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HORTICULTURE DIGEST

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In This Issue: FLOWER AND NURSERY INFORMATION
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Editor's Note: This special issue of the Horticulture Digest features many of the papers presented from the nursery/foliage session of the Fertilizer and Ornamentals Short Course held in Hilo, January 9–11, 1986.

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FACTS AND FALLACIES OF SOLUBLE SALTS

This is a summary of a talk given at the 4th Annual Fertilizer and Ornamentals Short Course, January 10, 1986, Naniloa Hotel, Hilo, Island of Hawaii. Thirty-one slides were used to make the presentation.

What is salt? For our purpose, salt is any fertilizer and non-fertilizer material that is dissolved in the water that is applied or is held in media for plant growth.

Some of the confusion about soluble salts probably is due to the fact that they can affect plants in several ways.

First, some plants can get contact "burn" or dries-up when water with more than three milliequivalents per liter of sodium or chloride is applied (69 ppm sodium, 107 ppm chloride) on the foliage.

Second, a white deposit of calcium carbonate may form on the leaves when the bicarbonate level in the water is greater than 1.5 milliequivalents per liter (91.5 ppm).

Third, too much salt can prevent plants from getting enough water, even if the media is adequately watered. Water and nutrients enter a plant primarily through the roots by the process of osmosis. Plant sap is more "salty" than the water in the medium, so the water will move by osmosis along with dissolved salts from the medium into the plant root. However, if the media is more "salty" than the plant sap, water will move from the plant into the media by osmosis and the plant will wilt and may become "burned" and die. The plant dries up. This is a very simple explanation of what happens.

Plants have a tolerance to salinity. Research information is available for some plants. The following is a general salinity tolerance scale:

Salinity, dS/m	Plant Tolerance to Salinity
0– 2	Most plants will grow
2– 4	Sensitive plants affected
4– 8	Many plants affected
8–16	Only tolerant plants will grow
Greater than 16	Very few plants will grow

This scale is for the saturated soil extracted method.

Salinity in agriculture was expressed in millimhos per centimeter (mmho/cm).

The unit of conductance, a mho (ohm spelled backward) is the reciprocal of the ohm which is the measure of resistance in physics for electricity. Water will conduct more electricity when the water is saltier and therefore has less resistance. This is the principle that is used to measure salinity. With a change in the scientific literature to the metric and the International Standard of Units, the unit for expressing salinity is: Decisiemen per meter (dS/m). Fortunately for us, one dS/m equals one mmho/cm.

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Fourth, too much of certain forms of salts can have a direct toxic effect. When the boron content in water ranges from 0.5 to 0.75 ppm, sensitive plants will show some injury. When the boron content is greater than 6.0 ppm, most plants will show injury. When the chloride content is less than 70 ppm, the water is safe for almost all plants. When the chloride content is greater than 350 ppm, severe problems may occur. When the sodium content is less than 90 ppm, the water is safe for most plants. When the sodium content of water is greater than 370 ppm, most plants will be injured.

As a frame of reference, ocean water contains 19,000 ppm chloride and 10,500 ppm sodium and has a salinity or conductivity of 45 dS/m.

Where does the salt come from?

1. Media components.
2. Using water containing high salt.
3. Improper application of fertilizer.

Why does salt accumulate in media?

1. When water evaporates at the surface.
2. When water is extracted by plants.
3. When plants on high fertility programs are not properly irrigated to provide adequate leaching of salts out of the container.
4. When plants on high fertility programs become too dry.

How to control media salinity.

1. Provide adequate drainage, as necessary.
2. Irrigate adequately (frequency and amount).
3. Use applicable fertilization practices.
4. Monitor media salinity—have the media tested.

The last area of confusion may be on the use of gypsum (calcium sulfate) on salt affected soils. In this situation, sodium has a detrimental effect on the physical properties of soils that are composed of smectite (montmorillonite)—type clay minerals. Gypsum is applied to provide the calcium which exchanges or drives out the sodium on the exchange positions on the clay minerals. When this exchange takes place, the physical properties of the soil improves.

Roger Watanabe
Soils Specialist

PSEUDERANTHEMUM PRODUCTION

The genus *Pseuderanthemum* belongs to the Acanthaceae family which includes many well known members that are commercially important ornamentals such as: *Aphelandra, Crossandra, Justicia, Fittonia, Hemigraphis,* and *Thunbergia.* Three relatively unknown species of *Pseuderanthemum* (*laxiflorum, sinuatum*, and an unidentified species) in the University of Hawaii acanthus collection appear to have considerable potential as new landscape plants for warmer climates. The following studies were established to evaluate their cultural requirements prior to release to commercial nurseries.

P. laxiflorum—a shrub, 2 to 4 feet high, with glabrous, oval or lanceolate-oblong leaves; axillary cymes with reddish purple flowers that contain an oblong, conical glabrous ovary. Believed to have originated in Fiji.

P. sinuatum—a sub-shrubby plant with linear, 3-inch long leaves that have deeply scalloped margins and are pinkish-purple beneath. The large flowers occur in terminal racemes and are white-spotted with purple. Originated in New Caledonia.

P. species—a shrub, 3 to 5 feet high, with glabrous, ovate leaves that are deep purple when mature; the white flowers, spotted with purple, are produced in axillary cymes, and are smaller than the flowers of *P. sinuatum*.

Rooting of the three *Pseuderanthemum* species was evaluated by treating uniform, six-inch terminal end stem cuttings with commercially available rooting powders (Hormex #3, Hormex #8 and untreated control). The three replications of 10 cuttings per treatment were rooted in vermiculite under intermittent mist, and rooting percentage and rooting index were determined after three weeks.

Uniform, well rooted cuttings were selected to determine the influence of Osmocote 18–6–12 rates (99, 198 and 396 g/cu ft) and light levels (30 and 80% shade) on growth and development of the 3 species. The cuttings were potted in 6-inch azalea pots in a 1:1, peat:perlite mix amended with dolomite lime, treble super phosphate and Micromax at 170, 17 and 28 g/cu ft, respectively, arranged in a split-plot design with 10 replications. Data were collected on plant height, growth index, flowering and plant dry weight.

All cuttings from the three species were well rooted after three weeks and were not influenced by treatment with rooting powders, the presence or absence of flowers, and the position on the mother plant.

Table 1. The influence of light and fertilizer (Osmocote 18-6-12) levels on growth and flowering of Pseuderanthemum

Treatment		*P. laxiflorum* (3 mo)		*P. sinuatum* (4 mo)		*P.* sp. (3 mo)	
Light Level	Fertilizer Rate (g/cu ft)	Dry wt(g)	Flowering[x]	Dry wt(g)	Flowering	Dry wt(g)	Flowering
30% shade	99	14.9 bc[y]	1.4 d	11.4 b	2.5 c	10.8 cd	1.9 d
	198	26.8 a	2.6 bc	14.2 b	3.3 b	18.1 b	3.2 b
	396	23.8 a	4.4 a	18.6 a	4.3 a	23.6 a	4.3 a
80% shade	99	12.0 c	1.3 d	5.9 c	1.2 c	7.4 d	1.9 d
	198	17.0 b	2.4 c	7.7 c	1.8 d	13.3 c	2.5 cd
	396	18.6 b	3.1 b	7.9 c	1.9 d	13.4 c	3.0 bc

[x] Flower rating: 1=no flowering, 5=heavy flowering
[y] mean separation within columns by LSD test, 5% level.

Dry weight increase was correlated with an increase in the rate of fertilizer applied (Table 1). Tallest plants were produced at the highest fertilizer rate used in this study (396 g Osmocote 18–6–12/cu ft) for *P. sinuatum* and *P.* species grown under 30% shade. Optimum growth of *P. laxiflorum* was noted at the medium fertilizer rate under high light and for all 3 species under the low light (80%) level. Best flowering was found on all 3 species at the high fertilizer rate and high light level.

Results to date suggest that:

1. All three species can be rooted readily under intermittent mist in three to four weeks without hormone application.
2. Best growth and flowering were obtained with higher fertilizer rates and high light level for *P. sinuatum* and *P.* species.
3. Optimum growth was found at the medium fertilizer rate and high light for *P. laxiflorum* but flowering was improved with higher fertilizer rates.
4. Plants of *P. laxiflorum* and *P.* species were too tall and leggy and would benefit from pinching or growth regulators to produce a compact 6-inch pot plant.
5. Finished 6-inch potted plants can be produced in three to four months from a well rooted cutting.

Doris K. Rodrigues, Grad. Student
Fred D. Rauch, Hort. Specialist

DISEASES OF ORNAMENTALS CAUSED BY *ALTERNARIA* SPECIES

The fungal pathogen *Alternaria* is common in Hawaii and contributes to several major diseases on ornamental plants. *Alternaria euphoribiae* causes severe floral and foliage spots on poinsettia. This disease was first found in Hawaii in 1981 and continues to occur at some nurseries during the fall. Large losses from this disease have also been noted in Florida.

Alternaria euphorbiae causes small spots, frequently on the brightly-colored bracts, which rapidly expands into larger spots and blights. The spots may have a pattern of concentric rings or may be entirely fuzzy and dark in color. Both of these situations are caused by the formation of spores by the fungus.

Another *Alternaria* species which has been troublesome to some growers, is *A. gomphrenae*. This fungus produces spots, blights and loss of flowers on globe amaranth and celosia. In many cases, the foliar infestation is so severe, that plants are killed by this pathogen. Leaf spots are somewhat circular and frequently have a purple border. Again, some of the older lesions will turn dark as the fungus sporulates. Flowers are also infected and as a consequence, seeds may be badly contaminated.

On carnation, *Alternaria dianthicola* causes a leaf spot and defoliation of potted and field grown plants. Leaf spots begin as tiny blemishes, expand to larger spots and finally kill the entire leaf.

Alternaria panax is a major pathogen of Brassaia *actinophylla* or octopus tree. This fungus also cuases leaf blights on *Tupidanthus, Schefflera*, and *Dizygotheca*. Young seedlings are severely blighted when the pathogen is present. On *Brassaia*, the lesions begin as small, depressed, tan to light brown spots. They expand within a week or two into large black lesions leading to blight and eventual defoliation. Under high humidity, dead leaves produce spores of the fun-

gus within 2 days. These spores are spread by water, air currents and handling of diseased plants. In the presence of abundant moisture, spores which have landed on healthy host leaves germinate, penetrate the host and begin the disease cycle over again.

On dendrobium flowers, *Alternaria alternata* produces small flecks on the petals which make the flower unmarketable. The fungus does not expand beyond this stage until the flower dies. Dead flowers as well as decomposing organic material support the growth and sporulation of this fungus.

Alternaria diseases are commonly seed-borne. The seeds may be infected or spores of the fungus may be adhering to the outer surface of the seed coat. In some cases, 50 to 75% of the seedlings are lost and surviving plants are plagued by foliar diseases caused by the fungus. Seed lots of globe amaranth, *Brassaia*, carnation, marigold, parsley, cabbage and zinnia have all been found contaminated with pathogenic *Alternaria* species.

Disease development is favored by high moisture levels. Moisture is needed for spore germination and penetration, encourages abundant sporulation and aids in the spread of the pathogen. Any effort to reduce moisture levels will help to control this disease. Besides using fiberglass or solid greenhouse covering, growers should irrigate in the morning instead of late in the afternoon (to shorten the duration of moisture saturation on leaves), use drip irrigation instead of overhead irrigation, and increase the spacing between plants to encourage air circulation.

Effective disease control cannot be obtained without serious attention to sanitation. All diseased and dead leaves should be removed, as feasible. A large number of infective spores will result in a large number of lesions. Only *one* spore is needed to begin a new lesion.

Fungicides should be applied as a supplemental aid to other control practices. Fungicides destroy only a percentage of the spores, which means that fungicidal efficacy increases dramatically with reductions in the amount of dead and diseased leaves.

Some fungicides which can be used for *Alternaria* control:

Host	Fungicides
Brassaia	Chipco 26019, Manzate 200, Dithane M45, Zyban.
Carnation	Daconil 2787, Chipco 26019, Dithane M45, Manzate 200.
Poinsettia	Ornalin, Zyban.
Dendrobium	Dithane M45.
Globe Amaranth	None cleared

Janice Uchida, Plant Pathology

DIAGNOSIS OF PLANT VIRUS DISEASES

Since there is no way to cure a plant virus disease once it occurs at the production level, control measures depend entirely on preventing entrance and spread throughout the crop. Viruses can be transmitted by mechanical means (contacting with contaminated hands, tools or machines), vegetatively propagating infected plants, living vectors (insects, nematodes, fungi, mites etc.), infected plant parts (seeds, pollen, fruit) and even in rare cases by infected soil. Most viruses utilize only a few of these mechanism and proper diagnosis is crucial in order to correctly target control measure. This report describe five procedures used to diagnose specific virus diseases.

1. *Initial symptoms*

To the trained observer the initial symptoms shown by a plant are a clue to the particular virus in question. In fact many viruses such as tobacco mosaic, pea streak and carnation mottle are named after the symptoms they caused and others produce unique enough symptoms to make an initial diagnosis upon inspection of the plants. However, since many viruses cause similar symptoms and other causes can mimic virus symptoms, further confirmation is almost always required.

2. *Indicator plant*

Many viruses can be transmitted simply by rubbing the leaves of a test plant with sap extracted from a diseased plant. By observing the reaction of a large number of species of plants that have been infected with known viruses a group of plants that give specific reactions to particular viruses have been identified. These are known as indicator plants and by comparing the response of a relatively small number of these plants with regard to their reaction to sap from a plant with an unknown virus disease a diagnosis can be made. For example, if sap from a diseased orchid causes the appearance of small brown spots on the leaves of *Cassia occidentalis* within 5–10 davs, it indicates the presence of cymbidium mosaic virus. Sap from the same plant will cause no reaction on *Chenopodium*

quinoa in that time span. On the other hand if sap from this orchid causes small necrotic spots on the Chenopodium, then it indicates the presence of odontoglossum ringspot virus. In a similar manner sap from plants suspected of being infected with viruses can be rubbed on 5–6 indicator plants and their responses carefully noted under controlled conditions. When this information is compared to known responses, the presence of specific viruses can be confirmed or ruled out.

3. *Observation in the Electron Microscope*

Although viruses are very small (ca 1/10,000 x 1/100,000 of an inch), it is possible to observe them in the electron microscope. The several hundreds of different plant viruses are arranged into about 26 groups based on the size and shape of the particles. These include small roughly spherical shapes, rigid rods, flexous rods, bullet-shaped and thread-like particles. These groups can be further subdivided by arranging them into size categories and by whether or not more than one size of particles occurs in an infection. By obtaining data on these factors, it is possible to rather quickly assign a virus to a particular group so that further more specific tests can be done.

4. *Serological Tests*

Serological tests provide a means for precisely identifying a particular virus. These tests are based on the fact that warm-blooded animals produce a substance in their blood (antibodies) that specifically attaches to foreign material that enters the body (antigens which are usually proteins). In some instances these antibodies last for the life of an animal and account for the fact that some animal virus diseases can only be contracted one time and also provide the basis for immunizations. The particular fraction of the blood (serum) that contains these antibodies can be harmlessly removed and used in the laboratory to identify a virus. Antiserum (serum with antibodies to a virus) is prepared by injecting an animal, usually a rabbit, with purified virus which will then produce antibodies. The blood serum is periodically tested for the presence of antibodies to the virus; and when the concentration is suitable some blood serum is removed and stored frozen. In the laboratory, tests are based on the fact that when antibodies react with the antigens used to illicit their formation (plant virus in this example) a visible precipitate forms. Test material such as plant sap suspected of containing virus is allowed to react with antiserum to a particular virus in either liquid or a semisolid medium such as agar. The presence of a visible precipitate is proof of the presence of the virus to which the anitserum was made. In more sensitive versions of this test such as ELISA (enzyme linked immunosorbent assays) or latex agglutination various materials are attached to the antibodies to make them easier to see when they have reacted with the virus. If these tests are done carefully and with proper controls such as known healthy material and known infected materials in addition to test samples, they are reliable, specific for particular viruses and sensitive.

5. *Detection of Viral Nucleic Acids*

The two major components of plant viruses are protein and nucleic acid. The serological test described above detects proteins and in a similar fashion hybridication test has been devised that detect specific viral nucleic acids. It is possible to purify virus, extract its nucleic acid (the genetic material) and synthesize a radioactive molecule (called a probe) that under the proper conditions will attach only to the viral nucleic acid used to direct its synthesis. This is analagous to using a keyhole as a mold to form a key which will now only fit back in the lock from which it was made or one exactly like it. To use this probe, plant sap is blotted onto a piece of paper and reacted with the probe, the paper is washed to remove probe not specifically bound to its template (the lock in our analogy) and then dried. The paper is placed on film in the dark. Since the probe is radioactive, it will expose the film and produce a black spot upon development. Only those areas over sap with virus will be exposed because only in these areas will there be radioactive probe "locked" on the paper. By lining the film up with the original spot pattern on the paper, it can be shown which plants had sap containing virus. Since probes are specific for particular viruses, this test is dagnostic. It has the added advantage of being very sensitive (will detect very low levels of virus thereby avoiding false readings of mildly infected plants) and can be adapted for the convenient assay of hundreds of samples at a time.

By using all or a combination of the above 5 general methods, it is often possible to make a diagnosis of a specific viral disease. Once this has been determined it becomes possible to implement control measures based on knowledge of how it is being brought into a crop.

Tom L. German
Plant Pathologist

AVAILABLE PUBLICATIONS

Several publications have recently been made available from the College of Tropical Agriculture and Human Resources (CTAHR) that may be of interest. Single copies of these publications are available from your county Extension office or by contacting the Agricultural Publications and Information Office, CTAHR, University of Hawaii, 2500 Dole Street, Krauss Hall Room 6, Honolulu, Hawaii 96822.

GROUND COVERS

Instant Information No. 15, *Ground Covers for Dry Locations*, by Fred D. Rauch provides information on conserving moisture in the home landscape including a list of ground covers requiring little water.

FRUITS AND NUTS

A list of the various fruits and nuts suggested for the home garden contained in HITAHR Brief No. 013 by R. A. Hamilton, C. L. Chia, and P. J. Ito, *Recommended Fruits and Nuts for the Home Garden.*

ANTHURIUM BLIGHT

Commodity Fact Sheet An-4(A), *Bacterial Blight of Anthurium*, by W. T. Nishijima and D. K. Fujuyama provides information on the causal agent, symptoms of the disease, hosts, spread and control measures for this potentially serious pest.

ANTHURIUM MEDIA

Recent media studies on Anthurium are summarized in Research Series 040, *Performance of Wood Products as media for Culture of Anthuriums*, by T. Higaki and J. S. Imamura.

LILIES

Research results on the production of lilies in Hawaii are presented in Research Extension Series 064, *Hybrid Lilies Adaptability Trial, Island of Hawaii*, by J. S. Imamura, T. Higaki, and L. Fuchigami.

STATE LAWS

HITAHR 06.11.85 provides information on *1985 State Laws & Resolutions Affecting Farmers in Hawaii*, prepared by C. Y. Oyama.

PALM BIBLIOGRAPHY

Additional palm references are listed in *Supplement to An Annotated Palm Bibliography*, Research Extension Series 057, by F. D. Rauch and P. Murakami.

DRACAENA BIBLIOGRAPHY

A compilation of the available literature on dracaena production is presented in *Dracaena: An Annotated Bibliography*, Research Extension Series 063, by R. Y. Iwata, F. D. Rauch, and R. A. Criley.

FOOD FOR THOUGHT

An amusing sign above a desk recently outlining the stages in development of a new project:

1. Enthusiasm
2. Confusion
3. Disillusionment
4. Search for Culprit
5. Punishment of Innocents
6. Congratulations of Non-participants

BRIGHT IDEAS

A lot of time can be wasted walking back and forth to the rubbish areas or the supply area for plant tags, pocket-knives etc. To cut back on this unnecessary waste of time and labour, one nurseryman has had aprons made with very large pockets for the employees who work with the plants. These aprons are worn first thing in the morning and not taken off until quitting time. Whenever workers are transplanting, pulling plants for shipping or performing any task with the plants, weeds can be pulled up and stuffed into the pockets. This helps eliminate the temptation to throw the weeds under the benches. Employees also carry a pocket-knife and a few plant care tags in another pocket.

Why tax reform?

"A dramatic example of how unfair our tax system has become was cited in a recent study by the Children's Defense Fund. The study pointed out that a mother with three children who earned near the poverty level income paid more federal taxes than Boeing, General Electric, Dupont, Texaco, Mobil, and AT&T paid altogether in 1983, even though these huge corporations posted enormous profits". From "Missing Money, A Common Cause Study of Federal Tax Expenditures," 1985.

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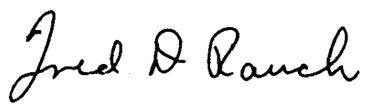

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