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HERBICIDE APPLICATION TO HEARTLEAF PHILODENDRON STOCK BEDS[1]

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Abstract. **Oxadiazon [2-tert-butyl-4-(2,4-dichloro-5-isopropoxyphenyl)-Δ^2-1,3,4-oxadiazolin-5-one] 2G at 2.2 kg ai/ha, napropamide [2-(a-napthoxyl)-N,N-diethylpropionamide] 10G at 4.5 kg ai/ha, simazine [2-chloro-4,6-bis(ethylamino)-s-triazine] 4G at 2.2 kg ai/ha, oxadiazon 2G + alachlor [2-chloro-2′,6′-diethyl-N-(methoxymethyl)acetanilide] 15G at 1.7 + 1.7 kg ai/ha and simazine 4G + napropamide 10G at 1.1 + 4.5 kg ai/ha were applied twice at 3 month intervals in 1980 and 1981 to ground stock beds of** Philodendron scandens oxycardium **(Schott) Bunt (heartleaf philodendron). Alachlor 15G at 2.2 kg ai/ha was applied at 6 week intervals to the beds. Weed control was excellent with the treatments containing oxadiazon and poor to fair with the others. No herbicide treatment caused significant visual symptoms of phytotoxicity. Herbicide treatments did not affect internode length or cutting weight as compared to controls and had no effect on rooting of cuttings taken from treated beds or on subsequent growth of the cuttings. Node position had little effect on rooting of cuttings.**

Heartleaf philodendron remains a popular foliage plant and stock is frequently grown in ground beds. In 1975, the most recent year for which figures are available, heartleaf philodendron accounted for 14% of all Florida foliage plants sold (7). Heartleaf philodendron stock beds remain in production for many years so potential for weed competition is high, especially after vines are harvested. Triazine herbicides such as atrazine at 2.2 kg ai/ha and simazine at 1.1 and 2.2 kg ai/ha have been shown to control weeds with no yield reduction of heartleaf philodendron when applied at 3 month intervals (2, 5). These 2 herbicides are commonly used in commercial heartleaf philodendron stock beds. Concern over reports of weed resistance to triazine herbicides (1, 3, 6, 8), need for alternative classes of herbicides to combat development of resistance, desire for broader spectrum weed control and availability of newer herbicides prompted this study.

Materials and Methods

Six-year-old commercial heartleaf philodendron stock ground beds in Mt. Dora, Florida were used in a split plot design with 4 replications of 7 whole plots which were divided into 2 subunits each. Plots were 3.7 m x 3.7 m, contained 2 rows of 1.2 m wide beds and were located in a shadehouse covered with 63% shade polypropylene fabric. Soil type was Astatula fine sand which had been amended with 1 inch of native sedge peat when the beds were planted. Organic matter percentage and pH were 3.3 and 4.4 respectively.

Treatments included an untreated control, oxadiazon 2G at 2.2 kg ai/ha, napropamide 10G at 4.5 kg ai/ha, simazine 4G at 2.2 kg ai/ha, alachlor 15G at 2.2 kg ai/ha, oxadiazon 2G + alachlor 15G at 1.7 kg ai/ha each and simazine 4G + napropamide 10G at 1.1 + 4.5 kg ai/ha applied August 2, 1980, November 1, 1980, May 2, 1981, and August 9, 1981. All plots, including controls, were weeded prior to herbicide application and 1.3-2.5 cm of water were applied using permanent overhead sprinklers following herbicide application. Plots receiving alachlor only were treated on September 13, 1980, December 13, 1980, and June 26, 1981 in addition to the above dates. Treatments were applied by hand. Dry sand was mixed with the alachlor granules to facilitate more uniform distribution.

Visual ratings of percent weed control by species as compared to controls were made monthly. Only overall weed control data are presented because of low weed incidence throughout this study probably caused by the intense canopy competition from the densely growing philodendron vines. Phytotoxicity was rated visually at each rating.

On January 27, and again on September 6, 1981, one 10-node vine was harvested from each plot. Internode lengths and cutting weights were measured. Five 1-node cuttings were made, starting with the first fully expanded leaf at the tip of each vine, dipped for 5 minutes in a solution containing 2000 ppm captan and 1500 ppm PCNB and planted in a 6.4 cm plastic pot. The bottom 5-node cuttings were treated the same way and planted in a separate pot. Two pots, each containing 5 cuttings, were therefore planted from each plot. All pots were randomly placed on a raised bench in an 80% shade greenhouse. On May 3, 1981 and October 10, 1981, respectively for the first and second harvest, the percentages of rooting and shoot development were observed and roots and shoots were harvested, dried, and weighed. Percentage data were transformed to the arcsine of the square root of the percentage before statistical analysis.

Results and Discussion

The major weed species present during this experiment (Table 1) were controlled with treatments containing oxadiazon (Table 2). The simazine, alachlor, and napropamide treatments controlled broadleaf weeds poorly. The latter 2 herbicides are classified as preemergence grass herbicides and, therefore, their lack of efficacy for broadleaf weeds is expected. No phytotoxicity was observed except very slight mottling in a few of the oxadiazon treated plots during the December ratings.

Table 1. Major weed species present.

Common name	Genus and species
Asiatic hawksbeard	*Youngia japonica* (L.) D.C.
Common yellow woodsorrel	*Oxalis stricta* L.
Cudweed	*Gnaphalium* sp.
Florida purslane	*Richardia scabra* L.
Large crabgrass	*Digitaria sanguinalis* (L.) Scop.

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Table 2. Weed control in six-year-old heartleaf philodendron ground beds.

Treatment	Rate (kg ai/ha)	Weed control (%)
Control	—	0
Alachlor (15G)	2.2	19
Napropamide (10G)	4.5	23
Oxadiazon (2G)	2.2	99
Simazine (4G)	2.2	62
Oxadiazon (2G) + alachlor (15G)	1.7 + 1.7	99
Simazine (4G) + napropamide (10G)	1.1 + 4.5	62

None of the herbicide treatments affected the fresh weight or internode length of cuttings, nor did they affect the subsequent rooting and growth of cuttings as compared to the controls (Table 3 and 4). Significant differences between internode lengths and shoot dry weights from some herbicide treated plots did occur but no pattern is clear. Previous research (4) has shown a high positive correlation between cutting size and subsequent vine length of heartleaf philodendron. Data presented here are in general agreement with those findings as no differences in cutting weights were observed and subsequent growth indices were generally the same for all treatments.

Node position had no effect on rooting percentages or shoot development percentages (Table 5). Results from the first planting show that slightly better root development (+7%) occurred on basal cuttings compared to distal cuttings. Differences also occurred between shoot dry weights from the second planting. Poole (unpublished data) has found that node position has little effect on subsequent vine length and the results reported here, with the exception of these second planting shoot data, tend to support that unpublished finding. The short 4 week growing period and resulting lack of shoot development may account for these differences.

These data indicate that excellent weed control in heartleaf philodendron ground beds can be obtained using oxadiazon at 1.7-2.2 kg ai/ha with little effect on subsequent growth of cuttings. Although less effective under these conditions, the other herbicides tested had little effect on subsequent growth of cuttings and, therefore, could be useful where efficacy of these herbicides for specific weeds is needed.

Table 3. Effects of herbicide treatment on heartleaf philodendron cuttings planted January 27, 1981 and harvested May 5, 1981.

Treatment	Rate (kg ai/ha)	Mean cutting fresh weight (g)	Mean internode length (mm)	Rooting (%)	Shoot development (%)	Mean root dry wt (mg)	Mean shoot dry wt (mg)
None	—	4.0 a[z]	80 a	100.0 a	97.5 a	668 a	494 ab
Alachlor (15 G)	2.2	4.2 a	88 a	97.5 a	97.5 a	730 a	383 ab
Napropamide (10G)	4.5	4.0 a	81 a	97.5 a	95.0 a	639 a	269 b
Oxadiazon (2G)	2.2	4.7 a	99 a	97.5 a	95.0 a	772 a	548 a
Simazine (4G)	2.2	4.5 a	80 a	95.0 a	95.0 a	529 a	428 ab
Oxadiazon (2G) + alachlor (15G)	1.7 + 1.7	3.3 a	77 a	97.5 a	97.5 a	643 a	285 b
Simazine (4G) + napropamide (10G)	1.1 + 4.5	4.2 a	81 a	95.0 a	92.5 a	534 a	375 ab

[z]Mean separation within columns by Duncan's new multiple range test, 5% level.

Table 4. Effects of herbicide treatments on heartleaf philodendron cuttings planted September 6, 1981 and harvested October 8, 1981.

Treatment	Rate (kg ai/ha)	Mean cutting fresh weight (g)	Mean internode length (mm)	Rooting (%)	Shoot development (%)	Mean root dry wt (mg)	Mean shoot dry wt (mg)
None	—	5.2 a[z]	64 ab	95.0 a	85.0 a	406 a	36 ab
Alachlor (15G)	2.2	5.0 a	64 ab	86.9 a	81.9 a	342 a	32 b
Napropamide (10G)	4.5	4.6 a	67 ab	97.5 a	92.5 a	438 a	57 a
Oxadiazon (2G)	2.2	4.9 a	69 ab	92.8 a	87.8 a	382 a	35 b
Simazine (4G)	2.2	4.3 a	58 b	95.0 a	92.5 a	360 a	39 ab
Oxadiazon (2G) + alachlor (15G)	1.7 + 1.7	3.8 a	56 b	97.5 a	92.5 a	443 a	50 ab
Simazine (4G) + napropamide (10G)	1.1 + 4.5	5.1 a	75 a	97.5 a	91.9 a	319 a	38 ab

[z]Mean separation within columns by Duncan's new multiple range test, 5% level.

Table 5. Node position effects on rooting and shoot development of heartleaf philodendron.

	January 1981 planting				September 1981 planting			
Node source	Rooting (%)	Shoot dev. (%)	Mean root dry wt (mg)	Mean shoot dry wt (mg)	Rooting (%)	Shoot dev. (%)	Mean root dry wt (mg)	Mean shoot dry wt (mg)
Distal 5	98	96	623	376	95	90	410	49
Basal 5	96	95	667	411	94	89	358	32
F values[z]	.6 NS	7.0 NS	26.7 *	10.1 NS	.04 NS	.07 NS	10.1 NS	32.1 *

[z]NS = not significant, * = significant at the 5% level.

Literature Cited

1. Bandeen, J. D. and R. D. McLaren. 1976. Resistance of *Chenopodium album* L. to triazines. Can. J. Plant Sci. 56:411-412.
2. Henley, R. W. and R. T. Poole. 1975. Influence of six herbicides on yield and weed control in *Philodendron oxycardium* stock beds. Proc. Amer. Soc. Hort. Sci., Trop Reg. 19:263-267.
3. Peabody, D. 1973. Aatrex tolerant pigweed found in Washington. Weeds Today 4:17.
4. Poole, R. T. and C. A. Conover. 1975. The importance of maintaining vigorous stock plants. Florida Foliage Grower 12(5):4-5.
5. ——— and W. E. Waters. 1972. The influence of herbicides on stock plant production of several foliage species. Proc. Amer. Soc. Hort. Sci., Trop. Reg. 16:271-276.
6. Ryan, G. I. 1970. Resistance of common groundsel to simazine and atrazine. Weed Sci. 18:614-616.
7. Smith, C. N. and J. R. Strain. 1976. Market outlets and product mix for Florida foliage plants. Proc. Fla. State Hort. Soc. 89:274-278.
8. Souza Machado, V., J. D. Bandeen and P. C. Bhowmik. 1978. Triazine tolerance of bird's rape biotypes. Can. Weed Comm. East. Sect. Rep. p. 338.

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AIR QUALITY ENHANCEMENT BY HORTICULTURAL ENGINEERING

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Abstract. **Frequently, a significant portion of air pollutants escape from industrial operations even though the operations employ the best available control technology. These fugitive pollutants may be removed from the ambient air under relatively stable meteorological conditions, especially when air flow rates are slow, by a perimeter planting of carefully selected plant material. Such a process might be termed Horticultural Engineering because of a similarity to Chemical Engineering. The concept of scrubbing may also be applied to roadsides and heavily urbanized areas.**

Air pollutants such as sulfur dioxide and acid fluorides are effectively scrubbed from air in a local situation by vegetation. Increasing industrialization, urbanization and fossil fuel combustion, together with decreasing environmental quality control, suggest that plants could be used to combat local air pollution problems at points of pollution, thereby contributing to an aggregate improvement.

Chemical and industrial engineering have adopted technology to control air pollution; however, there are usually fugitive emissions not subject to control. It is to attack this residual problem that Horticultural Engineering may develop a technology, methods and procedures to scrub ambient air masses as they flow away from localized point sources of air pollution. An example of such a problem is fluoride emanations from gypsum ponds. These emanations would most likely constitute a problem under a relatively stable, slow-moving air mass, which would collect fluoride from the acid waters and transport them, affecting nearby plants and animals before dispersing into surrounding areas. A perimeter planting of trees and/or shrubs would be helpful in reducing the locally serious problem. Also, these plantings should be selected to beautify the industrial area.

Sulfur dioxide and fluoride are highly phytotoxic air pollutants. These two compounds are ranked within the top five in importance with respect to the amount of plant damage (35). Their detrimental effects occur at relatively low concentrations. Sulfur dioxide is toxic at the parts per million (ppm) level while fluoride is toxic at the parts per billion (ppb) level.

Impact of SO_2 and F on vegetation has been documented extensively (1-7, 9, 12-30, 32-40). Airborne pollutants enter plants primarily via stomates in the leaves and is carried through the transpirational stream causing chlorosis and/or necrosis of margins and tips of leaf blades (2, 12, 23). Characteristic chlorosis and necrosis develops because of the accumulation of F at these locations (34, 35). Toxic symptoms of acute SO_2 exposure appear as small necrotic lesions between the veins and along the leaf margin, which may extend toward the midrib interveinally while necrotic areas coalesce (1). Chronic SO_2 injury develops from lower level exposure and appears as general chlorosis (1).

Plant metabolism is disrupted by SO_2 and F and may alter various chemical pathways in pollutant sensitive plants. Enzymes such as malate dehydrogenase, phosphatase and hexokinase are fluoride sensitive (23, 24) and ribulose diphosphate carboxylase and phosphoenolpyruvate carboxylase are SO_2 sensitive (38, 39). Both gases affect the uptake of oxygen and carbon dioxide (14, 15, 23, 35). Photosynthesis and chlorophyll content decline from SO_2 and F exposure (5, 7, 19, 35). Leaves fall off, new growth declines, flowers and fruits are lost, overall fitness is altered and yield and plant quality decrease (1, 6, 7, 9, 16, 17, 19, 21, 35).

Light, relative humidity, temperature, wind speed and edaphic conditions may increase or reduce a plant's resistance (5, 26, 33, 35). Individual characteristics such as physiological age, water status, internal nutritional balance, stomatal conductance and anatomy of a plant will determine relative susceptibility (4, 6, 14, 26, 37). Distance from the emission source and the concentration and duration of exposure control the amount of damage done to exposed plants (32, 35). Finally, combination of SO_2 with F may cause different responses from plants than either gas alone (18, 21, 25, 28).

Most pertinent to this discussion is the great diversity which exists between plant species in resistance to SO_2 and F among plant species (1, 3, 5, 7, 8, 9, 10, 13, 28, 35, 40). Differences may be related to the exclusion of the gases or by the metabolism enabling the detoxification or purging of the gases once they enter living tissue (7, 20, 26, 36). Great potential exists for breeding trees for resistance to air pollution based on individual differences with species (8, 9, 10, 11, 13, 28, 31). Tolerant plant material has been identified and may offer great potential in polluted environments (13).

The usefulness of tolerant species to scrub air pollutants from the air is evident (20, 29, 30). Relative amounts of absorbed gaseous pollutant do not necessarily correspond to symptom expression (3), and symptom expression may not lead to growth reduction (28). Woody plants can significantly reduce the amounts of SO_2 in the air in close proximity of the foliage (20, 30). This is a "boundary