



Managing Weeds Under Drought Conditions

While one of the best methods to reduce weeds is to not water them, there are some that survive even in drought conditions (Figure 1). As we continue to be impacted by the drought in California, we need to consider our weed management strategies:

- Which weeds will survive?
- How do drought conditions affect control?

Which Weeds will Survive?

Many weeds, once established, need very little water to survive. Weeds with extensive, deep root systems are able to “mine” water or otherwise have a physiological mechanism to survive under low soil moisture conditions. Many of these plants are perennials; but annuals, especially those that can quickly develop deep roots, can also be found in dry areas. For example, yellow starthistle (*Centaurea solstitialis*) (Figure 2) is a winter annual that develops a taproot to 6 feet deep or more allowing it to access deep moisture in summer. Some weeds, such as

yellow nutsedge (*Cyperus esculentus*) and broadleaf plantain (*Plantago major*) will establish best in wet areas but after maturing can tolerate very dry conditions.

Other weeds that survive well in drought conditions include the mallows (*Malva* spp.), knotweed (*Polygonum aviculare* L.), horseweed and hairy fleabane (both *Conyza* spp.). Perennial weedy grasses that can survive in low soil moisture include dallisgrass (*Paspalum dilatatum*) (Figure 3) and bermudagrass (*Cynodon dactylon*).

How do Drought Conditions Affect Control?

Not only does low soil moisture affect weed establishment; weed control with herbicides is also affected. Soil moisture factors that affect herbicide activity include degradation rate (residual) and herbicide uptake. For a herbicide to be active it must be absorbed by the plant then translocated to the site of action in high enough quantities to be toxic.

The effect of drought on preemergence herbicides. Most preemergence herbicides need rain or irrigation within 3 weeks of application to be effective but should optimally receive this “activating” moisture within a day or two of application. Herbicides that remain on a dry soil surface may degrade or volatilize off or can attach to soil particles and blow away. Rain or



Figure 1. Some weeds thrive in drought conditions.
(J. Roncoroni, UCCE, Napa County)

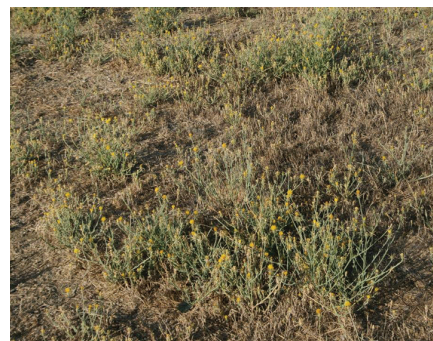


Figure 2. Yellow starthistle.
(J. Roncoroni, UCCE, Napa County)



Figure 3. Dallisgrass can withstand drought conditions once established.
(J. K. Clark, UC IPM)

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irrigation moves the herbicide down into the soil where germinating seeds will take it up. Because the preemergence herbicide must be at proper depth to work effectively, the amount of water applied must be enough to move the herbicide to that depth. Even though water use may be restricted, the herbicide application should be timed such that enough water is allocated to the area for good weed control.

It's important to remember that pre-emergence herbicides generally will not control weeds that have already, or are close to, emerging, so any weeds germinating between the time of herbicide application and delayed irrigation will not be controlled. Also, water stress may cause some weeds to germinate later than normal. In that case, a previously applied herbicide may not be present in a high enough concentration to be effective. Overall, drought conditions can shift weed control to postemergence herbicides due to preemergence herbicide failure and late weed emergence.

The effect of drought on postemergence herbicides. As noted above, a herbicide must be absorbed into the weed and moved to the site of activity to be effective. Therefore, anything that inhibits these steps will reduce a postemergence herbicide's activity. Plant stress under drought conditions

may result in a thickened cuticle, the waxy covering of a plant's leaf. The thicker the cuticle, the harder it is for the herbicide to be absorbed into the leaf. Additionally, plant leaves tend to get dustier in dry weather conditions, which can inhibit herbicide uptake. For example, glyphosate is very strongly adsorbed to organic soil particles. If the weeds are dusty, not only is it physically difficult for glyphosate to reach the leaf surface, it may bind with the dust and the overall herbicidal activity is, therefore, reduced.

Furthermore, plants that are actively growing will move the herbicide more effectively than those that are stressed. Under drought conditions, postemergence herbicides may not provide the kind of control you expect.

Overcoming the effect of drought on postemergence herbicide activity. Where plants are stressed but a postemergence herbicide is still the management choice, it may be worthwhile to actually water the site a few days prior to the herbicide application to ensure that weeds are growing and can take up the herbicide. Overhead irrigation will also help rinse dust off the plants.

Surfactants can be used if there is no contradiction on the herbicide label for their use. Surfactants are products



Figure 4. Surfactants can reduce surface tension of liquids. (Wikimedia Commons)

that enhance the ability of an herbicide to enter into a leaf or to stay in an aqueous solution, thereby improving herbicide uptake. Surfactants can reduce the surface tension of liquids, causing greater droplet contact with the leaf surface and aid in movement into stomata, can slow evaporation of herbicide droplets, and in some cases can assist in passage of hydrophilic herbicides through hydrophobic wax layers of the cuticle.

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Pest Note Updates

UC IPM recently released two new titles, Brown Marmorated Stink Bug and Leaffooted Bug, and eight revised titles in its Pest Notes series of publications covering home, garden, landscape, and wildlife pests.

Brown Marmorated Stink Bug
<http://www.ipm.ucanr.edu/PMG/PESTNOTES/pn74169.html>

Leaffooted Bug
<http://www.ipm.ucanr.edu/PMG/PESTNOTES/pn74168.html>

View these new/revised pest notes and the 165 other titles on our web site at www.ipm.ucanr.edu/PDF/PESTNOTES/index.html.



Understanding Neem-based Pesticides

Use of and demand for naturally-derived pesticides are likely to increase due to concerns from the general public about risks and hazards associated with pesticides, adoption of integrated pest management policies and approved pesticide lists by municipalities and public agencies, and regulatory restrictions on some conventional pesticide active ingredients. Many of these “green” or “natural” products are new to the urban pest management industry, although some of the active ingredients have been used for decades. The neem tree (Figure 1), *Azadirachta indica*, has a long history of being utilized as a source of traditional medical treatments. Its natural repellency to insects, though well known in its native India, became widely recognized in 1959 during a desert locust invasion in which all vegetation was devoured except the neem trees. Upon further investigation, neem extracts were found to have significant insecticidal, nematocidal, and fungicidal properties. Systematic analyses of the various compounds found pointed to a limonoid triterpene new to science (which was subsequently named azadirachtin) as the chief active ingredient responsible for the observed insecticidal properties. Today, numerous professional-use pesticidal products derived from the neem tree exist (Table 1); some list azadirachtin and some name neem oil (also known as margosa oil) as the active ingredient. As a pest management professional, you will be more successful when using these products once you understand how these different formulations and active ingredients affect the target pests.

Azadirachtin

Azadirachtin acts on insects in two important ways: as a natural insect growth regulator (IGR) and as an antifeedant. The IGR qualities of azadirachtin are due to its chemical similarity to ecdysones, important insect hor-

mones necessary for successful molting and reproduction. Azadirachtin competes for molecular binding sites with ecdysone and, therefore, leads to incomplete molting in immature insects, followed by death due to starvation and desiccation. In adult female insects, the same hormonal competition leads to sterility. Additionally, many insects will stop feeding once they have ingested azadirachtin, a behavior that leads to death by starvation. This antifeedant phenomenon has been observed in caterpillars, aphids, true bugs, beetle larvae, grasshoppers, sawflies, and many other insects. Azadirachtin is also known to move systemically within some plant species, so that sprays to one part of a plant may be effective in other parts of the same plant. Azadirachtin, though an important component of neem seeds and leaves, is typically not present in high concentration within neem oil prod-



Figure 1. Neem tree fruit and leaves. (G.D. Carr, OSU)

ucts. Pesticides listing azadirachtin as an active ingredient can be expected to have systemic insecticidal effects as IGRs and antifeedants and are more effective than neem oil against caterpillars, beetles, and other insects with complete metamorphosis or hard bodies.

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Table 1. Professional-use Neem-based Pesticides Registered for Use in California’s Urban Landscapes and Their Respective Concentrations (according to product labels) of Azadirachtin and Neem Oil.

Product Name	% Azadirachtin	% Neem Oil
Amazin Plus 1.2% ME	1.2	0
Aza-Direct	1.2	0
AzaGuard	3	0
AzaMax	1.2	0
AzaSol	6	0
Azatin XL	3	0
Azatin O	4.5	0
Azatrol EC	1.2	0
BioSafe Insect Control	3	0
§Cirkil CX	0	22
Debug Turbo	0.7	65.8
Molt-X	3	0
Neemix 4.5	4.5	0
Ornazin 3% EC	3	0
§Proof	0	5.5
Triact 70	0	70
Trilogy	0	70
§ This product has been registered for use against bed bugs within structures.		

The Good Side of Pruning

In the December 2013 issue of the *Green Bulletin*, we looked at “Pruning and Tree Physiology: The Bad and the Ugly” for pruning and maintaining ornamental trees as well as some pruning pitfalls. However, pruning can also be highly beneficial for many landscape trees. In this article I will review some approaches to pruning which either directly suppress pests or maintain tree health, and because impaired health predisposes trees to a number of diseases, these pruning measures could thus be considered part of an integrated pest management program.

Formative Pruning

A young tree arriving from the nursery, or getting established in its first few years in the landscape, often requires pruning, over multiple seasons, to guide the tree to a site-appropriate mature form. This is the best time to correct, by pruning, any structural deficiencies, such as co-dominant leaders, rubbing or overlapping branches, or girdling roots. In most cases, these structural problems are not “self-correcting,” making pruning a necessary measure. Importantly, a young tree is not only better able to tolerate the removal of live biomass than a mature tree (i.e., the “pruning dose” can be larger—up to 50% of foliage might be removed from a newly planted tree), but the pruning cuts themselves are

made on small branches and are thus smaller and more rapidly sealed over, minimizing the likelihood of infection by plant pathogens or wood decay fungi. A number of printed and on-line instruction manuals are available demonstrating the goals and methods of formative pruning, such as articles and leaflets from the University Of California and Tree Cue Cards from CAL FIRE.

Corrective Pruning

In cases where formative pruning was neglected or insufficient, or where a tree has suffered some physical damage (e.g., from storms or vandalism), pruning can be useful in correcting defects like broken or overlapping branches, double leaders, or poor branch spacing on mature trees. Corrective pruning aims for minimally-sized, properly located pruning cuts that promote successful “compartmentalization,” that is, cuts that allow the tree to seal over with callus tissue on the outside and that limit the spread inside the tree of any decay organisms that may invade. Proper pruning cuts are always preferable to failures (e.g., breaks or “tear-outs”) of branches or leaders, which are often caused by uncorrected structural defects and which frequently result in large wounds that compartmentalize poorly (e.g., because they are located mid-branch or they tear away large strips of bark) and



Figure 1. Branches infected with fire blight. (J. K. Clark, UC IPM)

remain a major invasion pathway for pathogens or wood decay fungi. The “pruning dose” for corrective pruning should be smaller than for formative pruning, not exceeding about 25% of foliage removal from an established tree. As little as 10% foliage removal is the recommended maximum for older, mature trees.

Eradicative Pruning

It is possible, in some cases, to use pruning as “surgery” to remove infected parts from trees, thus removing (eradicating) disease. Several diseases can be managed in this way, including some canker pathogens (like

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Disease Spread by Pruning

While spreading disease with pruning tools is a reasonable concern, it actually appears to be somewhat uncommon in the practice of landscape tree maintenance. To reduce the risk of contaminating pruning tools, the best approach is to ensure that pruning cuts are made well below cankers or branch lesions. For example, the current recommendations for fireblight are for branch cuts to be made at least 12 inches below the edge of the blight lesion.

For some diseases, however, spread through contaminated tools is a real threat, as exemplified by *Fusarium* wilt of Canary Island date palms or the somewhat uncommon canker stain of sycamore. In these cases, it may be possible to disinfect some pruning tools, such as hand saws, after each cut by using bleach or household disinfectants. However, tools like chainsaws are impossible to disinfect and should not be used to prune *Fusarium*-susceptible palms. Some practitioners have resorted to using a separate set of hand tools for each high-value palm tree so as to minimize the potential for spreading disease between individual trees.

Good Side of Pruning

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branch cankers) and tip necroses (like [fire blight](#)) (Figure 1) and even some insect infestations. For plant diseases, the effectiveness of eradica-tive pruning varies by pathogen as some spread quickly through the tree and are typically systemic by the time symptoms appear (e.g., [vascular wilts](#)). The effectiveness also varies by tree size and accessibility of the infected/infested branches. For example, [pitch canker](#) in Monterey pine is usually a set of individual infections from branch tips that can be cut off to re-duce the disease, but pruning away the multiple infected branchlets may be impractical on a large or tall tree. Fire-blight, on the other hand, often occurs on smaller-stature trees and can be successfully managed by removing infested branches well below the canker margin. In using this approach to manage pathogens, it is important that the pruning cut be made well below (8-12 inches or so) any infected tissue, so as to both remove all of the infected tissue and to prevent contamination of the pruning tool (see box on page 4). While the extent of some infestations on a tree branch is quite obvious, for other diseases you may have to look for subtle symptoms, such as sunken or discolored bark or wilted foliage to identify the margins of infection.

Sanitation Pruning

While practiced extensively in or-chards, sanitation pruning is often underappreciated in ornamental trees but is quite applicable here as well. It is especially effective in suppressing those diseases that overwinter in dead tips of twigs or branches or in hanging dead foliage or fruit (“mummies”). In landscape trees, spring inoculum for diseases such as anthracnose (e.g. in sycamores and plane trees) (Figure 2) and powdery mildews can often be effectively reduced by removing the dead twigs in winter.

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Figure 2. Anthracnose on sycamore twigs. (J. K. Clark, UC IPM)

Resource List

CAL FIRE Tree Cue Cards:

http://www.fire.ca.gov/resource_mgt/resource_mgt_urbanforestry.php

UCCE Ventura County Pruning Small Trees and Shrubs:

http://ceventura.ucanr.edu/Environmental_Horticulture/Landscape/Pruning/

UC Center for Landscape and Urban Horticulture:

<http://ucanr.edu/sites/UrbanHort/files/80115.pdf>

UC IPM Pest Notes

Fire Blight:

<http://www.ipm.ucdavis.edu/PMG/PESTNOTES/pn7414.html>

Pitch Canker:

<http://www.ipm.ucdavis.edu/PMG/PESTNOTES/pn74107.html>

Anthracnose:

<http://ucipm.ucdavis.edu/PMG/PESTNOTES/pn7420.html>

Powdery Mildew:

<http://www.ipm.ucdavis.edu/PMG/PESTNOTES/pn7493.html>

Palm Diseases (Fusarium Wilt):

<http://www.ipm.ucdavis.edu/PMG/PESTNOTES/pn74148.html#FUSARIUM>

UC IPM Pest Management Guidelines

Branch Canker:

<http://www.ipm.ucdavis.edu/PMG/GARDEN/PLANTS/DISEASES/cankerdiseases.html>

Vascular Wilts:

<http://www.ipm.ucdavis.edu/PMG/GARDEN/PLANTS/DISEASES/fusariumwilt.html>

Canker Stain:

<http://www.ipm.ucdavis.edu/PMG/GARDEN/PLANTS/DISEASES/cankerstain.html>



Check out our UC IPM Blog!

Our blog provides a one-stop site for UC IPM news related to pests of homes, gardens, landscapes, and structures. We will be posting articles from our newsletters as well as announcing new and revised Pest Notes and other new educational materials or activities of interest to urban and residential audiences.

View or subscribe to the blog at:
ucanr.edu/blogs/ucipmurbanpests

Neem-based Pesticides

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Neem Oil

Most neem-based pesticides list the active ingredient as “cold-pressed neem oil” or “clarified hydrophobic extract of neem oil.” Both refer generally to neem oil, obtained by cold-pressing neem seeds, which is effective against soft-bodied insects, such as aphids, scale crawlers, and other arthropods, such as spider mites, as well as some plant pathogens. Neem oil acts in much the same way other horticultural oils do as smothering agents, desiccants, and internal membrane disruptors. Some of these neem oil preparations may contain low concentrations of azadirachtin, but the lion’s share of azadirachtin is extracted from neem seeds

using a different process once the oil has already been removed. Apart from these physical modes of action shared by other oils, neem oil contains volatile sulfides that have been shown to have fumigant action against insects and some microorganisms. Thus, the strong sulfur smell associated with most neem oil preparations may actually kill and repel pests some distance away from the site of application. At least two new products targeting bed bugs, registered for use within bags or other sealed containers, explicitly utilize the fumigant activity of neem oil. Pesticides listing neem oil as the only active ingredient can be expected to kill, like other horticultural oils,

soft-bodied arthropods and some ectotrophic plant pathogens (such as powdery mildews and rusts) but may also be associated with small-scale fumigant activity. As with other oils, good coverage of infested plant surfaces is essential for maximum efficacy.

Azadirachtin and other active components of neem have never been synthesized and must, therefore, be obtained from neem trees, making most neem-based pesticides relatively expensive when compared to horticultural oils and synthetic IGRs.

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Ask the Expert!

Q How long do stored neem-based pesticides remain effective after purchase?

A Chemical constituents of neem products, such as azadirachtin and volatile sulfides, will be degraded and deactivated by heat and ultraviolet light, so shelf life can be greatly extended by storage within a cool, dark environment, such as a refrigerator. The physical properties of oil-based pesticides are much more resistant to environmental extremes, but it’s still a good idea to keep neem oil products out of the heat and the sun. In general, when stored properly and unless otherwise stated on the product label, pesticides remain effective for about one year after purchase.

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For more information about managing pests, contact your University of California Cooperative Extension office listed under the county government pages of your phone book, or visit the UC IPM Web site at www.ipm.ucanr.edu.

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Inquiries regarding ANR’s nondiscrimination policies may be directed to Linda Marie Manton, Affirmative Action Contact, University of California, Agriculture and Natural Resources, 2801 Second Street, Davis, CA 95618, (530) 750-1318.

WHAT IS IPM? Integrated Pest Management (IPM) programs focus on long-term prevention of pests or their damage through a combination of techniques including resistant plant varieties, biological control, physical or mechanical control, and modification of gardening and home maintenance practices to reduce conditions favorable for pests. Pesticides are part of IPM programs but are used only when needed. Products are selected and applied in a manner that minimizes risks to human health, beneficial and nontarget organisms, and the environment.