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INSIDE THIS ISSUE

The Herbicide Contaminated Compost Issue

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Herbicide contaminated composts have suddenly come to the fore as another important environmental issue threatening California's landscape and greenwaste recycling industries. Starting in 2001, articles began appearing in some of the state's major newspapers which focused the public's attention on the issue and raised its level of importance. It is borne out of problems that began in Washington state where herbicide-contaminated composts were found to be causing injury to garden plants.

Clopyralid was confirmed as the culprit by the manufacturer, DowAgrosciences (formerly known as DowElanco). Clopyralid residue has since purportedly been found in finished composts in California, but so far no plant damage from tainted compost has been reported in this state. The problem occurred in spite of warning language on many product labels to avoid composting clopyralid-treated plant material. This sparked a storm of controversy and concern in the green industry and the public over the safety of composted greenwastes here in California. The following discussion is intended to provide information on clopyralid and the problems it causes in compost, the California situation, and suggest steps the landscape industry can follow to minimize contamination of compost.

Clopyralid Products and Use

Clopyralid is a pre- and post-emergent herbicide with activity against a narrow range of certain annual and perennial broadleaf weeds. Products containing clopyralid have been on the U.S. market for more than 17 years and have been registered in California since 1997.

Clopyralid is a constituent of products sold under several trade names registered for a variety of uses including cropland, rangeland, turfgrass, roadside right-of-way and other non-crop applications. *Confront* is a turfgrass herbicide that also contains tryclopyr and is registered for use in commercial turfgrass applications and golf. *Lontrel* is an herbicide containing only clopyralid that is also registered for commercial turfgrass. *Stinger* is a product registered for use in agricultural crops, and *Transline* is used for industrial and right of way weed control. *Trupower* is formulated for use by Trugreen/Chemlawn in their commercial applications to turfgrass. *Millenium* is formulated by Scotts as a fertilizer/herbicide granule for use in golf and commercial turfgrass applications. *Millenium Ultra*, formulated by Riverdale Chemical Company, is a combination product (clopyralid, 2,4-D, and dicamba) registered for use on ornamental turf sites such as golf courses and lawns. No clopyralid products are available for use by homeowners in California.

Clopyralid has excellent activity against certain difficult to control leguminous weeds. In turfgrass it is particularly effective in controlling clovers and dandelions. Use of clopyralid enables applicators to attain control of certain broadleaf weeds with fewer herbicide applications. However, a relatively limited amount of clopyralid is used in California on turfgrass due to its expense and narrow registration of uses.

Clopyralid Basics and Mode of Action

Clopyralid is a plant growth regulator herbicide from the picolinic acid group of compounds. In susceptible plants, clopyralid disrupts auxin-regulated processes, including cell respiration and growth, causing uncontrolled and disorganized plant growth that leads to plant death. Uptake of the herbicide is either through roots or leaves, and it is both phloem and xylem mobile. Translocation throughout the plant is rapid and the material accumulates in growing points of the plant where it has its primary effect.

Clopyralid affects sensitive plants at a concentration as low as 10 parts per billion, – a very low concentration. Typical clopyralid toxicity symptoms include curved and twisted stems and leaves, cupping and crinkling of leaves, stem cracking, and hardened growth on stems and leaves. Complete browning and death can take a couple of weeks for seedlings or an entire season for susceptible perennial or woody plants.

Clopyralid is more selective (kills a more limited range of plants) than some other auxin-disrupting herbicides like picloram, triclopyr, or 2,4-D. Like these herbicides, clopyralid has little effect on grasses and other monocots. Also, clopyralid does little harm to members of the mustard family (Brassicaceae) and several other groups of broad-leaved plants. The basis of its selectivity is not well understood. Clopyralid is primarily effective against four plant families: Asteraceae (sunflower family); Solanaceae (nightshade/tomato family); Fabaceae (legumes/peas/clover family); and the Polygonaceae (buckwheat/knotweed family).

Clopyralid is water-soluble and does not bind strongly with soils or evaporate easily. The chemical breaks down comparatively slowly in soil and persists in plant material, even in non-susceptible and non-target species. Clopyralid may persist in the environment from a month to over a year. Its persistence is greatest in soils that are low in oxygen (compacted or water saturated most of the time) and low in microorganism activity (cold, heavily graded or disturbed soils). It is degraded almost entirely by microbial action in soils or aquatic sediments, but not by sunlight or contact with water. Microbial break down rates are highest in warm, moist soils that are low in organic matter, and lowest in cold, dry, compacted or waterlogged soils.

The only identified clopyralid degradation product is carbon dioxide. The inability of clopyralid to bind with soils and its persistence imply that it has the potential to contaminate water resources and non-target plant species, but no extensive offsite movement has been documented. Clopyralid is low in toxicity to aquatic animals and very low in toxicity to most animals, but it can cause severe eye damage including permanent loss of vision in humans.

Toxicity Problems and Compost Contamination

Toxicity problems started in Spokane, Washington when symptoms were first noted on tomato plants. Clopyralid was found as a contaminant in greenwaste composts incorporated in to the soil or applied around plants as mulch. The problem was noted at about the time that curbside recycling of green wastes and the associated composting programs began in that state. Since grass clippings are an important component in that state's green wastes, they were soon identified as the source of the herbicide, and the origins of it were traced back to applications of *Confront* to residential lawns.

There are a number of desirable crop and ornamental plant species among the families which clopyralid might affect including tomato, pepper, eggplant, potato, beans, peas, sunflower, chrysanthemum, daisy, petunia, acacia, honey locust and other leguminous plants. Age of the plant and rate of herbicide application will greatly impact the degree of injury that might occur. Plants are most tolerant to clopyralid applications when they are established and when there is some woody tissue around the stem or trunk. Thus, it is believed that woody plants are less likely to be damaged from the presence of clopyralid-contaminated compost in the landscape.

The characteristics of clopyralid allow it to remain active and available for plant uptake for a long period, thereby reducing the amount of herbicide and number of applications needed to achieve control of susceptible plants.

Conversely, its characteristics cause a significant problem when greenwaste from clopyralid-treated plants is composted. Clopyralid survives the composting process and very little of its residue is needed to cause toxic effects on non-target plants that come in contact with finished composts used as soil amendments or mulches.

Considerable study has been undertaken by the manufacturer to understand the persistence of clopyralid. Clopyralid persists to a variable degree in soil when applied to turfgrass or directly to soil as a pre-emergent treatment, so it remains available for any plants present to take it up and translocate it. However, it was discovered that when grass clippings or other plant materials containing clopyralid are composted, the herbicide becomes bound in the organic matter and it becomes more persistent, not less persistent after composting. For some time it was thought that the wrong microbes were in the compost and that addition of new clopyralid degrading organisms found in soil would solve the problem. This was subsequently tried and, unfortunately, it was shown that these organisms will not break down the herbicide when they are added to finished composts.

Other research showed that clippings collected between 2 and 14 days after being sprayed with the herbicides 2,4-D, triclopyr, clopyralid, or isoxaben caused unacceptable injury to tomatoes, beans, and impatiens when applied directly as mulch around these plants. However, after composting these clippings all of the herbicides except clopyralid degraded to non-detectable levels during 128 days or less of composting. In one study clopyralid was still detected after 365 days of composting.

Based on this research, labels of herbicides containing clopyralid typically state that turfgrass clippings treated with the herbicide should not be used as a garden mulch, and treated clippings should not be used to make compost during the season of herbicide application.

Recent research was conducted at the Washington State University – Puyallup turfgrass research facility to address the contaminated grass clipping problem. The objective was to determine if mowing practices or formulation (sprayable or granular) could be used to limit the amount of clopyralid entering the compost stream over a 10 week period. Clopyralid-treated turf was mowed weekly with clippings collected or mowed twice weekly with clippings returned. Clopyralid was applied to each mowing regime as a sprayable formulation or a granular formulation embedded on granules of 12-12-12 fertilizer. Sprayed plots received equivalent rates of fertilizer nutrients. Turf clipping samples were collected in each mowing regime at 0, 0.5, 1, 2, 3, 4, 5, 6, 7, 8, 9, and 10 weeks after clopyralid treatment. Regardless of formulation, the mowing treatment did not impact clopyralid concentration in clippings. By four and ten weeks after application, clopyralid concentrations in clippings were 7% and 0.4% of their initial concentrations in sprayed and granular formulation plots, respectively. Concentrations still averaged 150 ppb in clippings at ten weeks after application, which would be high enough in compost to cause injury to many plants. What is not known is what the final clopyralid concentration in compost would be based on an initial concentration of 150 ppb. A companion study is ongoing to measure the clopyralid degradation during composting.

What about California?

In March 2003, the California Department of Pesticide Regulation (CDPR) initiated cancellation action against 15 clopyralid-containing herbicide products intended for use on residential lawns. New restrictions were announced by CDPR in April 2003 to further protect possible herbicide contamination of commercial composts. CDPR will restrict sales of clopyralid to lawn and turf professionals, instruct those licensees to assure that green waste stays on site when the herbicide is used, and require dealers to provide written notice of the restrictions when they sell some clopyralid products. CDPR is drafting regulations to encourage those restrictions.

The agency expects its restrictions to affect about 15 cloryralid products used in parks, playing fields, and cemeteries. Golf courses were exempted after CDPR determined that grasscycling on site is a standard industry practice and that clopyralid product labels prohibit use on tees and greens. Clopyralid products labeled for farm, rangeland, and forest use are not affected.

The new restrictions do not go as far as some in the compost industry would have liked. The industry lobbied for a ban on commercial uses.

Compared to Spokane and perhaps other areas of the Pacific Northwest, many of California's urban areas produce greenwastes formulated from a variety of feed stocks with a higher proportion of woody materials to grass clippings. Also, the Spokane area has a relatively high concentration of residents who utilize commercial lawn care services, perhaps as much as twice the national average, and clopyralid is a popular herbicide used by them. There is a comparatively limited amount of clopyralid used in California landscapes and it is believed much of it, though not all of it is applied to turfgrass where the clippings are left to decay on the lawn (grasscycling), so they never enter the waste stream. In addition, Dow AgroSciences clopyralid herbicides have label restrictions on using compost containing grass clippings treated with the product.

Despite all of this, trace clopyralid residues have purportedly been found in greenwaste composts in Los Angeles, San Diego, and Sonoma Counties. Homeowners using professional lawn care services may not have been informed that clopyralid was used, or may not have known that restrictions apply, and unwittingly sent their grass clippings into the greenwaste stream. Fortunately, no serious damage has been reported on crop or ornamental plants receiving composted greenwastes in California.

Clopyralid, and possibly other persistent herbicides, threaten the state's greenwaste composting and recycling industry, the landscape industry, and state and local government programs that promote backyard and centralized composting as a method of dealing with greenwaste. Many in these industries and the public believe the existence of a class of herbicides that can damage the marketability of compost products is contradictory to recycling, resource conservation, and sustainability.

At this time, the potential or actual extent of contamination in California greenwastes is unknown. There is need for additional testing of greenwaste composts to get a clearer view of the threat.

However, clopyralid contamination should not become a disaster for California because of CDPRs recent actions and our compost feed stocks are diverse. It appears there is simply not enough clopyralid applied to turfgrass entering California's greenwaste stream for it to be a widespread, serious problem in compost.

Management Practices for Preventing Herbicide Contamination of Composts

There are multiple practices that can be followed to prevent herbicide contamination of greenwaste composts. The greatest risk is from herbicide-treated grass clippings, so steps must be taken to keep such clippings from entering the greenwaste recycling stream.

Landscape managers should carefully consider whether a clopyralid-containing herbicide is really needed to control the spectrum of weeds found in a given site. There are other herbicides that effectively control many broadleaf weeds but do not persist in turf clippings or other greenwaste. Also, turf that is maintained in good health and mowed at the correct height is less likely to be invaded by clover and other broadleaf weeds, which in turn reduces the need for herbicide applications.

If a clopyralid-containing product is applied to turfgrass, take all necessary actions to ensure clopyralid-treated grass clippings are not allowed to be used as mulch or compost feed stock. Be certain to follow label instructions and precautions and notify clients of the property that turfgrass clippings are not to be composted or used as mulch. Using a mulching mower to return clippings to the lawn area is the best way to manage treated grass clippings.

Contaminated compost should not be used in vegetable gardens, but it is probably safe to use it as a soil amendment for lawns or woody landscape plants, as most of these plants are not highly sensitive (although there may be exceptions). Compost should not be used as a sole growing medium, but should be mixed with soil at rates of up to 20% compost by volume. This will dilute clopyralid residue to a level most plants can tolerate. Also, microorganisms present in soil can break down clopyralid over time. It is recommended that landscape contractors ask their compost supplier about possible clopyralid contamination.

For additional information on clopyralid in compost, see the following web sources:

1. Washington State University:
   www.puyallup.wsu.edu/soilmgmt/Clopyralid.htm
   www.css.wsu.edu/compost/compost.htm
2. Dow Agrosciences:
   http://www.grrn.org/dow/DOW_Clopyralid_Compost_10-5-01.pdf
   http://www.wa.gov/agr/Dow_TolerantPlants.pdf

3. Technical background information on clopyralid:
   http://tncweeds.ucdavis.edu/handbook.html
   (scroll down to Chapter 7 and click on "Clopyralid")

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Runoff Water Quality Laws and Their Enforcement in California

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Water Quality Regulations are reshaping the way agricultural operations are conducted in the United States and throughout the world.

Federal Water Quality Regulations

Water quality regulations in the United States began in 1948 with the induction of the Federal Water Pollution Control Act (WPCA) of 1948. This policy, created and funded by the federal government, delegated responsibility of law development and implementation to each state (Houck, 1999). Since its creation, many amendments have been added (Table 1) which has resulted in major changes to the original WPCA. By the 1960s, the government realized that only focusing on point sources of pollution was not enough since surface and groundwater sources were still impaired. Therefore, in 1972, the WPCA was again amended with §303(d), which pointed toward regulations for water quality standards from both non-point in addition to point source polluters. This amendment also resulted in the renaming of the WPCA to the Clean Water Act (CWA). **This act now has two major programs:**

(1) **The Total Maximum Daily Loads (TMDLs),** a set of narrative recommendations that define how much of a specific pollutant a water body can receive on a daily basis without compromising water quality.

(2) The National Pollutant Discharge Elimination System (NPDES), which requires point-source polluters to mitigate effluent to meet specific water quality standards. Point-source pollution is defined as 'discernable, confined, and discrete conveyance'. The industries under this definition included factories, water treatment plants, and urban storm conveyance systems. However, the difference between point and non-point polluters is becoming less defined as developments such as golf courses, nurseries, and commercial urban landscapes become labeled as point source instead of non-point source polluters.

Under the Clean Water Act §303(d), states are to:

(1) Identify the water resources that are polluted,

(2) Establish the TMDLs that will restore water quality, and

(3) Allocate pollutant loads to discharge sources via state water programs and discharge permits.

In order to oversee these programs the EPA has divided the continental U.S. and associated territories into ten regions (Fig. 1 – http://www.epa.gov/ceppo/sta-loc.htm). Each region has an office, which is responsible for assisting states in the implementation and enforcement of water quality policies.

California Water Quality Regulations

Like all other states in the U.S., California was aware of the water pollution problems in their region. Therefore, The state developed its own water quality regulations. In 1969, California enacted the **Porter-Cologne Water Quality Control Act (PCWQCA).** Based on the PCWQCA, waste discharge permits (WDR), which meet the requirements for the federally regulated NPDES, are issued to anyone releasing waste into waterways. However unlike the federal regulations, these permits are not only issued to point source polluters, but also those that would be considered under federal regulations to be non-point source polluters.

Table 1. History of federal and California clean water quality regulations as they pertain to agricultural operations.

Date of creation	Program	Public Law #
1948	Water Pollution Control Act (WPCA) – federally funded. State regulated program to clean water polluted from point sources.	80-845
1965	Amendment to WPCA - provided federally approved water quality standards for interstate waters. Name changed to Water Quality Act of 1965.	89-234
1969	California Porter-Cologne Water Quality Act – state policy to regulate waste discharge. No distinction made between point and non-point source polluters. Fulfilled the federal requirements that would be established with amendment §303(d) in 1972.	NA
1972	Amendment §303(d) of Water Pollution Control Act – Regulations introduced with the Total Maximum Daily Loads (TMDLs) guidelines. Name eventually changed to the Clean Water Act.	92-500
1977	Amendment added – provided for the development of "Best Management Practices" programs. Name changed to the Clean Water Act of 1977.	92-500
1987	Amendment §304(l) and §319 – development of numerical rather than narrative water quality criteria. §319 addresses non-point source polluters Name changed to the Water Quality Act of 1987. However, most still refer to the act as the Clean Water Act.	95-217

Because of the large geographical size and the diverse industries in California (Fig. 2), pollution sources (Fig. 3) differ throughout the state. For instance, many nurseries and dairies operate in southern California; therefore, nitrates and phosphates are major pollutant in this area. In northern California, excess deposition of sediments into waterways is a primary concern due to erosion caused by the logging industry. Major differences in climate, especially rainfall also complicate water quality issues. To confront this problem, the State Water Resources Control Board (SWRCB) has divided the state into nine regions (Fig. 4), with each region housing its own Regional Water Quality Control Board (RWQCB). Each region, under the direction of the SWRCB is to develop pollutant discharge standards based on the level and type (pollutant) of impairments they encounter in their area. From the policies developed, WDR permits are issued to individuals.

Current Regional Regulations

The San Diego Water Basin (Region 9) was the first area to be affected by policy implementations. Environmentalists threatened to sue several municipalities in this area in the late 1980s. The pending lawsuits resulted in a series of policy implementations which initiated a chain reaction of similar suits in the central and northern regions of the state.

Even though all RWQCBs are following the PCWQCA, the regulations that have been developed differ from region to region. In San Diego (Region 9), runoff is limited to only storm water, excluding the runoff from the first storm event, which must be captured. Because of this 'zero runoff' policy, TMDLs and other similar regulations pertaining to runoff water have no applicability in the San Diego Basin. In the Santa Ana Basin (Region 8), runoff is allowed, but a WDR must be issued. Many physical and chemical restrictions must be followed according to the Santa Ana Basin Plan (Table 2). One of the most restrictive is the electrical conductivity (EC), which must not exceed 2.0 dS/M. This is challenging for most nurseries in this area, since most irrigation water is derived from the Colorado River, which usually has an EC of 1.5 dS/M. In the North Coast (Region 1), WDR are required, but only during the con-

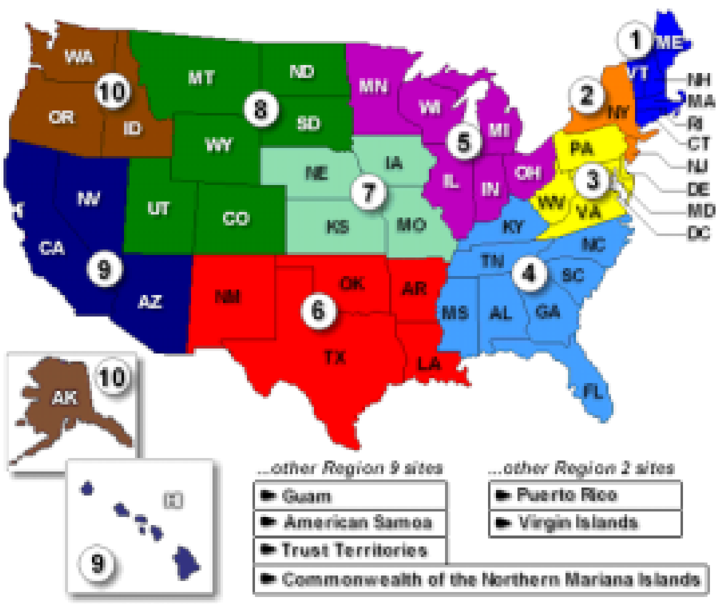
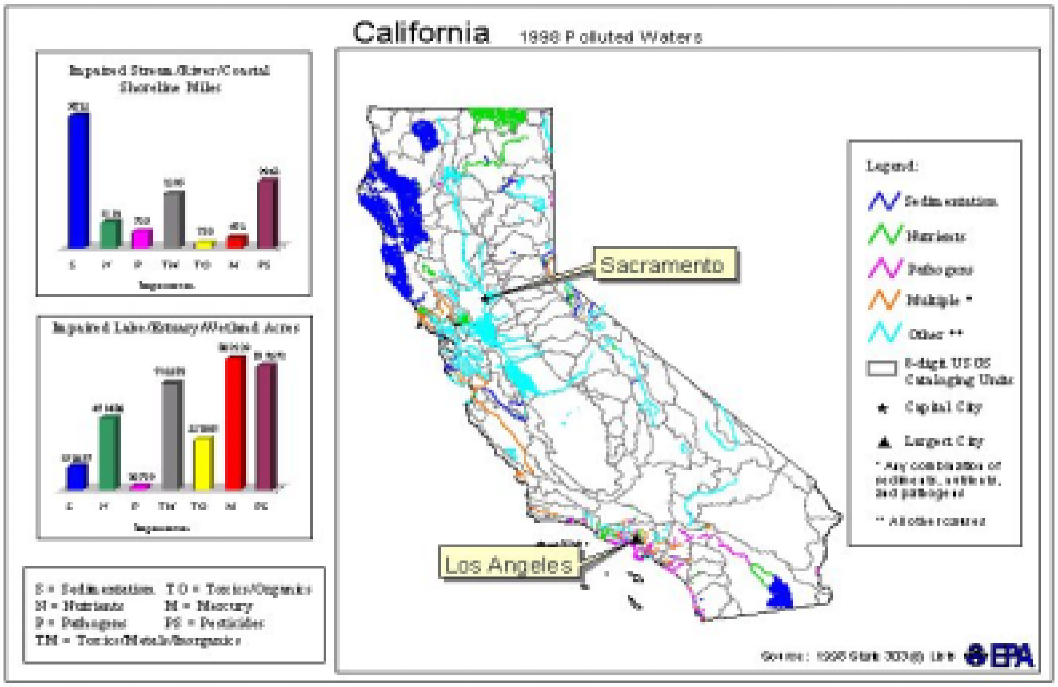


Figure 1. Map of the United States showing the division of the nine water districts as established by the EPA. Map is courtesy of the USEPA (http://www.epa.gov/ceppo/sta-loc.htm).

Figure 2. Agricultural commodities of California and their geographical distribution.

Figure 3. Map of the California showing the different types of pollution present.



struction of nursery facilities. However, no WDR is required for normal nursery operations. Based on the history of water quality regulations in California, it is likely that stricter regulations will fall upon the nursery industries throughout the state. Currently, grants have been funded to the University of California Cooperative Extension and growers associated with the nursery and floriculture industries in San Diego and Los Angeles counties to study and develop Best Management Practices (BMPs) to meet the water quality regulations set forth by the state and federal governments. In San Diego (RWQCB 9), a $300,000 grant was funded through Proposition 13 monies to implement BMP programs for nursery growers. In the fall of 2003, a similar grant of $3,000,000 will be funded for the development of BMP programs in Ventura County (Region 4).

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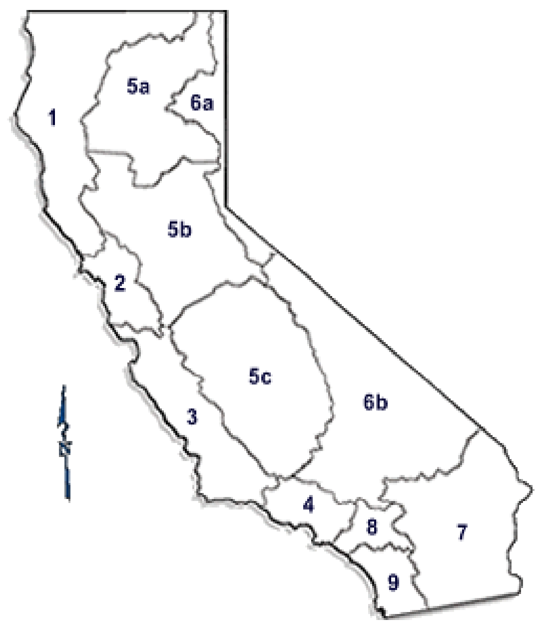

Figure 4. Map of California, USA, showing the boundaries of the state's nine Regional Water Quality Control Boards (RWQCB). Water quality regulations are overseen by the State Water Quality Resources Control Board (SWQRCB) which delegates the responsibility for the development and implementation of regional basin plans to the nine RWQCB. Map Courtesy of State of California, 2000, California Environmental Protection Agency, State Water Resources Control Board. http:www.swrcb.ca.gov/regions.html.

Table 2. Chemical parameters that have been listed by the EPA and adopted by the Water Quality Santa Ana River Basin (Region 8). Only those chemicals that may be of concern for nursery operations have been listed. Data from the 'Water Quality Control Plan, Santa Ana River Basin (8)', 1995.

Chemical	Water Body of Regulation	Environmental/Human Impact	Chemical Limits in Wastewater[1]
Chlorine (Cl)	Ocean, Inland surface water, Groundwater	Aquatic life -Chlorine and its reactants can be toxic to aquatic life.	NA
Hydrogen Ion Concentration (pH)	Ocean, Inland surface water, Groundwater	Aquatic life - Pollutants that change pH can harm aquatic life. Structural - Extreme water pH can deteriorate pipes and concrete.	Ocean -pH 7.0-8.5. Inland Waters-pH 6.5-8.5 Groundwater - pH 6.0-9.0
Surfactants - detergents, emulsifiers and wetting agents	Inland surface waters	Waterfowl - Reduced water surface tension can drown waterfowl. Aquatic life – Surfactants may affect some aquatic life. Aesthetics - Foaming is a physical and aesthetic problem.	NA
Toxic Substances	Ocean, Inland surface water	All life forms - Toxic substances cannot be discharged at quantities that bioaccumulate to toxic levels to humans. Toxic pollutants in water, sediments or biota should not affect beneficial uses.	NA
Boron (B)	Inland surface water, Groundwater	Higher plants - High levels (>0.75 mg/L) are toxic to many plants. Human health - Boron is toxic when concentrations exceed 20-30 mg/L	NA
Total Dissolved Solids (TDS)	Inland surface water, Groundwater	Plant life - Dissolved mineral content should be less than 700 mg/L when used for agriculture.	NA
Nitrate (NO_3)	Inland surface water, Groundwater	Human health - Infants develop blue baby syndrome (methemoglobinemia). Drinking water standard cannot exceed 10 mg nitrogen/L or 45 mg nitrate/L.	NA
Iron (Fe)	Groundwater	Human and animal health - High concentration of metals are toxic.	0.3 mg/L
Manganese (Mn)	Groundwater	Human and animal health - High concentration of metals are toxic.	0.05 mg/L

[1] NA indicates that no specific chemical concentrations were available.

Kikuyugrass

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Kikuyugrass *(Pennisetum clandestinum)* is an extremely aggressive perennial weed of turfgrass, ornamental plantings, orchards, and noncrop areas in California. Native to Africa, kikuyugrass is well adapted to warm, temperate climates such as those of the coast and inland valleys of southern and central California. Kikuyugrass was originally imported to California around 1918 as a ground cover to reduce erosion on ditch banks. With its rapid stolon growth and thatch formation, it quickly moved from these sites and became a serious weed pest. In the past kikuyugrass was often confused with St. Augustinegrass and may have been mistakenly propagated and planted in its place.

Impact

Kikuyugrass is a major weed problem in turfgrass and ornamental areas but can also be found in coastal and inland valley orchards of southern and central California. It causes physical, aesthetic, and competition problems. In turfgrass it forms thick mats that crowd out desirable species. The thick mat makes golf and other athletic uses difficult and in some cases dangerous. The light green color and coarse texture of kikuyugrass is not aesthetically desirable compared to other turf species. In golf courses it often invades greens and requires hand removal. In ornamental areas it invades ground covers and flower beds, often completely choking them out. Kikuyugrass can invade low-growing shrubs, blocking out light and reducing vigor. In orchards it can compete with trees for nutrients, interfere with irrigation by blocking sprinklers and emitters or drainage ditches, and overgrow fences.

Management

The best way to control kikuyugrass is to prevent its spread into new areas. Kikuyugrass can be spread both from seed and from stem sections and seems to be most commonly spread by mowing, cultivation, and renovation equipment. Clean equipment to remove any kikuyugrass seed or stem sections before moving it from infested areas. Kikuyugrass has also been spread in contaminated soil, sod, and planting stock. Make sure that any incoming materials are free of contamination. Maintain turfgrass and ornamental areas to assure they are at maximum vigor so that these plantings are as competitive as possible to help slow the invasion of this weed. Dense turfgrass and ornamental plantings shade the soil surface, making the establishment of kikuyugrass sprigs and seedlings more difficult. Vigorous, tall fescue varieties have been effective at reducing kikuyugrass invasion when used in the turfgrass. Regularly inspect orchards and noncrop areas for the presence of kikuyugrass and other invading weed species. Remove the invading species by hand or spot-treat them with an herbicide to prevent their spread.

Control

Kikuyugrass cannot be controlled with a single treatment or procedure in turfgrass. A vigorously growing turf coupled with early grubbing (removal of the entire plant, roots and all) of solitary infestations has been successful when practiced diligently. Spot-spraying isolated plants with glyphosate can be helpful but will also kill the turfgrass, leaving open areas in which kikuyugrass can easily reestablish itself. Overseed the open spots with the desired grass species to establish a vigorous turfgrass.

When they are applied in March, preemergent herbicides have been successful in limiting germination of kikuyugrass seeds in spring and early summer. Pendimethalin, bensulide, benefin, and prodiamine are available for use around the home. Because this weed spreads primarily by regrowth from stem sections, multiple applications of a postemergent herbicide are required to control established infestations. In cool-season turfgrass (tall fescue, perennial ryegrass, and Kentucky bluegrass) about three to four applications per year are necessary. Best control has been obtained from sequential applications of a combination of triclopyr and MSMA applied 4 to 6 weeks apart. Both are available for use around the home. Sequential applications of either MSMA or triclopyr alone will reduce kikuyugrass vigor and growth, but are not as effective as the combination.

In bermudagrass turf, either quinclorac or MSMA can be used alone or in combination to reduce a kikuyugrass invasion. Sequential applications will be necessary. Quinclorac is only available to commercial applicators.

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Figure 1. Kikuyugrass stolon showing rooting at nodes.

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