Field Production

Donna Fare
Section Editor and Moderator

Clay-based Protective Trunk Sprays for Ornamental Trees

W. E. Klingeman
University of Tennessee, Plant Sciences and Landscape Systems, 252 Ellington PSB, Knoxville, TN 37901-1071

Index Words: Borers, Drylock®, Sheetrock®, phenology, dogwood, maple

Nature of Work: Wood-boring insect pests present persistent challenges to efficient and cost-effective nursery production of ornamental and fruit trees. Tennessee growers and landscape managers follow recommendations to seasonally apply up to 6 pesticide treatments, from April through July, in order to control wood-boring pests (1, 2). Re-registration challenges may limit the future of chemical compounds labeled for controlling boring insects in ornamental trees: namely the organophosphate-insecticides lindane and Dursban®. Should these be lost, limited non-chemical options are available for managing wood-boring pests. The goals of this proposal were to investigate clay-based spray coatings that provide physical protection of ornamental tree trunks.

University and industry experts were consulted to provide material recommendations for products that would adhere readily to ornamental tree trunks, while giving optimum resiliency. The materials list included: 1) dried, powdered, OM4 ball clay (Highwater Clays, Asheville, NC), 2) Sheetrock® ceiling spray texture (United States Gypsum Co., Chicago, IL), 3) Drylock® powdered masonry water-proofer (United Gilsonite Laboratories, Scranton, PA), 4) dry, finely powdered bentonite clay (H. C. Spinks Clay, Paris, TN), 5) a liquid deflocculate, sodium silicate N, 6) Forbes emulsion wax resist, and 7) shredded (~1cm) nylon Durafiber^{SPM} (Durafiber Inc., Nashville, TN).

During June and July 2000, over 24 material consistency trials were conducted using 4-foot long trunk sections of flowering dogwood, red oak, red maple, and wild cherry trees (data not shown). All clays and their additives were pre-weighed and mixed in zipper-locked, 1-quart plastic bags. Materials were applied using a hand-held hopper gun (Wallboard Tool, Long Beach, CA) using a 4-gallon HP electric air compressor (Campbell Hausfeld, Harrison, OH). Clay solutions were applied to trunk sections at 40-psi compressor pressure (5.4 SCFM). Potential performance of sprayed coatings was assessed once they had dried. Treatment performance was ranked such that: 1 = large peeling flakes, 2 = plate-like cracks, 3 = fine fissures, or 4 = good surfaces (data not shown).

The weather-fast nature of the 7 best clay-coat treatment combinations were investigated in a randomized complete block design with 3 replicated groups of trunk sections from flowering dogwood and red maple trees. Caliper measurements were taken before and after treatments are applied, using a Lyman digital caliper (Lyman Products, Middleton, CT). Coated trunks were suspended, exposed for one month to overhead impact sprinkler cycles, or ambient rainfall, and durability was ranked.

Preliminary evidence, using Cornus florida 'Cherokee Brave' trees sprayed with a 100% Sheetrock® mix or an 80% Sheetrock® /20%OM4 clay mix, compared to unsprayed trees, found no differences in either tree growth, performance, or leaf senescence during a 4-week observation period. Tree phenological variability was further investigated using the three most promising clay-based treatments from the longevity trials and untreated trees (Table 1). Treatments were applied to dormant trunks of 18 Cornus florida 'Cherokee Princess' flowering dogwoods and 20 Acer rubrum 'Red Sunset' red maples in early March. Trees were completely randomized in 5 replicated groups on an outdoor gravel pad. One dogwood control tree and one dogwood assigned to treatment 3 died before coatings were applied, leaving 4 replicates in these groups. Treated trees were exposed to ambient rainfall and overhead impact sprinkler wetting and drying cycles for 5 weeks, during which tree phenology and coating durability were observed.

Results and Discussion: Material consistency tests yielded variable durability (data not shown). A 1:1 ratio of clay and water was most easily applied but was often too fluid to adhere to trunk sections. Bentonite thickened the solution unpredictably and Durafibers^{SPM}, which did not separate in solution, clogged the Hopper gun spray nozzles.
An equal ratio of Sheetrock® and water with 25 ml sodium silicate N provided the greatest resiliency, during material longevity trials, when oversprayed with either Drylock® or Forbes wax resist (Table 1). Overspray treatments were tested in 5-week long, live tree trials during 2001. The equal ratio of Sheetrock® and water with 25ml sodium silicate N oversprayed with Forbes wax resist showed ~1 month resiliency among smooth-barked red maple trees and phenological parameters were not notably affected by any sprayed-clay treatment (Table 2). Applying these spray coatings was difficult, inefficient (exceeding 30-50% over-spray material losses), included a high initial equipment expense, and labor and handling requirements greatly exceeded current environmental, management, or alternative pest-prevention expenses. Cracks and fissures, evident after one month, indicate that sprayed clay materials will not protect field-grown trees in the nursery or landscape during the four-month period that wood-boring pests are active.

Neither phenology of bract expansion, flowering, and leaf emergence of flowering dogwoods, nor foliage appearance, color or senescence among maples were affected. It is likely that minute fissures in the clay surface permitted gas exchange to occur through the bark. Gas exchange was also not restricted among the stems, branches, and leaves in the untreated tree canopy. For this reason, further experimentation with other types of pest-resistant coatings may be warranted if labor and application efficiencies can be maximized.

Significance to Industry: Clay materials and additives tested for consistency and durability in field trials with ambient and supplemental irrigation yielded variable results. Coverage and durability of sprayed-coatings were optimal using 1,200g Sheetrock® / 1,200g H_2O / 25ml sodium silicate over-sprayed with either 1 wax:1 H_2O (v/v) 500ml or 2,250g Drylock®:423ml H_2O once the sprayed coating had dried. However, the application process constituted a level of difficulty, initial equipment expense, and labor requirement that greatly exceeds current environmental, management, or alternative pest-prevention expenses. Since cracks and fissures were apparent after just one month, materials tested in this study would not protect the trees from the diversity of wood-boring pests, which are typically present during the four-month period of April to July.

Literature Cited:

1. Hale, F. A. and H. E. Williams. 1997. Dogwood borer, infestation, damage and control. Univ. Tenn. Agric. Ext. Serv. Publ. SP290C.

2. Hale, F. A., J. Yanes, Jr. and H. E. Williams. 1998. Maple petiole borer. Univ. Tenn. Agric. Ext. Serv. Publ. SP290M.

Table 1. Sprayed-clay treatments selected for longevity trials, initial and final clay thickness, and results of durability ranking after one- month exposure to either repeated wetting/drying cycles from overhead irrigation or ambient rainfall.

Sprayed Clay Treatments for Material Longevity Trials	Average Application Thickness (mm) ± SE	Final Rank Durability[a] O.H.[Amb.][b]
1. 850g Sheetrock® / 350g OM4 clay / 1200g H_2O / 25ml sodium silicate N	0.37 ± 0.06	4.75 [4.5]
2. 1200g Sheetrock® / 1200g H_2O / 25ml sodium silicate N	0.24 ± 0.06	5 [5]
3. 850g Sheetrock® / 350g OM4 clay/ 1200g H_2O/ 25ml sodium silicate N + 1 Forbes wax resist:1 H_2O (v/v) 500ml (once dried)	0.36 ± 0.06	4.75 [2.5[c]]
4. 1200g Sheetrock® / 1200g H_2O / 25ml sodium silicate N + 1 Forbes wax resist: 1 H_2O (v/v) 500ml (once treatment dried)	0.34 ± 0.04	2 [1]
5. 850g Sheetrock® / 350g OM4 clay / 1200g H_2O / 25ml sodium silicate N + (2250g Drylock®:423ml H_2O) (once treatment dried)	0.90 ± 0.11	2.25 [2]
6. 1200g Sheetrock® / 1200g H_2O / 25ml sodium silicate N + (2250g Drylock®:423ml H_2O) (once treatment dried)	0.53 ± 0.05	2.25 [1]
7. 1125g Drylock® / 290g H_2O	1.31 ± 0.11	2 [2.5]

[a] Final durability rank is provided for combined observations on maple trunks and dogwood trunks. Rank values are based on: 1 = clear, no cracks; 2 = small hairline fissures; 3 = hairline - 1mm fissures; 4 = plate-like cracks; and 5 = flaking of plate-like cracks.

[b] O.H. = overhead irrigation (approx. 6.1 in^3 = 99.9 cc), [Amb.] = ambient rainfall (approx. 2.5 in^3 = 41.0 cc)

[c] Smooth-barked maple trunk had a mean durability rank of 1.

Table 2. Sprayed-clay treatments selected for 2001 live tree trials and results of durability ranking after 2 and 5 weeks exposure to ambient rainfall and overhead irrigation (approximately 5.7 in^3 = 93.4 cc).

Treatments for Live Tree Trials	Average Application Thickness (mm) ± SE	Durability[a] Rank: Wk 2 *Cornus* [*Acer*]	Durability Rank: Wk 5 *Cornus* [*Acer*]	First King Flower[b] (*Cornus*)	First Leaf Break *Cornus* [*Acer*]
1. 1200g Sheetrock® / 1200g H_2O / 25ml sodium silicate N + 1 Forbes wax resist: 1 H_2O (v/v) 500ml (once treatment dried)	*Cornus* 1.6 ± 0.3 *Acer* 1.0 ± 0.1	0.4 [0.0]	2.6 [0.2]	April 7	4/5 [4/7]
2. 850g Sheetrock® / 350g OM4 clay / 1200g H_2O / 25ml sodium silicate N + 1125g Drylock® in 290g water (once treatment dried)	*Cornus* 3.0 ± 0.3 *Acer* 2.6 ± 0.3	0.2 [1.4]	3.0 [4.2]	April 8	4/5 [4/6]
3. 1200g Sheetrock® / 1200g H_2O / 25ml sodium silicate N + 1125g Drylock® in 290g water (once treatment dried)	*Cornus* 2.9 ± 0.6 *Acer* 2.8 ± 0.3	1.8 [1.2]	3.3 [3.8]	April 8	4/6 [4/7]
4. Untreated control trees	-NA-	-NA-	-NA-	April 9	4/4 [4/7]

[a]Durability rank based on: 1 = clear, no cracks, 2 = small hairline fissures, 3 = hairline - 1mm fissures, 4 = plate-like cracks, 5 = flaking of plate-like cracks

[b]King flowers represent the dominant flower, usually centrally located, within the cluster of flowers that are surrounded by the showy bracts of dogwoods.

Use of Poultry Litter in Field Nursery Production

Al Cooke, Ted Bilderback, Stuart Warren, and Robert Mikkelsen
NC State University, Dept. of Horticultural Science,
Raleigh, NC 27695 -7609

Index Words: leyland cypress, *X Cupressocyparis leylandii*, fertilizer, animal waste, organic.

Nature of Work: The poultry industry is currently seeking alternate disposal methods for litter produced during poultry production. For every one to five flocks raised, the litter (bedding and manure) is removed from confinement houses and replaced with fresh bedding. Litter is used primarily as an organic fertilizer on cropland. However, in some areas the nutrients in the manure exceed the capacity of local agricultural soils (1). Producers need alternate sites for litter application. Since acreage of field-grown nursery stock is increasing, it seems reasonable to evaluate the potential of poultry litter for use as a nutrient source in field-grown nursery stock. Therefore, a project was initiated at Knats Creek Nursery, Moore County, North Carolina to compare poultry litter with a controlled release fertilizer (CRF) and the water soluble fertilizer (WSF) used by the nursery. The nursery is located on an exposed ridge; the soil is a Candor sand with excessive drainage extending more than ten feet deep (4). Initial pH ranged from 5.8 to 6.1. The nursery is not irrigated.

The project, a randomized complete block design with three replications consisted of five treatments:

1. poultry litter, pre-plant incorporated at 50 pounds nitrogen (N) / acre, plus a surface applied litter application in the fall at 0.5 oz N / tree, plus yearly spring applications of 0.5 oz N / tree

2. poultry litter, pre-plant incorporated at 50 pounds N / acre, plus yearly spring applications of 0.5 oz N / tree

3. poultry litter, pre-plant incorporated at 100 pounds N / acre, plus yearly spring applications of 1.0 oz N / tree

4. controlled-release fertilizer (Polyon / Wilbro 16-5-10, 8.5% NH_4, 7.5% NO_3, 8 to 9 month) post-plant surface applied at 0.5 oz N / tree, plus yearly spring applications of 0.5 oz N / tree

5. water soluble fertilizer (10-10-10, N source = NH_4NO_3) post-plant surface applied at 0.5 oz N / tree, plus yearly spring applications of 0.5 oz N / tree (This was the nursery's standard fertility practice).

The same litter was used for all applications. Initial $N:P_2O_5:K_2O$ ratio was 1:1.4:1.4. The material was stored in plastic bags for subsequent use. $N:P_2O_5:K_2O$ ratio was 1:1.8:1.7 and 1:2:1.3 for December 1998 and Spring 1999 application, respectively.

After the initial litter application to treatments 1, 2, and 3, the entire site was tilled and graded. In April 1998, 32 1-gallon Leyland cypress (*X Cupressocyparis leylandii*) were planted in each plot with 5 ft between rows and in row spacing of 5 ft. In November 1998, poultry litter at 0.5 oz N / tree was surface applied in treatment 1. In March 1999, litter was surface applied at a rate of 0.5 oz N / tree in treatments 1 and 2 and 1.0 oz N / tree in treatment 3. All litter was lightly incorporated by hand raking. CRF and WSF were surface applied to treatments 4 and 5 respectively, at a rate of 0.5 oz N / tree in April 1998 and March 1999.

Eight plants in the interior of each plot were selected for growth measurements. Measurements for each tree included height, maximum width, and minimum width. A growth index (GI) was calculated for each tree as follows: GI = {[(maximum width + minimum width) ÷ 2] + height ÷ 2}. Trees were measured immediately after planting (April 1998), December 1998, and March 2000.

In July and December 1998, soil was sampled to a depth of 40 in next to four interior plants in each plot. Samples were divided into depths of 0 to 6 in, 6 to 12 in, 12 to 18 in, 18 to 30 in, and greater than 30 in. These samples were analyzed for ammonium and nitrate to track leaching of these nutrients through the soil profile.

Data were subjected to analysis of variance procedures (ANOVA). Mean separations were performed via least significant difference (LSD) procedures at P=0.05.

Results and Discussion: The initial GI was not significantly different between treatments so trees were of a similar size at planting. Percent increase in GI over one and two years was unaffected by treatments suggesting that poultry litter was as effective as CRF and WSF fertilizers. The GI increased an average of 95% over the two growing seasons. However, treatments significantly affected survival (Table 1). CRF and WSF had similar rates of survival. All poultry litter treatments significantly decreased survival compared to WSF. However, the poultry litter treatments had similar rates of survival. Poultry litter was positively correlated with tree mortality.

We suspect weather conditions, lack of irrigation, and the release mechanism of the fertilizers played a role in tree mortality. The study received 5 in of rain from April 24 until May 30, 1998. In addition, the average maximum air and soil temperatures for May were 81.5 F and 78.1 F, respectively (3). Growing conditions did not improve in June and July, total rainfall was 1.3 in and 2.2 in, respectively.

Treatment 3 with the highest addition of poultry litter consistently had the highest soil nitrate levels whereas, treatment 4 (CRF) had the lowest (Table 2). Treatments 3 and 4 were not always significantly different from treatments 1, 2, and 5. Poultry litter treatments 1 and 2, and treatment 5 (WSF) maintained similar levels of soil nitrate regardless of time and depth. Since the GI was similar across treatments the elevated nitrate level in treatment 3 might lead to increased nitrate losses. Soil data suggests that mineralization was nearly complete and nitrification advanced. Soil temperature was in ranges where this progression might have been predicted (2).

Significance to Industry: Poultry litter can be a usable source of nutrients for field nursery production. Since the grower has little control over the rate of mineralization of poultry litter, irrigation may be required to minimize damage to the crop. We would hesitate to suggest use of this material without the availability of irrigation.

Literature Cited:

1. Barker, J.C. and J.P. Zublena, 1995. Livestock manure nutrient assessment in North Carolina. Proc. 7th Intl. Symp. Agr. Food Processing Wastes, pp. 98-106

2. Sims, J.T., 1986. Nitrogen transformations in a poultry manure amended soil: Temperature and moisture effects. J. Env. Qual., 15: 59-63

3. State Climate Office of North Carolina at NC State University. http://www.nc-climate.ncsu.edu/ (retrieved May 2001).

4. Soil Survey of Moore County, North Carolina, 1995. U. S. Dept. Agr. Natural Res. Conserv. Service.

Table 1. Efffect of treatment on percent survival one year after planting.

Treatment	Survival (%)
1 (50 lbs plus fall plus spring)	46 bc[z]
2 (50 lbs plus spring)	29 c
3 (100 lbs plus spring)	46 bc
4 (CRF)	71 ab
5 (WSF)	87 a

[z]Means followed by the same letter or letters are not significantly different as determined by LSD, P = 0.05.

Table 2. Effect of treatment on soil nitrate concentration.

	Nitrate concentration (ppm)				
Depth (in)	Trt 1	Trt 2	Trt 3	Trt 4	Trt 5
July 1998					
0 - 6	21.7 b[z]	15.2 bc	37.4 a	4.9 c	19.5 b
6 - 12	15.0 ab	8.2 bc	19.4 a	2.0 c	7.3 bc
12 - 18	4.7 a	1.6 a	6.3 a	0.9 a	2.2 a
18 - 30	0.8 bc	0.6 bc	1.3 a	0.5 c	1.1 ab
> 30	0.4 a	0.4 a	0.5 a	0.4 a	0.6 a
December 1998					
0 - 6	2.5 b	2.6 b	8.6 a	4.3 b	3.4 b
6 - 12	1.4 b	1.8 a	4.6 a	2.4 b	2.6 b
12 - 18	1.5 b	1.8 b	3.1 a	1.4 b	1.6 b
18 - 30	1.4 b	1.8 b	2.6 a	1.3 b	1.5 b
> 30	1.0 ab	1.1 ab	1.9 a	1.3 ab	0.6 b

[z]Means within rows followed by the same letter or letters are not significantly different as determined by LSD, P = 0.05.

Response of Field-Grown *Ligustrum* to Granular and Solution Fertilizer

Tom Yeager[1], Frank Melton[2], Sylvia Shives[2], and Geri Cashion*
[1] Dept of Environmental Horticulture, Univ. of Florida, Gainesville, FL 32611
[2] University of Florida Extension, Manatee County, Palmetto, FL 34221

Index words: *Ligustrum japonicum* Thunb.

Nature of work: Plants grown in native soils are typically fertilized with about 6 lb. N/1000 sq. ft. per year (1) applied in multiple applications broadcast to the soil surface at the plant base. However, fertilizer placement or method of delivering the fertilizer to the root zone could necessitate altering the application rate. Application rates are based on the crop nutrient requirement or plant response that is achieved with a particular application method and fertilizer placement. The following study was conducted to determine if the broadcast nitrogen application rate (8.6 lb N/1000 sq. ft. per application) currently used by a central Florida nursery should be altered or supplemented with solution fertilizer to achieve optimal plant response.

In September 1995, one-gallon *Ligustrum japonicum* were planted in Myakka fine sand (siliceous, hyperthermic Aeric Haplaquods) at Ellenton Nursery, Parrish, Florida. Plants were spaced 10 ft. within a row and 20 ft. between each of 27 rows each containing about 60 plants. The 27 rows were split among three adjoining fields each containing 8, 9, and 10 rows of plants (Fields 1, 2, and 3, respectively). After planting, one-third gallon of Polystart [(8-30-5) 4 pt./100 gal., Morse Enterprises Limited, Inc., Miami, Florida] and 0.5 lb. Florganic fertilizer [6-3-0, derived from digested sewage sludge, Florida Favorite Fertilizer (FFF), Lakeland, Florida] were applied to soil in a 7 sq. ft. area around base of each plant. In October, 0.25 lb. 12-4-12 granular fertilizer (FFF) was applied to the 7 sq. ft. area at the base of each plant and in January 1996, 12-0-12 granular fertilizer (FFF) was applied at 0.25 lb. per plant in Fields 1 and 2, and 0.5 lb. per plant in Field 3. The later fertilizer did not contain phosphorus because soil test revealed very high phosphorus in the soil. Subsequently, each plant in each of three random treatment rows of each field received the 12-0-12 at rates of 0.25, 0.5, or 1.0 lb. per plant applied uniformly to the 7 sq. ft. area per plant (except for the 0.25 lb. rate in which there were four rows in Field 3 and two rows of the 0.25 lb rate in Field 1). Each rate was equivalent to about 4.3, 8.6, and 17 lb. N/1000 sq. ft., respectively, per application. The 12-0-12 was applied in April, June, August, and October of 1996, and April and September of 1997. The 0.25 lb rate was applied to all plants in December 1997. Prior to initiation of this study, 0.5 lb. of 12-4-12 per plant applied at six-week intervals was standard protocol for the nursery. All plants were irrigated with pressure compensating Netafim emitter [(1 gal./hr.) Netafim Irrigation, Altamonte Springs, Florida]. Plants in Fields 1 and 2 were irrigated with water containing 30-35 ppm N (derived from ammonium nitrate) while plants in Field 3 did not receive fertilizer in the irrigation water. Irrigation water in Field 1 was applied in two applications on days when needed, while one continuous application on days when needed was used for Fields 2 and 3. For example, Fields 2 and 3 received irrigation for 3 consecutive hours, while Field 1 received irrigation the first hour, then off for one hour, then on for one hour. Field 1 was irrigated for two-thirds the duration of Fields 2 or 3, but Field 1 had a non-irrigated time interval between irrigation applications. The non-irrigated interval was equal to the length of time for one of the irrigation intervals. This irrigation regime was initiated in October 1995 and is referred to as cyclic irrigation. In November 1995, March 1997, and January 1998 the height, widest width and perpendicular width were measured for ten plants near the center of each row. A growth index was calculated as height plus average width.

Results and Discussion: Plants within each field that received 0.25 or 0.5 lb. of 12-0-12 per 7 sq. ft. per application had similar growth indices in March and January regardless of fertilization rate (Table 1). Supplementing the 0.25 and 0.5 lb. granular fertilization rates with cyclic or continuous fertigation, did not result in plants with growth indices larger than plants receiving only granular fertilization. These data indicate that 0.5 lb of 12-0-12 per 7 sq. ft. per application surpassed the nutrient requirements for *Ligustrum japonicum* in view of a similar plant response for the 0.25 lb. rate. These results may have been different at lower application rates of granular fertilizer.

Significance to Industry: Plant response to nitrogen application rate may vary due to factors such as plant species, soil type, fertilizer application method, rate, and placement. Nursery operators should conduct tests to evaluate plant response to fertilizer under cultural conditions at the nursery. Data from this study indicate that *Ligustrum japonicum* could be fertilized with at least one half the granular fertilizer application rate (8.6 lb N/1000 sq. ft. per application) commonly used by the nursery.

Literature Cited:

1. University of Florida Extension Soil Testing Laboratory. Gainesville, Florida.

Acknowledgement: The authors gratefully acknowledge Ellenton Nursery Growers, Parrish, Florida, Florida Favorite Fertilizer, Lakeland, Florida, and Netafim Irrigation Inc., Altamonte Springs, Florida for their support and cooperation and the financial support of the FNGA Endowed Research Fund.

* Geri Cashion is a former employee of University of Florida Extension, Manatee County.

Trade names and companies are mentioned with the understanding that neither endorsement is intended nor is discrimination implied for similar products or companies not mentioned. This research was supported by the Florida Agricultural Experiment Station and a grant from the FNGA Endowed Research Fund and approved for publication as Journal Series No. N-02106.

Table 1. Data are growth indices [GI = height (meters) + average width (meters)] for field-grown *Ligustrum japonicum* that received 0.25, 0.50, or 1.00 lb. of 12-0-12 per plant per application in addition to fertigation or no fertigation during Oct. 1995 to Jan. 1998.

Date	Field 1			Field 2			Field 3		
	Fertigation Cycled + Granular Fertilizer (lb. granular fert. / app.)			Fertigation + Granular Fertilizer (lb. granular fert. / app.)			No Fertigation + Granular Fertilizer (lb. granular fert. / app.)		
	0.25	0.50	1.00	0.25	0.50	1.00	0.25	0.50	1.00
Nov. 1995	0.6 ± 0.1	0.6 ± 0.1	0.6 ± 0.1	0.7 ± 0.1	0.7 ± 0.1	0.7 ± 0.1	0.4 ± 0.1	0.5 ± 0.1	0.4 ± 0.1
March 1997	2.7 ± 0.2	2.4 ± 0.4	2.2 ± 0.4	2.6 ± 0.3	2.5 ± 0.4	2.5 ± 0.5	2.4 ± 0.5	2.4 ± 0.5	1.9 ± 0.4
Jan. 1998	3.7 ± 0.4	3.5 ± 0.8	3.4 ± 0.5	3.8 ± 0.6	4.0 ± 0.4	3.7 ± 0.7	4.0 ± 0.5	3.9 ± 0.5	3.4 ± 0.6

n = 30 ± standard deviation. Granular fertilizer (12-0-12) was applied in April, June, August, and October of 1996 and April and September of 1997 (see text regarding other granular fertilizer applications). Granular fertilizer was applied to 7 sq. ft. of soil surface at base of plant. Fertigation (approximately 35 ppm N) was delivered by 1 gal./hr. pressure compensating emitter at base of plant. Field 1 receive two-thirds the fertigation or irrigation duration of Fields 2 and 3.

Irrigation and Pruning Influence Hydrangea Dried Cut Flower Production

Winston Dunwell[1], Dwight Wolfe[1], Robert McNiel[2], Sharon Bale[2], and Dewayne Ingram[2]
[1]Research and Education Center, University of Kentucky, Princeton, KY 42445
[2]Department of Horticulture, University of Kentucky, Lexington, KY 40546

Index Words: Hydrangea, Cut-flowers, Irrigation, Pruning

Nature of Work: Cut flowers from field grown hydrangeas are a potential alternative source of income for Kentucky growers, and early production can increase financial returns on one's investment. Typically, *H. macrophylla* cultivars are grown for the cut flower market; while other species such as: *H. arborescens*, smooth hydrangea; *H. paniculata*, panicled hydrangea; and *H. quercifolia*, oakleaf hydrangea; have been grown as landscape plants (1, 2). Interest has been expressed in *H. arborescens* and *H. paniculata* as fresh cut and dried flowers by wholesale distributors (6). Expansion of the cut flower production mix to include these *Hydrangea* species could create specialty-niche markets for Kentucky growers.

A *Hydrangea* cut-flower cultivar trial was established at the University of Kentucky Research and Education Center, Princeton, KY, in the Spring of 1998 (4, 5, 7). The planting consisted of twelve plants each of nine cultivars allocated to 12 rows (blocks) in a randomized block design. The nine cultivars included one *H. aborescens* cultivar, 'Annabelle'; one *H. quercifolia* cultivar, 'Alice'; and seven *H. paniculata*, panicled hydrangea, cultivars, 'Boskoop'; 'Pink Diamond'; 'Unique'; 'Kyushu'; 'Tardiva'; 'Pee Wee'; and 'White Moth'. A planting with trickle irrigation was established in the Spring of 1999. It consists of six *H. paniculata* cultivars, 'Pink Diamond', 'Unique', 'Kyushu', 'Tardiva', 'Pee Wee', and 'White Moth', allocated to 8 rows (blocks) in a randomized block design. In the Autumn of 2000, alternate rows of each planting were pruned to ground level. The number of stems per plant, stem length, and bloom length were recorded.

Results and Discussion: 'Alice', 'Annabelle' and 'Boskoop' were not included in the irrigated planting. Pruning significantly affected the average number of stems per plant for all cultivars except for 'Annabelle' and 'White Moth', which showed no significant response to pruning (Table 1). 'Kyushu' and 'Pee Wee' produced largest numbers of stems when pruned and irrigated. Not pruning the plants resulted in stems less than the 36 inches in length needed for the cut-flower market (2).

Pruning 'White Moth' under irrigation resulted in vigorous long stems (Table 2) that tended to continue growing and not produce blooms. Plants of 'White Moth' that were pruned and not irrigated also did not produce any blooms. *Hydrangea quercifolia* flowers on year-old wood (3) and, as expected, the pruned plants of 'Alice' did not flower (Table 3).

'Kyushu' was the only cultivar that produced significantly longer blooms when not pruned. This was true for both the irrigated and non-irrigated plantings. A limiting factor to marketability of 'Kyushu' may be the observation that blooms do not have as many showy sterile flowers as 'Pink Diamond', 'Unique', or 'Pee Wee'.

Significance to Industry: Under the conditions found in this study 'White Moth' does not appear to be a good *H. paniculata* cultivar for hydrangea cut-flower production. All other *Hydrangea* cultivars show potential for producing white fresh and tan dried cut-flowers. The 'Kyushu' characteristics of producing large numbers of stems (115) and longer blooms (8.7 inches) when not pruned and irrigated needs to be studied further. Modifying production practices could result in a plant that produces large blooms and has a stem of adequate length for a specialty market.

Literature Cited:

1. Armitage, A.M. 1993. Specialty cut flowers. 1st ed. Timber Press, Portland, Ore.

2. Bale, Sharon. 1999. Personal communication.

3. Bir, Dick. 2000. Pruning Hydrangeas. 22 June 2001. <http://www.ca.uky.edu/HLA/Dunwell/hydprun.html>

4. Dunwell, Winston, Dwight Wolfe, and June Johnston. 2000. Hydrangeas for Cut Flowers: 1999 Observations. UK Nursery and Landscape Program: 1999 Research Report, PR 422:19.

5. Dunwell Winston, Dwight Wolfe, and June Johnston. 1999. *Hydrangeas* for Cut Flowers: Early Observations. Nursery and Landscape Program 1998 Research Report PR-409:37.

6. Trimble, Ann. 2000. Personal communication.

7. Wolfe, Dwight E. and Winston C. Dunwell. 1999. Production of cut flowers from field- grown hydrangeas. HortScience vol 34(3): 476 Abstract #202.

Table 1. Number of stems per plant as affected by pruning and cultivar for irrigated and non-irrigated plantings of *Hydrangea* cultivars at UKREC, Princeton, KY.

Cultivar	Pruned	Not Pruned	Mean	Pruned	Not Pruned	Mean
	Non-Irrigated Planting			*Irrigated Planting*		
	Average Number of Stems Per Plant					
Alice	0.0	23.4 *[1]	13.4			
Annabelle	14.2	16.7 ns	15.4			
Boskoop	7.8	29.0 *	19.3			
Kyushu	11.3	54.0 *	32.7	14.8	115.5 *	65.1
Pee Wee	5.0	24.3 *	14.7	12.8	112.0 *	62.4
Pink Diamond	11.2	41.3 *	26.3	19.8	49.5 *	34.6
Tardiva	7.5	21.7 *	14.6	12.0	95.8 *	53.9
Unique	18.2	37.0 *	27.6	24.8	86.3 *	55.5
White Moth	0.3	0.8 ns	0.5	1.3	4.3 ns	2.8
Mean	- -	- -	18.6	- -	- -	45.7
LSD $_{(P=0.05)}$	- -	- -	7.4	- -	- -	20.9

[1] "*"and "ns" indicate that mean in previous adjacent column is either significant or not significant, respectively, at the 0.05 probability level from mean in column.

Table 2. Average stem length as affected by pruning and cultivar for irrigated and non-irrigated plantings of *Hydrangea* cultivars at UKREC, Princeton, KY.

Cultivar	Pruned	Not Pruned	Mean	Pruned	Not Pruned	Mean
	Non-Irrigated Planting			*Irrigated Planting*		
	Average Length (inches) per Stem					
Alice	- -	10.0	9.9			
Annabelle	20.5	18.4 ns[1]	19.5			
Boskoop	30.2	16.1 *	22.5			
Kyushu	41.4	17.3 *	29.4	54.3	17.0 *	35.6
Pee Wee	43.3	15.3 *	29.5	52.4	14.9 *	33.7
Pink Diamond	35.8	16.0 *	25.9	39.2	17.1 *	28.1
Tardiva	38.2	16.2 *	27.2	50.8	19.5 *	35.2
Unique	33.2	15.5 *	24.3	38.7	18.6 *	28.6
White Moth	- -	12.9	13.0	78.2	16.6 *	37.2
Mean	- -	- -	24.4	- -	- -	32.9
LSD $_{(P=0.05)}$	- -	- -	3.8	- -	- -	3.9

[1] "*"and "ns" indicate that mean in previous adjacent column is either significant or not significant, respectively, at the 0.05 probability level from mean in column.

Table 3. Average bloom length as affected by pruning and cultivar for irrigated and non-irrigated plantings of *Hydrangea* cultivars at UKREC, Princeton, KY.

Cultivar	Pruned	Not Pruned	Mean	Pruned	Not Pruned	Mean
	Non-Irrigated Planting			*Irrigated Planting*		
	Average Bloom Length (inches)					
Alice	--	3.5	3.6			
Annabelle	3.5	3.1 ns[1]	3.3			
Boskoop	5.3	3.4 *	4.2			
Kyushu	5.0	7.2 *	6.1	7.2	8.7 *	8.0
Pee Wee	5.0	4.1 ns	4.5	7.5	5.5 *	6.5
Pink Diamond	6.8	5.0 *	5.9	7.3	5.3 *	6.3
Tardiva	5.5	3.9	4.7	8.1	5.8 *	6.9
Unique	5.0	3.4 *	4.2	7.7	4.6 *	6.2
White Moth	--	5.4	5.3	7.2	5.5 *	6.0
Mean	--	--	4.7	--	--	6.7
LSD $_{(P=0.05)}$	--	--	1.2	--	--	0.9

[1] "*"and "ns" indicate that mean in previous adjacent column is either significant or not significant, respectively, at the 0.05 probability level from mean in column.