Chase News

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Recent Summer Disease Finds

I have been visiting some nurseries in the past few weeks and am starting to see the telltale signs of heat. Phytophthora crown and root rot is one of the diseases that happens most often in the hot summer months. The disease can attack a wide range of plants including the petunia (1), Spathiphyllum (2) and vinca (3) shown here to the right. In the case of some plants like these petunias they were over-grown and stressed with heat and too much water. Irrigating plants excessively to try to keep them alive when they are overgrown often leads to their rapid collapse during the summer months.

The Spathiphyllum liners appeared to be infected upon receipt from the propagator which can be a serious problem. When plants start infected it is usually not possible to "cure" them even with the best fungicides.

The most common and devastating disease of annual vinca (*Catharanthus roseus*) for the past 20 years has been Phytophthora aerial blight. This disease is nearly impossible to control when the cultural conditions are favorable for disease. Extreme heat and overhead irrigation are perfect for Phytophthora.

I was a little surprised to find downy mildew active but then on Salvias (4) is a warm weather disease. Coleus downy mildew is also prevalent in the summer.

Finally, we still see plenty of bacterial leaf spots in the summer. This Xanthomonas leaf spot on lavender (5) is also common during cooler weather and has been shown to affect rosemary as well as many lavenders.

Keep your eyes open—a lot is going on out there!

Phytophthora on petunia (1), Spathiphyllum (2) and vinca (3). Downy mildew on blue salvia (4) and Xanthomonas on lavender (5).

CONTENT

Pseudomonas Leaf Spot Trials

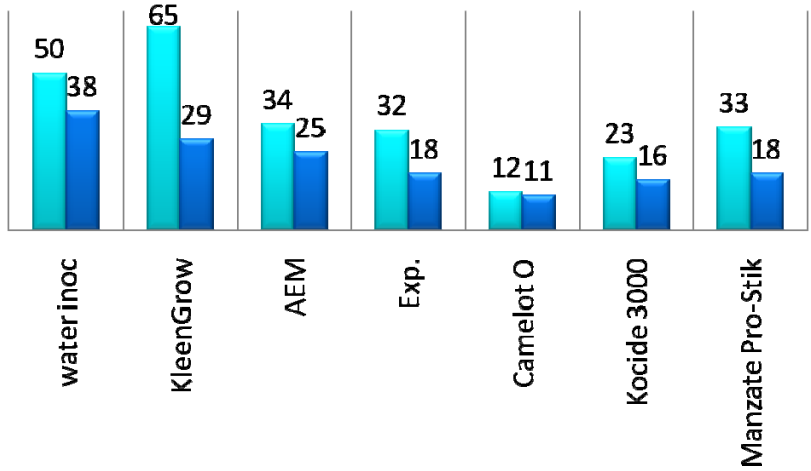
We started working on a variety of bacterial diseases on vegetables, herbs and fruit/nut trees in June. Don't jump to the conclusion that this does not help you as an ornamental producer since these are normally not your crops. The ability to control a Pseudomonas leaf spot on one plant often translates into control on a different crop. The wet weather through the winter, spring and into summer made bacterial diseases more important than usual on the West Coast. We saw outbreaks of Pseudomonas blast (also causes canker) on fruit and nut trees and is caused by strains of *Pseudomonas syringae* as well as a large number of very similar diseases on woody ornamentals like hibiscus and mandevilla.

Other strains of this bacterium cause bacterial speck on tomato while *Pseudomonas cichorii* has been shown to cause Pseudomonas leaf spot on basil. We started trials on these three diseases and plan for trials on bacterial spot on tomato and pepper caused by *Xanthomonas campestris* pv. *vesicatoriae* (now called *X. perforans*). This month I report on the bacterial blast trial on almond and speck on tomato.

The trials each contained an experimental product being developed by Phyton Corp. compared to Camelot O (copper octanoate which has an organic label) and Kocide 3000 (cupric hydroxide). We also included a mancozeb product (Manzate Pro-Stik), KleenGrow (a fourth generation quaternary ammonium product from PACE 49) and AEM (activated EM1) a biological product combining bacteria and yeast organisms (EMRO). The trials included inoculated and noninoculated control plants in each case. The almond trial was actually conducted on rootstock with a standing infection of bacterial blast and the tomato trial was conducted on 'Early Girl'. We treated the almonds three times on a weekly interval starting with one spray before inoculation and two after. The tomato trial was sprayed once before inoculation and once after also on a weekly interval.

Since the almonds were infected when we started I have omitted the noninoculated control column from the graph on the top of the column to the right. The best control was seen with Camelot O although the other copper products (Exp. and Kocide 3000) and Manzate Pro-Stik provided statistically equivalent control. The AEM and KleenGrow failed to provide significant control in this trial. None of the treatments damaged the almonds in any way we could determine.

Bacterial blast on Almond rootstock
Numbers of spots/plant—July 2 (light blue) and July 7 (dark blue).

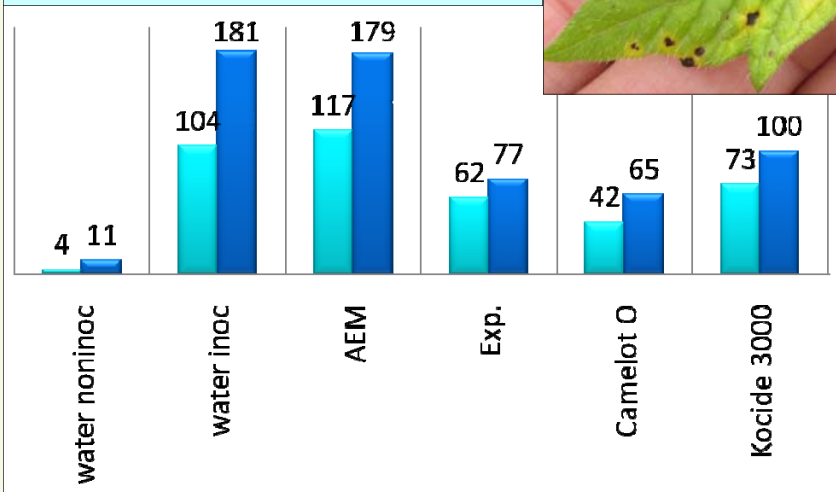


The tomato trial showed similar results although disease pressure was quite a bit higher (graph below). In this trial all three copper products (Exp., Camelot O and Kocide 3000) provided significant and equal prevention of bacterial speck. AEM failed to provide any significant control.

These two trials show that copper is still an important tool in preventing and controlling an outbreak of *Pseudomonas syringae*. It was also good to find out how well mancozeb can work alone. Traditionally, mancozeb and copper have been combined to effectively reduce the risk of copper resistant bacteria. One explanation has been that the mancozeb actually makes more copper available. However, recent work on many crops has shown that mancozeb alone can be an effective bactericide.

Next month the basil trial with *Pseudomonas cichorii* will be complete and I will report our results and perhaps the first results in Xanthomonas on pepper.

Bacterial speck control on tomato
Numbers of spots/plant—July 7 (light blue) and July 14 (dark blue).



Botrytis Blight Control on Geraniums and Black Root Rot Update

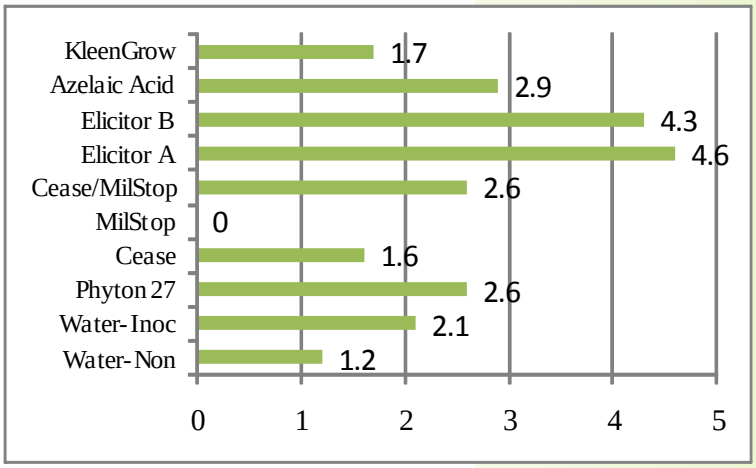
Fighting Botrytis blight is not always limited to growers. Last month I reported on a trial we conducted on Xanthomonas leaf spot on geranium. We have to inoculate plants with the bacterial pathogen, seal them in plastic bags and run intermittent mist over the course of the trial. This led to Xanthomonas as we hoped but we also saw significant development of Botrytis leaf spot.

We started with 'Elite Cherry' zonal geraniums planted in 4 inch pots containing Sunshine Mix. No. 1 on 15 March. The plants were sprayed once before inoculation and twice afterward on a weekly interval. Treatments included:

- Water-noninoculated
- Water-inoculated
- Phyton 27-50 oz/100 gal
- Cease-1.5%
- MilStop-2.5 lb
- Cease and MilStop
- Elicitor A (experimental)
- Elicitor B (experimental)
- Azelaic Acid (experimental)
- KleenGrow-6 oz

Botrytis severity was moderate in this trial. The graph below shows the number of leaves per plant with active Botrytis sporulation about one week after the final spray. The best control was seen with MilStop which was 100% effective. Phytotoxicity from both Elicitor A and B resulted in increased levels of Botrytis blight. None of the other products we tested had any significant effect on Botrytis blight in this trial.

Number of leaves with Botrytis sporulation on Geranium



We have been working on fungicides for black root rot control on pansies and vincas for many years. The disease is caused by *Thielaviopsis basicola*. The pathogen has routinely been a problem on pansies especially those grown for the fall market in hot climates such as the southern states. It has less often been found on vinca, salvia and poinsettia and in recent years is an increasing problem on Calibrachoa. Black root rot is also found on Lithodora in the Pacific Northwest.

Our trials have employed pansies most often but in the past 2 years we have been testing fungicides for control of black root rot on vincas which appear to be even more susceptible than pansies. For years, the best products in reported trials have been those containing thiophanate methyl. Our tests with 3336, Banrot and OHP-6672 (as well as Fungo formulations) have confirmed this. Other fungicides with less consistently effective control include: triflumizole (Terraguard) and fludioxinil (Medallion). We have not seen good results with biological control agents although occasionally a researcher will report good results with one. The most exciting recent work has shown reliable results with polyoxorim (Veranda O). The best rotation at present appears to be a thiophanate methyl with Veranda O.

Efficacy of fungicides on black root rot control on pansy and vinca (our trials 1998-present)

Fungicide	Rate/100 gal	Efficacy
3336	16 oz	very good to excellent
Actino-Fe	83g/yd3	none
Actinovate	6 oz	none
Banrot	8 oz	excellent
Banrot	8 oz	poor
Companion	16 oz	none
Compass O	2-8 oz	none
Disarm O	0.15-0.6 oz	none
Heritage	2 oz	poor
Insignia	8 oz	some
KleenGrow	25 oz	poor to good
Medallion	2 oz	poor to good
OHP 6672	16 oz	very good
Pageant	12-18 oz	none
Palladium	8 oz	none
Phyton 27	10 oz	some to very good
RootShield	8 oz	poor
Systhane	2-4 oz	none to some
Terraguard	4 oz	good to very good
Trinity*	6-12 oz	none
Veranda O	8 oz	some to very good
X3	5 oz	some

*Not currently labeled for ornamentals in the US. Green rows show the most consistently effective products based on our trials.

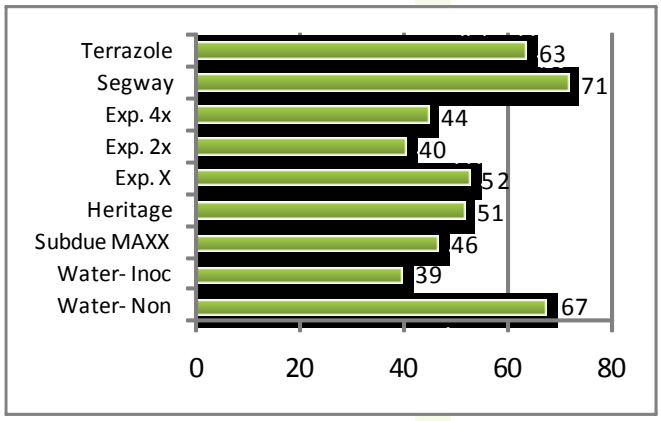
Fungicides For Pythium Root Rot on Ornamentals

PYTHIUM ROOT ROT ON GERANIUM—We have been working on controlling Pythium root rot with a variety of fungicides for many years. One of the most concerning developments in the past 20 years is development of resistance to Subdue MAXX. This trial on Pythium root rot on geranium was conducted with an isolate of *Pythium irregulare* that is resistant to Subdue MAXX. We used four inch pots containing Sunshine No. 1, top-dressed with Osmocote Plus 15-9-12. The trial employed zonal geranium cultivar 'Maverick Scarlet', which were started on 24 February. The treatments included:

- Water—noninoculated
- Water—inoculated
- Subdue MAXX—1 oz/100 gal
- Heritage—0.9 oz
- Experimental—x rate
- Exp.—2x
- Exp.—4x
- Segway—3 oz
- Terrazole 35W—6 oz

Products were applied as drenches three times on a 21 day interval starting on 1 April. We rated height and top grade periodically throughout the trial but these ratings did not show any significant effects. At the end of the trial we rated the percentage of healthy appearing roots which is often our only clear measurement of Pythium root rot on geraniums. The data are shown to the graph below.

Effect of fungicides on Pythium root rot on Geranium. The data are the % of healthy appearing roots.



As would be expected, Subdue MAXX was not effective in this trial. Only Segway and Terrazole produced roots equal to the noninoculated controls. Heritage sometimes gives some control of Pythium root rot as it did in this trial. The experimental product did not work at the rates used.

IR-4 PROGRAM PUBLISHES PYTHIUM SUMMARY—The IR-4 program has focused on evaluations of products for Pythium root rot on ornamentals over the past few years. In late May, Dr. Cristi Palmer (Ornamental Program Coordinator) posted a summary of their work on the IR-4 website. I decided to present part of that summary here for your information. The *Pythium* species tested and plants employed ranged from geranium to celosia to Douglas fir (*Pseudotsuga*) and trials were performed across the US by a number of researchers.

The summary shows that unfortunately some of the newer products including the strobilurins (Heritage, Insignia and Pageant) are variable in their ability to provide control of Pythium root rot. The phosphonates (Aliette, Vital and Magellan among others) are were more often than not ineffective. Mandipropamid is an experimental product that is not yet labeled and has had variable results on *Pythium* spp. The only newer product that provided generally good to excellent control was Segway. The most consistent results were seen with Subdue MAXX and Terrazole which are two long-term industry standards. Both products almost always provided excellent control regardless of the species of *Pythium* tested or the plants employed.

IR-4 Summary of Fungicide Trials on *Pythium* Species

Fungicide	*Pythium* species	Result (# tests)
Heritage	*irregulare*	Excellent, none
Heritage	*mamillatum*	Poor (1)
Heritage	*ultimum*	Poor-none (5)
Insignia	*aphanidermatum*	Some (1)
Insignia	*irregulare*	Fair (2)
Insignia	*ultimum*	None (1)
Pageant	*aphanidermatum*	Good-excellent
Pageant	*irregulare*	None
Pageant	*ultimum*	None (3) Some (1)
Phosphonates	*aphanidermatum*	None
Phosphonates	*irregulare*	Poor
Phosphonates	*mamillatum*	Poor
Phosphonates	*ultimum*	None
mandipropamid	*aphanidermatum*	None-good
mandipropamid	*irregulare*	Poor-good
mandipropamid	unknown	Good
Segway	*irregulare*	Good
Segway	*mamillatum*	Excellent
Segway	*ultimum*	None-excellent
Subdue MAXX	*aphanidermatum*	Excellent
Subdue MAXX	*irregulare*	Excellent
Subdue MAXX	*mamillatum*	Excellent
Subdue MAXX	*ultimum*	None (2) excellent (2)
Terrazole 35W	*aphanidermatum*	Excellent
Terrazole 35W	*irregulare*	Poor
Terrazole 35W	*mamillatum*	Very good
Terrazole 35W	*ultimum*	Very good to excellent (3) none (1)

Resistance Management Strategy for New Fungicides

I wrote a series of articles for **Greenhouse Management** in 2010. The following is a revised version of the final article in the series.

Some of the newest fungicides labeled or new use patterns for older products are registered for Oomycetes. This very important group of plant pathogenic fungi includes *Phytophthora*, *Pythium* and the downy mildew fungi such as *Peronospora*, *Bremia* and *Plasmopara*. It has been interesting to me to see the changes in labeling over the past few years with very special conditions placed on use of some of these new fungicides. This is probably a result of our growing understanding of resistance management but also growing caution.

The products I have chosen to focus on are Adorn, Segway, Stature SC and Subdue MAXX. A summary of some pertinent facts for each of these fungicides is included in the table below. Each one is the sole representative of a mode of action group for ornamentals. They would therefore make very good choices in a rotation program designed to manage resistance development. However, making them mesh with their particular labeling might be a challenge. They also have unique ranking by the FRAC (Fungicide Resistance Action Committee). This evaluation is made based on the actual mode of action as well as reported cases of resistance.

For instance fluopicolide (Adorn) does not have an actual evaluation of potential for resistance development probably since little is known about how this new MOA group acts and even the exact mode of action is not well understood.

Cyazofamid (Segway) has an unknown risk of resistance development but since some model systems (probably lab or bioassay tests) have mutated at the target site resistance management is required.

Dimethomorph (Stature) has had resistance reported in grape downy mildew but not in potato late blight and is judged to have a low to medium risk of resistance development. Obviously, I am not aware of everything that goes into the ranking.

Finally, mefenoxam (Subdue MAXX) has many cases of resistance reported in both crop (like vegetables) and ornamentals and it is considered at high risk of resistance development.

The newest fungicide with interesting resistance management wording is Adorn. This label takes an unusual stand and requires tank-mixing for any use which covers *Pythium*, *Phytophthora* and downy mildew. This is for resistance management and the label lists some possible tank-mix partners depending on which pathogen you are targeting. The Adorn label also recommends using IPM techniques to help manage resistance development which certainly is always a good idea.

Segway has more standard resistance management terminology recommending either alternation or tank-mixing. It also does limit the number of applications per crop or per year. This might be an environmental issue but also would aide in resistance management.

Stature SC recommends alternation or tank-mixing and also limits the number of consecutive applications to a crop before switching to another MOA group fungicide.

Subdue MAXX is newly registered on ornamentals for downy mildew control and the label contains important resistance management conditions. The REI changes from 0 hours for drench applications of Subdue MAXX to 48 hours for foliar sprays for downy mildew. It also must be tank-mixed for downy mildew and there are limits to the number of consecutive applications depending on the target pathogen.

Conclusions

These fungicides are each single representatives of a mode of action grouping so any alternation or tank mix would work to manage resistance development. The modes of action are narrow (when known) making the risk of resistance relatively high. The REI for each is 12 hours with the exception of Subdue MAXX which is 0 hours for Pythium and Phytophthora root diseases and 48 hours for downy mildew. Tank-mixing costs more than alternation since you should never reduce rates below those labeled. You cannot use Adorn alone. Please always follow the label directions carefully and completely—it is the law.

Fungicide	Manufacturer	Active ingredient (MOA)	Activity range	Crop fungicides (resistance reported)	Resistance Management Strategies
Adorn	Valent USA Corp.	Fluopicolide (43)	Downy mildew *Phytophthora*	No (unknown)	Tank-mix required, IPM suggested
Segway	FMC Corp.	Cyazofamid (21)	Downy mildew *Phytophthora* *Pythium*	Yes (unknown, medium to high risk)	Tank-mix or alternation, limits to applications per crop or year
Stature SC	BASF Corp.	Dimethomorph (40)	Downy mildew *Phytophthora*	Yes (yes, low to medium risk)	Tank mix or alternation, limits consecutive applications
Subdue MAXX	Syngenta Crop Protection	Mefenoxam (4)	Downy mildew *Phytophthora* *Pythium*	Yes (yes, high risk)	Tank-mix for downy, and tank-mix or alternation for *Pythium/Phytophthora*, limits consecutive applications

Rust Control—Protectants Are Still Effective

Rust diseases remain critical problems for production of ornamentals. We have just completed a trial on Hypericum rust (*Uromyces triquetrus*). We work on this disease every year but for the first time, we performed the trial in ground beds at our Mt. Aukum facility. I was interested to see that we had evaluated some of the same active ingredients in container grown Hypericum previously so I am bringing that data back for comparison.

Container trial on Hypericum rust control.

Treatment	Rate/100 gal.	Rust Control
Concert	16 oz	Good
Armada	3 oz	Very good
Armada	6 oz	Excellent
Hoist 40WSP	8 oz	Good
Heritage	4 oz	Excellent
Terraguard 4SC	8 oz	Good
Terraguard 50WP	8 oz	Good
Vitavax	4 oz	Very good

In the first trial, products were applied as a foliar spray three times on a 7-day interval. The best control of rust in this trial (Table above) was achieved with the 6 oz rate of Armada (a landscape product combining triadimefon and trifloxystrobin) or Heritage (azoxystrobin). Vitavax (oxycarboxin) provided very good control but caused severe stunting. This fungicide is no longer used in ornamental production. Some of the sterol inhibitors also caused significant stunting (triadimefon in the Armada and the Terraguard 50WP).

In the 2011 ground bed trial, we compared the following treatments:

- Control—water
- Armada—6 oz/100 gal
- Eagle 20EW—12 oz
- Cleary 3336—16 oz
- Daconil Ultrex—1.4 lb

Plants were sprayed on a 21 day interval. The first thing that differed is that there was no stunting at all with Armada Eagle. Use in ground beds may be safer with respect to stunting and products containing a sterol inhibitor like Armada.

All of the products tested provided significant control of Hypericum rust in this trial. Data are given as the mean number of active pustules per plant and we used 24 - 16 inch tall plants per treatment. I was a little surprised to see how effective thiophanate methyl (3336) and chlorothalonil (Daconil Ultrex) were in this trial.

We are still relying on protectant products available in the 1970's such as chlorothalonil, thiophanate methyl and mancozeb for prevention of rust. The newer, systemic fungicides like sterol inhibitors (propiconazole, myclobutanil and triadimefon) as well as strobilurins (azoxystrobin, kresoxim methyl, pyraclostrobin and trifloxystrobin) provide some eradicant benefits. It is important to realize that many of the newer fungicides for rust are based on the same chemical groups. Alternating on a 14-21 day application interval (or as labeled) with protectants like chlorothalonil and mancozeb when conditions are the best means of preventing resistance development. If an outbreak occurs, use of sterol inhibitors and strobilurins with a wetting agent may be your most effective means of eradication.

Hypericum rust on ground beds plants (below) and close-up of leaf underside (above).

Effect of fungicides on severity of Hypericum rust in ground beds.