



## Landscape Disease Problems in Hawai'i

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There was a recent landscaping boom in Hawai'i that coincided with the rapid growth in the real estate market, the construction of new houses, and the development of tourist resorts. People wanted to quickly create beautiful landscapes for their new properties.

This rush to build and develop during recent years left the door open for many problems in the landscapes. Many of the problems were probably avoidable, and they are expensive to manage after they develop.

This publication describes some of the foremost problems in Hawai'i's landscapes, their consequences for plant health, and some solutions to them.

### Land preparation

Bulldozer scraping of sites, a common practice used to break and remove large rocks, deepen the rooting zone level, and remove weed growth, can have long-term detrimental effects on plant growth. Bulldozing near *Metrosideros polymorpha* ('ōhi'a lehua) trees, for example, can lead to their eventual death by crushing, breaking or otherwise damaging the roots.

Scraping off the topsoil with bulldozers, instead of merely breaking up and harrowing the surface by tractor, can expose hardened, nutrient-poor subsoil layers. People who install landscapes into these clayey hardpans, which lack organic matter and nutrients, find that the plants do not grow well due to poor aeration or plant nutrient imbalances and may die from root or stem diseases.

**Solutions:** Try to keep bulldozers at least 10–20 feet or more away from mature *M. polymorpha* trees. Harrowing is superior to scraping in that it preserves soil structure and the topsoil; it provides better soil quality for growing plants and helps retain soil structure, porosity, and organic matter. Uptake of water and nutrients is an active

process that requires oxygen, so drainage is important. Compost is useful in improving the drainage of clay soils.

### Planting the wrong plants for a site

Plants may not thrive where they are planted in microenvironments (consisting of various degrees of sun, shade, soil, pH, etc.) to which they are not well adapted (see photo, p. 2). They may grow weakly, decline, and die, resulting in “disposable landscapes” that must be replanted continually.

**Solution:** Match plants to their native or naturalized environments, when possible (sun, shade, soil or growth medium, pH, salinity, wind exposure, etc). This might mean planting two or more plant species in succession at a site until the right one is found. This also requires an understanding of your site and knowledge of the key environmental factors at the site. Landscape architects may install the wrong plants because their designs do not fully consider the soil or growth medium, the water supply, or other environmental factors. These problems are expensive to correct and can be avoided. Some landscape architects may be poorly trained in tropical and subtropical plant materials, although with time in Hawai'i, their experience improves their knowledge.

### Poor fill soils in new landscapes

A common problem in new landscapes is the use of heavy subsoil that was inadvertently or intentionally collected during the process of scraping and acquiring good topsoil from a remote site. The heavy subsoil is usually high in clay, poorly drained, poorly aerated, and lacking nutrients. Such material is detrimental to plant growth. The nutritional, physical (compaction, poorly draining), and disease problems associated with these



This wilting beach naupaka (*Scaevola sericea*) plant was growing in a thin layer of soil covering a field of lava at a golf course on the North Kona coast of the island of Hawai'i. The natural growth substrate for this plant is coral beach sand, not soil brought from a location such as a pasture or abandoned sugarcane field. In this case, the soil contains a root-infecting, plant-pathogenic fungus, *Verticillium dahlia*, that caused a root and stem-wilting disease (naupaka dieback) when it colonized naupaka's vascular system and blocked the uptake of water from roots to foliage. This fungus does not commonly occur in Hawai'i's beach sands, so it does not normally cause naupaka to contract the disease in its native, coral beach sand habitat.

(All photos by S. Nelson)

poor subsoils used as topsoil can persist for many years. Soils used to prepare and fill new landscapes can also be infested with plant root parasites known as root-knot nematodes (*Meloidogyne* species). Where susceptible plants such as hibiscus or some popular groundcover species are grown in these infested soils, roots become galled and rotten and the foliage turns yellow, declines and plants may die.

**Solutions:** Use only topsoil for landscapes; do not use subsoil or subsoil mixed with topsoil; test and treat

acquired soils for plant-parasitic nematodes; add gypsum and organic amendments (compost) to improve soil structure, organic matter content, and plant nutrients. Because most topsoils and original soils do not drain well, one would save money by adding large amounts of compost to the original soil. Both cinder and beach sand tend to compact when walked on. Silica sand and man-sand (ground blue-rock) require uneconomical levels to improve drainage. Compost is best but is also required in large amounts.

### Grass and shrub beds installed in same irrigation zone

Shrubs tend to receive far too much irrigation water when they are put on the same irrigation schedule as adjacent grasses. Grasses are more shallow-rooted than shrubs and may need more frequent watering in hot and sunny environments. If plants with a wide range of moisture requirements occur in the same irrigation regime, the ones requiring the least amount of water may develop problems. The consequences of too much water for shrubs are loss of soil structure, root suffocation, nutrient deficiencies, and root rots.

*Solution:* Keep grasses on a separate irrigation schedule from shrubs, where possible.

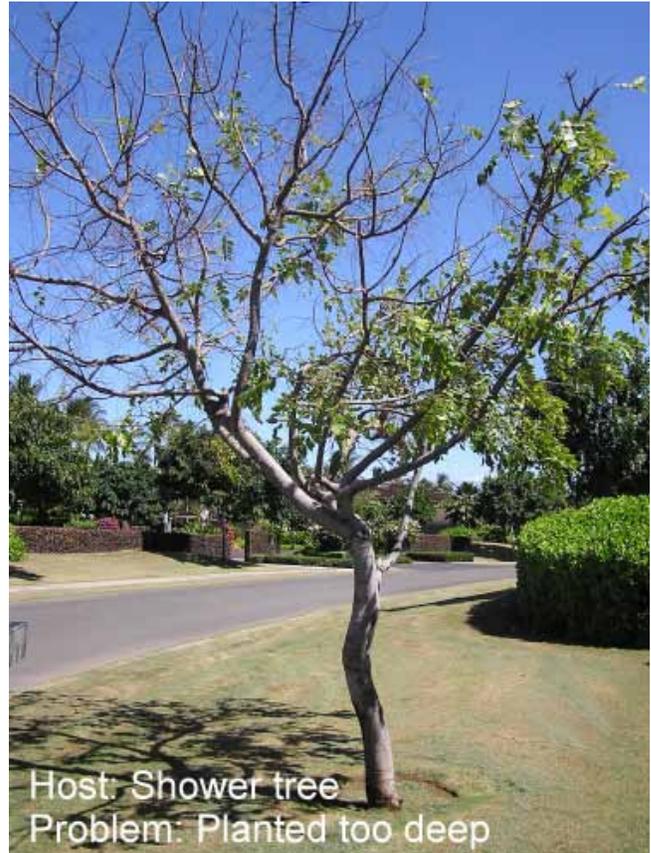
### Excessive irrigation

People tend to over-water their plants within dry-area landscapes to compensate for the arid environmental conditions. However, this often fosters root diseases and loss of soil structure and changes in soil properties due to sodium within the water supply. The sodium in the rather brackish water in the North Kona district of the island of Hawai'i can destroy soil structure by breaking down and dispersing soil materials into finer and finer sized particles. This causes soils to eventually lose aeration, become hard packed and drain poorly.

*Solutions:* Do not over-irrigate plants; periodically move irrigation emitters farther away from plant stem(s) to stimulate the growth of wider root systems; irrigate the landscape only as needed (based on the moisture content of soils), not on a fixed schedule; irrigate in the morning hours so that the soil does not remain saturated at night; avoid stem rots by placing emitters so that they do not wet the plant stem; irrigate less frequently to extend the life of the soil's structure; aerate affected soils and add conditioners such as compost; and treat acidified catchment waters to raise their pH to an acceptable range for plant growth and soil health. In the future, brackish water irrigation of some landscapes will be required, which will require monitoring for salinity effects on the soils and plants.

### Trees are planted too deep and then over-irrigated

If tree stems are planted too deep and then over-irrigated, their roots can suffocate and rot and the stem can decay and even girdle beneath the soil line, leading to plant decline. This commonly can affect coffee, longan, mon-



A shower tree in a landscape, shown several years after being planted too deep, with its branches slowly dying back. The tree's bark was almost completely girdled at the soil line. This problem is very common in Hawai'i. The tree had to be removed from this landscape and was replaced with another plant.

keypods, shower trees, and other valuable woody plants in landscapes (see photo, this page).

*Solutions:* When transplanting a tree, make sure the hole is not too deep and fill it in with soil and pack the base slightly before transplanting. The proper depth to plant a tree is to place it in the soil so that the soil line is even with the top of the first lateral root connected to the stem; do not place irrigation emitters immediately adjacent to stems for long, but place them at or near the tips of the roots (the drip line of the plant); and, if over time the new transplants sink vertically, dig soil away from the stem until you see the first lateral root. When grass is allowed to grow up to the trunk of shrubs or trees, maintenance of the grass with weed-whackers will often girdle the plants. Use herbicide, mulch, or compost to keep a grass-free zone near the plants. However, do



A common mistake in landscapes is to install plants having pot-bound or pathogen-infected root systems. The foliage of such plants may wilt, turn yellow or brown, and die back. Such landscapes become temporary, as replacement plants must be installed to replace the dying plants.

not allow contact between mulch and tree stems, because stem decay can occur when the mulch becomes hot during its composting.

### Planting of pot-bound plants

A pot-bound plant is one whose roots encircle excessively within a pot, having grown for too long in the pot. The plant essentially becomes too large for the pot. Pot-bound plants may eventually die or not grow well after they are transplanted into landscapes. The curling roots may not expand in the soils and may “choke” the stem of the plant (see photos, above).

*Solution:* Avoid planting pot-bound plants in landscapes; inspect them before purchase or use and discard them. Some growers may choose to clip or loosen the pot-bound root systems with shears before planting to interrupt the root curls.



This is the pot-bound root system of the wilting, yellowing, dying plant shown at left. The main roots were in a circular formation corresponding to the pot that contained it at the plant nursery. Such plants are not capable of surviving the stress of a hot, poorly shaded environment after planting. Nurseries should not allow plants to reach this stage and should transplant into larger pots periodically to retard this. People who buy plants should inspect them first to see if they are pot-bound, and they either should not purchase them or take measures to improve root growth and protect these plants from stress after planting.

### Loss of soil structure due to irrigation or rainfall

This problem can lead to poor plant growth and to soils that are hard-packed and drain poorly. Where soils are uncovered and receive frequent irrigation their structures may dissolve, leading to a hard-packed, moss- or algae-covered surface that does not drain well and is not well aerated. Less irrigation will also contribute to the development of deeper root systems.

*Solution:* Do not over-irrigate plants; use compost or mulch around plants to protect soils; aerate the soil around affected plants and add appropriate amendments to the soil (e.g., agricultural lime, dolomite, gypsum, beach sand, fertilizer amendments, composted manure, composts).

### Installation of landscapes is disconnected from maintenance of landscapes

Some landscapes are designed and installed professionally and then turned over to an owner/operator for management. Landscape designers and installers may not see



Fruit trees are often planted too deep in soils, and when soil moisture is commonly present or the soil is heavy, the effect is a rotting, girdled stem and tree death. Here, the fruit tree was planted at least 2–3 inches too deep. Trees should be planted so that their first lateral root is just below or at the soil surface.

all of the problems that can result from the installation.

*Solution:* Installers of landscapes in Hawai'i should consider helping sustain them for the first year, so that problems which develop can be seen and avoided in future designs.

### Under-fertilization

Plants need nutrients for their growth and development. If plants do not get enough of these elements, they will not grow well and they will not appear to be healthy. Certain plant nutrient elements tend to be deficient in many locations in Hawai'i, including nitrogen, potassium, magnesium, phosphorous, calcium and boron. One should also know the early symptoms of excess soil salinity on plants: dark green foliage, shorter internode length and leaf size, and slower rate of growth.

*Solution:* Apply enough fertilizer or nutrition for plants to grow sufficiently—it is probably better to apply fertilizer more frequently and in lesser amounts than less frequently and in greater amounts, especially in high-rainfall areas; periodically add calcium and boron or other nutrients on a yearly or biannual basis; take soil samples and apply recommended levels and types of fertilizers; learn to recognize characteristic deficiency symptoms associated with certain elements needed for plant growth.

### “Parking lot” diseases

Where trees or palms are planted in landscaped areas within or adjacent to asphalt or cement parking lots and sidewalk areas, the plants can suffer root diseases that express as yellowed or necrotic foliage and stunted plants. The plants roots may not get enough nutrient-laden moisture or enough aeration to remain healthy. The plant leaves turn yellow and new branches may not grow as readily. Plants may stop growing and eventually die back or die completely. Certain trees, such as lemon-scented eucalyptus, when planted too close to sidewalks, streets, or buildings will develop ethylene-induced gummosis on their trunks.

*Solution:* Plant trees in parking lots after the lots have been created and leave enough soil space around stems to replant the trees once they are mature but perhaps die.

### Soil pH problems

The pH of landscape soils changes over time as rain and irrigation water and nutrients and other materials contact and move through the soil. Soils in heavily managed landscapes, for example, may acidify each year. The soils may acidify to a degree that is damaging to plants and tie up some minerals in the soil structure, such as iron (Fe). Soil alkalinity and excessive soil phosphorus can induce deficiencies of minor elements, such as iron in plants vulnerable to iron deficiency.

*Solutions:* Monitor and treat soils yearly by submitting plant tissue and soil samples to the CTAHR Agricultural Diagnostic Service Center; understand the pH requirements for optimum growth of the plants in your landscape.

### Brackish irrigation water

On the Kona coast of the island of Hawai'i, and in some other areas in the state, the water used to irrigate landscapes is brackish (saline) to the degree that it causes root rot of plants. The water can also quickly break down the upper layer of topsoils, causing them to become impervious to water and to drain poorly.

*Solutions:* Use composts or mulches where appropriate; compost is better than fresh organic matter. Do not over-irrigate seedlings with brackish water; use catchment water in nurseries where possible.

### Position of irrigation hoses and emitters left unaltered

People often do not pay enough attention to moving



A common irrigation error is to leave irrigation and emitters immediately adjacent to tree stems for years. This causes constant moisture around the base of young trees, leading to the rot of the bark at the soil line and the eventual death of the tree. Move irrigation emitters away from plants over time to stimulate root growth toward the water source and to protect stems from rotting.

irrigation emitters away from plants in the weeks after transplanting. They often leave the irrigation hoses or emitters in the same position, quite near to the plants, for at least a year and sometimes for several years. This can inhibit root growth and lead to stem and root rots (which cause leaf yellowing and plant dieback), especially where irrigation is excessive.

*Solution:* Move irrigation emitters away from transplanted plant stems after a couple of weeks, out to the root tip zone.

### **Over-reliance on pesticides**

Some landscapes require that a lot of pesticides be applied in order to maintain them. This can result in a loss of biodiversity and to unwanted human exposure to chemicals.

*Solutions:* Planting other types of plants that require fewer pesticides might be an alternative; use specific-action pesticides where possible to avoid death of non-target organisms. Choose pesticides that are less deleterious to the environment and humans.

### **Failure to recognize and treat problems early enough**

Many landscape managers do not pay close attention to the initial symptoms of declining plant health, such as changes in leaf color from green to shades of yellow or

red. If problems are detected early, they usually are more treatable and more easily rectified, and their spread to other plants in the landscape may be prevented. Many heavily managed landscapes in Hawai'i, for example, get too much water and not enough of the right fertilizers for all of the plants in the landscape. This situation can persist for a number of years and eventually result in poor growth of important trees and shrubs and nutrient deficiency symptoms. Or, a significant pest or disease problem of roots or foliage may go undetected until it causes replanting to occur or be necessary.

*Solutions:* Submit soils samples for chemical analysis yearly; fertilize plants at least 2–3 times each year; scout or inspect plants as often as you can for any abnormalities and submit soil or plant samples for diagnosis as soon as possible following outbreaks of abnormal symptoms; keep records on landscape maintenance and take photographs of periodically.

### **Poor soil drainage**

This can lead to root rot of affected plants by lack of aeration and overly wet soil conditions.

*Solution:* Improve soil drainage or runoff, or plant grasses or water-loving plants such as wetland taro.

### **String trimmer injury**

The bark of trees cannot re-grow once it is removed by string trimmers. Nutrients flow within tree bark, and when bark is removed in a circular pattern around a stem, the affected plant may eventually die.

*Solution:* Use string trimmers carefully around young trees and consider wrapping exposed stems near ground level with trimmer-resistant materials such as rubber or plastic shields.

### **No compost or mulch is used**

Where plant beds are not mulched or composted, the structure of a soil can degrade over time, which negatively affects plant growth and health.

*Solution:* Add compost or mulch around landscape plants yearly (avoid placing compost or mulch into direct contact with tree or woody stems, however).

### **Large plants are too close to a house or building**

Some plants, when planted too close to a building, will cause structural damage to the property or they may grow poorly or in odd shapes.

*Solutions:* Allow enough space for a plant to grow normally next to a house or building; do not place plants too close together, each plant should have enough space to grow to maturity without being obstructed by other plants. Also, because Formosan subterranean termites (*Coptotermes formosanus*) require moisture, plants should not be planted close to buildings made of wood vulnerable to termite damage.

### **Under-irrigation**

Where plants are under-irrigated after their transplant they may develop yellow foliage and die back.

*Solution:* Irrigate plants after transplanting at least every few days in arid environments so they do not dry out and fail to grow properly. Large transplants such as palms or larger trees may need to be monitored carefully during their establishment. However, it is probably better to keep most plants a little bit too dry rather than a little bit too wet.

### **Improper diagnosis of problems**

Often when people see a wilting or yellowing plant, they conclude that the plant must need more water or fertilizer, when in fact more water and fertilizer can only worsen the situation. This is the case for root diseases of plants, which commonly express the symptoms of wilting, die-back or yellowing above ground.

*Solution:* Obtain an accurate diagnosis of a plant problem before attempting to treat it.

### **Poor pruning**

Plants that are not pruned when they could be, or pruned poorly, may suffer disease and have an unthrifty appearance. Shrubs and trees should be pruned so that the apical growth is in balance with the root system.

*Solution:* Understand the principles of tree pruning in landscapes.

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### **Acknowledgments**

Melvin Wong and Fred Brooks (UH-CTAHR) provided helpful review and information.