SECTION 4

ENTOMOLOGY

Frank Hale
Section Editor and Moderator

Section 1 and Section 13 may contain related titles.

Control Of Florida Wax Scale (Ceroplastes floridensis) on Dwf. Burford Holly (Ilex cornuta cv. 'Dwarf Burford')

Charles P. Hesselein, Joseph R. Chamberlin and Michael L. Williams
Dept. of Entomology, Auburn University, Auburn, AL 36849

Nature of Work: Florida Wax Scale is a common pest of hollies. Most injury is cosmetic due to excretion of honeydew by the scale and the subsequent growth of sooty mold. However, severe infestations can kill entire branches through direct feeding injury. This study was conducted to determine the efficacy of two acephate products, Pinpoint and an experimental, 2.5% a.i., sand based granular product, compared to a standard insecticidal oil spray (SunSpray Ultra-Fine Spray Oil (SunSpray USFO)) and a water sprayed control.

Heavily infested dwf. burford hollies growing in 10 inch pots were placed in a greenhouse. Initially, all scale sampled were eggs. Eggs were allowed to hatch and develop into second instars before plants were treated on May 14, 1996. Second instars were counted and insecticide efficacy was determined by the number of scale living at the end of the experiment. Efficacy is expressed as the percentage of scale living at the end of the experiment (Final Scale Count/Initial Scale Count). Treatments consisted of the following:

- Pinpoint 15 G (2.5 gm per pot or 0.375 gm ai/pot; ≈0.09 oz/pot or 0.013 oz ai/pot)
- Acephate 2.5G (15 gm per pot or 0.375 gm ai/pot; ≈0.53 oz/pot or 0.013 oz ai/pot)
- SunSpray UFSO (2% concentration sprayed to runoff with approx. 5 1/2 oz dilute spray per pot)
- Water sprayed control (approx. 5 1/2 oz water spray per pot)

On the day of treatment and three following days, plants were watered with 8 oz of water per pot. Subsequently, plants were irrigated daily with approximately 6 oz water per pot using a drip irrigation system.

Results and Discussion: The plants exhibited no signs of phytotoxicity or growth stunting as a result of any treatment. Sooty mold ratings were taken at the termination date (July10). A scale of 1 to 5 was used with 1=0%, 2= 1-25%, 3=26-50%, 4=51-75%, 5=76-100% of the foliage affected by sooty mold.

Sooty mold data were analyzed using Proc Npar1way (SAS Institute, 1985). The median scores for the different insecticide treatments were as follows: control, 5.0, Pinpoint 15G, 4.3; acephate 2.5G, 4.7; and SunSpray UFSO, 3.3;. While the overall test was significant (Kruskal-

Wallis Test, Prob>CHISQ=0.0068) mean separation using a method described by Gibbons (J. Gibbons, 1976) could only discern differences at $P \leq 0.10$. Only the SunSpray UFSO treatment had a significantly lower sooty mold score. In addition to insecticidal properties, oil sprays have the added benefit of loosening sooty mold from the leaf surface, making it easier for the sooty mold to wash or flake off.

Using Proc GLM (SAS Institute Inc., 1985) the F test for insecticide efficacy was statistically significant ($P \leq 0.0001$). Means were separated using Duncan's Multiple Range test ($P \leq 0.05$) with SunSpray UFSO and acephate 2.5G the most effective treatments followed by Pinpoint 15G (Table 1).

Significance to Industry: Many pest control manuals recommend timing pesticide sprays for scale insects when the insects are in the first instar (crawler) stage. This study demonstrates that it is possible to obtain satisfactory control of Florida wax scale by targeting the second instar stage. The advantages of targeting this stage are two-fold. First, the insects are much easier to see and monitor. Second, the timing of the spray is not as critical as the insect spends more time in the second instar stage than in the crawler stage.

It is important to realize that insecticidal oil sprays must contact the target pest in order to kill them. Thorough coverage of infested plants by the spray is necessary for satisfactory control.

Literature Cited

1. SAS Institute Inc. 1985. SAS/STAT™ Guide for Personal Computers, Version 6 Edition. SAS Institute Inc., Cary, NC

2. Gibbons, J.D. 1976. Nonparametric Methods for Quantitative Analysis. Holt, Rinehart and Winston. New York, NY

Table 1. Insecticide efficacy as measured by the percent of living Florida wax scale per sample area at the study's conclusion

Treatment	Mean Percentage of Living Scale
Control	38[z] a
Pinpoint	25 b
Acephate 2.5%	8 c
SunSpray UFSO	1 c

[z]means with the same letter not statistically different ($P \leq 0.05$)

IR-4 Research For Pest Control In Nursery Crops - 1996

J. Ray Frank
Rutgers/State University of New Jersey, New Market, MD 21774

Nature of Work: Efficacy and phytotoxicity research is needed for use in obtaining national pesticide label registrations including biopesticides. During 1996, research was needed for 34 fungicides, 30 herbicides, 27 insecticides and 7 plant growth regulators. The research needed includes evaluations for plant production in the nursery, greenhouse, forest sites, interior plantscapes and commercial landscape.

Protocols were developed to insure uniformity and accuracy of the data needed for national label registrations. In 1996 research was conducted by 20 state, federal and private researchers in 14 states on 445 separate trials. This research included the biological fungicide, Ampelomyces quisqualis (AQ-10) on rhododendron.

Results and Discussion: During 1996, data was collected for these 10 fungicides: Ampelomyces quisqualis (AQ-10), Bordeaux Mixture, Captan, chlorothalonil (Daconil), copper complex (Phyton 27), copper hydroxide (Kocide), Etridiazole (Banrot, Ethazole), Myclobutanil (Eagle), Oxytetracycline (Mycoshield), Streptomycin sulfate (Agri-mycin 17). Twenty herbicides were also evaluated during 1996 including: Bentazon (Basagran), Clethodim (Prism), 2,4-D Amine (Weedar 64), 2,4-D Ester (Weedone LV4), Dithiopyr (Dimension), Diuron, Fluazifop-p-butyl (Fusilade), Halosulfuron (Manage, Permit), Isoxaben (Gallery), Metoloachlor (Pennant), Napropamide (Devrinol), Oryzalin (Surflan), Oxadiazon (Ronstar), Oxyfluorfen + Oryzalin (Rout), Oxyfluorfen + Pendimethalin (Orn. Herb. II), Pendimethalin (Southern Weed Grass Control), Prodiamine (Barricade, Factor), Sethoxydim (Vantage), Sulfentrazone (Authority), Trifluralin (Gowan Trifluralin). Research was also conducted on 9 insecticides including: Acephate (Orthene), Bifenthrin (Talstar), Champons 100% Natural (Capsaicin), Chlorpyrifos (Dursban), Formetanate-HCL (Carzol), Imidacloprid (Marathon), Pirimicarb (Pirimor), horticulural oil (SunSpray Ultra-Fine Spray Oil), Tefluthrin (Fireban).
During 1996, 879 new label registrations were added for use in the nursery and floral crop industry (Table 1).

Significance to Industry: The IR-4 ornamental research program has developed data for over 4900 label registrations for the nursery and floral crop industry.

Literature Cited

1. IR-4 1993.Project Statement.October 1,1993-September 30,1998. NJAES Cook College, Rutgers University, New Brunswick, NJ. 37pp

2. IR-4 1996. Annual report NJAES, Cook College, Rutgers University, New Brunswick, NJ. 103pp

3. IR-41997. Commercially Grown Floral, Forestry, Nursery and Turf Crops, IR-4 Minor Use Report Card- 1997 Update. 15pp

Table 1. 1996 Pesticide Registrations Supported by IR-4 Data

Abamection (Avid)
- Acuba
- Cotoneaster
- Holly
- Holly, Japanese
- Japanese Pittosporum
- Juniper
- Rose
- West Indies Mahogany

Acephate (Orthene)
- Arborvitae
- Balsam
- Christmas Cactus
- Chrysanthemum
- Geranium
- Marigold
- Periwinkle
- Petunia
- Snapdragon

Azadirachtin (Margosan-O)
- Citrus (non-bearing)
- Coconut Palm
- Ornamental Cabbage
- Ornamental Kale
- West Indies Mahogany

Bendiocarb (Ficam)
- Pear (non-bearing)

Benefin + Oryzalin (XL-2G)
- Lilyturf
- Pampas Grass

Bentazon (Basagran)
- Algerian Ivy
- Arborvitae
- Balsam
- Crape Myrtle
- Dusty-miller
- Flowering Dogwood
- Hawthorn
- Japanese Pittosporum
- Lilyturf
- Marigold
- Ornamental Cabbage
- Petunia
- Photinia
- Privet
- Red Bud
- Snapdragon
- Southern Yew
- Yew

Bifenthrin (Talstar)
- Ash
- Holly, Japanese
- Pear (non-bearing)

Calcium Polysulfide (Lime Sulfur)
- Crabapple (non-bearing)
- Hawthorn
- Plum (non-bearing)

Captan
- Begonia
- Blueberry (non-bearing)
- Camellia
- Cherry (non-bearing)
- Gladiolus
- Shasta Daisy
- St.augustine Grass

Carbofuran (F) (Furadan)
- Pine

Champons 100% Natural (Capsaicin)
- Azalea
- Holly, Chinese
- Holly, Japanese
- Juniper

Chlorothalonil (Daconil)
- Firethorn
- Leatherleaf Fig
- Lilac
- Magnolia
- Maple
- Marigold
- Poinsettia

Chlorpyrifos (Dursban)
- Camellia
- Croton
- Lobelia
- Weeping Fig

Chlorpyrifos (Microencapsulated) (Dursban)
- Carnation
- Chrysanthemum
- Hibiscus
- Leatherleaf Fig
- Persian Violet
- Poinsettia
- Rose
- Snapdragon

Clethodim (Prism)
Potentilla

Copper Hydroxide (Kocide)
- Andromeda
- Arborvitae
- Arrowwood
- Balsam
- Boston Fern
- Boxwood
- Bridal-wreath
- Camellia
- Canna
- Carnation
- Cedar
- Cherry (non-bearing)
- Corn Plant
- Crabapple (non-bearing)
- Date Palm
- Dumb Cane
- Egyptian-star-cluster
- Elm
- Fern
- Flag
- Flowering Dogwood
- Flowering Quince
- Gardenia
- Geranium
- Good-luck Plant,Ti Plant
- Grape Ivy
- Hibiscus
- Holly
- Hydrangea
- Indian Hawthorn
- Japanese Pittosporum

Juniper
Leatherleaf Fig
Lilac
Loquat
Magnolia
Magnolia, Saucer
Maple
Maple Sugar
Maple, Red
Marigold
Mountain Ash
Oak
Oak, Laurel
Palm
Pansy
Pear (non-bearing)
Peony
Periwinkle
Phlox
Photinia
Plum (non-bearing)
Pothos
Queen Palm
Rhododendron

Copper Hydroxide (Kocide)
Rose Periwinkle
Shasta Daisy
Snapdragon
Spathe Flower
Umbrella Tree
Willow
Zebra Plant
Zinnia

Copper Sulfate, Basic
Begonia
Rose

Cyfluthrin(Decathlon)
(Tempo)
Ageratum
Carnation
Chrysanthemum
Dahlia
Geranium
Marigold
Pansy
Petunia
Rose
Scarlet Sage
Shasta Daisy
Snapdragon
Zinnia

Cyromazine (Citation)
Daylily
Dumb Cane
Lilyturf

Cyromazine (foliar)
(Citation)
Baby's-breath
Calendula
Marigold
Pansy
Periwinkle
Shasta Daisy
Snapdragon

Cyromazine (soil) (Citation)
Calendula

DCPA (Dacthal)
Ageratum
Marigold
Moss Rose
Spruce

Diazinon
Balsam
Chrysanthemum
Gazania
Marigold

Diazinon
Petunia
Primrose
Rose
Scarlet Sage
Vervain

Diazinon(E)(DZN) (AG 500)
Almond (non-bearing)
Apricot (non-bearing)
Arrowwood
Ash
Aspen
Baby's-breath
Bridal-wreath
Carnation
Cherry (non-bearing)
Christmas Trees
Chrysanthemum
Crabapple (non-bearing)
Flowering Dogwood
Gladiolus
Honey Locust
Honeysuckle
Lily
Marigold
Pansy
Peach (non-bearing)
Petunia
Plane Tree
Purpleleaf Wintercreeper
Rose
Shasta Daisy
Wax Vine
Yellowwood
Yew

Diazinon
(Microencapsulated)
(Knox Out)
Azalea
Balsam
Calendula
Crape Myrtle
Firethorn
Flowering Dogwood
Geranium
Good-luck Plant
Honeysuckle
Marigold
Oleander
Petunia
Poinsettia
Primrose
Snapdragon
Wax Vine
Zinnia

Dichlobenil (Casaron)
Heather

Dienochlor (Pentac)
Bottle Ponytail
Cast-iron Plant
Gladiolus
Good-luck Plant
Nephthytis
Spathe Flower
Tupidanthus calyptratus

Diflubenzuron (Dimilin)
- Aglaonema
- Betel Palm
- Bottle Ponytail
- Cast-iron Plant
- Corn Plant
- Dumb Cane
- English Ivy
- Good-luck Plant
- Hydrangea
- Leatherleaf Fig
- Nephthytis
- Parlor Palm
- Periwinkle
- Philodendron
- Poinsettia
- Pothos
- Sentry Palm
- Spathe Flower
- Tupidanthus Calyptratus
- Umbrella Tree

Dimethoate
- Arborvitae
- Camellia
- Carnation
- Citrus (non-bearing)
- Gardenia
- Holly
- Leatherleaf Fig
- Oak
- Purpleleaf Wintercreeper
- Rose
- Yew

Disulfoton (Di-Syston)
- Camellia

Diuron
- Elm

Endosulfan (Thiodan)
- Chrysanthemum

Ethofumesate (Nortron)
- entgrass

Etridiazole (Ethazole)
- Andromeda
- Aucuba
- Betel Palm
- Blanket Flower
- Boxwood
- Christmas Cactus
- Cineraria
- Columbine
- Coralbells
- Daphne
- English Ivy
- Flowering Dogwood
- Good-luck Plant
- Heather
- Larkspur
- Laurel
- Mugwort
- Natal Plum
- Palm
- Periwinkle
- Pine, Norfolk Isle
- Primrose
- Shasta Daisy
- Song of Jamaica
- Umbrella Tree

Etridiazole (G) (Ethazole)
- Ageratum
- Balsam
- Chrysanthemum
- Dahlia
- Foxglove
- Marigold
- Petunia
- Scarlet Sage
- Transvaal Daisy
- Vervain

Fenarimol (Rubigan)
- Sweet Pea

Fenpropathrin (Tame)
- Holly

Ferbam
- Betel Palm
- Cherry (non-bearing)

Fluazifop-p-butyl(Fusilade)
- Ajuga
- Aucuba
- Begonia
- Christmas Trees
- Chrysanthemum
- Tickseed

Flurprimidol (Cutless)
- Ash
- Maple
- Oak, Red
- Sycamore

Fonofos (Dyfonate)
- Kentucky Bluegrass

Fosetyl Al (Aliette)
- Baby's-breath
- Pinks
- Snapdragon
- Vervain

Gibberellic Acid (GA)
- Azalea
- Chrysanthemum
- Persian Violet

Gliocladium Virens (Soil gard)
- Dahlia
- Geranium
- Pansy
- Periwinkle

Glyphosate (Roundup)
- Kentucky Bluegrass
- Marigold

Glyphosate (topical) (Roundup)
- Spruce

Hexythiazox (Hexagon)
- Arborvitae
- Crabapple (non-bearing)
- Forsythia
- Honey Locust
- Japanese Spurge
- Maple
- Oak
- Purpleleaf Wintercreeper
- Spruce
- Yew

Imidacloprid (Merit)
- Arrowwood
- Ash
- California Poppy
- Crape Myrtle

Dahlia
Elm
Flowering Dogwood
Foxglove
Fuchsia
Gazania
Hibiscus
Imidacloprid (Merit)
Holly
Juniper
Larkspur
Lavender
Lilac
Linden
Maple
Oak
Poinsettia
Shrub Verbena

Iprodione (Chipco 26019)
Almond (non-bearing)
Apricot (non-bearing)
Begonia
Boston Fern
Conifer
Dusty-miller
Foxglove
Leatherleaf Fern
Marigold
Orchid
Petunia
Pothos
Shasta Daisy
Song of Jamaica

Isoxaben + Oryzalin (Snapshot)
Lilyturf, Creeping
Magnolia

Lindane
Pine, Austrian
Pine, Red
Pine, Scotch

Malathion
Carnation
Christmas Cactus
Rose

Mancozeb + Copper Hydroxide (Junction)
Geranium

Mefenoxam (Subdue)
Blanket Flower
Christmas Cactus

Metam-sodium (Vapam)
Pine

Metolachlor (EC) (Pennant)
Blanket Flower

Metolachlor (G) (Pennant)
Blanket Flower
Columbine

Myclobutanil (Systhane)
Bee Balm
Cherry (non-bearing)
Crabapple (non-bearing)
Hydrangea
Pear (non-bearing)
Phlox
Plum (non-bearing)
Poinsettia

Naled (ULV) (Dibrom)
Marigold
Shasta Daisy

Napropamide (G)(Devrinol)
Photinia

Napropamide(WP) (Devrinol)
Gazania

Oryzalin (Surflan)
Baby's-breath
Bear Grass
Bleeding Heart
Buttercup
False Spirea
Honey Locust
Lilac
Lily, Plantain
Lilyturf
Moss Rose
Plane Tree
Potentilla
Stonecrop

Oxadiazon (Ronstar)
Ajuga
Carpet Bugleweed
Kentucky Bluegrass

Oxadiazon (G) (Ronstar)
Honeysuckle
Lilac
Maple, Tatarian

Oxadiazon (irrig.) (Ronstar)
Aucuba
Azalea
Boxwood
Gardenia
Japanese Pittosporum
Photinia
Pine
Privet
Purpleleaf Wintercreeper
Southern Yew

Oxamyl (Vydate)
Aster
Camellia
Christmas Cactus
Marigold
Persian Violet

Oxyfluorfen + Oryzalin (Rout)
Baby's-breath
Corn Plant
False Cypress
Flowering Dogwood
Forsythia
Holly Olive
Honeysuckle
Potentilla
Privet
Protea
Red Bud
Tailflower
Yew
Maple, Red

PCNB (Terraclor)
- Aster
- Baby's-breath
- Camellia
- Carnation
- Cherry (non-bearing)
- Crabapple (non-bearing)
- Fern
- Flowering Dogwood
- Good-luck Plant
- Hawthorn
- Hollyhock
- Jade Plant
- Maple Sugar
- Maple, Red
- Pansy
- Philodendron
- Pine, Norfolk Isle
- Plum (non-bearing)
- Purpleleaf Wintercreeper
- Red Bud
- Statice

Pendimethalin (Prowl)
- Baby's-breath
- Blanket Flower
- Cast-iron Plant
- Montauk Daisy
- Peony
- Purple Coneflower
- Stokes Aster
- Pendimethalin (G) (Prowl)
- Daylily
- Fern, Tree
- Lilyturf
- Pansy

Permethrin (Astro)
- Azalea
- Baby's-breath
- Bromeliads
- Carnation
- Gladiolus
- Lily-of-the-incas
- Rose

Prodiamine (2G)
(Barricade, Factor)
English Ivy

Prodiamine (WG)
(Barricade, Factor)
- Azalea
- Butchers Broom, Israeli Ruscus
- Cotoneaster
- Fern, Tree
- Forsythia
- Leatherleaf
- Leatherleaf Fern
- Photinia
- Privet
- Redroot
- Rose
- Tulip

Pronamide (Kerb)
- Cotoneaster

Propiconazole
(Banner Maxx)
- Rhododendron
- Snapdragon

Resmethrin
- Aster
- Christmas Cactus
- Marigold
- Orchid
- Pansy
- Periwinkle
- Scarlet Sage
- Wandering Jew

Sethoxydim (Poast)
- Bellflower
- Coral Bells
- Hydrangea

Simazine (Princep)
- Honey Locust
- Juniper

Simazine (herbigation)
(Princep)
- Juniper
- Pine

SunSpray Ultra-Fine
Spray Oil
- Aglaonema
- Corn Plant
- Daffodil
- Fuchsia
- Jade Plant
- Lisianthus
- Ornamental Cabbage
- Ornamental Kale
- Pear (non-bearing)
- Umbrella Tree

Thiophanate Methyl
(Cleary's 3336)
- Cherry (non-bearing)
- Douglas Fir
- Dusty-miller
- Elephant's Ear
- English Ivy
- European Larch
- Fir
- Foxglove
- Fuchsia
- Holly
- Holly, Chinese
- Holly, Japanese
- Hollyhock
- Hydrangea
- Larch
- Pine, Jack
- Pine, Scotch
- Poinsettia
- Rose
- Spruce, Norway
- Spruce, White

Thiophanate Methyl +
Mancozeb (Zyban)
Daffodil
Photinia

Triadimefon (Bayleton)
- Alumroot
- Ash
- Aster
- Azalea
- Bee Balm
- Cineraria
- Crape Myrtle

Triadimefon (Bayleton)
- Dahlia
- Douglas Fir
- Elm
- Fern
- Fir
- Fuchsia
- Honey Locust
- Larch
- Marigold
- Phlox
- Shasta Daisy
- Spruce
- Spruce, Colorado
- Stonecrop
- Sunflower
- Sweet Pea
- Zinnia

Triflumizole (Terraguard)
- Zinnia

Trifluralin (Treflan)
- Arrowwood
- Avens
- Azalea
- Baby's-breath
- Bald Cypress
- Barberry
- Birch
- Blanket Flower
- Bottlebrush
- Boxwood
- Cotoneaster
- Creeping Phlox
- Cypress
- Daffodil
- Elm
- Firethorn
- Flag
- Gardenia
- Heavenly Bamboo
- Holly
- Holly Olive
- Honeysuckle
- Indian Hawthorn
- Japanese Pittosporum
- Lamb's-ear
- Madwort
- Magnolia
- Mock Orange
- Moss Rose
- Pecan (non-bearing)
- Photinia
- Poplar
- Privet
- Red Bud
- Russian Olive
- Shasta Daisy
- Trifluralin (Treflan)
- Southern Yew
- Spanish-bayonet
- Statice
- Stokes Aster
- Sumac
- Sweetgum
- Tulip
- Yarrow

Triforine
- Azalea
- Begonia
- Rose

Vinclozolin (Ornalin)
- Baby's-breath
- Crape Myrtle
- Elm
- Fir
- Juniper
- Leatherleaf Fig
- Marigold
- Oregon Grape
- Poppy
- Pothos
- Protea
- Stock
- Tulip

Red Imported Fire Ant Management Studies Summer 1996, Dallas, TX

James A. Reinert and Steven J. Maranz
Texas Agricultural Experiment Station, Dallas, TX 75252

Nature of Work: The red imported fire ant (RIFA), *Solenopsis invicta* Buren, was accidentally introduced from South America and became established in Mobile, Alabama in the 1930s (3). It is recognized as a serious pest of urban landscapes across its distribution in the Southern U. S. RIFA reached Texas during the 1950s and has continued to spread across the state (2). It is now distributed throughout the eastern two thirds of Texas with confirmed colonies as far west as Ector and Midland counties and to Sherman county bordering on the Oklahoma Panhandle (1,4). RIFA populations have been identified as far north as the Texas Panhandle, North Central Oklahoma and from Southern Tennessee across and up the coast of most of North Carolina.

Even though RIFA is considered beneficial in several agricultural crops, it causes considerable disruption of turfgrass plantings and urban landscapes by its extensive mound building and the tunneling reaching out from these mound. Even more important, however, is the medical problems associated with RIFA stinging and biting as they disrupt recreational and sporting activities. These ants sting repeatedly and attack anything or anyone near the colony when it is disturbed. For these reasons, control measures are often necessary in urban landscapes around residential and commercial buildings, in parks and on and around other recreational and sports turf facilities.

The following two studies were conducted on a lawn with a mixture of bermudagrass, *Cynodon dactylon* (L.) Pers. and buffalograss, *Buchloe dactyloides* (Nutt.) Engelm. on a Community College campus in the Dallas, TX metroplex. In Experiment 1, late summer applications, applied on 7 August 1996, of several granular formulations of bifenthrin were compared with standard treatments of chlorpyrifos (Dursban) and diazinon granular treatments and an untreated check. Treatments were applied with a walk behind drop fertilizer spreader at the rates listed in Table 2, to plots ranging from 500-700 ft^2, each with 5 to 10 (mean = 8, mode = 7, total = 320) active colonies. Plots were delineated with white turf marking paint; each colony within a plot was identified by numbers painted on the turf ca. 1.5 ft from the mound.

Pretreatment foraging activity of the ants within each plot was assayed by placing 3, 8-dram shell vial traps near the central area of the plot for a ca. 30 min exposure. Vials werebaited with ca. 1.5-1.8 g pieces of hot dog and placed no closer than ca. 3 ft from the nearest active RIFA

colony. After exposure, the labeled vials were collected, rubber stoppered, and transported to the laboratory for counting. In the lab, vials were flooded with 70% ethanol, emptied into 10 cm diameter petri dishes and the ants counted. Plots were divided into 4 replicates based upon pretreatment foraging samples and treatments were randomly assigned within each rep. This method assured that plots with the highest foraging activity were in rep 1 with the next highest group comprising rep 2, and so forth.

RIFA foraging activity was assessed 2 d before treatments were applied, and at 1 and 3 d, and at 1, 2, 4, and 6 wk posttreatment. Individual mound mortality was determined at 1, 2, 4, and 6 wk after treatment by stomping hard (4-5 times) on the soil or turf ca. 1 ft from the mound in a circle around each mound. Upon disturbance, an active mound would yield many active workers. For the final rating at 4 and 6 wk, a ca. 1.5 g piece of hot dog was dropped upon the mound and observed 20-30 min later. If the colony was active, workers would be foraging the piece of hot dog within this time period.

In Experiment 2, many of the same methods from Experiment 1 were used. Granulated bait formulations of 3 active ingredients (chemicals and rates listed in Table 2) were applied to individual mounds within each plot on 28 August 1996. Applications were applied with a hand held shaker to distribute the bait evenly over an area ca. 3 ft in diameter with the mound in the center. Plot size ranged from 300-500 ft2, each with 3 to 5 (mean = 3.7, mode = 3, total = 59) active colonies. Plots and colonies were marked and numbered as above. Individual mound mortality (stomping) and foraging activity (baited vials) within each plot were assayed, as in experiment 1, at 1, 2, 3, 5, and 7 wk posttreatment. Hot dog pieces were also used in this test for the final assessment of mound activity at 5 and 7 wk.

For each experiment, data was analyzed using the General Linear Model procedure and mean separated by Waller-Duncan multiple comparison procedures (k ratio = 100) (5). The analysis was performed on mean sampled ants per bait trap and on an arc sine transformation of the percentage mortality data for each plot.

Results and Discussion: Experiment 1 results are provided in Table 1. Each of the treatments except the lowest rates for both Talstar™ and bifenthrin (an unlabeled formulation of the same active ingredient in Talstar™) provided apparent good control of greater than 60% when mounds were examined at 1 wk. The initial quick control recorded at 1 wk, however, was not as apparent at 2 wk. Many of the colonies had recovered and expressed some activity at the 2 wk evaluation. All treatments of bifenthrin including the Talstar™ formulations provided

increasingly better control in time, with the highest rate of bifenthrin 0.05G providing 92.9% control and the higher rate of Talstar™ 0.02G providing 100% control at 6 wk after treatment. For each formulation, control increased as the rate was increased, and among the 2 formulations at the same rate, the bifenthrin 0.05G almost always provided numerically better control than the Talstar™ 0.02G formulation. All chemical treatments were significantly better than the untreated check at 6 wk posttreatment.

Additionally, the high (0.4 lb/acre) rate of bifenthrin and the Dursban and Diazinon treatments each reduced the foraging activity to zero by 1 d after treatment, while foraging was reduced to zero by day 3 in the Talstar 0.2G plots. Some foraging activity was apparent in one of the Talstar high rate plots by 2 wk and by 4 wk in the 0.4 lb/acre plots of bifenthrin. High foraging activity reoccurred by 4 wk in the Diazinon plots while only low numbers were detected in the Dursban plots by 6 wk. However, at the 6 wk evaluation, no significant difference was recorded in the foraging activity in the plots treated with the highest rate (0.4 lb/acre) of Talstar and bifenthrin, and in the Dursban plots, but each was significantly lower than the mean for the Diazinon treated plots. By 6 wk, all treatment means except the low rate for Talstar produced significantly lower foraging activity than the untreated check plots.

Experiment 2 results are presented in Table 2. Significant control (57.5%) of colonies was provided by hydramethylnon within 1 wk and by (S)-methoprene (33.3%) within 3 wk. All three products (hydramethylnon, (S)-methoprene, & fenoxycarb) were significantly better than the untreated check by 7 wk. Foraging activity within the plots was significantly reduced by hydramethylnon within 1 wk. All three materials produced significantly less foraging than the untreated check by 3 wk. However, none of the treatments completely eliminated foraging. The extended drought and low relative humidity during the summer of 1996 may have contributed to the reduced effectiveness experienced during this test. Also, bait formulations of insect growth regulators are slow acting and may not have reached their full potential during this 7-wk evaluation period.

No phytotoxicity was observed in either experiment due to any of the treatments.

Significance to Industry: The red imported fire ant is a major problem in nursery (field and container) production and in the landscape. Nesting often occurs near the base of plants or within the container, and even though the RIFA colony may be located outside the actual growing area, the RIFA workers interact significantly with the nursery workers and create a serious medical problem for the owner or nursery manager.

New information on control of this pest will be applicable to all levels of plant production and landscape establishment and maintenance.

Literature Cited

1. Drees, B. M., C. L. Barr, S. B. Vinson, R. E. Gold, M. E. Merchant & D. Kostroun. 1996. Managing red imported fire ants in urban areas. TX Agric. Ext. Serv., TX A&M Univ. System, College Station, TX Bull. B-6043. 18 p.

2. Drees, B. M. & S. B. Vinson. 1991. Fire ants and their management. TX Agric. Ext. Serv., TX A&M Univ. System, College Station, TX Bull. B-1536 18 p.

3. Oi, D. H., D. F. Williams, P. G. Koehler & R. S. Patterson. 1994. Imported fire ants and their management in Florida. Univ. FL, Coop. Ext. Serv. Bull. SP 161. 20 p.

4. Porter, S. D., A. Bhatkar, R. Mulder, S. B. Vinson & D. J. Clair. 1991. Distribution and density of polygyne fire ants (Hymenoptera: Formicidae) in Texas. J. Econ. Entomol. 84(3): 866-874.

5. SAS Institute. 1985. SAS User's Guide: Statistics, Version 5 ed. SAS Institute, Cary, NC.

Table 1. Control of red imported fire ant with broadcast applications of insecticides (Summer 1996' Dallas, TX) (4 reps).

Treatment	Rate lb/acre	Pretreat	1-Day	3-Day	l-Week		2-Week		4-Week		6-Week	
		no.[1]	no[1]	no.[1]	%[2]	no	%[2]	no.[1]	%[2]	no[1]	%[2]	no[1]
TalstarO.2G	0.1	253.3 a[4]	198.3 c[4]	172.5 c[4]	24.1 cd[34]	49.7 b[4]	0 e[34]	238.3 d[4]	0 d[34]	2330 f[4]	19.9de[34]	222.5 c[4]
TalstarO.2G	0.2	257.3 a	76.6 bc	40.7 ab	61.5 bc	17.4 a	14.3 de	126.2 bc	34.2 bcd	116.3 bcde	52.5 cd	103.6 b
Talstar 0.2G	0.4	249.8 a	3.3 a	O a	91.4 a	O a	71.2 ab	8.0 a	82.2 a	36.8 bcd	100 a	3.3 a
bifenthrin 0.05G	0.05	255.3 a	139.0 bc	108.3 c	60.0 bc	O a	15.0 de	53.5 ab	19.6 cd	31.4 abc	31.3 de	53.9 ab
bifenthrin 0.05G	0.1	270.0 a	20.0 a	29.5 ab	41.8 bcd	O a	28.1 cde	142.1 c	34.7 bcd	121.4 cafe	49.2 cd	83.8 b
bifenthrin 0.05G	0.2	257.3 a	43.7 a	15.5 a	70.0 ab	O a	51.8 abc	34.4 a	66.4 ab	17.8 ab	64.3 bc	38.6 ab
bifenthrin 0.05G	0.4	295.0 a	O a	O a	68.5 ab	O a	56.2 a	O a	70.5 a	2.3 a	92.9 a	12.5 a
Dursban 1G	1	244.3 a	O a	O a	64.1 ab	O a	66.2 ab	O a	59.0 bc	O a	86.7 ab	9.3 a
Diazinon 5G	4.36	271.8 a	O a	O a	70.8 ab	O a	34.3 bcd	O a	16.4 cd	125.6 cde	66.4 bc	92.3 b
Untreated Check	O	258.8 a	301.5 d	182.8 c	O d	53.4 b	3.1 e	241.4 d	3.1 d	225.9 ef	6.3 e	257. 4 c

[1]Mean number of RIFA trapped per vial from 3 hot dog baited shell vial traps per plot.
[2] Mean percent control of mounds per plot at weeks post-treatment.
[3] Analysis was made on arc sine transformation of the percent mortality data: Percent mortality is presented.
[4] Means in a column not followed by the same letter are significantly different by Waller-Duncan k-ratio t test (k = 100) P = 0.05).

Table 2. Contro] of red imported fire ants with individual mound bait applications (Summer 1996, Plano, TX) (4 reps).

Treatment (baits)	Rate tbs/ mound	1-Week		2-Week	3-Week		5-Week		7-Week	
		%[1]	no.[2]	no.[2]	%[1]	no.[2]	%[1]	no.[2]	%[1]	no.[2]
Amdro 0.73% (hydramethylnon)	5	57.5 a[3,4]	43.3 c[4]	32.1 b[4]	64 9 a[3,4]	65 8 b[4]	73.2 a[3,4]	12.8 c[4]	87.5 a[3,4]	4.2 b[4]
(S)-Methoprene 0.5%	5	10.0 b	258.8 a	65.2 ab	33.3 b	80.0 b	50.0 a	40.5 b	50.0 b	35.3 b
Award 1%		3	0 b	130.4 b	100.0 a	6.3 c	76.7 b	18.8 b	60.2 b	20.8 c
13.3 b (fenoxycarb)										
Untreated Check	0	0 b	202.7 ab	104.1 a	0 c	143.1 a	0 b	87.9 a	6.3 c	89.8 a

[1]Mean percent control of mounds per plot at weeks post-treatmen)3-5 mounds per plot).
[2] Mean number of RIFA trapped per vial from 3 hot dog baited shell vial traps per plot.
[3] Analysis was made on arc sine transformation of the percent mortality data: Percent mortality is presented.
[4] Means in a column not followed by the same letter are sign)ficantly different by wailer-Duncan k-ratio t test (k=100) (P= 0.05).

Controlling Japanese Beetle Grubs in Root Balls at the Time of Digging

Catharine Mannion, Win McLane, and Nick Gawel
TSU Nursery Crop Research Station, McMinnville, TN 37110

Nature of Work: Japanese beetle, *Popillia japonica* Newman, is a significant problem to nursery growers that ship from areas of infestation to areas of little or no infestation. Root balls dug in areas of Japanese beetle infestation can potentially contain grubs and, therefore, need treatment before shipping to uninfested areas. Although the treatment requirements for B&B (ball and burlapped) nursery stock can differ from state to state, typically a treatment targeting the grub population is required in addition to clean cultivation and foliar pesticides applied during adult flight. Generally, the most suitable time of chemical application for grub control is while the grubs are most susceptible, i.e. 1st and 2nd instar, and are found relatively close to the soil surface (summer and early fall). However, it may be necessary to make an application during the winter months when the grubs are 3rd instars and found deeper in the soil. If a treatment is found to be effective during this time period, it would allow for increased shipping opportunities of B&B nursery stock.

The objective of these tests was to compare granular insecticides applied to B&B trees and to trees in the field in February and March. These tests were conducted in a block of linden and ash trees in a commercial nursery in Grundy County, Tennessee. In the first of two tests, the trees were dug, balled and burlapped with a 24-inch root ball, and treated with an insecticide on the upper surface of the root ball before closing the burlap. The B&B trees were then placed back in the holes for protection against drying out or freezing until evaluation. In the second test, insecticides were applied around the base of each tree in a circle with a 30-inch diameter (assuming a 24 inch ball with a 6 inch buffer). These trees were not dug until evaluation. Both tests (B&B and field) received treatment application in February and were evaluated 30 and 60 days after treatment (March and April). These tests were repeated with treatment applications in March and evaluation in April and May. Treatments and rates are listed in Table 1. At the time of evaluation, the root balls were broken apart and thoroughly examined for grubs. Live grubs were counted and identified. The data were subjected to analysis of variance (1). Non-normal data sets were transformed [log(x+1)]. Experimental design was completely random with 7 replications (single-tree) per treatment.

Results and Discussion: The number of live Japanese beetle grubs in B&B trees was less in all treatments compared with the control treatment (Table 2). These differences were not significant (P<0.05) 30 days after

treatment in both the February and March applications. However, 60 days after treatment, Oftanol, Dylox, and Turcam significantly reduced the number of Japanese beetle grubs compared with the control. The number of live Japanese beetle grubs was less for all chemical treatments 60 days after treatment compared with 30 days after treatment. This trend occurred for both the February and March application.

The trends seen in B&B trees were also seen in trees receiving chemical prior to digging (Table 3). For example, all treatments reduced the number of Japanese beetle grubs compared with the control but not always significantly (Table 3). Sixty days after treatment, Oftanol and Dursban significantly (P<0.05) reduced the number of grubs compared with the control in the February application. In the March application, only Oftanol reduced the number of grubs significantly compared with the control at 60 days after treatment. Additionally, with one exception of equal numbers of grubs, there were fewer grubs 60 days after treatment compared with 30 days after treatment.

Oftanol consistently reduced the number of Japanese beetle grubs 60 days after treatment in both the B&B and field tests as well as for both application timings (February and March). The mean number of Japanese beetle grubs for this treatment at 60 days after treatment ranged from 0.1 to 0.6 per root ball. Although more testing is needed, Oftanol may provide an additional opportunity for control of Japanese beetle grubs during the winter months. Oftanol has also been shown to be effective when used as a dip treatment (2). It is important to note, however, that other control measures are still necessary to reduce the grub population as much as possible and not to rely solely on a “last minute” grub treatment.

Significance to Industry: There are very few treatment options for growers wanting to ship B&B nursery stock from areas of Japanese beetle infestation to areas with little or no infestation. Therefore, if additional treatment options can be demonstrated, growers will have more opportunities to continue shipping to uninfested areas. Additionally, this type of application is not only more convenient and less time consuming than other methods previously used (i.e., injection and dipping), it may offer considerably less exposure to the pesticide.

Literature Cited

1. SigmaStat. 1995. SigmaStat User’s Manual, Jandel Corporation.

2. Mannion, C. M., D. G. Nielsen, M. G. Klein, and W. McLane. 1996. Impact of root ball dips on white grub survival. Proceedings of SNA Research Conference. 41:165-167.

Table 1. Treatment List

Treatment	Active Ingredient	Rate (lbs/1000sqft)
Dylox 6.2G	Trichlorform	3.0
Turcam 2.SG	Bendiocarb	2.8
Dursban 2.32G	Chlorpyrifos	4.0
Oftanol S.OG	Isofenphos	0.9
Sevin 6.3G	Carbaryl	3.0
Control	--	--

Table 2. Mean Number Live Japanese Beetle Grubs in Root Balls Treated After Diggng

	February Application		March Application	
	Mean No. Live JB Grubs		Mean No. Live JB Grubs	
	30 DAT	60 DAT	30 DAT	60 DAT
.Dylox 6.2G	1.7 a	0.9 b	2.7 a	1.1 b
Turcam 2.5G	2.1 a	1.7 ab	.2.0 a	1.9 b
Dursban 2.32G	3.0 a	0.4 b	4.3 a	2.7 ab
Oftanol 5.0G	3.0 a	0.1 b	0.9 a	0.3 b
Sevin 6.3G	3.4 a	2.3 ab	3.6 a	3.1 ab
Control	6.1a	5.9a	.3.7a	5.3a

Table 3. Mean Number Live Japanese Beetle Grubs in Root Balls Treated Before Digging

	February Application		March Application	
	Mean No. Live JB Grubs		Mean No. Live JB Grubs	
	30 DAT	60 DAT	30 DAT	60 DAT
Dylox6.2G	7.2a	3.4ab	1.0 a	1.0 ab
Turcam 2.5G	5.9 a	4.0 ab	5.4 a	2.1 ab
Dursban 2.32G	5.6 a	1.0 b	3.4 a	2.6 ab
Oftanol 5.0G	6.1 a	0.6 b	1.1 a	0.4 b
Sevin 6.3G	8.9 a	3.4 ab	4.0 a	2.9 ab
Control	9.9 a	5.7 a	3.7 a	3.9 a

Woolly Apple Aphid, *Eriosoma lonigerum* (Hausmann), Control on Crab Apple Grown In Containers

F.A. Hale, C. Mannion and M. Halcomb
UT Agricultural Extension Service, Nashville, TN 37211

Nature of Work: The woolly apple aphid is a pest of crab apple, apple, pear, hawthorn, mountain ash and elm (4) and is transcontinental in distribution (5). The use of Merton Malling rootstocks from resistant Northern Spy apple trees has reduced its status to a sporadic pest on apples (1). Unfortunately, resistant rootstocks are not thought to be used on crab apples in Tennessee commercial nursery production. The general practice is to use seedling apple rootstocks to graft crab apples (2).

Resistant, dwarfing rootstocks such as M111 or M106 cost approximately 33 to 50 percent more then seedling rootstock (3). There is not a high demand from the consumer for dwarf crab apples (2).

The female woolly apple aphid adult is purplish and the adult male is olive-yellow while both are covered by a mass of long, white waxy strands (4). The cottony masses are found around pruning cuts and other abrasions above ground although the most serious damage is found on the roots. Their feeding causes the formation of the knotty galls on the roots. These galls increase in size over time, predispose the roots to fungal attack and the woolly apple aphid has been shown to transmit apple canker (*Pezicula malicorticis*) in certain parts of the country (4).

The Robinson crab apple trees were bud grafted three years prior to 1996. Generally infested trees dug from the field were put in 5 gallon pots during the winter of 1996. Ten insecticide treatments plus an untreated control were used in the test (Table 1). There were four single tree replicates per treatment. The trees were treated on May 24, 1996. The foliar sprays were applied using a CO2 compression sprayer operating at 0.5 liter/4 trees at 40 psi with two TXVS-18 hollow cone nozzles. The whole tree and the planting media surface was sprayed. A half gallon of water was applied to all trees soon after foliar and/or granular treatment.

The treatments were evaluated on October 4, 1996. The trees were first lifted out of the containers and rated as either infested or not infested. The number of colonies on the outside of the root mass of each plant were counted. The maximum size of a single woolly apple aphid colony was defined as being 0.75 square inch. The infested root masses were rated as light (10 or fewer colonies), medium (11 to 30 colonies) or heavy (31 or more colonies).

Results and Discussion: One of the four replicates for treatment 6 (Marathon 1G) could not be found when the ratings were taken. The treatments were not significantly different (Table 2) (1). It should be noted that treatment 10 (Orthene 2.5 G) had no infestation and the means for treatment 1,2,3,8 and 9 were less than the low infestation rating of 1. The use of multiple applications of insecticide may be necessary to control woolly apple aphid on container grown crab apple.

Significance to Industry: More cost effective ways need to be developed to utilize resistant rootstocks in managing woolly apple aphid on crab apple. If grower awarness is not increased, insecticides with all the associated costs will continue to be the primary means of control.

Table 1. Insecticide Treatment Rates for Woolly Apple Aphid Control

Treatment	Insecticide	Rate
1	Pinpoint 15G	3.5 gm/5 gal container
2	Pinpoint 15G	4.5 gm/5 gal container
3	Pinpoint 15G plus Tame 24EC	3.5 gm/5 gal container 10.67 fl oz/100 gal
4	Tame 2.4EC	10.67 fl oz/100 gal
5	Orthene TTO 75WP plus Tame 2.4EC	0.67 lb/100 gal 10.67 fl oz/100 gal
6	Marathon 1G	2.7 gm/5 gal container
7	Marathon 1G plus Talstar 10WP	2.7 gm/5 gal container 0.96 oz/10 gal
8	Di-Syston 15G	1.6 gm/5 gal container
9	Di-Syston 15G plus Talstar 10WP	1.6 gm/5 gal container 0.96 oz/10 gal
10	Orthene 2.5G	21 gm/5 gal container
11	Untreated control	

Table 2. Woolly Apple Aphid Infestation Rating on Crab Apple

Treatment	Treatment	Mean Infestation Rating	SEM
1	Pinpoint 15G - low	0.5	0.289
2	Pinpoint 15G - high	0.5	0.289
3	Pinpoint 15G plus Tame 2.4EC	0.75	0.250
4	Tame 2.4EC	1.5	0.645
5	Orthene TTO 75SP plus Tame 2.4EC	2.0	0.707
6	Marathon 1G	1.0	0.577
7	Marathon 1G plus Talstar 10WP	1.0	0.707
8	Di-syston 15G	0.75	0.250
9	Di-syston 15G plus Talstar 10WP	0.25	0.250
10	Orthene 2.5G	0	0
11	Untreated Control	1.0	0.408

	df	SS	MS	F	P-Value
Treatment	10	12.610	1.261	1.598	0.15
Residual	32	25.250	0.789		

Infestation Rating: 0 = no infestation, 1 = low infestation, 2 = medium infestation, 3 = high infestation

Literature Cited

1. Abacus Concepts. 1989. SuperANOVA, 4th ed. Berkley, CA.

2. Conlon, H.P. Telephone interview. 24, July 1997.

3. Fare, Donna C. Telephone interview. 16, June 1997.

4. Howitt,A.J. 1993. Common tree fruit pest. Michigan State University Extension, NCR 63, East Lansing, MI.

5. Johnson, W.T. and H.H. Lyon. 1996. Insects that feed on trees and shrubs. 2nd ed. Comstock Publishing Associates, Cornell University Press. Ithaca, NY.

The Effect of Coconut Coir and Water Management on Fungus Gnat, *Bradysia spp,* Development.

Ronald D. Oetting and Denise L. Olson
Dept. of Entomology, Georgia Experiment Station, Griffin, GA 30223

Nature of Work: A preliminary study was conducted to determine if substituting coconut coir for peat moss would have an effect on the development of fungus gnat larvae. Coconut coir is a new media substitute for sphagnum peat with similar characteristics (Evans and Stamps 1996) and fungus gnats are pests of many ornamental crops (Harris et.al. 1995) , especially in the first weeks after planting. A constant temperature study was conducted comparing pure coir, sterilized coir, and coir plus yeast added as a food source with pure peat, sterilized peat, and peat with yeast added as a food source for fungus gnat larvae. Larvae were added to the media and checked daily for adult emergence, adult emergence was recorded and compared among treatments. This experiment was conducted twice and replicated ten times each study.

A second study was conducted to evaluate the impact of peat vs. coir on fungus gnat survival in potting media of different textures and at levels of moisture loss. Fine (Metro Mix RediEarthR), medium (Metro Mix 366R), and coarse (Metro Mix 510R) texture media, each formulated with peat or coir were tested. In addition, each of these media was also tested at different levels of moisture loss. The treatments were to water the media to saturation only when pots had lost 10, 28.8, 47.5, 68, and 85 per cent of moisture. Ten percent was considered keeping near saturation and 85% was the initiation of the plant flagging. All treatments were replicated four times. In each pot a chrysanthemum cutting was planted and 50 fungus gnat eggs were introduced at the beginning of the experiment. Fungus gnat populations were estimated by placing a one inch (2.5 cm) potato on the media surface, 17 days past egg introduction, for three days and counting the larvae under the potato each day. Adults were collected by placing the pot in a fabric potting sleeve and closing the top. Two yellow sticky cards, one high and one low, were placed in this enclosure to capture the adults as they emerged. The population estimates for larval and adult fungus gnats were compared to determine the survival in each media and moisture condition.

Results and Discussion: There was no direct effect of coir or peat on the development of fungus gnat larvae. In the sterilized and non-sterilized media, for both coir and peat, there was very little survival of fungus gnat larvae. This would indicate that the larvae can not survive on just the media. There has to be plant material or fungal growth present for food for larval growth and development. When yeast was added as a food source, there was good survival of larvae. In one experiment 65%

of the larvae survived to emerge as adults in both media. In the second experiment 60% emerged in the peat and <40% emerged as adults in the coir. There was a difference in developmental time in both experiments. Larvae emerged in approximately 17.5 days from coir while it took over 19 days for emergence from peat.

In the study looking at coir and peat and components of different media texture and at different moisture levels, there was no significant difference at different moisture levels but there was a higher population of larvae in the coarse media containing peat. Among the different textures containing peat, the coarse provided the best media for development and the medium texture was next. In the coir based media the fine textured media had the highest population level of fungus gnats. Between media, fungus gnats survived best in fine textured coir media and in the medium and coarse textured peat media. At different levels of moisture there were no significant differences within a media type. However, there was a tendency for lower population levels in the most moist and the driest media and the highest level of survival in the media that was maintained at 52.5% moisture.

Significance to the Industry: The use of coconut coir in place of sphagnum peat, in commercial potting media, does not have an impact on fungus gnat development in all situations. The most noteworthy difference was in coarse media with sphagnum peat were fungus gnats survived the best of all media. The use of coir instead of peat in coarse media, which is the most commonly used media in larger pots, would reduce the chances for fungus gnat problems in this type media and the need for control of fungus gnats.

Literature Cited

1. Evans, M.R. and R.H. Stamps. 1996. Growth of bedding plants in sphagnum peat and coir dust-based substrates. J. Environ. Hort. 14(40: 187-190.

2. Harris, M.A., R.D. Oetting, and E.H. Moody. 1996. Dissemination of Thielaviopsis basicola and Fusarium proliferatum by fungus gnats. Proc. SNA Res. Conf. 40: 63-64.

Insect Control with Soil Applied Insecticides in the Landscape - Part 2

David Tatum, Bob Fulgham, and Joe Chamberlin
Dept. of Horticulture, Mississippi State University,
Mississippi State, MS 39762

Nature of Work: This is the second year of study of using a method of injecting insecticides into the ground for uptake by the plant for insect control. A field study using Orthene Tree, Turf, Ornamental™ (OTTO), acephate, insecticide at two rates and in combination with Merit™75wp, imidacloprid, insecticide was conducted in a landscape planting of crape myrtle Lagerstromia indica 'Watermelon Red' in Tupelo, MS, August 29, 1996. A completely randomized design using six treatments, with four replications per treatment was used in this study. Three leaves of four plants per treatment (twelve leaves per treatment) were identified and Crape Myrtle aphid (*Tinocallis kahawaluokalani* (Kirkaldy)) counts were made at 0,1,2,3,4,5,6,7,8,10,14 and 28 days after treatment. Treatments were made with a Guin Deep Root Feeder/Injector using 200-300 pounds psi with injection holes 8 to 12 inches deep. Injections were made around each tree based on the total diameter of all stems originating at ground level (Table 1). Measurements were made 6 inches above ground level using standard tree calipers. All treatments were made within a 10 X 10 areas (100 square feet) around each tree using the Guin Soil Injector, applying a volume of eight ounces per injection (Table 1).

Results and discussion: There was a significant difference between the treated and untreated treatments by 2 DAT. A sudden cool snap reduced the aphid population dramatically in all treatments by 5 DAT. Even though counts continued for 28 DAT, the aphid population did not become significant, even on the check. However, OTTO had significantly reduced the aphid population by 2 DAT. There was no sooty mold or aphid infestation on crape myrtle treated in 1995 with Merit, indicating the presence of this chemical from the 1995 application.

Significance to Industry: Orthene is rapidly absorbed through the root system and translocated to the growing point of the plant. This aspect should make it an ideal insecticide/acaracide for soil application. This method of application would lessen the risk of exposure while providing prompt and effective pest control.

Table 1. Amount of OTTO and Merit applied per tree using a Guin Deep Root FeedertInjector using 200-300 pounds psi and the number of injections per tree (8 ounces total volume per injection).

Treatment	Total Volume of Water	Amount of Chemical	Number of Shots
1	1.6 gallons of water	97 grams of Orthene	26 - 8 ounce shots
2	1.25 gallons of water	144 grams of Orthene	0 - 8 ounce shots
3	1.0 gallon of water	33 grams of Merit	16 - 8 ounce shots
4	1.2 gal1ons of water	38 grams of Merit +1 139 grams of Orthene	9 - 8 ounce shots
5	1.0 gallon of water	none	16 - 8 ounce shots
6	1.2 gallons of water	19 grams of Merit	19 - 8 ounce shots

First Generation Azalea Lace Bug Cohorts in Presence and Absence of Indigenous Natural Enemies in Nursery Environments

Janet Kintz and David Alverson
Dept. of Entomology, Clemson University, Clemson, SC 29631

Nature of Work: Azalea lace bugs (*Stephanitis pyrioides* Scott) have no known pathogens or vertebrate predators but do have a few known arthropod predators, including mirid plant bugs (1,3) an *Anagrus spp.* parasitoid (2), spiders, lady beetles and lacewings (4). Leddy (4) found lace bug mortality was higher in architecturally complex landscape environments than in open simple landscape environments and attributed differences to arthropod predation levels. There has been no evaluation of the impact of lace bug natural enemies in containerized azaleas in nursery environments. The objective of this experiment was to determine whether indigenous enemies affected the population density of established first generation cohorts in containerized azaleas within a nursery environment.

One hundred-twenty azalea cuttings (cultivar 'Fashion') each 12cm (4.8in) in length, were rooted in peat moss in 5cm (2in) PVC pipe tubes, each 17.5cm (7 in) long. Cuttings were maintained in a humidity chamber until well rooted. Ca. 2500 adult azalea lace bugs were introduced into the chamber for one week. Sixty cuttings were then covered with a chicken wire mesh cage wrapped in white organdy for predator exclusion, and 60 were left uncaged.

Two weeks after adults were removed, cuttings were paired (one caged and one uncaged) in 2 gal. plastic pots and placed randomly in an azalea area at Gro-Mor Nurseries, Easley, SC. Ten pots were randomly removed and returned to the laboratory in each of six sequential sampling periods during the months of April and May. Cuttings were examined for egg, nymphal and adult populations and also for evidence of parasitism. All data were analyzed using a t-test to determine differences between caged (predator excluded) and uncaged (predator accessible) established first generation cohorts. Because of overlapping stadia of population profiles in the sequential samples, mean maximum numbers were used in comparisons of caged vs. uncaged azalea lace bugs.

Results and Discussion: Cuttings each had a mean(±SE) of 75.09 (± 6.00) total lace bug eggs prior to placement in the nursery on April 8, 1997. No eclosion occurred in the first two samples taken one and two weeks following placement in the nursery; hence the third sample was taken four weeks after initial placement in the nursery. Mean maximums (±SE) of 31.00 (±8.57) and 50.9 (±17.23) eclosed eggs were found on

caged and uncaged cuttings, respectively (Figure 1). This was consistent with a 50% emergence rate from overwintering eggs (Braman et al. 1992). Mortality from eclosed eggs to fifth instar, determined by the difference between the number observed for each stadium and the maximum potential from the eclosed eggs, was 92-99%, and more than the 46% reported by Leddy (1996) in ambient conditions and the 80% reported by Braman et al. (1992) in laboratory conditions at 15%C and 40% at 30 %C. Mean maximum observed densities per cutting (±SE) for second, third, fourth and fifth instars were 3.90 (± 2.08), 4.10 (±2.28), 3.50 (±1.95) and 1.20 (±0.59) for caged cuttings and 1.10 (±0.99), 1.20 (±0.99), 1.40 (±1.29) and 1.5 (±1.10) for uncaged cuttings. There was no significant effect of predation or parasitism upon egg eclosion or subsequent instars between caged and uncaged cuttings.

Second and third instars were present in samples three, four, five and six. Fourth and fifth instars were present during samples four, five and six. Adults were present only in sample six. Based on population densities of fourth and fifth stadia in the sixth sample of this experiment, additional fifth instars and adults may have been observed in a seventh or eighth sample if collected, potentially resulting in a higher maximum mean for adults though it could not have exceeded the mean maximum number of fourth instars.

No significant differences were observed between caged and uncaged azalea lace bug populations for any particular stadia within any of the six samples. This suggests that predation did not significantly impact lace bug population densities when exposed to or isolated from natural enemies in a low diversity nursery setting. Low numbers of potential natural enemies, mostly spiders, were observed visually throughout the experiment.

Significance to Industry: First generation lace bug populations were not significantly reduced by exposure to indigenous natural enemies in containerized azaleas in the nursery setting. However, the relative stablility of successive stadia following eclosion illustrates the necessity for close monitoring to prevent development of further population growth. First generation early instars should be treated as needed.

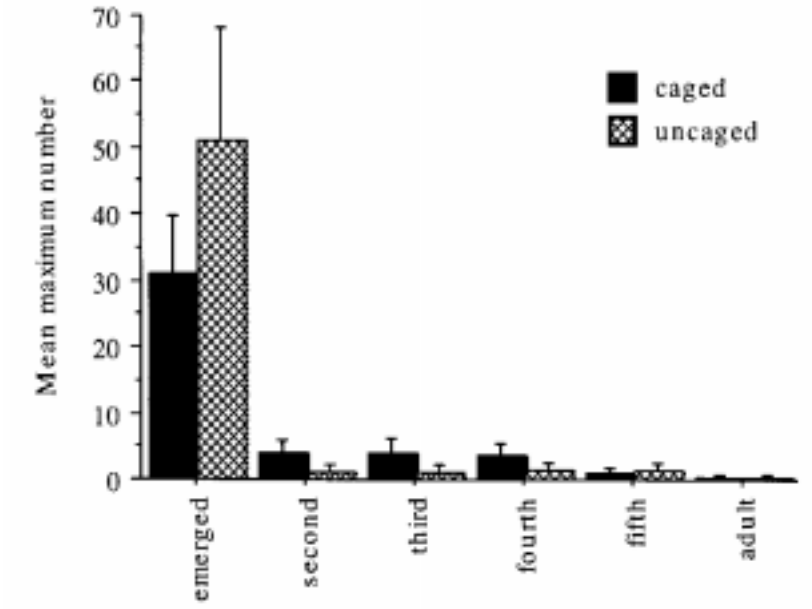

Figure 1. Mean maximum population density of azalea lace bug emerged eggs and stadia from six sequential samples. Bars represent standard error.

Literature Cited

1. Braman, K.S. and R. Beshear. 1994. Seasonality of predaceous plant bugs (Heteroptera: Miridae) and phytophagous thrips (Thysanoptera: Thripidae) as influenced by host plant phenology of native azaleas (Ericales: Ericaceae). Environ. Entomol. 23(3): 712-718.

2. Braman, K.S., A. Pendley, B. Sparks and W.G. Hudson. 1992. Thermal requirements for development, population trends and parasitism of azalea lace bug(Heteroptera:Tingidae). J. Econ. Entomol. 85(3): 870-877.

3. Henry, T.J., J.W. Neal, and K.M. Gott. 1986. *Stethoconus japonicus* (Heteroptera: Miridae): A predator of *Stephanitis* lace bugs newly discovered in the United States,promising in the biocontrol of azalea lace bug (Heteroptera: Tingidae). Proc. Entomol. Soc. Wash. 88(4):722- 730.

4. Leddy, P.M. 1996. Factors influencing the distribution and abundance of azalea lace bug, *Stephanitis pyrioides*, in simple and complex landscape habitats. Doctoral dissertation. University of Maryland.

Using Degree Day Collection in Nursery Insect Management

Peter B. Schultz
Hampton Roads Agr. Experiment Station, Virginia Tech, Virginia Beach, VA 23455

Nature of Work: Degrees Days (DD) have a multitude of abbreviations (GDD, CDD, AGDD for growing, cumulative, and accumulated degree days respectively) that are synonymous. Using degree days (DD) for nursery plant pest prediction begins with the monitoring for the pest. The first requirement is the monitoring of the insect (or mite) to determine hatch, adult emergence or whatever the desired stage. Visual inspection, beating sheet, and presence of honeydew are all direct evidence. Monitoring tools vary with the pest, ranging from light traps to sticky cards to pheromone traps. A large number are available including many sizes and shapes of sticky cards and pheromone traps with pheromones for an ever-increasing number of pests. The primary objective is to predict the time period to either begin monitoring or initiate control. The result is the timely forecasting of a biological event which can lead to improved pest management decisions. A non-numerical method of prediction is through plant monitoring, using the flowering of an indicator plant to predict the event. Plant monitoring can utilize the Orton System of Pest Management, which lists an extensive list of flowering events and pest management timing (Orton 1989).

Weather monitoring is accomplished by recording or obtaining the maximum and minimum daily temperatures and using these data to numerically calculate the DD prior to the biological event. The methodology in calculating degree days involves 4 steps: 1) select a threshold temperature (e.g. 50(F); 2) select a starting date (e.g. January 1); 3) calculate the degree days above the threshold temperature each day (e.g. maximum and minimum temperatures of 75°F and 45°F [75 + 45]/2 - 50 = 10 DD; 4) accumulate DD.

For easier forecasting, computer programs have been written that will determine the threshold temperature, calculate degree days and predict the occurrence of a designated event. One such program is Forecaster, developed by Drs. Mark E. Ascerno and Roger D. Moon, Department of Entomology, University of Minnesota, St. Paul, MN. (Extension Service Publication AG CS 3029). The maximum and minimum temperatures for each day are entered to create a temperature data table. Thirty year normal temperatures (obtained from a nearby NOAA weather station) are also entered. The threshold temperature with the smallest error (or 50°F) is used as the threshold temperature for the event. The temperature data table is used to predict the date of the event. Thirty year normal

temperatures are used when the prediction date falls past the dates of the observed temperatures, allowing predictions in advance. There are devices available that combine a recording thermometer and a calculator to display the DD as they accumulate for pre-specified base temperatures. They range in price depending on the desired tasks. At the lower end, one that displays 2 days of maximum/ minimum temperatures and accumulated DD is near $200. The DD figures can then be related to publications which list the degree days for selected insect and mite pests that have been compiled from assorted sources.

Results and Discussion: Factors to be aware of in using DD in pest management include the effect of microclimates and exposure. The closer one obtains the plant flowering or temperature data, the more accurate the prediction. Winter warm spells and late spring freezes must be taken into account. The 184 DD that accumulated in January and February, 1997 at the Hampton Roads AREC may not have contributed to the DD totals in biological terms, since freezing weather followed those warm days. Several years of additional research will be needed to be assess the effects of early DD accumulations. Another consideration is the interpretation of the compiled information. Are reported “flowering” or “hatching” DD the onset, the peak, or the completion?

Significance to Industry: The different approaches, by plant flowering or weather data collection and computation should be considered and the best for each firm likely depends on the capabilities of the employees. Using Degree Day as a component of nursery pest management will improve timing of control measures and reduce pesticide and labor costs.

Literature Cited

1. Orton, D.A. 1989. Coincide: The Orton System of Pest Management. Plantsmen’s Public. Flossmoor, IL.