effect on the yield of fruit. At these high temp the few abnormal flowers that developed dried up and failed to set fruit. Semeniuk and Stewart (4) reported that temp during and after flowering had a marked effect on the yield of fruits of several important florists' crops.

Literature Cited

1. Post, K. 1942. Effects of daylength and temperature on growth and flowering of some florist crops. *Cornell Univ. Agr. Expt. Sta. Bul.* 787.
2. Semeniuk, P. 1974. 'Blue Troll' Browallia. *HortScience* 9:605.
3. ———. 1973. Response of *Browallia speciosa* Hook. to temperature in controlled environments. *HortScience* 8:481.
4. ———, and R. N. Stewart. 1960. Effect of temperature on fruit and seed production of lily, stock, poinsettia, rose and snapdragon. *Proc. Amer. Soc. Hort. Sci.* 75:726-729.
5. Thompson, H. C. 1939. Temperature in relation to vegetative and reproduction development in plants. *Proc. Amer. Soc. Hort. Sci.* 37:672-679.

Calcium Oxalate Variability in Dieffenbachia Seedlings[1]

F. W. Zettler and B. B. Rhodes[2]
University of Florida, Gainesville

Abstract. **Significant differences in oxalate levels were obtained with hybrid progeny of *Dieffenbachia picta* (Schott) 'Exotica' which indicate a potential for selection for low oxalate levels.**

Dieffenbachia spp. are important as foliage plants but are considered hazardous because they are toxic when leaf or stem materials are ingested. Dieffenbachia plant juice also induces severe irritation when it comes in contact with the skin or mucous membranes. Needle-shaped crystals of calcium oxalate, or raphides, have been implicated in dieffenbachia poisoning. When swallowed or rubbed on the skin, these raphides apparently cause mechanical injury to sensitive tissues allowing the ingress of proteolytic enzymes responsible for the characteristic symptoms of dieffenbachia poisoning (5, 6, 7).

The acceptibility of dieffenbachia as an indoor foliage plant would be enhanced considerably if nontoxic varieties were available. According to Barnes and Fox (1), interest in developing such cultivars has been expressed by horticulturalists. To date, the prospects for developing them through programs of breeding and selection have been limited since dieffenbachia is not seed propagated. Recently, Hartman et al. (4) demonstrated the feasibility of breeding *Dieffenbachia picta* (Schott) 'Exotica' through manual cross-pollination, and he also observed marked phenotypic differences among the resulting progeny.

The purpose of this study was to analyze some of the selections developed by Hartman et al. (4) for calcium oxalate levels in an effort to determine if sufficient variability was present to warrant selective breeding for this trait.

Plants of 'Exotica' were included as the control. All plants were individually transplanted May, 1974, into 15 cm plastic pots containing a soil mix and were maintained in a greenhouse. In Jan. and March, 1975, recently developed, but fully expanded, leaves were collected for calcium oxalate analysis. The sample leaves were oven dried at 50-60°C about 48 hr prior to assay.

The procedure used for oxalate determination was as described by Franco and Krinitz (3) except that dried rather than fresh leaves were assayed and that this material was steam heated at 70.3g/sq. cm (10 psi) rather than boiled. The procedure involved acid hydrolysis of extracts and thus oxalates are determined as oxalic acid. Since no soluble oxalates are detectable in dieffenbachia extracts (6), this procedure is considered to be a reflection of the calcium oxalate content of this species. As controls, 100 mg calcium oxalate standards were assayed along with leaf samples; calcium oxalate recovery rates were ca. 95%. Each value obtained was based upon 4 leaves collected from each of 3 plants, except clones 3, 9, and 15 which were based on 2 plants sampled. In all trials, duplicate 0.5 g subsamples were assayed from each plant.

Significant differences in the amounts of oxalate were noted among the dieffenbachia progeny (Table 1). Mean values recorded during the initial assay ranged from high values of 62.3, 63.9, and 66.0 mg oxalic acid/g dry tissue for clones 1, 2, and 3 to low values of 46.1, 36.1, and 31.6 mg/g for clones 17, 18, and 19, respectively. These values were significantly different from that of the 'Exotica' parent (55.2 mg/g). Differences between the 1st and 2nd assays were not significant by the "t" test of comparison. High oxalate levels were also recorded in the 2nd assay for clones 1, 2, and 3 (64.9, 62.6, and 60.0 mg/g, respectively) whereas clones 17, 18, and 19 had low values (40.6, 46.5, and 45.9 mg/g, respectively). Again, an intermediate value (50.4 mg/g) was recorded for 'Exotica' control (Table 1).

Table 1. Calcium oxalate levels (mg oxalic acid/g dry wt.) among seedling progeny of dieffenbachia 'Exotica'.

Clone no.	Means of assay 1	Means of assay 2	Overall means[z] ±SE
1	62.3	64.9	63.6 ± 1.9a
2	63.9	62.6	63.3 ± 1.3a
3[y]	66.0	60.0	62.4 ± 2.3a
4	57.8	–	– –
5	57.4	–	– –
6	57.2	–	– –
7	56.7	51.6	54.1 ± 2.5ab
Exotica	55.2	50.4	52.0 ± 2.3b
8[y]	53.9	–	– –
9	53.4	–	– –
10	53.1	–	– –
11[y]	52.7	–	– –
12	49.4	–	– –
13[y]	48.5	–	– –
14	47.2	53.3	50.1 ± 1.9b
15	38.3	54.7	44.9 ± 4.7bc
16	42.4	–	– –
17	46.1	40.6	43.3 ± 4.3c
18[y]	36.1	46.5	41.3 ± 4.4c
19	31.6	45.9	38.7 ± 7.4c

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

[y]Clones with uniformily green leaves and no variegation pattern.

No relationship between foliar variegation and oxalate level was evident in this study (Table 1). Clone 3 without variegation proved to have high oxalate levels during both assays (66.0 and 60.0 mg/g) whereas clone 18 had relatively low values (36.1 and 46.5 mg/g). The values recorded for the remaining 3 clones (8, 11, and 13) approximated those of the 'Exotica' parent (Table 1).

The results indicated that a breeding program designed to select dieffenbachia cultivars with relatively low oxalate levels may be successful. Plants of clone 19 average 26% lower levels of oxalates than 'Exotica' controls and 39% less than clone 1 with the highest recorded
than clone 1 with the highest recorded
oxalate level. Presumably, further selections from the next generation would result in even lower values. Since no correlation was noted between oxalate levels and degree of foliar variegation, breeding for this trait will not result in plants without the attractive variegated foliage. However, whether other desirable traits, such as vigor, will be sacrificed remains to be determined.

Although various authors have compared toxicities of dieffenbachia species (1, 2, 7), this is the first attempt

[1]Received for publication May 5, 1975. This research was supported in part by U.S.D.A. Cooperative Agreement No. 12-14-7001-284. Florida Agricultural Experiment Stations Journal Series No. 5912.

[2]Associate Professor and Interim Assistant Professor, Departments of Plant Pathology and Vegetable Crops, respectively.

to make a comparison among the hybrid progeny. It has been generally assumed that raphides of calcium oxalate are primarily responsible for the toxicity of dieffenbachia and other members of the Araceae. Recently, this assumption has been questioned (1, 2, 6, 7) although some authors still believe that oxalates can contribute to the toxicity of these plants (5, 6, 7). For this reason, a breeding program designed to develop nontoxic dieffenbachia cultivars should not be based solely on oxalate levels.

Literature Cited

1. Barnes, B. A., and L. E. Fox. 1955. Poisoning with *Dieffenbachia. J. Hist. Med. Allied Sci.* 10:173-181.
2. Fochtman, F. W., J. E. Manno, C. L. Winek, and J. A. Cooper. 1969. Toxicity of the genus *Dieffenbachia. Toxicol. Appl. Pharm.* 15:38-45.
3. Franco, V., and B. Krinitz. 1973. Oxalic acid in foods. *J. Assoc. Offic. Agr. Chem.* 56:164-166.
4. Hartman, R. D., F. W. Zettler, J. F. Knauss, and E. M. Hawkins. 1972. Seed propagation of caladium and dieffenbachia. *Florida State Hort. Soc. Proc.* 85:404-409.
5. Middendorf, E. A. 1968. Plants with blowguns. *Turtox News* 46:162-164.
6. Pohl, R. W. 1964. Dieffenbachia poisoning: a clarification. *J. Amer. Med. Assoc.* 187:963.
7. Walter, W. G., and P. N. Khanna. 1972. Chemistry of the aroids I. *Dieffenbachia seguine, amoena* and *picta. Econ. Bot.* 26:364-372.

An Evaluation of Plastic and Fibrous Materials as Mulches for Total Vegetation Control[1]

R. A. Creager[2] and D. Katchur[3]

Department of the Army, Fort Detrick, Frederick, Maryland

Abstract. **Twenty-three plastic and fibrous materials were tested in the greenhouse to determine their growth suppression capacity on herbaceous and woody plants. Promising treatments were then applied under field conditions. Materials which controlled vegetation most effectively were rigid urethane foam (a new mulch material), fiberglass mat, fiberglass mat over black polyethylene film, and burlap impregnated with either *tert*-butylcarbamic acid ester with 3-(*m*-hydroxyphenyl)-1,1-dimethylurea (karbutilate), or 5-bromo-3-*sec*-butyl-6-methyluracil (bromacil).**

Due to emphasis on environmental protection, alternatives to direct application of chemicals for vegetation control have become important during the last few years. There is a need for safe, economical methods in such areas as nurseries and horticultural crops to suppress, limit or exclude vegetation. This study was designed to find temporary methods of control of plant growth without causing detrimental effects, especially from chemical injury.

Greenhouse studies. Initial tests of 23 plastic and fibrous mulch materials were made under greenhouse conditions in wooden flats containing soil. Seven species were planted in each flat prior to mulch application and treatments were replicated 3 to 6 times. Species used were: corn (*Zea mays* L.), oats (*Avena sativa* L.), sorghum (*Sorghum vulgare* (L.) Pers.), black locust (*Robinia pseudoacacia* L.), honey locust (*Gleditsia triacanthos* L.), silk tree (*Albizzia julibrissin* Durazz.), and quackgrass (*Agropyron repens* (L.) Beauv.).

Treatments found effective in the initial tests and selected for subsequent field trials were: clear and black polyethylene film, burlap impregnated with either karbutilate or bromacil, fiberglass mat, fiberglass mat over black plastic, rigid urethane foam and the nonwoven fiber sheetings, Tyvek and Cerex. Effective control of plant emergence was considered to be 90% or greater, based on untreated controls and a potential plant population of 130 individuals per flat.

Observations of vegetation control were made for a minimum of 90 days. Treatments and maximum rate or mulch thickness found to be ineffective under greenhouse test conditions are listed by material groupings:

Plastic or petroleum mulch sprays
- Soil Gard
- Encap petroleum mulch
- Vapor Gard antitranspirant concentrate
- Curasol-AE
- Curasol-AH
- Dow-Corning 772 silicone water repellent (8415 liters/ha)
- asphalt emulsion (1402 liters/ha)

Impregnated burlap
- trifluralin (1.12 kg/ha)
- dalapon (4.48 kg/ha)

Wood byproducts
- paper slurry (2.54 cm)
- sawdust (10.2 cm)
- wood chips (10.2 cm) ± asphalt emulsion (1402 liters/ha)

Field studies. Eleven mulch treatments were applied in 2 areas during the spring of 1973 for evaluation of vegetation control of established grasses and perennial weeds and of newly-planted or established field crops and woody plants.

Area I consisted of an abandoned field with quackgrass predominating, and a broadleaf herbaceous component of field bindweed (*Convolvulus arvensis* L.), buckhorn plantain (*Plantago lanceolata* L.), and Canada thistle (*Cirsium arvense* (L.) Scop.). The area had a 7-year-old stand of California privet (*Ligustrum ovalifolium* L.) planted in a 3.05 × 3.05 m spacing. Prior to plot establishment, the area was mowed and the privet plants pruned to a stump height of 10.2 cm or less. Each 3.05 × 6.1 m plot was positioned to include 2 privet plants. Treatments of Tyvek and Cerex were restricted to this area and were made in Nov., 1973 in contrast to the spring application of the remaining materials.

Area II consisted of a plowed-and-planted strip adjacent to undisturbed weedy grassland. Plots 3.05 × 9.1 m alternating with buffer strips of equal size included both plowed and undisturbed vegetation. Field corn and sorghum were seeded and transplants of sugarcane (*Saccharum* sp.), paragrass (*Brachiaria mutica* (Forsk.) Stapf), and 2-year-old California privet established in the plowed area prior to treatment. Prior to treatment application the undisturbed area was mowed to a maximum height of 10.2 cm.

Evaluations were made monthly of plant responses in terms of emergence through the applied material, plant height and character of growth in comparison with check or control plots. These control plots had no mowing or weeding after the initial plot preparation. Longevity and resistance of the physical treatment or covering to erosion and weathering were also noted. The criteria for evaluation of performance included the following: a) capability of growth suppression of established plants or germinating seedlings; b) exposure durability, or ability to withstand seasonal climatic fluctuations without loss of effectiveness in vegetation control; c) adaptability for use under varying

[1]Received for publication March 24, 1975.

[2]Horticulturist. Present address: Weed Physiology and Growth Regulator Research Unit, Agricultural Research Service, U.S. Department of Agriculture, Frederick, Maryland 21701.

[3]Physical Science Technician. Present address: Department of the Army, Vegetation Control Division, Fort Detrick, Frederick, Maryland 21701.