

# Crop Profile for Chrysanthemums in Ohio

Prepared Feb.,2001

## General Production Information

- Area of production in Ohio: 3,886,000 sq. ft - 70% for wholesale market
- Percent of US Acreage/Rank: 7%/5<sup>th</sup>
- Number of Growers: 152
- Wholesale Price Per Pot: \$1.90

Value of Wholesale Production in Ohio: \$7,037,000

### Production Methods:

Chrysanthemums are propagated by cutting from stock grown by specialists. Cuttings are taken 2-3 inches long from the stock plants. They are rooted in either a peat-lite medium and then transplanted or planted directly into the pot. The cuttings are rooted under low light and intermittent mist. Usually 4-6 cuttings are planted in a 6 inch pot. Several spacing techniques can be used to grow the plants each with different temperature and light regimes. The technique used depends upon the amount of space and labor required and timing of production. Once a good root system is established and 1 ½ to 1 ¾ inches of new top growth has occurred, the plant is ready for pinching. Pinching is done to ensure the maximum numbers of flowers per plant. However, to achieve the desired plant height, it is necessary to pinch in relation to the beginning of the short day period, anywhere from 7 to 21 days from planting. Chrysanthemums are short day plants, requiring a long dark period for both flower induction and development. The exact length of the critical photoperiods depend upon the cultivar used and temperature of the greenhouse. When the flower buds show color, short day treatments can be stopped. Disbudding is used to modify the number of flower buds per shoot, delay flowering and increase flower size. Growth regulators are also used depending upon the season, the cultivar, the desired final plant height and the greenhouse setup. As with all ornamental plants, managing pests and diseases is a critical component of chrysanthemum production since any damage usually renders a plant unsaleable

## Insect Pests

### Thrips

Thrips are often the most serious insect pest in greenhouses. They are very difficult to control once a population becomes well established. Thrips feed on leaves and flowers of a wide variety of host plants. The feeding injury can render a plant unmarketable and the act of feeding by a thrips can transmit viruses to a susceptible host plant. The thrips lifecycle begins as an egg is deposited in plant tissue. After the larvae emerge they begin feeding on the plant. Thrips pass through 2 larval and transformation stages before becoming an adult. Feeding injury is done by the larvae and adults, but only the adults can transmit viruses. The lifecycle of a thrips is temperature dependant with development occurring between 50 – 90° F. The egg to adult cycle lasts between 10-14 days at these temperatures. At temperatures below 50° F thrips can survive but no development occurs.

### Aphids

There are many species of aphids that can attack greenhouse plants but the two most common species are the green peach

aphid (*Myzus persicae*) and the melon/cotton aphid (*Aphis gossypii*). Both of these species are green in color but it can vary from light to dark green for the melon aphid and from light green to nearly pink for the green peach aphid. Aphids have small soft bodies with piercing-sucking mouth parts which they use to insert into the phloem tissue of plants and remove fluid. Aphids cause problems from injury by feeding, the transmission of viruses and by spreading sticky honeydew over the surface of leaves and flowers. In the greenhouse most aphids are female and they produce live young called nymphs. An average female produces between 50 to 200 nymphs during her lifetime. The nymphs, that are all female, begin reproducing in 7-10 days. Adult aphids appear in 2 forms, winged and wingless, depending on population density and /or host plant conditions. Winged aphids are troublesome because they are able to disperse throughout the greenhouse and are also able to fly into the greenhouse from outdoors.

### **Fungus Gnats**

The fungus gnat is a common pest of greenhouse plants. The adults are tiny, dark, slender, fragile looking flies. They have long antennae and legs and a small head in relation to their bodies. The lifecycle of the fungus gnat is completed in 25-30 days. The adults live about one week and lay up to 200 eggs. The eggs hatch in about 4 days into larvae. The fungus gnat larvae are white and translucent with shiny black heads. The larvae live in the soil for two weeks and feed on the roots of plants. The pupal stage lasts 3-4 days before the adults emerge. Extensive damage can result from larval feeding, resulting in plants that show signs of wilting. The adult fungus gnat is primarily a nuisance pest.

### **Whiteflies**

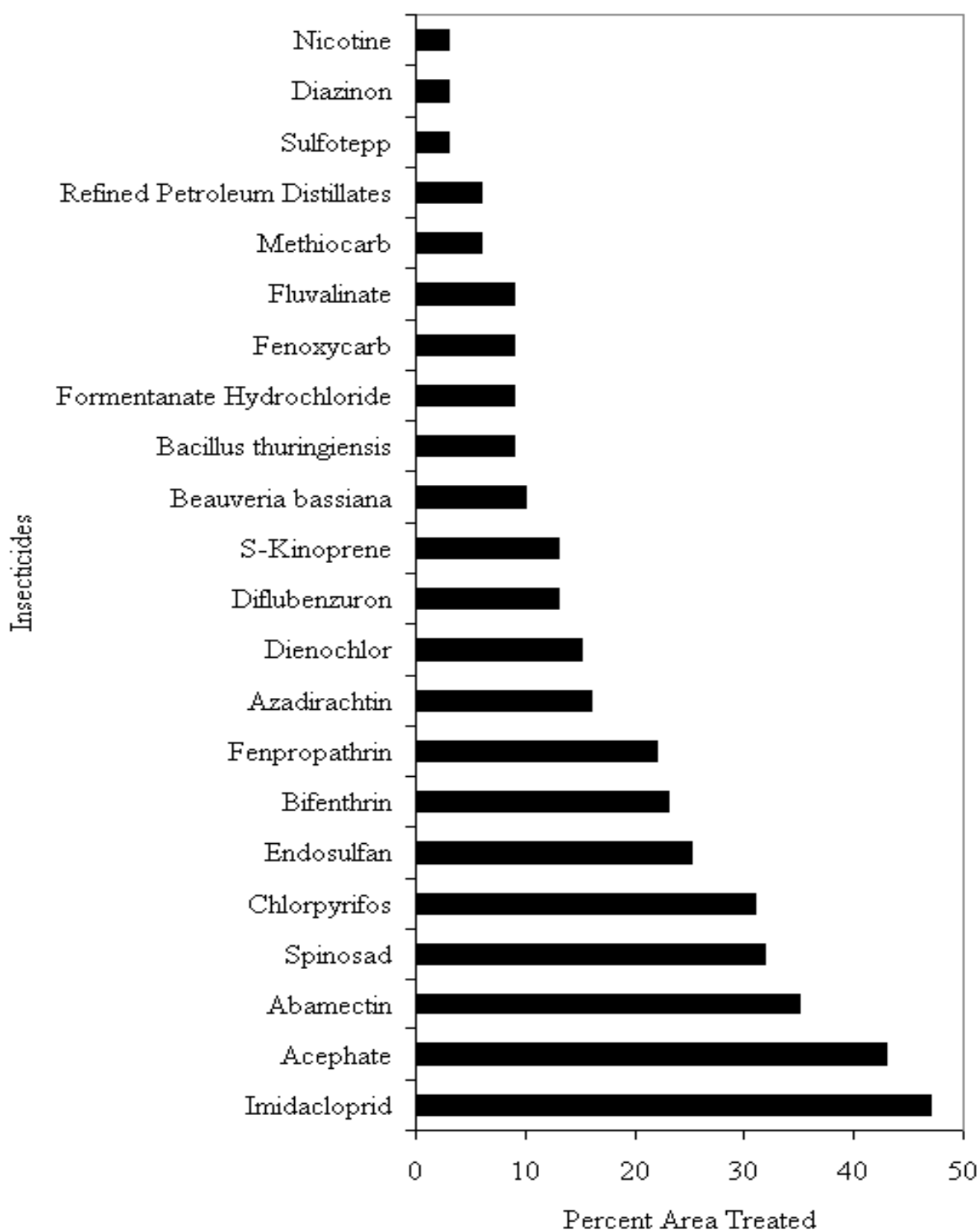
Whiteflies are a very common pest in greenhouse production. The most common species are the greenhouse whitefly (*Trialeurodes vaporariorum*) and the silverleaf white fly (*Bemisia argentifolii*). The adult silverleaf whiteflies are smaller, more yellow and active than the greenhouse whiteflies. In the pupal state the silverleaf whiteflies are flat without spines or fringes whereas the greenhouse whitefly pupae have vertical sides with spines. The adult whitefly lifecycle lasts from 21-36 days. Each female produces 60 to 100 eggs that hatch in 7-10 days. The newly emerged crawlers move for a short distance before settling down to feed. After molting 3 times the pupae emerge and in 6 days will grow into adults. During development whiteflies are usually found on the underside of leaves. The adult and immature stages of whiteflies use their piercing-sucking mouth parts to extract fluid from plant tissue. A few adult whiteflies on plants are a nuisance. However, feeding by a large number of adults and especially immatures can weaken or kill a plant. Whiteflies also produce a sticky honeydew that can be a growth medium for black sooty fungus.

### **Spider Mites**

Spider mites are a persistent pest problem in the greenhouse. Many species of spider mites are found in the greenhouse, but the most common is the two-spotted spider mite (*Tetranychus urticae*). Spider mites are very small arthropods that develop mostly on the undersides of leaves. Their lifecycle lasts between 7-14 days but varies considerably depending on temperature. An adult female spider mite can produce 100-200 eggs in her lifetime. The eggs hatch into tiny larvae in a few days. The larvae pass quickly through several nymph stages before becoming adults. Spider mites cause injury to plants while feeding. Using their piercing-sucking mouth parts, they extract plant fluids. Feeding injury often give the upper leaf surface a characteristic mottled or speckled appearance. Large numbers of spider mites produce a webbing that can completely cover leaves and flowers.

### **Chemical Insect Controls:(4)**

(all chemicals applied at an average rate of 200 gal/A unless otherwise noted)



**Imidacloprid (Marathon)**

Percent of total area treated:47%

Target pests: Whiteflies and Aphids

Average rate and frequency of application of most common formulations: (2)

Marathon 1% - ½ tsp (2 grams)/8 inch pot, once

Marathon 60 WSP – 1.1 oz/100 gal, once

Application method: top dress for 1% and drench for 60 WSP

REI: 12 hours

Efficacy rating: Very Good

### **Acephate (Orthene)**

Percent of total area treated: 43%

Target pests: Whiteflies, Aphids and Thrips

Average rate and frequency of application of most common formulations: (2)

Orthene TT&O – 11 oz/100 gal, 2.1 times

Application method: Fogger or High Volume Spray

REI: 24 hours

Efficacy rating: Good

### **Abamectin (Avid)**

Percent of total area treated: 35%

Target pests: Thrips and Mites

Average rate and frequency of application of most common formulations: (2)

Avid 0.15 EC – 6 oz/100 gal, 1.8 times

Application method: High Volume Spray or Fogger

REI: 12 hours

Efficacy rating: Good to Very Good

### **Spinosad (Conserve)**

Percent of total area treated: 32%

Target pests: Thrips

Average rate and frequency of application of most common formulations: (2)

Conserve SC – 6 oz/100 gal, 2.3 times

Application method: High Volume Spray

REI: 4 hours

Efficacy rating: Very Good

### **Chlorpyrifos (DuraGuard)**

Percent of total area treated: 31%

Target pests: Thrips, Aphids, Fungus Gnats and Whiteflies

Average rate and frequency of application of most common formulations: (2)

DuraGuard ME – 44 oz/100 gal, 1.7 times

Application method: High Volume Spray or Aerosol

REI: 12 hours

Efficacy rating: Good to Very Good

### **Endosulfan (Thiodan)**

Percent of total area treated: 25%

Target pests: Aphids, Thrips and Whiteflies

Average rate and frequency of application of most common formulations: (2)

Thiodan 50 WP – 16 oz/100 gal, 1.5 times

Thiodan 3EC – 32 oz/A, twice

Application method: High or Low Volume Spray

REI: 24 hours

Efficacy rating: Good to Very Good

### **Bifenthrin (Talstar)**

Percent of total area treated: 23%

Target pests: Whiteflies and Thrips

Average rate and frequency of application of most common formulations: (2)

Talstar F – 13 oz/100 gal, 1.7 times

Application method: High Volume Spray

REI: 12 hours

Efficacy rating: Good to Very Good

### **Fenprothrin (Tame)**

Percent of total area treated: 22%

Target pests: Whiteflies, Aphids and Thrips

Average rate and frequency of application of most common formulations: (2)

Tame 2.4 EC – 14 oz/100 gal, 2 times

Application method: High Volume Spray

REI: 24 hrs.

Efficacy rating: Good

Used with Orthene TT&O for best results.

### **Azadirachtin (Azatin)**

Percent of total area treated: 16%

Target pests: Thrips and Whiteflies

Average rate and frequency of application of most common formulations: (2)

Azatin XL – 14 oz/100 gal, 1.4 times

Application method: High Volume Spray or Fogger

REI: 12 hours

Efficacy rating: Good

### **Dienochlor (Pentac)**

Percent of total area treated: 15%

Target pests: Mites

Average rate and frequency of application of most common formulations: (2)

Enstar II – 8 oz/100 gal, 2.5 times

Application method: High Volume spray

REI: 4 hours

Efficacy rating: Very Good

### **Diflubenzuron (Adept)**

Percent of total area treated: 13%

Target pests: Fungus Gnats (larvae)

Average rate and frequency of application of most common formulations: (2)

Adept 25 WP – 2 oz /100 gal, twice

Application method: Drench

REI: 12 hours

Efficacy rating: Good

### **S-Kinoprene (Enstar)**

Percent of total area treated: 13%

Target pests: Whiteflies, Aphids and Fungus Gnats

Average rate and frequency of application of most common formulations: (2)

Enstar II – 10 oz/100 gal, 1.5 times

Application method: High Volume spray

REI: 4 hours

Efficacy rating: Very Good

### ***Beauveria bassiana* (BotaniGuard, Naturalis-O)**

Percent of total area treated: 10%

Target pests: Thrips, Aphids and Whiteflies

Average rate and frequency of application of most common formulations: (2)

BotaniGuard 22WP – 80 oz/100 gal, 3 times

Naturalis-O – 32oz/100 gal, 5 times

Application method: High Volume Spray

REI: 4 hours

Efficacy rating: Good

***Bacillus thuringiensis var. israelensis* (Gnatrol)**

Percent of total area treated: 9%

Target pests: Fungus Gnats (larvae)

Average rate and frequency of application of most common formulations: (2)

Gnatrol 16 oz/100 gal, 2.4 times

Application method: Drench

REI: 4 hours

Efficacy rating: Good

**Formentanate Hydrochloride (Carzol)**

Percent of total area treated: 9%

Target pests: Thrips

Average rate and frequency of application of most common formulations: (2)

Carzol – 16 oz/A, once

Application method: High Volume Spray

REI:

Efficacy rating: Good

**Fenoxycarb (Precision)**

Percent of total area treated: 9%



Target pests: Thrips

Average rate and frequency of application of most common formulations: (2)

Precision – 4 oz/100 gal, 3 times

Application method: High Volume Spray or Aerosol (Preclude)

REI: 12 hours

Efficacy rating: Good

### **Fluvalinate (Mavrik Aquaflow)**

Percent of total area treated: 9%

Target pests: Thrips

Average rate and frequency of application of most common formulations:  
Mavrik Aquaflow – 8 oz/100 gal, once

Application method: High or Low Volume Spray

REI: 12 hours

Efficacy rating: Average

### **Methiocarb (Mesurol)**

Percent of total area treated: 6%

Target pests: Thrips and Aphids

Average rate and frequency of application of most common formulations: (2)

Mesurol 75W – 1 oz/100 gal, once

Application method: High Volume Spray or Fogger

REI: 24 hours

Efficacy rating: Very Good

### **Refined Petroleum Distillate (Sunspray Ultra-Fine)**

Percent of total area treated: 6%

Target pests: Thrips, Whiteflies and Aphids

Average rate and frequency of application of most common formulations: (2)

Sunspray Ultra-Fine – 6 oz/A, 1-2 times

Application method: Cold Fogger

REI: 4 hours

Efficacy rating: Good to Very Good

### **Sulfotepp (Plantfume)**

Percent of total area treated: 3%

Target pests: Whiteflies and Aphids

Average rate and frequency of application of most common formulations: (2)

Plantfume 103 – 1 can/20,000 sq.ft, once

Application method: Smoker

REI: 4 hours

Efficacy rating: Very Good

### **Diazinon (Knox Out)**

Percent of total area treated: 3%

Target pests: Thrips and Aphids

Average rate and frequency of application of most common formulations: (2)

Knox Out GH - 16 oz/100 gal, twice

Application method: Spray to potting mix surface

REI: 12 hours

Efficacy rating: Average

### **Nicotine (Plant Product)**

Percent of total area treated: 3%

Target pests: Thrips, Whiteflies and Aphids

Average rate and frequency of application of most common formulations: (2)

Plant Product Nicotine – 1 can/20,000 cu. ft, 1.5 times

Application method: Smoke

REI: 4 hours

Efficacy rating: Very Good

### **Cultural Controls:(3,5)**

Quarantine new plant material for at least one week. Use screens on ventilation system and doors to exclude pests. Practice proper sanitation and weed control in and around the greenhouse. Avoid excessive fertilization since some pests thrive on plant tissue high in nitrogen.

### **Biological Controls:(3,5)**

Some new and effective biological control products are available for the greenhouse grower. Most growers are taking a cautious approach to these new products and only applying them to small portions of their operations.

## **Diseases**

### ***Botrytis* Gray Mold**

The most common disease of greenhouse floral crops is gray mold. Gray mold is caused by the fungus *Botrytis cinerea*. It is a common fungus, with a very wide host range and can persist in the greenhouse year-round. The fungus produces a large amount of spores that move throughout the greenhouse via air currents. Under environmental conditions of relative humidity at or above 85%, little or no air circulation and free water on the leaf surface, the fungal spores land on plant surfaces, germinate and penetrate the host. The symptoms of gray mold vary depending on the host and the environmental conditions associated with the host. In most cases the disease is characterized by the production of leaf spots, flower blight, bud rot, stem canker, stem and crown rot, cutting rot, damping off and in extreme cases, plant death. The fungal growth is characterized by the presence of fluffy gray/brown mycelium that produce a cloud of spores if disturbed. Affected tissue is soft and brown, and sometimes has a water soaked appearance. This disease can be anything from a common nuisance to an economic disaster depending on the host and the conditions under which the crop is grown.

### **Powdery Mildew**

Powdery mildew is one of the most wide spread diseases in the floriculture production industry. It is caused by the fungus *Oidium* spp. whose spores are easily spread by physical movement and air currents. In most cases, symptoms of this disease are relatively easy to identify. The disease is characterized by the fluffy white fungal growth on the leaves, stems, and flowers of infected plants. The disease typically shows up on leaves first and if left unchecked it will spread to the stems and flowers. Tissues infected with powdery mildew can eventually become necrotic. This disease is responsible for significant economic losses in the greenhouse. Powdery mildew tends to be more of a problem later in the growing season when night temperatures get cooler. High humidity is also necessary for development of the fungus. However, it depends on the individual organism as to when and where the disease shows up.

### **Root Rots**

Root rots of poinsettias are generally caused three different fungi. *Rhizoctonia solani* causes both stem and root rot. The

symptoms of the disease include brown rotting of the stem at the soil line and roots with brown lesions. *Pythium ultimum*, a water mold root rot, causes rotting of the root tips and cortex. The disease can advance up the stem causing the lower leaves to yellow and rot. It is the most common disease of commercially produced poinsettias. *Thielaviopsis basicola* causes black root rot. The symptoms include black rotted areas on the roots, reduction in plant vigor, leaf yellowing and drop and sometimes sudden collapse of the plant. Root rots are favored in cool, moist soils and are usually most severe at rooting and just before maturing.

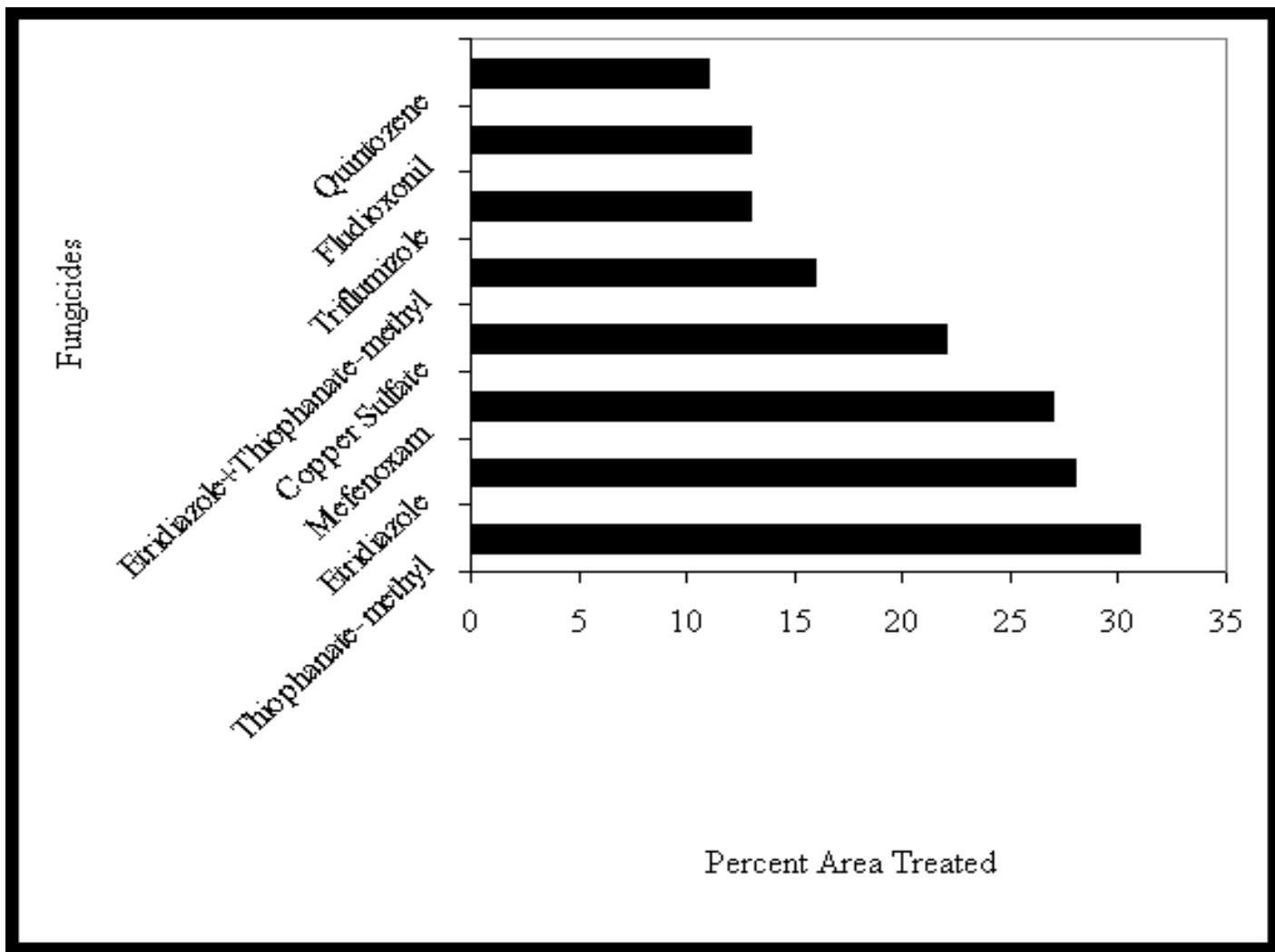
## **Rust**

The fungus that causes rust on ornamental plants is most commonly of the *Puccinia* species. The fungus is spread via spores in the air or in splashing water. The spores land on the leaf surface and will germinate if free water is present. Infection occurs through the stomate. The first symptoms of the disease can be seen about seven days after infection. Small spots ranging in color from yellow to brown will appear on the upper and lower leaf surface. In about a week brownish spore masses appear in the center of the yellow spots, mostly on the underside of the leaf. The "rust-like" spot expands in a concentric ring like growth. The leaf spots will continue to expand and coalesce if not treated, eventually causing leaves to turn yellow and drop. All of the plant can be covered with rust making the plant unmarketable.

## **Septoria Leaf Spot**

Septoria leaf spot is caused by the fungus *Septoria obesa*. Septoria fungal spores survive in plant debris and in the soil for up to two years. Infected plants develop irregular or circular brownish black dead spots that grow progressively upward from the base of the plant. Tiny black fungal fruiting bodies are found in the center of the spots. Spores are spread in splashing water and infection is favored by wet weather and humid conditions.

## **Chemical Disease Controls:(4)**



(all chemicals applied at an average rate of 200 gal/A unless otherwise noted)

**Thiophanate-methyl (Cleary’s 3336, Fungo)**

Percent of total area treated: 31%

Target pests: *Rhizoctonia*, *Botrytis*, Root Rots

Average rate and frequency of application of most common formulations:  
 Cleary’s 3336 4.5F - 10 oz/100 gal, 1.3 times

Fungo 50WP – 12 oz/100 gal, once

Application method: Drench

REI: 12 hours

Efficacy rating: Good to Very Good

**Etridiazole (Truban)**

Percent of total area treated: 28%

Target pests: Root Rots

Average rate and frequency of application of most common formulations:  
Truban 30WP – 5 oz/100 gal, 1.3 times

Application method: Drench

REI: 12 hours

Efficacy rating: Good to Very Good

### **Mefenoxam (Subdue MAXX)**

Percent of total area treated: 27%

Target pests: Root Rots (*Pythium*, *Rhizoctonia*, and Black Root Rot)

Average rate and frequency of application of most common formulations:  
Subdue MAXX – 0.66 oz/100 gal, once

Application method: Drench

REI: None

Efficacy rating: Very Good

### **Copper Sulfate (Phyton-27)**

Percent of total area treated: 22%

Target pests: *Botrytis* and Powdery Mildew

Average rate and frequency of application of most common formulations:  
Phyton-27 5.5EC – 16 oz/100 gal, 1.8 times

Application method: High Volume Spray

REI: 12 hours

Efficacy rating: Very Good

### **Etridiazole + Thiophanate-methyl (Banrot)**

Percent area treated: 16%

Target pests: Root Rots

Average rate and frequency of application of most common formulations:

Banrot 40WP– 8 oz/100 gal, once

Application method: Drench

REI: 12 hours

Efficacy rating: Good to Very Good

### **Triflumizole (Terraguard)**

Percent of total area treated: 13%

Target pests: *Rhizoctonia* and Powdery Mildew

Average rate and frequency of application of most common formulations:  
Terraguard 50WP – 20 oz/100 gal, once

Application method: Drench and High Volume Spray

REI: 12 hours

Efficacy rating: Good to Very Good

### **Fludioxonil (Medallion)**

Percent of total area treated: 13%

Target disease: *Botrytis* and *Rhizoctonia*

Average rate and frequency of application of most common formulations:  
Medallion – 1 oz/100 gal, once

Application method: Drench

REI:

Efficacy rating: Very Good

### **Quintozene (Terraclor)**

Percent of total area treated: 11%

Target pests: Root Rots

Average rate and frequency of application of most common formulations:  
Terraclor 400 – 4 oz/100 gal, once

Application method: Drench

REI: 12 hours

Efficacy rating: Good to Very Good

### **Cultural Controls:(3,5)**

Buy resistant varieties whenever possible. Quarantine new plant materials for at least a week. Screen the greenhouse doors and vents. Plant disease free cuttings and seeds. Keep growing area clean. Remove all diseased plants as soon as they have been detected. Periodically disinfect the hose end, especially after touching the growing mix or the contaminated water on the floor or benches. Benches should also be disinfected at the end of each crop cycle. Eliminate all weeds and algae. Fertilize plants judiciously. Adjust the pH of the growing medium appropriately. Control relative humidity of the greenhouse, especially during the evening hours. This can require simultaneously ventilating and heating the greenhouse during critical hours. Providing adequate air circulation will also help. The use of well draining growth mediums will help reduce the incidence of root diseases.

## **Weeds**

Weeds are a persistent problem in greenhouse production. Weeds are unsightly and can harbor insect pests and diseases. Therefore, weed management in and around the greenhouse is important to assist with pest and disease control and well as to improve aesthetics.

### **Chemical Controls:(4)**

(all chemicals applied at a rate of 200 gal/A unless otherwise noted)

#### **Glyphosate (Roundup)**

Percent of total area treated: 32%, primarily used as a spot spray in the work area

Target pests: Annual and Perennial Weeds

Average rate and frequency of application of most common formulations:  
Roundup Pro – 1.6 oz/gal, as needed

Application method: High Volume Spray

REI: 4 hours

Efficacy rating: Good to Very Good

#### **Glufosinate-ammonium (Finale)**

Percent of total area treated: 13%

Target pests: Annual Grasses and Broadleaf Weeds

Average rate and frequency of application of most common formulations:  
Finale – 1.5 gal/100gal, once



Application method: High Volume Spray

REI: 12 hours

Efficacy rating: Very Good

### **Cultural Controls:** (3,5)

Use weed block fabric to cover the floor and remove any weeds that grow in along the edges of the fabric. Hand weeding and solarization can also be used to control weeds. Managing weeds outside the greenhouse is important to eliminate the major source of air borne weed seeds and to prevent perennial weeds from growing in under the foundation. Regular mowing can help prevent the most weed seed formation. However, maintaining a weed-free barrier around the greenhouse may be more effective. Adding lime to soil can help too.

## **Contacts**

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Compiled by: M.F. Huelsman, July, 2000