



An aerial view showing White Gate Trail at center and Muddy Hollow Road at back right. The fire jumped the livestock pond in foreground.

Park rangers report that the stark landscape shown here is now flourishing with new growth — both native and nonnative. Staff and volunteers are working to control nonnatives through several habitat restoration programs.

are moving to fire-prone areas like the Sierra foothills and the interior chaparral in Southern California, and all of them are justifiably afraid of fire. "Large so-called catastrophic fires are a natural and inevitable feature of the California landscape," says Keeley. "I suggest that we recognize that and attempt to live within that constraint."

While the conflicts over how to manage fire in California are far from resolved, there is hope. "Agencies are starting to question their ideologies and the data behind them, and are allowing other agencies to work with them," says CDFG's Shaffer, who is also a member of the California Fire Strategies Committee, which coordi-

nates private landowners, conservation groups and government agencies. "There's a lot more common ground than people had expected."

— Robin Meadows

#### For further reading:

Conard, Susan G. and D.R. Weise. "Management of Fire Regime, Fuels, and Fire Effects in Southern California Chaparral: Lessons from the Past and Thoughts for the Future." Tall Timbers Fire Ecology Conference. Boise, Idaho.

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Haidinger, T.L. and J.E. Keeley. 1993. "Role of High Fire Frequency in Destruction of Mixed Chaparral." *Madroño* 40:141-147.

Minnich, Richard A., M.G. Barbour, J.H. Burk and R.F. Fernau. 1995. "Sixty Years of Change in California Conifer Forests of the San Bernardino Mountains." *Conservation Biology* 9:902-914.

Sierra Nevada Ecosystem Report to Congress. 1996. Wildland Resources Center Report Number 36. University of California, Davis.

## News from the recycling front . . .



# Agriculture could provide a major market for recycled green waste

Every year, 10 million tons of grass clippings, tree leaves, limbs and twigs, vegetable cuttings and other organic wastes are produced in California. As the largest single component of the state's waste stream, recycling this "green waste" offers a significant opportunity for reducing inputs to landfills.

The most likely end user for the tons of compost and mulch produced with recycled green waste is the California agriculture industry. Whether green waste is beneficial to agricultural crops, and whether it is practical and economical have become questions for the UC Cooperative Extension.

In 1989, the California Legislature passed the Integrated Waste Management Act, which established a new approach for the management of California's waste stream. Assembly Bill 939 required a 25% diversion of the state's waste

from landfills by 1995, and a 50% diversion by 2000.

Officials at the California Integrated Waste Management Board (CIWMB) estimate 3% of green waste is currently composted in backyards for on-site use. While community education programs like the one described in this issue (see p. 11) can increase this amount, the large-scale reductions required by law necessitate an array of strategies. Many communities are turning to curbside collection and commercial recycling programs.

When the Integrated Waste Management Act became law, California was diverting 12.5% of its waste from landfills. Today, more than 500 communities, serving 20 million people, offer some curbside recycling; 173 of those, serving 8.5 million people, pick up green waste. CIWMB is still analyzing city and county

annual reports, but estimates the 25% diversion goal set for 1995 was surpassed.

The green waste collected from homeowners, landscape maintenance contractors, at golf courses, schools and parks is hauled to large composting facilities where the materials pass through a grinder, are stacked in windrows and irrigated. The materials are mechanically turned three times a day for the first two weeks, and then as needed to maintain the proper temperature. After about a month, the product is sifted through a ½-inch screen, run past a powerful magnet to separate any incidental metal and placed for sale at \$14 to \$20 per ton.

Because they play different roles in agricultural production, the cost of green waste compost cannot be directly compared to less expensive, conventional fertilizers. Although green waste compost does deliver nitrogen, phosphorus, potassium and other nutrients, its proponents say the benefits go far beyond fertilization. Applying compost reportedly increases soil organic matter, results in a more diverse soil microbial population, reduces leaching of soil nutrients, allows for better soil moisture retention and reduces the need for fertilizer applications needed to sustain crops.

The use of green waste compost also has environmental benefits. It extends the life of the state's landfills, delaying the need for building new facilities; and it lessens the risk of nitrate groundwater contamination.

Many farmers have experienced excellent results with green waste products. San Benito County organic farmer Michael Halprin has used green waste as a mulch and as a compost for two years. "Last winter I looked at one of my ranches and, brushing through the soil, saw lots of worms," he said. "Thirty feet away, a conventional farm has not a single worm." Worms are more abundant in soils with higher levels of organic matter. Their castings and the channels they create as they move through the soil improve water infiltration and root growth, and enhance the physical stability of the soil.

Using green waste on farms, in nursery plantings or as a top dressing on turf grass completes a natural cycle. But many producers are reluctant to purchase the material before they see the benefits proven scientifically. Reliable data will help establish a stable, long-term market for green waste products — a step that is essential to achieving the 50% reduction goal for 2000.

In 1994, CIWMB provided \$484,500 for five science-based demonstration projects on the use



Jack Kelly Clark

of municipal green waste in commercial agriculture. Each project involves local growers, compost producers, UC academic staff and local government. The projects are bringing to light the best approaches to expand the green waste recycling effort in California and extend this knowledge to California farmers.

These preliminary results indicate green waste's potential role in agriculture. However, the actual benefits of green waste products will vary widely according to the crop, the soil and the climate.

- In a project started with industry funds in 1993, farm advisor Harry Andris compared steer manure, composted steer manure, slow-release chicken manure pellets and ammonium nitrate with green waste compost in a Fresno County peach orchard. He said the green waste supplied the trees' nutritional needs and appeared to minimize nitrate leaching below the root zone. During the first two seasons, scientists were excited to see a lower incidence of brown rot in fruit on the trees treated with green waste compost.
- Stanislaus County farm advisor Jesus Valencia applied green waste compost to sweet corn, watermelon and tomatoes. He saw yield increases from the first year to the second and anticipated another increase in the third year. "It seems like the longer it's used, the better the response will be," Valencia said. He said the compost also increased the pH of acid soils, bringing them

**At Sonoma Compost Company, a Scarab windrow turner stirs compost piles to aerate them.**



**Front-end loader transfers compost to a truck and trailer. It will be delivered to Sonoma Compost's commercial customers, including agricultural groups and landscape supply nurseries.**

closer to neutral. As part of this grant, farm advisor Ed Perry looked at using green waste compost in the production of nursery plants. He found that the compost could be used as a substitute for traditional organic amendments, such as fir bark, redwood compost, peat moss or sawdust.

- In Tulare County, farm advisor Carol Frate applied green waste compost, poultry manure and conventional fertilizers to portions of the Bergman Farm. In areas where green waste and manure were applied, nitrogen fertilizer was added to meet the crop's nutrition needs. Cotton was grown the first year, followed by winter wheat and corn the second. The treatments showed no variation. "It may take several years of applications to garner the benefits of green waste in this intense agricultural rotation," Frate said.
- The City of San Jose is coordinating a demonstration in Santa Clara County comparing green waste compost and mulch on a variety of crops that include grapes, peppers, lettuce and strawberries. Although the three-year trial has not resulted in significant differences in crop yield, technical specialist Will Gehr says he expects soil tests will reveal higher organic matter in areas treated with the green waste products.
- Working with UC Santa Cruz, environmental studies scientist Marc Buchanan has found lower levels of disease in lettuce and onion

fields that were treated with green waste compost. In 1995, there was a very significant reduction in *Fusarium* basal plate in onions, he said. However, when the trial was repeated in 1996, there was no difference in disease levels. In lettuce, numerical trends suggested a reduction in *Sclerotinia* (lettuce drop) in lettuce. Although the trend was not proven statistically, Buchanan said that may be due to the disease's propensity to be distributed in clumps.

Other studies are also being conducted with green waste composts and mulches. UC Riverside plant pathologist John Menge is studying whether green waste compost inoculated with beneficial organisms can combat *Phytophthora* root rot in avocado trees and *Phytophthora* root rot of citrus. Menge's work with green waste has already resulted in changes in avocado production. Early in his research, he found that green waste mulch applied to newly planted avocados increased yield 140%. "Because of our success with the mulch, almost all avocado growers putting in new trees use these mulches," Menge said.

In Tulare and Fresno counties, environmental horticulture advisors Michelle LeStrange and Pam Elam are using urban green waste as a top dressing on turf. With one-half inch of compost applied twice a year, the turf showed a significant reduction in weed populations, increased turf density and better color retention in the fall compared to untreated turf.

Although communities that do not comply with AB 939 are subject to fines of up to \$10,000 per day, the Integrated Waste Management Board acknowledges that it will not be easy to reduce inputs to the levels required by the law. "With the cooperation of industry, environmental groups and local governments, we think it can be done," said John Frith, director of the CIWMB public affairs. "We will do everything in our power to ensure the legislative mandate is achieved."

If growers — particularly those near urban centers — can justify the cost of purchasing, transporting and spreading green waste compost and mulch on their farms, they will make a substantial contribution to California's efforts to meet its ambitious waste management goals.

— Jeannette Warnert