SECTION 4
ENTOMOLOGY

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Insect Control with Soil Applied Insecticides in the Landscape

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Nature of Work: The application of pesticides using conventional high volume sprayers in the landscape has many applicators concerned about drift and liability. Large shrubs and trees are customarily sprayed using a high pressure and high volume sprayer to obtain thorough coverage of the plant canopy. As a result, spray droplets may move off target! When available, injection techniques and soil applied pesticides are used in the landscape to avoid “off target” movement. This study was designed to evaluate the application of two systemic insecticides using high pressure and low volume via soil injection application equipment.

Results and Discussion: Two field trials using acephate (OTTOTM) and imidacloprid (MeritTM) were conducted during the summer of 1995 to determine the extent of control of Crape Myrtle aphids (*Tinocallis kahawaluokalani* (Kirkaldy)) on *Lagerstromia indica* ‘Watermelon Red’ (Red Crape Myrtle) and *Betula nigra* (River Birch). The plants were treated after a visible infestation of aphids were observed feeding on the plants. River Birch used in the experiment were under field production at Larmour’s Nursery, Caledonia, MS. The Crape Myrtle used in the experiment were established landscape plants, under irrigation, at the Executive Inn, Tupelo, MS. The plants were measured to determine size and number of trunks per plant. Aphid counts were made on predetermined leaves each day from day 0-5, day 10, day 14 and day 20. The same leaves were counted each time and the number of live aphids recorded. Due to the extremely dry conditions, the amount of aphid infestation on the River Birch at Larmour’s Nursery was erratic. Crape Myrtle showed an increase in aphid count within the check over time (Table 1).

Environmental issues and public concern about the use of pesticides certainly warrants further studies regarding the injection of systemic pesticides into the root zone of ornamental shrubs and trees for the control of foliar insects.

P. B. Schultz determined that Marathon 1G was effective within 7 days of application, and remained effective throughout the 6 week evaluation period (1). OTTO offers quick knockdown through rapid root absorption while Merit offers long term control.

Significance to Industry: Landscape maintenance is a very important segment of the Green Industry. Charles R. Hall, et al, reported that total expenditures on lawn maintenance by single- family households in Texas in 1993 was estimated to be $2.5 billion (2). OTTO offers immediate control while Merit provides extended control. This application technique appears to offer landscape maintenance personnel another method of applying pesticides within the landscape safely and effectively.

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2. Hall, Charles R., Curtis F. Lard, Clarinda L. Smith and Brad E. Seidel. Comparison of Lawn Maintenance Expenditures Among Households in the Southern Region. Vol. 40, pg 345-347. SNA Research Conference, 1995.

Table 1. Soil Injected Insecticides to Control Aphids on Crape Myrtle

treatment	(average number of aphids)
T1-.13 oz. OTTO/ inch dbh (injected)	46.56 b
T2 -.25 oz. OTTO/ inch dbh (injected)	44.39 b
T3- 10.5 oz. Orthene/ 100 gal. Water (foliar)	23.50 b
T4 - 6.4 oz. Merit/ 25 gal. Water (injected)	71.94 b
Check	268.11 a

There is no significant difference between insecticide treatments over time, however all were significantly different from the check.

Efficacy of Pyrethroid Products, Rates, and Formulations on Control of Adult Japanese Beetle Feeding

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Nature of Work: The objective of this study was to evaluate the efficacy of selected pyrethroid products, rates, and formulations on the control of adult Japanese beetle feeding. Two taxa of highly preferred host trees, 'Red Splendor' crabapple (Malus 'Red Splendor') and 'Okame' cherry (Prunus x 'Okame'), were used in the study (Ranney and Walgenbach, 1992). Crabapple trees were approximately 2' in crown diameter, 6.5' high, and spaced 5.5' apart in rows. Cherries were approximately 18" in crown diameter, 30" tall, and spaced 4' apart in rows. Plots with 'Red Splendor' crabapple and 'Okame 'cherry were separate and considered separate experiments. Each experiment was arranged as a randomized complete block design with 5 individual tree replicates. Treatments were applied on the morning of July 7, 1995 at 9-10:30 AM. Weather was partly cloudy, 75°F, with wind of 0-5 MPH. Formulations were 1) Tame 2.4 EC (0.84ml/l; 0.64 tsp/gal), 2) Tame 2.4 EC (1.25 ml/l; 0.95 tsp/gal), 3) Tame 2.4 EC (0.84 ml/l; 0.64 tsp/gal) and Orthene TTO (0.8 g/l; 0.11 ounces/gal), 4) Deltamethrin DTM 5SC (0.30 ml/l; 0.23 tsp/gal), 5) Saga TLM 40 WP (0.04 g/l; 0.005 ounces/gal), 6) Deltamethrin DMT 0.05D (2.4 g/sq. m; 0.07 oz./sq. yd.), 7) Tempo2 24.3% EC (0.12 ml/l; 0.09 tsp/gal), and 8) Contro - H_2O. Each crabapple tree received approximately 0.2 L (0.05 gal) per tree and each cherry tree receive approximately 0.15 L (0.04 gal) per tree. Liquid formulations were applied with a Solo backpack sprayer. Deltamethrin dust was applied with a Chapin Duster. Visual ratings of percent defoliation (skeletonization) were conducted each week for 4 weeks following treatment. Any defoliation observed on the date of treatment was subtracted from subsequent determinations. Adult Japanese beetles began emerging the last week of June with the highest populations observed in the 2nd and 3rd weeks of July. Few adult beetles remained after July. In general, the population of adult Japanese was considerably less than for other years. For example, in nearby test plots, defoliation by Japanese beetles was approximately 35% for untreated 'Red Splendor' crabapples this year while defoliation has been as high as 83% in prior years.

Results and Discussion: 'Red Splendor'Crabapples. At 7 days after treatment, all products, with the exception of DTM dust significantly reduced feeding injury compared to the control (Table 1). On subsequent dates, feeding injury on plants treated with the low rate of Tame increased and was no longer significantly different from the untreated plants, suggesting that this rate may be inadequate for longer term control. At 28 days after treatment, feeding damage on untreated 'Red Splendor' crabapples resulted in 28% defoliation. At this time, all treatments, with the exception of DTM dust and low rate of Tame, were still effective in reducing injury compared to the control. Plants treated with the high rate of Tame, Tame + Orthene, Tempo2, Saga, and DTM, were not significantly different on any of the dates. Dead beetles were not observed on or near any of the trees. There were no symptoms of phytotoxicity on any of the plants.

'Okame' Cherries. Feeding intensity on these plants was low in our study. Defoliation of control plants was only 5% at 28 days after treatment (Table 2). There were no significant differences between the control and any of the treatments nor was there any significant differences among the treatments. The presence of what appeared to be a more preferred host plant ('Red Splendor' Crabapple) in an adjacent plot, may have reduced feeding pressure on these plants. There were no signs of phytotoxicity on any of the plants.

Significance to Industry: Under the moderate insect pressure experienced in this study, a number of pyrethroid based products provided single application control (deterrency) for adult Japanese beetles. For a highly polyphagous pest like Japanese beetle, application of an apparent antifeedant, such as these pyrethroids, may to be an effective method for deterring pests from susceptible crops. Tame 2.4 EC (1.25 ml/l; 0.95 tsp/gal), Tame 2.4 EC (0.84 ml/l; 0.64 tsp/gal) combined with Orthene TTO 75 SP (0.8 g/l; 0.11 ounces/gal), Tempo2 (0.12 ml/l; 0.09 tsp/gal), Saga 40 WP (0.04 g/l; 0.005 ounces/gal), and Deltamethrin 5SC (0.30 ml/l; 0.23 tsp/gal) were effective, but not significantly different, in reducing defoliation by adult Japanese beetles.

Acknowledgment - Thanks are expressed to Mr. Don Shadow and Shadow Nursery, Inc., Winchester, TN, for providing plants for this study.

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Table 1. Percent defoliation (skeletonization) of foliage of 'Red Splendor' crabapple treated with different insecticides

		Days after Treatment			
Product	Rate of Product	7	14	21	28
Tame	4.73ml/gal	0.4 *[z]	0.5 *	2.3 *	
Tame + Orthene	3.16ml/gal 3.04g/gal	0.5 *	1.4 *	2.1 *	2.9 *
Tempo2	0.45ml/gal	0.8 *	1.6 *	3.3 *	3.1 *
Saga-TLM	0.15g/gal	1.4 *	2.7 *	4.3 *	9.8 *
DTM	1.15ml/gal	3.6 *	6.5	7.1	9.8 *
Tame	3.16ml/gal	2.0 *	5.7	7.1	12.7
DTM Dust	2.4g/sq.m	19.0	24.0	24.0	27.0
Control	-	16.7	19.9	22.4	28.1
$LSD_{0.05}$		11.9	14.8	15.9	16.2

All values are corrected for any initial defoliation at the time of application.
*Indicates value is significantly different from the control, P=0.05.
$LSD_{0.05}$ apply to means within a given column.

Table 2. Percent defoliation (skeletonization) of foliage of 'Okame' cherry treated with different insecticides.

		Days after Treatment			
Product	Rate of Product	7	14	21	28
Tame	4.73ml/gal	0.5[z]	1.0	1.6	1.6
Tame + Orthene	3.16ml/gal 3.04g/gal	0.5	0.5	0.5	2.1
Tempo2	0.45ml/gal	1.0	1.0	2.9	3.4-
Saga-TLM	0.15g/gal	0.0	0.0	1.5	3.8
DTM	1.15gl/gal	0.0	0.0	0.5	1.0
Tame	3.16ml/gal	0.5	0.5	1.0	2.0
DTM Dust	2.4g/sq.m	0.5	1.9	5.6	8.8
Control	-	0.5	0.5	4.6	5.4
$LSD_{0.05}$		1.1	2.1	4.4	5.4

[Z] All values are corrected for any initial defoliation at the time of application.

Soil and Foliar Applied Insecticides for the Control of *Proteoteras aesculana* Riley (Lepidoptera: Tortricidae) in Red Maple

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Nature of Work: A shoot boring, caterpillar, *Proteoteras aesculana* Riley, attacks the buds and shoots of red maple. If the terminal bud is destroyed an undesirable forked double leader is produced. Past studies were conducted to determine the proper timing of chemical pest control and the most efficacious insecticides (1,2). A test was designed to further delineate efficacy and timing using soil applied systemic insecticides and foliar applied insecticides (both systemic and not systemic).

A block of seedling red maple at Wanamaker Nursery in Warren County, Tennessee was selected for the test. The distance between rows was five feet. The trees had an average height of approximately five feet and this was the second growing season in the field. The systemic insecticides Di-Syston 15G (5 lb/1000 linear feet) and Pinpoint 15G (13.2 lb/acre) were applied on April 15 and April 17, 1996, respectively. The tree phenology on April 15 for 67.7 percent of the trees ranged from tight bud to half inch green while 32.3 percent ranged from 3/4 inch green to three pair of leaves. Foliar insecticide applications were made on April 24. Tree phenology on April 24 for 9.5 percent of the trees ranged from half inch green to one pair of leaves, 61.9 percent had two pair of leaves and 28.6 percent had three pair of leaves. The insecticides applied as foliar sprays were Orthene Turf, Tree and Ornamental {Orthene T, T & O} 75 SP (0.67 lb/100 gal) plus Tame 2.4 EC Spray (10.67 fl oz/100 gal), Orthene T, T & O 75 SP (1 lb/100 gal), Orthene T, T & O 75 SP (1.33 lb/100 gal), Tame 2.4 EC Spray (10.67 fl oz/100 gal) as a follow-up spray to trees treated on April 17 with Pinpoint 15 G, Talstar T & O 10 WP (0.96 oz/10 gal), and Talstar T & O 10 WP (0.96 oz/10 gal) as a follow-up spray to trees treated on April 15 with Di-Syston 15 G. The foliar sprays were applied at a 25 gal/acre rate using a CO_2 compression sprayer operating at 40 psi, equiped with two TXVS-18 hollow cone nozzles. The treatments of 35 feet of row were replicated four times. There was an average of 16.6 trees per treatment. On May 3, a complete tree inspection for borer damaged shoots was made on all the trees in each treatment. The number of damaged shoots was recorded for each tree inspected.

Results and Discussion: The raw data for the number of trees with borer damaged shoots were converted to percent because the number of trees in each treatment differed. These data were then transformed using arcsin (sqrt) to normalize the data. The number of borer damaged shoots per tree were not converted to percent and transformed to normalize. There were no significant differences among treatments for either the mean percent trees with borer damaged shoots (Table 1) or for the mean number of borer damaged shoots (Table 2). While not significant, the Talstar T & O 10 WP and the Di-Syston 15 G plus Talstar T & O 10 WP treatment tended to be the most effective. In a 1995 study (2) the Talstar T & O 10 WP treatment significantly reduced the mean number of damaged shoots so that there was 88.5 percent less damage than in the control. In the present study, the mean number of damaged shoots was reduced by 87.0 percent. The amount of insect damage in the 1995 study was much higher than in the present study. The number of shoots damaged per tree was 1.7 for the control in the 1995 study, while it was only 0.34 for the control in the present study. Given these circumstances, our sample size was not adequate to detect significant differences among the treatments.

Significance to Industry: There is a high potential for damage from *p. aesculana* each year. More effective early season control will allow for the increased production of high quality red maple trees. The amount of labor needed to train a new single leader on damaged trees will also be minimized.

Literature Cited

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2. Hale, F.A. and M. Halcomb. 1995. Timing and Control of *Proteoteras aesculana* (Lepidoptera: Tortricidae) in red maple. Proc. SNA Res. Conf. 40: 198-200.

Table 1. Red maple trees with damage by *Proteoteras aesculana* Riley, mean percent ± SEM.

Treatment	Mean Percent Trees with damage
Pinpoint	12.9 ± 5.4
Orthene (low rate) + Tame	5.7 ± 4.2
Orthene (high rate)	10.3 ± 4.5
Di-Syston	12.9 ± 9.1
Tame	14.6 ± 7.1
Pinpoint + Tame	7.9 ± 5.9
Di-Syston + Talstar	3.0 ± 3.0
Orthene (medium rate)	23.3 ± 6.3
Talstar	3.3 ± 3.3
Control	20.0 ± 6.2

Table 2. Damaged red maple shoots from *Proteoteras aesculana* Riley, mean ± SEM.

Treatment	Mean Shoots with damage
Pinpoint	5.00 ± 3.39
Orthene (low rate) + Tam	4.25 ± 2.53
Orthene (high rate)	2.00 ± 0.91
Di-Syston	2.75 ± 2.10
Tame	4.75 ± 3.43
Pinpoint + Tame	2.00 ± 1.16
Di-Syston + Talstar	0.50 ± 0.50
Orthene (medium rate)	8.00 ± 2.27
Talstar	0.75 ± 0.75
Control	5.75 ± 2.46

IR-4 Research for Pest Control in Nursery Crops - 1995

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Nature of Work: Efficacy and Phytotoxicity research is needed for use in obtaining national label registrations for pesticides including biological pest control products. During 1995 research was needed for 27 fungicides, 27 herbicides, 22 insecticides and 7 plant growth regulators. The research needed includes evaluations in the field, greenhouse, interior plantscapes and the landscape.

Protocols were developed to insure uniformity and accuracy of the data needed for national label registrations. Research was conducted in 1995 by 21 state, federal and private researchers in 16 states on 443 separate trials. Research during 1995 included the following biological pest control products:

1. Biological Fungicide - *Ampelomyces quisqualis* (AQ-10) - Ecogen
2. Botanical Insecticide - Azadiractin (Margosan-O)- Scotts
3. Biological/Microbial Fungicide *Gliocladium virens* (Gliogard 21, SoilGard) - W.R. Grace

Results and Discussion: During 1995 data was collected for these 12 fungicides: *Ampelomyces quisqualis* (AQ-10), Captan, Copper Complex (Phyton 27), Copper Hydroxide (Kocide), Etridiazole (Ethazole, Banrot), Fosetyl-Al (Aliette), *Gliocladium virens* (Gliogard 21, Soilgard), Iprodione (Rovral), Myclobutanil (Eagle), Piperalin (Pipron), Propiconazole (Banner), Thiophanate Methyl (Topsin).

Twenty herbicides were also evaluated during 1995 including:
Bentazon (Basagran), Benefin + Oryzalin (XL 2G), 2,4-D Amine (Weedar 64), 2,4-D LV Ester (Weedone LV4), Dithiopyr (Dimension), Fluazifop-Butyl (Fusilade), Halosulfuron (Permit), Isoxaben (Gallery), Isoxaben + Oryzalin (Snapshot 80 DF), Isoxaben + Trifluralin (Snapshot 2.5G), Lactofen (Cobra), Metolachlor (Pennant), Napropamide (Devrinol), Oryzalin (Surflan) Oxadiazon (Ronstar), Oxyfluorfen (Goal), Oxyfluorfen + Oryzalin (Rout), Oxyfluorfen + Pendimethalin (Orn. Herb. II), Pendimethalin (Pendulum, Southern Weed Grass Control), Prodiamine (Barricade), Sethoxydim (Vantage), Trifluralin (Gowan Trifluralin).

Research was also conducted on 9 insecticides including: Azadiractin, (Margosan- O), Bifenthrin (Talstar), Carbofuran (Furadan), Clofentezine (Ovation), Diazinon (AG-500, Knox-Out), Formetanate Hydrochloride (Carzol), Imidacloprid (Marathon), Isofenphos (Oftanol), Sunspray Ultra Fine Spray Oil (Sunspray 6E).
During 1995, 377 new label registrations were added for use in the nursery and floral crop industry (Table 1).

Table 1. 1995 Pesticide Registrations supported by IR-4 data.

Abamectin (Avid)	Andromeda, Azalea, Citrus (non-bearing), Coconut Palm, English Holly, Hemlock, Blue Holly, Japanese Holly, Rhododendron, West Indies Mahogany
Acephate (Orthene)	African Violet, Balsam, Begonia, Easter Lily, Eucalyptus, Geranium, Indian Hawthorn, Lily, Marigold, Petunia, Snapdragon
Ancymidol (A-Rest)	Aralia Ivy, Blazing Star, Bleeding Heart, Candytuft, Ceriman, Clematis, Columbine, Larkspur, Umbrella Tree
Azadiractin (Margosan-O)	Azalea, Baby's Breath, Birch, Carnation, Cherry (non-bearing), Firethorn, Parlor Palm, Peach (non-bearing), Plane Tree, Plum (non-bearing), Rhododendron, Rose, Yew
Benefin + Oryzalin (XL-2G)	Eucalyptus
Chlorpyrifos (Dursban)	Balsam, Croton, Hibiscus, Indian Hawthorn, Rose
Chlorpyrifos (Dursban) (Microencapsulated)	Ageratum, Balsam, Calendula, Carnation, Dahlia, Geranium, Hydrangea, Marigold, Scarlet Sage, Shasta Daisy
Copper Complex (Phyton)	Balsam, Poinsettia
Copper Hydroxide (Kocide)	Egyptian Star Cluster, Indian Hawthorn, Mulberry, Rose of Sharon, Verbena
Diazinon (E) (D Z N)	Cotoneaster, Hemlock
Diazinon (Knox-Out)	Ageratum, Balsam, Carnation, Coleus, English Ivy, Good-Luck-Plant, Madwort, Prayer Plant, Scarlet Sage, Shasta Daisy, Velvet Plant, Wandering Jew
Dienochlor (Pentac)	Parlor Palm
Etridazole (Ethazole)	Azalea, Boxwood, Daphne, Dogwood, Japanese Andromeda, Japanese Holly, Juniper, Larkspur, Lily, Mountain Laurel, Natal Plum, Norfolk Island Pine, Periwinkle (Vinca), Rhododendron, Shasta Daisy, Tailflower
Etridazole + Thiophanate Methyl (Banrot)	Nasturtium

Table 1 (con't)

Fenpropathrin (Tame)	Azalea, Firethorn, Gardenia, Holly, Juniper
Isoxaben (Gallery)	Daylily, Lilyturf, Potentilla
Isoxaben + Oryzalin (Snapshot)	Firethorn, Weigela
Mancozeb (Protect)	Balsam, Fir, Hickory, Larkspur, Loquat, Nasturtium, Palm, Palm-Beach-Bells, Phlox, Pine, Poplar, Scotch Pine, Spathe Flower
Metalaxyl (Subdue)	Baby's Breath, Columbine, New Guinea Impatiens, Photinia, Rose, Stonecrop, Tailflower, Yew
Metolachlor (Pennant)	Bayberry, Lambs-Ears, Madwort, Pampas Grass, Rose, Speedwell (Veronica), Yarrow
Metolachlor + Simazine (Derby)	Arrowwood, Bridal-Wreath, Christmas Trees, Cleyera Japonica, Crape Myrtle, Firethorn, Forsythia, Gardenia, Heavenly Bamboo, Japanese Pittosporum, Lilyturf, Maple, Photinia, Pine, Privet, Purple-Leaf Wintercreeper, Rose, Southern Yew
Myclobutanil (Eagle)	Phlox
Napropamide (Devrinol) (G), (W)	Indian Hawthorn
Oryzalin (Surflan)	Acacia, Agave, Arrowwood, Ash, Aster, Bellflower, Blazing Star, Elephant's Ear, False Spirea, Flag, Indian Hawthorn, Peach (non-bearing), Scarlet Sage, Shasta Daisy, Stokes Aster
Oxadiazon (Ronstar)	Acacia, Ajuga, Indian Hawthorn, Potentilla, Protea
Oxyfluorfen (Goal)	Canada Hemlock
Oxyfluorfen + Oryzalin (Rout)	Indian Hawthorn

Table 1 (con't)

PCNB (Terraclor)	Aglaonema, Azalea, (Rhododendron), Balsam, Bee Balm, Betal Palm, Canna, Carnation, Columbine, Elephant's Ear, Flowering Maple, Foxglove, Gardenia, Gazania, Grape Ivy, Houseleek, Larkspur, Lupine, Madwort, Maple, Natal Plum, New Guinea Impatiens, Parlor Palm, Persian Violet, Pocketbook Flower, Stonecrop, Tailflower, Vervain
Pendimethalin (Pendulum)	Eucalyptus, Gaillardia, Leyland Cypress
Piperalin (Pipron)	Rose
Prodiamine (Barricade)	Ajuga, Andromeda, Bahia Grass, Barberry, Carpobrotus, Cast Iron Plant, Cypress, Daffodil, Delosperma, English Ivy, False Cypress, Heavenly Bamboo, Hemlock, Honey suckle, Hop Bush, Indian Hawthorn, Creeping Lilyturf, Giant Lilyturf, Magnolia, Maple, Pampas Grass, Periwinkle (Vinca), Photinia, Pieris, Privet, Redroot, Spruce, Stonecrop
Prodiamine (Barricade-Foliage Production Herbicide)	Leatherleaf Fern, Tree Fern (Asparagus)
Resmethrin	Balsam, Begonia, Carnation, Parlor Palm, Petunia, Poinsettia
Sethoxydim (Vantage)	Andromeda, Avens, Baby's Breath, Blue Beard, Christmas Trees, Coneflower, Daffodil, False Cypress, Lamb's Ear, Black Locust, Oregon Grape, Stokes Aster, Tulip, Yarrow Simazine (Princep) Arborvitae, Holly, Juniper, Palm, Yew
Sunspray Ultra-Fine Spray Oil	Azalea, Begonia, Chrysanthemum, Dumb Cane, Easter Lily, Gardenia, Hibiscus, Palm, Poinsettia
Triflumazole (Terraguard)	Azalea, Rhododendron, Spathe Flower

Significance to Industry: The ornamental research conducted in the IR-4 Program has developed data used for over 4100 label registrations for the nursery and floral crop industry.

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Evaluation of Plant Tags To Educate Consumers About Plant Pests

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Florida

Nature of Work: Consumers have many misconceptions about the function, selection and care of plants resulting in needless waste of resources. Education concerning pest management for all segments of the industry is needed. Consumers, due to their number, are relatively the least educated. Influencing their decision making towards energy reduction and environmental concerns are a major goal of the Cooperative Extension Service. This survey was conducted to address the feasibility of using plant tags to educate the consumer about plant pests.

A survey instrument was developed in the form of a plastic tag attached to containerized crape myrtle, *Lagerstroemia indica* L. To catch the attention of consumers, one side of the tag consisted of the headline “Environmentally Friendly Plant” and a colorful 7-spotted lady beetle adult and larva, with aphids on a leaf. Messages concerning the crapemyrtle aphid, *Tinocallis kahawaluokalani* (Kirkaldy), its positive impact on beneficials and host plant specificity was also included (Fig. 1). Tags were attached to a self-addressed, postage-paid plastic postcard with survey questions on the opposite side (Fig. 1).

During June-July 1995, 5505 tags were placed on 3- to 7-gal crape myrtle in the following locations: Simpson Nursery, Monticello, FL, shipped 5300 to southern and mid-Atlantic states primarily to Wal-Mart, Lowe’s and Home Depot. Another 205 were placed on plants at local Florida/Georgia retail nurseries: 30 at NeSmith Nursery in Thomasville, GA, 100 at Tallahassee Nursery, Tallahassee, FL and 25 each at Pettijohns Nursery in Tampa, FL, Home Depot and Frank’s Nursery in Brandon, FL.

Results and Discussion: Crape myrtle and its host-specific pest, the crapemyrtle aphid, and biological control were selected for the survey because they represent an unusual example of a pest which can be very beneficial for biological control agents in landscape situations (3,4,5). Aphids do little damage to the plant, however, their copious honeydew production results in heavy buildup of unsightly sooty mold which reduces plant quality. Sooty mold not withstanding, crapemyrtle aphids represent potentially a neutral or positive pest situation from the perspective of nurserymen or retailers who may view negative (pest) information about plants as adversely affecting sales.

Of the 5,505 tags, 184 or 3.3 percent were returned from twelve states and 104 cities. Fifty-five percent of the respondents read the lady beetle tag before purchasing the plant and 25% indicated the tag influenced their purchasing decision.

Of the five tag messages concerning crapemyrtle aphids and biological control, 71 to 91% of respondents recognized them as part of the tag message (Fig. 1). Most respondents (98%) indicated the desire for further information in the tag format. Only 9% of the respondents had heard of IPM, while 83% indicated they had heard of biological control. Note that biological control was mentioned on the tag in the last message.

Forty cards were returned with comments. Most were along the lines of “Thank you”, “Great idea” or “Send more information”. Several mentioned the lady beetle symbol specifically, stating that the tag was perceived on sight as representing something “good”. For this reason we believe a lady beetle could be developed as a universal symbol of environmentally friendly plants, products, IPM and/or biological control.Ã

Crape myrtle is one of the most popular plants in the southern U.S. The popularity and consumer familiarity with crape myrtle probably decreased the amount of influence the tag had on purchasing decisions of the survey respondents. Several respondents commented that they had intended to purchase the crape myrtle anyway. Therefore, the survey probably underestimated the influence that such tags on unfamiliar plants might have on consumers.

This study indicates that plant tags could be an effective educational tool to deliver information on plant pests to consumers. Consumers are accustomed to looking to plant tags for horticultural information and it is likely that pest management information would also be considered. We did receive some resistance to the tags from retailers who were concerned about the loss of sales if consumers were presented with negative information, i.e. a profile of the plant’s potential pests. Participating nurserymen were also concerned about the extra labor required to attach the tags to the plants. Davis (1) reported an industry trend of more sophisticated and specific labels requested by retailers. However, Marciel (2) expressed the view that labels detract from plant appearance and cause more work for growers. In Marciel’s (2) opinion better use of larger signs in retail stores was a more practical option.

Significance to Industry: The easiest and most cost-effective way to eliminate plant pests is to eliminate the host plant and replace it with a resistant or unsusceptible plant termed Host Plant Resistance and a cornerstone of IPM. It is an environmental imperative that we educate the landscape architect to specify, the nurseryman to grow and the consumer to choose plants that match the site and are resistant to pests. Plant tags relating pest management information appear to be an effective method to educate consumers.

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We Would Greatly Appreciate Your Help By Answering the Following Questions (With Pencil) Concerning the Ladybug Tag. Then Put It In the Mail.

1. Did you read the Ladybug tag before buying this plant? ☐ No ☐ Yes
2. Did the Ladybug tag influence your decision to buy the plant? ☐ No ☐ Yes
3. Check the messages you found on the Ladybug tag.
   - ☐ Crape myrtle gets aphids but is environmentally friendly.
   - ☐ Crape myrtle aphids attract beneficial insects.
   - ☐ Crape myrtle aphids help in biological control.
   - ☐ Predators and parasites help reduce pesticides use.
   - ☐ Crape myrtle aphids do not spread to other plants.
4. Would you like to see more tags on plants with information about pests? ☐ No ☐ Yes
5. Are familiar with the terms: IPM ☐ No ☐ Yes; Biological Control ☐ No ☐ Yes
6. City: ____________ State: ______
7. Comments:

*** THANK YOU VERY MUCH FOR YOUR TIME AND HELP! ***

Crape Myrtle

- Has beautiful flowers
- Is very hardy.
- Has aphids that only attack crape myrtles.
- Aphids attract beneficial predators and parasites to your landscape that control other pests on other plants.
- Parasites and predators are useful to help reduce pesticide use.
- Do it with Biological Control.

Figure 1: Plant tag used in the survey showing the information provided on crape myrtle and questions posed.

Impact of Root Ball Dips on White Grub Survival[1]

Catharine M. Mannion, David G. Nielsen, Michael G. Klein, and Win McLane
Tennessee and Ohio

Nature of Work: Japanese beetles are a significant threat to the profitability of nurseries. Currently, individual state quarantines require treatment or production practice-based certification for nursery stock originating in infested areas before plants are exported to uninfested areas. The following states maintain exterior quarantines or other certification requirements for Japanese beetle: Arizona, Arkansas, California, Idaho, Kansas, Minnesota, Missouri, Nevada, Oregon, Utah, Washington, and Wisconsin (1). Dipping root balls of one foot diameter or less in insecticides is currently used by some nurseries as a method to eliminate white grubs, but there is little scientific evaluation of the efficacy of this method on larger rootstock. In 1995, Nielsen and Klein (2) found that 15 to 18 inch lilac and witch hazel root balls dipped in Dursban TI and 50WP for 30 seconds significantly reduced white grub survival. Additional research is necessary to determine the effect of soil type, root ball size, and the duration of dipping on the efficacy of dipping. Therefore, a collaborative study among researchers at Tennessee State University, The Ohio State University - OARDC, USDA - ARS, and USDA - APHIS was conducted to examine the efficacy of chemical dip treatments of 24 and 32 inch root balls, from two soil types, dipped for three different time periods, on control of white grubs.

Trees were selected from three different nurseries in Ohio. Selection was based on previous sampling for white grubs to insure a natural infestation of larvae in the root balls. Two sites were in northern Ohio where the soil was sandy and well-drained. Trees selected from these two sites included magnolia, ash, linden, and maple. Most of the grubs found from these root balls were Oriental beetle (81%), followed by European chafer (9%), Asiatic garden beetle (8%), and Japanese beetle (2%). The third site was located in southern Ohio where the soil was heavy (clay) and poorly drained. All the trees selected there were Sargent crabapple. Japanese beetle was the dominant grub (79%) followed by masked chafer (21%).

Trees from all locations were transferred to one site for dipping. Treatments included Dursban 50WP at 2 lb ai/100 gallons, Dursban 4E at 2 lb ai/100 gallons, and Oftanol 2F at 0.2 lb ai/100 gallons and at 0.4 lb ai/100 gallons. Root balls were dipped for 1, 2, and 5 minutes in each of the chemical treatments. The control trees were dipped in water 1, 2, and 5 minutes. There were 4 single-tree replications for each chemical-dip time combination. Both 24 and 32 inch root balls from northern Ohio (sandy soil) and only 24 inch root balls from southern Ohio (clay soil) were dipped. At the time of dipping, root ball temperatures ranged from 32 to 43^{o}F and the ambient temperature remained below 50^{o}F. All trees were transported to Wooster, Ohio, one week after dipping. The root balls were evaluated five weeks after dipping. All the soil within each root ball was thoroughly examined for the presence of white grubs. The number of live and dead grubs were documented and the live grubs were identified. Additional trees that were dipped and subsequently planted are currently being evaluated for phytotoxicity. The data were transformed (log X+1) and subjected to analysis of variance. Means were separated with Tukey's multiple range test (3).

Results and Discussion: Overall, insecticide treatments reduced the number of live grubs compared to the control treatment (Table 1). Dead and decaying grubs were found in all insecticide treatments. Dipping for a minimum of 2 minutes with either insecticide gave the best results. The 5-minute dip performed similarly to the 2-minute dip. Insecticide treatments were essentially similar regardless of root ball size and soil type. Dursban 4E performed slightly better than Dursban 50WP and both rates of Oftanol 2F. The fewest number of live grubs were most consistently found in root balls dipped in Dursban 4E.

Dipping root balls can be an expensive and "messy" method of controlling white grubs, but it can be a reasonably effective regulatory treatment. The results of this study indicate that dipping root balls can be a viable method to use for eliminating grubs. Further research may allow for "fine-tuning" application rates and dip duration with reference to soil type, root ball size, and phytotoxicity.

Significance to Industry: Although it is not suggested that dipping root balls be the primary method of grub control, it can potentially be used as a "last resort" effort if a nursery wants to undertake the expense and potential hazards in working with large quantities of insecticide. These data demonstrate that this method can be efficacious against white grubs.

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[1]This article reports results of research only. Mention of a proprietary product does not constitute an endorsement or a recommendation for its use.

Table 1. The effect of dipping root balls in insecticide on larval (grub) survival.

Location	Root Ball Size (inches)	Treatment	Rate (lb ai/100 gal)	Dip Time	Mean No. Live Larvae/ Root Ball (+ SE)1		
Northern Ohio	24	Control		1	33.7	(24.4)	d
		Control		2	4.7	(1.2)	bcd
		Control		5	8.5	(3.2)	cd
		Dursban 50WP	2.0	1	1.0	(0.6)	abc
		Dursban 50WP	2.0	2	0		a
		Dursban 50WP	2.0	5	0.2	(0.2)	ab
		Dursban 4E	2.0	1	0		a
		Dursban 4E	2.0	2	0		a
		Dursban 4E	2.0	5	0		a
		Oftanol 2F	0.2	1	1.0	(0.4)	abc
		Oftanol 2F	0.2	2	0		a
		Oftanol 2F	0.2	5	0		a
		Oftanol 2F	0.4	1	1.2	(0.6)	abc
		Oftanol 2F	0.4	2	0.7	(0.5)	ab
		Oftanol 2F	0.4	5	0		a
	32	Control		5	21.5	(17.3)	a
		Dursban 4E	2.0	2	0.5	(0.5)	a
		Dursban 4E	2.0	5	0		a
		Oftanol 2F	0.2	2	0.5	(0.3)	a
		Oftanol 2F	0.2	5	0.5	(0.3)	a
Southern Ohio	24	Control		5	2.5	(1.3)	b
		Dursban 4E	2.0	2	0		a
		Dursban 4E	2.0	5	0		a
		Oftanol 2F	0.2	2	0		a
		Oftanol 2F	0.2	5	0		a

[1]Means followed by different letters are significantly different ($P<0.05$; ANOVA)

Identification, Seasonality, and Host Preference of Tip-Feeding Pests of Red Maples

W.H. Mitchell and P.B. Schultz
Virginia

Nature of Work: Red maple, *Acer rubrum* L., is commonly grown and marketed as a landscape tree in the eastern United States. An increasingly common problem is that of a complex of moths whose larvae infest the succulent terminals during the growing season. During early stages of infestation, the unfolding leaves wilt, and are subsequently webbed together with silk to form a shelter. Leaves and tips turn brown and then black. The larvae may also bore into the growing terminal. Frass mixed with webbing forms shelters around the entrances. Infested tips are killed, resulting in substantial lateral growth, and trees become deformed (Solomon, 1995), which leads to correctional pruning, and increases time required for the tree to reach marketable size.

Tip-feeding injury to red maples, particularly the new cultivars, have been reported in Maryland (Staines, 1976), Tennessee, and Oregon. The objectives in this study were to 1)identify the injurious species, 2)determine relative abundance of those species, 3) determine if there is susceptibility to selected cultivars, and 4)determine if irrigation effects tip infestation.

Maple tips seemingly infested with tip-borers were collected from 1992 to 1995 from nurseries in four localities in Virginia (Chesterfield and Powhatan counties, and cities of Chesapeake and Virginia Beach) several times annually. Terminals were placed in cages composed of 5oz water-filled plastic cups, a Plexiglas cylinder with fine mesh covering secured by a rubber band. These containers were placed in an environmental chamber at 26(C day, 20(C night, and a 16:8 hour photoperiod. Cages were periodically checked for adult emergence. Adults were mounted and the associated pupal skins and larval head capsules were retained to assist in identification.

Acer rubrum and three cultivars ('Armstrong', 'October Glory', and 'Red Sunset') were planted in a randomized complete block with a split block design, using 48 of each species/cultivars. The main effects were with and without 30 minutes of daily irrigation through a drip system. Species/cultivar comprised the subplots. There were 4 plants per cultivar per plot in each of six blocks. Total numbers of terminal tips per tree and the number of infested tips per tree were counted each summer, 1993-95, and the ratio of infested to uninfested terminals determined. Data were transformed by arcsin prior to analysis.

Results and Discussion: Three species of moths were identified from the collections: *Episimus tyrius* Heinrich (Lep.: Tortricidae), *Proteoteras aesculana* Riley (Lep.: Tortricidae), and *Moodna ostrinella* (Clemens) (Lep.: Pyralidae). The most frequently collected was *E. tyrius*, 67 specimens, with 4 specimens of *P. aesculana*, and 6 of *M. ostrinella*. There were four additional specimens of three different species that were not identified.

Significant differences in maple tip borer infestation among cultivars were observed in 1993 and 1995. The cultivar 'Armstrong' had the lowest levels of maple tip borers, significantly lower than *A. rubrum* is 1993, and significantly lower than 'Red Sunset' in 1995. Significant differences were observed in 1993 and 1994 with greater maple tip borer infestations in the irrigated trees.

Significance to the Industry: The species feeding and injuring tips of red maples in Virginia is primarily *Episimus tyrius*, and occurs throughout the season beginning in May. Nurserymen should monitor their trees for evidence of injury. Control measures can be directed at the larval stage when insects are observed.

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Table 1. Maple tip borer injury to red maple cultivars

	1993	1994	1995
A. r. Armstrong	9.54a*	2.25ns	2.05a
Acer rubrum	27.83b	3.54	4.15ab
A. r. Red Sunset	23.69ab	4.85	6.37b
A. r. October Glory	14.75ab	2.15	5.71ab

*Column means followed by the same letter do not differ significantly, LSD (.05)

The Interaction of IGRs with Natural Enemies

Denise L. Olson and Ronald D. Oetting
Georgia

Nature of Work: Laboratory and greenhouse studies were conducted to examine the interaction and compatibility of IGRs with natural enemies of the melon aphid, *Aphis gossypii* (Glover), and green peach aphid, *Myzus persicae* (Sulzer).

The effects of IGR sprays and residues on an aphid parasitoid, *Aphidius colemani* and entomopathogen, *Beauveria bassiana*, were tested in laboratory studies. To test the effect of IGRs on *B. bassiana,* individual IGR (kinoprene [0.2 lb AI/100 gal (0.39 ml/l)], fenoxycarb [0.05 lb AI/100 gal (0.22 g/l)], or buprofezin [0.11 lb AI/100 gal (0.34 ml/l)]) applications were made to individual chrysanthemums at 1 through 7 d, and 0 hr and 1 hr prior to applying *B. bassiana* (strain JW-1 [2.3 x 10^7 CFU/2.5 oz]). A plant treated with water only served as the control for this experiment. Twenty-four hours after the entomopathogen application, 5 leaves were sampled from each treatment plant. The leaves were rinsed with distilled water. Wax moth larvae *(Galleria mellonella)* were dipped into a treatment rinsate for 30 s. The larvae were placed on moistened filter paper in a petri dish and placed in an incubator for 6 d. At this time, the larvae were examined for *B. bassiana* infectivity. Three larvae were exposed to the rinsate per IGR treatment, and each IGR treatment consisted of 5 replications.

To test the effect of IGRs on the aphid parasitoid *(Aphidius colemani),* mature chrysanthemums were sprayed with an IGR (kinoprene [0.2 lb AI/100 gal (0.39 ml/l)], fenoxycarb [0.05 lb AI/100 gal (0.22 g/l)], buprofezin [0.11 lb AI/ gal (0.34 ml/l)], cyromazine [0.12 lb AI/100 gal (0.2 g/l)], diflubenzuron [0.1 lb AI/100 gal (0.5 g/l)], azadirachtin [0.03 lb AI/100 gal (1.1 ml/l)], or pyriproxyfen [0.01 lb AI/100 gal (0.11 ml/ l)]) as stated above. A plant treated with only water served as a control for this experiment. Leaf disks (0.5 in) were taken from the individual treatment plants and placed into individual vials. A single adult parasitoid was exposed to a leaf disk for 48 hr. Parasitoid survival was recorded at 1 through 8 hr, and 24 and 48 hr post exposure to the IGR residue or spray. Ten parasitoids were tested per IGR treatment, and each IGR treatment was replicated three times.

The compatibility of *A. colemani* or *B. bassiana* with an IGR was tested in the greenhouse. To test the compatibility of *B. bassiana* (strain GHA) with kinoprene (0.2 lb AI/ 100 gal [0.39 ml/l]), four week old chrysanthemum plants, infested with green peach aphids, were treated with kinoprene, kinoprene plus a low (2.5 x 10^{10} CFU/0.04 oz [1.25 ml/l]), medium (4.38 x 10^{10} CFU/0.14 oz [4.38 ml/l]), or high rate (1.5 x 10^{11} CFU/0.3 oz [7.5 ml/l]) of *B. bassiana* or *B. bassiana* only. Plants not treated with either product served as the control for this experiment. *B. bassiana* was applied twice weekly and kinoprene every 7 d. Each treatment consisted of 12 plants replicated 4 times . One week following treatment applications, aphid counts were recorded for each experimental treatment. Aphid counts were continued for 6 wk, until chrysanthemum buds showed color.

To test the compatibility of *A. colemani* with azadirachtin (0.02 lb AI/100 gal [0.94 ml/l), adult parasitoids were exposed to the IGR at 8, 12, or 24 hours post spray application to chrysanthemum plants infested with aphids. Plants not receiving an IGR treatment or parasitoid release served as the control for this experiment. Each treatment consisted of 4 replications with 4 plants per rep. One week after parasitoids were released, the number of aphids, aphid mummies and parasitoid emergence was recorded. Data were recorded for 4 consecutive weeks.

Results and Discussion: Residues or sprays of fenoxycarb, kinoprene or buprofezin appeared to have minimal or no effect on the infectivity of *B. bassiana*. Greater than 85% of the larvae were infected when *B. bassiana* was exposed to 0 hr sprays of either fenoxycarb or kinoprene. Buprofezin resulted in the lowest percentage (83%) of the larvae infected with *B. bassiana*.

Exposing *A. colemani* for 24 hr to residues or sprays of fenoxycarb, buprofezin, pyriproxyfen, diflubenzuron, cyromazine, or azadirachtin did not have a negative effect on the adult survival compared to the water control. A significant percent (70%) of the adult parasitoids died within 24 hr when they were exposed to direct sprays or up to a 1-day old residue of kinoprene. However, exposing parasitoids to kinoprene residues greater than 1-day old did not significantly reduce adult survival as compared to the water control.

Aphidius colemani, when released 8 hr post application of azadirachtin, were as effective at managing the melon as compared to those not exposed to the IGR. One week following treatment applications the aphid populations had at least 1 fewer aphid per leaf than the control. In four weeks there were 0.1 to 0.3 aphids/leaf when *A. colemani* or *A. colemani* plus azadirachtin was used, respectively. These aphid populations had at least 33 aphids per leaf fewer than the control.

B. bassiana effectively controlled the green peach aphid populations when kinoprene was applied for other insect pests on the same chrysanthemums, as compared to when *B. bassiana* was used alone. When aphids treated with *B. bassiana* were exposed to direct sprays of kinoprene, there was at least a 99% reduction in the aphid population by the time the chrysanthemum buds began to show color. When *B. bassiana* treated aphids were not exposed to direct sprays of kinoprene, there was at least an 83% reduction in the aphid population at the same plant growth stage. The number of aphids on the control plants increased by 89% by the time the chrysanthemums were showing color.

Significance to Industry: Most ornamental crops grown in the greenhouse are host to a complex of pest species. When using biological control for one pest species, it may be necessary to apply insecticides to control other pest species that are occurring on the same crop. The laboratory and greenhouse studies indicate that *A. colemani* or *B. bassiana* can be used to manage melon or green peach aphids when an IGR is used to control other pests such as whitefly, thrips, or fungus gnats. The most suitable biological control agent/IGR combination will depend on the pest species complex that this IPM approach is targeting.

Leaf Beetle Damage to Coreopsis in Low Maintenance Wildflower Plantings

Kris Braman and Will Corley
Georgia

Nature of Work: Use of low-maintenance wildflowers in the landscape and along roadsides has steadily increased. *Coreopsis spp.* currently constitute a substantial component of wildflower mixes for the southeast. Leaf beetles have been recently observed causing significant damage to the foliage of *Coreopsis lanceolata.* Research was undertaken to determine the identity , potential host plant range, and the likelihood of infestation and damage by this pest.

Local populations of the leaf beetle were sampled and specimens submitted for identification. Observations of the insect's life history were recorded. Host plant preference tests were also conducted in the laboratory examining approximately three dozen cultivated or wild plants to determine susceptibility to the beetle.

Results and Discussion: Beetles were discovered in significant numbers in Spalding, Pike, and Clarke Counties in plantings of wildflowers. Collected specimens were subsequently identified as *Phaedon desotonus* (Balsbaugh). Although present in experimental plots in extremely high numbers, the beetle had previously been known only from the holotype taken in Dekalb Co., Alabama. Because several other North American species in this genus are associated with Brassicaceae=Cruciferae ornamentals in this family and two lines of canola were included in early screening for potential hosts.

Only four species of 36 entries were found to be susceptible to feeding damage by either adult or larval *P. desotonus*. *Coreopsis lanceolata, C. verticillata, C. tinctoria,* and *Bidens aristosa* were fed upon by both stages of the beetle. *Coreopsis lanceolata* and *C. verticillata* were rated the most susceptible among these four species in a series of 3 preference tests where damage was also assessed on a 1-10 scale.

Observation suggests that the beetle has a single generation with adults overwintering in litter and larval damage to wildflower plantings becoming apparent as early as March 15. Adults were present in large numbers during May, but ceased feeding by late May.

Significance to the Industry: Although *P. desotonus* can be controlled with insecticides, this approach to management of this emerging pest is inconsistent with the idea of low- maintenance wildflowers that act as refugia for a wide variety of beneficial arthropods. Impetus for the increasing populations of this pest is currently unclear. Tachinid and braconid parasitoids were collected from adult and larval beeteles, respectively. Predaceous stinkbugs were also observed feeding on the larval stage, suggesting some potential for biological control of this pest.