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Division of Agricultural Sciences

UNIVERSITY OF CALIFORNIA

GUIDE TO TURFGRASS PEST CONTROL

This leaflet is designed to be used in conjunction with Manual 41, TURFGRASS PESTS, and to supply information concerning chemicals that can be recommended for use in controlling such pests.

Because of frequent changes in regulations as well as new discoveries, information regarding chemicals often has an extremely short life. What can be recommended one day may be declared illegal next week, or a new and better chemical may be discovered the week after. As a result, this leaflet will be revised and reissued as often as necessary to keep it current. BEFORE APPLYING ANY CHEMICAL LISTED HERE, make sure you have the latest edition of this leaflet; check with your local University of California Farm Advisor office, or with

Agricultural Publications
University of California
Berkeley, Calif. 94720

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CALIFORNIA AGRICULTURAL
Experiment Station
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How to use this leaflet

The leaflet will be of little value without the companionpiece, Manual 41. Copies of the manual may be obtained from most Farm Advisor Offices or from Agricultural Publications. They sell for \$2.00 a copy.

The manual will help you to identify your pest, whether it be an insect, disease, weed, rodent, or whatever. In most cases the manual will also suggest cultural practices or other nonchemical means of avoiding or controlling the problem.

However, if chemical control is still called for, this

WEED CONTROL

The following tables are for use with Manual 41, TURFGRASS PESTS. Here's how to use the two publications:

- 1. Identify the weed or weeds you want to control by using the color photos on pages 18 to 30 in the manual.
- 2. Consult the treatment calendar on pages 16 and

HERBICIDE

NOTE: To reduce weeds before planting the turf, consult column 1. To control difficult weeds nonselectively, using spot treatments in established turf, consult column 2.

	1	2
	For preplant treatment	For nonselective spot treatments
BROADLEAF WEEDS Annual species:		
Black medic, <i>Medicago lupulina</i>	Methyl bromide, Calcium syanamid, Metham, Dazomet, Amitrole, Cacodylic acid, Paraquat	Dicamba
Chickweed, <i>Stellaria media</i>		Dicamba
Clover, California bur, <i>Medicago polymorpha</i> var. <i>vulgaris</i>	"	Dicamba MCP
Geranium, cut.eaf <i>Geranium dissectum</i>	"	2,4-D amine

leaflet will list one or more materials that can be recommended.

In all cases:

1. Observe safety precautions. Turf can be replaced; people can't.
2. Follow manufacturer's recommendations as to dosage. Applying more can be both dangerous and costly; applying less can result in poor control or no control at all.
3. Keep in mind that you, the applicator, are responsible for any damage done to neighboring turf or other plants from drift of your material.

17 of the manual to determine the best time of year for control measures.

3. Use the table below in this leaflet to determine the best chemical to apply.

4. Consult the table on page 8 for suggestions on how the chemical should be applied.

5. For information regarding measurements, see the section starting on page 4 of the manual.

6. IN ALL CASES, follow the safety suggestions in the first section of the manual.

SELECTION GUIDE

To control weeds selectively in the types of turf listed, consult columns 3 to 7.

For specific application rates, timing, etc. consult the table starting on page 8 of this leaflet.

3	4	5	6	7
For selective treatment in				
Bentgrass	Bermudagrass	Bluegrass, Kentucky	Fescue, fine-leaf	Dichondra
Dicamba MCP	Dicamba Silvex MCP	Dicamba Silvex MCP	Dicamba Silvex MCP	....
Dicamba	Dicamba	Dicamba	Dicamba	Monuron
Dicamba MCP	Dicamba MCP	Dicamba MCP Silvex	Dicamba MCP	Monuron
2,4-D amine	2,4-D amine	2,4-D amine	2,4-D amine	....

	1	2
BROADLEAF WEEDS (continued) Annual species	For preplant treatment	For nonselective spot treatments
Knotweed, prostrate, <i>Polygonum aviculare</i>	Methyl bromide, Calcium cyanamid, Metham, Dazomet, Amitrole, Cacodylic acid, Paraquat	Dicamba
Lettuce, prickly, <i>Lactuca scariola</i>		2,4-D amine
Mallow, little (cheeseweed) <i>Malva parviflora</i>	"	2,4-D ester
Oxtongue, bristly, (biennial) <i>Picris echioides</i>	"	2,4-D amine
Pearlwort, birdseye, <i>Sagina procumbens</i>	"	MCPP
Pigweed, redroot, <i>Amaranthus retroflexus</i>	"	2,4-D amine
Pimpernel, scarlet, <i>Anagallis arvensis</i>	"	2,4-D amine
Common Purslane, <i>Portulaca oleracea</i>	"	2,4-D amine
Soliva, <i>Soliva sessilis</i>	"	2,4-D ester
Speedwell, birdseye, <i>Veronica persica</i>	"	....
Spurge, spotted, <i>Euphorbia maculata</i>	"	Silvex
Perennial species:		
Bindweed, field, <i>Convolvulus arvensis</i>	"	Dicamba 2,4-D amine
Catsear, spotted, <i>Hypochoeris radicata</i>	"	2,4-D amine
Chickweed, mouseear, <i>Cerastium vulgatum</i>	"	MCPP
Clover, white, <i>Trifolium repens</i>	"	MCPP
Dichondra <i>Dichondra repens</i>	"	....
Dandelion, <i>Taraxacum officinale</i>	"	2,4-D amine
Dock, curly, <i>Rumex crispus</i>	"	Dicamba 2,4-D amine
English daisy, <i>Bellis perennis</i>	"	Dicamba
Healall (selfheal), <i>Prunella vulgaris</i>	"	MCPP

3	4	5	6	7
For selective treatment				
Bentgrass	Bermudagrass	Bluegrass, Kentucky	Fescue, fine-leaf	Dichondra
Dicamba MCPP 2,4-D amine	Dicamba MCPP 2,4-D ester Bromoxynil	Dicamba MCPP 2,4-D ester Bromoxynil	Dicamba MCPP 2,4-D ester	....
2,4-D amine	2,4-D amine	2,4-D amine	2,4-D amine	....
MCPP 2,4 D amine	MCPP 2,4-D ester	MCPP 2,4-D ester	MCPP 2,4-D ester	....
2,4-D amine	2,4-D amine	2,4-D amine	2,4-D amine	....
Dicamba MCPP	Dicamba MCPP	Dicamba MCPP	Dicamba MCPP	....
2,4-D amine Dicamba	2,4-D amine Dicamba	2,4-D amine Dicamba	2,4-D amine Dicamba	....
2,4-D amine	2,4-D amine	2,4-D amine	2,4-D amine	....
2,4-D amine	DCPA 2,4-D amine	DCPA 2,4-D amine	DCPA 2,4-D amine	....
2,4-D amine	2,4-D ester	2,4-D ester	2,4-D ester	....
....	Benefin Terbutol	Benefin Terbutol	....	....
....	2,4-D acid Bromoxynil	2,4-D acid Silvex Bromoxynil	2,4-D acid	Neburon Monuron
2,4-D amine Dicamba	2,4-D ester Dicamba	2,4-D ester Dicamba	2,4-D ester Dicamba	....
2,4-D amine	2,4-D amine	2,4-D amine	2,4-D amine	....
Dicamba MCPP	Dicamba MCPP	Dicamba MCPP Silvex	Dicamba MCPP	.... ....
Dicamba MCPP	Dicamba MCPP	Dicamba MCPP Silvex	Dicamba MCPP	Monuron Neburon
2,4-D amine	2,4-D ester	2,4-D ester	2,4-D ester	....
2,4-D amine	2,4-D amine	2,4-D amine	2,4-D amine	....
Dicamba 2,4-D amine	Dicamba 2,4-D amine	Dicamba 2,4-D amine	Dicamba 2,4-D amine	....
Dicamba Dicamba + 2,4-D	Dicamba Dicamba + 2,4-D	Dicamba Dicamba + 2,4-D	Dicamba Dicamba + 2,4-D	....
MCPP Dicamba + 2,4-D amine	MCPP Dicamba + 2,4-D ester	MCPP Dicamba + 2,4-D ester	MCPP Dicamba + 2,4-D ester	....

	1	2
BROADLEAF WEEDS (continued): Perennial species	For preplant treatment	For nonselective spot treatments
Plantain, broadleaf, <i>Plantago major</i>	Methyl bromide, Calcium cyanamid, Metham,	2,4-D amine
Plantain, buckhorn, <i>Plantago lanceolata</i>	Dazomet, Amitrole, Cacodylic acid	2,4-D amine
Sorrel, Red, <i>Rumex acetosella</i>	Paraquat	Dicamba
Woodsorrel, creeping, <i>Oxalis corniculata</i>	"	Silvex
Yarrow, common, <i>Achillea millefolium</i>	"	2,4-D ester
NARROWLEAF WEEDS Annual species:		
Barnyardgrass, <i>Echinochloa crusgalli</i>	.	....
Bluegrass, annual, <i>Poa annua</i>	"	....
Crabgrass, large, <i>Digitaria sanguinalis</i>	"	....
Crabgrass, smooth, <i>Digitaria ischaemum</i>	"	....
Goosegrass, <i>Eleusine indica</i>	"	Dalapon
Ryegrass, Italian, <i>Lolium multiflorum</i>	"	....
NARROWLEAF WEEDS Perennial species:		
Bentgrass, <i>Agrostis</i> sp.	Dalapon Dazomet Metham Methyl bromide TCA	Dalapon Dazomet Metham TCA
Bermudagrass, <i>Cynodon dactylon</i>	Methyl bromide Metham	"
Bluegrass, Kentucky, <i>Poa pratensis</i>	Dalapon Dazomet Metham Methyl bromide	"
Dallisgrass, <i>Paspalum dilatatum</i>	"	"
Kikuyugrass, <i>Pennisetum clandestinum</i>	Methyl bromide Metham	Dalapon Dazomet Metham TCA

3	4	5	6	7
For selective treatment				
Bentgrass	Bermudagrass	Bluegrass, Kentucky	Fescue, fine-leaf	Dichondra
2,4-D amine	2,4-D amine	2,4-D amine	2,4-D amine	....
2,4-D amine	2,4-D amine	2,4-D amine	2,4-D amine	....
Dieamba	Dieamba	Dieamba	Dieamba	....
....	....	Silvex	....	Monuron Neburon
2,4-D amine	2,4-D ester	2,4-D ester	2,4-D ester	....
Bensulide	Bensulide DCPA Benefin	Bensulide DCPA Benefin	Bensulide DCPA Benefin	Bensulide Diphen.
Bensulide	Bensulide Benefin Terbutol	Bensulide Benefin Terbutol	Bensulide Benefin	Bensulide Diphen.
Bensulide	Bensulide DCPA Terbutol Benefin	Bensulide DCPA Terbutol Benefin	Bensulide DCPA Benefin	Bensulide Diphenamid Monuron, Neburon
DSMA AMA	DSMA AMA	DSMA AMA	DSMA AMA	DSMA AMA, Dalapon
Bensulide	Bensulide DCPA Terbutol DSMA AMA Benefin	Bensulide DCPA Terbutol DSMA AMA Benefin	Bensulide DCPA DSMA AMA Benefin	Bensulide Diphenamid DSMA AMA, Dalapon
Bensulide	Bensulide	Bensulide	Bensulide	Bensulide
....	....	....	....	Dalapon
..	2,4-D ester	Silvex	....	Dalapon Diphenamid
....	....	....	....	Dalapon
....	....	....	....	Dalapon Diphenamid
DSMA MSMA	DSMA MSMA	DSMA MSMA	DSMA MSMA	DSMA Dalapon
DSMA	MSMA	MSMA	MSMA	DSMA Dalapon

	1	2
NARROWLEAF WEEDS (continued): Perennial species:	For preplant treatment	For nonselective spot treatments
Nutsedge, yellow, <i>Cyperus esculentus</i>	Methyl bromide	....
Tall fescue, <i>Festuca arundinacea</i>	Dalapon Dazomet Metham TCA	Dalapon Dazomet Metham TCA
St. Augustinegrass, <i>Stenotaphrum secundatum</i>	"	"
German velvetgrass <i>Holcus mollis</i>	Dalapon Dazomet Metham Methyl bromide	Dalapon Dazomet Metham Methyl bromide

HERBICIDE RATES, TIMING

Name of chemical	Trade name(s)	Formulation(s)	Use
AMA	Super Crab-E-Rad ® Methar ®	Soluble liquid	Selective, foliage-applied, translocated
Amitrole	Amitrol 90 ® Amizol ®	Sol. Pow.	Nonselective, foliage- applied, translocated
Benefin	Balan ®	Gran. with fertilizers	Selective, soil-applied, pr emergent
Bensulide	Betasan ® Presan ®	Emul. liq., gran., with fertilizer	Selective, soil-applied, pr emergent

3	4	5	6	7
For selective treatment				
Bentgrass	Bermudagrass	Bluegrass, Kentucky	Fescue, fine-leaf	Dichondra
DSMA MSMA	DSMA MSMA	DSMA MSMA	DSMA MSMA	DSMA
....				
2,4-D amine	2,4-D ester MSMA	2,4-D ester MSMA	2,4-D ester MSMA	....
....	DSMA MSMA	DSMA MSMA	....	....

AND OTHER DETAILS

Rate	Remarks
4-6 lbs. ai/A*	<p>Temperature and turf type determine degree of selectivity. Grass turf—low rate: If temperature is above 80° use 4 lb. ai/A if used on bentgrass or dichondra. High rate: 6 lb. ai/A used on mature crabgrass plants or on bluegrasses, zoysia, or bermudagrass.</p> <p>NOTE: Temporary discoloration may occur, especially on fescue, bentgrass, or dichondra turf.</p>
5 lb. ai/A + 1 qt. surfactant/100 gals. water 2 oz. 90% formulation in 2 gals. water + 2 tsp. surfactant/1,000 sq. ft.	<p>Apply as a preplant for control of principally annual weeds. To avoid extended soil residue, apply only during spring and summer and keep soil moist. Do not plant within 4 weeks.</p>
3 lb. ai/A	<p>Crabgrass: Apply 2-3 weeks before initial crabgrass germination (January for Los Angeles Basin, early to mid-February for Central Valley and Central Coast, mid-February to 1st of March for northern California and north coastal areas). Sprinkle irrigate after application to wash herbicide off leaves and into the soil.</p> <p>Annual bluegrass: Apply 2-3 weeks before initial annual bluegrass germination (August-September). Sprinkle irrigate after application to wash herbicide off leaves and onto the soil.</p> <p>Speedwell: Apply preemergence in January.</p> <p>NOTE: Do not apply to bentgrass greens.</p>
15 lb. ai/A	<p>Crabgrass: Apply 2-3 weeks before initial crabgrass germination (January for Los Angeles Basin and South Coast area, early to mid-February for Central Valley and Central Coast, mid-February to 1st of March for northern California and north coastal areas).</p> <p>NOTE: Crabgrass may germinate and become established in turf in late summer if lower rates are used. Good management practices and a tight turf will allow use of lower rates.</p>
10 lb. ai/A in fall and 10 lb. ai/A in midwinter (Jan.-Feb.)	<p>Annual bluegrass: Apply in early fall before annual bluegrass germinates. Normally mid-August to mid-September.</p> <p>NOTE: Exclude children and pets during application and until treated area has been thoroughly sprinkler irrigated.</p>

Name of chemical	Trade name(s)	Formulation(s)	Use
Bromoxynil	Nu-Lawn ®	Emul. Concentrate	Selective, foliage-applied, contact
Cacodylic acid	Phytar 560 ® Kilz-All ®	Sol. liq. sol. pow.	Nonselective, foliage-applied, postemergent contact
Calcium arsenate	Tri-calcium arsenate ®	Granular or wettable powder	Selective, soil-applied, pre emergent
Calcium cyanamide	Aero Cyanamid ®	Gran.	Nonselective, Soil-applied. Use Preplant
CMA	Calar ® Weedone Crabgrass Killer ®	Sol. liq. or sol. powder	Selective, foliage-applied, translocated
Dalapon	Dowpon ®	Sol. powder	Selective or nonselective, foliage-applied translocated Principally a grass herbicide
Dazomet	Mylone ®	Wettable powder	Nonselective, soil-applied, fumigant, preplant
DCPA	Dacthal ® Kem-Krab ®	Wettable powder Granular, formulated with fertilizer	Selective, soil-applied, pre emergent

Rate	Remarks
6 oz. ai/A 3.2 oz. of 8.4% formulation per 1,000 sq. ft.	Apply on young grass turf after grass has emerged and when broadleaf weeds are in 3 to 4 leaf stage or on rosette plants before they exceed 1½ inches in diameter. NOTE: May have wide use on other broadleaf weeds.
6-8 lb. ai + 1 qt. surfactant/A	Apply as a preplant for control of principally annual weeds.
1-1.5 lbs./1,000 sq. ft.	Annual bluegrass: Apply in early fall (mid-August to mid-September) before annual bluegrass germinates. May be used on bentgrass greens. Rate should be closely linked to phosphorous level of soils. Lower rate should be used when phosphorous is low. Sprinkle irrigate after application to wash the herbicide off of the leaves and onto the soil. NOTE: Injury may occur on most turf species. <i>Hazardous material</i> —should not be used where children or pets can come into contact with the material.
2,200 lbs. formulation/A 50 lb. formulation/1,000 sq. ft.	Prepare soil in seedbed condition; apply one-half the rate and incorporate with tiller 2-3 inches deep. Apply remaining one-half on surface. Keep soil moist for 3 weeks. Wait 6 weeks if temperature is below 50° before seeding. Calcium cyanamide decomposes in moist soil to release nitrogen (21 per cent).
2.0-5.0 lbs. ai/A	Temperature and turf type determine degree of selectivity. Grass turf—Low rate: Young crabgrass, for use on bentgrass, dichondra, or fine-leaved fescue turf, or when daily high temperature exceeds 85°. High rate: Mature crabgrass, for use on Kentucky bluegrass turf when temperature is 85° or less, and for bermudagrass turf. NOTE: Apply uniformly over area regardless of distribution of crabgrass. Hesitating over more weedy spots may cause excessive rate and injure or kill turf. Repeat on 5-7 day intervals for total of 2-3 treatments for crabgrass. May temporarily discolor turf. May injure St. Augustine and fescue and some bentgrass species.
5 lbs. formulation in 100 gals. water/A	·(Selective use in established dichondra only) Apply uniformly over dichondra turf regardless of distribution of weedy grass clumps. Hesitating over more weedy spots may cause excessive rate and kill dichondra. Irrigate thoroughly 1-2 days before applying dalapon; wait 3-5 days following spraying for next irrigation. Some discoloration of dichondra may occur.
10 lbs. formulation + 1 qt. surfactant/100 gal. water or 0.1 lb. formulation + 2 tsp. surfactant/gal. water.	For spot spraying. Nonselective in dichondra or grass turf. Apply as a nonselective spray to individual weedy grass clumps. Repeat when new growth appears. Apply no more spray than is required to just wet the foliage.
430 lbs. ai/A or 10 lbs. ai/1,000 sq. ft.	Apply in water; mix into soil 6 inches deep with a power tiller. Seed in 2-3 weeks if temperature is over 60° and soil is moist but not wet. Wash into soil with sprinkler irrigation when spot treating. Effective principally on annual weeds.
15 lbs. ai/A	Apply 2-3 weeks before initial crabgrass germination (January for Los Angeles Basin and South Coast area, early to mid-February for Central Valley and central coast area; mid-February to 1st of March for northern California and north coast area). NOTE: Do not use on bentgrass or dichondra. Exclude children and pets during application and until treated area has been thoroughly sprinkler-irrigated. Young crabgrass plants may become established in turf in late summer if lower rates are used.

Name of chemical	Trade name(s)	Formulation(s)	Use
Dicamba	Banvel ®	Sol. liquid	Selective, foliage-applied translocated
Dicamba + 2,4-D	Scott's Turfbuilder Plus 4 ® Weedone Super D ®	Sol. liquid, granular formulated with fertilizer	Selective, foliage-applied translocated
Diphenamid	Dymid ® Enide ® Scott's Dichondra Fertilizer Plus 3 ®	Wettable powder or granular formulated with fertilizer	Selective, soil-applied, preemergent
DSMA	Clout ® Sodar ® Dimet ® Crab-E-Rad ® Ortho DSMA 100 ®	Sol. liquid or sol. powder	Selective, foliage-applied, translocated
Mecoprop	Mecopex ® Chipco Turf Herbi- cide MCPP ®	Soluble liquid	Selective, foliage-applied, translocated
Metham	Vapam ® VPM ®	Soluble liquid	Preplant or nonselective soil-applied fumigant.

Rate	Remarks
$\frac{1}{2}$ lb./a + 1 qt. surfactant/100 gals. water	Chickweeds, clovers, English daisy, prostrate knotweed, pearlwort, red sorrel, curly dock. Respray in 2-4 weeks where necessary.
$\frac{1}{2}$ lb. ae + 1 qt. surfactant/100 gals. water. or 1 tsp. + 2 tsp. surfactant/gal.	For spot spraying (applies to 4 lb. ae/gal. formulations). NOTE: Do not exceed $\frac{1}{4}$ lb. ae/A on bentgrass. Active through the soil; do not use where roots of ornamental plants may extend into treated area. Spray on calm days to avoid spray drift onto susceptible crops or ornamentals. Non-selective in dichondra.
$\frac{1}{4}$ lb. ae Dicamba + 1 lb. ae 2,4-D + 1 qt. surfactant in 100 gals. water/A	For English daisy or other difficult-to-control broadleaf weeds where there is dandelion or plantain present. NOTE: Do not exceed $\frac{1}{4}$ lb. ae/A of dicamba on bentgrass turf. Active through the soil; do not use where roots of ornamentals may extend into treated area. Spray on calm days to avoid spray drift onto susceptible crops or ornamentals. Non-selective in dichondra.
For dichondra turf only; effective preemergence and early postemergent mainly for grass control.	
0 lbs. ai/A	Annual bluegrass: Apply in early fall and spring. Crabgrass: January for Los Angeles Basin; February for Central Valley and Central Coast; March for northern California and north coast area. Bermudagrass: Apply to suppress growth, does not eradicate established plants. NOTE: Will seriously injure or kill turfgrasses. Exclude children and pets during application and until treated area has been thoroughly sprinkler irrigated.
Effective in controlling crabgrass, dallisgrass, and nutsedge. Temperature, soil moisture, and turf type determine degree of turf-selectivity. Avoid spraying under hot, droughty conditions. Bent and fine-leaved fescues are most sensitive, bermudagrass is most tolerant. Do not use on St. Augustine turf. Apply uniformly in 175-200 gallons per acre.	
1 lb. ai/A	Use this lower rate on bentgrasses, fine-leaved fescues and dichondra turf. Sufficient rate for young crabgrass, and with repeat monthly sprays for established dallisgrass and nutsedge. Use this lower rate if daily temperatures exceed 80° F.
0 lb. ai/A	This higher rate required for mature crabgrass, requires 2-3 resprays on 5-7 day interval. Satisfactory rate for use in bermudagrass, and if temperatures are 80° or less in Kentucky bluegrass as well. Will yellow zoysia turf. Repeat sprays will reduce kikuyugrass.
$\frac{1}{2}$ lb. ae/A + 1 qt. surfac. per 100 gals. spray For spot spraying: Use same concentration per 100 gals. or 4 tps. + 2 tps. surfact./gal. water.	Clover, prostrate knotweed, pearlwort. NOTE: Spray on calm days to avoid spray drift onto susceptible crops or ornamentals. Prostrate knotweed should be treated when young (2-4 inches in diameter). Non-selective in dichondra. (Rate for spot spraying—applies only to formulations containing 2 or 2½ lbs. ae/gal.)
30 lbs. ai/A or 0 lbs. ai/1,000 sq. ft.	Apply in water on calm day; follow immediately with sprinkler irrigation to seal the soil surface, or preferably cover with vaporproof covering. Seed in 2 weeks on light sandy soils; in 3-4 weeks on heavier clay or muck (organic) soils. Extend waiting period if temperature is below 60°. Two applications usually required to eradicate bermudagrass or kikuyugrass. Rototilling prior to treating will enhance control.

Name of chemical	Trade name(s)	Formulation(s)	Use
Methyl bromide		Pressurized gas	Nonselective, soil-applied, fumigant, preplant
Monuron	Cooke Oxalis Control [®] Cha-Kem-Co. Oxalis-Kil [®] Niagara Monuron 2 [®]	Wettable powder	Selective, soil-applied, pre- or post-emergence
MSMA	Ansar 529 [®] Ansar 170 [®] Daconate [®]	Soluble liquid	Selective, foliage-applied, translocated
Neburon	Scott's Bonus for Dichondra	Granular	Selective, soil-applied, pre- or post-emergence
Paraquat	Paraquat [®]	Water-soluble liquid or aerosol cans	Nonselective, foliage-applied contact
Silvex	Kuron [®] Weedone 2,4,5TP [®]	Emulsifiable liquid	Selective, foliage-applied.
Terbutol	Azak [®]	Wettable powder, formulated w/fertilizers	Selective, soil-applied, preemergent

Rate	Remarks
30 lbs./A or 0 lbs./1,000 sq. ft.	<p>NOTE: EXTREMELY DANGEROUS. Should be handled by experienced applicator only. Vapor toxic when removing sealed cover. Exclude children, pets and the general public until cover has been removed and gas has dissipated.</p> <p>Inject under a vaporproof cover, sealed at the edges; remove cover in 24 hours. Will kill roots of trees and shrubs present in the fumigated soil. Double this application rate to kill bermudagrass, field bindweed, kikuyugrass, and nutsedge. Control may be incomplete for hard-seeded species—mallow, clovers, medics, and pigweed. Soil should be friable.</p>
1 lb. ai/A	<p>For control of annual grasses, chickweed, creeping wood-sorrel. Apply in early spring or summer. Retreatments may be required. Do not apply more than twice in any 6-month period.</p> <p>NOTE: For dichondra turf only, margin of selectivity is narrow—apply uniformly. Sprinkler irrigate immediately following application to reduce chemical burn on dichondra. Will give temporary preemergence control of spotted spurge.</p>
6 lbs. ai/A	<p>Temperature and turf type determine degree of selectivity. Use lower rate for nutsedge control, on bentgrass, and on other turf types when daily temperature exceeds 85°. Apply at monthly intervals for control of dallisgrass and nutsedge.</p> <p>NOTE: Apply uniformly over area regardless of distribution of the weed. Hesitating with sprayer over more weedy spots may cause excessive rate and injure or kill the turf. Repeated applications of high rates reduces kikuyugrass. Turf may be temporarily discolored. Injurious to St. Augustine grass, red fescue, dichondra or zoysia.</p>
4 lbs. ai/A	<p>For control of annual grasses, chickweed, creeping wood-sorrel. Use low rate on light, porous soils; high rate on heavier soils. Apply in early spring or summer. Retreatments may be required.</p> <p>NOTE: For dichondra turf only. Sprinkler irrigate immediately following application to reduce chemical burn on dichondra. Preemergence, late winter application will give temporary control of spotted spurge.</p>
2-1 lb. ai + 1 qt. surfactant in 100 gals. water/A or spot spraying 2-4 tsp. + 2 sp. surfact./gal. water	<p>Apply to young annual grasses or broadleaf plants. May be used around shrubs and annual plantings, in parkways or other noncrop areas. Do not allow spray to drift or contact desirable foliage or green stems. Mallow and knotweed are resistant.</p> <p>NOTE: Paraquat is inactivated on contact with clay or loamy soils. Comply with cautions on the label.</p>
2 lbs./A or spot spraying (applies to lb., ae/gal. formulations) lb. ae/100 gal. water or 2 tps./ al.	<p>Use low rate for California bur clover, black medic, common (annual) chickweed.</p> <p>Use high rate on mouseear (perennial) chickweed, spotted spurge. Repeated spot applications will control bentgrass selectively in Kentucky bluegrass turf.</p> <p>NOTE: Damages stoloniferous grasses—bentgrass, bermudagrass. Nonselective in dichondra. Spray only on calm days; use low pressure to avoid spray drift onto susceptible crops or ornamentals.</p>
5 lb. ai/A	<p>Apply 2-3 weeks before initial crabgrass germination. January, Los Angeles Basin and South Coastal area; February, Central Valley and Central Coastal area; March, northern California and North Coastal area; Preemergence control of annual <i>Veronica</i> species when applied in September-October.</p> <p>NOTE: Do not use on bentgrass or fine-leaved fescues. May injure dichondra. Exclude children and pets during application and until treated area has been thoroughly sprinkler irrigated. Normally, young crabgrass plants will become established in turf in the fall if lower rates are used.</p>

Name of chemical	Trade name(s)	Formulation(s)	Use
2,4-D			Selective foliage-applied, translocated
	Water-soluble amines: Formula 40 ® Weedar 64 ® 2,4-D Amine No. 4 ® (others)		
	Low volatile esters: Esteron 90 concentrate ® 2,4-D Low Volatile Ester 4L ® Weedone LV-4 ® (others)	Emulsifiable	
2,4-D continued	Parent acid: Weedone 638	Emulsifiable	
Weed Oil	Richfield Weedkiller A Hykil Weed Killer No. 6 Others	Liquid (with or without emulsifier)	Nonselective, foliage-applied, contact

The trade names given here are for the reader's convenience. Use here does not constitute an endorsement of any named product by the University of California, nor does it indicate criticism of any similar products not included in the listing.

Rate	Remarks
selective in grass turf with appropriate precautions. Use in dichondra turf only as a nonselective spot treatment. Teaspoon rates per gallon of water apply to formulations containing 4 lbs. ae/gal.	
1 lb. ae + 1 qt. surfactant in 100 gals. water/A or 2 tsps. formulation + 2 tsps. surfactant to gal. water for spot treatment.	To control dandelion, plantain, young pigweed. NOTE: On bentgrasses use water-soluble amine only and do not exceed $\frac{3}{4}$ lb. ae/A.
2 lbs. ae + 1 qt. surf. in 100 gals. water/A or 4 tsps. formulation + 2 tsps. surf. to gal. water for spot treatment.	To control young knotweed (2- to 4-leaf stage), field bindweed, wild lettuce, filaree.
2 lbs. ae in 100 gals. water/A or 4 tsps. formulation per gal. water for spot treatment	To control common yarrow, speedwells, mallows, mature knotweed.
2 lbs. ae in 100 gals. water/A or 5 tsps. formulation per gal. water for spot treating.	To control spotted prostrate spurge in bermudagrass and Kentucky bluegrass turf.
100 gals oil/A	Apply as a preplant spray to kill existing annual weeds and to top-kill perennial weeds. Will stain painted surfaces, concrete, masonry, and soften asphalt.

* ai/A means active ingredient per acre.

ae means acid equivalent—roughly the same as active ingredient.

TURF DISEASES

Disease	Recommended fungicide*
Brown patch	benomyl, Daconil [®] , PCNB, thiram
Dollar spot	anilazine, Daconil [®]
Fusarium patch	benomyl, Daconil [®]
Melting out (on bluegrass)	anilazine, captan, cycloheximide Daconil [®] , folpet
Melting out (other than bluegrass)	"
Leaf blotch	"
Loose smut	seed treatment
Stripe smut	benomyl
Red thread	mancozeb
Grease spot	Dexon [®] , Koban [®]
Rust	cycloheximide, mancozeb, maneb
Seed rot, damping off, or root rot	seed treatment with thiram, captan; soil fumigation with methyl bromide, DMTT, MIT, SMDC

* Use at rates and frequencies recommended by the manufacturer.

The following is a list of turf fungicides and the trade names under which they may be purchased at nurseries or supply houses. The chemical names are given in lower case; the trade names, many of which are copyrighted, have their initial letters capitalized. This list is offered only as a guide to be used in conjunction with the recommendations above and does not constitute endorsement of any commercial product or discredit for any product not mentioned.

Some products not mentioned are known to give excellent results in University tests, but are not yet registered for use commercially and therefore cannot be recommended.

TURF FUNGICIDES

ORGANIC

anilazine = 2,4-dichloro-6-(*o*-chloroanilino)-s-triazine:

Dyrene Turf Fungicide, Turf Fungicide, Turf-Tox D-50

benomyl = methyl 1-(butylcarbamoyl)-2-benzimidazole-carbamate; Tersan 1991

captan = N-trichloromethylmercapto-4-cyclohexene-1,2-dicarboximide; Orthocide, Captan

cycloheximide: Acti-dione RZ, Acti-dione-Thiram, Acti-dione Ferrated
 daconil = tetrachloroisophthalonitrile: Daconil 2787
 dexion = p-dimethylaminobenzenediazo sodium sulfonate: Dexon
 folpet = N-(trichloromethylthio) phthalimide: Phaltan, Ortho-Lawn & Turf Fungicide
 koban = 5-ethoxy-3-trichloromethyl-1,2,4-thiadiazole: Koban
 mancozeb = coordination product of zinc ion and manganous ethlenebisdithiocarbamate: Fore, Manzate 200
 maneb = manganese ethylene bisdithiocarbamate: Dithane M-22, Tersan LSR
 PCNB = pentachloronitrobenzene: Fungiclor, Terraclor, Best Turf Fungicide
 polyethylenethiuramsulfide: Ethisul
 thiram = tetramethylthiuramdisulfide: Tersan 75, Pano-ram, D & P Turf-tox, Thiramad, Thiuram 75

COMBINATIONS

Acti-dione RZ = cycloheximide + PCNB
 Acti-dione-Thiram = cycloheximide + thiram
 Chipco Fore No. 3 = folpet + thiram
 Ortho Lawn Disease Control = captan + PCNB
 Pro Turf Fertilizer plus Fungicide II = PCNB + fertilizer

SOIL FUMIGANTS

DMTT = 3,5-dimethyl-tetrahydro-1,3,5-2H thiadiazine-2-thione: Mico-fume, Mylone, Soil Fumigant M
 methyl bromide: Bed Fume, Bromex, Brom-o-gas, Dow-fume MC-2, Iscobrome, MBC Fumigant, Pano-Brome, Pestmaster Soil Fumigant, Tribrome, Weedfume
 MIT = methylisothiocyanate: Vorlex (Vorlex is 20% MIT, 80% chlorinated hydrocarbon)
 SMDC = sodium N-methyldithiocarbamate: Vapam, VPM

A LIST OF CHEMICALS FOR PREPLANT AND POSTPLANT NEMATODE CONTROL ON TURF

Chemicals	Pests controlled*	Requires tarping†	Method applied
Preplant materials			
Methyl bromide	1, 2, 3, 4	Yes	Inj. and #1 cans under tarp
Chloropicrin	1, 2, 3, 4	No	Injection
Vapam	1, 2, 3, 4	No	Sprinkle on and Water
Mylone	1, 2, 3, 4	No	Mix in soil
Vorlex	1, 2, 3, 4	+ & -	Injection
DD mixture			
Telone	1	No	Injection
Vidden D			
Postplant materials			
Nemagon	1	No	Injection & Water
Fumazone			

NOTE: The chemicals listed above are registered and recommended by several chemical manufacturers for nematode and other pest control on turf. Users of these chemicals should be certain to investigate local restrictions on handling and applying any of the listed chemicals. Read the labels on containers and follow instructions carefully.

* Pests controlled: 1) Nemas, 2) Fungi, 3) Insects, 4) Weeds.

† Several of these pesticides do not require plastic tarping, however their efficiency usually is improved if a tarp is used.

CONTROL MEASURES

Pest	Insecticide
Lawn moths (sod webworms)	Diazinon spray or granules or Sevin® spray or granules
Cutworms Skipper larvae	Diazinon spray or granules
Leafhoppers Leafbugs Fungus gnats March flies Vegetable weevil Flea beetle	Malathion spray Diazinon spray
Eriophyid mite Fruit fly	Diazinon spray
Spider mites	Kelthane spray
White grubs	Chlordane spray or granules
Billbugs Chinch bugs*	Diazinon spray or granules
Snails and slugs	Baits or granules containing: Methaldehyde or Methaldehyde plus Calcium arsenate or Methaldehyde plus Sevin®

* Other materials registered for control of chinch bugs are Akton® and Dursban®. If you decide to use one of these materials be sure to follow the directions on the label.

RODENT CONTROL

Ground squirrels (genus *Spermophilus*)

Strychnine-barley used as a poisoned bait is most effective when green feed is scarce and the rodents are "pouching" and storing grain. Compound 1080 on grain may be effective but must be used in a program supervised by the Agricultural Commissioner.

Fumigation may give control when the soil is moist and not porous. Carbon bisulfide may be rolled into burrows on jute balls or pumped in with an applicator. Calcium cyanide, chloropicrin, or methyl bromide may be used, but the latter may kill nearby trees.

In small areas auto exhaust can be used to good advantage.

Meadow mice (genus *Microtus*)

Broadcast 2 per cent zinc phosphide on oat groats, or spot-place 1 per cent zinc phosphide grain directly

FOR LAWN INSECTS

Amount of actual insecticide per 1,000 sq. ft.	Remarks
2 oz.	Mow and water well before treatment. Apply when plants are dry. With sprays, do not water again until necessary. Because of the relatively short residual action of Sevin, frequent applications of this material may be necessary.
3 oz.	Mow and water well before treatment. Apply when plants are dry. With sprays, do not water again until necessary.
4 oz.	Mow and water well before treatment. Apply when plants are dry. Do not water again until necessary.
2 oz.	Repeat applications may be necessary for flea beetles.
2 oz.	Mow and water well before treatment. Apply when plants are dry. Do not water again until necessary. Two sprays, two weeks apart may be necessary for mite control.
See Note 2	
4 oz.	Water heavily after application to wash insecticide into soil. Do not wash insecticide away by flooding. Repeat applications may be necessary for billbugs and chinch bugs.
3 oz.	
Follow manufacturer's directions	Apply in late evening. Sprinkling area lightly with water prior to treatment to activate snails and slugs will greatly improve control.

in the runways. Compound 1080 may also be used under supervision of the County Agricultural Commissioner.

Pocket gopher (genus *Thomomys*)

Strychnine-treated grain or vegetable bait may be placed directly in the burrow system by making a hole with a probe and inserting the material.

If it is desired to try fumigation, the auto exhaust is probably the most effective method, but calcium cyanide, carbon bisulfide, methyl bromide or commercial "gopher bombs" may be used.

Moles (genus *Scapanus*)

The same chemicals used for ground squirrels may be used in fumigating for moles, but only limited success may be expected from these or from the use of strychnine-treated grain.

See Manual 41 for other recommended control measures.

W A R N I N G

The descriptions of poisons and poison baits given here are intended as a brief guide to their properties and uses. ALL ARE HAZARDOUS, should be handled carefully and kept in locked storage when not in use.

Where possible, poisoned baits should be purchased already mixed from the County Agricultural Commissioner or from some commercial supplier. Hand mixing in small quantities is not recommended because of the hazards involved. It should never be attempted by anyone who is not thoroughly familiar with the techniques involved and who does not have available all of the equipment needed to maintain complete safety during the operation.

Strychnine is especially hazardous and baits containing this material should be purchased ready-mixed.

CHARACTERISTICS OF RODENTICIDES

Sodium monofluoroacetate (Compound 1080)

May be used *only* by governmental agencies, federal, state, or local, and licensed pest control operators. Compound 1080 on grain baits, oat groats, or rolled barley, used to control ground squirrels and, in certain situations meadow mice. Very toxic material, mixed at one-two ounces per hundred pounds of grain. Stable, but very water-soluble, compound; is selective in its action because of varying susceptibility of different species. It is very poisonous to dogs and some other mammals that might eat the dead rodents, but birds are very resistant to this poison.

Strychnine

Strychnine formulas for controlling ground squirrels usually contain 0.3 per cent strychnine on grain. These may also be used to control meadow mice, jack rabbits, and pocket gophers.

Buy strychnine-coated baits ready-made. Do not mix them yourself.

Strychnine is a quick-acting poison, very toxic to mammals and to birds other than gallinaceous species (pheasants, quail, chickens, etc.) which have rather high resistance.

Strychnine's strong, characteristic taste often keeps rodents from eating bait on which it is used. They seem to associate the taste with the rapid, convulsive

reaction it produces in them and when they have once had too small a dose to kill them, they will avoid strychnine-baited material thereafter.

Zinc phosphide

This metallic poison is used at 1 per cent concentration on grain for hand baiting to control ground squirrels or meadow mice. Two per cent bait is used if bait is broadcast; for large infestations of meadow mice two per cent bait is applied by aircraft at five to ten pounds per acre, depending upon mouse density. Zinc phosphide slowly hydrolyzes upon exposure to air so fresh bait and prompt usage is recommended. The pungent phosphine odor does not repel rodents yet serves as a human warning agent as does the black color imparted to treated baits. It is highly toxic to all forms.

Fumigants

Any chemical of this group may be used for control of burrowing rodents (moles, pocket gophers, and ground squirrels). Effectiveness depends on production of a toxic concentration within the burrow system so is affected by soil moisture, absorptive properties, temperature and tightness, and by burrow capacity. Application time and labor and equipment involved usually limit the method to small infestations, or as a follow-up treatment to other methods. The highly toxic nature of most fumigants creates special hazards calling for extreme safety in usage.

Calcium cyanide

This chemical may be used as flakes inserted into burrow with a spoon (one-two ounces each placement), or dust pumped in with an applicator. The compound is stable when dry but atmospheric moisture produces deadly hydrocyanic gas to be inhaled by the rodents. Underground placement and quick decomposition make the material fairly safe to other wildlife or to domestic animals.

Carbon bisulfide

This most widely used gas for ground squirrel control may be applied to balls of jute or cotton waste to be rolled down burrows. The burrow should then be closed with earth. Another and more effective method is to apply it with a special applicator hose and pump. In using applicator (*Demon Rodent Gun*) apply four ounces (2 pump strokes) per burrow. Carbon bisulfide is extremely volatile and flammable and chronic exposure to fumes causes serious symptoms in hu-

mans. It is harmful to plants and should not be used within range of desirable shrubs or plants.

Carbon monoxide

This gas may be produced for burrow fumigation by attaching a hose to a tractor or automobile exhaust, or by use of commercial rodent "bombs." These usually are fused cartridges containing charcoal and an oxidizing agent in proportion to create incomplete combustion, resulting in a fog of carbon monoxide.

Chloropicrin

"Tear gas" is an effective rodent fumigant usually supplied as a liquid to be poured onto absorptive material and inserted in the burrow. The irritating odor serves as an effective warning factor to the operator. It is unpleasant but not poisonous to humans.

Methyl Bromide

An odorless, tasteless chemical that is highly toxic on contact. Should not be stored in dwellings or carried in passenger compartment of automobiles. Usually supplied in cans with a special dispenser or may be used with pump applicator. Should not be used in burrows adjacent to desirable plants.

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