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Botrytis - Taking The Big Image Approach To Preventing This Common and Avoidable Disease

Botrytis has been an issue spring 2015 and for some it was a big surprise. Botrytis can be avoided! Prevent future outbreaks by planning ahead and implementing some protocols from the crop start to finish. Establish a treatment course of action too!

Botrytis is back on the radar, and its being seen across the U.S. due to the lengthy weather issues. Several of my colleagues have published articles in local Extension newsletters (referenced at the end of this Alert). Every greenhouse owner experiences *botrytis* infections. The disease is ubiquitous, hiding in every cement crack and fragment of spent flower. However, there is ALWAYS a reason why the infections have had a chance to get established, and this includes the recent outbreaks that have been brought to my attention. When I discuss actions taken just weeks before, it becomes apparent many growers set themselves up to have an issue by changing something up, or ignoring something they knew needed to be addressed. Let's look at this from a

Figure 1. Classic petal spotting caused by Botrytis infection on a petunia hybrid. Soft, thin tissues such as flower petal tissue are particularly susceptible. (Photo Credit: Owen Garret and Roberto Lopez, Perdue. Univ.

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non-plant pathologists view and go over the big-image items. I will then ask my colleague, Dr. Jean Woodward to give us some treatment and preventative program guidelines.

Historic Weather Pattern

I can only share with you my experience given every part of the country has different micro-climates. We know in the South that from November through February, we will be cool, sometimes cloudy, with occassional fast-moving storms. *Botrytis* is not usually a huge problem except for Poinsettias, as crops are immature, the heating units are often on at night, and with those comes good, dry air circulation. Without fail, come mid-March, growers decide to save money and turn down, or turn off the heat. This is also about the time we see the resurgence of gulf moisture, and wild swings in temperature (The Spring "Swing" - See E-Gro Alert 3-15). Worst of all, the HAF fans are turned off at night to save money. This is also the time many crops such as Geranium start growing into each other. Reduced air movement in the seedling/young plant canopy, high humidity, wild swings in temperature equal a perfect environment for *botrytis*.

Figure 2. Botrytis infection of plug tray seedlings. This infection likely started with dead or dying leaves and spread quickly underneath the canopy.

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When I lived in Pennsylvania, we had months of cloudy, cold weather and we worried about disease 24/7...and like clock-work the botrytis issues used to pop up the week before Mothers Day. Folks were busy, things were warming up, humidity rose and crops were dense....same scenario. So this begs the question. How do you handle the shift from active heating to ambient air venting, and in the south, to active cooling. All of these operational modes change the relative humidity and air flow. How many folks have an anemometer that can measure humidity levels, air flow? They are not expensive and can help you understand the times of year you need to be vigilant and reduce relative humidity.

Crop Planning & Growth

Every grower knows the trade off between spacing plants out by the "text book recommendation," and the reality of profit generation. Growing pot to pot, or when growing plugs, or young cuttings, is fine...until the adjoining leaves start overlapping. It's not about light. It's about micro-climate! We all know if we wait too long, plants stretch when grown too close together.

Figure 3. Characteristic necrosis caused by botrytis infection of cut or broken plant tissues. Photo Credit: Professor Mary Hausbeck, Michigan State University

Figure 4. Classic infection of Geranium leaves, likely preceded by infection of senescing flower clusters or hanging baskest debris nearby.

Figure 5. Young Oenathera speciosa seedlings affected by Botrytis due to crowding and poor air circulation within the plant canopy. HAF fan was on 24/7 nearby.

However, by that time you've already had a week or two of high humidity within those spaces between the leaves. The time to space plants out is criticial to *botrytis* control. If you document crop losses and assign economic value, spacing them out properly a week earlier will likely save you money, not cost you. Schedule that labor!

Crop Placement

After 25 years as an Extension Specialist, it is very obvious which plants are the most susceptible, or are the most likely to have that first *botrytis* infection.By tracking what crops show botrytis in your facility, and when that infection is first seen, you can group plants that you know will require frequent scouting and perhaps institute a preventative treatment program. I understand plug shipments come in out of the order you had hoped for, but making that extra effort not to fragment crops such as Geraniums, will go a long way to make disease supression more efficient. Fragmented crops tend to be mis-spaced and may be treated more like adjoining crops.

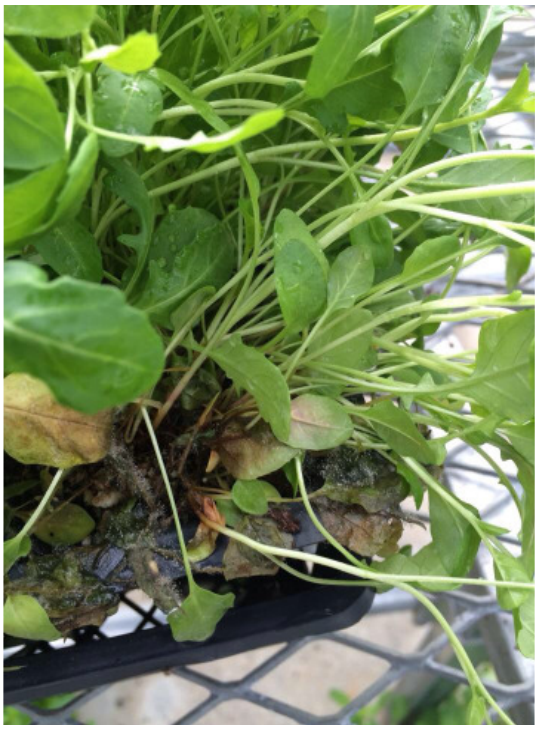

Figure 6. Another image showing the development of Botrytis, and the obvious stretching of seedlings starved for air and light due to crowding and delayed planting.

Figure 7. A significant infection of Botrytis on lettuce. The infection likely started at the matt/soil stem interface due to lack of air movement and high humidity.

Crop Susceptibility

Any plant pathologist can and will tell you that *botrytis* is an equal opportunity infector! Almost any senescing tissue from plants can be infected. Given this fact, its critical to base control strategies on identifiying susceptible crops where the disease most often starts. Scouting and keeping records is the only cure for being blindsided by Botrytis infection.

Sanitation Policy

Ok, everyone tries to keep a clean greenhouse. The issue here is preventative sanitation. Most growers can't take the time or devote the labor to deadheading early Geranium flowers. However, because you know those dying early flowers are out there, your sanitation policy should be that that greenhouse is carefully sanitized pre-planting, and the scouting program fof that cropshould be vigorous! Even during high crop turn-over situations such as exhists with bedding plant growers, an effort to clean up after the current crop ships before moving the next turn into that space

can significantly reduce issues.

Air Flow Pattern

Air flow is tricky. Most greenhouses have HAF fans (or should) and have some sort of unit heating system. If you watch the pattern of air movement, it can often change dramatically from the heating vs the passive air venting season. Cool Pads change the air flow very significantly. With each change, some areas of your houses may not be getting the air flow it was receiving just weeks before. This can lead to surprises as we are all creatures of habit.

The best time to evaluate is NOW when crops are almost mature and the houses are full. Are baskets blocking flow? Is a tall crop blocking flow? Are the vents/fans adequate to allows a slight breeze in the house?

Relative Humidity Control

The key to controlling *botrytis* is to reduce and control relative humidity. Remember, the "relative humidity" is the ability of air to hold moisture at a certain temperature. The warmer the air, the more moisture it can hold, the less moisture settles on leaves, flowers etc. The cooler the air, the less humidity it can hold. Holding moisture is GOOD. Lowering air temperature without reducing humidity is a problem! When your moist greenhouse air cools, tiny droplets of condensation can form on the leaves. Condensation and micro-climate saturation of air pockets in cool, cloudy weather, in greenhouses without HAF

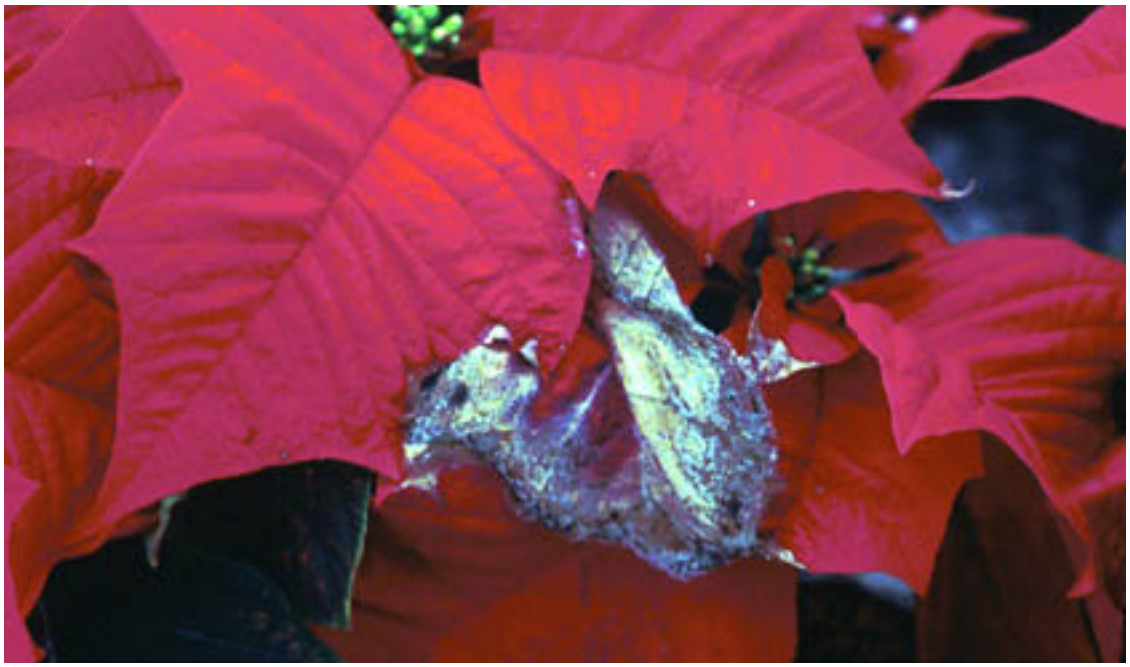

Figure 7. Botrytis infection on poinsettia. Rapidly shifting temperatures, cooler nights with rising relative humidity and the high desity of the bract canopy can be a perfect combination for disease occurrence. HAF fans are essential, and a preventative program is recommended. Photo Credit: Brian Whipker, North Carolina State University.

fans running, with crops jammed up against each other...is what *botrytis* spores live for!!!

Tina Smith, and John Bartok, professors at the University of Massachusettes, published a great article on reducing humidity in the greenhouse. Interestingly, a greenhouse at 86 degrees F can function without a great promotion of *botrytis* with a 95% relative humidity level. Of course, less humidity is better...far better. However at 55 degrees F, the limit to relative humidiy drops to 86%. Remember, we are talking microclimate humidity in the canopy here. The basic idea is that the cooler you keep night temperatures to save money, the more air flow you need and the drier your greenhouse air must be!

Here is a synopsis: 1) Water in the morning. 2) Maintain air flow 24/7. 3) Monitor condensation on plastic greenhouse coverings, and side walls. 4) If condensate is seen, implement the pulse heat, full vent policy described by Smith and Bartok. Also do this when algae appears on walks/side wall plastic, or when fungus gnats are thriving. These itemsignal you have a wet/humid greenhouse that needs drying out. This heat/vent procedure is absolutely essential prior to 6:00 pm if/when dropping night temperatures below 60 degrees F.

The take home message is that pulse heating and venting a greenhouse will cost you far less than the cost of fungicides and lost profits from disease.

Petunia flower discoloration and petal necrosis caused by Botrytis. Those assigned to scouting need to be trained to look for more than just fuzzy grey mold.

Scouting!!!

Plants pathologists will scold me for not placing this item highter on the list. Scouting is everything! There are growers whom do not institute preventative spray programs, or whom have customers that wish minimal pesticides be applied. By scouting and taking control of your environmental issues, you can reduce the chances of an infection of *botrytis* spreading.

So what do you scout for? 1) Anything turning yellow or dying (senescing) as this will be the food for *botrytis*. 2). Pay close attention to the under sides of tight canopies such as plug trays, crops that are close to needing spacing, dense floral clusters of all types, including Cyclamen, Mums, Geraniums, and any other highly petalled crops. Just the tiniest presence of petal spotting and leaf discoloration can be indicators. 3) Scout for any fuzzy grey patches on stem or even on the soil near the base of the plant. It may be something other than *botrytis*, but telling the IPM/BMP manager you have something is critical. Be familiar with other *botrytis* symptoms, such as flower spotting, leaf tip yellowing, and leaf curl that can be associated with developing infections of *botrytis*. Keep records! The scouting effort is less effective when records are not kept! Remember: Who what where when why and how. Then go back and note treatment and outcome.

Response/Preventative Fungicide Program

It is inevitable that you will see infections of *botrytis*. Many growers should consider both a response program, and a prevetative program as part of every crop BMP.

Botrytis Management with fungicides

Botrytis disease development is almost guaranteed with some floriculture crops. Preventative fungicide applications can help reduce disease incidence and severity. However, fungicide resistance is known for *botrytis* populations. Therefore, some fungicides will work more effectively than others in individual greenhouses. To reduce fungicide resistance development, it is recommended to tank mix or rotate fungicides with different modes of action.

To make it easier to identify different modes of action, the Fungicide Resistance Action Committee (FRAC) numerically grouped fungicides with different modes of action. The numerical group is listed on fungicide label. It is recommended that growers rotate (preferred) or tank mix fungicides from different FRAC Groups.

Resistance is known for fungicides in FRAC Group 1 (benzimidazoles), which includes the often used thiophanate methyl. It is also known that *botrytis* isolates resistant to thiophanate methyl are also cross-resistant to fungicides in FRAC Group 2 (dicarboxi-

mides) with the active ingredient, iprodione. For this reason, these fungicides are often not solely recommended to for use in *botrytis* management. To reduce fungicide resistance development for all fungicides, do not apply more than two consecutive applications before rotating to another effective fungicide with a different mode of action.

The most effective fungicides against *botrytis* are fenhexamid (Decree), chlorothalonil (Daconil), fludioxinil (Medallion), and iprodione (Chipco 26019). Very little phytoptoxicity has been reported with fenhexamid. Chlorothalonil is very effective; however, it can cause some phytotoxicity to blooms. Chlorothalonil is also available as a smoke dust (Exotherm Termil) that is very effective in enclosed greenhouses. When using smoke products, phytotoxicity can occur when canisters are placed within 6-10 feet of flowering plants. Fludioxonil is also excellent in Botrytis management; however, stunting and yellowing of geranium cultivars has been reported. When *botrytis* infection is present, a tank mix of chlorothalonil and iprodione is very effective. Then, rotate to a fungicide with a different mode of action (different FRAC Group). Use higher rates and/or shorter intervals when *botrytis* infection is present and conditions are conducive for disease development. Lower rates at longer intervals should be used for preventative applications. Always read labels for use restrictions and always use products according to labeled rates and directions.

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Fungicides Labeled for Managing Botrytis Disease Development.

FRAC Group	Chemical Name	Brand Name	Rating*	Notes
1	thiophanate methyl	Cleary's 3336	F	Fungicide resistance known.
2	iprodione	*Chipco 26019 Iprodione Pro 2SE*	G-E	Fungicide cross-resistance with benzimidazole (FRAC 1) is known.
3	triflumizole	Terraguard SC	G	Use high rate for initial application and heavy disease pressure. Do not use on impatiens plugs.
3	triticonazole	Trinity TR	G	Elevate container above the plant canopy and clear a 6 ft. area around can. Shut off exhaust and close vents. Repeat at 7 day intervals up to 3x per crop (2x for pansies).
11	azoxystrobin	Heritage	F-G	For suppression only.
11	trifloxystrobin	Compass O	G	Use preventively.
11	fluoxastrobin	Disarm O	F-G	Use preventively.
11 + 7	pyraclostrobin + boscalid	Pageant	F-VG	Use preventively.
12	fludioxonil	Medallion	E	May stunt or yellow some impatiens, New Guinea impatiens, and some geranium cultivars. Do not apply to leatherleaf fern.
9 + 12	cyprodinil + fludioxonil	Palladium	G	Do not apply to leatherleaf fern.
17	fenhexamind	Decree	E	Do not make more than two consecutive applications.
M5	chlorothalonil	Daconil Ultrex Exotherm Termil	E	May discolor flowers/bracts.
M5 + 1	chlorothalonil + thiophanate methyl	Spectro 90WDG	P-G	May discolor flowers/bracts.
M3	mancozeb	Dithane 75DF Fore 80WP Protect DF	G	
M1	copper hydroxide	CuPRO 2005 T/N/O, Nu-Cop	F	
M1 + M3	copper hydroxide + mancozeb	Junction	F	
M1	copper salts of fatty and rosin acids	Camelot O	F	Discoloration of blooms may occur. Do not spray just before or during bloom periods.
M1	copper pentahydrate	Phyton 27	F	

* Efficacy ratings are based upon published disease management reports; where P = Poor; F = Fair; G = Good, VG = Very Good; E = Excellent Botrytis control when used according to labeled rates and directions.