

2016/2017

DISEASE CONTROL GUIDE

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 **BASF**

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A SUPPLEMENT TO:

Greenhouse
MANAGEMENT

SPONSOR LETTER

The pace of change in production horticulture challenges even the most progressive growers. BASF is committed to providing valuable and timely information about grower solutions to keep up with change and help growers produce the highest quality ornamentals. Once again, BASF is pleased to partner with *Greenhouse Management* to produce this Disease Control Guide for the ornamental industry.



Our goal in this publication was to assemble and deliver the best information available from around the country to help growers make the best decisions for their operations to yield the highest crop quality and drive business profitability. Resources like the Disease Control Guide bring the most up-to-date information about resistance management and solutions that validate the range of cultural practices that really work.

BASF is driven to create chemistry that is innovative and moves the industry forward. **Orkestra™ Intrinsic®** brand fungicide, our latest introduction to the Intrinsic line, offer growers long-lasting, broad-spectrum disease control throughout the production cycle, and delivers plant health benefits to enhance resistance to stresses such as drought, heat and shipping. Visit betterplants.basf.us to learn more about how growers improve the health, quality and visual appearance of their crops with BASF fungicides, herbicides, insecticides and biologicals.

BASF takes the lead as a manufacturer that possesses the depth and breadth of research and development resources to deliver pest management solutions to meet the ever-changing industry challenges of today and tomorrow. We look forward to hearing from you how the Disease Control Guide sponsored by BASF is working to serve your professional horticulture education and reference needs.

Grow healthy,

Joe Lara

Sr. Product Manager, Professional & Specialty Solutions

BASF

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On cover: Fusarium stem cankers on Kalanchoe

Introduction

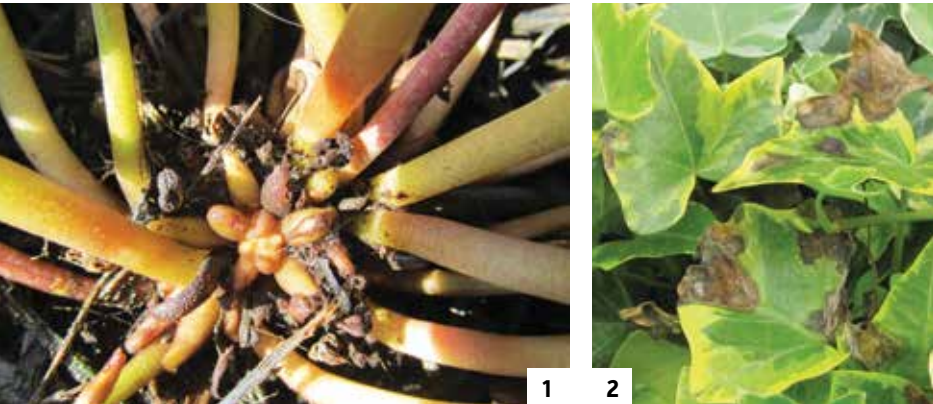
By Dr. A.R. Chase

The following is a quick reference guide to some of the best products for control of greenhouse ornamental diseases. They were chosen based on research trials conducted over the past 30+ years. For some diseases, I have listed many choices and for others only a few. My intention is that you check the FRAC group and choose two or three from different FRAC groups for a rotation. If a product has one of the same FRAC groups as another in a rotation, you are not rotating — pick a different number. Don't use them all as this will just confuse the issue of what is safe and what is working. I have listed the products by FRAC group so there is no preference based on order of listing.

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Sclerotinia causes crown rot in dianthus.



- 1. Anthracnose on Cyclamen can affect immature leaves.
- 2. Anthracnose on English ivy
- 3. Anthracnose on hydrangea causes circular spots.



Anthracnose

Pathogens: *Colletotrichum*, *Gloeosporium* and *Glomerella* spp.

Symptoms: leaf spot, crown, stem and cutting rot, sometimes dieback

Occurrence: from propagation through finishing, year-round

Common hosts: cyclamen, hydrangea, foliage plants like ivy

Best products to choose for a rotation:

| FRAC GROUP | PRODUCT |
|------------|---|
| FRAC 3 | Trinity or Eagle |
| FRAC 11, 7 | Pageant Intrinsic or Orkestra Intrinsic |
| FRAC 12, 9 | Palladium |

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- 1. Erwinia soft rot on Calla lily
- 2. Erwinia soft rot on Phalaenopsis
- 3. Xanthomonas causes a systemic leaf spot on many aroids like Aglaonema.
- 4. Pseudomonas blight on Gerber daisy

Bacteria

Pathogens: *Pectobacterium* (=Erwinia), *Xanthomonas* and *Pseudomonas* spp.

Symptoms: leaf spots, blight, cutting rot and wilt

Occurrence: often in propagation and any time when crops are under overhead irrigation, usually under warmer conditions

Common hosts: poinsettia, foliage plants, bedding plants

Best products to choose for a rotation:

| FRAC GROUP | PRODUCT |
|-------------------|-----------------------|
| Biocontrol agents | Cease or Triathlon BA |
| Not classified | KleenGrow |
| FRAC M1 | Copper |

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1. Botrytis stem rot on Bacopa cuttings
2. Botrytis can cause discrete leaf spots on calibrachoa.
3. Botrytis attacks flowers of geranium.

Botrytis blight

Pathogens: *Botrytis cinerea*, *B. elliptica* and *B. tulipae*

Symptoms: flower spots and blight, stem rot, leaf spots and blight, cutting rot, bulb and corm rot and damping-off

Occurrence: usually cool, dark weather in propagation or after flowering starts

Common hosts: all flowering plants and those in propagation

Best products to choose for a rotation:

| FRAC GROUP | PRODUCT |
|------------|---------------------------|
| FRAC 2 | Chipco 26019 or 26GT |
| FRAC 11, 7 | Pageant Intrinsic |
| FRAC 12, 9 | Palladium |
| FRAC 17 | Decree |
| FRAC M5 | Daconil (before blooming) |

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1. Cylindrocladium petiole rot on Spathiphyllum
2. Cylindrocladium stem rot on azalea liners
3. Cylindrocladium cutting rot on Pieris in propagation

Cylindrocladium

Pathogen: *Cylindrocladium* spp.

Symptoms: stem rot, root rot, crown rot and leaf spot on palms

Occurrence: cutting propagation and as crop nears the finishing stage

Common hosts: Spathiphyllum, palms, azalea, rose, other woody in propagation (myrtle, boxwood)

Best products to choose for a rotation:

| FRAC GROUP | PRODUCT |
|------------|---|
| FRAC 11, 7 | Orkestra Intrinsic or Pageant Intrinsic |
| FRAC 12 | Medallion or Palladium (FRAC 12, 9) |

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1. Coleus downy mildew appears as off-color angular spots.

2. Rose downy mildew is easily mistaken for phytotoxicity.

3. Impatiens downy mildew creates masses of white spores on leaf undersides.



Downy mildew

Pathogens: *Peronospora*, *Plasmopara*, and *Bremia* spp.

Symptoms: angular spots, leaf curl and sometimes leaf drop, downy growth underside of leaves that might be white to purple

Occurrence: cool, humid or rainy weather from propagation through finishing

Common hosts: salvia, rose, coleus, pansy, stock, snapdragon and impatiens

Best products to choose for a rotation:

| FRAC GROUP | PRODUCT |
|------------|---|
| FRAC 4 | Subdue Maxx (tank mix for downy mildew) |
| FRAC 21 | Segway O |
| FRAC 33 | phosponate (phosphite) |
| FRAC 40 | Stature SC or Orvego (FRAC 40, 45) |
| FRAC 43 | Adorn (tank mix only) |
| FRAC U15 | Segovis |



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1. White mycelium of Fusarium on Chrysanthemum stem
2. Fusarium stem rot on Mandevilla
3. Fusarium stem cankers on Kalanchoe are dark brown to black.

Fusarium

Pathogens: *Fusarium oxysporum*, *F. solani* and *F. moniliforme*

Symptoms: wilt, crown rot, cutting rot and sometimes leaf spot

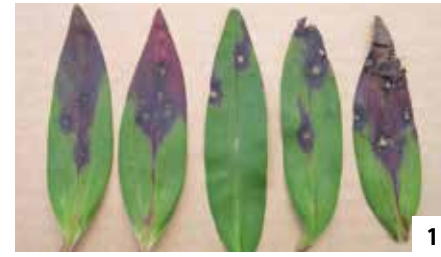
Occurrence: wilt is often after flowering starts; crown rot usually happens as crop nears finishing

Common hosts: dracaena, cordyline, cyclamen, bulb crops, mandevilla, cacti and succulents

Best products to choose for a rotation:

| FRAC GROUP | PRODUCT |
|------------|---|
| FRAC 3 | Trinity or Terraguard |
| FRAC 11 | Empress Intrinsic (mainly for roots/cuttings) |
| FRAC 11, 7 | Pageant Intrinsic or Orkestra Intrinsic |
| FRAC 12 | Medallion |

PHOTOS COURTESY OF A. R. CHASE



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1. Heterosporium leaf spot on *Dianthus* spp. with reddish-purple discoloration
2. *Alternaria* leaf spot on poinsettia leaves and bracts occurs under overhead irrigation.
3. *Corynespora* leaf spot on salvia often found in propagation
4. *Cercospora* leaf spot on pansy has characteristic irregular margins.

Leaf spots

Pathogens: *Alternaria*, *Cercospora*, *Corynespora*, *Helminthosporium*, *Heterosporium* and *Myrothecium* spp.

Symptoms: discrete spots anywhere on leaf, often with a yellow or red margin and occasionally cutting rot

Occurrence: year-round under overhead irrigation

Common hosts: bedding plants, foliage plants

Best products to choose for a rotation:

| FRAC GROUP | PRODUCT |
|------------|---|
| FRAC 3 | Eagle or Trinity |
| FRAC 11, 7 | Pageant Intrinsic or Orkestra Intrinsic |
| FRAC 12, 9 | Palladium |
| FRAC M5 | Daconil (before blooming) |

PHOTOS COURTESY OF A. R. CHASE



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1. Phytophthora aerial blight is very common on annual vinca.
2. Petunia with Phytophthora stem rot
3. Phytophthora crown rot on Gerber daisy causes sudden collapse.

Phytophthora

Pathogens: *Phytophthora parasitica* (sometimes called *P. nicotianae*) *P. drechsleri*, *P. cactorum*, *P. palmorum* and *P. tropicalis*

Symptoms: leaf spots that are very large and wet that can merge to cause aerial blight, stem and crown rot.

Occurrence: worst under high heat and wet conditions

Common hosts: foliage plants, Gerber daisy, lilies and annual vinca

Best products to choose for a rotation:

| FRAC GROUP | PRODUCT |
|------------|------------------------------------|
| FRAC 4 | Subdue Maxx |
| FRAC 21 | Segway O |
| FRAC 33 | phosphonate |
| FRAC 40 | Orvego (FRAC 40, 45) or Stature SC |
| FRAC 43 | Adorn (tank mix only) |
| FRAC U15 | Segovis |

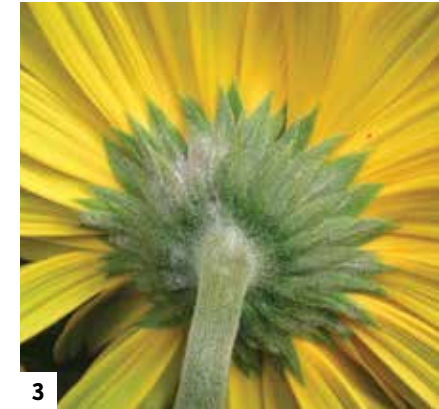
PHOTOS COURTESY OF A. R. CHASE



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1. Sedum powdery mildew may appear as scarring with little white sporulation.
2. Powdery mildew on petunia often occurs in hanging baskets where it escapes detection.
3. Powdery mildew can be found on Gerber daisy flowers, stems and leaves.

Powdery mildew

Pathogens: *Oidium*, *Erysiphe* and *Sphaerotheca*, as well as others

Symptoms: white powdery coating on leaves, sometimes flower petals. They might be discrete spots or merge to cover the entire leaf.

Occurrence: common in spring or fall

Common hosts: Gerber daisy, rose, hydrangea, zinnia and other bedding plants

Best products to choose for a rotation:

| FRAC GROUP | PRODUCT |
|-------------------|---|
| Biocontrol agents | Cease or Triathlon BA |
| Not classified | MilStop |
| FRAC 3 | Trinity or Eagle |
| FRAC 11, 7 | Pageant Intrinsic or Orkestra Intrinsic |
| FRAC 12, 9 | Palladium |

PHOTOS COURTESY OF A. R. CHASE



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1. Pythium damping-off leads to blighting on alyssum.
2. In a calibrachoa basket, some plants may wilt and die of Pythium root rot.
3. Pythium causes stunting on mums (right) compared to healthy plant (left).
4. Pythium root rot causing yellowing and stunting of some nemesia

Pythium

Pathogens: *Pythium irregulare*, *P. splendens*, *P. aphanidermatum* and *P. ultimum*

Symptoms: wilting, stunting, yellow leaves, sparse roots and rot

Occurrence: often when plants are over-watered during seasonal changes

Common hosts: over-watered and over-fertilized plants

Best products to choose for a rotation:

| FRAC GROUP | PRODUCT |
|-------------------|---|
| Biocontrol agents | RootShield Plus (apply preventively only) |
| FRAC 4 | Subdue Maxx (resistance is possible) |
| FRAC 11 | Empress Intrinsic |
| FRAC 14 | Terrazole or Banrot |
| FRAC 21 | Segway O |

- 1. Rhizoctonia cutting rot on Osteospermum
- 2. Rhizoctonia aerial blight on Fittonia
- 3. Rhizoctonia crown rot on dianthus



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Rhizoctonia

Pathogens: *Rhizoctonia* spp.

Symptoms: damping-off, root rot, stem rot (especially at soil line), leaf spot and web blight

Occurrence: most common under hot, wet conditions (summer)

Common hosts: cuttings in propagation (like rosemary, hydrangea, poinsettia) and bedding plants, web blight on ferns

Best products to choose for a rotation:

| FRAC GROUP | PRODUCT |
|-------------------|---|
| Biocontrol agents | RootShield Plus (apply preventively only) |
| FRAC M1 | thiophanate methyl |
| FRAC 11 | Empress Intrinsic or Heritage |
| FRAC 12 | Medallion or Palladium (FRAC 12, 9) |

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- 1. Snapdragons have typical brown rust pustules on leaf undersides.
- 2. Rose rust occurs commonly on some cut roses as well as some potted plants.
- 3. Rust on veronica showing brown pustules

Rust

Pathogens: mainly *Puccinia* spp.

Symptoms: yellow spots on leaf tops with pustules bearing the dusty brown, yellow, white or orange spores underneath

Occurrence: overhead irrigation or exposure to rainfall in spring and fall mainly

Common hosts: rose, chrysanthemum, snapdragon, many herbaceous perennials

Best products to choose for a rotation:

| FRAC GROUP | PRODUCT |
|------------|--|
| FRAC 3 | Eagle or Trinity |
| FRAC 11 | Heritage or Mural (FRAC 11, 7) or Pageant Intrinsic (FRAC 11, 7) |
| FRAC M1 | Mancozeb (preventative only) |

PHOTOS COURTESY OF A. R. CHASE



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1. Black sclerotia form in zinnia stems infected by sclerotinia.
2. Sclerotinia rapidly infects petunias that are spaced too closely.
3. Sclerotinia causes crown rot in spring on many bedding plants, like dianthus.

Sclerotinia (white mold)

Pathogens: mainly *Sclerotinia sclerotiorum*

Symptoms: white growth in dying crowns, occasionally leaf spot and petal spot

Occurrence: often in spring when perennial and bedding crops are near maturity

Common hosts: Gerber daisy, bedding plants (petunia, calibrachoa, zinnia) and most cut flower crops

Best products to choose for a rotation:

| FRAC GROUP | PRODUCT |
|------------|---|
| FRAC 2 | Chipco 26GT or 26019 |
| FRAC 11, 7 | Pageant Intrinsic or Orkestra Intrinsic |
| FRAC 12, 9 | Palladium |
| FRAC M5 | Daconil |

PHOTOS COURTESY OF A. R. CHASE



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1. New Guinea Impatiens showing stem rot with light brown sclerotia at their base.
2. Chrysanthemums with Southern blight wilt and die.
3. Pothos cuttings with Southern blight show fan-like white growth with mustard seed-like sclerotia.

Sclerotium (Southern blight)

Pathogen: *Sclerotium rolfsii*

Symptoms: water-soaked, necrotic spots on stems, later forming round fruiting bodies that look like mustard seeds when mature

Occurrence: hot, wet conditions

Common hosts: foliage plants, many herbaceous perennials (like host), chrysanthemums, New Guinea Impatiens

Best products to choose for a rotation:

| FRAC GROUP | PRODUCT |
|------------|---|
| FRAC 11, 7 | Pageant Intrinsic or Orkestra Intrinsic |
| FRAC 12 | Medallion |
| FRAC 14 | PCNB |

PHOTOS COURTESY OF A. R. CHASE



1. Pansy with typical yellowing and stunting due to black root rot infection
 2. Black spores of Thielaviopsis at poinsettia stem base
 3. The petunia on the right shows stunting and blackened roots due to black root rot.



1. Tradescantia with unidentified virus showing mosaic and leaf distortion
 2. TMV on petunia showing new leaf distortion
 3. INSV on common impatiens with black ringspots
 4. INSV on cineraria shows as chlorotic markings

Thielaviopsis

Pathogen: *Thielaviopsis basicola*

Symptoms: black root rot, yellowing and stunting

Occurrence: stressed crops especially during spring and late summer-fall. pH above 5.5 and soil temperatures between 55 and 70 are favorable for disease.

Common hosts: pansy, salvia, poinsettia, petunia, penstemon, calibrachoa

Best products to choose for a rotation:

| FRAC GROUP | PRODUCT |
|------------|--------------------|
| FRAC 1 | thiophanate methyl |
| FRAC 11, 7 | Orkestra Intrinsic |
| FRAC 19 | Affirm |

PHOTOS COURTESY OF M.L. DAUGHTREY

Viruses

Pathogens: Tospoviruses (INSV and TSWV mainly), TMV, CMV and many others

Symptoms: stunting, mosaic, leaf chlorosis, vein clearing, vein banding, ring spots, distortion and flower break

Occurrence: year-round depending on specific virus

Common hosts: rose, impatiens, petunia, and many other bedding plants, araceous foliage plants

Best products and practices to choose for a rotation:

- Gloves to collect symptomatic plants and dump them
- Disinfectants to clean cutting instruments
- Dumpster
- Control thrips to help reduce spread of tospoviruses

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