

## California Weed Science Society Meets

The California Weed Science Society met in Monterey, California January 19-21st. Some of the talks were updates on specific herbicides for use in a wide variety of sites including roadside, aquatics, vegetables, turf and even ornamental nurseries.

There were two talks on liverwort control in containers. Dr. Cheryl Wilen (IPM Specialist at the University of California at Riverside) and Steve Tsjvold (UC Farm Advisor). Dr. Wilen cited two web resources for weed control information:

[www.ipm.ucdavis.edu](http://www.ipm.ucdavis.edu)  
[www.wric.ucdavis.edu](http://www.wric.ucdavis.edu)

Liverworts (*Marchantia polymorpha*) usually are worse when water and fertilizer management is not ideal. Liverworts impeded plant development by using water and fertilizer intended for crop growth and forming a water barrier across the surface of the potting medium. Once the potting medium surface is covered with liverworts, they can cause other problems including runoff of pesticides due to poor penetration of the potting medium. They also

create what Cheryl called a “house” for fungus gnats, snails and other weed pests (see image below).

Liverworts form spores that are spread by splashing water. They are also easily moved by breaking off pieces which can happen during hand removal.

Cheryl and Steve also performed some trials on liverwort control including pre-emergent treatments like herbicides (Broadstar and Sureguard) and mulching with various materials (like mustard seed meal). Their results were different showing that efficacy may be based on growing conditions. Cheryl found no control with Sureguard and Broadstar but excellent prevention with Freehand (granular herbicide from BASF). Cheryl also tested post-emergent control of liverworts finding that freehand had some ability to eradicate liverworts as well as prevent them from developing.

Steve got better results with Sureguard and Broadstar but poor results with the mustard seed meal. Unfortunately, Steve did not include Freehand in his trials.

### Liverwort characteristics

- Like nitrogen
- Need light for spore germination
- Require the potting medium surface to be wet
- Don't like heavy metals like copper, manganese, zinc and iron

Control of liverwort must start with a rigorous scouting program, fertilizer and water management. Use mulches to keep the potting medium surface drier. If you are in an outdoor nursery you can use Freehand as a preventative. Remember that prevention is always more effective and less costly than eradication. You can go to the BASF website for more information on using Freehand in an effective and legal manner.

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Typical mixture of liverwort, moss, algae and weed seedlings under a greenhouse bench.

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# BOTRYTIS THOUGHTS—Dr. George Staby

We have worked with Dr. Staby (PRO Institute) for many years. His specialty is post harvest handling of products like cut flowers. Ann

Botrytis is probably the most common disease damaging floral crops, especially after harvest. While trained as a horticulturalist, not a plant pathologist, I am always asked Botrytis-related questions where people are looking for the “silver bullet” to answer all their Botrytis problems. While such a silver bullet does not exist, there are some basic production and post-production factors that, when properly addressed, can reduce the damages caused by this disease. Presented below are some thoughts to consider in preventing and/or controlling this disease. For those wanting more information about Botrytis from a plant pathologist, then I recommend that you contact the person I always rely on, Dr. Ann Chase.

**Production Identification** - Of prime importance is to determine if any plant and/or flower symptoms that look like Botrytis are in fact this organism. In an ad hoc test conducted a few years ago, over half the time Botrytis was misdiagnosed, meaning that people say it is this disease when in fact it is something else. Thus, use a Botrytis test kit such as one from [www.pocketdiagnostic.com](http://www.pocketdiagnostic.com) to know for sure if the symptom in question is Botrytis. Spraying for Botrytis when in fact it is not this disease can be expensive if not counterproductive.

**Proper fertilization** can reduce the chances of Botrytis problems. For example, adequate silicon (Si) levels can provide physical protection to plants and flowers, while minimizing the use of ammonium nitrate fertilizers can result in less succulent/damaged leaves and therefore again reducing the chances of Botrytis infection.

**Humidity Control** - High humidity and free moisture on flowers and plants promote Botrytis development. Venting humidity out of the greenhouse allows for plant drying and humidity removal is advantageous and should be done at

sunset, especially on clear, cool evenings. The more humidity at sunset, the more that will have a chance to condense on the leaves and flowers, which gives Botrytis a chance to start an infection.

When vents are open, increasing the air circulation during this period by turning on horizontal circulation fans might help force some of the humidity out of the greenhouses, which reduces the amount of water-saturated air going through the night.

Water plants when they will dry the fastest, which is generally well before afternoon, to give the resulting humidity a chance to dissipate and the plants to dry before sundown.

Horizontal air fans should be used to move air around as much as possible and to reduce the humidity immediately around the plants themselves regardless



Botrytis on Alstroemeria

if vents are opened or closed.

**Fungicides** - Thiophanate methyl (or similar products) can be very good for Botrytis but resistance to them is widespread anywhere they have been

used for a few years.

Very active fungicides for Botrytis control are fludioxinil (Syngenta), iprodione (Bayer), a combination of pyraclostrobin and boscalid (BASF) and fenhexamid (Arysta).

Regardless of fungicides used, weekly fungicide applications are needed when conditions are good for Botrytis development. **Always follow the fungicide label!**

#### Summary

- Identification Botrytis first followed by proper fungicide applications
- Silicon levels need to be adequate
- Minimize ammonium nitrate fertilizers
- Venting in evening, especially on clear days
- Horizontal air movement regardless

of venting

- Irrigate at the correct time of the day to promote rapid drying of flowers and leaves.

#### Harvest and Postharvest (background)

This is the last place where an effective control can be applied. All of the cultural methods noted above are fine but they are much less important than controlling the level of Botrytis inoculum on the flowers and plants themselves just after harvest.

The benefit of rapid cooling for controlling Botrytis is proven, as it can slow down the infection process. For example, rapid (30 minute) strawberry cooling after harvest resulted in 40% less Botrytis than when cooling took place over a six-hour period. Subsequently, keeping them cool is absolutely critical during shipping to keep them healthy.

Dipping with a combination of pyraclostrobin and boscalid (BASF Corporation) has provided excellent results, as long as the dip solutions are changed routinely as directed by the label. Electrostatic spray systems should be tested, as they can result in better coverage than traditional spraying and the use of fewer pesticides. One source for such sprayers is <http://www.maxcharge.com/>.

Determine if using bleach (sodium hypochlorite) or peracetic acid sprays/dips work for you. Using chlorine dioxide releasing paper can significantly reduce the spread of Botrytis during storage and/or transport but will not kill the pathogen.

#### Summary

- Minimize water usage to keep flower and plant surfaces dry
- Precooling to proper temperature as soon as possible (except some lily cultivars)
- Proper fungicide treatment, test electrostatic type sprayers
- Minimize temperature fluctuations so dew points (condensation) are not reached
- Test the efficacy of chlorine dioxide releasing paper under your conditions

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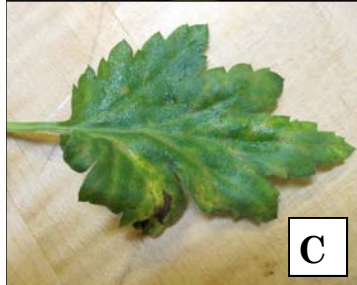
# WINTER WOES



A



B



C



D



E

There are a number of diseases that are showing up over the past few weeks. They are more prevalent during the winter in many cases. Some of them occur in the winter when wet conditions prevail and others show up because of the cold temperatures. Still others develop because the plant they are attacking is weakened by winter conditions.

Many trees and shrubs are afflicted with cankers and dieback that start to appear over the winter. The worst symptoms may not develop until spring but they can start in the winter. We have been working on Nectria and Fusarium cankers and are doing a couple of field trials in California. The first image (A) shows active sporulation of Nectria on elm. Our trials are concentrating on Heritage, Medallion and Pageant. I will be reporting results in the early summer.

You can also expect to see plants with water imbalances that result in edema. The ivy shown in (B) has typical blisters that resulted from cold potting medium and warmer leaves. Under these conditions, the excess water is pulled into the leaves but since it is not used ends up causing blisters.

We are also seeing many viruses including the Tospoviruses—INSV and TSWV (C, D and E). In many parts of the country, the weeds outside a greenhouse may die down and force insects populations in the warmer shade houses and greenhouses. These thrips may be carrying Tospoviruses into the greenhouse crops. Be sure to stay on top of thrips control to minimize virus transmission. We are seeing other viruses too such as this Tobacco Mosaic Virus on liners of Iberis.

Finally, watch for the winter pathogens—especially Botrytis and Sclerotinia. These petunia were infected with Sclerotinia but did not show the characteristic black sclerotia until we cultured from them. The best product for Sclerotinia blight in the trials we have conducted and seen reported is Pageant. It is also excellent on Botrytis and since both can occur at the same time on a crop, it is a good choice. Be sure to rotate with another fungicide mode of action group. These include Chipco 26019, Medallion and Daconil (non-flowering).

- A—Nectria on Elm
- B—Edema—English ivy
- C—TSWV on aster
- D—TSWV on mum.
- E—INSV on snapdragons.
- F—TMV on Iberis.
- G—Sclerotinia blight on petunia



F



G

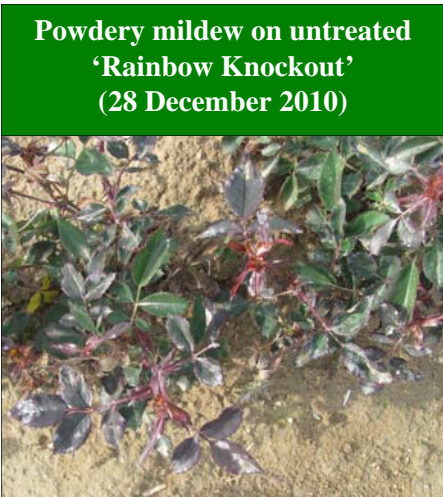
# IMPROVING STROBILURIN EFFICACY WITH ADJUVANTS with Gary Osteen

We have been working down in field-grown roses for the past few years with our partner Gary Osteen. Gary is a Pest Control Adviser in the Bakersfield, CA area who has worked on roses quite a bit over the years. The trial was designed to evaluate ability of a newer adjuvant specifically designed for strobilurin fungicides. We decided to test it for rose powdery mildew control. We did this trial the first time last spring and the weather became too dry for powdery mildew to remain active. So we started over again in late November only to have the unusual rainfall almost wipe it out again.

The treatments included:

- Water only
- Heritage (1 oz/100 gal)
- Heritage (1 oz) and Bond MAX (4 oz)
- Heritage (1 oz) and Franchise (32 oz)
- Pageant (12 oz)
- Pageant (12 oz) and Bond MAX (4 oz)
- Pageant (12 oz) and Franchise (32 oz)
- Disarm O (1 oz)
- Disarm O (1 oz) and Bond MAX (4 oz)
- Disarm O (1 oz) and Franchise (32 oz)

We used 'Rainbow Knockout' that had moderate levels of powdery mildew when we started the trial. Products were applied three times on about a weekly interval starting on 18 November and ending on 7 December. Due to the rainfall, we could not get into the fields until 28 December when we did make our final rating. We rated severity of powdery mildew and degree of new growth. Disease was rated on the following scale: 1(none), 2 (slight), 3 (moderate) and 4 (severe).



seen with the addition of Bond MAX in this trial. Franchise dramatically improved powdery mildew control with Heritage on roses. We have often wondered why Heritage has not been as effective on rose powdery mildew as on other powdery mildew in our trials. It may be strictly a matter of using the right adjuvant. It was further very interesting to see that Pageant was exceptionally effective with or without any adjuvant.

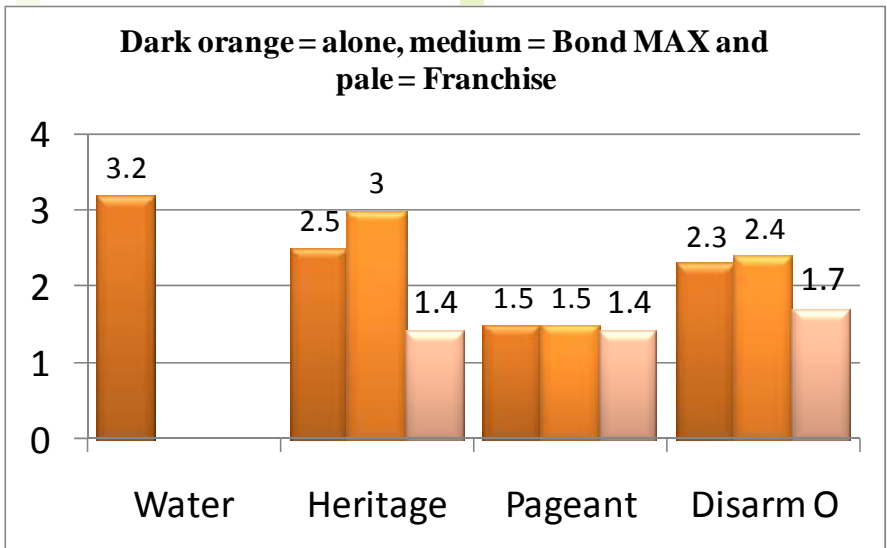
None of the treatments significantly affected the development of new growth on roses in this trial (data not shown). Thus neither the treatments or the degree of powdery mildew had affected new growth during the trial period.

Gary and I have found that revisiting "finished" trials leads to increased understanding of long-term affects of

The best control of rose powdery mildew was seen with Pageant treatment alone or in combination with either Bond MAX or Franchise (graph below). Indeed, there was no added benefit of the adjuvants when Pageant was used. In contrast, both Heritage and Disarm O were more effective on powdery mildew control on rose when Franchise was added. This was not

*"Franchise dramatically improved powdery mildew control with Heritage on roses"*

disease control on roses. We plan to check this plot out again and see how the plants are growing out over the next few months.



Disease was rated on the following scale: 1(none), 2 (slight), 3 (moderate) and 4 (severe).



# RESEARCH REVIEW

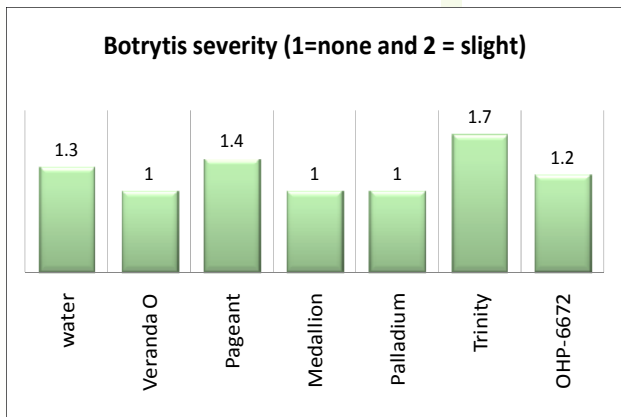


Botrytis sporulation

**BOTRYTIS ERADCIATION ON VERONICA LINERS**—We had some *Veronica* ‘Inspire Blue’ liners that slowly developed Botrytis blight in November last year. We decided to see how effective some of the best Botrytis products might be in eradicating the outbreak.

The following treatments were used:

- Water
- Veranda O (8 oz/100 gal)
- Pageant (12 oz)
- Medallion (4 oz)
- Palladium (6 oz)
- Trinity (8 oz)
- OHP-6672 (16 oz)



Plants were sprayed twice on a weekly interval (17 and 24 November) and we rated Botrytis sporulation on 29 November. The graph above shows the data. It was rated on a scale of 1 (none) to 2 (slight) and 3 (moderate). None of the plants showed even a moderate level of *Botrytis*. However, the fungicides that worked best were Veranda O, Medallion and Palladium. These three products eradicated *Botrytis* sporulation in this trial. Medallion and Palladium share a common active ingredient (fludioxinil) and Veranda O contains polyoxorim.

**BORATE FOR ANTHRACNOSE CONTROL ON MANGO**— Researchers in China recently published on some work to determine if sodium borate was effective in preventing post-harvest anthracnose on mango fruit. The pathogen is *Colletotrichum gloeosporioides* which is one of the most common causes of anthracnose on ornamentals too. Use of borate (K2B4O7) on trees improved fruit set and decreased incidence of anthracnose on harvested fruit. Borate itself inhibited germination of spores through a variety of means. The authors suggest that borate might be a good alternative to use of synthetic chemicals. Apparently, borate is used on a variety of fruit crops to inhibit diseases including Botrytis and blue mold (*Penicillium*). It might be a good idea to test borate for use on bulbs and/or cut flowers and foliage. For a complete report see: Shi et al. 2011. Plant Disease 95:63-69.

**EFFECT OF PLANT GROWTH REGULATORS AND FUNGICIDES ON SCLEROTINIA**— One of the most common diseases of turf in the US is dollar spot (*Sclerotinia homeocarpa*). Researchers Ok, Campbell-Nelson and Jung reported on their research evaluating fungicide resistance of the common pathogen. They found that there was a significant correlation between resistance to one mode of action class and others. Multiple and cross-resistance has developed in *S. homeocarpa*. There was a high correlation between resistance to DMI fungicides (propiconazole, triadimefon, myclobutanil, metconazole, triticonazole and tebucaonzaole) and two PGRs (flurprimidol and paclobutrazol). They suggest that use of these PGRs might actually increase chances of resistance in *S. homeocarpa* to the DMI fungicides that are so commonly used on turf. We have previously believed that switching between MOA groups can aide in resistance management but in turf at least this is not always true. Resistance in one MOA group speeds development of resistance to another. For the complete report see: Ok, Campbell-Nelson and Jung. 2011. Plant Disease 95:51-56.

**XANTHOMONAS BLIGHT ON POINSETTIA**—I was really interested to see a report on *Xanthomonas* leaf spot and blight on poinsettia from Slovenia in 2009. The disease was initially found on ‘Christmas Feeling’ but seen on other cultivars subsequently. Rating the percentage of affected cuttings showed the following: ‘Christmas Feeling’ (10%), ‘Crazy Marble



Xanthomonas on poinsettia

Star’ (90%), ‘Crazy Christmas’ (35%), ‘Lemon Snow’ (10%) and ‘Cortez Red’ (5%). I don’t know of anyone who has initiated studies on the *Xanthomonas* outbreak in the US last fall. It appears that this disease may become a more common feature of poinsettia production than it has been over the past 20-30 years. For a complete report see: Dreo et al., 2011. Plant Disease 95:70.

**KASUGAMYCIN FOR BACTERIAL SPOT ON TOMATO**—We have worked on kasugamycin for the past 3-4 years in a variety of trials for bacterial diseases on ornamentals. Vallad et al. published a series of experiments to evaluate the benefit of alternating or tank-mixing kasugamycin (a newer antibiotic-Kasumin 2L) for control of bacterial spot on tomato caused by *Xanthomonas campestris* pv. *vesicatoria*. Greenhouse and field trials found that although it was as effective as the standard copper-mancozeb treatment it was not better either used alone or as a tank-mix. Rapid resistance development to antibiotics is considered a limiting factor in long-term use of this antibiotic. The complete report is: Vallad et al., 2010. HortScience 45(12):1834-1840.

In ornamental trials with kasugamycin we have seen good control in only one of the twelve trials. Further work on ornamental pathogens is planned by the IR-4 Project for the 2011 season. We are hoping to test products for crown gall.

## APPLICATION RATE, INTERVAL AND TIMING

Last September, I wrote the following article and it was published in **Greenhouse Grower**. I am sure that this title is pretty dull but if you do not pay attention to these aspects of fungicide use, you will be wasting A LOT of money and end up pretty irritated.

### Does rate really matter?

I always ask what rates are being used to treat a disease before I try to suggest a control strategy. It is interesting to me how often the rates being used are too low to be effective. You might as well be spraying water if you use too low a rate. Remember, that water is not neutral but something that fungi and bacteria thrive on. So spraying very low rates can end up with more disease and not less.

### How do you decide the rate to use?

After doing fungicide trials for over 30 years, I have seen some cases where a lower rate is more effective than a higher rate. One of the best examples in our trials has been the negative effect of using the highest labeled rate of Aliette for downy mildew. When I first moved back to California I heard how this fungicide was not effective on downy mildew even when used at 5 lbs/100 gal. I set out to find out the reason and discovered after a couple years that the most effective rates were 1-2 lbs/100 gal and if the rates were increased to 5 lbs/100 gal, the degree of disease control was less. Only testing in your facility will tell you what the best rate is so I always suggest starting in the middle of label rates when testing a new product.

Higher efficacy at a lower rate may be due to unseen or un-detected phytotoxicity. Some pathogens – such as *Botrytis* - take advantage of stressed plants and are worse when the plant is damaged. This is seen when copper fungicides are used when they cannot dry quickly. The resulting burn can end up infected with *Botrytis* and actually more disease. Read the labels and stay in the middle of the road – at least the first time around.

In a *Rhizoctonia* cutting rot trial, we saw that one of the three fungicides tested was slightly more effective at the highest rate tested while the other two gave the same degree of control at all labeled rates tested. Rates on fungicide labels reflect the summation of many trials conducted all over the US and sometimes all over the world. Rarely,

I find that the rates are not what our trials have shown. Sometimes they might be lower than our trials indicate are effective and at other times they are higher. The bottom line is you must use the rates on the labels and if they are not working for you then switch fungicides.

### Can I reduce rates when I tank mix?

Nope – this is especially true if you are adding two MOA groups to manage development of resistance. One of the ideal ways to actually develop resistance is to use a low rate of an active ingredient many times without rotation. This stresses the fungus or bacterium just enough to allow the strains with higher resistance to that active ingredient to develop. Since you probably do not want to promote fungicide resistance, try to avoid using lower than labeled rates. In other cases, tank mixes are designed to expand the range of the spray. For instance, if you are applying something for *Pythium* and something different for *Rhizoctonia* and you decrease both rates you are once again applying water.

### Stretching the Interval to the Breaking Point

This is another experiment that commercial growers should not do. The result of applying products less frequently than suggested on the label is an outbreak of the disease. It is always harder to stop a disease that is active than prevent one. Unfortunately we have seen some situations, such as certain anthracnose diseases and *Fusarium* crown rot, where applying products too frequently makes the disease worse. This is due to a combination of the fact that every application adds water and as I said earlier fungi like water and phytotoxicity on the crop. *Fusarium*, *Botrytis* and anthracnose fungi like *Phyllosticta* take advantage of damaged leaves and stems. Phytotoxicity is always a function of rate and interval with a sensitive plant.

The interval must be based on how severe disease pressure is. The interval changes with the crop age and also the weather and only experience can tell you when a one week interval is needed instead of 2-4 weeks.

### When should I start spraying?

The old saying ‘An ounce of prevention is worth a pound of cure’ has been around for a very long time because it is correct. The key question is when will disease start? Knowing the weather that promotes certain diseases allows us to time treatments to occur right before disease might occur. You can avoid this guessing game somewhat if you are an excellent scout. If you can see the very first signs of disease, many times, that is the best time to start treatments. However, there are some diseases that cannot be cured no matter how fast you react and they should always be prevented.

It is especially critical for crops like poinsettias that have a narrow target market time. I always suggest applying products when the particular disease is most likely to be present or at the final date you can apply an effective treatment. On poinsettias, *Rhizoctonia* cutting and stem rot only causes significant losses during the rooting and first month of production phase. Using fungicides for *Rhizoctonia* rot for the entire 3-4 month production cycle is a costly and wholly unnecessary step. The late season *Botrytis* stem rot that is sometimes found is often confused for *Rhizoctonia* stem rot. Once poinsettias have closed their canopy you cannot apply a spray to their stems for *Botrytis* stem rot. So an application of something for this disease must occur right before the canopy closes for best effect.

### Conclusions

Deciding what to spray, how much, how often and when to start is a tough set of answers to come up with. It takes years of experience and constantly learning to be a great grower. Only you can make sure your efforts are successful. There are no magic bullets—just great growers.

- Does rate really matter?
- How do you decide the rate of use?
- Can I reduce rates when I tank mix?
- Stretching the interval
- When should I start spraying?

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