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Salinity Effects in Nursery and Landscape Plants

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Injury to plants caused by accumulation of salts in the soil is common in nurseries and outdoor landscapes. Salinity damage is frequently observed in ornamentals such as hibiscus, wedelia, poinsettia, false eranthemum, ruellia, and trailing lantana in landscapes maintained by both homeowners and professionals. Salt-affected soils are those that have been adversely modified for the growth of plants by the presence of soluble salts, exchangeable sodium, or both. The salts involved are largely chlorides, sulfates, and nitrates. Possible causes contributing to salination include

- excessive application of chemical fertilizers
- application of animal manure or compost with high salts content
- use of brackish irrigation water
- high water table and exposure to salt spray near the ocean.

When the appropriate fertilizer program for the particular soil and plants has not been determined, there is a risk of applying too much fertilizer or using a formulation with a greater nutrient content than is necessary. In landscapes, the situation is complicated by a general lack of information on the nutrient needs of most tropical ornamental plants.

Most students in agricultural and plant sciences are trained to recognize the advanced symptoms of salinity in plants: "burning" ("firing," browning) and death (necrosis) of leaf edges or other leaf tissues, including entire leaves. More useful in correcting salinity problems, however, is recognition of the *early* symptoms of salinity damage, which are

- leaves with a bluish-green color that is bluer and darker than their normal color
- leaves that are smaller than normal
- stems with shorter internodes than normal
- growth that is stunted, sometimes extremely so
- leaves that become chlorotic (yellowed) in the older stages.

Figure 1 compares normal leaves and early symptoms of salinity in wedelia.

Salinity is determined by measuring the electrical conductivity of the solution extracted from wet soil. The more salts in the solution, the higher its conductivity. The laboratory measurement of salinity is expressed as either of the equivalent terms *millimhos per centimeter* (mmho/cm) or, in International System units, *decisiemens per meter* (dS/m). Because conductivity varies with the temperature of the solution, laboratory determinations are made at a standard 25°C (77°F). A soil salinity test can be done by the CTAHR Agricultural Diagnostic Service Center (via Cooperative Extension Service county offices) or by a commercial soil-test laboratory.

In terms of potential to cause plant injury, the lower limit of salinity in a soil or potting medium for the majority of plants is 4 dS/m, whereas sensitive plants are affected at about 2, and tolerant plants are affected at 8–10 or more. Highly tolerant plants include coconut and many ornamental palms, zoysiagrass and bermudagrass, bougainvillea, and native Hawaiian coastal plants such as ‘**a**kia, hala, hinahina, ohai, and p**o**hinahina.

Salinity tolerances of many vegetable, fruit, and grain crops have been determined, but the tolerances of most tropical and subtropical ornamental plants have not been investigated. The early symptoms listed above may seem somewhat subjective and thus not definitive, but with experience they can be useful.

Difficulty in diagnosis of early symptoms of salinity problems can occur with plants such as mondo grass and mock orange, which already have small, dark bluish-green leaves. In these cases, one should look for

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chlorotic or necrotic older leaves and a history of high fertilizer use. If salinity damage is suspected, a soil test for salinity should be done, with any level over 4 dS/m considered cause for alarm.

Salinity problems often occur with prolonged fertilizer misuse. When more fertilizer is applied than the plant can take up or the rainfall or irrigation water can flush away, the soil can become salinated. This is common in annual row-cropping situations in other parts of the world, although it is rare in Hawaii. Soil salinity can develop in Hawaii in intensively managed landscape areas, and it is more common in dry areas than in places with high rainfall.

When soil salinity is due to an excessive fertilizer program, applications must stop until the levels of salts are reduced. In the case of potted plants, the soil or medium must be replaced.

If the foliage is a little darker green than usual but the leaves are normal in size, there is no need for concern, but the situation should be monitored. When the leaves start to decrease in size, steps should be taken to reduce fertilizer salts concentration and the number of fertilizer applications until the symptoms disappear.

Another cause of salination is salts in irrigation water, and in the future in Hawaii, commercial and recreational landscapes may be required to use brackish water to conserve potable water. When brackish water is used, the total salts level of the water must be considered when developing a landscape design. Some important considerations should be

- characteristics of the soil (ease of drainage)
- installation of underground drainage pipes
- rainfall amount and distribution
- irrigation system design
- use of salt-tolerant plants
- availability of potable water to flush salts from the soil.

A total salts level in the irrigation water of 3 dS/m or higher should be considered a severe hazard; 1 dS/m is approximately 640 ppm. The higher the salt level of the irrigation water, the more thought should be put into the design plan to deal with this problem. Using potable water to leach salts down into the soil does not mean the problem is solved. If the soils are imperfectly drained and the leachate is not adequately moved downward or drained horizontally through drainage pipes, the salts can move back up into the active root zones of the landscape plants through capillary action as the soil dries.

When salinity damage in landscape plants is due to exposure to salt spray or a high water table near the ocean, the most practical solution is to remove salt-sensitive plants and grow only salt-tolerant ones.

The use of plant tissue analysis to survey for salt injury can be confusing and is not often practical, although toxic levels of certain elements, like boron and chlorine, can be detected. Soil salinity analyses are much more definitive for detecting total salts levels and the possibility of salt damage to plants.

References and further reading

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Figure 1. The wedelia stem at left is under salinity stress; note the smaller, darker leaves and shorter internodes, which indicate stunted growth.

Damage to plants due to high soil salinity often occurs because early symptoms of salinity are not detected. Early stages of injury from salinity to look for are

- dark bluish-green color of the foliage
- smaller leaves
- shorter internodes
- sharply reduced rate of growth
- chlorotic lower leaves at later growth stages.