Chase News

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GREETINGS FROM AZ

That is Arizona not Ann Zemke! As we wind down towards the end of the year I'd like to say I'm sure it's been a challenge for most of our industry. It's been a challenge for us as well, both business wise and personal.

First off for those who may not know, Ann and I have made our move to Arizona. We did this starting on Labor Day weekend and then took several moving trips over September mixed in with business travel. I'm glad that's over! The second is, I'd like to reaffirm everyone that **Ann and I are not retiring**; we just moved and will be doing business from Arizona.

On a business level, we will be closing Chase Horticultural Research, Inc. at the end of March next year. Ann and I will be starting our new business with the emphasis on consulting; we'll also focus on producing educational materials such as apps for smart phones and tablets and continue with Chase News, Chase Base and talks of course.

During this transition we will still be available via phone (530-391-3069—Mike and 530-391-3068 and office 928-634-0400) and email (archase@chaseresearch.net and mike at chaseresearch.net). This new business venture is exciting for us and I'm sure we'll be out in force (x2). We have a lot of business idea's to think about and see about the possibilities.

We will have the new business ready to launch on January 1st, so after that you will start seeing some changes in our operations. Again, if you have any questions you can call or email Ann or me.

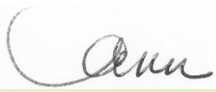
Last, I'd like to say I hope everyone has a safe Thanksgiving. It's the time to put our jobs and everyday stress on hold and just spend the day with family or friends.

Mike

Please take note of our new office phone/fax number: (928) 649-0400.

I spent the first part of this past week in Central Florida at the BWI Symposium.. It was fun to see people I had not seen in 20 years and meet new people. The final day I also got to get out to a tree nursery and enjoyed looking around. Here I am with Dr's Shad Ali (left) and Dave Norman (right) of the Mid-Florida Research and Education Center. They are working on identifying an unknown disease on one of the tree crops.

Happy Holidays!!!



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Research Reviews and News

Susceptibility of Eastern Ninebark to Powdery Mildew—Researchers at the University of Connecticut published results of some trials performed on different cultivars of *Physocarpus opulifolius*) to powdery mildew caused by *Podosphaera aphanis* var. *physcarpi*. They performed tests in 2006 and 2007 with similar results. The table below shows a summary of their work.

Eastern Ninebark	Powdery Mildew Severity
'Nanus'	None
'Snowfall'	Moderate
'Center Glow'	Moderate
'Mindia' Coppertina	Moderate
'Monlo' Diablo	Low-moderate
'Seward' Summer Wine	Low
'Dart's Gold'	High
'Luteus'	Low-moderate
'Morning Star'	Very high
'Nugget'	Very high

The cultivars did not react based on leaf color. The table shows green-leaved forms in green shading, purple leaved and finally yellow leaved. Each leaf color group had a range of reactions, thus making choice of one color over another unnecessary as a means of minimizing disease. For the full report see: J. Environ. Hort. 29(3):105-107 (September 2011).

New Fungicide for Downy Mildew and Phytophthora—Micora (Syngenta) is a new fungicide that is being registered for some uses on ornamentals for control of these serious diseases. The active ingredient is mandipropamid which belongs to the MOA group 40 - a new one for ornamentals. A review published by IR-4 ornamentals program in 2010 showed good to excellent control of lamium, snapdragon and coleus downy mildews. A summary of IR-4 trials with Micora and Phytophthora diseases reported: provided good to excellent control of *P. cinnamomi* on azalea and rhododendron, excellent efficacy on *P. nicotianae*, and good efficacy of *P. ramorum*. Once Micora is registered, I will do a summary of our work with this new product.

Mefenoxam and Pythium Damping-off on Geranium—A team of research from Oklahoma State University and The Pennsylvania State University (Garzon, Molineros, Yanez, Flores, Jimenez-Gasco and Moorman) reported on some very interesting work to determine effects of sub-lethal doses of mefenoxam (active ingredient in Subdue MAXX). They tested a Pythium aphanidermatum isolate known to be resistant to mefenoxam for reaction to "low" doses of the fungicide and found that growth was actually greater when the culture medium contained mefenoxam than when it did not. They also saw that this isolate was able to significantly increase damping-off in geraniums when low disease of mefenoxam were applied compared to the isolate alone. These results indicate that using a fungicide at lower than optimal rates can actually make disease worse when a pathogen is resistant to that fungicide. You could approach this situation by always using the highest labeled rates of a product but resistance might still be present. Another approach would be to tank mix mefenoxam with another fungicide or product to enhance the level of control and prevent increased levels of disease. For the complete report see: Plant Disease 95:1233-1238 (October 2011).

Pythium Root Rot on Douglas Fir Seedlings—The IR-4 program funded a trial (Doe, Central University) on Douglas Fir seedlings to prevent Pythium root rot caused by *P. ultimum* and *P. mammillatum*. In the first trial, optimal control was seen with Subdue MAXX (2 oz/100 gal), Terrazole L (7 oz), Segway (3 oz) and FenStop (10 oz) for both species of *Pythium*. Adorn (2 oz) worked really well on *P. ultimum* but not as well on *P. mammillatum*. Other products including Heritage and Disarm O worked significantly but were not as effective. BW240 and Remedier gave little significant control of either pathogen. The results have been seen before with some products able to provide control of many *Pythium* species while others (like Adorn) very effective on one species but ineffective on another.

Can you tell the difference? - It is very difficult to tell different leaf spots apart. I recently saw a report on a sample of *Nandina* with leaf spots and remembered more diseases from the past.

Bacterial leaf spot (usually caused by *Xanthomonas*) on Nandina (above) and a fungal leaf spot—anthracnose (*Colletotrichum*) (below).

The key differences are:

- Bacteria often have wet-looking spots—appearing greasy.
- Bacteria can invade the leaf veins and spread that way.
- Fungi often have rounded spots
- Fungi may create fruiting bodies in the dead areas—this one shows typical black specks of Colletotrichum.
- Fungi often have very colorful margins—yellow, red or purple.

Unfortunately, bacteria and fungi often infect the same plant at the same time making diagnoses by appearance alone impossible!

Recent Armada Fungicide Trials

We have tested Armada occasionally over the past ten years. Armada is a combination of the active ingredient in Strike (triadimefon) and the active ingredient in Compass O (trifloxystrobin). We also included Terraguard as a possible standard. Armada is not currently available for greenhouse ornamental use but in preparation for this possibility we did a few trials on typical diseases of greenhouse ornamentals.

The first trial was performed using cyclamen and *Colletotrichum* sp. (the cause of anthracnose). Fungicides were applied weekly for a total of four weeks. We inoculated the plants after the first application. In this trial, we did not see a large number of spots perhaps due to the cultivar we choose—'Tianis White'. Another cultivar inoculated with the same fungus at the same time showed severe disease.

Efficacy of fungicides in prevention of anthracnose on Cyclamen

Treatment	Rate/ 100 gal.	# spots 10-3-11	Top grade 10-3-11
Water Noninoculated	-----	0.0 a	3.7 a
Water Inoculated	-----	9.7 b	3.8 a
Armada WDG	3 oz	0.8 a	3.6 a
Armada WDG	6 oz	1.1 a	3.4 a
Armada WDG	8 oz	0.6 a	3.7 a
Compass O	4 oz	0.1 a	3.6 a
Terraguard	4oz	1.3 a	3.5 a

Numbers in the same column followed by the same letter are not statistically different.

All fungicides tested were very effective in preventing anthracnose on this cyclamen. None of the products caused significant reduction in growth although the DMI fungicides (Armada and Terraguard in this trial) sometimes do have PGR effects on greenhouse crops. The top grade showed that none of the products reduced plant quality.

In our most recent trial, we tested control of Alternaria leaf spot on Impatiens. The same treatments were used on a weekly interval for a total of three applications. Once again, plants were inoculated after the first fungicide application.

Efficacy of fungicides in prevention of Alternaria leaf spot on Impatiens

Treatment	Rate/ 100 gal.	Height (cm) 10-26-11	Top grade 10-26-11	# spots 11-1-11
Water Noninoculated	-----	9.2 bc	3.7 d	0.0 a
Water Inoculated	-----	8.8 abc	2.5 a	107.5 c
Compass O	4 oz	8.3 abc	3.3 c	12.5 a
Armada	3 oz	9.2 bc	3.4 c	20.5 a
Armada	6 oz	8.0 ab	3.4 c	19.0 a
Armada	8 oz	7.7 a	3.2 bc	8.0 a
Terraguard	4 oz	7.5 a	3.0 b	12.0 a

Numbers in the same column followed by the same letter are not statistically different.

The disease pressure was extreme in this trial with an average of more than 100 spots per 4 inch pot in the inoculated controls. All three rates of Armada gave very good prevention as did Compass O and Terraguard. There were slight affects on top grade based mainly on severity of the Alternaria leaf spot due to lack of control. In contrast, plant height was affected by the three weekly applications of the high rate of Armada (8 oz/100 gal) and the Terraguard. These results were not surprising based on our research with DMI fungicides over the past 20+ years.

We have completed a few other trials on Armada with very good to excellent results including rust on Bellis (English daisy), rust on Hypericum and anthracnose on sycamore. This winter two more will be conducted (rust on Hypericum in containers and powdery mildew on rose).

Armada was labeled in 2005 for turf and ornamentals in interiorscapes and residential and commercial landscapes. The label lists anthracnose, black spot, leaf spots (like *Cercospora*), downy mildew, powdery mildew, rust and scab diseases on ornamentals in these settings. Remember that Armada is not currently labeled for the ornamentals produced in greenhouse, nurseries or field locations. We hope that the continued interested in testing leads to a label for ornamental production soon.

AVOIDING FUNGICIDE RESISTANCE

Fungicide resistance remains a serious consideration for most ornamental producers. The manufacturers of new products have taken this issue very seriously as well with specific use patterns designed to avoid development of fungicide resistance as long as possible. Despite these steps sometimes resistance develops. It is important to know whether the failure of an application is due to fungicide resistance or if it is due to other factors.

What are the reasons for fungicide failure?

It seems that the first thought is usually fungicide resistance but in reality this is the least likely cause of fungicide failure. The most common reason for fungicide failure is lack of an accurate diagnosis. I often talk to growers who are shooting from the hip on diagnosis often leading to fungicide failure. Once you know what the cause of the disease, you must choose the right product and the right application rate, interval and site. If you don't get good coverage, even the best product used at the right rate, interval and application site will not give optimal results. Finally, if everything else checks out you might be seeing resistance to the fungicide.

Which pathogens become resistant the most easily?

The pathogens that become resistant to fungicides most quickly are those that reproduce quickly and in high numbers. These include powdery mildew fungi (e. g. *Oidium*), downy mildew fungi (e.g. *Peronospora*), *Botrytis*, *Pythium*, *Phytophthora* and bacteria (e. g. *Pseudomonas*, *Xanthomonas*, *Erwinia* etc.).

What are the methods used to reduce the potential for resistance development?

It is important to do everything in your power to reduce disease including using alternative methods – practice IPM. If you do nothing but spray fungicides you are placing too much strain on them and they certainly are more likely to fail. Don't wait – be preventative when necessary. Downy mildew and some bacterial diseases are not easy or sometimes even possible to control if preventative applications are not made. Use products according to their labels – the fungicide manufacturers really do know more about how to use their products effectively than anyone else does. Learn more about important diseases of your crops so you can find their Achilles heel. Finally, rotate or tank mix products.

Is tank-mixing or rotation best?

Most studies have shown that both methods work for resistance management so the preference is yours. If you make a tank mix with two products that control the same disease, then you are doing so to manage resistance. If however, you combine products with different spectrums, you are simply using a shotgun approach. This gives you some assurance you will control an un-diagnosed situation or one that is caused by more than a single pathogen.

I find that many growers like to use tank mixes and that one reason is they think they can reduce costs by using lower rates of the fungicides if they mix them. Sometimes this is true – but not always. You can reduce the rate of fungicides in a tank mix when you are treating preventatively, disease pressure is low, both products work on the target fungus and you are sure you do not have resistance to either product. You should not go below labeled rates in most circumstances. Do not reduce rates when you do not know the cause of the disease, more than one disease is present, the fungicides have a narrow or similar mode of action or the product is new to you.

Examples of fungicide resistance

Last year, resistance to fenhexamid was found in *Botrytis* in Pennsylvania. Research has shown that *Botrytis* is quite likely to develop resistance when products are used exclusively or for a long period of time. Work nearly 20 years ago found *Botrytis* populations which were resistant to both iprodione and thiophanate methyl.

In that same time frame we started to see resistance in some *Pythium* populations to mefenoxam (metalaxyl at the time). This spurred several researchers in the Northeastern states to evaluate many populations of *Pythium* spp. for possible resistance to this active ingredient. The prevalence of resistance seems to be growing although the product (Subdue MAXX) continues to be used extensively throughout the country. In the case of resistance in *Pythium*, the populations do not always become immune but react with lower sensitivity to the fungicide. Sometimes effective use of Subdue MAXX remains through rotations, tank mixes or use of higher labeled rates.

Conclusions

I favor rotation over tank-mixing for resistance management because it can teach you to be a better grower. You have to know what the disease target is and how to use the fungicide. You do not need to know everything about fungicide classes, since using only two products (in different classes) in an alternating routine can go a long way to avoiding resistance development. Rotation also allows you to decide what happened – if the application worked or failed or caused phytotoxicity, at least you can interpret it. In tank mix situation, one never really knows which product or even if the combination is responsible for the reaction. In the end it is a matter of your preference. Whether you choose tank mixing or rotation at least choose one of them.

Crown Gall Prevention on Solidago

We have been working with IR-4 for the past few years evaluating bactericide candidates. Some of these products have worked well in trials for *Xanthomonas* or *Pseudomonas* and even *Erwinia*. However, this year, we performed a trial on *Agrobacterium tumefaciens* on goldenrod (*Solidago*). Crown gall is notoriously hard to affect with bactericides and even soil fumigants do not always work. The disease has been problematic in field grown fruit and nuts trees, roses, cut flowers, woody ornamentals and more recently a wide range of perennials.

This trial started in March, 2011 when goldenrod rooted cuttings were planted in 3.5 inch pots containing Fafard Mix 2B. The plants were fertilized with 1/2 tsp. Osmocote Plus 15-9-12 (8-9 month) the same day. The test was conducted in a heated greenhouse with poly and shade cloth covering the top and sides.

Plants were inoculated with a culture of *Agrobacterium tumefaciens* by spraying onto wounded stem bases on 17 August, 2011. Wounds were made using a sterilized dissecting needle and piercing the stem bases (3-5 per plant). After inoculation the plants were placed into clear plastic bags under mist for 48 hours. The bags were removed and the mist was turned off.

Treatments included:

- Water—noninoculated
- Water—inoculated
- Acibenzolar drench
- Acibenzolar spray
- Citrex
- HM-0736 (laminarin)
- Kasumin
- CG100
- Regalia SC (1%)
- NAI-4201
- ZeroTol (1%)
- Agri-Mycin (8 oz/100 gal)

I have only listed the rates for products you might conceivably use on ornamentals. All of the others are not labeled for use on our crops at this time as far as I know. Most of the products were sprayed weekly starting on 1 August for a total of nine applications. Many of them were applied less often as per manufacturers directions.

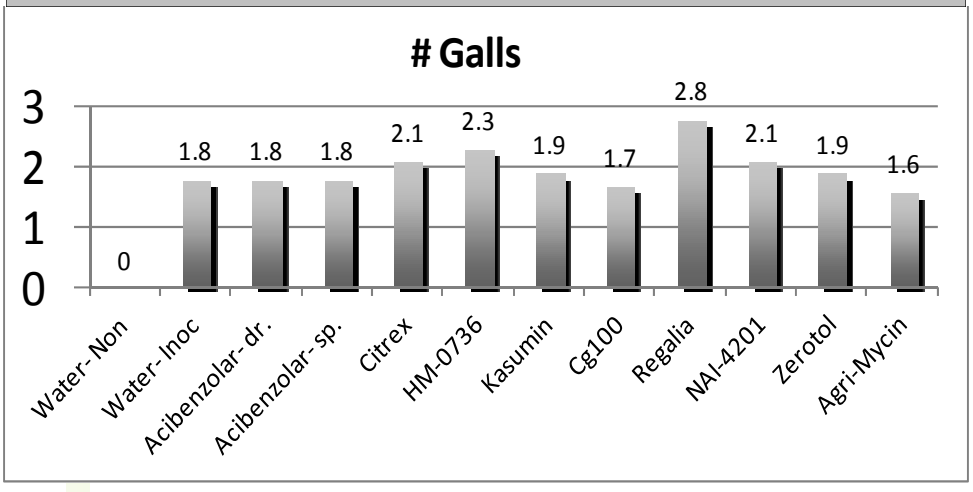
We rated plant reaction (top grade, height) and galls formation. At no time did these products affect the number of developing galls (final data shown in the graph below). We also rated the relative size of the galls at the end of the trial in case that was affected, but it was not. The only distinctive plant reaction was shown by those sprayed with Agri-Mycin which developed severe stunting, tip necrosis and overall very poor quality (image to the right).

Typical galls at base of goldenrod grown for cut flowers (top).

Reaction of goldenrod to repeated sprays of Agri-Mycin (plants on right) compared to water sprayed controls (left) - (below).

So this is very discouraging but not really unexpected. IR-4 has also funded a trial on the east coast for crown gall control on sunflowers. I am looking forward to seeing the results. In the meantime, scouting and roguing diseased plants is the only way to control crown gall on perennials. In the soil, fumigation remains the only effective means but the life of fumigants like methyl bromide is very short now due to worldwide political decisions.

Effect of bactericides sprays on crown gall severity on goldenrod.



Fungicides for Some Azalea Diseases

I recently completed a review of the fungicide work published on diseases of azalea and rhododendron. The summary below highlights this research and I have presented the references so you may research further should you desire.

Colletotrichum (anthracnose)

Hagan et al. and McGovern performed trials on prevention of anthracnose on azalea in Alabama and Florida, respectively in the late 1990's. Treatments in the Alabama trial were applied on a 14 day interval for 4 months. Control was evaluated as degree of defoliation. Optimal control was seen with chlorothalonil, copper, mancozeb and azoxystrobin. Thiophanate methyl (four products included) was not effective in this trial. In 1997, McGovern found very good to excellent control with azoxystrobin and to a lesser degree chlorothalonil. The next year, all products tested gave significant control but azoxystrobin was again the most effective.

- Hagan, A. K., Olive, J. T. and Parrott, Jr., L. C. 1997. Screening of fungicides for the control of anthracnose on azalea, 1997. F&N Tests 53:474.
- McGovern, R. J. 1998. Evaluation of fungicides for control of Colletotrichum leaf spot on azalea, 1998. F&N Tests 54:531.

Cylindrocladium cutting rot

Over the years I have performed a series of trials to control Cylindrocladium cutting rot on azaleas. Products were applied once the day after cuttings were stuck (peat-bark based soil-less medium). They were inoculated one week later with a conidial suspension of *Cylindrocladium scoparium* and rated for disease three weeks after that. Rate of fungicide used affected degree of control but only fludioxonil was highly effective in this trial.

Phytophthora root rot

The largest number of chemical control trials on an azalea disease has been performed on Phytophthora root rot caused by *P. cinnamomi* or Ramorum blight caused by *P. ramorum*. A brief review of some of the most recent trials on Phytophthora root rot on rhododendron shows little control when products (fludioxinil, dimethomorph, cyazofamid or mefenoxam) were applied as foliar sprays with the exception of fenamidone which was effective at higher rates tested (28, 56 oz/100 gal). Applications were made to the point where the potting medium was penetrated as well as leaves and stems were covered. There were a total of 7 applications on a 14 day interval. The same year Benson and Parker reported on control of Phytophthora root rot on azalea with sprays (fosetyl aluminum or phosphites) or drenches (cyazofamid, fenamidone, etridiazole, fosetyl aluminum, dimethomorph or mefenoxam). Products were applied three times on a monthly interval. Excellent control was seen with the sprays listed above or drenches with fenamidone, fosetyl aluminium and dimethomorph.

In 2007, Benson and Parker tested phosphonates on azalea using a monthly interval for a total of three applications. All products tested were nearly 100% effective in preventing root rot: phosphonates (fosetyl aluminum and phoshite), cyazofamid, fenamidone, strobilurins (pyraclostrobin and fluoxastrobin), mandipropamid, mefenoxam and fluopicolide.

- Benson, D. M. and Parker, K. C. 2005. Efficacy of cyazofamid, fenstar, and other fungicides for control of Phytophthora root rot of azalea, 2004. F&N Tests 60:OT013.
- Benson, D. M. and Parker, K. C. 2005. Efficacy of cyazofamid, fenstar, and other fungicides for control of Phytophthora root rot of rhododendron, 2004. F&N Tests 60:OT014.
- Benson, D. M. and Parker, K. C. 2007. Efficacy of registered and unregistered fungicides for control of Phytophthora root rot of azalea, 2006. Plant Disease Management Reports 1:OT001.

Powdery Mildew

A few trials have been reported for eradication or prevention of powdery mildew on azalea. Pscheidt compared a variety of active ingredients in 2000 for control of powdery mildew on deciduous azalea. Treatments were applied four times on a 14 day interval. The most effective product was trifloxystrobin followed by propiconazole. Azoyxystrobin was less effective used at lower rates.

Kenyon et al. reported on fungicide effects on powdery mildew on rhododendron in the United Kingdom. The same active ingredients are not available in the United States at this time. Fenpropidin and penconazole were most effective with the industry standard (bupirimate and triforine) the least effective. Fenarimol, propiconazole and triadimenol (all DMI fungicides) were also very effective.

- Kenyon, D. M., Dixon, G. R. and Helfer, S. 1997. The repression and stimulation of growth of *Erysiphe* sp. on *Rhododendron* by fungicidal compounds. Plant Pathology 46:425-431.
- Pscheidt, J. W., 2000. Comparison of fungicides for control of powdery mildew on deciduous azalea, 2000. F&N Tests 56:OT2.

Rhizoctonia Web-blight

Web blight on azalea (and other woody ornamentals) has been researched primarily in the Southeastern US. In 2001, Hagan et al. reported on iprodione finding moderate levels of control with two formulations (WP and WDG). Another trial compared strobilurins at different rates as well as myclobutanil and chlorothalonil. The trial was conducted in containers in a shade house with products applied on a 14 day interval for three months. In this trial, azoxystrobin and pyraclostrobin were 100% effective. Trifloxystrobin performed similarly and myclobutanil had slight disease development while chlorothalonil was also very effective.

- Hagan, A. K., Rivas-Davila, M. E., Olive, J. T. and Stephenson, J. 2001. F&N Tests 57:OT03.
- Hagan, A. K., Rivas-Davila, M. E., Olive, J. T. and Stephenson, J. 2001. Comparison of Heritage 50W, Compass 50W and Insignia 20WG for the control of web blight on Azalea. F&N Tests 57:OT02.