

# Lessons from Lotusland: Sustainability in the Garden

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The road to better, healthier, safer gardens lies in making intelligent choices that stress prevention of potential problems rather than drastic cures.

**L**otusland is a thirty-seven-acre estate garden with landscape features dating from three different eras. R Kinton Stevens developed the property as a nursery and farm from the 1870s until his death in 1896. Between 1920 and 1941 the Palmer Gavit family constructed major buildings and landscape elements, most of which remain today. In 1941, Madame Ganna Walska purchased the property and, for over forty years, significantly enhanced the plantings. Lotusland's plant collections now include aquatic plants, cactus, aloes, euphorbias, and many other succulents, plus ferns, begonias, palms, and cycads. There is an outdoor theatre, a Japanese style garden, orchards, and other formally landscaped gardens. Upon her death in 1984, the non-profit, educational Ganna Walska Lotusland Foundation assumed management of the property and opened the garden to the public in 1993.

The diversity of plants and the intensive planting schemes have created some interesting challenges for the garden staff. In Madame Walska's day, local contractors were called in to spray the gardens on a regular schedule, to prevent any damaging insects and other plant pests from establishing a foothold on the property; hundreds of pounds of chemical fertilizers were spread according to the standards of the time. When the foundation became responsible for Lotusland, however, there was greater latitude for the grounds staff to formulate methods for improving plant care. Plant health became an important criterion of successful gardening, where, formerly, a pristine appearance had

been the paramount goal, no matter how it was achieved.

## A Staff Initiative

In 1988, when Mike Iven was promoted to grounds superintendent, he and John Lafleur, his assistant grounds superintendent, realized that, as a public garden, Lotusland needed a better system for preventing damage from plant pests and for fostering good plant health. The use of toxic pesticides and fungicides was not only incompatible with visitors in the garden, but was also recognized as having long-term detrimental effects on the plants it was meant to protect—and on the environment as a whole. Under their leadership, Lotusland adopted an integrated pest management (IPM) program that reduced dependence on toxic chemicals by tolerating a certain level of insect damage and by treating heavier infestations with the least toxic materials possible. Biological controls were later introduced and, to allow these to work effectively, the spraying of insecticides was further reduced to avoid indiscriminately killing off the good with the bad.

As John, Mike, and other horticultural staff attended seminars, read the latest scientific papers, and searched the internet for better solutions to pest and disease control, their knowledge and commitment to sustainable plant health grew. New techniques were considered, adapted, tested, and put into practice.

A plan for sustainable gardening evolved that incorporates the use of environmentally safe methods of pest treatment, a nurturing of healthy soil and healthy plants, wise plant selection, and green waste management.

Nutrient cycling, disease suppression, and insect/plant relationships are examples of beneficial interactions that come from sustainable management of the garden. At Lotusland, plant management decisions are no longer made at the organism level, but at the community level. This means that careful consideration is given to the effect any plant management task might have on all the organisms in the garden.

## **It Starts With Healthy Soil**

Healthy plants are better able to resist disease and pests, and the best way to improve the health of plants is by improving the health of the soil in which they grow. Healthy soil contains a complex web of beneficial organisms. In natural systems, the food chain in the soil starts with organic material that rains down on the soil surface from the plants above. Some of the major movers of this organic matter down into the soil are earthworms or nightcrawlers. There can be as many as fifty to 150 worms per square yard of healthy soil. They make permanent vertical burrows, and, along with other worms that forage horizontally, they can break down 3,000 to 5,000 pounds of leaves per acre per year. They improve the structure of the soil by creating pores for the water and oxygen that are required by plant roots to recycle nutrients.

Earthworms are not the only important inhabitants of soil. One teaspoon of healthy soil can contain about 600 million bacteria. There can also be 150 to 500 feet of fungal hyphae (the strands of cells that make up the vegetative body of a fungus), 10,000 protozoa, twenty to thirty beneficial nematodes and several thousand mites, springtails, and other microarthropods in this same teaspoon of soil. Each of these organisms plays a vital role in soil ecology; together, they perform the necessary task of decomposition. The end result for plants is that nutrients are released from the organic matter as it decomposes. Soil that has as little as

two percent organic matter has a reserve of 2000 pounds of nitrogen per acre; the higher the concentration of organic matter, the higher the reserve of nitrogen. This process, called nutrient cycling, occurs naturally in all healthy ecosystems. The goal at Lotusland has been to re-introduce as many elements of such ecosystems as possible into the artificial garden setting, thereby reducing the need for inputs of fertilizers and other chemicals.

To build a healthy soil food web that not only contains all the nutrients required by the plants, but also augments the disease suppression capabilities of the soil, the Lotusland staff increases the soil organic matter with compost added during garden renovations and with organic mulch. All green waste from Lotusland is recycled; most is managed on site in compost piles and returned to the garden as mature compost. Green waste that is difficult to compost, such as fibrous agave leaves and palm fronds, is transported to Santa Barbara County's green waste recycling program. A thick organic mulch is maintained throughout the garden to provide food and shelter for earthworms; great quantities of mulch from the county's green waste program, as well as wood chips from tree companies, and commercial mulches, provide this organic matter. Compost tea, calcium, and other soil improvement materials are also used to encourage large earthworm populations.

Other practices that contribute to healthy soil at Lotusland include the use of a mulching mower that returns finely chopped grass clippings to the lawn. The clippings soon decompose, releasing valuable nutrients into the soil and greatly reducing fertilizer requirements. Where supplemental nutrients are required, gardeners add organic fertilizers that benefit the soil food web organisms and eliminate the possibility of ground-water pollution caused by nitrate fertilizers. Beneficial fungi are also widely used to combat pathogens and strengthen susceptible plants. These practices help provide for a natural management of once-problematic soil-borne diseases that had been managed, though not always successfully, by routine drenches of chemical fungicides. Beneficial nematodes (microscopic worms that feed on soil grubs) are also incorporated into the soil

where necessary, eliminating the need for chemical insecticides to control such pests.

## Compost Teas

A recent innovation in routine maintenance utilized throughout Lotusland is the extensive use of compost tea. A basket containing a few pounds of finished compost is immersed for twenty-four hours in a tank that circulates aerated water through it, creating conditions that promote the growth and multiplication of soil micro-organisms. The resulting brew contains the same organisms present in the compost, but in numbers as much as 1,000 times higher than that of the initial compost sample. As a soil drench, the diluted tea can reintroduce these organisms into degraded soils quickly and is of particular value in areas of the garden where organic mulches are not an option. Lotusland's succulent collections, for example, have historically been mulched with mineral mulches (most notably, lava rock gravels), and, for design reasons, these remain. Compost tea applications, made with each regular irrigation, boost the disease suppression capabilities of these soils and improve the structure of the soil as well. Foliar applications of compost tea also help in disease suppression, by providing a film of living beneficial organisms that prevent fungal disease spores from infecting the plants.

All these techniques have been most successfully employed in areas such as the rose garden and fruit orchard. There have been failures, but these have usually provided the staff with new lessons for sustainable gardening. For several years, the rose garden had been a good example of sustainable horticultural practices with a healthy soil food web and nutrient cycling providing most of the roses' cultural needs; mulch and compost tea were the primary inputs to this dynamic system. It was disappointing, then, to see the system crash due to major infections of bacterial crown gall and fungal stem canker throughout the beds. By allowing the mulch layers to become depleted and/or inactive, the beneficial organisms were no longer present in sufficient numbers to out-compete the pathogens. Being made aware of the

fragility of the system was a valuable lesson. It was a reminder of the importance of clean maintenance practices, of providing mulch and other inputs in a timely manner, and of monitoring conditions regularly.

The success of sustainable practices in the fruit orchard has been more consistent. Extensive mulching has led to adequate nutrient cycling and far fewer fungal problems (such as peach leaf curl) than with conventional methods of fertilizing and dormant spraying. An added benefit of mulching there is the suppression of weeds without the use of herbicides.

A soil-building technique that has proven successful in renovating old planting beds or preparing new ones is the use of cover crops, usually involving mixes of annual legumes (*Vicia*, *Pisum*) and oats (*Avena*). In areas where all the plants need to be removed to rejuvenate the soil and in the few occasions when an entirely new bed is begun, the soil will be amended, subsurface drainage added, if necessary, and a cover crop planted that will be tilled into the soil just prior to planting. This not only provides additional organic matter, but encourages the growth of beneficial soil fungi before the plantings are put in place.

## Mycorrhizae on the Rise

The result of these soil-building practices is healthier and more productive plants. To further refine these techniques, John Lafleur, now plant health care manager, assesses their outcome through soil and compost analyses. A small laboratory was set up for this through the generosity of the Stanley Smith Horticultural Trust. John is able to identify many of the beneficial organisms and the amount of nutrient cycling occurring in the soil; more comprehensive testing is carried out by commercial soil testing labs. An important indicator of a healthy garden, and a sign that natural disease suppression is increasing, is the return of beneficial fungi, such as mycorrhizae, to the garden's soils. Mycorrhizae are always found in natural systems and provide a multitude of benefits to the plants with whose roots they form symbiotic associations. Commercial strains of these fungi have been

incorporated into new plantings in an attempt to re-colonize the garden with native strains; research has shown that introduced species of mycorrhizae help restore the soil to conditions that are suitable for native species of soil fungi. A recent lab report for an area of the Japanese garden at Lotusland (where the soil had recently been rebuilt) read, “This looks like a great soil for these plants. The roots are perfectly covered with ectomycorrhizal fungi; the fungal community is an extremely beneficial one.” Such feedback, in the form of analytical measurement, is helpful in modifying and improving sustainable cultural practices.

## Encouraging Beneficial Insects

Another strategy to improve conditions throughout the garden has been the establishment of insectary plantings. By increasing the diversity of plants that attract beneficial insects, it is possible to promote a balanced insect ecology, which, at Lotusland, has reduced insect damage to the plant collections and eliminated the dependency on insecticides. These “good bugs” comprise a natural army of pest control allies, and it is important to provide them with suitable living conditions. For example, adult syrphid, or flower, flies (whose larvae provide control of pests such as aphids) must feed on pollen or nectar to mature their eggs prior to laying. Many other insects use pollen and nectar to sustain themselves, allowing them to survive longer, produce more pest controlling young, and provide a higher level of biological control. Having supplementary food available from the flowering plants in the insectary gardens can greatly increase the beneficial activities of these insect friends.

The majority of garden plants produce flowers with nectar that is not accessible to many of these tiny beneficial insects, whose mouthparts are shorter than those of other, better-known, nectar feeders such as bees and butterflies. Nectar-producing flowers with short tubes, such as those in the mint and cabbage families (Lamiaceae and Brassicaceae, respectively), or those with nectaries accessible from outside the flower, as in the legumes and spurge

(Fabaceae and Euphorbiaceae, respectively), provide sustenance to a wide range of insects. Plants that produce many flowers in a single head, as seen in the sunflower and the carrot families (Asteraceae and Apiaceae, respectively), are also attractive to beneficial insects. Insectary plantings successfully provide insects with a year-round, supplemental source of food (pollen, nectar, and, sometimes, prey), even when pest populations are low. The goal is to create refuges for the natural enemies of garden pests by choosing a variety of plants with overlapping flowering seasons to cover the entire year, to ensure that plenty of food and breeding sites are available. Supplemental releases of beneficial insects are occasionally needed. Beneficial insects can be gathered from the insectaries in one part of the garden with a vacuum and insect net and then released in other, more remote areas.

Larger garden pests like slugs, snails, and pocket gophers can do major damage to plants in the collection at Lotusland, but dangerous poisons are no longer used to manage them. Snails and slugs are now controlled with the use of an organic iron compound that is non-toxic and, in fact, breaks down into plant nutrients. Pocket gophers can be eliminated or controlled through a coordinated and consistent trapping program. Learning to “think like a gopher” has resulted in an effective program for baiting and setting the traps, and the number of gophers are kept in check.

## Spreading the Message of Sustainability

Lotusland’s sustainability program has received several awards and has been the subject of workshops for landscape professionals and home gardeners. A Spanish language version of last year’s popular sustainability workshop will be offered this fall. Perhaps best of all, the message of sustainability is now part of the fourth grade outreach program that serves more than 1,000 Santa Barbara area students each year.

As Lotusland has progressed toward its goals of sustainable management of the gardens, staff members have been collaborating to write a set



The insect vacuum gently collects beneficial insects from one of the insectary gardens for release in other parts of the garden to control pest insects. Photograph by John Laffleur



Smaller versions of this commercial compost tea brewer are available for the home gardener. Photograph by Mike Iven



This butterfly garden is just one of the insectary plantings at Lotusland; a variety of flowers throughout the year provide food and habitat for beneficial insects, which in turn help control pest insects. Photograph by Mike Iven

of easy-to-follow guides that address common garden problems. This series of Best Management Practices (BMP) covers such topics as methods to control specific insect pests, including ants, aphids, scale, thrips, and mealybugs; methods of trapping gophers and applying snail bait; and Lotusland's approach to weed

control and turf management. Others outline the tactics employed in growing roses, cacti, cycads, and palms; throughout these cultural guides, soil building, plant health management, and plant vigor are the objectives. The guides can be found on Lotusland's website ([www.lotusland.org](http://www.lotusland.org)). 🌿