Bacterial Diseases:

Are we losing the battle?

With the popularity of perennials, we have seen more bacterial diseases; find out what recent bactericide introductions mean for control and rotation.

By A. R. Chase

Top: Pseudomonas on snapdragon; bottom: Pseudomonas on impatiens. (Photos courtesy of A.R. Chase)

The uproar over Ralstonia in geraniums during the past year or so is more a sign of the times than the state of bacterial disease control in the ornamentals industry. If the same thing happened 10 years ago the level of concern would surely not have reached the heights it has now. For another thing, technology then was not able to give us the high degree of identification it can deliver today. We can get an accurate identification of many bacterial pathogens within a few days (or sometimes hours) compared to weeks in the past. Nevertheless, management of bacterial diseases still relies on many factors beyond the application of bactericides.

The first step to control any disease is to gather background information, such as what diseases can occur on your crop, when disease occurs and what cultural controls are important. If the problem is new to you, samples must be sent to a diagnostic laboratory for culturing or indexing since this is the only reliable way to determine the cause of the problem. When a bacterial pathogen is isolated from a plant do not jump to the conclusion that it is causing the disease without further proof. Check your records and the literature, or consult with extension personnel or another disease expert to make sure that the specific bacterium has been demonstrated to cause disease on the same type of plant. Unfortunately, many bacteria can be found on and in ornamental plants, but not all are known to cause disease.

CURRENT PERSPECTIVES

Bacterial diseases of perennials have been gaining in importance at almost the same pace as new perennials are being introduced. Xanthomonas leaf spot and blight are really gaining ground in our perennial nurseries. For example, we have introduced many new cultivars of wallflower, candytuft and other crucifers that have unfortunately been infected with Xanthomonas. We found candytuft infected with this bacterium from a Washington nursery last fall. Through fatty acid analysis, the bacterium has been identified as the same one that infects stock (matthiola) via seed contamination. Nobody has proven how erysimum and iberis become infected, but bacteria from all three plants caused leaf blight on alyssum and stock in a recent trial. On stock, the disease can be systemic, causing stems to crack and reveal mushy centers. Wallflowers and candytuft also have leaf spots, but on candytuft the stems show symptoms indicating systemic infection. One nursery had inadvertently spread the infection throughout their wallflower crops using electric pruning shears.

Another example of a recent change is bacterial problems occurring on rosemary and lavender. We isolated *Pseudomonas cichorii* from these plants in the

past but most recently have started to isolate Xanthomonas instead. From the standpoint of chemical control, this is probably not relevant since bactericides work reasonably well on both pathogens. All of the lavender types we have found can be infected with one or the other of these bacteria. Use of these plants in the rapidly growing perennial market has resulted in production systems that supply more water and fertilizer than is ideal for these crops. These two conditions weaken the plants and promote disease. Changing cultural practices is the most effective means of controlling bacterial diseases. Finally, Xanthomonas has traditioanlly been a warm weather pathogen, but the temperature preferences of bacteria attacking perennials appear to be changing to more moderate regimes. Unfortunately, Xanthomonas can be systemic, making latent (without symptoms) infection of rooted cuttings a real concern.

SOME KEY ELEMENTS OF CULTURAL CONTROL

1. Know which diseases occur on your crops (See Figure 1, below).

2. Know when each disease is most likely to occur. Pseudomonas leaf spot is more severe during the cooler months while Erwinia blight is worst during the hottest periods of the year. Xanthomonas is typically more problematic during the summer, but in some perennials we are starting to see Xanthomonas during cooler times as well.

3. Use pathogen-free cuttings and seeds whenever possible. Several prominent diseases caused by Xanthomonas are known to be seed-borne (for example, on ranunculus, zinnia and matthiola). Still others might be present on plugs or cuttings (for example, Erwinia, Pseudomonas and Ralstonia). Never plant a cutting or plug that has spots of blight.

4. Eliminate overhead irrigation and exposure to rainfall when possible. Splashing water moves bacteria and allows infection of new leaves. Irrigate when the leaves will dry quickly.

5. Scout crops as they are received and once a week afterward, and remove plants with symptoms as soon as they are found. Keeping diseased plants around makes contamination of new crops possible.

6. Have problems diagnosed by a laboratory, and keep good records of problems and what you did to control them. It is remarkable how hard it is to remember something after a year or more if it has not been recorded.

Figure 1. Some bacterial diseases of ornamentals.

Plant	Disease
Basil	Leaf spot (*Pseudomonas cichorii*)
Bougainvillea	Leaf spot (Pseudomonas andropogonis)
Calla lily	Soft rot (*Erwinia* spp.)
Chrysanthemum	Leaf spot and blight (Pseudomonas)
Candytuft (iberis)	Blight (*Xanthomonas campestris* pv. *campestris*)
Cone flower (echinacea)	Pseudomonas leaf spot (Pseudomonas)
Coreopsis	Pseudomonas leaf spot (*Pseudomonas cichorii*)
Delphinium	Leaf spot (Pseudomonas and Xanthomonas)
English daisy (bellis)	Leaf spot (Xanthomonas)
English ivy (*Hedera helix*)	Leaf spot (*Xanthomonas campestris* pv. *hederae*)
Geranium species	Pseudomonas leaf spot (*Pseudomonas cichorii* and Acidovorax) Southern wilt (Ralstonia) Blight (*Xanthomonas campestris* pv. *pelargonii*)
Gerber daisy	Pseudomonas leaf spot (*Pseudomonas cichorii*)
Hibiscus	Leaf spot (*Pseudomonas cichorii*, *Pseudomonas syringae* and *Xanthomonas campestris* pv. *malvacearum*)
Impatiens species	Pseudomonas leaf spot (*Pseudomonas cichorii* and *Pseudomonas syringae*)
Lavender	Leaf spot and Blight (Pseudomonas and Xanthomonas)
Marigold	Pseudomonas leaf spot (*Pseudomonas syringae*)
Poinsettia	Xanthomonas leaf spot (*Xanthomonas campestris* pv. *poinsettiaecola*) Blight (*Erwinia spp.*)
Primula	Pseudomonas leaf spot (Pseudomonas)
Ranunculus	Leaf spot and Blight (*Xanthomonas campestris*)
Rosemary	Leaf spot and Blight (Pseudomonas and Xanthomonas)
Snapdragon	Pseudomonas leaf spot (Pseudomonas)
Stock (matthiola)	Blight (*Xanthomonas campestris* pv. *campestris*)
Verbena	Leaf spot and Blight (Pseudomonas and Xanthomonas)
Wallflower (erysimum)	Blight (*Xanthomonas campestris* pv. *campestris*)
Zinnia	Leaf spot (*Xanthomonas campestris* pv. *zinniae*)

BACTERICIDES

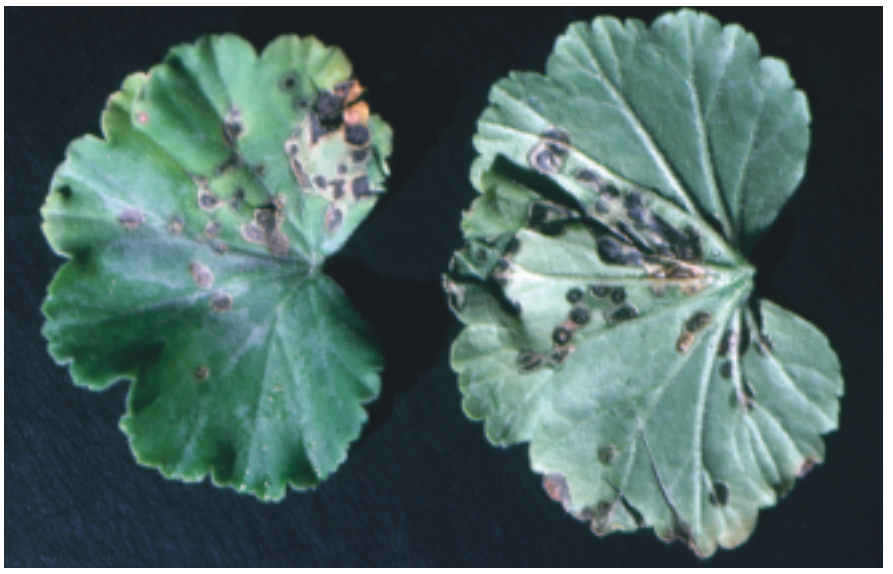
The following section relates our most recent research experience in bacterial disease control. I apologize in advance for failing to include a discussion of all registered bactericides; we are not able to work with ➧

Figure 2. Efficacy of Bacillus subtilis *against Pseudomonas on delphinium, impatiens and verbena and Xanthomonas on geranium and stock. Numbers given are the percent control. Above 50 percent would be good for a bactericide.*

Product	oz. per 100 gal.	Delphinium	Impatiens	Geranium	Stock	Verbena
Camelot	48	63	NT	84	70	41
Phyton 27	25 50 for geranium	90	76	76	63	70
Kocide TNO	16	NT	NT	NT	70	NT
Rhapsody	128-256	84	18-62	33-84	NT	NT
ZeroTol	128	0	NT	NT	NT	NT

NT=not tested.

Pseudomonas on delphinium.



Xanthomonas on geranium.

every product available in every experiment and only write about those products we have direct knowledge of.

Controlling bacterial diseases remains difficult, but recent registration of a new biological pesticide (Rhapsody, from Agraquest, containing *Bacillus subtilis*) makes rotation between copper and something else a reality. Our trials in 2002 and 2003 with this product showed good efficacy against Pseudomonas and Xanthomonas leaf spots on bedding plants and cut flowers (Figure 2, below). Rhapsody was tested in three trials at 1 or 2 percent and gave control approximately the same as the copper products in the same trial. At least one copper product was employed in each trial as the chemical standard (Camelot, Kocide TNO and/or Phyton 27). Phyton 27 was tested in each of the five trials with control ranging from 63 to 90 percent (over the water-sprayed inoculated controls). In four trials, Camelot gave 41-84 percent control. Finally, Kocide TNO was tested against Xanthomonas on stock giving 70 percent control. Results for two of these five trials are included in figures 3 and 4, right.

PSEUDOMONAS LEAF SPOT ON DELPHINIUM

Delphinium 'Blue Shadows' plugs were established in containers in a greenhouse in late summer. Plants were sprayed with a bactericide three times on a 7- to 10-day interval. They were inoculated with the pathogen, *Pseudomonas delphinii*, four days after the first bactericide application. The number of leaves with spots was recorded 10 days after the final application. Phyton 27 gave very good control when used at either 15 or 25 oz. per 100 gal. (See Figure 3, top right). Rhapsody also gave very good control when used at 1 percent but failed to give control when used at 2 percent, probably due to phytotoxicity. The combination of Rhapsody and Phyton 27 was not effective in this trial. Zerotol was used at 1 percent, and it failed to give any control of Pseudomonas leaf spot on delphinium.

XANTHOMONAS BLIGHT ON GERANIUM

Later in the fall, we performed another trial with some of the same treatments. In this case, we tested control of Xanthomonas blight on rooted geranium cuttings. The plants were sprayed twice on a 14-day interval and inoculated three days after the first application. We saw the best control with Phyton 27 at 50 oz. per 100 gal., Rhapsody at 2 percent and Camelot at 16 oz. per 100 gal. (See Figure 4, bottom right). Lower rates of Phyton or Rhapsody gave a lesser degree of control.

CONCLUSIONS

It is always best to have a plan of control before disease occurs. The plan should include use of pathogen-free plant materials and an irrigation system that does not wet the leaves. These are the first levels of defense in controlling bacterial diseases and are critical in applying an integrated approach to bacterial disease control. Scouting the crop should be a routine procedure by the same

Figure 3. Control of Pseudomonas leaf spot on delphinium.

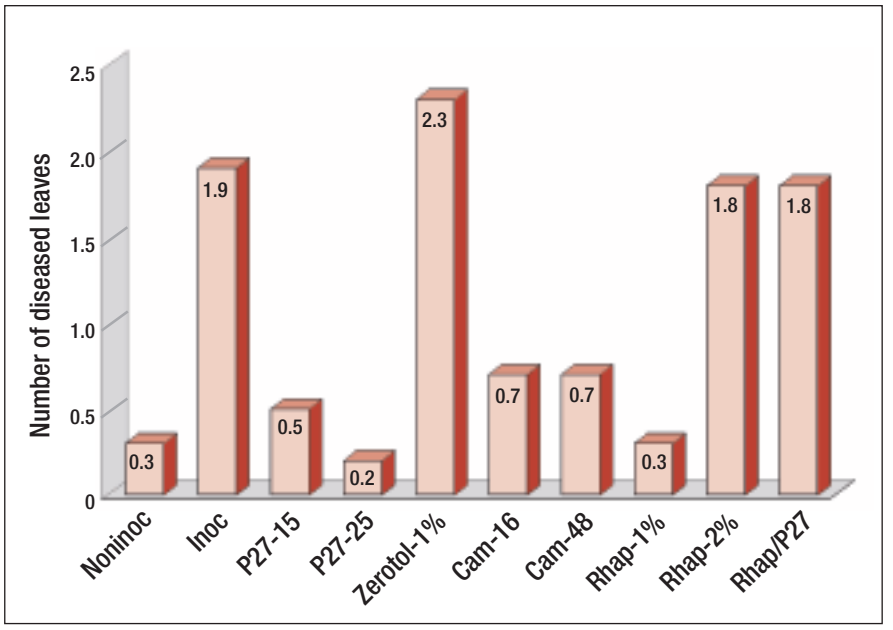
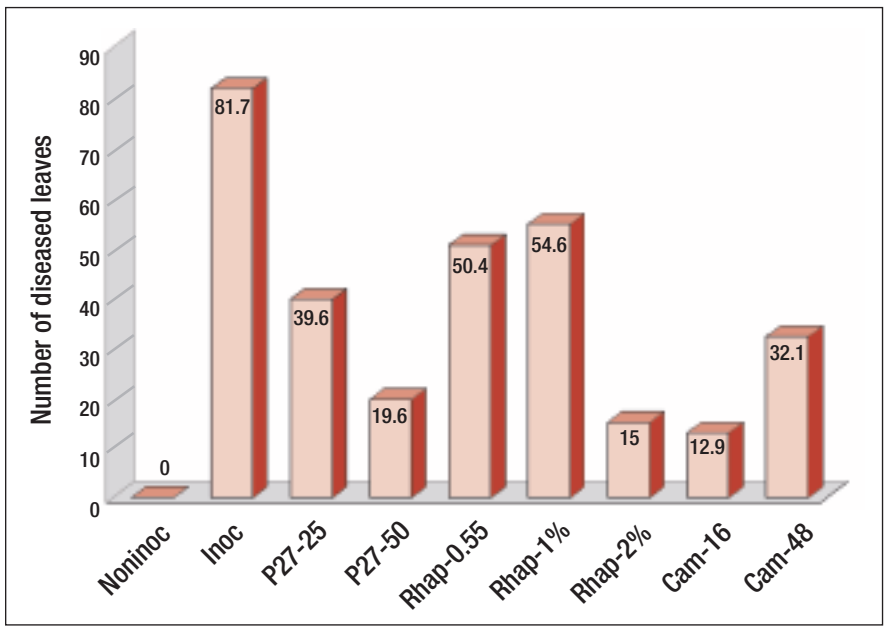


Figure 4. Control of Xanthomonas blight on geranium.



person at least once a week. It is very important to critically examine all new plant materials as they come into the greenhouse. Before a problem develops, you should know which laboratory or expert can confirm your diagnosis, how to submit samples and/or what information the expert will require. Finally, emergency procedures should include removing symptomatic plants from each crop at least twice a week and destroying them promptly. Placing infected plants in a cull pile near production areas simply promotes the continued spread of the disease in your crop. Use bactericides only as the final step.

If you do not implement these cultural controls, bactericides will not be as effective. Alternating between your favorite copper product and Rhapsody would be a good way to get optimal control of these bacterial diseases while minimizing the chance of resistance development to either product. For leaf spots, our trials indicate best rates are 1.5 percent for Rhapsody, 48 oz. per 100 gal. for Camelot and 25 oz. per 100 gal. for Phyton 27. Higher rates appear to be needed for Xanthomonas blight on geraniums. As always — follow the labels — they are the law! GPN

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