THE EFFECT OF CALIFORNIA'S DROUGHT ON LANDSCAPE HORTICULTURE

by W.D. Hamilton [1]

The effects of the two-year drought, the most severe on record for central California, are relative in regard to landscape horticulture. Normal winter rainfall for San Francisco Bay and eastward to Sacramento is approximately 14 to 15 inches. Rainfall in the winter of 1976-1977 was about half normal and this is minimal to subminimal for numerous plants. Drought stress symptoms were most striking in this area. A sudden collapse of plants and plant parts was frequent.

In eastern Marin County, where they have been on watering rationing for two years, normal rainfall approaches 30 to 40 inches annually. During the winter of 1976-1977 they received about half this amount and still can maintain considerable vegetation. Plant drought symptoms there were quite different from the eastern side of the Bay, a slower development, progressive wilting, gradual decline, and early leaf fall.

Geographic and climatic differences between Marin and the East Bay partially account for what we saw. The urbanized areas of eastern Marin County are especially blessed with well structured and very deep clay soils in a mild climate marked with summer fogs. Coast redwood, bay laurel, and madrone comprise the natural woodland. Vegetation is generally dense and self-protecting against wind and sudden temperature changes. Thus, drought stress symptoms have developed gradually.

The East Bay is an open wind-swept area; the alluvial fans and canyons in the hills support coast live oaks and bays. The soils of the heavily populated alluvial plains are generally layered and root restrictive zones are common. Depth of rooting is shallower and trees are shorter than on the deeper soils. Frequent supplementary irrigation is necessary to obtain the desired plant growth. As a result, urban landscapes in this area are more dependent on irrigation. Thus, the onset of drought symptoms are often sudden; so sudden, in fact, that many plant functions such as flowering, fruit set, and shoot growth have ceased in mid-operation.

The water supply for central California comes from the Sierra Nevada Mountains, its foothills, and from ground water pumping. The water supply in central Contra Costa County originates in the San Joaquin-Sacramento River Delta country and is delivered via canals. The lack of fresh water replacement is allowing sea water intrusion into the ground water. Use of this water is frought with the problems of high sodium and chloride content. Total salts of some of these waters range from 600 to 1,000 ppm. Chlorides, since December 1976, have been running from 250 to 300 ppm. These waters may be classified as "poor" and have subsequently caused plant stunting and leaf burn. Some trees, especially the deciduous broadleafs planted for one or two seasons, have an appearance similar to fire blight disease. Their leaves are especially necrotic. Soil reclamation will be a major effort in the future. Present use of salty water will leave significant effects for years after the drought is over. One of the dangers of using salty water is that the results are not immediately vivid and tend to be cumulative. In addition, soils high in salt are difficult to treat.

How has the California drought of 1976-77 affected other parts of the urban forestry world, such as insects, diseases, rodents, and weed species survival? What has been learned from the drought experience?

Insects and other animal pests

With the early desiccation of grasses and succulent vegetation, evidence of gopher activity has dramatically increased. Old runs are difficult to keep vacated.

---

[1] Submitted for publication December 7, 1977.

Boring insect activity has increased in some trees not adapted to warm, dry conditions. There are more problems in Monterey pines with red turpentine beetle (*Dendroctinus valens*) and the California five-spined engraver beetle (*Ips paraconfusus*), the latter causing many tree deaths, especially on shallow and nonirrigated soils in the hot summer areas.

With the weakening of many trees and shrubs, scale insects have been more destructive during this drought period. Sycamore scale on sycamore (*Platanus* sp.) caused considerable dieback. Problems with other sucking insects were about normal in 1977. Light rains occurred at the right time in the spring. It allowed sufficient shoot growth to support normal levels of sucking insects.

We apparently are at the end of a two- to three-year cycle of the California oak moth and expect its presence to remain low for four to six years. However, two defoliations a year on the California live oak (*Quercus agrifolia*) plus the water stress of 1976-77 have caused many live oaks to not refoliate this year. Whether these oaks will refoliate or how they emerge from this stress is still conjecture. Because of the timing of the insect population cycle and the drought, it is difficult to separate effects of the two.

The scattered rains of late winter and early spring in 1977 did not fill the soil, but they did provide the essential environment for several foliage diseases which are often normal problems. The anthracnose disease on Modesto ash, sycamore, and Chinese elm were no worse than usual.

Weeds

Logical thinking would lead one to believe that in a dry period, weeds would be less of a problem. On the contrary, Russian thistle (tumbleweed) was more of a problem in 1977 because it is able to germinate and grow in drier soils.

Landscapers who applied pre-emergent herbicides, believing that rains would activate them, had problems. There were many weed control failures. Translocated herbicides did not give desired results where water stress became severe because of reduced plant activity.

Summary

Now let's try to put the picture together for practical horticulture. California did not totally dry up. Even in thirsty Marin County there were street tree avenues of acceptable Chinese elms (*Ulmus parviflora*), American and English elms and their hybrids (*Ulmus* sp.), and sweet gum (*Liquidambar styraciflua*).

However, evidence of a severe drought was apparent. Parks have been closed. They were too dry for use and a fire hazard. Some hills next to town were fire-scorched where rainfall allowed ample growth of wild annual grasses, and hills and mountains just out of town burned as a result of the large and potentially dangerous Mt. Diablo fire in August 1977. Mt. Diablo is just 15 miles from five million people in the Greater Bay Area.

Early August leaf fall was quite evident on Lombardy poplar (*Populus nigra* 'Italica') trees and on southern magnolias (*Magnolia grandiflora*). Southern magnolias have been a widely planted street tree in several cities of the San Francisco Bay Area.

Decline of inner branches and dropping of foliage was the most common horticultural symptom of the drought. This occurred one to two months earlier than normal. This condition was not all bad, however, since many eucalyptus have taken on a thinned and pleasing sculptured appearance and do not appear to be dying. Most eucalyptus in the irrigated landscape of the Bay area normally are more dense than they were in 1977.

However, many trees have been injured. Early leaf abscision was the rule where ground water was insufficient for the California horsechestnut (*Aesculus hippocastanum*). Some of these trees did not even complete flowering in early August 1977. Many plants showed symptoms by early August; dull gray-green or yellowish leaves, as illustrated by the groves of Tasmanian blue gum (*Eucalyptus globulus*), eucalyptus on the Stanford University campus in Palo Alto, the Modesto ash (*Fraxinus velutina* 'Modesto'), the European plane trees (*Platanus acerifolia*), and the glossy privets (*Ligustrum lucidum*) in several other San Francisco Bay area communities. The glossy privets were often unable to complete flowering.

The fairways and roughs of many golf courses were dry or nearly so. Many caretakers irrigated a very narrow center strip of fairway, and others only the tees and greens. The pressure to use recycled water of various grades was intense. It was delivered and used in unique ways. Some golf course irrigators discovered improved control and management of the common weed, annual bluegrass (*Poa annua*). Most managers discovered that they can get along very well with less water.

Some drought-related tree symptoms were spectacular. Foliage, twig, and limb dieback were common with the drought intolerant Sierra redwood (*Sequoiadendron giganteum*), coast redwood (*Sequoia sempervirens*), and madrone (*Arbutus menziesii*). Where these trees are crowded, tree death has occurred.

Insect activity has been related to the drought. The California five-spined engraver beetle (*Ips paraconfusus*) was especially active in Monterey pine in the areas where the pine is growing out of its preferred habitat. This species has been a particularly susceptible target in the dry, warm hills away from the San Francisco Bay. These trees have succumbed in six weeks.

The California oak moth larvae have been feeding twice a year on coast live oaks (*Quercus agrifolia*) for the last two to three years. There was concern where these trees did not refoliate after the 1977 spring feeding. Even though the epidemic cycle for this insect is nearing its end (some trees were not attacked in 1977), the arborists were concerned about tree survival.

Twig and limb dieback was quite spectacular in some trees during 1977. While some dieback is normal in California's arid climate, the rate of development has been accentuated in recent years. The summer of 1971 was extra hot and long. Rainfall did not completely wet the root zones the winter of 1971-72. The summer of 1972 was a repeat of 1971, but a heavy rain storm in October initiated crown rot problems and resulted in tree stress. The week-long freeze in December 1972 played havoc with the tops of nearly three million blue gum eucalyptus. Much evidence of these weather patterns were carried over into the current drought period.

Much has been learned from this extreme weather. The junipers are most drought hardy. The true cedars, the commonly-planted olive, rosemary ground cover, and the low-growing manzanitas are also hardy. Some plants, grown as ground covers, are not drought tolerant, such as the cool-season lawn grasses (blue and rye grasses), *Arctotheca calendula*, and St. John's Wart (*Hypericum*) and the large-leaved ice plant. Vinca (*Vinca minor* and *V. major*) does not appear drought hardy, but it retains its droopy leaves and looks fresh again with winter rains. English and Algerian ivies sunburn too, when under water stress. Although not universally acceptable, some folks said to heck with growing lawns and large plants and went to astro turf and plastic plants.

The California laurel (*Umberllaria california*), also known as Oregon myrtle, was not drought tolerant, nor was the Monterey cypress (*Cupressus*). The southern magnolia required summer water to prevent abscission of mature leaves. The European birch (*Betula alba*) required a constant supply of water, almost as much as turf.

Commonly used small trees and shrubs that had few symptoms of water stress include California toyon (*Heteromeles arbutifolia*) and the related species from the Mediterranean, and strawberry tree (*Arbutus uneda*).

Drought tolerance is often a matter of degree. Oleander often put on an extra brilliant display, but in other locations glossy privet and oleander foliage and flowers were stressed. Although often seen in nonirrigated locations, *Pittosporum* and Victorian box (*P. undulatum*) suffered from drought. The differences between stress and no stress are often small. Arctotheca ground cover, protected from the afternoon sun, and Aleppo pine, often appeared quite vigorous.

The significance of the drought on central California landscape horticulture may not be as important now as in the future. Relatively few plants have died as a direct result of drought stress. With adequate rainfall and supplies of irrigation water, most plants will return to an acceptable state of growth.

Will we again have inexpensive water in California sufficient to maintain our New England style urban landscapes? Probably not. John Madison, Professor of Environmental Horticulture at the University of California in Davis, recently said, "Since projected water use for the year 2,000 greatly exceeds the fresh supply, there will be future restrictions on the use, and fresh water will have to be used more than once." The limited supplies of high-quality water for an expanding population and the expensive costs of that water will force changes in the use of water for landscaping.

The plants in high demand will be those that are inexpensive to maintain and require minimal supplemental irrigation. Such plants will require little pruning and pest control. The intended function of landscape plantings will receive strict attention — wind break, screen, shade, architectural effect or a recreational element. We may be unable to justify use of water for plantings of lesser priority. The arrangement and spacing of plants in a landscape design will be much different from what it is today. Plants will be arranged according to their cultural requirements and functions. They will be spaced according to what can be maintained on the site with limited water.

Out of this will come a California landscape, perhaps with a flavor of what it was during the California Mission period and prior to colonization by northern Europeans. The 1976-77 central California drought was an important impetus to initiate such changes.

Horticultural Advisor
University of California
Alameda County
Hayward, California

ABSTRACTS

Baumgardt, J.P. 1977. **Nutrients.** Grounds Maintenance 12(10): 44, 46, 49-50, 52.

Green plants take some minerals from the soil, others from the air, and they manufacture still other chemical compounds internally, all for various metabolic processes. From a practical standpoint, a gardener can manipulate only soil chemicals, but in doing so he can encourage vigorous, healthy plant growth which makes optimum use of gaseous compounds taken in through the leaves and permits optimum internal metabolic processes. Many chemical elements enter plants through the roots; only a few are taken in through pores in the leaves. Chemical compounds always enter plant roots in solution. It follows that the availability of nutritional compounds in the soil depends on soil moisture. One group, elements which are fixed in plant cell development, or which are required in large amounts, are known as major nutrients; the second group, those used only in very small amounts, are called trace elements, minor nutrients, or micronutrients. For normal, vigorous growth plants need ample supplies of these substances. We determine what is available in the soil by soil tests and supply the lacking amounts. It is all very simple when approached from a sensible, scientific standpoint.

Boardman, R.M. 1977. **Biological control: pitting insects against insects.** California Agriculture 31(10): 8-11.

Biological control involves discovering, importing, and using the most effective natural enemies of pest insects or weeds that can be found. UC scientists estimate that the importation and release of biological control agents in California alone has saved producers and consumers of food and fiber about $300 million in the last half century. In this review, "biological control" (BC) refers to only one of the many nonchemical insect control methods on which UC scientists are working. BC is the importation, colonization, and spreading of natural enemies (usually from the "old country" where the pests originated) to reduce a pest's population density to a lower average than would otherwise occur.