

RESEARCH

Fire-Resistant Plants: Project studies on fire-resistant plants have received major emphasis during the last two-year period, with emphasis on erosion control. The following species of fire-resistant plants are recommended:

Atriplex lentiformis

Atriplex Breweri

Atriplex canescens

Atriplex semibaccata

Achillea tomentosa

Baccharis pilularis, 'Dwarf'

Cistus hybridus

Cistus ladaniferus

Cistus villosus

Eriodictyon trichocalyx

Helianthemum nummularium

Psoralea bituminosa

Rosmarinus officinalis prostratus

Santolina virens

Research is continuing on field seeding methods. These are being approached through new seeding media such as tar paper planting disks. Initial studies indicate that tar paper disks provide conditions for germination that enable young plants to compete with native plant materials. In addition, the disks can be placed on steep mountain slopes inaccessible by foot but readily accessible to helicopters. Assistance in this work has come from the San Gabriel Valley Women's Clubs who have made the tar paper plant disks.

The fire-resistant plant program has received added emphasis as its importance and concepts gain recognition from Federal, State and local agencies. Others interested in this project are local fire departments, landscape architects, the Brush Fire Safety Committee, housing developers, fire insurance agencies, and civic improvement groups. The Brush Fire Safety Committee published and distributed 200,000 pamphlets titled "Fire-Resistant Plants" based on the Arboretum research project. Information has been disseminated on fire-resistant plants by speaking before 62 interested groups as well as by distributing mimeographed information sheets and participating in television appearances or some 68 written magazine and newspaper articles. An educational film entitled "Greenbelt U.S.A." is now being shown extensively throughout the United States and presents some of the research work that the Arboretum has accomplished on the fire-resistant plant concept. Another film documenting the Arboretum's work on fire-resistant plants was edited for TV and shown to various groups for educational purposes.

Turfgrass Research: The second Plant Physiologist is in charge of maintaining the various experimental turfgrass plantings including 34 permanent turf exhibition plots. He assists with two turfgrass shows a year.

Turfgrass Research Projects have included studies on the following:

1. Automatic irrigation control.
2. Improved management practices for hybrid Bermuda grass, Dichondra and other lawn grasses.
3. Research and selection of turfgrass that will remain green during winter months.
4. The development and use of selective herbicides for control of crab grass, Dallis grass and Kikuyu grass.
5. The effectiveness of Difenamid and "Dalapon" as selective herbicides for grass control. The use of Sodium thiocyanate for the oxalis control in lawn grass or dichondra plantings.
6. The effect of smog injury to hybrid Bermuda grass.
7. Studies on the use of fertilizers, soil amendments, and soil penetrants for lawn care.

"Operation Green Carpet" was initiated in the spring of 1964 to promote interest in the development of superior turfs and home lawns, as well as to provide a means for dissemination of turf information. Attendance was 10,000 for the Saturday and Sunday event. It was established in cooperation with the University of California Agricultural Extension Service and the Southern California Turf Grass Council. The latter representing the turf grass industry of this area. Subsequent to "Operation

Green Carpet" biennial Spring and Fall Lawn Expositions for the home gardener had been held. These shows featured demonstrations on lawn building, development, and maintenance, and have included rather extensive displays and samples of commercially available equipment and materials used for lawn care.

In conjunction with Operation Green Carpet, "Better Lawns Week" was initiated during the spring of 1965 and received an official proclamation by the Los Angeles City Council. Visitors to the demonstration turf grass plots, where over 30 varieties of lawn grasses are grown for the information of the public, has steadily increased and now numbers about 100 daily, and over 1,000 on week-ends. During the last fiscal year more than 1,000 persons received individual help on lawn problems.

An educational display on the identification of turfgrass varieties was developed and displayed at the following locations: Fourth Annual Materials and Equipment Exposition, Brookside Park, Pasadena; University of California Agricultural Extension Nursery, Landscape Tree and Turf Conference, Riverside; and at the Third Annual Spring Home Lawn Exposition, Arboretum.

Herbarium: Approximately 5,000 herbarium specimens have been collected or otherwise added in this biennium; currently, total holdings of the LASCA Herbarium are now in excess of 25,000 specimen sheets and other reference materials. Special collections of research specimens have been provided, or referred, to both foreign and domestic arboreta and botanic institutions.

Herbarium activities have emphasized the identification and validation of field collections and processing these for final disposition; concomitantly, duplicate sheets among the collection sets have been prepared for exchange with herbaria of comparable interests.

The filing system for collections has been completed. All herbarium cases were sorted and readied for insertion of specimen sheets. "Worked" specimens have been catalogued and filed, thereby becoming available for immediate reference use. In addition, a fumitorium and storage room for new and exchange collections was prepared and placed in operation.

With the full and effective assistance of the staff gardeners and Plant Records Office, an inventory of the field plantings was prepared for reference. This 82-page report contains the identification number and name, and also notes the relative maturity, location and quantity of most accessioned plantings throughout the Arboretum. The inventory provides a convenient collation of field plantings for staff and public use in locating particular plants, indicating special groups receiving emphasis, gaining an awareness of represented materials, and suggesting complementary acquisitions; it also functions in other staff requirements. Regular supplements are anticipated to maintain a current record.

Additional extension services have included plant identification and related assistance or information to large numbers of home gardeners, students, teachers, commercial gardeners, nurseries, various civic agencies and others. It is estimated that more than 2,500 such requests or contacts have been served in this biennium. Frequent staff consultation regarding taxonomic and related matters also has been provided.

The current Arboretum Seed Exchange List of 308 items, along with a covering explanatory letter, was sent to more than 435 various plant-science institutions and other contacts in 70 countries. In addition, detailed correspondence and exchange requests have been concentrated on contacts in areas of particular promise or interest regarding plant introductions. The response to this has widely increased liaison with sources of potential value, especially within Asia and some other regions that have been relatively unrepresented or quite out of contact in prior years.

Around 4,000 requests for seed and plants have been placed with other institutions or private sources. Receipt of ordered exchange items average less than half, how-

ever, an estimated field survival of introductions reduces this by at least half again. Nonetheless, the contribution to a basic plant-introduction program has continued to be a major one. Three criteria guide request selections; ornamental potential, taxonomic significance and collection balance. Taxonomic research on ornamental taxa of horticultural importance or promise within Southern California necessitates the establishment of reasonably complete plant collections of groups scheduled for eventual study.

Plant Taxonomy: As a public service this office has regularly identified plant materials, brought or sent in by high school and college students, teachers, home owners, nurseries, law enforcement agencies and the general public. It is estimated that 6,000 specimens were identified during the last two-year period.

The Plant Taxonomist represented the Department at meetings of the American Institute of Biological Sciences, Boulder, Colorado, 1964 and the Pacific Division of American Association for the Advancement of Science, Riverside, California, 1965 where he presented a paper on the "Problems of Plant Identification." He also regularly teaches classes in "Plant Identification" for both the Professional Gardeners' School and Adult Education Classes at the Arboretum.

Plant Records Unit: Seed Control and Labelling Statistics:

<u>Accessions</u>	<u>1963-64</u>	<u>1964-65</u>
Accessions	1,814	1,392
Seed planted	963	1,191
Cuttings inserted	5,048	6,117
Plants moved to one-gallon cans	4,034	5,571
Plants moved to five-gallon cans	29	12
Plants moved to permanent field locations	2,998	393
Aluminum labels, embossed	2,467	1,271
Fiber glass labels, laminated	451	479

Weather Data for the Two-Year Period:

<u>Date Recorded</u>		<u>1963-64</u>	<u>Date Recorded</u>	<u>1964-65</u>
Lowest Temperature	12/12/63	32°	1/1/65	31°
Highest Temperature	9/25/63	112°	10/6/64	103°
Total precipitation	Annual	11.94 in.		16.48 in.
Total evaporation	Annual	46.34		48.02
Heaviest monthly rainfall	Annual 1/64	3.15 in.	4/65	8.75 in.

Of special interest is the increased seed exchange with foreign botanic gardens. There is now seed exchange with 135 foreign botanic gardens. Seed is sent to 32 Russian botanic gardens and to ten other Iron Curtain countries. In return seed was received from twenty of these countries, and since some of these botanic gardens are new, receipt of seed should increase as they mature in development. Also, by devious routes, a request for seed of Cupressus macrocarpa and Sequoia sempervirens was received from the Lu Shan Botanic Gardens in Kuling, Kiangsi Province, China. This is the first time contact has been made and seed exchanged with Red China.

Plant Breeding and Other Research: In a plant breeding project utilizing X-ray and neutron-irradiated seed of several genera, preliminary observations on germination and seedling survival indicate that the higher levels of neutron radiation were significantly harmful in only two test materials. In other instances where some injury was noted, the X-irradiated material appeared most affected in all but one case. Losses in only ten of the original nineteen taxa included in the studies remain and in most of these, the surviving populations are quite limited. Those that have survived are now well established in field test plots. Precocious flowering and growth response indicates an expected, but limited, increase in seedling variation which, in turn, eventually promises a relatively rich potential for improved horticultural selections from at least certain test materials.

Observations on floral biology and exploratory hybridization attempts were made in Calliandra, Cassia (in cooperation with the Geneticist) and Tabebuia. All crosses in Calliandra failed immediately. Those in Cassia eventually failed, but this loss was associated with a heavy drop of open-pollination legumes as well and failure in this case appears unrelated to the hybridization. The crosses between a purple-flowered and yellow-flowered species of Tabebuia were unsuccessful with pollen stored at room temperature; those where pollen stored at low temperatures was used are too recent for determination of results.

In reciprocal cooperation with C. R. Parks and the Camellia Research Advisory Committee, several associated studies on camellias and related taxa are in progress. This has also entailed concentrated effort to complement these particular plant collections by introduction and other means. Chemotaxonomic, cytological, morphological and anatomical approaches have been employed in this work. More than 150 species and cultivars, with emphasis on the section Paracamellia, have been chromatographed and otherwise studied. Basic analysis of the polyphenolic chromatograms is nearing completion. It is anticipated that these studies will lead to a better understanding of intrageneric relationships and taxonomic discrimination.

A relatively large population of F_2 seedlings from Camellia sasanqua 'Shishigashira' x 'Narumi-gata' has been grown for variation survey and potential selection. At present only half of the group has flowered; however, this material is marked by high flower and habit quality evident in the young plants. Several promising seedlings already have been tentatively selected for eventual introduction.

Entomology: Identification of insects referred by the gardeners and the general public, and assistance to those who request help on plant pest control problems have highlighted the work in entomology over the past two years. Periodic inspections were made of the Arboretum and Descanso Gardens to check on insect development which provided information for timely application of control measures and prevention of pest injury to plants, shrubs, and trees.

Observation hives of bees, with educational labels, are maintained at both the Arboretum and Descanso Gardens as a display for educational purposes. The Comstock world-wide collection of insects (on loan from the Los Angeles County Museum) also has been maintained for use in the Department's Educational program. Recently, a start has been made towards establishing a departmental collection of insects which will serve as an aid in identification as well as in teaching activities.

Entomological research has dealt mainly with the biology and control of the psyllid fly, Psylla uncatoides. Investigation has shown it to be a pest on nearly one-half of the more than 100 species of Acacia and Albizia trees growing in this area. This study has provided valuable information on controlling such pests with the use of systemic insecticides.

Plant Pathology: The Plant Pathologist has continued to diagnose specific disease problems for the public and to present classroom lectures to the Professional Gardeners' School students.

There has been continuing emphasis on studies on the control of oak-root fungus disease which is a serious threat to ornamental plantings in Los Angeles County, as it attacks many plant species in addition to oak trees. Efforts to control this fungus have included the testing of plants to determine possible resistance to the disease. Included in test plots at Descanso Gardens and the Lux Arboretum are plants representing fifty genera. Thus far, representative plants in seven genera (Brassia, Cassia, Cocculus, Euphorbia, Geranium, Nerium and Pinus) have become diseased. An investigation to determine whether longevity plays a role in disease resistance of our native oaks also is in progress.

Efforts are being made to find and evaluate systemic materials which move through the plant internally and destroy the fungus. At present, a controlled method of testing these materials has been devised and initial screening of compounds has begun.

Another program has been initiated to evaluate systemic fungicides in control of the palm rot disease which has been a serious menace to our native palm, Washingtonia filifera.

Air Pollution Research: The main objective of the research project, which is financed by the National Institute of Health, is to determine whether there is any means to protect plants from damage due to air pollution. During the past year, two substances have been tried which show some promise. One of these is a powder, gum guaiac, which when dusted on a few plants, has protected them from ozone damage. The other is propyl gallate which, when sprayed on a few plants as a weak water solution, protected them from ozone. More extensive studies of these materials must be made to determine their value for use outside the laboratory and on a wide range of plant subjects.

Atmospheric pollution has been measured at the Arboretum by two methods, chemical analysis and bio-assay. The first, chemical analysis for the total oxidant in the atmosphere, is performed semi-automatically on the hour between 8:00 a.m. and 5:00 p.m. daily. This has continued over a number of years using the apparatus originally designed by Dr. A. J. Haagen-Smit of the California Institute of Technology and presented by him to the Arboretum. A summary of the data obtained is submitted quarterly to the State of California for their records. The second method is by a "Bio-assay" by means of sensitive plants, using the method developed by the Air Pollution Control District. This has been used daily since March, 1964 and provides an arbitrary measure of phytotoxicants. It distinguishes between the various types of pollutants which damage plants.

Symptoms of air pollution injury to vegetation in Los Angeles County and in other parts of Southern California, have been observed and recorded. The two most critical pollutants causing damage to vegetation are ozone and peroxyacyl nitrate. Ethylene damage is of consequence to orchid growers and is most severe in coastal areas. The so-called "aerosol" injury has been observed in the vicinity of installations burning large quantities of residual fuel oil containing sulfur. Using chemicals known to be emitted from these sources, this injury has been reproduced on plants at the Arboretum. Localized damage due to hydrogen fluoride has been continuously observed in some areas.

Many introduced plants being studied at the Arboretum to determine their adaptability to this area have been carefully observed for their resistance to air pollution. These observations have emphasized the fact that very young plants are more sensitive than mature plants. If small seedlings could be protected by suitable filters until they had passed the critical stage, they could develop into mature plants, although they might never become completely resistant. In a number of cases, air pollution has been the major factor causing the death of young plants. Serious injury due to ozone has been increasingly observed on many mature shrubs and trees. Some of the more seriously affected are sycamore, silver maple, elm and locust. Camellia on the other hand, appears quite resistant.

Field trips have been made at the request of the Agriculture Commissioner's staff and of the Arboretum's plant pathologist to identify the cause of injury to crops and ornamentals. A number of talks have been given to local agricultural and horticultural groups and to college classes. Exhibits are regularly prepared for "Operation Green Carpet," held at the Arboretum. At least three conferences pertaining to air pollution have been attended. Many photographs, both in color and in black and white, have been used to record damage symptoms and areas of occurrence. One entire issue of Lasca Leaves was prepared on the subject of air pollution damage to vegetation, describing the findings of this project and reviewing previous studies in this field by the Air Pollution Control District.

Camellia Breeding - Plant Geneticist: Both from the greenhouse and from the laboratory come data which is helping us to better understand the biology and the taxonomy of the genus Camellia. In our program our major limitations are the long life cycle and the essential self-sterility of most species of the genus Camellia. These conditions limit the depth of genetic investigation that can be carried out. The ease of culture and the relatively high compatibility of most Camellia species partially compensate for these limitations. These assets make the Camellia a relatively good subject for

studies of the biology and genetics of a woody ornamental plant -- not to mention the well known great ornamental value of many of the species of this genus.

In general we can see definite progress in the areas of development of cold-hardiness and fragrance, while we are at least coming to better understand the problems involved in our efforts to widen the camellia color spectrum. The experiments being carried out to develop cold-resistant camellias are largely based on the co-operation project between the Arboretum and Dr. R. W. Lighty of Longwood Gardens, Kennett Square, Pennsylvania. Most of this program is based on the systematic inter-crossings of Camellia japonica cultivars which have performed well in the Longwood field tests. Our hopes for introducing fragrance into the camellia are still largely based on combinations with the species Camellia lutchuensis. First-generation hybrids with this species have bloomed to date, and the fragrance characteristic is carried to them. To a lesser degree other species are being used in this part of the project. If the small amount of yellow coloration in the species C. japonica can be increased, this will likely take at least two breeding cycles. Attempts to develop bluer shades in the camellia also have been carried out. Genetic analysis of Camellia japonica progeny is being done to determine the manner in which flower form and color characteristics are inherited.

Chromatographic Studies on Camellias: Chromatographic analysis, a micro-chemical approach, of camellia types is yielding considerable information regarding the taxonomic relationships of camellia taxa. We are completing a study of hybrid recognition by rapid chromatography. By this approach a large number of plants can be surveyed in a short time to determine if they have chemical components common to both of their parents. Thus far we have been able to show a large number of our hybrids intermediate. Mr. Malcolm McLeod of Pomona, California is carrying out this part of the work.

Our more involved and long term chromatographic task is the identification (as far as possible) and quantification of the polyphenolic substances of all of the Camellia species in cultivation. This information will tell us much about the inter-relationships of the species of the genus Camellia. This project is necessarily longer term.

Hibiscus Research: This project, established in 1957 with the objective of producing hibiscus cultivars better adapted to southern California conditions than those from Hawaii and other areas, was suggested by Mr. Ross Gast, Director at large of the American Hibiscus Society. He is collaborating with Mr. J. W. Staniford on the introduction and breeding of Hibiscus rosa-sinensis and allied species. In addition to their donations of time, Mr. Gast has travelled world-wide collecting hibiscus breeding material. He also has established a reserve fund with the California Arboretum Foundation, Inc. to purchase equipment, assistance, and defray shipping costs. A research greenhouse and outdoor planting area now are filled with hibiscus progeny from previous years crosses and with the introduced plants.

Several new hibiscus types have been developed within the last two years and soon will be introduced. Display and test plantings of these are now being located in various Los Angeles county and city parks.

The dedicated interest of these gentlemen is gratefully acknowledged and appreciated. They are designated "Research Associates" of the Arboretum.



Stewart, William S. 1961. "Research." *Biennial report* 1963-65, 15-20.

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