New Copper Fungicides for Organic Disease Management in Vegetables

Margaret Tuttle McGrath

Plant Pathology and Plant-Microbe Biology, Cornell University
Long Island Horticultural Research and Extension Center,
3059 Sound Avenue, Riverhead, NY 11901. 631-727-3595. mtm3@cornell.edu

There are several different copper fungicides approved for use in organically-produced crops. Copper fungicides are important tools for managing diseases that cannot be effectively managed with cultural practices alone. They have broad-spectrum activity, acting on bacteria as well as fungi. Following many years of use, there is a lot more information on efficacy of copper fungicides than the newer biological products. Manufacturers of some biologicals recommend that they be used in a management program with copper fungicides (often in alternation or at low label rate). Thus it appears copper fungicides will continue to be important for managing diseases. Copper fungicides differ in their active ingredient, use rate, re-entry interval, and the amount of copper. Copper is an inorganic compound thus it does not breakdown like organic compounds and consequently copper can accumulate in soil when used intensively. Plants take up some copper from soil because it is a micronutrient. Similarly, humans need a small amount of copper in their diets. Metallic copper equivalent (MCE) is a commonly used measure of the quantity of copper in fungicides.

Three copper fungicides registered recently are Badge, Cueva, and Nordox. They differ in active ingredient, labeled rate, MCE, and REI (see table). All three are OMRI-listed.

Four experiments were conducted in 2013 at LIHREC on Long Island to evaluate Badge X2 (0.75-1.75 lb/A), Cueva (2 qt/A), and Nordox 75WG (1 lb/A). They were compared with a standard copper fungicide, Basic Copper 53 (2-4 lb/A). The rate used was the maximum-label rate for the crop (see table) or the rate recommended by the manufacturer. The goals of the experiments were to determine whether there were differences among these products in ease of mixing, amount of visible residue on plants, crop safety, and efficacy. Amount of residue was assessed by applying these four fungicides at least three times on a weekly interval to plots of tomato, lettuce (Romaine and butterhead), and Brussels sprouts in three adjacent replicated experiments. The later two crop types were also examined for injury from the treatment. Efficacy was examined for powdery mildew in zucchini. Three additional copper fungicides were included in the efficacy experiment: Champ (1.33 pt/A), NuCop (2.66 pt/A), and a conventional (non-organic) copper fungicide, Cuprofix Ultra 40 (2 lb/A). A preventive 7-day application schedule was used starting 4 weeks after transplanting. A total of five applications were made. Powdery mildew was assessed weekly by estimating severity on upper and lower leaf surfaces. Applications in all experiments were made with a backpack sprayer that delivered 50 gal/A at 54 psi.

Clear plastic bottles were used to prepare the fungicide solutions for application which facilitated observations on mixing ability. The bottles were filled with the quantity of water needed, next the product was added, then the container was shaken before spraying. Cueva was observed to mix most readily into water, none of the product settled to the bottom of the container. In contrast, vigorous shaking was required with Basic Copper 53 to get product that settled into solution. NuCop was similar, but it was not as difficult to loosen settled material. After spraying, there was no residue of Cueva visible on the inside of the bottle. More time was needed for clean up with Basic Copper 53 and Nordox 75WG because both left residue on the inside of the bottle.

The copper fungicides tested also differed in amount of visible residue on plants and occurrence of injury to treated plants (crop safety). The most residue was observed on leaves of all crop types (tomato, lettuce and Brussels sprouts) and on tomato fruit on plants treated with Basic Copper 53. Less residue was observed on plants treated with Nordox (red color) or Badge; neither was consistently better across all crops. Cueva left the least amount of residue. Nordox caused the most injury to lettuce and Brussels sprouts; Basic Copper 53 caused slightly less injury; Badge caused much less injury; while Cueva caused very little damage. All products affected the Butterhead lettuce variety much more severely than the Romaine.

There was some variation among the copper fungicides tested in efficacy for controlling powdery mildew in zucchini. Conditions were very favorable for powdery mildew in 2013 at this location. All but Cueva were effective* based on Area Under Disease Progress Curve (AUDPC) for severity on upper leaf surfaces, which is a summation of severity over all assessments (*effective means AUDPC value significantly less that that for the non-treated plants). However, Cueva was applied at the manufacturer recommended rate for this use, which is a quarter of the highest rate. It is labeled for use at 0.5 – 2 gal/A. There were no significant differences among any of the treatments in AUDPC values or in severity on each rating date. Degree of control achieved based on AUDPC for severity on upper leaf surfaces was 41% for Badge, 62% for Cuprofix Ultra, 65% for Nordox, and 66% for Basic Copper 53, NuCop, and Champ. AUDPC value for Cueva was 40% less than that for non-treated plants. Powdery mildew was not suppressed on lower leaf surfaces by any of the copper fungicides, which is not surprising as these are contact fungicides. Lack of control on lower leaf surfaces, where powdery mildew develops best, likely compromised control of this disease on upper leaf surfaces.

Please Note: The specific directions on fungicide labels must be adhered to -- they supersede these recommendations, if there is a conflict. Before purchase, make sure product is registered in your state and approved by your certifier. Any reference to commercial products, trade or brand names is for information only; no endorsement is intended.

Information about some copper fungicides approved for organic production including the amount of copper applied for select vegetable crops.

Product	Active ingredient	Metallic copper equivalent	Maximum Labeled Rate (MCE in lb/A)				REI	PHI
			Broccoli	Lettuce	Squash	Tomato		
Badge X2	24% copper oxychloride + 21% copper hydroxide	28%	0.75 lb/A (0.21)	1.75 lb/A (0.49)	1.25 lb/A (0.35)	1.75 lb/A (0.49)	48 hr	0 day
Basic Copper 53	98% basic copper sulfate	53%	3 lb/A (1.59)	3 lb/A (1.59)	2 lb/A (1.06)	4 lb/A (2.12)	24 hr	0 day
Camelot	58% copper salts of fatty and rosin acids	5.14%	0.75 pt/A (0.05)	3 pt/A (0.22)	3 pt/A (0.22)	3 pt/A (0.22)	12 hr	0 day
Champ WG	77% copper hydroxide	50%	2 lb/A (1.0)	Not labeled	3 lb/A (1.5)	4 lb/A (2.0)	24 hr	0 day
CS 2005	19.8% copper sulfate pentahydrate	5%	25.6 oz/A (0.8)	Not labeled	25.6 oz/A (0.8)	32 oz/A (1.0)	48 hr	0 day
Cueva	10% copper octanoate	1.8%	2 gal/A (0.3)	2 gal/A (0.3)	2 gal/A (0.3)	2 gal/A (0.3)	4 hr	0 day
Nordox 75	84% cuprous oxide	75%	2 lb/A (1.5)	1.25 lb/A (0.94)	1.25 lb/A (0.94)	2.5 lb/A (1.88)	12 hr	0 day
NuCop HB	77% copper hydroxide	50%	1 lb/A (0.5)	1 lb/A (0.5)	1.25 lb/A (0.63)	2 lb/A (1.0)	24 hr	1 day

* MCE = Metallic copper equivalent. REI = Re-entry interval. PHI = Pre-harvest interval. Most labels do not state minimum time after an application that harvest can be done; however, the REI for Worker Protection Standard affects harvest. The MCE in lb/A number, which is in parentheses, is the amount of copper in an application and thus is the number to use to select a product when copper accumulation in soil is a concern.