

## Projects Continue on Bacterial Diseases

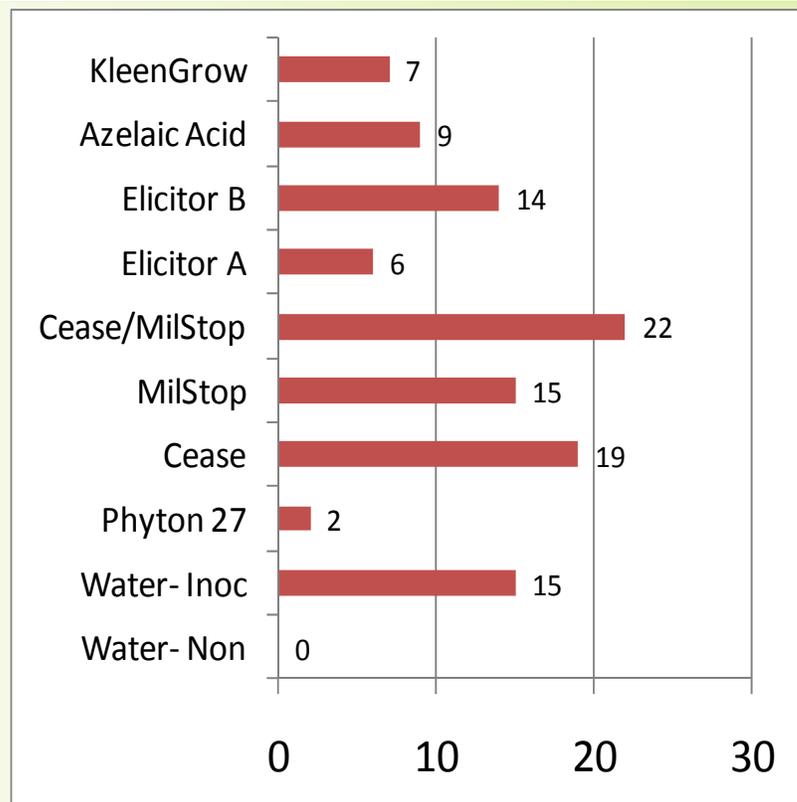
This year we are doing more bacterial trials than ever. They are mainly being conducted on *Xanthomonas* and *Pseudomonas* leaf spots. In upcoming months I will be reporting on efficacy of coppers, KleenGrow and some biological control products for speck on tomato (*Pseudomonas syringae*), spot on tomato and pepper (*Xanthomonas campestris* pv. *vesicatoriae*), blast on almonds (*Ps. syringae*) and crown gall on solidago (IR-4 trial). This month I report on a trial we just finished with *Xanthomonas* leaf spot on geranium.

This trial started in early May with three weekly sprays. Our geraniums were 'Elite Cherry' zonals that we planted in 4 inch pots containing Sunshine Mix. No. 1 on 15 March. We almost always grow our trial plants for quite awhile before use to make sure they do not have any bactericide/fungicide applications. The plants were sprayed once before inoculation and twice afterward. Treatments included:

- Water-noninoculated
- Water-inoculated
- Phyton 27-50 oz/100 gal
- Cease-1.5%
- MilStop-2.5 lb
- Cease and MilStop
- Elicitor A (experimental)
- Elicitor B (experimental)
- Azelaic Acid (experimental)
- KleenGrow-6 oz

Disease severity was low to moderate in this trial. The graph to the right shows the number of spots per plant two weeks after the final spray. The best control was seen with Phyton 27 (highest labeled rate). Elicitor A, KleenGrow and Azelaic acid were also about 50% effective. The Elicitor products caused severe phytotoxicity but other products were safe. In this trial Cease and MilStop were not effective at the rates and intervals tested. KleenGrow can be used at 12.5 oz and may work better at higher labeled rates.

Effect of bactericide on *Xanthomonas* leaf spot (number of spots) on geranium



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## Sphaeropsis Galls on Woody Ornamentals

Sphaeropsis gall on holly and other woody ornamentals is caused by the fungus – *Sphaeropsis tumefaciens*. It has been reported throughout the Southeastern and Gulf Coast states. The disease might be confused occasionally with bacterial crown gall which is caused by *Agrobacterium tumefaciens*. In the case of crown gall, most symptoms are found at wound areas or around the base/crown of the plant. Sphaeropsis gall, however, is often found scattered throughout the canopy of the plant on large stems and tiny twigs.

since they may have many growth spurts or produce new growth almost year-round. Products including those with chlorothalonil, copper, mancozeb, propiconazole and thiophanate methyl are all listed on labels for Sphaeropsis tip blight on pines. Be sure to get a lab diagnosis of any galls you find since them distinguishing them by sight alone is very risky and can lead to losses by following an ineffective control program.



Sphaeropsis gall on Loropetalum

Sphaeropsis gall has been found on holly, hawthorn, bottlebrush, crape myrtle, ligustrum, citrus, oleander and prunus species. In a recent trip to Texas, I found it on Loropetalum too. Symptoms have been more common in some states from May through July. Spores are thought to be spread by cutting tools and using diseased plants as cutting sources. In addition, some reports indicate that immature leaves may be directly infected without wounding, perhaps by wind-driven rain or irrigation. Little is known concerning specific means of spread and infection. Humid weather and wet foliage are needed for spores to be produced and infect new twigs.

Although some studies have shown slight differences in cultivar susceptibility such as that shown below on holly (Harmon, P. F., 2005, University of Florida) little other research has been reported.

No fungicide research has been reported on Sphaeropsis gall to my knowledge but research has been conducted on Sphaeropsis (now called *Diplodia* on this plant) tip blight on pine regarding fungicide efficacy. Use of the fungicides was two sprays targeted to the time when the new pine shoots were susceptible. On ornamentals this may become more often

## Rhizoctonia on Azalea

Controlling disease depends on many things including first knowing where the pathogen originates. Copes et al. (ARS-Poplarville, MS) recently completed studies on Rhizoctonia web blight on azalea. The research focused on the influence of season on levels of the pathogen in growing medium, leaf litter and stems of azalea.

The frequency was highest from the lower stems since Rhizoctonia is a soil-borne fungus. The isolates were identified as binucleate Rhizoctonia which was established for this disease in the early 1980's. Blighted leaves had the highest recovery as one would anticipate. Interestingly, there was no real difference in how much Rhizoctonia was recovered in different seasons showing that it is well adapted to the environment of a southern nursery.

It would be very important therefore to practice good sanitation throughout the year in nurseries. Remove leaf litter and do not allow debris to sit in the growing area even when the crop is not actively being produced.

Rhizoctonia is soil-borne that infects leaves, stems and roots. Normally the best place to apply a fungicide is the leaves when the disease is foliar or the potting medium/soil when the affects the roots or stems. When I worked at the University of Florida on aerial blight on a number of foliage plants (English ivy, pothos, pittosporum to name a few) we found that spraying the leaves or drenching the potting medium were equally effective in preventing disease. In one case you are protecting the leaves from infection while, in the other you are eliminating a portion of the pathogen at the source. Therefore, the most cost effective means of applying a fungicide for web or aerial blight can be chosen.

For a complete copy of Dr. Copes work see: Plant Disease 95:705-711 (2011).

### Susceptibility Ilex cultivars to Sphaeropsis gall

| Highly susceptible              |
|---------------------------------|
| I. glabra 'Nigra'               |
| I. x 'Mary Nell'                |
| I. crenata 'Compacta'           |
| I. crenata 'Helleri'            |
| Moderately susceptible          |
| I. x attenuata                  |
| I. crenata 'Sky Pencil'         |
| I. x 'Nellie R. Stevens'        |
| I. vomitoria pendula            |
| Low susceptibility              |
| I. opaca 'Savannah'             |
| I. vomitoria 'Pride of Houston' |
| I. cornuta 'Carissa'            |
| I. vomitoria 'Schellings Dwarf' |
| I. cornuta 'Rotunda'            |
| I. cornuta 'Delcambre'          |

## Palladium Review

Palladium (Syngenta) is one of the newer fungicides registered in our market (not yet in California). It is a combination of two active ingredients—fludioxonil (MOA group 12) and cyprodinil (MOA group 9). It has a 12 hour REI and is in many ways similar to Medallion as they share fludioxonil as an active ingredient.

Palladium is registered for many fungal leaf spots including *Alternaria*, *Colletotrichum*, *Cercospora*, *Phoma* (sometimes called *Phyllosticta*), red leaf spot (*Stagonospora*) and *Myrothecium*. It is also registered for Botrytis blight, Fusarium blight, Rhizoctonia aerial blight and Sclerotinia blight as well as powdery mildew. Use rates vary from 2-6 oz/100 gal depending on disease target and interval for use is 7-14 days. Palladium is not registered for residential ornamentals and can only be applied as a spray (no drenches). It is not registered for delivery in any irrigation system so no chemigation is allowed.

I present to the right a summary of many of the trials we have completed with Palladium over the past ten years. You can see that our results certainly support the labeled uses. Palladium does not work on downy mildew but is good on powdery mildew. In one trial last year, it was the only product we tested that stopped development of powdery mildew on Gerber daisy after it was quite advanced. We have seen no control of rust on Hypericum (two trials) with Palladium and the product is not labeled for rust. Application of Palladium for Rhizoctonia stem rot on Impatiens or cutting rot on Poinsettia was achieved with a heavy spray-sprenc and was good to excellent as I would expect based on trials for more than 20 years with Medallion.

Palladium presents an excellent tool for resistance management of *Botrytis* since both active ingredients are very good against this pathogen. The label does however, stipulate, rotating to a different MOA group after two sequential uses of Palladium for any disease. Remember when rotating for resistance management that you cannot rotate Medallion and Palladium. You could choose another premix, Pageant which has active ingredients from MOA group 11 and 7. You can choose a fungicide that works well on your chosen target disease. Just check the MOA group to make sure it is not 9 or 12.

**Follow the label carefully—it is the law!**

| Disease                                 | Plant           | Interval     | Effect                           |
|---|-----------------|--------------|----------------------------------|
| Alternaria leaf spot                    | zinnia          | 14 days      | excellent at 4 oz                |
| Alternaria leaf spot                    | impatiens       | 7 days       | excellent at 2-4 oz              |
| Alternaria leaf spot                    | pittosporum     | 10 days      | very good to excellent at 4-8 oz |
| Black root rot ( <i>Thielaviopsis</i> ) | vinca           | 7 days       | none                             |
| Botrytis blight                         | impatiens       | 14 days      | very good at 6 oz                |
| Botrytis blight                         | pansy           | 7 or 14 days | excellent                        |
| Botrytis blight                         | gerbera         | 7 days       | very good                        |
| Botrytis blight                         | cyclamen        | 7 or 14 days | very good to excellent at 4 oz   |
| Botrytis blight                         | gerbera         | 7 days       | excellent                        |
| Botrytis blight                         | gerbera         | 7 days       | excellent                        |
| Cercospora leaf spot                    | moluccella      | 7 days       | good at 4-8 oz                   |
| Cercospora leaf spot                    | pansy           | 7 days       | excellent                        |
| Colletotrichum leaf spot                | mandevilla      | 10 days      | poor to good                     |
| Colletotrichum leaf spot                | cyclamen        | 7-17 days    | very good to excellent at 4-6 oz |
| Cylindrocladium leaf spot               | myrtle          | 14 days      | excellent at 4-6 oz              |
| Downy mildew                            | snapdragons     | 7 days       | none                             |
| Fusarium leaf spot                      | dracaena        | 7 days       | good at 3 oz                     |
| Fusarium wilt                           | cyclamen        | 14 days      | none                             |
| Myrothecium petiole rot                 | pansy           | 14 days      | excellent at 4-6 oz              |
| Phyllosticta leaf spot                  | hydrangea       | 14 days      | poor                             |
| Powdery mildew                          | gerbera         | 7 days       | good                             |
| Powdery mildew                          | rose            | 7 or 14 days | excellent                        |
| Rhizoctonia stem rot                    | impatiens       | 14 days      | excellent at 1-6 oz              |
| Rhizoctonia cutting rot                 | poinsettia      | 7 days       | good at 4-8 oz                   |
| Rust ( <i>Uromyces</i> )                | Hypericum       | 7 days       | none                             |
| Sclerotinia blight                      | petunia/primula | 7 days       | excellent at 4 oz                |

# Fusarium Diseases—Update

I have been working on fungicides for *Fusarium* diseases for many years. Starting with *Fusarium* leaf spot on *Dracaenas* when the 1980's when I worked at the University of Florida. This was actually the first contract I ever conducted for a chemical company. *Fusarium* is a fungal pathogen that can cause leaf spots, crown rots and wilts and is often very difficult to control even when preventative measures are taken.

I am always trying to learn more about pathogens and found a reference recently stating that *Fusarium* spores can be airborne and it surprised me. That really changes the approach for control. The study on sorghum showed that the *Fusarium* spores were more abundant in air at a time when infection of the grain would be highest. They also found that systemic infection which resulted in wilt occurred through spores in the soil.

The presence of *Fusarium* is very common in most environments making prevention an ongoing concern. Studies conducted on gladiolus corms by Dr. Wade Elmer (Connecticut Agric. Exp. Stn.) determined possible benefits of using acibenzolar (an SAR=systemic

acquired resistance chemical). Dr. Elmer found that a preplant corm soak provided almost 50% increase in marketable flowers but the difference in disease development was not statistically significant. Use of Medallion or Terraguard doubled marketable flowers and significantly reduced disease. In contrast, neither 3336 nor biological products tested (Actinovate, Companion, RootShield and MycoStop) did not affect disease or number of marketable flowers. Combining acibenzolar with Heritage provided 100% suppression of *Fusarium* wilt although neither alone provided any control. For a complete report see: Can. J. Plant Pathol. 28:609-614 (2006.)

We started a trial on *Fusarium* wilt of *lisianthus* (a cut flower crop) on 21 March of this year. Products were applied between March and May and the final ratings were taken on 23 May. We inoculated plants on 11 April and started to see disease symptoms 3-4 weeks later. The graph below shows final disease severity ratings where 1=no disease, healthy and 5=dead.

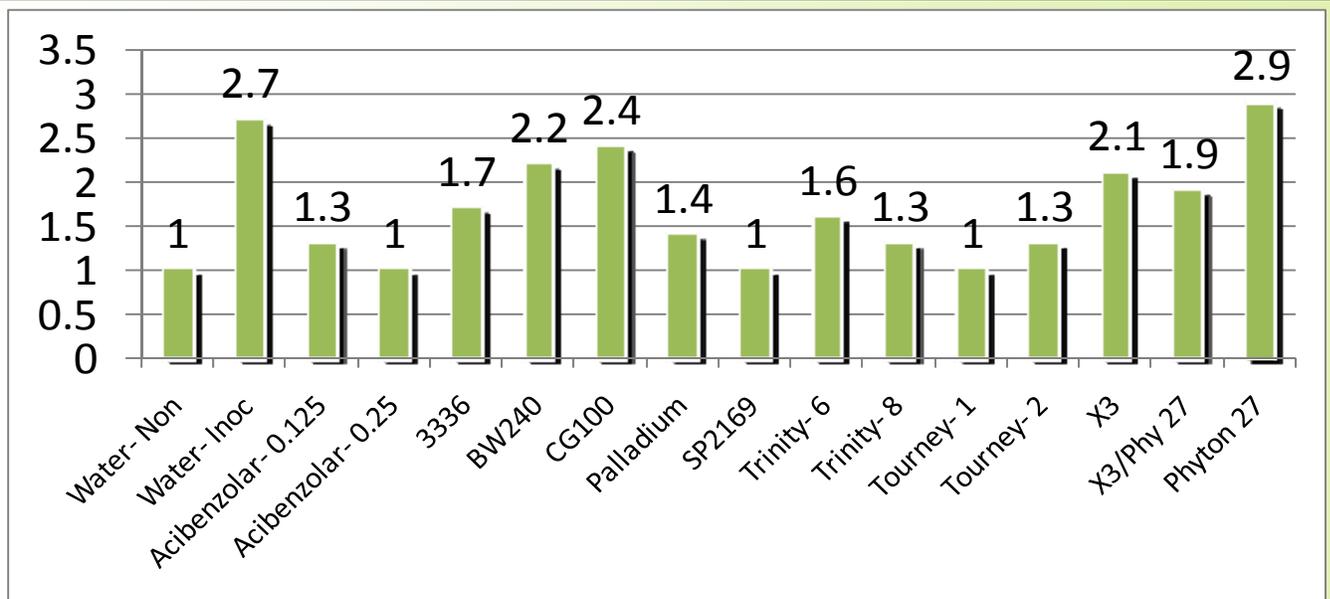
Optimal control was seen with acibenzolar drenches, SP2169 (no longer under development) and Tourney (which also caused severe stunting). Palladium and Trinity were also moderately effective. Many other products were ineffective in this trial including BW240, CG100, X3 and Phytion 27.

**Fusarium corm rot on gladiolus**



The most effective fungicides for *Fusarium* diseases remain Heritage, Medallion and Terraguard. Potential products that may be good rotational or tank mix partners are acibenzolar and triazoles (Tourney and Trinity). Since the triazoles can have PGR effects, they must be tested prior to broad-scale use. Acibenzolar is not currently labeled for ornamentals but is under scrutiny at Syngenta now. Hopefully, trials will continue to indicate the benefits and a label for ornamental use will be forthcoming.

Effect of fungicides on prevention of *Fusarium* wilt on *Lisianthus*. Disease was rated on the following scale: 1=none, healthy, 2=slight yellowing of lower leaves, 3 = moderate yellowing and wilting, 4 = advanced wilting and leaf necrosis and 5 = dead.



# Powdery Mildew Control—Recent Research

Over the years we have seen many products developed for powdery mildew control. In addition, many researchers have sought to reduce powdery mildew concerns through testing for resistance among the myriad cultivars often in the trade. Although both approaches have merit neither has been entirely successful. The very nature of the ornamentals industry has limited the ability of growers to chose only resistant cultivars. Further, the development of new races or strains of pathogens means that even resistant cultivars may be attacked by newly emerging races of the pathogen. I am reporting here on recent work performed by Dr. Mark Windham (University of Tennessee) on susceptibility of hydrangea cultivars to *Erysiphe polygoni*. I also report on a recent trial we performed on Gerber daisies infected with *Oidium* sp.

## HYDRANGEA CULTIVAR RESISTANCE TO POWDERY MILDEW—

This research was conducted over a 3-year period in Tennessee on 90 cultivars on *Hydrangea macrophylla*. Their work showed that ‘Veitchii’ is resistant to powdery mildew.

In contrast, the following cultivars were moderately to highly susceptible:

- ‘All Summer Beauty’
- ‘Dooley’
- ‘General Vicomtessee de Vibraye’
- ‘Holsten’
- ‘Madame Emile Mouillere’
- ‘Nikko Blue’
- ‘Preziosa’

High levels of resistance was confirmed for ‘Miyama-yae-Murasaki’. There were also some that have been shown to have a variable response including:

- ‘Ami Pasquier’
- ‘Ayesha’
- ‘Frilleibet’
- ‘Goliath’
- ‘Lilacina’
- ‘Miranda’
- ‘Sister Therese’
- ‘Souvenir du President Doumer’
- ‘Tokyo Delight’

Unfortunately, this long-term study highlights the difficulty of establishing resistance level to a single disease making its use in commercial production quite a challenge.

For a complete report see: J. Environ. Hort. 29(2):60-64.

## POWDERY MILDEW PREVENTION ON GERBER DAISY—

We started this trial in early April and sprayed the products three times on a 14 day interval. Treatments are listed in the table below. Disease was rated on the following scale: 1 (none), 2 (slight), 3 (moderate), 4 (severe). The first rating occurred two weeks after test initiation.

Initially, all products provided excellent prevention of powdery mildew which was somewhat different by the end of the trial. Hoist (myclobutanil) provided the best prevention although Trinity was statistically the same at 16 or 24 oz which will probably be much higher than the final label will allow. Hoist and Trinity are both in MOA 3—sterol inhibitors which are well established as excellent products for powdery mildew control. KleenGrow was also statistically effective. KleenGrow is a quaternary ammonium compound that we have found to be very effective in a number of our trials on ornamental diseases.

| Summary of Chase Horticultural trials on powdery mildew control. |        |               |
|--|--------|---------------|
| Product  | MOA    | Efficacy      |
| Banner MAXX  | 3      | Very good/exc |
| Concert  | 3, M5  | Excellent     |
| Hoist  | 3      | Very good/exc |
| Rubigan  | 3      | Very good/exc |
| Strike   | 3      | Good/exc      |
| Terraguard   | 3      | Very good/exc |
| Trinity  | 3      | Excellent     |
| Tourney  | 3      | Excellent     |
| Pipron   | 5      | Very good/exc |
| Compass O  | 11     | Very good/exc |
| Cygnus   | 11     | Very good/exc |
| Disarm O   | 11Ver  | None          |
| Heritage   | 11     | Very good/exc |
| Insignia   | 11     | Good/exc      |
| Pageant  | 7, 11  | Very good/exc |
| Aliette  | 33     | Poor/some     |
| Alude  | 33     | Very good     |
| Fosphite   | 33     | Some/vgood    |
| Vital  | 33     | Very good/exc |
| Camelot  | M1     | Poor/vgood    |
| Phyton 27  | M1     | Good/exc      |
| Junction   | M1, M2 | Fair/vgood    |
| Dithane  | M3     | Some          |
| Protect T & O  | M3     | Good/vgood    |

## Control of powdery mildew on Gerber daisy with fungicides. Disease was rated on the following scale: 1(none), 2(slight), 3 (moderate) and 4 (severe).

| Treatment                  | Rate/ 100 gal. | Disease 4-20-11 | Disease 4-27-11 | Disease 5-4-11 |
|----------------------------|----------------|-----------------|-----------------|----------------|
| <b>Water Noninoculated</b> | -----          | 2.3 ab          | 2.5 b           | 3.3 d          |
| <b>Water Inoculated</b>    | -----          | 3.3 b           | 2.5 b           | 3.4 d          |
| <b>Trinity</b>             | 6 oz           | 0.3 a           | 1.5 a           | 2.5 c          |
| <b>Trinity</b>             | 8 oz           | 0.4 a           | 1.3 a           | 2.0 bc         |
| <b>Trinity</b>             | 16 oz          | 0.0 a           | 1.2 a           | 1.6 ab         |
| <b>Trinity</b>             | 24 oz          | 0.0 a           | 1.4 a           | 1.4 a          |
| <b>Hoist (Eagle)</b>       | 4 oz           | 0.0 a           | 1.0 a           | 1.0 a          |
| <b>KleenGrow</b>           | 12.5 oz        | 0.8 a           | 1.6 a           | 2.2 bc         |

Numbers in the same column followed by the same letter are not significantly different using Student-Newman-Keuls Method.

# Controlling Cercospora Leaf Spot with Fungicides

We have been testing products for Cercospora leaf spot control over the past ten years. Our test systems have included Cercospora leaf spot on pansy, Cercospora leaf spot on myrtle (not common) and Cercospora leaf spot on Moluccella (Bell's of Ireland) which is a seed-borne disease. There are of course many other Cercospora diseases such as angular leaf spot on pitosporum, Cercospora leaf spot on Ligustrum and Cercospora leaf spot on Rhododendron as well as many perennial crops. You can check our website for a more thorough listing of Cercospora diseases on ornamentals ([www.chasehorticulturalresearch.com](http://www.chasehorticulturalresearch.com)).

There are quite a few very effective products for Cercospora prevention. Research

starting over 30 years ago indicated that thiophanate methyl products (MOA 1) were excellent and they remain so today (3336). Of the newer fungicides, triazoles (MOA 3) such as Banner MAXX have been good to excellent can be used on woody ornamentals but not inside a greenhouse. The exception to this is Eagle which is labeled for use in greenhouses too. The strobilurins also provide excellent control (MOA 11).

Many other types of products including those that are not classified (nc), can be very effective, including Cease (biological), KleenGrow (quaternary ammonium) and X3 (peroxy acid combination).



## Summary of fungicide trials for control of Cercospora leaf spot on ornamentals (Chase Horticultural Research).

| chemical               | Rate/100 | interval   | % control           | MOA group |
|------------------------|----------|------------|---------------------|-----------|
| <b>Banner MAXX</b>     | 4 oz     | 14 days    | good-excellent      | 3         |
| <b>Cease</b>           | 0.5-2%   | weekly     | some-excellent      | nc        |
| <b>Chipco 26019</b>    | 16 oz    | 10 days    | some                | 2         |
| <b>Cleary 3336</b>     | 16 oz    | 7-14 days  | excellent           | 1         |
| <b>Compass O</b>       | 2 oz     | 7-14 days  | very good-excellent | 11        |
| <b>Cygnus</b>          | 3.2 oz   | 7 days     | excellent           | 11        |
| <b>Daconil Ultrex</b>  | 22.4 oz  | 10-14 days | excellent           | M5        |
| <b>Eagle (Hoist)</b>   | 4 oz     | 10-14 days | excellent           | 3         |
| <b>Heritage</b>        | 1-4 oz   | 7-14 days  | excellent           | 11        |
| <b>Insignia</b>        | 4 oz     | 7-14 days  | excellent           | 11        |
| <b>KleenGrow</b>       | 12.5 oz  | 7 days     | very good           | nc        |
| <b>Medallion</b>       | 1 oz     | 7-14 days  | some-excellent      | 12        |
| <b>MilStop</b>         | 2.5 oz   | 7 days     | excellent           | nc        |
| <b>OHP 6672</b>        | 16 oz    | 7 days     | poor                | 1         |
| <b>Pageant</b>         | 12 oz    | 7 days     | excellent           | 7 and 11  |
| <b>Palladium</b>       | 4-6 oz   | 7 days     | good-excellent      | 9 and 12  |
| <b>Phyton 27</b>       | 15-25 oz | 7 days     | good-excellent      | M1        |
| <b>Protect T&amp;O</b> | 16 oz    | 10-14 days | excellent           | M3        |
| <b>Regalia SC</b>      | 1%       | 7 days     | good                | nc        |
| <b>Terraguard</b>      | 2-4 oz   | 7 days     | very good           | 3         |
| <b>Trinity</b>         | 1-4 oz   | 7 days     | very good           | 3         |
| <b>Veranda O</b>       | 3.6 oz   | 7 days     | some                | 19        |
| <b>X3</b>              | 1:1500   | 7 days     | very good           | nc        |