



Chemical Weed Control Options for Turfgrasses in Hawai'i

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Turfgrass weed control in Hawai'i is challenging. Environmental conditions in the state favor the year-round growth of weed populations. Winter weather doesn't eliminate weed populations like it does on the mainland; thus, many species traditionally classified as "annual" act as perennials here in Hawai'i.

Weed infestations are a sign of a weakened turfgrass stand. Insects, diseases, nematodes, poor soil conditions, inadequate fertility, improper mowing, and insufficient watering can all weaken a turfgrass stand, reducing density and vigor. Reductions in turfgrass density create voids in the canopy in which weeds can become established. Herbicides may temporarily remove these weeds, but failure to correct the factors leading to weed encroachment will ensure that the weeds will return and continue to be a problem. The best approach to minimizing weed problems is to maintain a healthy, dense turf.

There are three basic types of turfgrass weeds: grassy weeds, broadleaf weeds, and sedges. Photos illustrating the types are on pages 2–3.

Broadleaf weeds

Broadleaf weeds generally have wide leaves that are produced in pairs or multiples. Leaves are usually affixed to the plant by a sub-stem or petiole (Photo 1). Leaf arrangements may be simple (having one leaflet, like a dandelion; Photo 2) or compound (having more than one leaflet, like white clover; Photo 3). Broadleaf weeds often have a pinnate venation where veins protrude outward from a central axis, giving a "netted" appearance (Photo 4).

Grassy weeds

Grassy weeds are botanically related to turfgrasses and thus have a similar appearance and growth habit in many cases. Their leaves usually have a blade-like appearance (Photo 5) and attach directly to the main stem of the plant. Grassy weeds often have parallel venation, where veins within the leaves are parallel to the leaf margins (Photo 6).

Sedges

Sedges have leaves that are similar in appearance to grassy weeds, but these plants are not classified as grasses. These plants have triangular stems and leaves arranged in three vertical rows.

In situations where herbicide applications are needed to control weed infestations, the following tables can serve as a guide for selecting the correct product. Selection is based on two factors: turfgrass tolerance and herbicide efficacy. In order to select the correct herbicide to control a weed infestation, the product must be able to be safely applied to the turfgrass species in which weeds are present, and the product must also effectively control the weed(s) present.

Tables 1 and 2 list expected turfgrass tolerances to various preemergent and postemergent herbicides. Note that the information in these tables refers to the turf's tolerance to a single application of the named compound, applied alone, at rates specified on the product label. Tank mixes of two or more herbicides may result in increased turfgrass injury. Caution should be taken when applying

*This revises Instant Information Series no. 20 (1996) by D. Hensley, R.K. Nishimoto, and J. DeFrank.



1. Petiole of a black medic (*Medicago lupulina*) leaflet
 (Photo courtesy of <http://www.msuturfweeds.net/images/galleries/medic/2.jpg>)



2. Simple leaf arrangement of Cupid's shaving bush (*Emilia fosbergii* Nicols.) Photo: J.T. Brosnan

tank mixes of different herbicides to a turf. Additionally, errors in application (overlaps, skips, drift, failure to allow the product to dry) may negatively affect both



3. Compound leaf arrangement of yellow wood-sorrel (*Oxalis stricta* L.) Photo: J. DeFrank



4. Pinnate venation of *Wedelia trilobata*
 Photo: J.T. Brosnan

turfgrass tolerance and herbicide efficacy.

Before application, always read the label of the product to be applied. Herbicide labels are legal documents that must be followed. Labels provide users with specific information about turfgrass tolerance and plant species controlled, as well as information about where the product can be safely applied. For example, some products are not labeled for use on home lawns, while others are



5. Blade like appearance of hilograss (*Paspalum conjugatum*) foliage Photo: J.T. Brosnan



6. Parallel venation of St. Augustinegrass (*Stenotaphrum secundatum* [Walt.] Kuntze)

Photo: Max Schlossberg, Penn State Univ.

not labeled for use on golf greens. Consult the label to determine if the herbicide selected is labeled for the desired use. The present document is intended only as a guide for product selection.

Many herbicides are not labeled for use on seashore paspalum, because its widespread use as a desirable turfgrass species is a relatively new development in the industry. However, wording on some herbicide labels

allows users to determine the suitability of the product on species not listed as tolerant on the label; these products are indicated with an asterisk in Table 3. Note that in many cases applying herbicides to species not listed as tolerant on the label may result in significant injury to the desired turfgrass stand. Herbicides labels allowing users to determine suitability on species not listed on the label place all liability in the event of injury on the user. It is recommended that applications of these materials be made to a small area in order to evaluate phytotoxic injury before broadcasting across desirable turfgrass stands.

It is essential that the weeds to be controlled are accurately identified, since no single herbicide will control all weeds. Tables 4–8 list the effectiveness of preemergence and postemergence herbicides in controlling common weeds found in turfgrass stands throughout Hawai'i. Herbicides in these tables are listed alphabetically by common name. Consumers may be more familiar with the trade names of these products, rather than their common names; thus, Table 3 lists the trade names of all the herbicides registered for use in Hawai'i as of June 2008. Not all weed species are listed in these tables. Herbicide labels will provide specific information about the various weed species a compound will control. Most chemical companies make labels for each herbicide in their product line available on their website. Databases of herbicide labels are available at websites such as www.cdms.net and www.greenbook.net. A list of all pesticides labeled in Hawai'i can be found at <http://state.ceris.purdue.edu/htbin/stmenu.com>.

Preemergence applications should be made before weed seeds have germinated. Many preemergent herbicides need to be “watered in” in order to become activated; therefore, do not apply preemergent herbicides in times of drought unless supplemental irrigation is available. Postemergence applications should be made when weeds are small in size. Often, herbicide sensitivity is greater on smaller, less mature plants. Many post-emergence herbicides need to remain on the leaf surface for a certain period of time in order to be translocated throughout the plant's vascular system; therefore, do not apply these materials in rainy conditions. To control some perennial weed species postemergently, multiple herbicide applications may be required.

The information in the following tables should not be considered recommendations for use of herbicides on turfgrasses but rather as resource material to enhance the understanding of turfgrass responses to herbicides.

Table 1. Tolerance of warm-season turfgrasses to various preemergent herbicides §
(REFER TO HERBICIDE LABEL FOR SPECIFIC SPECIES LISTINGS)

Herbicide	Bahia-grass	Bermuda-grass [†]	Bermuda-grass golf greens	Centipede-grass	St. Augustine-grass	Seashore paspalum	Zoysiagrass
atrazine	NR	NR	NR	S	S	NR	I
benefin	S	S	NR	S	S	NR	S
benefin + oryzalin	S	S	NR	S	S	NR	S
benefin + trifluralin	S	S	NR	S	S	NR	S
DCPA	S	S	NR	S	S	NR	S
dithiopyr	S	S	D	S	S	S	S
ethofumesate	NR	NR	NR	NR	S	NR	NR
isoxaben	S	S	NR	S	S	NR	S
napropamide	S	S	NR	S	S	NR	S
oryzalin	S	S	NR	S	S	NR	S
oxadiazon	NR	S	NR	NR	S	S	S
pendimethalin	S	S	S	S	S	NR	S
proflumicafone	S	S	NR	S	S	S	S
simazine	NR	I	NR	I	I	NR	I

§ Letters indicate the turf's tolerance to a single application of the named compound, applied alone, at rates specified on the product label. S = safe when applied at label rates on mature, healthy turf; I = intermediate safety—may cause slight damage to mature, healthy turf; D = damaging, do not apply; NR = not registered for use on this turf species

[†] Non-dormant

Table 2. Tolerance of warm-season turfgrasses to various postemergent herbicides §
(REFER TO HERBICIDE LABEL FOR SPECIFIC SPECIES LISTINGS)

Herbicide	Bahia-grass	Bermuda-grass [†]	Bermuda-grass golf greens	Centipede-grass	St. Augustine-grass	Seashore paspalum	Zoysiagrass
atrazine	NR	NR	NR	S	S	NR	I
bentazon	S	S	NR	S	S	NR	S
carfentrazone	S	S	S	S	S	S	S
clethodim	NR	NR	NR	S	NR	NR	NR
clopyralid	S	S	NR	S	S	S	S
2,4-D	S	S	S	I	I	NR [¶]	S
2,4-D + dicamba	S	S	S	I	I	NR [¶]	S
dicamba	S	S	S	I	I	NR [¶]	S
diclofop	NR	S	S	NR	NR	NR	NR
fluazifop	NR	NR	NR	NR	NR	NR	S
fluroxypyr	S	I	NR	S	D	NR	S
foramsulfuron	NR	S	NR	NR	NR	NR	S
halosulfuron	S	S	NR	S	S	S	S
imazaquin	NR	I	NR	S	S	NR	S
metribuzin	NR	S-I	NR	NR	NR	NR	NR
metsulfuron	NR	S	NR	S	S-I	NR	S
MSMA	NR	S	S	NR	NR	NR	I
rimsulfuron	NR	S	I	I	I	NR	I
sethoxydim	NR	NR	NR	S	NR	NR	NR
simazine	NR	I	NR	I	I	NR	I
sulfentrazone	S	S	NR	S	I	S	I
sulfosulfuron	NR	S	NR	S	S	S	S
triclopyr + clopyralid	S	S	NR	S	NR	NR	S
trifloxysulfuron	NR	S	I	NR	NR	NR	S

§ Letters indicate the turf's tolerance to a single application of the named compound, applied alone, at rates specified on the product label. S = safe when applied at label rates on mature, healthy turf ; I = intermediate safety- may cause slight damage to mature, healthy turf; NR = not registered for use on this turf species; D = damaging, do not apply

[¶] = Speedzone Southern™, a pre-mixed combination of carfentrazone, 2,4-D, MCPP, and dicamba, is labeled for use on seashore paspalum.

[†] Non-dormant

Table 3. Trade names of herbicides labeled for use in Hawai'i

Herbicide	Trade name	Herbicide	Trade name
atrazine.....	Atrazine	halosulfuron	SedgeHammer
benefin	Balan	isoxaben.....	Gallery*
benefin + oryzalin.....	XL*	imazaquin.....	Image
benefin + trifluralin	Team	metribuzin	Sencor
bentazon	Basagran	metsulfuron	Blade
carfentrazone.....	QuickSilver	MSMA	MSMA
clethodim	Envoy	napropamide.....	Devrinol
clopyralid.....	Lontrel*	oryzalin.....	Surflan*
DCPA.....	Dacthal*	oxadiazon.....	Ronstar
2,4-D.....	2,4-D	pendimethalin	Pendulum
2,4-D + dicamba	many	proflaminate	Barricade
dicamba	Banvel	rimsulfuron	TranXit
diclofop	Illoxan	sethoxydim.....	Poast
dithiopyr	Dimension	simazine	Princep
ethofumesate	Prograss*	sulfentrazone.....	Dismiss*
fluzafop.....	Fusilade II	sulfosulfuron	Certainty
fluroxypyr	Spotlight	triclopyr + clopyralid	Confront*
foramsulfuron.....	Revolver*	trifloxysulfuron	Monument

* = Label wording indicates that users can determine the suitability of this product for use on species not listed as tolerant on the product label.

Table 4. Preemergence herbicides exhibiting efficacy against various grassy weeds

Herbicide	Annual bluegrass (<i>Poa annua</i>)	Crabgrass (<i>Digitaria</i> spp.)	Crowfootgrass (<i>Dactyloctenium aegyptium</i>)	Dallisgrass (<i>Paspalum dilatatum</i>)	Goosegrass (<i>Eleusine indica</i>)	Orchardgrass (<i>Dactylis glomerata</i>)	Sandbur (<i>Cenchrus longispinus</i>)	Smutgrass (<i>Sporobolus</i> spp.)
atrazine	X	X			X	X		
benefin	X	X	X		X			
benefin + oryzalin	X	X	X		X			
benefin + trifluralin	X	X	X	X	X	X	X	
DCPA	X	X			X			
dithiopyr	X	X	X	X	X	X		X
isoxaben								
napropamide	X	X			X			
oryzalin	X	X	X	X	X	X	X	
oxadiazon	X	X	X	X	X	X		
pendimethalin	X	X	X	X	X	X	X	
proflaminate	X	X	X		X	X	X	
simazine	X	X			X	X		

X = Herbicide exhibits greater than 70% control.

Herbicide	atrazine	benefin	benefin + oryzalin	benefin + trifluralin	DCPA	dithiopyr	isoxaben	napropamide	oryzalin	oxadiazon	pendimethalin	proflarime	simazine
Common chickweed (<i>Stellaria media</i>)	X	X	X	X	X	X	X	X	X	X	X	X	X
Cudweed (<i>Gamochaeta</i> spp.)		X					X	X			X		
Dandelion (<i>Taraxacum officinale</i>)			X				X						
Dichondra (<i>Dichondra carolinensis</i>)		X											
Docks (<i>Rumex</i> spp.)							X						
Henbit (<i>Lamium amplexicaule</i>)	X	X	X	X	X	X	X	X	X	X	X	X	X
Hop clovers (<i>Trifolium campestre</i>) (<i>Trifolium dubium</i>)	X		X	X			X			X	X		
Knotweed (<i>Polygonum</i> spp.)	X		X	X			X			X	X	X	X
Lespedeza (<i>Lespedeza striata</i>)	X						X						
Mallow (<i>Malva</i> spp.)							X				X		
Mouseear chickweed (<i>Cerastium vulgatum</i>)	X	X	X	X	X	X	X	X	X	X	X	X	X
Mustards (<i>Sisymbrium</i> spp.) (<i>Brassica</i> spp.)	X	X	X	X			X	X	X	X	X	X	X
Pennywort (<i>Hydrocotyl</i> spp.)							X						
Plantains (<i>Plantago</i> spp.)							X	X					
Speedwell (<i>Veronica</i> spp.)	X		X	X	X	X	X	X	X	X	X	X	X
Spurges (<i>Euphorbia</i> spp.)	X		X	X			X	X			X		
Sticky chickweed (<i>Cerastium glomeratum</i>)	X	X	X	X	X	X	X	X	X	X	X	X	X
White clover (<i>Trifolium repens</i>)	X						X						
Yellow woodsorrel (<i>Oxalis stricta</i>)	X		X	X			X						

Table 5. Preemergence herbicides exhibiting efficacy against various broadleaf weeds

X = Herbicide exhibits greater than 70% control.

Table 6. Postemergence herbicides exhibiting efficacy against various grassy weeds

Herbicide	Bahiagrass (<i>Paspalum notatum</i>)	Annual bluegrass (<i>Poa annua</i>)	Crabgrass (<i>Digitaria</i> spp.)	Crowfootgrass (<i>Dactyloctenium aegyptium</i>)	Dallisgrass (<i>Paspalum dilatatum</i>)	Goosegrass (<i>Eleusine indica</i>)	Orchardgrass (<i>Dactylis glomerata</i>)	Sandbur (<i>Cenchrus longispinus</i>)	Smutgrass (<i>Sporobolus</i> spp.)	Torpedograss (<i>Panicum repens</i>)
atrazine		X	X			X				
bentazon										
carfentrazone										
clethodim	X	X	X	X		X		X		
clopyralid										
2,4-D										
2,4-D + dicamba										
dicamba										
diclofop						X				
fluzifop	X	X	X	X	X	X	X	X		
fluroxypyr										
foramsulfuron		X			X	X				
halosulfuron										
imazaquin		X	X					X		
metribuzin		X	X	X	X	X		X	X	
metsulfuron	X	X								
MSMA	X		X	X	X			X		
rimsulfuron		X								
sethoxydim	X		X	X	X	X	X	X	X	
simazine		X								
sulfentrazone		X								
sulfosulfuron	X	X								
triclopyr + clopyralid										
trifloxysulfuron	X	X	X		X					X

X = Herbicide exhibits greater than 70% control.

Table 7. Postemergence herbicides exhibiting efficacy against various broadleaf weeds

Herbicide	Black medic <i>Medicago lupulina</i>	Common chickweed <i>(Stellaria media)</i>	Cudweed <i>(Gamochaeta spp.)</i>	Dandelion <i>(Taraxacum officinale)</i>	Dichondra <i>(Dichondra carolinensis)</i>	Docks <i>(Rumex spp.)</i>	Henbit <i>(Lamium amplexicaule)</i>	Hop clovers <i>(Trifolium campestre)</i> <i>(Trifolium dubium)</i>	Knotweed <i>(Polygonum spp.)</i>	Lespedeza <i>(Lespedeza striata)</i>	Mallow <i>(Malva spp.)</i>	Mouseear chickweed <i>(Cerastium vulgatum)</i>	Mugwort <i>(Artemisia vulgaris)</i>	Mustards <i>(Sisymbrium spp.)</i> <i>(Brassica spp.)</i>	Pennywort <i>(Hydrocotyl spp.)</i>	Pigweed <i>(Amaranthus spp.)</i>	Plantains <i>(Plantago spp.)</i>
atrazine		X		X			X	X				X		X			X
bentazon																X	
carfentrazone	X						X									X	
clethodim																	
clopyralid																	
2,4-D	X	X	X	X	X	X		X									X
2,4-D + dicamba		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
dicamba	X	X		X	X	X	X	X	X	X	X	X	X	X	X	X	X
diclofop																	
flazifop																	
fluroxypyr	X	X	X	X			X	X				X					X
foramsulfuron							X										
halosulfuron																	
imazaquin		X		X			X										
metribuzin		X					X	X									
metsulfuron		X		X			X	X	X	X		X	X	X			X
MSMA			X				X	X									X
rimsulfuron		X					X										
sethoxydim																	
simazine			X				X	X									
sulfentrazone		X	X				X										
sulfosulfuron		X					X										
triclopyr + clopyralid	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
trifloxysulfuron	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X

X = Herbicide exhibits greater than 70% control.

Table 7 (continued). Postemergence herbicides exhibiting efficacy against various broadleaf weeds

Herbicide	Shepardspurse (<i>Caspella bursa-pastoris</i>)	Speedwell (<i>Veronica</i> spp.)	Spurges (<i>Euphorbia</i> spp.)	Sticky chickweed (<i>Cerastium glomeratum</i>)	Thistles (<i>Cirsium</i> spp.)	Violets (<i>Viola</i> spp.)	White clover (<i>Trifolium repens</i>)	Yellow woodsorrel (<i>Oxalis stricta</i>)
atrazine	X	X		X			X	X
bentazon	X	X		X			X	
carfentrazone								
clethodim								
clopyralid	X		X	X	X		X	
2,4-D	X		X	X	X		X	
2,4-D + dicamba	X	X	X	X	X		X	X
dicamba	X	X	X	X	X		X	X
diclofop								
fluzilfop								
fluroxypyr		X	X	X			X	X
foramsulfuron								
halosulfuron								
imazaquin				X	X		X	
metribuzin	X		X	X			X	
metsulfuron	X		X	X	X		X	X
MSMA								X
rimsulfuron	X		X					
sethoxydim								
simazine		X	X					
sulfentrazone			X	X			X	
sulfosulfuron	X							
trifloxy + clopyralid	X		X	X			X	X
trifloxysulfuron			X					

X = Herbicide exhibits greater than 70% control.

Table 8. Postemergence herbicides exhibiting efficacy against various sedge and kyllinga species

Herbicide	Kyllinga (<i>Kyllinga</i> spp.)	Purple nutsedge (<i>Cyperus rotundus</i>)	Yellow nutsedge (<i>Cyperus esculentus</i>)	Annual sedge (<i>Cyperus compressus</i>)
bentazon	X		X	
halosulfuron	X	X	X	
imazaquin	X	X	X	
MSMA	X	X	X	X
rimsulfuron				X
sulfentrazone	X	X	X	
trifloxysulfuron	X	X	X	X

X = Herbicide exhibits greater than 70% control.

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