
Copper Sulfate

October 4, 2011

List: §205.601 Synthetic substances allowed for use in organic crop production.

(a) As algicide, disinfectants, and sanitizer, including irrigation system cleaning systems.

(3) Copper sulfate—for use as an algicide in aquatic rice systems, is limited to one application per field during any 24-month period. Application rates are limited to those which do not increase baseline soil test values for copper over a timeframe agreed upon by the producer and accredited certifying agent.

(e) As insecticides (including acaricides or mite control).

(4) Copper sulfate—for use as tadpole shrimp control in aquatic rice production, is limited to one application per field during any 24-month period. Application rates are limited to levels which do not increase baseline soil test values for copper over a timeframe agreed upon by the producer and accredited certifying agent.

Background

History:

Copper sulfate as algicide, invertebrate pest control in rice

- Approved 10/16/01
- Allowed synthetic: vote 10-3-1
- 3 TAP reviewers: 1 in favor of approval, 2 against
- Annotation: one application per field per 24 month period, not to increase baseline soil test values for copper over a timeframe agreed upon by the producer and accredited certifying agent
- 205.601(a)(3), 205.601(e)(3)
    - Approval renewed 11-30-07
    - 11-3-1 vote
    - “Material is still needed in organic aquatic rice systems. No compelling new information presented to warrant removal from the list.”

The original petition by CCOF stated, “In southeastern growing states there is a whole different set of rice pests and crop management issues and so the material is not widely used or needed.”

Summary

There have always been concerns over the use of copper, particularly in rice, because of its toxicity to aquatic organisms. Two out of three TAP reviewers opposed this use because of the toxicity to aquatic organisms and the fact that rice fields are attractive to animals like frogs. The TAP review also looked at alternatives to copper sulfate.

Now the Crops Committee has additional information on the severity of the threat to aquatic organisms. The California Rice Commission lists 230 species known to use rice fields in California. These include birds, mammals, reptiles, and amphibians. Tadpoles—the larval form of frogs and toads, not the tadpole shrimp—eat algae, making them a candidate for controlling algae in rice paddies. But copper is highly toxic to amphibians (including mortality and sodium loss), with adverse effects in tadpoles and embryos at concentrations expected with the listed use. The California Rice Commission also points out that 95% of California's wetlands are gone, so rice fields provide important habitat for aquatic and semi-aquatic species who have been displaced.

ATSDR says that when copper sulfate is used in ponds, lakes, and reservoirs for controlling algae, the copper levels in the water column return to pretreatment levels within a few days. "The reduction in dissolved copper during this period was accompanied by an increase in particulate copper (e.g., sorption to algae or other organic matter, which settles into the sediments of these bodies of water). The copper in the settled particulates is in equilibrium with the water column, which greatly favors copper in a bound state." They also say that copper can enter surface water in agricultural runoff. "The copper in the runoff water was found to be predominantly bound to drift material in the water (e.g., algae, vascular plants, invertebrates, vertebrates, and detritial material)."[1]

Hundreds of studies document lethal and sublethal impacts of copper on aquatic food chains. These have been summarized by Carol Ann Woody as follows:[2]

> Starting at the bottom the bottom of the food chain, at just 1.0 µg Cu/L green algae (*Chlorella* spp.) growth declined, at 5.0 µg Cu/L photosynthesis declined, and at 6.3 µg Cu/L photosynthesis was inhibited in a mixed algae culture (USEPA 1980). Zooplankton feed on algae and their growth and reproduction are affected by food availability. Declining algae production causes declining zooplankton production (Urabe 1991, Müller-Navarra and Lampert 1996), reducing food availability for species, such as sockeye salmon (*Oncorhynchus nerka*), that feed on zooplankton.

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[1] ATSDR, 2004. Toxicological Profile for Copper. http://www.atsdr.cdc.gov/toxprofiles/tp132.pdf P. 141. Accessed 8/30/2011.

[2] Carol Ann Woody, 2007. Copper Effects on Freshwater Food Chains and Salmon: *A review,* Fisheries Research and Consulting. Pp 10-11.

Thus, copper used in rice fields tends to concentrate in the "particulate matter", which is composed of remains of algae, plankton, and invertebrates, and this "particulate matter" is the food of tadpoles and forms the basis of aquatic food chains. The LC50 for tadpoles of *Bufo boreas* (one of the frogs found in California rice fields) is 47.49 parts per *billion* copper (0.04749 ppm).[3] According to the TAP review (lines 680-683):

> Typical application rates in paddies to control algae appear to range from 0.25 ppm to 2.0 ppm. For treating tadpole shrimp, application rates appear to be "less than 10 ppm". With aquatic organisms showing detrimental effects at levels of about 0.4 ppm and above, this means that the application of CuSO4 to rice paddies could kill mosquito fish, pond snails, and other organisms that could have beneficial properties.

In California, rice growers describe a system of drill seeding or dry planting rice that does not rely on copper. In this system, the seed drilling/dry planting, described in *Alternative Agriculture* (National Research Council, National Academy of Sciences, 1989) and currently in practice, allows the rice plant to be established to a stage that is not vulnerable to tadpole shrimp by the time the field is flooded. However, overly wet and warm weather in the spring is a factor that can prevent the use of this practice. The Washington State Department of Ecology describes below the action of an alternative material to copper sulfate for algae control, sodium carbonate peroxyhydrate products (http://www.ecy.wa.gov/programs/wq/plants/algae/lakes/ControlOptions.html). This alternative, which appears to make the use of copper sulfate as an algicide unnecessary, is approved under 205.601 with the following annotation: (a)(8) Sodium carbonate peroxyhydrate (CAS #–15630–89–4)—Federal law restricts the use of this substance in food crop production to approved food uses identified on the product label.

> These Environmental Protection Agency (EPA)-registered sodium carbonate peroxyhydrate products are fast acting algaecides (algae killer) or algaestats. Algaestats do not kill algae outright but instead inhibit their growth, preventing bloom formation. Lake managers apply these products to the water to prevent algal blooms or to treat existing algae. Lake managers use these products as an alternative to copper-based algaecides not allowed in most Washington water bodies. In some parts of the world, there are copper-resistant algae strains and these products provide an alternative to treat copper-resistant algae.
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> The EPA registered sodium carbonate peroxyhydrate products for use in ponds, lakes, reservoirs, and drinking water sources. Sodium carbonate peroxyhydrate acts as an oxidizing agent to kill algae. When applied to water, these granular products break down into sodium carbonate and hydrogen peroxide. . .

Comments were submitted by Wolf, DiMatteo and Associates (WD+A) and CCOF. WD+A supports the continuation of the listings with annotation similar to the terrestrial use, but did not give any reasoning for the continuation. CCOF supports the

[3] EPA, 2007. *Aquatic Life Ambient Freshwater Criteria—Copper*, Office of Water. EPA-822-R-07-001

continuation with annotation and change of "algae" to "scum" to match international usage. CCOF says most organic rice is exported, and none of the countries receiving CCOF certified exports recognize copper sulfate for shrimp control. However, since the methods for controlling shrimp without copper also seem to manage "scum" when it is at a damaging stage (i.e., when rice is below the water level), there appears to be little justification for keeping either listing.[4]

The information received by the committee concerning the hazards to aquatic ecosystems and the availability of alternative practices leads us to the conclusion that the use of copper sulfate in rice production should be restricted as much as possible. Our conversations with rice growers leads us to believe that particular weather conditions in some years rule out the use of cultural practices (drill-seeding) that would eliminate the need for copper sulfate. Therefore, we are recommending an annotation to both uses. We hope that the uses of and alternatives to copper sulfate will become a research priority.

Committee Recommendations

1. The Crops Committee recommends adding an annotation to the listing of copper sulfate as an algicide in rice. The motion was to approve the listing with the following addition (in italics):

> **List: §205.601 Synthetic substances allowed for use in organic crop production.**
> (a) As algicide, disinfectants, and sanitizer, including irrigation system cleaning systems.
> (3) Copper sulfate—for use as an algicide in aquatic rice systems *when it is determined that weather conditions prevent the drill-seeding production practice*, is limited to one application per field during any 24-month period. Application rates are limited to those which do not increase baseline soil test values for copper over a timeframe agreed upon by the producer and accredited certifying agent.

2. The Crops Committee recommends adding an annotation to the listing of copper sulfate for control of tadpole shrimp in rice. The motion was to approve the listing with the following annotation (in italics):

> **List: §205.601 Synthetic substances allowed for use in organic crop production.**

[4] TAP lines 591-594: If pre-germinated seed were drilled and allowed to grow for a short while before flooding the fields, the rice most likely would escape the impacts of the shrimp and algae that only bother seedlings or rice that have not emerged above the water level. Lundberg website: "Our dry planting technique helps protect the rice from shrimp. The rice plant is well established by the time we apply the permanent flood, so the shrimp cannot ruin the crop."

(e) As insecticides (including acaricides or mite control).
(4) Copper sulfate—for use as tadpole shrimp control in aquatic rice production *when it is determined that weather conditions prevent the drill-seeding production practice*, is limited to one application per field during any 24-month period. Application rates are limited to levels which do not increase baseline soil test values for copper over a timeframe agreed upon by the producer and accredited certifying agent.

Committee Vote on Annotation Changes
Moved: Jay Feldman Second: Steve Demuri
Yes__**4**___ No__**0**___ Abstain__**0**__ Absent__**3**___

Committee Vote to Relist
§205.601 Synthetic substances allowed for use in organic crop production.
(a) As algicide, disinfectants, and sanitizer, including irrigation system cleaning systems (3) Copper sulfate and (e) Copper sulfate.
Moved: Jay Feldman Second: Steve Demuri
Yes__**4**___ No__**0**___ Abstain__**0**__ Absent__**3**___