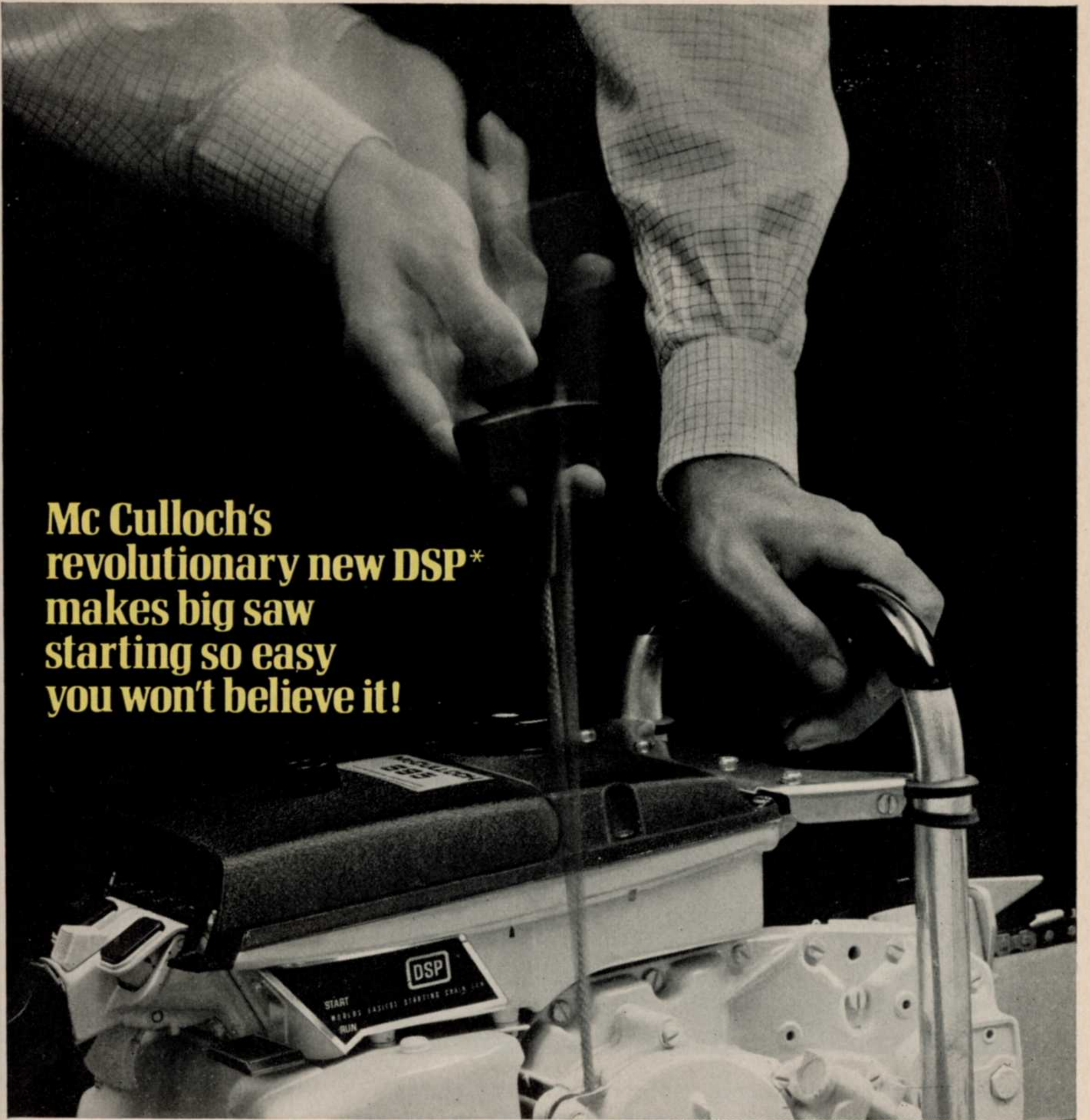

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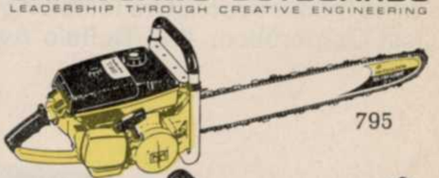

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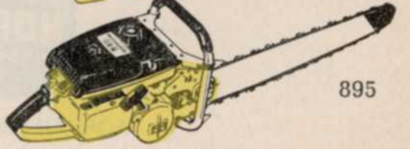

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quately with these matters. Reread it and note the paragraphs stressing the need for knowledge of trees and the qualities of their wood. Also note the types of trees you can "hinge."

We "hinge" a majority of trees, and have for years. Even when we have to "top out" first and lower a part of the trunk, we still "hinge" the remaining snag to lessen the impact of its fall, when this is a consideration. There is no other way to lay a tree down so exactly, and with such ease—with no flip-flop.

Granted, we do not have a man sawing with a power saw on the tree when we pull the tree over. And when we use the fall cut we put a rope in the treetop and pull it over if there is any danger whatsoever that it might split and kick back. We cut until we think the tree can be pulled over. Then we pull. Sometimes we have to go back and cut some more. But we "clear" before the tree starts to fall. Any other procedure is a prime violation of safety rules in our book. Of course we do not try to hinge every tree. Our article on this method was to emphasize the usefulness of the "hinge."

Re: Florida Endothall Release

I would like to call to your attention the article "New Herbicides Show Promise for Southern Naiad Control," which appears on page 23 of the January, 1966, issue of *Weeds Trees and Turf*. The article implies that endothall is toxic to fish, which is not true. In the experiment referred to, the amine salt of endothall, which is toxic to fish, was used. However, there are several other formulations of endothall which are effective for aquatic weed control and are not toxic to fish.

This clearly illustrates that it is necessary in aquatic weed research to be specific as to what formulation was used in the experiment.

Robert D. Blackburn

Research Botanist
Crops Research Division, ARS
U. S. Dept. of Agriculture
Fort Lauderdale, Fla.

Fig. 1. Tree dying of oak wilt caused by the fungus *Ceratocytis fagacearum*. The oak wilt fungus may spread locally from tree to tree through natural root grafts, which are common among oaks growing close together. Premature leaf shedding during the growing season is one of the best diagnostic symptoms in red or black oaks.

How To Diagnose

Tree Diseases

By

DR. P. P. PIRONE
Senior Plant Pathologist
New York Botanical Garden
Bronx, New York

DR. ROBERT S. HALLIWELL
Department of Plant Sciences
Texas A & M University
College Station

PLAIN ordinary common sense is the most important qualification of a good plant disease diagnostician. Some refer to this as a knack, or intuition, or good judgment. Diagnosticians must also have a thorough understanding of a so-called "normal" tree, including the tree species being examined. Not only must he know the name of the tree, but it is also necessary to know about the species' resistance to environmental factors such as dry and wet soils or adverse winter weather.

The good diagnostician will not be afraid to ask questions. Some tree owners and park officials, for some mysterious reason, withhold information essential for proper diagnosis. The history of the tree, such as when and how it was planted, and some information on the past climatic history must be known. This can be acquired from original records or by asking the owner or person in charge of the tree. Information about drought periods, severity of previous winters, and prevalence of hurricanes or other unusual weather must also be considered.

The relation between the soil and the tree must be thoroughly understood by the diagnostician. Is the soil properly drained; is it well aerated; does it hold enough moisture; is it fertile? All of these should be considered. Soil fertility can be determined only by a complete soil test. The expert must also have a working knowledge of entomology and plant pathology.

A reliable arborist will not hesitate to admit his inability to diagnose some abnormalities, nor will he hesitate to recruit the aid of a specialist to help in the diagnosis.

Following are the standard procedures used by specialists in diagnosing tree troubles. They will vary somewhat with the individual and with the plant species. Some diagnosticians consider symptoms above ground more than those below ground. Others feel that the most serious tree troubles and those most difficult to diagnose are frequently associated with below-ground symptoms and factors.

General Exam Comes First

Before examining any one part of an ailing tree, one should study the general surroundings. Are other nearby trees healthy? Have any special treatments been given prior to the discovery of abnormal conditions? Is the tree so situated that a leaf bonfire beneath it, for example, or another diseased tree may have played a part in its decline? After these, and perhaps many other related questions have been answered, one should proceed then with the direct examination of the tree (Fig. 1).

Leaves Show Symptoms First

Leaves constitute the best starting point for examination, because they are the most accessible and are first to show outwardly the effects of any abnormal condition. Here also, a complete understanding of a normal leaf is essential. Size and color of normal leaves vary greatly among different tree species and even among trees of the same species.

Insect injury to leaves is rather easily diagnosed by the specialist, either by the presence of the pest or by the damage caused when it feeds or lays eggs. Leaves may be partly or completely eaten (Fig. 2), or they may be yellowed as a result of insects sucking sap, blotched from feeding between the leaf surfaces, or deformed from feeding and irritation.

Leaf injuries caused by parasitic fungi are not diagnosed so

Fig 2. Black walnut stripped of foliage by tent caterpillars supports only the silken tents left by the ravaging insects which are sure signs of their damage. *(Photo by H. P. Bryan).*

Fig. 3. Norway maple with a wilt disease, caused by the fungus *Verticillium alboatrum*, microscopic in size, has lost more than half its leaves.

Fig. 4. Leaves scorched on a sugar maple (center) are caused in this case by lack of water. Extremely hot weather may also give maples a similar appearance.

readily (Fig. 3), because the organisms that cause the disease are usually visible only with the aid of a microscopic lens. In some instances, tiny, black pinpoint fungus bodies in disease areas, visible without a hand lens, give a clue to the type of disease-causing organism. Lesions from fungus attack have a more or less regular outline with varying shades of color along the outer edges. They may range from tiny dots to spots more than ½ inch in diameter. When several spots spread and fuse together, coalesce, the leaves may wilt and die.

Atmospheric conditions preceding the appearance of spots on leaves often can be used to advantage in determining the cause of the injury. For example, when leaf spots appear after a week or 10 days of continuous rainy and cloudy weather, it is safe to assume that some parasitic organism is responsible, because such conditions are favorable for leaf spot development. Following a week or more of extremely dry, hot weather, lack of water (Fig. 4) may be responsible for spotted or scorched leaves. Low temperatures in late spring may also result in much injury to tender, newly sprouted leaves.

Leaf structure, appearance, or function may change because of widely different causes. Some are toxic vapor or fume injury, deficient or excessive moisture, lack of available food, poor soil aeration, root injuries, or diseases. All but the last two causes can be eliminated, if healthy trees of the same species as the one being diagnosed are healthy nearby. In other words, root injuries and diseases may affect leaves of an individual tree without affecting trees of the same species nearby.

Inspect Bark

A careful inspection of the branches and trunk should follow the leaf examination. Sunken areas in the bark indicate injury to tissues which lie beneath (Fig. 5). These injuries may have been produced by fungus or bacterial infection or by

Fig. 5. Cross section of a hackberry tree infected with the fungus, *Phymatotrichum omnivorum*, shows damaged tissue which lies beneath the bark. This fungus species flourishes on more than 2,000 wild and cultivated plants. When it attacks cotton, the disease is called cotton root rot *(Photo by H. P. Bryan)*.

Fig. 6. Wood beneath the bark of a tree diseased by the oak wilt fungus, *Ceratocytis fagacearum*, is matted by a pathogenic growth. The bulbous growths are pressure pads that lift and crack the bark; the gray area around each pad is the fungus mat. Bark has been removed.

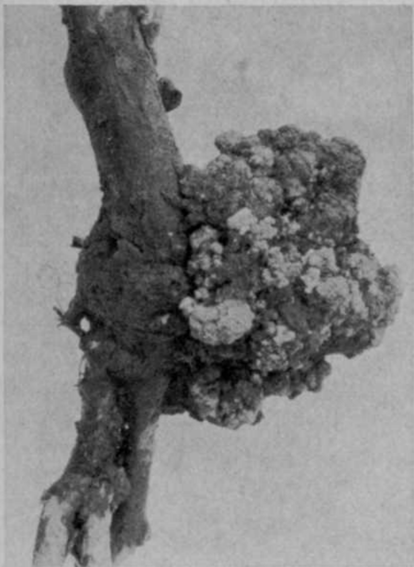

Fig. 7. Crown gall occurs at ground level on many kinds of trees, especially those belonging to the rose family. The malformations of crown gall are caused by bacteria, *Erwinia tumefaciens.*

Fig. 8. Below ground, the fungus *Armillaria mellea,* produces black strands of tissue that resemble shoe strings. Careful manipulation of the soil is required to detect these below-the-ground fungal growths.

nonparasitic agents such as low or high temperatures. The presence of fungus bodies in such areas does not necessarily indicate that the fungus is the primary cause of injury. There are pathogenic species and nonparasitic species, and only a person with considerable mycological training can distinguish between the two.

As a direct result of fungus attack, diseased wood beneath the bark shows a gradual change in color from diseased to healthy tissue (Fig. 6). The injured area is usually dark brown in the earliest and most severely infected parts. In the more recently affected parts, the color is light green or brown with deeper hues toward the old injury section. On the other hand, injuries caused by low or high temperatures are usually well defined by an abrupt line of demarcation between affected and unaffected tissues.

The bark of the trunk and branches should be examined for small holes, sawdustlike frass, and scars or ridges. These are signs of borer infestations in the inner bark, sapwood, or heartwood. As a rule, most borers become established in trees of poor vigor. Because of this, it is necessary to investigate the cause of the weakened condition rather than to assume that borers are the primary cause. Branches and small twigs always should be examined for infestations of scale insects. Although most scales are readily visible, a few so nearly resemble the color of the bark that they are sometimes overlooked.

Branches and twigs with no leaves or with wilted ones should be examined for discoloration of the sapwood. This is the typical symptom caused by wilt-producing fungi. Because positive identification can be made only by laboratory isolations from the discolored tissue, a pathologist is needed to determine the species of fungus involved.

Suckers or watersprouts along the trunk and main branches may result from a sudden change in environmental conditions, structural injuries, disease, or excessive, incorrect, and ill-timed pruning.

Microbial parasites and unbalanced water relations between the soil and the tree may occasionally cause galls or overgrowth on the main trunk (Fig. 7). Many such malformations are produced by factors not yet clearly understood.

General vigor of a tree usually is revealed by the color in the bark fissures and the rapidity with which a wound callus forms. Fissures are much lighter than the bark surface in vigorously growing trees. A callus roll that develops rapidly over the wound also indicates good vigor.

Injured or Diseased Roots Cause Major Loss

Because of their inaccessibility, roots are rarely inspected by many arborists. To diagnose general disorders, however, the possibility of root injury or disease must be carefully considered (Fig. 8). More than one-half of the abnormalities in the hundreds of street and shade

(Continued on page 28)

Fig. 9. White oak trees become defoliated and die from the top first, then towards the ground. This die-back is a result of an invasion below the ground of the shoe-string root rot fungus, *Armillaria mellea* (Photo by J. C. Carter).

Plants Need Minor Elements

By
VERNON W. OLNEY
Geigy Agricultural Chemicals

PLANTS NEED nourishment in the forms of nitrogen, phosphate, and potassium, the three major food requirements, in order to grow healthy and vigorous. However, plants which have been adequately fertilized can still appear sickly. Plants as well as man and animals need, in addition to the major elements, very minute quantities of certain metals to act as agents to regulate many intricate mechanisms which constitute a living organism. Because these elements are needed in such small amounts, they are called minor elements, trace elements, or sometimes micronutrients.

Yellow Leaves Need Iron

Iron deficiency has long been recognized by the typical symptom of yellow leaves with only the veins remaining green. Iron sulfate has been used as the remedy for this sick condition of plants. There are a number of drawbacks to the use of this form of iron. If used in too strong concentrations, it can burn the foliage. If placed in the soil, much of it becomes tied up with other chemicals and is available to the plants. Iron citrate, a form of chelated iron, gives some temporary correction as a foliage spray, but is of such weak construction that it is rapidly broken down in the soil.

In the early 1950's, ethylenediamine tetraacetate (EDTA) proved effective and stable for the chelation of iron, zinc, manganese, copper, magnesium, and other metals. The EDTA-iron combination is very effective and is still a major remedy for iron chlorosis of citrus in Florida. This form of iron chelate does not correct iron chlorosis of plants growing in the alkaline soils of western states. Most of the iron deficiency cases in the West can be remedied by using sodium ferric diethylenetriamine pentaacetate, developed by Geigy as Sequestrene 330 Fe. Continuing research, however, has produced a much stronger chelating agent, sodium ferris ethylenediamine di-(o-hydroxyphenylacetate). It has proven safe and effective for treating iron deficient plants in any kind of soil, particularly in alkaline soils.

Chelated minor elements are excellent tools for diagnosing the ills of plants. If a chlorotic plant fails to respond to iron chelate, then we can be quite sure the plant is not deficient in iron, or that there is another minor element so deficient that normal plant processes cannot be maintained.

Iron Chlorosis Uncertain

Soil and climatic conditions which result in iron chlorosis of plants may also cause zinc and manganese deficiencies. The three deficiencies apparently go hand in hand. Many times, what appears to be typical iron deficiency conditions treated with iron chelate shows up the following year, not as iron deficency again but as a severe case of zinc deficiency. Treated with zinc chelate, the tree returns to normal. The following year, however, the tree may show symptoms of manganese deficiency. Combinations of all three chelated trace elements, applied either as a soil or foliage application, will prevent the progression of deficiencies and obtain a better and nicer looking, healthy plant.

Three years ago, a combination of iron, zinc, and manganese chelates was applied as a soil treatment to selected and paired ornamental trees in Ala Moana Park, Hawaii. One application of 2/3 to 1 lb. of each chelate per tree helped them produce leaves and twigs larger and more luxuriant than on check trees. Differences between treated trees and checks are still evident three years after the one application.

Mild Symptoms Not Seen

During our travels we find plants, shrubs, and trees of all kinds showing signs of disease. At times, symptoms are so mild that growers are unaware their plant production may be unusually low. Only when deficiencies become so acute that the plant becomes severely chlorotic and

crop production has fallen, do growers call in a plant disease diagnostician. Applications of chelated minor elements are the quickest and easiest way to determine just what ails the plant if symptoms indicate a nutrient shortage.

In states west of the Rocky Mountains, iron deficiency is severe or pronounced. Slight to moderate and sometimes severe deficiencies of zinc are found in Hawaii. There are only a few areas where plants show signs of manganese deficiency; pahala blight of sugar cane on the island of Hawaii is an example. Conversely, it is said that most areas have too much manganese and a toxic manganese condition exists. Here again, chelates may correct the situation. Because of a copper deficiency in Florida, growers continue to spray citrus trees with copper until they create a toxic condition with symptoms similar to iron deficiency. Iron chelate applications correct this condition by offsetting the excess copper rather than fulfilling an iron shortage. In the Pacific Northwest, after years of spraying with lead arsenate for codling moth control, soils became so saturated with arsenic that young peach trees failed to grow. Dr. Nels Benson, Wenatchee Experiment Station, found that a soil application of zinc chelate would offset this toxic condition and allow the young peach trees to grow normally.

Manganese chelate, as a foliage spray on manganese deficient Yellow Newton apple trees in the Watsonville area of California, gives only partial correction. Zinc chelate has very little effect when applied alone on these trees, but the combination of both manganese and zinc chelates does an excellent job. Dr. K. Uriu, University of California, Davis, found that the soil conditions causing these deficiencies have not been changed; growers must apply manganese and zinc chelate sprays every year if trees of good color and production are to be maintained.

Severely sick almond and apple trees grow in Zee Canyon near San Luis Obispo, Calif. Tests with the various chelates revealed that a severe copper deficiency was the cause. Copper deficient plants may start new growth in the spring but soon run out of steam; the terminals die, and leaf tips and edges progressively burn and die back.

These same symptoms were noted on lychee and macadamia nut trees growing in the Knudsen Gap area of Kauai, Hawaii. Various chelates were tested on these sick trees. These tests have shown that copper chelate, applied as a foliage spray at ½ lb. per 100 gals. of water with a good wetting agent was sufficient to help these trees return toward normality and to set a nut crop. The check trees are still sick.

Tree Drip Area Sprayed

In December, iron, zinc, manganese, magnesium, and copper chelates were applied separately to young macadamia nut trees on the Honomalino Ranch, south of Kona, Hawaii. These chelates were applied to the soil at 1, 2, and 4 ounces per tree and distributed over the drip area (under the canopy) of each tree. Preliminary data show that trees treated with the copper chelate are ahead of all others in appearance, color, and leaf size.

A severe twisting and deforming condition of new branches is fast becoming a serious problem of the young macadamia nut trees growing in this area. Indications are that copper chelate prevents this condition. Further tests are needed to verify these findings.

Three years ago, sick, young slash pine seedlings, at the Kamuela Tree Nursery on the big island, Hawaii, were saved with a foliage spray of copper chelate at ¼-teaspoon per gallon of water.

Homeowners are usually unaware of sick plants in their yards. If they do notice diseased plants, their application of a general fertilizer may not give the green garden envisioned as normal for their part of the country. With this in mind, and using a balanced combination of chelates, concentrate solutions of trace elements have been developed; one is Geigy's "Greenzit." Tests are now underway to verify the early results of tests with this material. Such concentrates can be applied through a hose sprayer for convenience or by a regular spray machine. They have been applied to a wide variety of ornamental plants, shrubs, trees, and lawns. Tests were established in the latter part of July on golf greens at the Navy Marine Golf Course. So far, only one plant, the poinsettia, is found sensitive to the spray solution. However, new growth more than makes up for slight "burning" of the terminal leaves.

Response to a foliage spray has been very rapid. New leaves and blossoms appear within a week after application. Dormant buds are activated and make plants bushier. Color of old, chlorotic leaves is not changed to any large extent, but new leaves emerge larger and stronger with a liquid luster. Combination chelate sprays intensify any natural color variation of the plant; the reds become redder, the yellows more yellow, and the green a more luxuriant green. With the help of these chelated minor or trace elements, we are now able to make plants greener and more beautiful than ever before.

New Ornamental Developed

An extremely hardy, evergreen, ornamental vine, adapted to shady and partially shady areas, has been developed by the United States Department of Agriculture, at the University of Maryland agricultural experiment station.

Particularly suited for use as a ground cover and as a cover for low masonry walls, the new vine has been named Longwood. A type of euonymus, the vine is a vigorous grower with dark leaves and light-colored veins. Leaf dimension is one-half by three-quarter inches, and is readily propagated from cuttings.

The new ornamental has withstood temperatures from minus 25°F. to 106°F. Grown in full sun, at high temperatures it may scald. Longwood has been distributed for commercial reproduction and will be available on the retail market in 1967.