

2016/2017

# DISEASE CONTROL GUIDE

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 **BASF**

We create chemistry

A SUPPLEMENT TO:

**Greenhouse**  
MANAGEMENT

## SPONSOR LETTER

**T**he 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](http://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

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**On cover:** Fusarium stem cankers on Kalanchoe

## Introduction

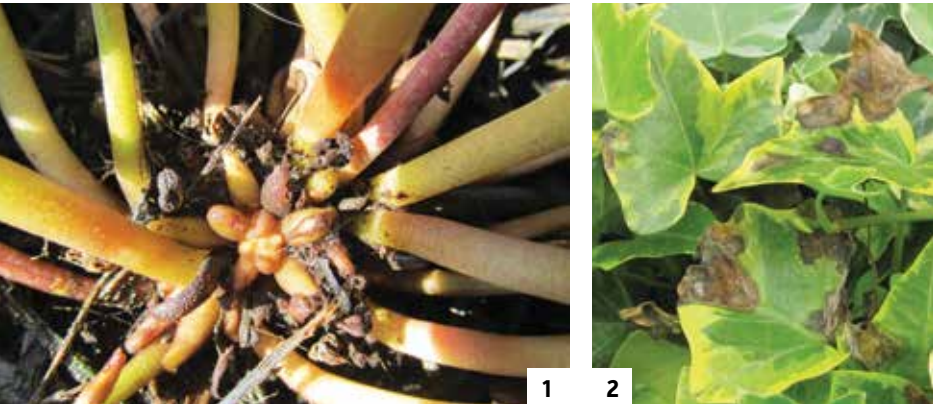
By Dr. A.R. Chase

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

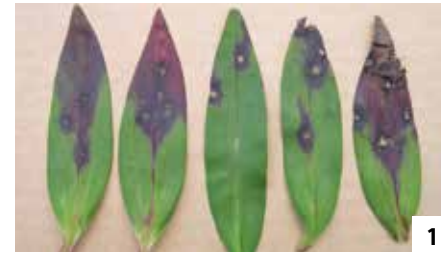
**Occurrence:** wilt is often after flowering starts; crown rot usually happens as crop nears finishing

**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

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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)

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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

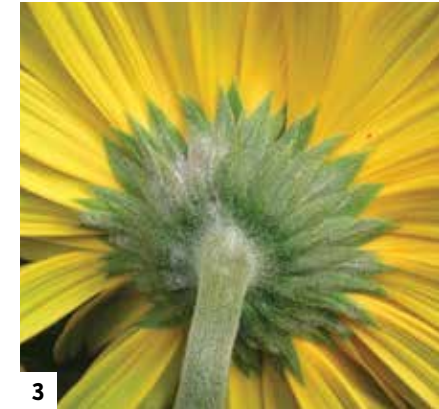
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1. Sedum powdery mildew may appear as scarring with little white sporulation.
2. Powdery mildew on petunia often occurs in hanging baskets where it escapes detection.
3. Powdery mildew can be found on Gerber daisy flowers, stems and leaves.

# 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

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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)

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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

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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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