SECTION 12
WATER MANAGEMENT

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Influence of Subirrigation on Postproduction Longevity of Poinsettias

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Nature of Work: Increasing awareness of water quality will affect the content of effluent that can be legally discharged from agricultural businesses. Ebb and flow production technology is a closed subirrigation system which prevents water used in irrigating greenhouse crops from being routinely discharged into the environment. This technology has been adopted by many European growers but by few Americans. Three primary barriers to adoption of subirrigation systems have been identified: cost of installation, fear of disease spread, and lack of production schedules (1). Another concern expressed by growers and researchers has been that subirrigation may reduce the postproduction longevity of plants if excess fertilizer salts are not leached.

The objective of this work was to determine the influence of hand irrigation or subirrigation on the postproduction quality of 'Supjibi' poinsettia.

On August 26, 1991, cuttings of 'Supjibi' were stuck into 6-inch azalea pots using a commercial soil-less growing medium (Metromix 360, Grace-Sierra). Cuttings were allowed to root under intermittent mist for 14 days. Twelve plants per treatment were fertilized at each irrigation beginning September 9 using equal parts (by volume) of calcium nitrate and Peter's 20-10-20 Peat Lite. Fertilizer concentration initially was 200 ppm N; from November 11 to December 9, 100 ppm N was used. Irrigation method was either hand or subirrigation. Hand irrigation consisted of watering plants with a hose until water began to drip from the bottoms of containers. Subirrigation consisted of flooding watertight benches to a depth of about 3/4-inch for 15 minutes. Media leachates were taken at two-week intervals-to determine soluble salts.

On December 9, 1991, plants were moved to a simulated consumer environment maintained at 70°F and about 75 foot candles of light provide by cool-white fluorescent lamps from 0600 HR to 1800 HR. Data were taken on the first day in this postproduction environment on growth index ((height + $width_1$ + $width_2$)/3), plant grade, and numbers of leaves, bracts, cyathia, and inflorescences. Thereafter, data taken weekly for five weeks included plant grade and cumulative drop of leaves, bracts, and flowers (cyathia).

Results and Discussion: Media soluble salts for hand irrigated plants on the first sampling date (October 21) were significantly greater than for subirrigated plants (data not shown). On the three subsequent samplings, soluble salts were similar regardless of irrigation method. At the time plants entered the postproduction environment, subirrigated plants had greater growth indices and numbers of bracts and cyathia as compared to hand irrigated plants (data not shown). Plant grade and the numbers of leaves and inflorescences were similar.

After one week in the postproduction environment, leaf drop was greater for subirrigated plants, but cyathium drop was greater for hand irrigated plants; plant grade was similar for both irrigation methods (Table 1). After two weeks, cyathium drop remained greater for hand irrigated plants, but leaf drop and plant grade were similar regardless of irrigation method. From week three to week five in the postproduction environment, irrigation method had little influence on any measured variable.

Previous research demonstrated that plant grade and leaf retention were significantly lower for subirrigated poinsettias (2). However, media pH and soluble salts were not routinely monitored. Therefore, the postproduction quality could not be related to any media characteristics. The data reported in this paper indicate that irrigation method had minimal impact on overall plant grade. Initial differences in leaf and cyathium drop may be related to differences in media soluble salt levels during production. Additional experimentation is planned with monitoring and control of media soluble salts levels.

Significance to Industry: Increasing environmental concerns may necessitate many greenhouse growers using subirrigation as a tool for water management. These results indicate that the postproduction quality of subirrigated plants can be at least as good as that produced by hand irrigation.

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Table 1. Influence of irrigation method on plant grade, leaf drop, and cyathium drop of 'Supjibi' poinsettia after one or two weeks in a postproduction environment.

	Week 1[z]			Week 2		
Irrigation Method	Grade[y]	Leaf Drop (%)x	Cyathium Drop (%)[x]	Grade	Leaf Drop (%)	Cyathium Drop (%)
Hand	3.8a[w]	8.2a	65.5a	2.6a	39.7a	IOO.Oa
Sub-	4.0a	12.5 b	38.3 b	3.8 a	37.5 a	82.7b

[z]Number of weeks in postproduction environment.

[y]Rated on a scale from 1 (poor) to 5 (excellent).

[x]Percentages are cumulative leaf or cyathium drop relative to total number present at Week

[w]Means in a column followed by the same letter are not significantly different at $p \leq 0.05$ by Duncan's Multiple Range test.

Irrigation of Poinsettias at Different Frequencies and Automated by Tensiometers

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Louisiana

Nature of Work: The amount and frequency of irrigation needed to produce high quality plants is of obvious interest to growers. Although conservation of water is not yet a major concern to growers in south Louisiana, it may be in the future. Chemicals in runoff water from plant irrigation may be a more immediate concern. This study was initiated to determine the effects of variations in the frequency of irrigation on some aspects of growth and development of poinsettia pot plants and to evaluate the performance of a switchiny tensiometer for controlling irrigation of pot plants.

Rooted cuttings of three poinsettia cultivars, 'Eckespoint Celebrate', 'Annette Hegg Dark Red', and 'Gutbier V-14 Glory', from Paul Ecke Poinsettias were received August 21, 1991, and were potted in 6" plastic azalea pots. The medium was Pro-Mix BX with 8 lbs. of Sierra 17-6-10 Plus Minors added per cubic yard. Pro-Mix BX is 60% peat, 20% vermiculite, and 20% perlite plus 10 lbs. dolomitic limestone, 2% lbs. 0-20-0, 11/2 lbs. KNO^3, 3 oz. FTE, and 5 oz. wetting agent per cubic yard. The plants were placed in a greenhouse under two layers of 47% shade cloth. One layer of shade was removed September 4 and the final layer on October 28. Temperatures were generally maintained between 62° and 90°F, but there were exceptions at both ends of the scale.

Plants were arranged in three replications, each consisting of one bench for each of the three treatments. Each bench contained six plants of each of the three cultivars, grouped at the same randomly assigned positions on all three benches of a replication. Treatments were assigned randomly to the three benches within a replication.

Plants of Treatment 1 were irrigated daily for two periods of 1 minute each, 1/2 hour apart, which supplied almost 600 ml per day. Plants of Treatment 2 were irrigated every second day for the same periods of time. For Treatment 3, an Irrometer model RA switching tensiometer was placed in one pot of 'Gutbier V-14 Glory' in each replication. Switches were set to allow irrigation each day that the tensiometer indicated soil moisture tension of 10 centibars or more. The irrigation system consisted of a six-zone electronic controller, 24-volt solenoid valves, water meters, polyethylene tubing, and individual emitters. Irrigation treatments were begun on October 17 and discontinued on December 5. After this period, all plants were irrigated every second day.

On August 29, a mixture of Benlate 50DF at 1 lb./100 gal., Subdue 2E at 2 oz./100 gal., and Buffer X at 225 ml/100 gal. was applied to the medium at the rate of 6 oz./plant. Stem tips of all plants were removed on September 18. No further pruning was done.

On October 15, 22, and 29, 150 ml of solution containing 700 ppm N, 105 ppm P_2O_5, 490 ppm K_20, and 0.2 ppm Mo were applied to each plant. Sources of N were equal parts $Ca(NO_3)2$, KNO_3, and NH_4NO_3. The N and K^2O contents were increased to 1000 and 700 ppm, respectively, for applications on November 5, 12, 19, and 25. Aqua-Gro L was added to the fertilizer solution on November 25 at the rate of 1 oz./5 gal.

Quality ratings were made by three people on December 4. The plant quality rating covered all aspects of plant quality (size, shape, number and formation of inflorescences, etc.) except foliage quality.

Results and Discussion: 'Celebrate' developed flowers very early and produced the least growth (Table 2). 'Glory' was the same height as 'Celebrate' but was wider and produced more branches. 'A. H. Dark Red' was last to flower and was taller than the others at maturity. The tensiometers were placed in 'Glory' plants because they were intermediate in size. Plants of 'A. H. Dark Red' often became very dry between tensiometer-controlled irrigations and were slightly wilted on a few occasions.

Plants with tensiometer-controlled irrigation received only 30% as many irrigations and only 17% as much water as daily-irrigated plants (Table 1). The discrepancy exists between these two percentages because the tensiometers usually closed the solenoid valves of Treatment 3 after the first minute of irrigation. Table 2 shows the rather modest difference in size and quality that resulted from these huge differences in irrigation. Height of 'Celebrate' was unaffected by treatments, but the other cultivars were tallest with daily irrigation and shortest with the least irrigation. Plant width (averaqe of the greatest and that perpendicular to it) of 'A. H. Dark Red' was greatest with every-second-day irrigation, but that of the other cultivars was unaffected.

Plant quality ratina of 'A. H. Dark Red' was greater with every-second-day irrigation than with either of the other treatments (Table 2). That of 'Glory' was greater with either daily or every-second-day irrigation than with tensiometer control. No significant differences in quality rating were found with 'Celebrate'. Foliage quality ratings were highest with the least irrigation and lowest with daily irrigation. These differences were the result of leaching of N and possibly other nutrients from the growth medium with excessive watering and are very small considering the large differences in amounts of water applied.

Observation of test plants through January 1992 did not reveal any conspicuous differences due to treatment in regard to keeping quality.

No losses from disease occurred with any of these irrigation treatments, even thouqh the daily-irrigated medium was constantly near saturation. The predominantly peat medium may be responsible for lack of such problems and the relatively good growth and quality even with excessive watering.

Significance to Industry: This study illustrates the wide variation in irrigation frequency that the poinsettia plant can tolerate, at least under the conditions provided. It also illustrates the possibility of usinq a switching tensiometer for automatic control of irrigation. It will be necessary to control irriqation of plants of different vigor or under different environmental conditions separately. Using two tensiometers wired in parallel may provide greater safety than relying on one instrument.

Minimal irrigation has the advantages of reducing runoff and therefore pollution potential, improving quality with a given amount of fertilizer, and possibly reducing height, as was found with one of the cultivars used in this experiment.

Table 1. Amount of water applied to poinsettia plants from October 21 through December 4, 1991.

Treatment number	Irrigation treatment	Applied per plant per day (ml) Water	Fertilizer solution	Total	In 44-day period Total applied per plant (gallons)	Number of irrigations
1	Daily	596	20	616	7.16	44
2	Second day	278	20	298	3.46	21
3	Tensiometer	99	20	119	1.38	13

Table 2. Size and quality of poinsettia plants after different irrigation treatments from October 21 through December 4, 1991.

Irrigation treatment	Cultivar: Celebrate	A. H. Dark Red	V-14 Glory	Mean
		Height (cm)		
Daily	31.3 a[1]	43.3 a	32.8 a	35.8 a
Second day	30.7 a	41.4 a	31.4 ab	34.5 b
Tensiometer	31.7 a	38.9 b	29.7 b	33.4 b
		Average Width (cm)		
Daily	45.0 a	48.4 b	52.2 a	48.6 b
Second day	46.4 a	52.9 a	52.1 a	50.5 a
Tensiometer	46.3 a	49.8 ab	51.0 a	49.0 ab
		Plant Quality[2] Rating[3]		
Daily	7.08 a	5.26 b	7.18 a	6.51 b
Second day	7.15 a	5.68 a	7.29 a	6.70 a
Tensiometer	7.08 a	5.30 b	6.78 b	6.39 b
		Foliage Quality Rating[3]		
Daily	6.31 b	5.86 b	6.03 b	6.06 c
Second day	6.68 a	5.91 b	6.28 a	6.29 b
Tensiometer	6.82 a	6.42 a	6.37 a	6.54 a

[1]Values within a column followed by a common letter are not siqnificantly different (P =0.05).
[2]Overall plant quality considering all factors except foliage quality.
[3]Rated 1-10: 10 = excellent, 1 = very poor.

Spray Stake Irrigation of Container-Grown Plants

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Nature of Work: Trickle irrigation, such as with spray stakes, can significantly increase irrigation efficiency compared to overhead irrigation (Bonaminio and Bir, 1983; Weatherspoon, 1977; Weatherspoon and Harrell, 1980), because emitters are in the container and deliver water directly to the medium. Trickle irrigation, while more efficient than overhead irrigation, can cause excessive leaching especially with porous, soilless potting mixes (personal observation). Furthermore, emitters are designed with large orifices to reduce clogging and deliver water at a relatively high rate. Trickle irrigation efficiency may be increased by intermittent irrigation, which is the application of the daily water allotment in more than one application (Karmeli and Peri, 1974; Mostaghimi and Mitchell, 1983) and increases efficiency by decreasing overall application rate (Karmeli and Peri, 1974; Zur, 1976). Limited detailed research on intermittent irrigation with trickle systems has been completed on soilless growing media. The purpose of this study was to investigate spray stake irrigation efficiency as affected by: 1) pre-irrigation medium moisture deficits, 2) continuous vs. intermittent water application, and 3) intermittent application volume and frequency.

Taqetes erecta L. 'Apollo' were grown in 3 gal. plastic containers filled with pine bark medium (Pinus taeda L.) amended with 5 lb dolomitic lime/yd^3. Prior to treatment (all experiments), bark was thoroughly irrigated by hand with a watering wand. Following this irrigation, evapotranspiration losses were determined by weighing; when bark reached targeted moisture deficits, shoots were severed at the medium surface to eliminate transpiration during treatment and container drainage. One spray stake per container (Roberts Spot Spitters, Roberts Irrigation Products, Inc., San Marcos, Calif.), was used for water application. Collected leachate was measured, and irrigation efficiency calculated [{(amount applied - amount leached) / amount applied}•100].

Influence of application rate on irriqation efficiency at three moisture deficits. When bark reached targeted moisture deficits of 18, 36, and 54 oz per container, containers were spray stake-irrigated with 100% of the respective moisture deficits. Containers were irrigated at 4.4 oz./min. (low flow stake), 6.6 oz./min., or 8.1 oz. (high flow stake) in factorial combination with each moisture deficit.

Intermittent vs. continuous irriqation. When bark reached targeted moisture deficit of 18 oz., containers were irrigated (4.4 oz./min) with 12 or 18 oz. which coincide with 65% and 100% of the moisture deficit, respectively, in factorial combination with two irrigation methods: continuous (total volume applied in one application) or intermittent (3 oz. applications at 30 min. intervals between applications). Leachate volume was measured at the end of each interval and one hour after the last application.

Intermittent irriqation efficiency influenced by volume and frequency of application. When bark reached targeted moisture deficit of 18 oz., containers were intermittently irrigated with a total of 18 oz. (4.4 oz./min) in a 3 x 3 factorial combination of three application volumes (1.5, 3.0, or 4.5 oz.) with three intervals between applications (20, 40, or 60 min.); in a control treatment 18 oz. were applied in a single continuous application. Collected leachate was measured at the end of each interval and one hour after the last application.

Results and Discussion: Influence of application rate on irrigation efficiency at three moisture deficits. Application rate did not affect irrigation efficiency (data not shown). Apparently, application rates less than 4.4 oz./min are needed to increase efficiency. Irrigation efficiency was 65%, 51%, and 53% for medium moisture deficits of 18, 36, and 54 oz., respectively. Bark at relatively low moisture contents has hydrophobic properties which results in water channeling during irrigation. The greatest efficiency (65%) resulted when moisture deficit was 18 oz. and was similar to other work (Weatherspoon, 1977; Weatherspoon and Harrell, 1980) in which irrigation efficiencies of various drip/trickle systems ranged from 44% to 72%. However, direct comparisons of efficiencies between authors is difficult because medium moisture contents or deficits are often unreported.

Intermittent vs. continuous irriqation methods. Irrigation efficiency was greater when water was applied intermittently compared to a continuous application with degree of efficiency dependent the amount of deficit replacement (Fig. 1). Efficiency was relatively high for intermittent irrigation (94%) and continuous application (84%), at 65% replacement. Efficiency for the continuous treatment at 100% return was 68%. For intermittent irrigation, the efficiency was 84% at 100% replacement. Overall efficiencies following each of the first three 3 oz. applications were 100% and were 96%, 89%, and 84% following the fourth, fifth, and sixth 3 oz. applications, respectively. Thus, after 9 oz. are applied, a water-holding threshold is reached, beyond which bark can no longer absorb water as fast as it is applied.

Intermittent irrigation efficiency influenced by volume and frequency of application. An interaction between length of time between applications and volume of application was absent. Irrigation efficiencies were 83%, 72%, and 69%-for application volumes of 1.5, 3.0, and 4.5 oz. respectively. Efficiencies were 69%, 79%, and 77% for interval between applications of 20, 40, and 60 min, respectively. Efficiency was greatest (86%) with a regimen of 1.5 oz. applications and at least 40 min. between applications. Efficiency of the control treatment (total deficit returned in a single, continuous application) was 62%. All irrigation regimens, except the 4.5 oz. application with 20 min. interval, were more efficient than the control treatment. Regardless of application volume, efficiency following the first

9 oz. applied (≈100%) was greater than after the second 9 oz. were applied (Fig. 2).

Significance to Industry: When using spray stakes, applying the daily water allotment to plants in a single application is relatively inefficient. Irrigation efficiency can be improved by applying the daily water allotment in more than one irrigation (intermittent irrigation). Intermittent irrigation reduces the amount of water that leaches from containers and thereby reduces fertilizer loss from containers.

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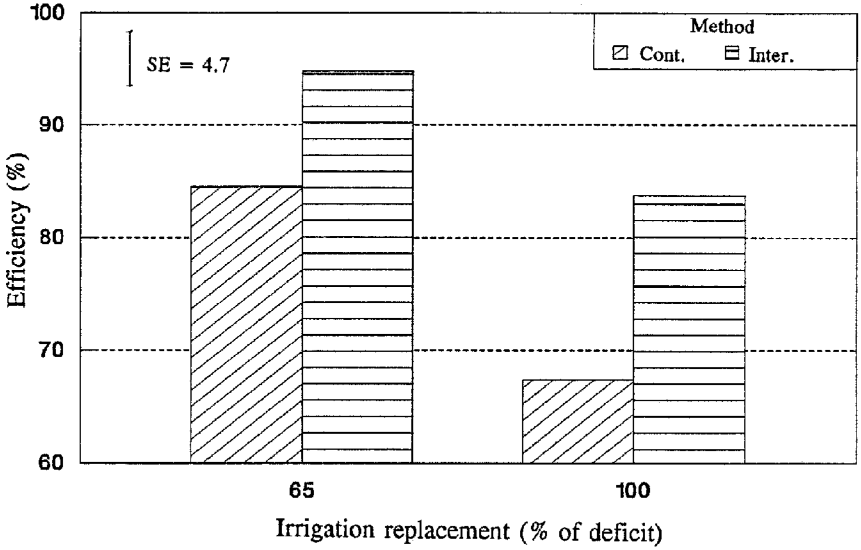

Fig. 1. Efficiency of continuous and intermittent irrigation at 65% and 100% replacement of the moisture deficits of 400 (12 oz.) and 600 ml (18 oz.), respectively. SE indicates pooled SE of the means, n = 10, P = 0.05.

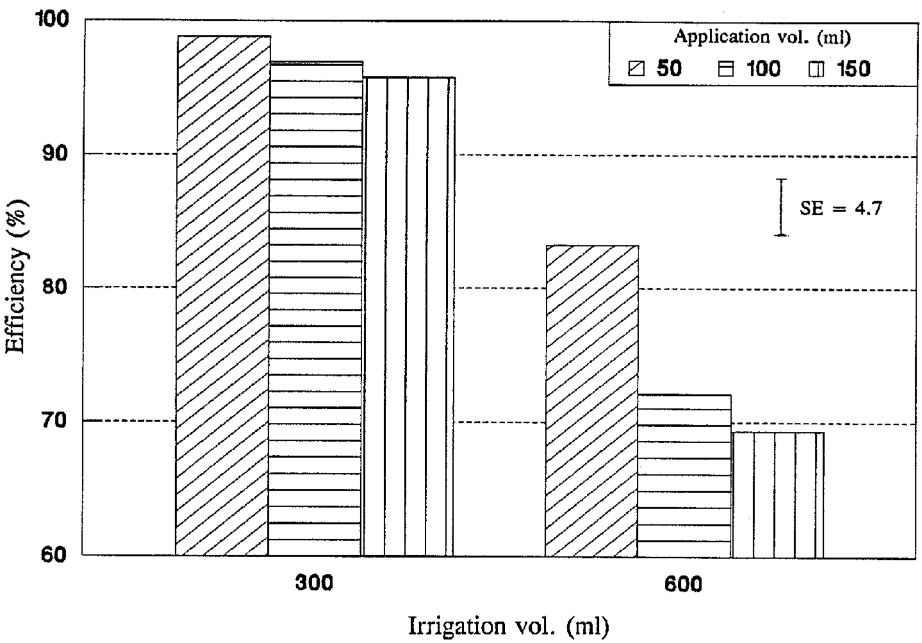

Fig. 2. Irrigation efficiency after 300 (9 oz.) and 600 ml (18 oz.) were applied with 50 (1.5 oz.), 100 (3.0 oz.), or 150 ml (4.5 oz.) applications (pooled over time intervals between applications). SE indicates pooled SE of the means, n = 10, P = 0.05.

Herbicide Analysis in Containment Pond Water and Sediment

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Nature of Work: Herbicides are widely used in container nurseries for weed control. Granular formulations are commonly applied by broadcast application which results in herbicide formulations being delivered to both the containers and to surfaces surrounding the container. Rout (Grace-Sierra Chemical Co.) and OH-$_2$ (Scotts) are two of the most commonly used herbicide formulations in container nurseries. These formulations contain one of the dinitroaniline herbicides, pendimethalin or oryzalin, with the diphenyl ether, oxyfluorfen. The possibility exists for herbicide runoff into containment ponds. Herbicide residues in containment ponds could lead to several problems: plant damage as a result of using water for irrigation purposes, damage to other non-target organisms and the possibility of water containing herbicides leaving the nursery site.

Herbicide runoff in general is dependent on several factors including chemical properties of the herbicides, soil properties or bed construction, and timing of application in relation to rainfall or irrigation (4). Oxyfluorfen was strongly adsorbed to soil and not readily desorbed or leached (2) with less than 2% of the parent material found in leachate. The half-life of oxyfluorfen in the upper 6 inches of organic soils was between 30 and 103 days (3). Rainfall had a significant effect on both pendimethalin (5) and oryzalin (1) disappearance from soil and presence in leachate.

Two SC container nurseries with distinctly different soil and geographic properties were used for this study. Both nurseries contain their runoff water on the premises and reuse it for irrigation. Water and sediment samples were collected from irrigation and catch ponds every 4 weeks beginning February 1991. All glassware used for collection and analysis was silanized to prevent herbicide adsorption. The pH of water samples was recorded and then adjusted to pH 2.2-2.3 with 6N HCI. Herbicides were extracted from the water (200 ml) after filtering by passing it through a C_{18} solid phase extraction column. Herbicides were then eluted with 2 ml acetone. Sediments were dried 3-4 hours at 105C then ground to a powder using a mortar and pestle. Samples (5 g) were placed in a 50 ml flask with 10 ml methanol and agitated for 2 hours on a shaker and then filtered. All samples were filtered (0.2µacrodisc) and stored in a freezer prior to analysis. Samples were injected into a Varian HPLC equipped with a C_{18} column and a variable wavelength UV detector (206 nm) for herbicide quantitation. Running conditions consisted of a gradient of 60:40 acetonitrile:water to 100% acetonitrile at 1.4 ml/min. Retention times were 6.0, 11.8, and 13.0 min for oryzalin, oxyfluorfen and pendimethalin, respectively. Detection limits were approximately 0.001 ppm (1 ng/ml) for water samples and 0.1 ppm (0.1 µg/g for sediment. Confirmation of oxyfluorfen and pendimethalin was obtained utilizing gas chromatography-mass spectrometry.

Results and Discussion: February samplings, prior to major applications of herbicides, revealed no herbicides detectable in either water or sediment samples (Fig. 1-4). Herbicide levels in water and sediment samples increased in general throughout the growing season (March-September) when major herbicide applications were made. Similar levels of herbicides were detected in both ponds studied on the site. Herbicide levels in water and sediment samples were lower during winter months when reduced usage of herbicides occurred. Maximum herbicide levels detected in water during the study were 0.008 µg/ml (ppm) pendimethalin, 0.016µg/ml (ppm) oryzalin, and 0.052µ1g/ml (ppm) oxyfluorfen. Maximum herbicide levels detected in sediment were 3.73µg/g (ppm) pendimethalin, 9.58µg/g(ppm) oryzalin, and 10.45µg/g (ppm) oxyfluorfen. Overall results do not indicate a significant accumulation of herbicides in water or sediment during the growing season which could present problems where water is subsequently used for irrigation or is leaving the nursery site. This study is being continued for a second year to confirm the trends observed during the first year. The time of sampling in relation to herbicide application can significantly affect the herbicide levels detected especially when applications occurs just prior to sampling. Studies of herbicide runoff and effect of low levels of herbicides on plant growth and development are being conducted.

Significance to Industry: Knowledge concerning the presence of herbicides in water and sediment from containment ponds is important to nursery operators in determining if: damage may occur when using the water to irrigate plants, damage may occur to non-target organisms in the aquatic system, and herbicide residues are present in water leaving the nursery site. Results from 1991 indicate that pendimethalin, oryzalin, and oxyfluorfen residues exist in water and sediment samples but are rapidly dissipated and do not accumulate.

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Figure 1. Summary of Water Analysis from Irrigation Pond during 1991. ORY (oryzalin) and OH-2 (Scotts) indicate major herbicide application.

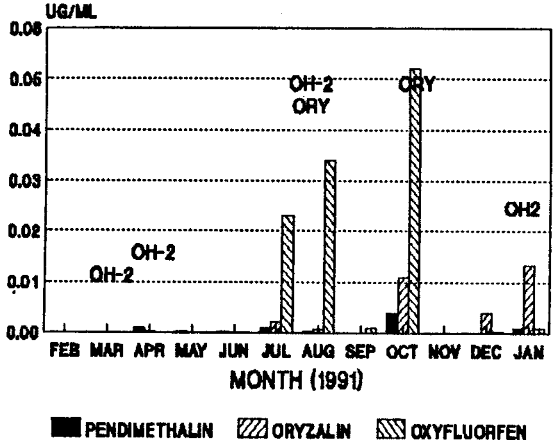


Figure 2. Summary of Sediment Analysis in Irrigation Pond during 1991. ORY (oryzalin) and OH-2 (Scotts) indicate major herbicide application.

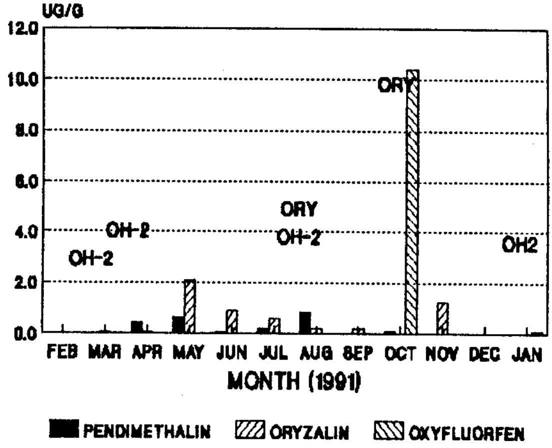


Figure 3. Summary of Water Analysis from Catch Pond during 1991. ORY (oryzalin) and OH-2 (Scotts) indicate major herbicide application.

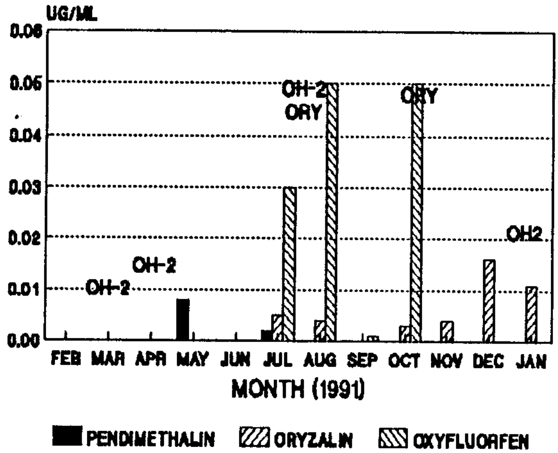
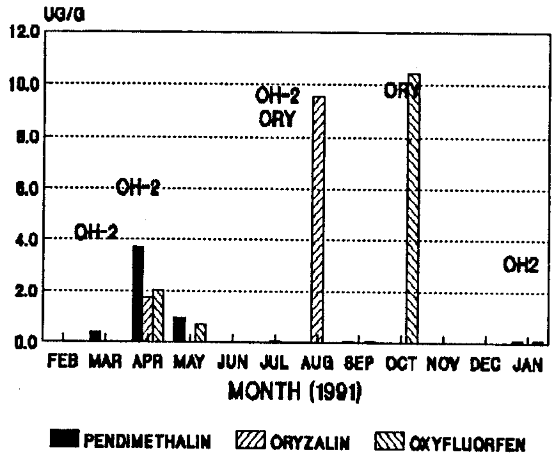


Figure 4. Summary of Sediment Analysis from Catch Pond during 1991. ORY (oryzalin) and OH-2 (Scotts) indicate major herbicide application.



Alkaline Water Acidification Reduces Leaf Chlorosis of 'Crystal Bowl Yellow' Pansy

E. W. Bush
Louisiana

Nature of Work: Alkaline irrigation water throughout Louisiana has reduced the quality of several horticultural crops. Container-grown azaleas (2,4), poinsettias (3) and bedding plants (1) have been adversely affected by poor water quality. Increased nitrogen and iron fertilization by nurserymen resulted in little or no effect on foliage chlorosis. Pansy plants appeared spindly, with sparse discolored foliage.

Alkaline water types (sodium bicarbonate and calcium bicarbonate) are often groundwater irrigation sources for Louisiana nurseries. Several bedding plant producers have been forced to dig expensive surface ponds, install water purification systems, and/or inject acid to reduce high pH water sources. Acidification is often the most practical method of lowering water pH for nursery plant production.

The objective of this experiment was to determine the effects of alkaline water acidification on bedding plant production.

On August 29, 1991 'Crystal Bowl Yellow' pansies (406 plugs) were transplanted into 3.5" X 5.25" X 2.3" deep cell packs filled with Sunshine #1 medium. Plant trays were arranged in a RCB design with 3 blocks (10 plants/block) and were placed into a covered greenhouse. Each pansy tray was irrigated with 500 ml of treatment solution as needed. Acidification treatments included: deionized water (pH 6.5), alkaline water (pH 8.5), Water Regime(WR) 1 (pH 7.5), (WR) 2 (pH 6.5), (WR) 3 (pH 5.5). The alkaline water source (439 ppm alkalinity) was used for each of the water regime treatments. Sulfuric acid was used to lower the pH of each water regime treatment to within 0.2 pH units. Plants were fertilized using a constant feed solution (100 ppm) of Total Gro 20-19-18 fertilizer. Growth measurements, plant quality ratings and leachate data were evaluated statistically at the conclusion of the experiment.

Results and Discussion: Pansy plants irrigated with alkaline water resulted in poor quality plants. Foliage chlorosis and spindly growth became apparent after 6 weeks. Plant quality ratings for (WR) 1 & 2 were not significantly different from the alkaline water source (Table 1). Acidification to pH 7.5 and 6.5 produced no significant improvement in plant quality ratings. Leaf chlorosis and plant growth were significantly improved by acidifying the alkaline water source to pH 5.5, despite a significant increase in leachate conductivity (Tables 1 and 2). (WR) 3 produced significantly better quality plants when compared to the alkaline water treatment (Table 1). Deionized water and (WR) 3 produced statistically similar quality plants. Acidification to pH 5.5 significantly increased the availability of Ca and Mg in relation to Na in medium leachates (Table 2). Past research has noted the significance of appropriate Ca and Mg levels in the presence of high sodium (2). Top fresh weight and stem diameter of pansy plants were significantly increased by acidification in (WR) 3 (Table 2). Acidification of alkaline water to pH 5.5 improved pansy plug quality. Alkalinity can be measured at most soil and water testing labs. Recommendations are usually prescribed as a specific amount of acid/liter of water. Laboratory suppliers stock acid injection tanks and metering pumps. Acidification can be achieved by simply injecting a dilute solution of acid through an acid approved fertilizer proportioner.

Significance to Industry: High alkalinity irrigation water reduces the quality of bedding plants. Chlorotic foliage causes nurserymen to apply additional fertilization with little or no benefits. Acidification of alkaline water sources can improve quality of bedding plants. Irrigation water analysis is needed to identify alkaline water sources.

Literature Cited

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Table 1. Growth measurements of 'Crystal Bowl Yellow' pansy after 6 weeks of irrigation.

Water Sources	[z]Plant quality	Fresh wt(g)	Stem dia(mm)	Plant ht(cm)
Deionized water (pH 6.5)	5.0a[y]	3.8a	3.la	6.5a
Alkaline water (pH 8.5)	3.7b	2.6b	2.7b	5.9ab
Water Regime(WR) 1 (pH 7.5)	3.7b	2.7b	2.6b	5.5b
WR 2 (pH 6.5)	3.7b	3.0b	2.7b	5.5b
WR 3 (pH 5.5)	4.6a	3.6a	3.0a	5.9ab

[z]Plant quality: 5=excellent, 1=very poor.

[y]Means followed by the same letters are not significantly different, (p=0.05,DMRT).

Table 2. Leachate analysis of growing medium after 6 weeks of irrigation.

Water Sources	pH	E.C. (umhos/cm)	Ca (PPm)	Mg (ppm)	Na (ppm)
Deionized water (pH 6.5)	6.30c[z]	1267c	63bc	47bc	60c
Alkaline water (pH 8.5)	7.50a	2233b	49c	37c	423b
Water Regime(WR) 1 (pH 7.5)	6.91b	2283b	68b	50b	431b
WR 2 (pH 6.5)	6.72b	2433b	75b	56b	423b
WR 3 (pH 5.5)	6.29c	3133a	158a	IO9a	557a

[z]Means followed by the same letters are not significantly different, (p=0.05,DMRT).