Bordeaux mixture— a combination of copper sulfate, lime, and water—is an effective fungicide and bactericide that has been used for decades to control diseases of fruit and nut trees, vine fruits, and ornamental plants. These natural minerals, when mixed in the correct order, provide long-lasting protection to plants against diseases.

The ability of Bordeaux mixture to adhere to plants in rainy weather makes it an excellent choice for a winter fungicide. Applying Bordeaux after trees break dormancy generally isn’t recommended, because it can injure leaves.

Among Bordeaux’s many uses are applications in fall and winter to manage:

• Fire blight on pears and apples;
• Leaf curl and shot hole on peaches and nectarines;
• Downy mildew and powdery mildew on grapes;
• Peacock spot on olives;
• Walnut blight on walnut; and
• Black spot on roses.

Because Bordeaux can leave a blue-green discoloration on plants or painted surfaces, use it on dormant, deciduous plants that are away from buildings and fences.

Fixed copper fungicide sprays (e.g. tribasic copper sulfate, copper oxychloride sulfate, and cupric hydroxide) also control many of the same disease-causing organisms as Bordeaux mixture. Although fixed copper sprays are much easier to prepare and don’t stain surfaces, they don’t withstand winter rains as successfully. However, they are the most effective and best choice to use in spring after trees begin to show new growth.

With all Bordeaux and fixed copper sprays, thorough coverage is essential to give plants the desired protection from disease-causing pathogens. Advantages and disadvantages of fixed copper and Bordeaux sprays are compared in Table 1.

Bordeaux mixture is commercially available in premixed packages, but freshly made Bordeaux sticks and weathers better on trees.

THE BORDEAUX FORMULA

Although there are many formulas for preparing Bordeaux mixture, generally a ratio of 10-10-100 works well for many disease-causing pathogens. The three hyphenated numbers represent the amount of each material to add.

The first number refers to pounds of copper sulfate, the second to pounds of dry hydrated lime, and the third to the total gallons of water. Thus a 10-10-100 Bordeaux mixture would be comprised of 10 pounds of copper sulfate, 10 pounds of lime, and 100 gallons of water.

A more manageable amount for the home gardener would be a 1-gallon mixture of 10-10-100 Bordeaux, which would contain $\frac{1}{10}$ of a pound of each of the dry ingredients, which would be $3 \frac{1}{3}$ tablespoons of copper sulfate and 10 tablespoons of dry hydrated lime in 1 gallon of water. You can purchase copper sulfate and hydrated lime at most garden centers.

THE MATERIALS

Copper Sulfate

Powdered copper sulfate, often referred to as “bluestone,” is a finely ground material that dissolves relatively quickly in warm water. Ordinary, lump copper sulfate isn’t satisfactory, because it is slow to mix into the solution. Store copper sulfate in a dry place. It gets moist, it becomes lumpy and difficult to work with. Fixed copper fungicides shouldn’t be used in making up a Bordeaux mixture.

### Table 1.

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Fixed Coppers</th>
<th>Bordeaux Mixture</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ease of storage</td>
<td>Store dry</td>
<td>Store in stock solutions or dry</td>
</tr>
<tr>
<td>Effectiveness</td>
<td>Less effective, less persistent</td>
<td>Highly effective and long lasting</td>
</tr>
<tr>
<td>Environmental impact</td>
<td>Less active for less time, seldom stains</td>
<td>Longer lasting, more active, stains surfaces</td>
</tr>
<tr>
<td>Phytotoxicity</td>
<td>Safe for most plants and tender growth</td>
<td>High pH, leaves a salty deposit, more phytotoxic</td>
</tr>
<tr>
<td>Compatibility</td>
<td>Compatible with many pesticides</td>
<td>Not compatible with most pesticides</td>
</tr>
<tr>
<td>Ease of preparation</td>
<td>Easily prepared, less safety equipment</td>
<td>Takes longer, requires more knowledge to prepare, safety equipment required</td>
</tr>
<tr>
<td>Corrosiveness</td>
<td>Less corrosive spray mixture</td>
<td>Corrosive spray mixture</td>
</tr>
</tbody>
</table>

*Effectiveness is a function of coverage, timing, and concentration.
Lime
You can use either dry hydrated lime or slaked lime to prepare Bordeaux. The most important point is to use fresh lime. Don't use lime from last season, and purchase only what you can use in the current season.

Hydrated Lime. Use only good quality hydrated lime (calcium hydroxide). The hydrated lime should be fresh and not carbonated by prolonged exposure to air. Hydrated lime is a dry product commonly used to make plaster and is readily available under several trade names. When mixing lime, protect your eyes, nose, and mouth by using a dust-and-mist-filtering respirator (Fig. 1).

Slaked Lime. Slaked lime is prepared by adding “quick” (hot, burned) lime (calcium oxide) to water to produce calcium hydroxide. Slaking quick lime in water can produce heat sufficient to boil the water, so regulate the amount of lime you add to the water at any one time, so the mixture doesn't splash. Wear goggles or safety glasses to protect your eyes (Fig. 2) and stir the mix with a wooden stick while adding the lime to the water. The slaking chemical reaction takes $\frac{1}{2}$ to 2 hours, so prepare the lime mixture before you plan to spray.

To make slaked lime add 1 pound of quick lime per gallon of water. This results in a mixture the consistency of milk. Slaked lime makes a superior suspension, but it requires more time, effort, and containers than prepared hydrated lime. If using slaked lime, follow the procedures in the Stock Solutions section below.

MAKING THE BORDEAUX MIXTURE
The effectiveness of a Bordeaux spray depends almost entirely on following the correct procedure for mixing. You can prepare Bordeaux directly in a spray tank equipped with an agitator (Fig. 3), or if you don't have a power sprayer, you can prepare smaller amounts for use in a hand sprayer (Fig. 4). If you use a hand sprayer, you'll first need to mix up stock solutions of lime and copper sulfate as described below. No matter how you mix the ingredients, you'll need to use the spray solution soon after you prepare it, since the mixture will deteriorate upon standing.

When applying Bordeaux, be sure to wear protective clothing, including goggles, because the spray deposit is corrosive, can permanently stain clothing, and is difficult to wash off.

Dry Form
If both materials are still in dry form you'll need to use a tank with an agitator. Follow these steps to make a tank mix of 10-10-100 formula. Use a ratio of 1 gallon of water, $3 \frac{1}{3}$ tablespoons of copper sulfate, and 10 tablespoons of hydrated lime for each gallon of spray mixed.

Start flowing water into the spray tank. When you have put about $\frac{1}{3}$ of the water into the tank and the mechanical agitator is in operation, start washing the copper sulfate into the tank through a screen with water from the supply hose. A wooden paddle is useful for working the copper sulfate through the screen. Don’t hurry it through the screen; give the copper sulfate time to get into solution in the tank. By the time $\frac{2}{3}$ of the water is in the tank, all of the copper sulfate should be mixed in.

In a plastic bucket or other corrosion-resistant container, mix the dry hydrated lime into a portion of the remaining water. Then slowly pour the lime suspension into the copper sulfate and water mixture. Finish filling the tank to the correct volume of water. You can include the rinse water from the mixing container.

Continue agitating the tank while adding the ingredients and applying the spray. A bypass agitator system usually isn't adequate for preparing a tank mix of Bordeaux.

Apply the Bordeaux the same day you prepare it. After you have used up the mixture, immediately rinse the equipment at least three times, since the...
mixture is highly corrosive to metal tanks and pump parts. Add a small amount of vinegar to the rinse water to neutralize any leftover residue.

**Stock Solutions**

The old-fashioned way of making a Bordeaux mixture is to prepare “stock” solutions of lime and copper sulfate that you later mix by pouring them into water in a sprayer. This method also works best for making small quantities of Bordeaux.

Using a plastic bucket, dissolve 1 pound of copper sulfate into 1 gallon of warm water. You can store this solution indefinitely in a stopped, glass container.

For the lime, use the slaked lime suspension described above or mix a solution of 1 pound of fresh hydrated lime in 1 gallon of water. This mixture needs to stand for about 2 hours before use. You can store the lime mixture indefinitely as well in a stopped container. Preparing a stock mixture of lime eliminates the need to obtain fresh hydrated lime each time you prepare a Bordeaux mixture.

Be sure to clearly label both stock solutions and store them where children can’t get into them, since these materials, especially the copper sulfate, are very toxic and corrosive.

To make 2 1/2 gallons of a 10-10-100 Bordeaux mixture, measure 2 gallons of water into a strong plastic bucket. Shake the copper sulfate solution vigorously before adding 1 quart of it to the 2 gallons of fresh water. Always add the copper to the spray water before adding the lime. Shake the lime mixture, and add 1 quart to the 2 gallons of water. Keep stirring the spray water mixture while adding the copper and the lime and continue stirring or shaking for several minutes before pouring it into the sprayer. The mixture now is ready to use.

Be sure to constantly shake the sprayer while using it to avoid clogging. Read the label directions carefully on the copper sulfate regarding the proper protective equipment to wear when preparing the stock solutions and when spraying. Bordeaux performs best if nothing is added to the prepared mix described above.

This formulation of Bordeaux mixture will be adequate for practically all home-garden, disease-protection needs. If you wish to maintain Bordeaux mixture on a tree throughout the entire winter rainy period, you can reapply the spray, or use a slightly stronger mixture—1 1/2 quarts of each stock solution to 2 gallons of water. In spring when buds are opening or on sensitive plants, use a slightly weaker mixture—1 pint of each solution to 2 gallons of water—or use a fixed copper spray.

**REFERENCES**


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**ILLUSTRATIONS:** Figs. 1-4. D. Kidd.

This and other Pest Notes are available at www.ipm.ucdavis.edu.

For more information, contact the University of California Cooperative Extension office in your county. See your telephone directory for addresses and phone numbers, or visit http://ucanr.org/ce.cfm.

**WARNING ON THE USE OF CHEMICALS**

Pesticides are poisonous. Always read and carefully follow all precautions and safety recommendations given on the container label. Store all chemicals in the original, labeled containers in a locked cabinet or shed, away from food or feeds, and out of the reach of children, unauthorized persons, pets, and livestock. Pesticides applied in your home and landscape can move and contaminate creeks, rivers, and oceans. Conserve chemicals to the property being treated. Avoid drift onto neighboring properties, especially gardens containing fruits or vegetables ready to be picked. Do not place containers containing pesticide in the trash or pour pesticides down the sink or toilet. Either use the pesticide according to the label, or take unwanted pesticides to a Household Hazardous Waste Collection site. Contact your county agricultural commissioner for additional information on safe container disposal and for the location of the Household Hazardous Waste Collection site nearest you. Dispose of empty containers by following label directions. Never reuse or burn the containers or dispose of them in such a manner that they may contaminate water supplies or natural waterways.

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