Chase News

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Phytotoxicity Can Steal Your Profits

In these times of belt-tightening it is a good idea to know how to get the most out of your fungicide dollar. Simply replacing a product with one you think is less expensive may not be the answer. In the next year, I will examine some of the places where you should focus your efforts to maximize fungicide benefits including this first in the series on phytotoxicity. The overall aim is to remind each of us of the ways that we lose money by skipping steps. Others in this series will be: how cultural controls impact fungicide efficacy, choosing the right fungicide - diagnosis and application site, the importance of rate, interval and timing in controlling disease losses and finally rotate or tank mix to avoid fungicide resistance.

PHYTOTOXICITY COSTS YOU MONEY

Pesticides are routinely employed by many ornamental plant producers. They are generally effective and safe for the labeled crops but whenever a new product hits the market questions of safety must be addressed. Remember that phytotoxicity directly impacts your bottom line by reducing crop quality and increasing production times. Many of the newer products are labeled in a way to allow use on ornamental crops that are not specifically listed on their labels. Wording like – "For use on ornamentals such as…" This is very helpful in our industry since no fungicide manufacturer can test their new products on "ALL" of the ornamentals we grow under all of the conditions we grow them. It is therefore critical to evaluate them for safety to your crops under your very special conditions. If you do not test new products (or older products on new crops) you are taking a chance with phytotoxicity. Use of fungicides on sensitive plants, such as aster, impatiens, schefflera and geraniums, can sometimes result in plant injury. If any of these are in your product mix, they would make good test subjects for a phytotoxicity trial. The test description below is best used for foliar products. If you have a drench product that will be used in propagation, you will have to test the possibility that it can delay rooting. Be sure to compare untreated cuttings of exactly the same cultivar and age when evaluating pesticide safety.

HOW TO PERFORM A PHYTOTOXICITY TEST

I have listed below the basic steps I would suggest to conduct a fungicide (or any other pesticide) phytotoxicity test.

1. Read the label of the product – determine how you will most likely use it – drench or spray.
2. Choose the highest labeled rate for that use pattern.
3. Choose healthy, well-established test plants. Do not use stressed or overgrown plants.
4. Place one block of plants (at least 10 containers) in a group and another block (same size) in a separate group.
5. Do the test under your normal growing conditions.
6. Be sure to label it clearly so the plants won't be moved and you can tell which ones were treated 1 or 2 months later.
7. Mark one group of plants to treat with water only – this is the control (such as one label color or A).
8. Mark the other group differently to denote the product being tested (such as a different label color or B).
9. Treat the control plants with plain water. This will help you to make sure any damage is from the test fungicide and not water alone.
10. Use your normal sprayer if possible. If not, use a pump action hand-sprayer and spray to drip (or follow the label).
11. Take pictures of the two groups of plants right before each treatment. This will help you compare results later.
12. Re-treat the plants on the closest labeled interval such as weekly and apply a total of three times to make sure multiple applications are safe.
13. At the end of the trial you can compare overall appearance. You could measure the plant height if you suspect stunting and compare the averages of the water treated to the test fungicide.
14. Look for signs of phytotoxicity including: yellowing, leaf distortion, burning (speckles or burned tips or edges particularly), darkening green color, smaller leaves and stunting.
15. Take notes and add pictures. Relying on memory alone is usually not very effective.

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Research Reports

Preventing artillery fungus in the landscape—*Sphaerobolus* spp. are called artillery fungi because they release their spore masses violently. The spores are sticky and leave a tar-like mass on buildings and cars, especially those with light surfaces. These spores are very hard to remove from surfaces and thus a real nuisance. Previous work by Davis and Fidanza (Penn State University) showed a significant reduction of artillery fungus with aged (weathered or composted) mushroom compost up to 40% by volume. Most recently, these researchers tested the ability of fresh mushroom compost. The study tested various rates of incorporation of fresh mushroom compost in mulch. The table below shows their results.

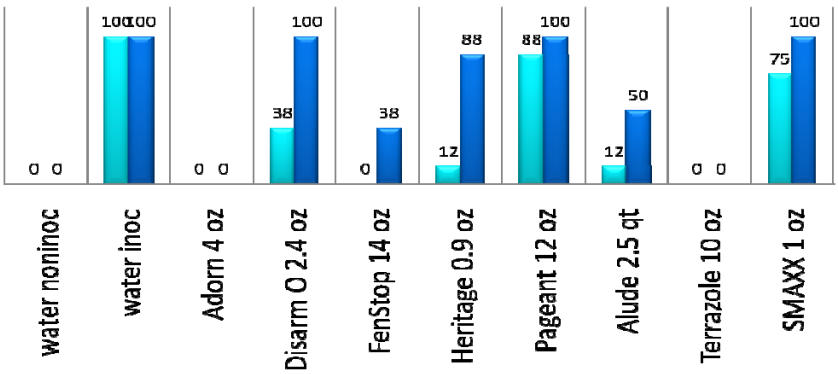
% mushroom compost	% reduction artillery fungus
0	0
10	62
20	80
40	95
100	97

Clearly optimal reduction occurred when fresh mushroom compost was incorporated at 40%. It was helpful to find out that use of either fresh or aged mushroom compost can be employed to control this problem. The full report can be found at : J. Environ. Hort. 29(2):91-95. 2011.

Efficacy of Some Fungicides on Damping-off on Geranium— Enzenbacher, Hausbeck and Harlan (Michigan State University) reported on a trial performed in 2010 using 'Orbit White' geranium seedlings and damping-off caused by *Pythium ultimum*. Seedlings were transplanted and treated with fungicides on August 5 and again on August 18. The *Pythium ultimum* strain used was resistant to mefenoxam (Subdue MAXX). Treatments included:

- Water, noninoculated
- Water, inoculated
- Adorn—4 oz/100 gal
- Disarm O—2.4 oz
- FenStop—14 oz
- Heritage—0.9 oz
- Pageant—12 oz
- Alude—2.5 qt
- Terrazole—10 oz
- Subdue MAXX—1 oz

Effect of fungicides on plant death on Geraniums infected with *Pythium*. The percentage of dead seedlings is given.



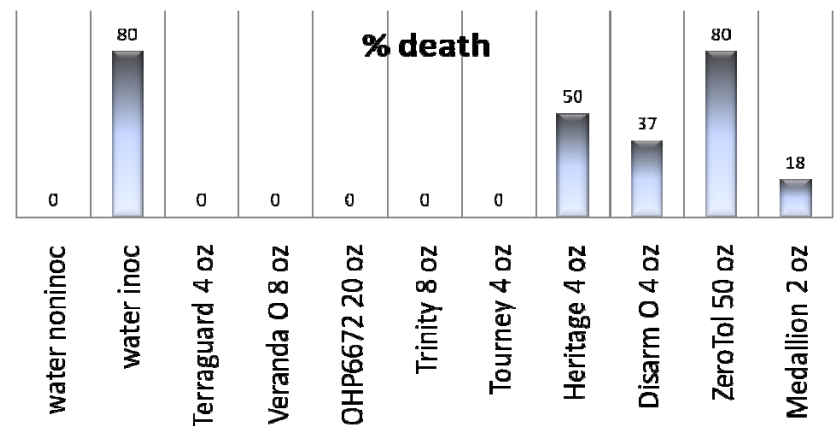
Germination was recorded weekly and I show the data for 9 August (light blue) and 23 August (dark blue). The most effective products were Adorn and Terrazole which were each 100% effective. FenStop and Alude were somewhat effective but the other products did not significantly reduce losses due to Pythium damping-off. For the complete report see: Plant Disease Management Reports 5:OT011.

Efficacy of Some Fungicides for Black Root Rot on Pansy—In a recent article for GMPro (August, 2011 pages 48-50), Dr. Hausbeck wrote about prevention of black root rot on pansy. Her study evaluated several newer fungicides including one that is not yet registered for ornamentals. Treatments included:

- Water, noninoculated
- Water, inoculated
- Terraguard—4 oz/100 gal
- Veranda O—8 oz
- OHP6672—20 oz
- Trinity—8 oz
- Tourney—4 oz
- Disarm O—4 oz
- ZeroTol—50 oz
- Medallion—2 oz

Optimal control was seen with Terraguard, Veranda O, OHP6672, Trinity and Tourney. Medallion was somewhat effective in this trial. Tourney is not registered for use in greenhouses and may show PGR effects on these crops. Trinity is not registered and is in the same MOA group as Tourney, Banner MAXX and Eagle. The two strobilurins fungicides (Heritage and Disarm O) were only somewhat effective at the rates tested. Results are similar to those of other researchers.

Effect of fungicides on plant death on Pansies infected with black root rot. The percentage of dead seedlings is given.



Choosing Bedding Plants for the Landscape

In the early 1990's, Phytophthora diseases emerged as serious problems in the landscape. The first description of Phytophthora aerial blight on vinca (*Catharanthus roseus*) was made from Southern California and grew into a serious problem for many landscapes through the southern portion of our country. Last year Margery Daughtrey (Cornell University Extension Plant Pathologist) and I found these vinca in a Missouri garden. They were infected with Phytophthora aerial blight.

Phytophthora aerial blight still attacking landscape vinca.

Many researchers started searching for an effective fungicide for controlling losses in both production and in the landscape and although some where found they were not sufficiently effective in some environments. As a result researchers throughout the southeast started to perform studies on the host range of this Phytophthora disease across many common bedding plants. At North Carolina State University, Dr. Ron Jones (now retired extension plant pathologist) assembled a table of the most common diseases on bedding plants in the landscape and their relative susceptibility to these problems. I decided that since I have not seen any updates on this topic it would be good to reprint it. A version of his table is shown below.

One of the potential applications of this information is choosing plants that are not susceptible to a given disease. You can see that knowing what the exact problem (s) might be in a given landscape would be critical. Another use is to know what type of plant might survive well when replacing a previous planting. Phytophthora and other soil-borne fungi and bacteria can easily live in the soil between crops, infecting new plants quickly when they are transplanted.

Using soil fungicides is rarely an effective tool in a ground bed. Treating the new plants prior to planting may also be suggested but has limited benefits since the disease pressure from the soil can be very high. Use of solarization can be very effective but not feasible in most landscapes since it requires extended periods free of plants and covered in plastic. So—choosing a resistant crop may be one of the only ways of reducing losses from soil-borne diseases in the landscape.

Unfortunately many of the common bedding plants are susceptible to Phytophthora diseases. The profile for Pythium root rot differs with geranium highly susceptible and coleus, impatiens, petunia and snapdragon susceptible. Only five of the bedding plants listed are resistant to Rhizoctonia stem rot. In contrast, only pansy and vinca are listed as susceptible to black root rot (*Thielaviopsis basicola*). Overall, the most sensitive plants to diseases appear to be petunia and snapdragon followed by geranium, impatiens and pansy. The most resistant was zinnia with begonia, coleus, marigold and vinca intermediate.

The greatest difficulty is that many of the soil-borne plant pathogens are very general and not crop specific. Cultural control therefore becomes even more critical in the landscape but once again impractical in some locations. Managing fertility and irrigation are important and always using plants from reliable sources may help keep new ground beds free of soil-borne pathogens.

Relative susceptibility of bedding plants to diseases in the landscape.
Reactions are coded as follows: S—susceptible, SS—slightly susceptible, HS—highly susceptible and R—resistant.

	Bacterial wilt	Black root rot	Botrytis	Phytophthora	Powdery mildew	Pythium	Rhizoctonia	Root knot nematode
Begonia	R	R	R	SS	S	R	SS	HS
Coleus	R	R	R	SS	R	S	R	HS
Geranium	S	R	HS	SS	R	HS	R	?
Impatiens	R	R	R	SS	R	S	HS	HS
Marigold	HS	R	HS	R	R	R	R	R
Pansy	R	HS	S	HS	R	R	R	SS
Petunia	S	R	HS	SS	R	S	SS	SS
Salvia	R	R	R	HS	R	R	R	R
Snapdragon	R	R	S	HS	S	S	SS	HS
Vinca	R	S	R	HS	R	R	SS	R
Zinnia	R	R	SS	R	S	R	SS	R

Rhizoctonia Review—Temperature Effects and New Fungicides

It's nearing the end of summer in some parts of the country. Rhizoctonia diseases are generally more severe under warmer weather but actually decline when it is too hot. When I worked at the University of Florida in the early 1990's I conducted some trials on Rhizoctonia aerial blight on Boston fern and Rhizoctonia petiole rot on pothos. The effect of potting medium temperature and air temperature on these two Rhizoctonia diseases was evaluated.

Rhizoctonia aerial blight on Boston fern

Our trials on Boston fern showed that aerial blight significantly declined when air temperatures exceeded 95F or potting medium temperatures were 90F. The test was conducted using constant temperatures so the normal diurnal fluctuation would probably result in significant Rhizoctonia aerial blight if these high temperatures were reached but not sustained. For a complete report on this work see: Chase and Conover, 1987, HortScience 22:65-67.

When we performed similar trials on petiole rot on pothos we included the same type of evaluation for air and potting medium temperatures. On pothos, maximum temperatures of 86F for either air or potting medium resulted in reduced severity of petiole rot. In addition, continuous temperature or 86F was also too high for significant disease development. The worst disease occurred when temperatures were continuously 60 to 85F. We checked the effect of continuous temperature on growth of the pathogen—*Rhizoctonia solani*. Fastest growth occurred with temperatures between 75 and 85F. Thus the reduction in disease above 86F may be simply due to the decreased ability of the pathogen to grow at these temperatures. For the complete report see: Chase and Poole, 1990, J. Environ. Hort. 8(3):139-141.

There are quite a few very effective fungicides and biological controls for Rhizoctonia diseases on ornamentals including thiophanate methyl (like 3336 and OHP6672), fludioxinil (like Medallion, Hurricane and Palladium), polyoxin D (like Veranda O) and strobilurins (like Heritage and Insignia). Nevertheless, new formulations and active ingredients are still being evaluated.

I usually do trials on hydrangea cutting rot, impatiens stem/crown rot, damping-off on celosia and cutting rot and root rot on poinsettias. This year we are testing Rhizoctonia cutting rot and Rhizoctonia root rot in two poinsettia trials. The first trial was performed using several rates of Trinity (a triazole fungicide from BASF not currently labeled for ornamentals). We sometimes see PGR effects with triazoles but in this case, no growth response was seen with these well rooted poinsettias. We saw significant death in the inoculated controls but all rates of Trinity have been 100% effective in protecting the poinsettias. The standard Medallion was also excellent.

In the second trial, we tested the ability of some fungicides for prevention of Rhizoctonia on un-rooted poinsettia cuttings. In this case, we treated once and several more times on a weekly interval. Disease started to appear within 4 days of inoculation and continued to increase quickly. All fungicides provided excellent prevention of disease with the exception of KleenGrow which gave no control in this trial. This was perhaps due to the relatively low rate employed since in previous work we have tested 12.5 oz/100 gal.

Severity of Rhizoctonia root rot on poinsettia as affected by Trinity.

Treatment	Rate/100 gal.	Disease severity 8-16-11
Water Noninoculated	-----	1.0 a
Water Inoculated	-----	3.8 b
Trinity	6 oz	1.0 a
Trinity	8 oz	1.0 a
Trinity	12 oz	1.0 a
Trinity	24 oz	1.0 a
Medallion	2 oz	1.0 a

Disease was rated from 1=none to 5=dead. Numbers followed by the same letter are not statistically different using Student Newman Keuls method.

Severity of Rhizoctonia cutting rot on poinsettia as affected by fungicides.

Treatment	Rate/100 gal.	Disease severity 8-12-11	Disease severity 8-16-11	Disease severity 8-19-11
Water Noninoculated	-----	1.0 a	1.0 a	1.0 a
Water Inoculated	-----	2.2 b	3.5 b	4.4 b
Medallion	1 oz	1.0 a	1.0 a	1.0 a
Hurricane WP	1.5 oz	1.0 a	1.0 a	1.0 a
Hurricane WG	1.5 oz	1.0 a	1.0 a	1.0 a
Cleary's 3336	16 oz	1.0 a	1.0 a	1.0 a
KleenGrow	6 oz	2.3 b	3.9 b	4.1 b

Disease was rated from 1=none to 5=dead. Numbers followed by the same letter are not statistically different using Student Newman Keuls method.

Phytophthora Research Update

Phosphonates for Phytophthora Crown Rot on Trees—Controlling Phytophthora diseases in trees whether they are ornamentals or nut and fruit trees is a serious problem throughout the country. Effective products for containerized trees may or may not be effective under field conditions. The amount of work performed on fruit and nut trees far exceeds what is performed on ornamentals and can be a good resource for our crops.

USDA and University of California researchers recently reported on some work performed on walnut for Phytophthora crown rot control. The trial was conducted on field-grown walnuts to evaluate the ability of a phosphonate fungicide (like Aliette) to reduce severity of disease when applied as foliar sprays or by chemigation. They applied sprays or three root applications by chemigation in September and then inoculated the trees. The crop was watched for the next ten months to monitor development of Phytophthora canker. The results of this study showed that the foliar spray was more effective in reducing disease than the chemigation treatments.

Previous work on almonds showed a higher degree of efficacy with the chemigation treatment. This was perhaps due to the timing of treatment which was July during a period of peak evapotranspiration. In the fall, when transpiration was less, perhaps the amount of phosphonate taken up in the transpiration stream was lower resulting in lower disease control.

It is very important therefore to make sure that the plant is in the right stage of growth for certain fungicides to be optimally effective. It is also critical to apply the product to the plant in an effective manner. Thus when and where to apply can dictate how effective the product is.

The complete report can be found at:
Browne, G. T., Prichard, T. L., Schmidt, L. S., and Krueger, W. H. 2011. Evaluation of phosphonate treatments for control of Phytophthora crown rot of walnut. Online. Plant Health Progress doi:10.1094/PHP-2011-0601-01-RS.

***Phytophthora* spp. in Floricultural Crops—**Olson and Benson (North Carolina State University) reported on studies conducted in 2007 and 2008 on species of *Phytophthora* found in floricultural crops in NC. They characterized the isolates of *Phytophthora* collected from each plant type and tested them for possible mefenoxam resistance. Results are presented in the table below.

By far, the most common species isolated was *P. nicotianae*. It was found in all of the plants I included in the table except for the gloxinia. Dusty miller, petunia and calibrachoa were most often infected with this species. *Phytophthora drechsleri* was also isolated in high numbers although nearly all of them from Gerbera daisy. *Phytophthora cryptogea* was also isolated multiple times from dusty miller, gerbera daisy and verbena. The least frequently isolated species were *P. tropicalis* and *P. citrophthora*.. The authors suggest that *P. tropicalis* is a serious newly emerging problem (especially on pothos).

The authors also reported on mefenoxam resistance and found that 100% of P. drechsleri and 76% of P. nicotianea were resistant. In contrast, none of the *P. citrophthora, P. cryptogea* or *P. tropi-*

A similar study was conducted in many of the same North Carolina greenhouse operations in 2001-2002. Results in some cases were comparable although the overall percentage of isolates resistant to mefenoxam had increased from 48% to 66%. The authors noted that the operations with mefenoxam-resistance also reported Phytophthora epidemics which is predictable unless other fungicides or methods are employed to reduce disease. Using a fungicide against resistant strains is ineffective at best.

It is commonly held belief that if we stop using a fungicide the resistant strains will slowly be replaced by sensitive strains. Unfortunately, this is not proving to be true. Studies indicate now that the mefenoxam resistant strains may actually be better able to compete with sensitive strains even when the mefenoxam is not being used. This means that a population may become stable and long-lived in a greenhouse. Extreme sanitation steps may be required to fight this persistent problem. Understanding and implementing rotational programs designed to reduce development of fungicide resistance are critical if we are to continue to produce floricultural crops. Once developed, resistance does not easily go away.

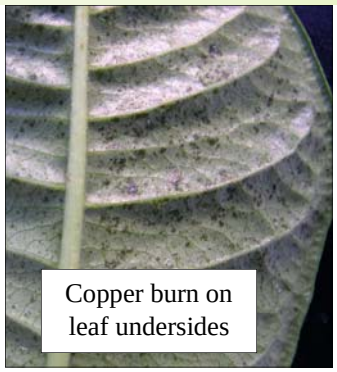
***Phytophthora* species isolated from specific floriculture crops with total numbers and number of isolates resistant to mefenoxam.**

Plant	*citrophthora*	*cryptogea*	*drechsleri*	*nicotianae*	*tropicalis*
Annual vinca				0 of 1	
Calibrachoa				10 of 17	
Dusty Miller		0 of 10		26 of 26	
Fuchsia			3 of 3	4 of 4	
Gardenia				8 of 8	
Gerbera daisy		0 of 4	33 of 33	0 of 3	
Gloxinia					0 of 2
Petunia	0 of 1			18 of 18	
Verbena		0 of 1		0 of 10	0 of 3
% of isolates resistant to mefenoxam	0	0	100	76	0

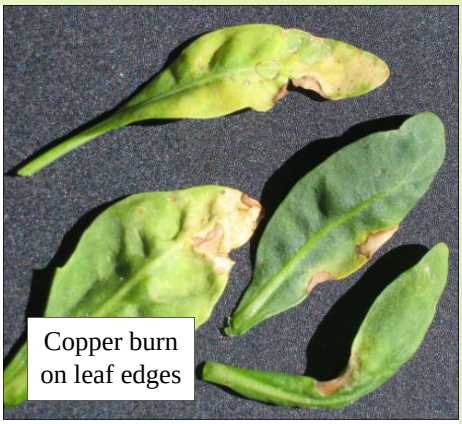
Phytotoxicity Can Steal Your Profits (cont. page 1)

WHAT DOES PHYTOTOXICITY LOOK LIKE?

This is not always easy to answer and that is the real purpose of including a group of water treated plants in any phytotoxicity test. Some of the symptoms I have seen are: tip or edge burns, overall yellowing, stunting, small leaf size, leaf curling and cupping and other distortions, dark green color (typical of triazole fungicides), speckling, delays in flowering and delays in rooting.



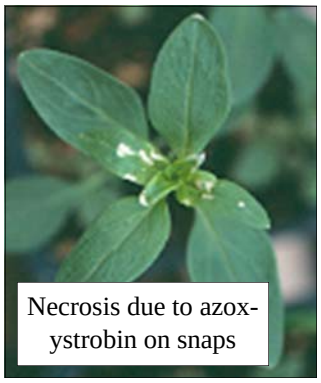
Copper burn on leaf undersides



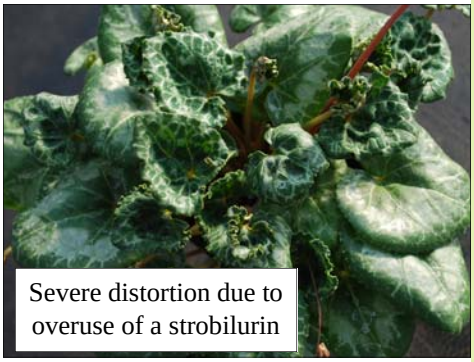
Copper burn on leaf edges

Once you have completed the phytotoxicity test, you can start to use the product in your general production. Since many practices of plant production can increase the chances of phytotoxicity you should remember that a single test may not tell you how safe the product is on all of your plants, all year round. The best ways to avoid phytotoxicity on products that are typically safe include the following rules:

- Do not allow sprays of herbicides outside a greenhouse to drift and do not use herbicides that are known to volatilize to be used in enclosed structures.
- Do not drench with any product that is not specifically labeled for drench applications.
- Try not to apply a copper product when the spray takes a long time to dry.
- Do not spray when it is too hot or too cold. Whenever possible pesticide applications should be made between 60 to 85 F using water at or near the air temperature.
- Do not apply a copper product with an acidic one since this can make too much copper available.
- Never combine products against label directions. This includes using the wrong type of adjuvant.
- If all else fails – read the product label. It is usually a great source of information on how to avoid crop damage.



Necrosis due to azoxystrobin on snaps



Severe distortion due to overuse of a strobilurin

Stunting on alyssum caused by many fungicides

Stunting on gerbera daisy caused by triazoles

Marginal burning on geranium caused by some fungicides