GROWERTALKS

Features

2/1/2022

Copper: It's Not Just for Bacteria

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Some of the first fungicides developed contained copper. In the 1800s, copper sulfate pentahydrate was formulated with lime into Bordeaux mix. Many other types of coppers followed, including cuprous oxide in 1932. Since then, plant safety became a goal with the development of more effective copper fungicides—copper hydroxide was first used in 1968. Many of the currently available copper fungicides are based on copper hydroxide (CuPRO 5000, Kalmor, Kocide 3000), as well as copper sulfate pentahydrate (Phyton 27), basic copper sulfate (Cuproxat) and copper octanoate (Camelot O, Grotto).

Copper is used in various forms as an algaecide, bactericide, fungicide and in water treatment. In ornamentals, copper is often thought of as a bactericide only, perhaps due to the fact that there are very few effective bactericides in our industry. In nurseries, copper fungicides are widely used on leaf diseases due to their relatively low expense (in some cases) and broad-spectrum activity.

Copper fungicides are classified as multi-site and act by disruption of many cellular proteins, making resistance to them theoretically unlikely to develop. This is difficult to understand, as bacteria become resistant to copper rapidly if it's the main or only type of product used for disease control. This was noted many times in certain ornamental and vegetable crops since at least the 1960s.

Table 1. Efficacy of copper products on various foliar fungal diseases.

Disease	Efficacy level
Algal leaf spot	Very good to excellent
Alternaria leaf spot	Good
Botrytis blight	None to good
Cercospora leaf spot	Some to excellent
Colletotrichum leaf spot (anthracnose)	Good to excellent
Coniothyrium cane rot	Some
Corynespora leaf spot	Very good to excellent
Cylindrocladium leaf spot	Some to good
Downy mildew	Poor to very good
Entomosporium leaf spot	None to some
Erwinia blight and soft rot	None to good
Fireblight (Erwinia)	Very good
Fusarium crown rot/wilt	None to very good
Gliocladium pink rot	None
Myrothecium leaf spot	None to very good
Phytophthora foliar blight	Poor to good
Phytophthora root rot	Poor to very good
Powdery mildew	Poor to excellent
Pseudomonas leaf spot	Some to very good
Pythium root rot	Fair to very good
Rhizoctonia foliar blight	Some to very good
Rust	Poor to very good
Scab (Sphaceloma)	Fair to excellent
Sclerotinia blight	None
Thielaviopsis (black root rot)	None
Xanthomonas blight	Some to very good

There are many uses for copper fungicides besides bacterial diseases (see Table 1). One thing that's interesting to note is trial results have been quite variable. For instance, control of downy mildew can be poor to very good depending on the plant, the level of disease when treatments start and the safety of the specific copper to that crop. This may indicate that unless treatments are preventative, they may not be as effective.

Treatment interval can be critical, as well. Copper fungicides are thought to remain on the leaf surface for one to two weeks, depending on rainfall or overhead irrigation. Thus, treatments that are less frequent can be expected to yield lower levels of disease control.

Some of the best targets for copper fungicides (besides bacterial diseases) have been leaf spots (like Alternaria, Cercospora, Colletotrichum and Sphaceloma), powdery mildew and rust. Our research wouldn't support use of copper fungicides for Botrytis blight. These products can cause minor phytotoxicity during the winter when sprays dry slowly, which sometimes makes Botrytis worse after a copper spray than before one. The closely related Sclerotinia blight hasn't been controlled by copper products tested in our trials. (Be sure to read labels for use sites and rates.) Most of the drench trials included in the table were conducted on Phyton 27.

One of our most recent trials with a copper product employed *Gerbera jamesonii* Revolution Orange With Dark Eye and Flor Midi Yellow With Dark Eye. Data in the graph (Figure 1) represent the yellow cultivar, which was more susceptible to the powdery mildew than the orange-flowered ones. Plants were inoculated on November 27, 2020 by placing gerbera daisy plants infected with powdery mildew in the same greenhouse and using an oscillating fan to move conidia of *Oidium sp.* throughout the trial.

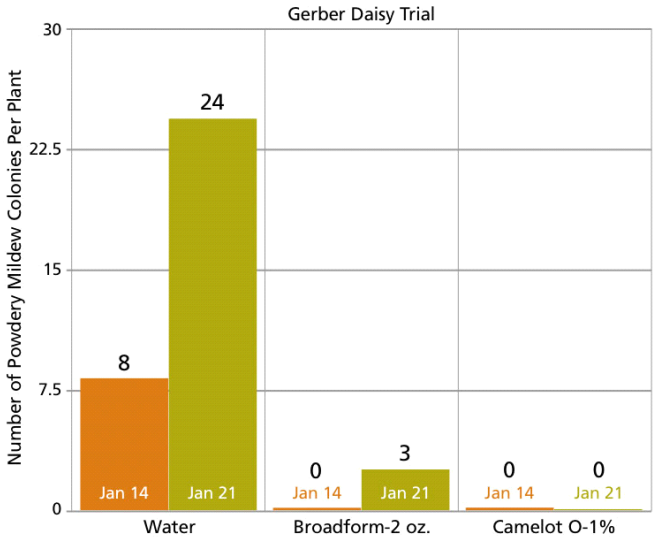


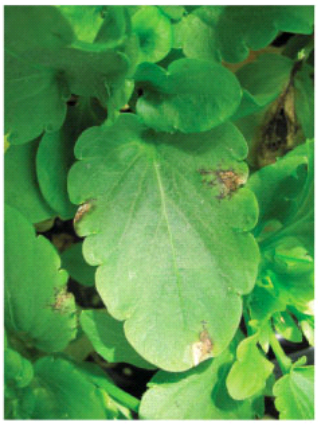
Figure 1. Efficacy of Broadform and Camelot O in preventing Gerber daisy powdery mildew. Data are given as the number of powdery mildew colonies per plant.

Treatments were applied with a pump action hand sprayer three times (November 26, and December 10 and 24) to the point of runoff. Disease was rated on January 14, 2021 by counting the number of powdery mildew colonies on each plant. The data showed that Camelot O was as effective as Broadform on both cultivars in preventing this powdery mildew.

One way to broaden the level of control with copper products might be to use a tank mix or even a premix. Tank-mixing some of the OMRI-listed products like Triathlon BA with an OMRI-listed copper like Camelot O can result in a broader spectrum spray that also helps prevent the possibility of copper-resistance development. This combination has been promoted by organic vegetable producers. It might be especially helpful when fighting bacterial diseases, but clearly copper can be effective on some fungal diseases as well.

Alternatively, you could add a very broad-spectrum fungicide like mancozeb with a copper to aid in deleting copper resistance development to bacteria and many fungi. Junction is one such pre-mix that can control both a range of foliar diseases, as well as assist in delaying resistance.

As we continue to see premixes registered for our industry, it'll be a good idea to consider making your own, specific to your particular needs. Remember coppers can be key components in a broad-spectrum approach to disease management. **GT**



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Clockwise from top left: Cercospora leaf spot on pansy. Powdery mildew on gerbera daisy. Collectotrichum leaf spot (anthracnose on cyclamen).