LAWN DISEASES: PREVENTION AND MANAGEMENT

Integrated Pest Management for Home Gardeners and Landscape Professionals

Maintaining a healthy, vigorously growing lawn is the best way to prevent a severe disease outbreak in turfgrass. Each square foot of turf contains about 500 to 1,000 individual plants, each requiring optimum amounts of water and fertilizer, the right mowing regime, and an aerated, well-drained soil. If any of these factors are missing or in excess, the grass may become stressed and more susceptible to disease.

For a disease to occur, all three sides of the "disease triangle" must be present (Fig. 1). Even if a disease-causing pathogen is present, infection won't occur unless the environment (i.e., temperature, quantity of water, etc.) is conducive to disease development and susceptible grass is available. Selecting a turfgrass species that is adapted to the local climate and intended use, then following through with cultural practices that favor the grass rather than the pathogen, are important steps a home gardener can take to avoid severe lawn diseases.

Many common diseases are active only under specific environmental conditions and will affect the lawn only for a short time. When the weather becomes more favorable to growth of the turfgrass, the lawn will often recover on its own if proper cultural practices are followed. However, if conditions and practices that favor disease are allowed to continue, the result can be long-term damage to the lawn that is difficult to recover from. Although we can't control the weather, selecting the right grass and good cultural practices are keys to reducing disease. Fungicides are rarely needed for lawns when the right grass is planted and maintained correctly.

IDENTIFICATION

The cause of lawn damage is often difficult to identify, and diseases aren't always the primary cause. It's a good idea to inspect your lawn once a week to immediately identify problems and act quickly to determine the cause before it's too late. Diseases tend to start off as small patches or spots of dying grasses that spread over time. If the damage is sudden, widespread, and severe, other pests or problems such as insects, pathogens, weeds, or environmental stress—such as too much or too little moisture or fertilizer—may be contributing to the observed symptoms. Damage that resembles disease symptoms may also result from incorrect watering, fertilizing, or mowing practices; damage from dog urine, herbicides, and other chemicals; poor drainage; compaction; vertebrate or insect damage; extremely high or low temperatures; competing vegetation; or thatch that is more than $^1/_2$ inch thick.

Irrigation problems are the most common cause of discolored lawns. Fixing broken sprinklers and conducting "catch can tests" to ensure even water coverage might be all that is necessary to improve the health and appearance of a lawn. (See the Irrigation section.) No amount of fungicide will control a problem that results from poor watering practices.

Almost all lawn diseases are the result of pathogenic fungi that infect the blades, stems, or roots of turfgrass plants. Such diseases often are diagnosed by identifying symptoms of the disease and signs of the causal agent. Typical signs and symptoms include leaf spots; white, powdery growth; thin, open grass; and small

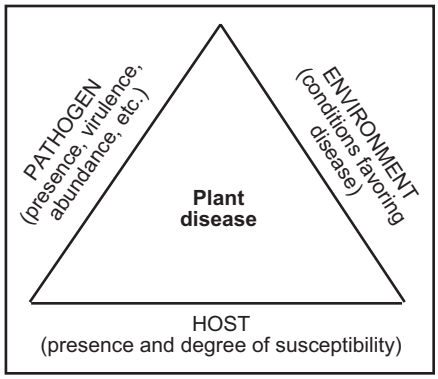

Figure 1. The disease triangle. All components must be present for disease to occur.

to large areas of discolored or dying lawn. Visible parts of the pathogen (called signs)—such as whitish, cottony growth or small, hard, dormant structures (sclerotia)—are very useful in the identification process. Other typical symptoms of lawn diseases include "frog-eye" patterns (e.g., a circular area of dead grass with healthy grass in the center), leaf spots, rotted crowns and roots, yellow leaves, stunting, and wilting. Affected lawn areas can become discolored and lose density quickly.

Table 1 lists and describes the most common diseases occurring in home lawns in California. See The UC Guide to Healthy Lawns at http://www.ipm.ucdavis.edu/TOOLS/TURF/ for more information about how to manage lawns and diagnose problems.

SELECTING A SUITABLE LAWN GRASS

All types of turfgrass have positive and negative characteristics. There is no one perfect turfgrass suitable for all lawns. The type of grass you choose for your lawn should be compatible

PEST NOTES Publication 7497

University of California
Agriculture and Natural Resources
Statewide Integrated Pest Management Program

September 2011

with your climate, anticipated use and maintenance level, and aesthetic desires; it also should have some resistance to common diseases.

Cool-season grasses (e.g., bluegrasses, fescues, ryegrasses, etc.) perform best at daytime temperatures between 70° to 85°F. Warm-season grasses (e.g., bermudagrass, seashore paspalum, St. Augustinegrass, and zoysiagrass) perform best between 80° to 95°F. Often, diseases most impact grasses when they aren't vigorously growing. Cool-season grass is more prone to disease infestations during the summer, while warm-season grasses are more prone to diseases in late fall through early spring.

Make every effort to choose a grass that grows well in your conditions. For instance, too much shade causes stress that can lead to disease development. Similarly, some species are more heat- or drought-tolerant than others.

New and improved cultivars of lawn grasses offering greater disease resistance, color, texture, density, and uniformity have been developed the past several years. Contact a reputable nursery or the UC Cooperative Extension office in your county for specific recommendations. Also see the publication *Turfgrass Selection for the Home Landscape* listed in References.

CULTURAL PRACTICES TO REDUCE LAWN DISEASE

To prevent lawn diseases, employ cultural practices that promote a dense, vigorous, actively growing grass with good recuperative ability. Good cultural practices include irrigation, fertilization, mowing, soil cultivation, and thatch removal. Table 1 outlines cultural practices that help prevent specific diseases.

Irrigation

Much of California has a Mediterranean climate characterized by rainfall in winter and spring and very little rain during summer and fall. Throughout the state, lawns require irrigation. It's important to follow sound watering practices—whether watering by hand or using an automated system—to promote an environment favoring growth of the lawn rather than disease. Applying too much or not enough water can result in unhealthy, slow-growing grass that is vulnerable to pathogens. Waterlogged soils are poorly aerated, which restricts root growth, promotes some diseases, and allows algae and moss to thrive. In general, a deeply watered lawn develops a deeper and more extensive vertical root system, which provides it with greater drought and disease resistance than a shallowly watered lawn.

Turfgrasses vary in water requirements. Warm-season turfgrasses are more drought-resistant than cool-season grasses and require about 20% less water. See Table 2 for information on how many minutes to water warm- and cool-season lawns each week in various parts of California, based on the output of the irrigation system or hose-end sprinkler. It is best to water the lawn thoroughly at longer intervals, until runoff just begins, rather than watering a little every day.

The number of times to water each week depends on how long the irrigation system can run before water just starts to puddle or run off the soil surface. For example, if a grass needs 40 minutes of irrigation each week but runoff begins after 20 minutes, water twice a week for 20 minutes. In cases where soil takes up water so slowly that runoff occurs before 10 minutes, water cycling is necessary. To cycle, irrigate until runoff just begins, turn the system off, and repeat the process in 30 minutes before the soil surface dries out. Several cycles per day might be necessary to apply the desired amount of water.

To determine sprinkler output, conduct "catch can tests" by setting small, empty, straight-sided, equal-sized containers such as tuna or cat food cans on top of your lawn every 10 to 15 feet between sprinkler heads operated by the same

SAMPLING FOR COMMERCIAL LABORATORY DIAGNOSIS

When a disease outbreak in a home lawn is suspected, the best course of action may be to seek the professional services of a plant disease diagnostic laboratory. Accurately identifying the problem before symptoms become severe allows for corrective action to be taken before there is an unnecessary loss of large lawn areas. Contact a nursery or your local UC Cooperative Extension office for a list of diagnostic laboratories.

An accurate diagnosis depends on the quality of the sample submitted, so the way a sample is taken is important. Collect entire grass plant samples—leaves, stems, roots, and soil—from several lawn areas that appear to exhibit different stages of the observed symptoms. It is a good idea to sample on the edge of an infected area, making sure to include plants that are just beginning to show symptoms. Remember that the pathogen isn't always active in the part of the grass plant exhibiting disease symptoms, so be sure to include the entire plant. For example, symptoms observed in the foliage such as chlorosis (yellowing) or wilting could be associated with a vascular wilt or a root rot. Also, take samples from plants just beginning to show symptoms; often dead turf will be overrun with secondary fungi and bacteria that may be decomposing the dead turf, making accurate diagnosis difficult.

Place samples in a plastic bag and carefully label it. Placing a moist paper towel in the bag will help keep the samples as fresh as possible during transport. Don't allow roots to dry out. Attach a written description of the type of lawn and symptoms you observed. Also include information on cultural management practices, any chemical applications that have been made, and any other relevant information that might be useful in making an accurate diagnosis as well as the date the sample was collected and your name and contact information.

Keep the samples cool and moist, and submit them as soon as possible; refrigerate as necessary, but don't freeze them. Sending the samples by Priority Mail or Next Day delivery is optimum.

valve (Fig. 2) and run the system for 15 minutes. After 15 minutes, turn off the system and measure the amount of water in each can with a ruler to determine the average amount of water per can. To find the average, add up the measurements from all the cans and divide this number by the number of cans used. Multiply this number by four to calculate the sprinkler output rate per hour. Compare this number to the outputs listed in Table 2 to determine how many minutes you need to irrigate weekly. Conducting can tests regularly also is useful for determining how evenly irrigation water is distributed over the area watered and allows for sprinkler head misalignments and other mechanical problems to be discovered and corrected.

The best time to water is early in the morning, when evaporation rates are lowest and water pressure is at its peak. Irrigating in the afternoon is wasteful because of higher evaporation rates; also, prolonged damp conditions in the evening can encourage disease development. Remember that irrigation requirements change from month to month and irrigation might not be needed at all if it has rained. Reset your sprinkler system to meet your lawn's changing irrigation needs.

Fertilization

Applying the correct amount of fertilizer is an important aspect of maintaining a healthy, dense lawn with good disease resistance. Fertilization influences turfgrass growth, which in turn influences the recuperative ability of stressed grass. All turfgrasses require nitrogen, and certain sites may also require other nutrients, including iron, on a regular basis. Applying too much nitrogen, especially in a highly soluble, fast-release form, can result in excessive, succulent leaf and stem growth, leading to increased opportunities for fungal penetration that might result in diseases such as brown patch, Pythium blight, and leaf spot. Over-fertilized lawns also require more frequent mowing and watering. Conversely, lawns grown under nitrogen-deficient conditions are prone to dollar spot, rust, and red thread diseases.

For moderate, even growth, apply a total of 4 to 6 pounds of actual nitrogen per 1,000 square feet of lawn area annually. Avoid applying more than 1 pound of actual nitrogen per application. Sandy soils require the same amount of nitrogen as clay soils, but apply it at lower rates and more frequently. Fertilizer should be applied during the active growing season of the grass, which generally is during spring and summer for warm-season grasses and during fall and spring for cool-season lawns.

Mowing

Maintaining a lawn at the recommended mowing height will improve its ability to resist diseases and give it greater aesthetic appeal. The frequency with which the lawn is mowed should be based on the growth rate of the grass. Lawns should be mowed often enough so that no more than one-third the length of the grass blade is removed at any time. Removing too much of the grass blade can increase the susceptibility to several diseases by depleting food reserves in the plant, making it difficult for the plant to recover from stress and injury. Repeated scalping kills or greatly reduces the vigor of a turfgrass. Maintain sharp mower blades to avoid mechanical damage to turf.

When grass is mowed regularly, clippings can be left on the lawn, a practice called "grasscycling." Grasscycling hasn't been found to significantly increase thatch or disease incidence. For additional information, see *Mowing Your Lawn and "Grass-cycling"* listed in References.

Soil Cultivation and Thatch Removal

Soil compaction reduces root growth as well as recuperative ability, thus increasing a lawn's relative susceptibility to diseases. Soil cultivation, such as coring or aerification, will improve shoot and root growth and recuperative ability while decreasing the likelihood of disease and insect damage. Cultivation should be done during times when the grass is growing vigorously and can take advantage of the reduction in soil compaction (spring and fall for cool-season turf and early summer for warm-season grass).

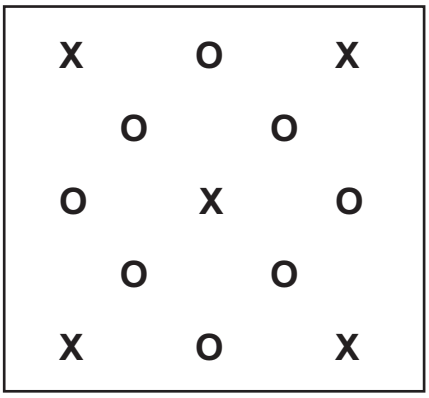

Figure 2. Layout of a catch-can test, showing placement of catch cans (O) and sprinkler heads (X).

Thatch is a partially decomposed layer comprised of roots, stems, rhizomes, crowns, and stolons above the soil surface. Up to 1/2 inch of thatch is beneficial: it provides insulation to roots, reduces soil water evaporation, cushions playing surfaces, and can prevent soil compaction. However, thatch layers greater than 1/2 inch should be removed to avoid restricting water entry into the root zone.

Several turfgrass pathogens can survive in the thatch layer, including those that cause summer patch, leaf spot, and melting-out diseases. Heavy thatch may also lead to fairy ring problems. Bermudagrass, Kentucky bluegrass, and kikuyugrass produce more thatch than most other turfgrasses and require regular dethatching. Equipment rental businesses often carry dethatching (verticutting) machines that are specifically designed to remove thatch from home lawns.

The UC Guide to Healthy Lawns at http://www.ipm.ucdavis.edu/TOOLS/TURF/ provides additional information on how to choose turfgrass species as well as how to irrigate, fertilize, and manage your lawn to prevent disease.

Table 1.

Common Lawn Diseases in California.

DISEASE	PATHOGEN	SUSCEPTIBLE GRASSES	SYMPTOMS	CONDITIONS FAVORING DISEASE	PREVENTION	CHEMICAL TREATMENT[1]
dollar spot  M. A. Harivandi	*Sclerotinia homeocarpa*, *Lanzia* sp., *Moellerodiscus* sp.	bermudagrass, annual bluegrass, fescue, ryegrass, Seashore paspalum, zoysiagrass	small, circular spots from 1–5 inches in diameter; spots might merge to form large, irregular areas; leaves appear watersoaked then brown, often exhibiting a reddish band across the leaf; fine, white cobwebby threads seen in early morning	moderate temperatures (60°–80°F); excess moisture or water stress; fog; thatch; survives in soil as hard, dark structures (sclerotia)	fertilize adequately; reduce thatch; water appropriate length of time to a depth of 4–6 inches but don't extend interval too long; maintain air circulation; compost top dressings can suppress disease	if present in previous years, fungicide might be useful; apply in early spring or fall before symptoms occur
fairy ring  J. K. Clark	*Agrocybe* spp., *Marasmius oreades, Lepiota* spp., other Basidiomycete spp.	all lawn grasses	a dark green band of turf develops in a circle (4 inches up to 30 feet) or semicircle in moist turf; mushrooms might or might not be present; an area of brown, dying grass might occur just behind the dark green band; a second ring of dying grass might appear inside the circle; weeds commonly invade	soils high in thatch or undecomposed organic matter containing lignin	apply adequate nitrogen; aerate soil for better water penetration, water heavily in holes for several days; verticut if more than 1/2 inch of thatch accumulates; rake mushrooms to improve appearance of turf; to eliminate, remove turf and root zone containing white, cottony mass to a depth of 12 inches and 2 feet beyond outer edge of the ring; refill with clean soil and reseed or resod	fungicides available, but control has been erratic
Fusarium blight  A. H. McCain	*Fusarium culmorum*, *F. tricinctum*	Kentucky bluegrass	small, circular, grayish green areas, ranging from a few inches up to a foot in diameter; some plants in center can survive, giving a frog-eye appearance; the crown or basal area of dead stems has a reddish rot and is hard and tough; dead foliage appears bleached	daytime temperatures of 85°–95°F; drought-stressed areas in full sun; survives in thatch and grass residues	water appropriate length of time; don't apply more than 1 pound nitrogen/1,000 square foot/application or more than 6 pounds annually; use a mixture of 20% perennial ryegrass when seeding bluegrass; mow at highest recommended height; verticut if more than 1/2 inch thatch	fungicides don't give complete control in California; make application in spring before or just after symptoms appear

gray leaf spot  L. P. Tredway	*Pyriculria grisea*	fescues, kikuyugrass, ryegrasses, St. Augustinegrass	irregular blighted patches of turf with bleached spots with dark margins on leaves; ryegrass develops a fishhook appearance	daytime temperatures of 85°–95°F; high humidity or rainfall; overwatered and overfertilized turf	irrigate properly; don't overfertilize; reduce shading; increase air movement	fungicides are available, but cultural controls are more practical
Microdochium patch (pink snow mold)  A. H. McCain	*Microdochium nivale*	annual bluegrass, bluegrasses, fescues, ryegrasses, zoysiagrass	circular patches of 1–2 inches that can enlarge to 12 inches; leaves first appear watersoaked, then reddish brown, and finally bleached; minute, gelatinous spore masses sometimes seen on dead leaves; white or pinkish fungal threads might be seen in early morning; more prevalent in Central and Northern California	consistently cool temperatures (40°–65°F) and wet conditions; high nitrogen applications in fall; neutral or alkaline soil pH; pathogen survives in grass residues	reduce shade and improve soil aeration and water drainage; water appropriate length of time; avoid excess nitrogen, especially in fall; maintain soil pH between 6.5–6.7.	if a serious problem in past, have licensed applicator apply fungicide in fall before symptoms appear
leaf spot  M. A. Harivandi	*Bipolaris* spp. and *Helminthosporium* spp.	bermudagrass, bluegrasses, fescues, kikuyugrass, ryegrasses, zoysiagrasses	circular to elongated brownish spots with brown centers and dark brown or purple borders on leaf blades, sheaths, and stems; crowns and roots frequently have a dark brown rot; crown-infected plants might die in hot, windy weather, leaving thinned areas throughout the turf; spores are windborne	warm temperatures (70°–90°F) for bluegrasses, ryegrasses, and fescues; cool temperatures (60°–70°F) for bermudagrass and zoysiagrass; high humidity; low clipped turfgrass; most severe with excess nitrogen fertilization or deficiency	reduce shade; improve soil aeration and water drainage; avoid dry spots and too much nitrogen fertilizer; maintain as high a cutting height as possible	fungicides available but often not warranted
Pythium blight (Grease spot)  M. A. Harivandi	*Pythium* spp.	all grasses	small, circular spots (2–6 inches) that run together; blackened leaf blades rapidly wither, turn reddish brown, lie flat, stick together, and appear greasy; roots might be brown; in humid conditions, masses of fungal mycelium might appear	low spots that remain wet; warm temperatures (80°–95°F daytime, >68°F night time); survives as spores in soil for long periods	reduce shading; improve soil aeration and water drainage; water appropriate length of time; avoid mowing wet grass and applying high levels of nitrogen during hot, humid weather	fungicides available but primarily prevented by cultural practices in California

Rhizoctonia blight  J. K. Clark	*Rhizoctonia solani* AG1-A, AG 3	bluegrass, annual bluegrass, fescues, ryegrasses	first appears as small, irregular brown patches or rings that can enlarge to many feet in diameter; centers might recover resulting in rings of diseased grass; leaves and sheaths become watersoaked, wilt, turn light brown, and die; in light infestations, roots usually not infected and plants often recover; soil-inhabiting fungus that forms fine, fungal threads in soil or on turfgrass	excess thatch and mat along with high temperatures (80°–95°F); high humidity; soft, lush growth due to excessive nitrogen; most common in warm, inland areas	reduce shading and improve soil aeration and water drainage; water appropriate length of time to a depth of 4–6 inches; avoid excess nitrogen; maintain thatch less than 1/2 inch	fungicide useful if disease severe in past or for seedlings in young turf
Rhizoctonia large patch  A. H. McCain	*Rhizoctonia solani* AG 2-2LP	bermudagrasses, kikuyugrass, St. Augustine grass, zoysiagrass	first appears as small, irregular brown patches or rings that can enlarge to many feet in diameter; centers might recover resulting in rings of diseased grass; leaves and sheaths become watersoaked, wilt, turn light brown, and die; plants pull out easily from soil with rotten stolons, in light infestations, roots usually not infected and plants often recover; soil-inhabiting fungus that forms fine, fungal threads in soil or on turfgrass	excess thatch and mat along with cool temperatures (60°–70°F); wet soil conditions	reduce shading and improve soil aeration and water drainage; water appropriate length of time to a depth of 4–6 inches; avoid excess nitrogen in the fall; maintain thatch less than 1/2 inch	fungicide useful if disease severe in past
red thread  A. H. McCain	*Laetisaria fuciformis*	bentgrasses, bermudagrasses bluegrasses, fescues, ryegrasses	red thread may kill turfgrass in patches that are 2–8 inches in diameter, or the disease may occur over large areas without killing the plants; pink web of fungal threads bind the leaves together; look for pink, gelatinous fungal crusts projecting from the leaves to help identify this disease	common under conditions of mild air temperatures (60°–75°F) and extended periods of leaf wetness; often appears on plants deficient in nitrogen during periods of cool or warm temperatures if there is adequate moisture (e.g., excess irrigation or rainfall)	proper irrigation and fertilization can reduce the incidence; adequate nitrogen usually can prevent this disease from occurring; prevent drought stress by irrigating turfgrass based on evapotranspiration needs of the turfgrass; provide adequate air circulation; reduce shading	fungicides rarely warranted except in severe cases

rust  A. H. McCain	*Puccinia* species	all grasses	irregular patches of weak turf covered with rust colored growth (spores)	moderately warm air temperatures (70°–75°F) and extended periods of leaf wetness favor development; turf that is deficient in nitrogen is more susceptible	maintain turfgrass vigor by following proper irrigation and fertilization requirements for turf species; mow regularly and remove clippings to reduce number of spores if lawn is infected	follow proper cultural practices; fungicides shouldn't be needed
spring dead spot  A. H. McCain	*Ophiosphaerella korrae*	bermudagrass, Seashore paspalum, zoysiagrass	circular areas of dead grass 6–12 inches in diameter appear in spring when growth resumes; spots might coalesce to form large areas; typically affects turfgrass more than 2 years old	affects dormant plants; most severe when soil temperatures are < 65°F; survives as sclerotia and in infected roots and stolons	remove dead grass; fertilize in summer to maintain vigor; don't overfertilize in late summer; water appropriate length of time.	fungicides available but primarily prevented by cultural practices in California
summer patch  E. B. Nelson	*Magnaporthe poae*	bluegrasses, fine fescues	circular, yellow or tan areas of dead and dying plants up to 1 foot in diameter; can have green, apparently healthy plants in center; roots, crowns, and stolons have dark brown fungal hyphae on them; vascular discoloration and cortical rot occur in later stages	high temperatures (> 85°) in late spring through the summer; most severe when turf is mowed low or when soil moisture is excessive	aerate soil and apply slow-release nitrogen; improve drainage; reduce compaction; water appropriate length of time; don't mow too low; control thatch; reduce soil pH if higher than 7	systemic fungicides in fall usually necessary when disease has been severe

[1]For currently registered fungicides, see *UC IPM Pest Management Guidelines: Turfgrass* listed in References.

Table 2. Minutes to Irrigate Warm- and Cool-season Turfgrass per Week in California.[1]

SOUTHERN COAST

	Warm-season Turfgrasses				*Cool-season Turfgrasses*				
	Minutes to irrigate/week if hourly sprinkler output is:					Minutes to irrigate/week if hourly sprinkler output is:			
	0.5 in	1.0 in	1.5 in	2.0 in		0.5 in	1.0 in	1.5 in	2.0 in
JAN	44	22	15	11	JAN	59	29	20	15
FEB	57	28	19	14	FEB	76	38	25	19
MAR	63	32	21	16	MAR	84	42	28	21
APR	76	38	25	19	APR	101	50	34	25
MAY	88	44	29	22	MAY	118	59	39	29
JUN	95	47	32	24	JUN	126	63	42	32
JUL	107	54	36	27	JUL	143	71	48	36
AUG	95	47	33	24	AUG	126	63	42	32
SEP	82	41	27	20	SEP	109	55	36	27
OCT	69	35	23	17	OCT	92	46	31	23
NOV	50	25	17	13	NOV	67	34	22	17
DEC	38	19	13	9	DEC	50	25	17	13

SOUTHERN INLAND VALLEYS

	Warm-season Turfgrasses				*Cool-season Turfgrasses*				
	Minutes to irrigate/week if hourly sprinkler output is:					Minutes to irrigate/week if hourly sprinkler output is:			
	0.5 in	1.0 in	1.5 in	2.0 in		0.5 in	1.0 in	1.5 in	2.0 in
JAN	52	21	14	10	JAN	56	28	19	14
FEB	57	28	19	14	FEB	75	38	25	19
MAR	80	40	27	20	MAR	106	53	35	27
APR	96	48	32	24	APR	128	64	43	32
MAY	119	60	40	29	MAY	159	80	53	40
JUN	144	72	48	36	JUN	193	96	64	48
JUL	165	83	55	41	JUL	221	110	74	55
AUG	155	77	52	39	AUG	207	103	69	52
SEP	124	62	41	31	SEP	165	82	55	42
OCT	88	44	29	22	OCT	117	59	39	29
NOV	54	27	18	14	NOV	73	36	24	18
DEC	42	21	14	10	DEC	55	28	19	14

SOUTHERN DESERTS

	Warm-season Turfgrasses				*Cool-season Turfgrasses*				
	Minutes to irrigate/week if hourly sprinkler output is:					Minutes to irrigate/week if hourly sprinkler output is:			
	0.5 in	1.0 in	1.5 in	2.0 in		0.5 in	1.0 in	1.5 in	2.0 in
JAN	54	27	18	14	JAN	65	32	22	17
FEB	75	38	25	19	FEB	90	46	30	23
MAR	121	61	40	30	MAR	145	73	48	36
APR	165	83	55	41	APR	198	100	66	49
MAY	211	106	70	53	MAY	253	127	84	64
JUN	243	121	81	61	JUN	292	145	97	73
JUL	251	126	84	63	JUL	301	151	101	76
AUG	218	109	73	54	AUG	262	131	88	65
SEP	180	90	60	45	SEP	216	108	72	54
OCT	121	61	40	30	OCT	145	73	48	36
NOV	69	35	23	17	NOV	83	42	28	20
DEC	43	22	14	11	DEC	52	26	17	13

CENTRAL COAST

	Warm-season Turfgrasses				*Cool-season Turfgrasses*				
	Minutes to irrigate/week if hourly sprinkler output is:					Minutes to irrigate/week if hourly sprinkler output is:			
	0.5 in	1.0 in	1.5 in	2.0 in		0.5 in	1.0 in	1.5 in	2.0 in
JAN	38	19	13	9	JAN	50	25	17	13
FEB	50	25	17	13	FEB	67	34	22	17
MAR	63	32	21	16	MAR	84	42	28	21
APR	88	44	29	22	APR	118	59	39	29
MAY	101	50	34	25	MAY	134	67	45	34
JUN	113	57	38	28	JUN	151	76	50	38
JUL	95	47	32	24	JUL	126	63	42	32
AUG	113	57	38	28	AUG	151	76	50	38
SEP	95	47	32	24	SEP	126	63	42	32
OCT	69	35	23	17	OCT	92	46	31	23
NOV	50	25	17	13	NOV	67	34	22	17
DEC	38	19	13	9	DEC	50	25	17	13

[1]Irrigation is not needed when precipitation provides equivalent or more water.

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Table 2. Minutes to Irrigate Warm- and Cool-season Turfgrass per Week in California[1], cont.

SAN JOAQUIN VALLEY

	Warm-season Turfgrasses				*Cool-season Turfgrasses*				
	Minutes to irrigate/week if hourly sprinkler output is:					Minutes to irrigate/week if hourly sprinkler output is:			
	0.5 in	1.0 in	1.5 in	2.0 in		0.5 in	1.0 in	1.5 in	2.0 in
JAN	19	9	6	5	JAN	25	13	8	06
FEB	38	19	13	9	FEB	50	25	17	13
MAR	69	35	23	17	MAR	92	46	31	23
APR	101	50	34	25	APR	134	67	45	34
MAY	132	66	44	33	MAY	176	88	59	44
JUN	164	82	55	41	JUN	218	109	73	55
JUL	170	85	57	43	JUL	227	113	76	57
AUG	145	72	48	36	AUG	193	97	64	48
SEP	113	57	38	28	SEP	151	76	50	38
OCT	69	35	23	17	OCT	92	46	31	23
NOV	32	16	11	8	NOV	42	21	14	11
DEC	13	6	4	3	DEC	17	8	06	4

SACRAMENTO VALLEY

	Warm-season Turfgrasses				*Cool-season Turfgrasses*				
	Minutes to irrigate/week if hourly sprinkler output is:					Minutes to irrigate/week if hourly sprinkler output is:			
	0.5 in	1.0 in	1.5 in	2.0 in		0.5 in	1.0 in	1.5 in	2.0 in
JAN	19	9	6	5	JAN	25	13	8	6
FEB	44	22	15	11	FEB	59	29	20	15
MAR	69	35	23	17	MAR	92	46	31	23
APR	101	50	34	25	APR	134	67	45	34
MAY	126	63	42	32	MAY	168	84	56	42
JUN	158	79	53	39	JUN	210	105	70	53
JUL	164	82	55	41	JUL	218	109	73	55
AUG	145	72	48	36	AUG	193	97	64	48
SEP	113	57	38	28	SEP	155	76	50	38
OCT	82	41	27	20	OCT	109	55	36	27
NOV	38	19	13	9	NOV	50	25	17	13
DEC	19	9	6	5	DEC	25	13	8	6

SIERRA MOUNTAINS

Warm-season Turfgrasses	*Cool-season Turfgrasses*			
	Minutes to irrigate/week if hourly sprinkler output is:			
	0.5 in	1.0 in	1.5 in	2.0 in
	JAN	31	15	10	8
	FEB	43	22	14	11
	MAR	79	39	26	20
	APR	124	62	41	31
	MAY	164	82	55	41
NOT RECOMMENDED	JUN	207	103	69	52
	JUL	231	115	77	58
	AUG	198	99	66	50
	SEP	141	70	47	35
	OCT	96	48	32	24
	NOV	40	20	13	10
	DEC	20	10	7	5

NORTHEASTERN MOUNTAIN VALLEYS

Warm-season Turfgrasses	*Cool-season Turfgrasses*			
	Minutes to irrigate/week if hourly sprinkler output is:			
	0.5 in	1.0 in	1.5 in	2.0 in
	JAN	17	8	6	4
	FEB	34	17	11	8
	MAR	59	29	20	15
	APR	101	50	34	25
	MAY	134	67	45	34
NOT RECOMMENDED	JUN	168	84	56	42
	JUL	210	105	70	53
	AUG	176	88	59	44
	SEP	126	63	42	32
	OCT	76	38	25	19
	NOV	25	13	9	6
	DEC	17	9	6	4

[1]Irrigation is not needed when precipitation provides equivalent or more water.

... continued on the next page

Table 2. Minutes to Irrigate Warm- and Cool-season Turfgrass per Week in California[1], cont.

NORTHERN COAST

Warm-season Turfgrasses		***Cool-season Turfgrasses***				
		Minutes to irrigate/week if hourly sprinkler output is:				
			0.5 in	1.0 in	1.5 in	2.0 in
		JAN	15	7	5	4
		FEB	36	18	12	9
		MAR	55	27	18	14
		APR	67	34	22	17
		MAY	88	44	29	22
NOT RECOMMENDED		JUN	97	48	32	24
		JUL	95	47	32	24
		AUG	90	45	30	23
		SEP	76	38	25	19
		OCT	48	24	16	12
		NOV	32	16	11	8
		DEC	21	11	7	5

NORTHERN INLAND VALLEYS

Warm-season Turfgrasses					***Cool-season Turfgrasses***				
Minutes to irrigate/week if hourly sprinkler output is:					Minutes to irrigate/week if hourly sprinkler output is:				
	0.5 in	1.0 in	1.5 in	2.0 in		0.5 in	1.0 in	1.5 in	2.0 in
JAN	19	9	6	5	JAN	25	13	8	6
FEB	32	16	11	8	FEB	42	21	14	11
MAR	50	25	17	13	MAR	67	34	22	17
APR	69	35	23	17	APR	92	46	31	23
MAY	101	50	34	25	MAY	134	67	45	34
JUN	126	63	42	32	JUN	168	84	56	42
JUL	132	66	44	33	JUL	176	88	59	44
AUG	120	60	40	30	AUG	160	80	53	40
SEP	95	47	32	24	SEP	126	63	42	32
OCT	57	28	19	14	OCT	76	38	25	19
NOV	25	13	8	6	NOV	34	17	11	8
DEC	13	6	4	3	DEC	17	8	6	4

[1]Irrigation is not needed when precipitation provides equivalent or more water.

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TECHNICAL EDITOR: M. L. Flint

EDITOR: M. L. Fayard

ILLUSTRATIONS: Fig. 2, adapted from Schwankl, L. J., D. A. Shaw, M. A. Harivandi, and R. L. Snyder. 1992. *Evaluating Turfgrass Sprinkler Irrigation Systems.* Oakland: Univ. Calif. Agric. Nat. Res. Publ. 21503.

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University of California scientists and other qualified professionals have anonymously peer reviewed this publication for technical accuracy. The ANR Associate Editor for Urban Pest Management managed this review process.

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This material is partially based upon work supported by the Extension Service, U.S. Department of Agriculture, under special project Section 3(d), Integrated Pest Management.

Produced by **UC Statewide Integrated Pest Management Program**
University of California, Davis, CA 95616

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