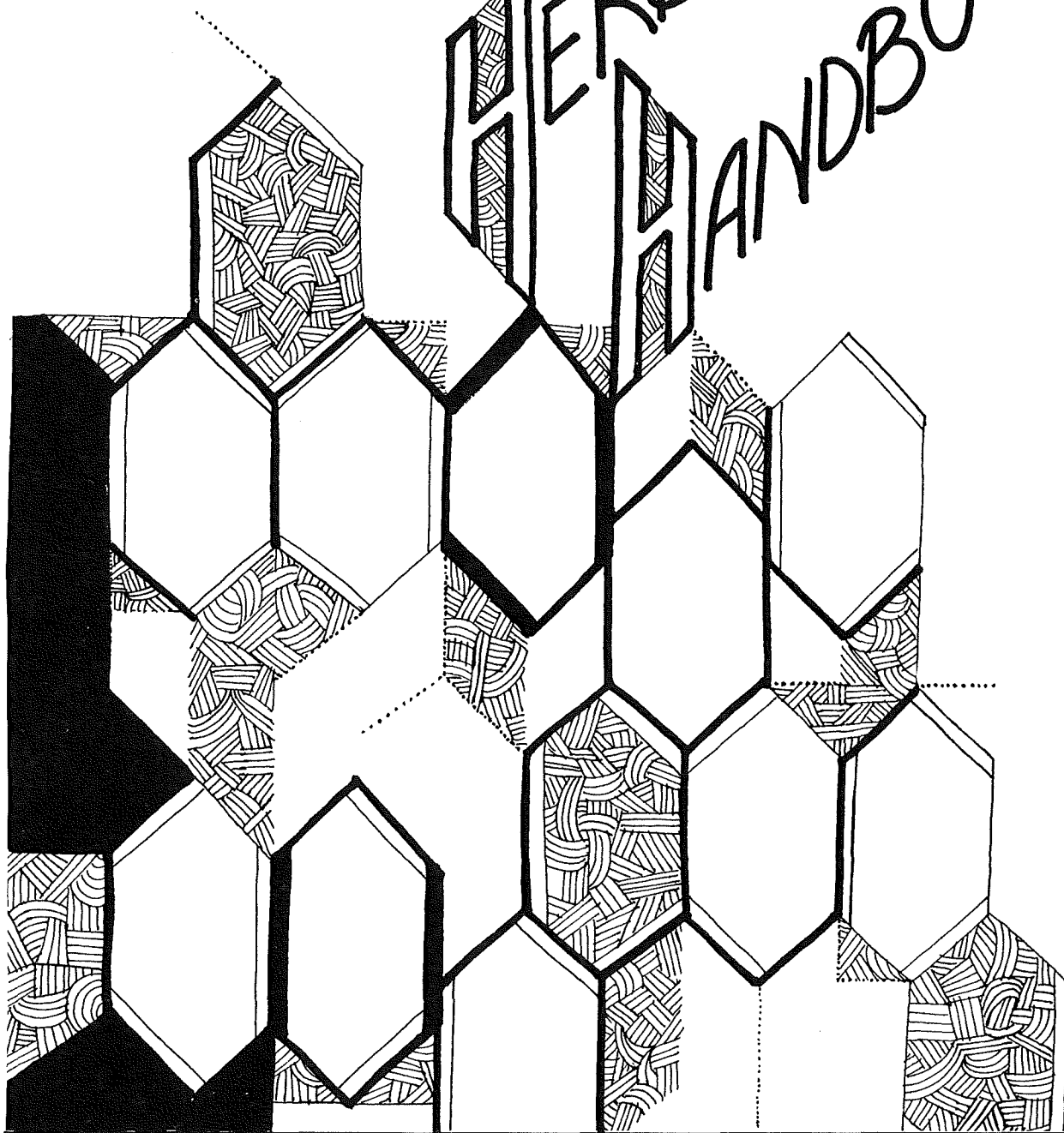


(WEED SCIENCE TRAINING AID)

# HERBICIDE HANDBOOK



Division of Agricultural Sciences  
UNIVERSITY OF CALIFORNIA

PRINTED JANUARY 1978

SPECIAL PUBLICATION

3243

THIS PUBLICATION IS PREPARED FOR INFORMATIONAL PURPOSES ONLY, AND SHOULD NOT BE USED FOR THE GIVING OF RECOMMENDATIONS.

This Weed Science Training Aid was prepared to consolidate pertinent technical information on new and established herbicides. Additional information can be obtained from product labels and technical data sheets supplied by herbicide manufacturers and dealers and from the Herbicide Handbook of the Weed Science Society of America.

Herbicides are separated into the following groups or chemical families: triazines, substituted ureas, uracils, carbanilate and carbamate, amides (chloroacetamides), substituted anilines, phenoxies, chlorinated benzoic acid derivatives, nitriles, organic arsenicals, dipyridylum, biphenyl ethers, and miscellaneous.

This publication can be used in conjunction with the Weed Science Training Aid, Special Publication 3056, "Common and Proprietary Trade Names of Herbicides".

Prepared by

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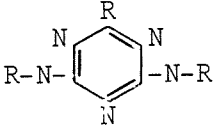
University of California, Cooperative Extension

NOTE: Phytotoxic soil life as indicated is derived from irrigated cropland.

Revised: 8/77

## Triazines

General characteristics: Long residual (3-18 months), relatively insoluble in water, low volatility, soil-applied, weak on some grass species, tolerance of many plants due to placement. Sorghum and some other monocotyledon generas degrades some enzymatically. Symptoms from soil applications often interveinal.

BASIC STRUCTURE	EXAMPLES (water sol.)	TRADE NAMES	USES	PERFORMANCE	TOLERANT SPECIES
	ametryn (185 ppm) LD <sub>50</sub> = 1150	EVIK <sup>®</sup>	potato desiccant	Florida registration only.	
	atrazine (70 ppm) LD <sub>50</sub> = 3080	AATREX <sup>®</sup>	corn, grain sorghum, noncrop sites, certain Christmas trees	Applied with non-phyto-toxic oil to milo and corn for barnyardgrass control. Relatively long-lived in soil.	turkey mullein, plantains, annual panicum, most grasses at low rates.
	secbumeton (620 ppm) LD <sub>50</sub> = 1000	SUMITOL <sup>®</sup>	compound shelved	Winter broadleaf and grass control. Common groundsel.	
	prometon (750 ppm) LD <sub>50</sub> = 2920	PRAMITOL <sup>®</sup>	noncrop	Long residual, should not be used around ornamentals.	
	prometryn (48 ppm) LD <sub>50</sub> = 3750	CAPAROL <sup>®</sup>	cotton, celery	Limited to transplant celery, controls chickweed, groundsel.	grasses
	propazine (8.6 ppm) LD <sub>50</sub> = 5000	MILOGARD <sup>®</sup>	grain sorghum	Relatively long-lived in soil.	

Triazines (continued)

BASIC STRUCTURE	EXAMPLES (water sol.)	TRADE NAMES	USES	PERFORMANCE	TOLERANT SPECIES
	cyanazine (160 ppm) LD <sub>50</sub> = 334	BLADEX <sup>®</sup>	corn, grain sorghum	Short-lived in soils.	
	simazine (5 ppm) LD <sub>50</sub> = 5000	PRINCEP <sup>®</sup> AQUAZINE <sup>®</sup>	corn, apples, citrus, pears, plums, cherries, walnuts, asparagus, artichokes, Christmas trees, ornamentals, algae	Essentially no post- emergence activity at low rates. Relatively long-lived in soil.	plantain, filaree, cheeseweed, crabgrass, barnyardgrass, and annual panicum grasses.
	terbutryn (58 ppm) LD <sub>50</sub> = 2400	IGRAN <sup>®</sup>	grain sorghum, winter wheat (Pacific Northwest)	Relatively short-lived in soil, some post- emergence activity.	
	metribuzin (1200 ppm) LD <sub>50</sub> = 1937	SENCOR <sup>®</sup> LEXONE <sup>®</sup>	potato, tomato, soybeans	preemergence and early postemergence.	weak on most grasses
	cyprazine (insol.) LD <sub>50</sub> = 1200 E.C. = 4.35	FOX-4 <sup>®</sup>	corn	Relatively long-lived soil, preemergence and postemergence activity.	weak on barnyardgrass

Triazines (continued)

BASIC STRUCTURE	EXAMPLES (water sol.)	TRADE NAMES	USES	PERFORMANCE	TOLERANT SPECIES
	dipropetryn (GS 16068) (16 ppm) LD <sub>50</sub> = 5000  procyazine (CGA 18762) (300 ppm)  terbuthylazine (GS 13529) LD <sub>50</sub> = 1200	SANCAP®   CYCLE®	cotton   corn	Light soils in midwest only.   Shorter residual than atrazine.	

Substituted ureas

General characteristics: Long residual (3-18 months), relatively insoluble in water, low volatility, tolerance of many plants due to placement, soil-applied, symptoms from soil applications often veinal chlorosis.

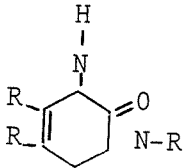
BASIC STRUCTURE	EXAMPLES (water sol.)	TRADE NAMES	USES	PERFORMANCE	TOLERANT SPECIES
$\begin{array}{c} \text{O} \\ \parallel \\ \text{R}_2\text{-N-C-N-R}_2 \end{array}$	chlorbromuron LD <sub>50</sub> = 2150	MALORAN <sup>®</sup> BROMEX <sup>®</sup>	soybeans (seed)	Preemergence grass and broadleaf.	
	chloroxuron (3.7 ppm) LD <sub>50</sub> = 3700	TENORAN <sup>®</sup> NOREX <sup>®</sup>	annual weeds in strawberries, onions, carrots	Soil residual life from 3-6 months, not effective in high O.M. soils. Effective on seedling weeds pre or post-emergence.	sowthistle, sweet clover
	diuron (42 ppm) LD <sub>50</sub> = 3400	KARMEX <sup>®</sup>	cotton, walnuts, pears, vines, apples, asparagus, non-crop areas, alfalfa	Some postemergence activity with surfactant on seedling weeds.	common groundsel, wild oats, turkey mullein, plantains, spurge, Russian thistle
	fenuron (3850 ppm) LD <sub>50</sub> = 4000	DYBAR <sup>®</sup>	brush control	Effective in mineral soils.	
	fluometuron (90 ppm) LD <sub>50</sub> = 8900	COTORAN <sup>®</sup>	cotton	Shorter residual than monuron or diuron.	
	linuron (75 ppm) LD <sub>50</sub> = 1500	LOROX <sup>®</sup>	pre or early postemergence	Foliage active. Relatively short-lived in soil.	carrot family, Russian thistle, some annual grasses.

Substituted ureas (continued)

BASIC STRUCTURE	EXAMPLES (water sol.)	TRADE NAMES	USES	PERFORMANCE	TOLERANT SPECIES
	metobromuron (320 ppm) LD <sub>50</sub> = 3000	PATORAN <sup>®</sup>	preemergence in potatoes	Soil persistence 6 to 8 months. Do not use on soils of less than 1% organic matter.	
	monuron (230 ppm) LD <sub>50</sub> = 3600	TELVAR <sup>®</sup>	noncrop area, dichondra	Leaches faster than most ureas.	common groundsel, turkey mullein, plantains, spurge
	neburon (4.8 ppm) LD <sub>50</sub> = >11,000	BONUS FOR DICHONDRA <sup>®</sup>	dichondra	Solubility low, leaches slowly.	
	siduron (18 ppm) LD <sub>50</sub> = 7500	TUPERSAN <sup>®</sup>	pre or post- plant pre- emergence con- trol in turf- grass.	Has not controlled crabgrass effectively in California. Injures bermudagrass. Controls bermudagrass seedlings.	cool season grasses (annual bluegrass, ryegrass, fescue, bluegrass)
	tebuthiuron LD <sub>50</sub> = 644	SPIKE <sup>®</sup>	noncrop, herbaceous annuals	Very persistent, 3 years or more at high rates.	turkey mullein at low rates.

## Uracils

General characteristics: Long residual (to 24 months), relatively insoluble in water, low volatility. Tolerance of many plants due to placement, soil-applied, symptoms from soil applications of veinal or blotchy leaf chlorosis.

BASIC STRUCTURE	EXAMPLES (water sol.)	TRADE NAMES	USES	PERFORMANCE	TOLERANT SPECIES
	<p>bromacil (815 ppm) LD<sub>50</sub> = 5200</p> <p>terbacil (740 ppm) LD<sub>50</sub> = 5000</p>	<p>HYVAR-X<sup>®</sup> combined with diuron (KROVAR<sup>®</sup>)</p> <p>SINBAR<sup>®</sup></p>	<p>pre and early postemergence annual weed and bermudagrass control in citrus and non- crop.</p> <p>terbacil used in applies, citrus, peaches, and mint.</p>	<p>Soil-applied. With early postemergence activity. Long soil residual except under excessive irrigation water. Leaches and moves with surface water.</p> <p>Postemergence activity on seedling weeds. Long residual.</p>	<p>common mullein to 6 to 8 lb. ai/A., grasses more tolerant than broadleaf weeds.</p> <p>mint family (henbit), some annual grasses, catsear, and false salsify.</p>



Carbanilates and Carbamates

General characteristics: Short soil residue, need incorporation, volatile, relatively insoluble in water, excellent grass control, symptoms normally twisting or stunting of seedlings, strapped leaves of some broadleaf plants.

BASIC STRUCTURE	EXAMPLES (water sol.)	TRADE NAMES	USES	PERFORMANCE	TOLERANT SPECIES
$\begin{array}{c} \text{R} \quad \text{O} \\ \diagdown \quad \parallel \\ \text{N}-\text{C}-\text{O}-\text{R} \\ \diagup \\ \text{R} \end{array}$ <p>Carbanilates</p>	propham (280 ppm) LD <sub>50</sub> = 9000	CHEM HOE® (IPC)	lettuce, winter annual grass control	Mechanical incorporation or sprinkler irrigation, or rainfall must follow application.	composites, shepherdspurse, lambsquarters
	chlorpropham (88 ppm) LD <sub>50</sub> = 3800	CHLORO IPC® (CIPC)	alfalfa, ladino, garlic	Short soil life, dodder control.	many composites
	barban (11 ppm) LD <sub>50</sub> = 1350	FURLOE® CIPC (CIPC + PPG 124)	postemergence wild oat control in cereals	Specific for wild oats. Timing of application critical.	broadleaves
	carbetamide LD <sub>50</sub> = 5000	CARBYNE®  LEGURAME®			
$\begin{array}{c} \text{R} \quad \text{O} \\ \diagdown \quad \parallel \\ \text{N}-\text{C}-\text{S}-\text{R} \\ \diagup \\ \text{R} \end{array}$ <p>Thiocarbamates</p>	cycloate (85 ppm) LD <sub>50</sub> = 2000	RO-NEET®	sugar beets	Incorporate.	shepherdspurse, groundsel
	EPTC (375 ppm) LD <sub>50</sub> = 1652	EPTAM®	preemergence annual weed control in beans, alfalfa	Short lived. Most effective applied on dry soil. Incorporate immediately.	legumes, mallow, groundsel, puncturevine

Carbanilates and Carbamates (continued)

BASIC STRUCTURE	EXAMPLES (water sol.)	TRADE NAMES	USES	PERFORMANCE	TOLERANT SPECIES
Thiocarbamates	butylate (45 ppm) LD <sub>50</sub> = 4659	SUTAN <sup>®</sup>	corn	Short soil life.	hairy nightshade
	butylate + R-25788	SUTAN <sup>®</sup> +	corn	Greater selectivity than SUTAN <sup>®</sup> to corn.	
	diallate (14 ppm) LD <sub>50</sub> = 39.5	AVADEX <sup>®</sup>	preemergence wild oat control in cereals	Works best incorporated.	most broadleaves
	ethiolate LD <sub>50</sub> = 400-500	PREFOX <sup>®</sup>	corn		
	triallate (4 ppm) LD <sub>50</sub> = 1675	AVADEX BW <sup>®</sup> FAR-GO <sup>®</sup>	preemergence wild oat control in cereals	Postplant, shallow soil incorporation.	most broadleaves
	pebulate (< 30 ppm) LD <sub>50</sub> = 921	TILLAM <sup>®</sup>	preemergence annual weed control in tomatoes, sugar beets	Incorporate. Suppres- sion of yellow nutsedge.	many crucifers, puncturevine, burning nettle.
	molinate (1000 ppm) LD <sub>50</sub> = 720	ORDRAM <sup>®</sup>	barnyardgrass control in rice	Pre or post flood, preemergence or early postemergence.	broadleaf rice weeds, sprangletop, nutsedge
	vernolate (109 ppm) LD <sub>50</sub> = 1780	VERNAM <sup>®</sup>	soybean		
benthocarb LD <sub>50</sub> = 1903	BOLERO <sup>®</sup>	rice	Excellent - early post- emergence on sprangle- top.		

Carbanilates and Carbamates (continued)

BASIC STRUCTURE	EXAMPLES (water sol.)	TRADE NAMES	USES	PERFORMANCE	TOLERANT SPECIES
$  \begin{array}{c}  R \quad S \\  \diagdown \quad    \\  N-C-S-R \\  \diagup \\  R  \end{array}  $ <p>Dithiocarbamates</p>	<p>CDEC (92 ppm) LD<sub>50</sub> = 850</p> <p>metham LD<sub>50</sub> = 820</p>	<p>VEGADEX<sup>®</sup></p> <p>VAPAM<sup>®</sup> VPM<sup>®</sup></p>	<p>broccoli, lettuce, tomatoes</p> <p>soil fumigant for preplant or nonselective postemergence</p>	<p>Short soil residue, preplant incorporation. Short term dodder control.</p> <p>Soil surface is sealed with water or tarp.</p>	<p>Crucifer family, grass, malva, solonaceae, knotweed</p> <p>nutsedge, cheeseweed</p>
$  \begin{array}{c}  H_2N \quad SO_2 \quad NHCOOCH_3 \\  \diagdown \quad \diagup \\  \text{Benzene ring}  \end{array}  $	<p>asulam (sol.) LD<sub>50</sub> = 8000</p>	<p>ASULOX<sup>®</sup></p>	<p>promising for postemergence control of some perennial weeds (bracken fern) and annual grasses</p>	<p>Some soil activity. Avoid use near trees or vines.</p>	<p>cocklebur</p>
<p>Methyl carbanilate</p>	<p>phenmedipham (&lt; 1 ppm) LD<sub>50</sub> = 8000</p> <p>desmedipham (7 ppm) LD<sub>50</sub> = &gt; 10,250</p>	<p>BETANAL<sup>®</sup></p> <p>BETANEX<sup>®</sup></p>	<p>postemergence broadleaf weeds in sugar beets</p> <p>postemergence broadleaf weeds in sugar beets</p>	<p>Apply low gallonage 1 qt/10 gal. water per acre, moderate agitation only.</p> <p>Broadleaf weed control, pigweed and lambs- quarters.</p>	<p>redroot pigweed, redmaids, and barnyardgrass</p> <p>grasses</p>
<p>Methyl carbamate</p>	<p>terbutol (6 ppm) LD<sub>50</sub> = &gt; 15,000</p>	<p>AZAK<sup>®</sup></p>	<p>compound shelved</p>	<p>Not as volatile as most carbamates, longer residual.</p>	<p>grasses except fescue</p>

Amides (chloroacetamides)

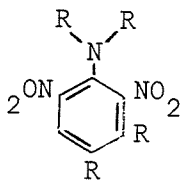
General characteristics: Short to long soil residual (2-12 months), relatively insoluble in water, slight volatility, good grass control, soil-applied except propanil, symptoms from soil application usually stunting.

BASIC STRUCTURE	EXAMPLES (water sol.)	TRADE NAMES	USES	PERFORMANCE	TOLERANT SPECIES
$\begin{array}{c} \text{O} \\    \\ \text{R}-\text{C}-\text{NH}-\text{R} \end{array}$ <p align="center">Amide</p>	CDAA (20,000 ppm) LD <sub>50</sub> = 750	RANDOX <sup>®</sup>	preemergence or directed post-emergence on onions	CDAA: more active in soils of medium to high organic matter.	
	diphenamid (260 ppm) LD <sub>50</sub> = 1373	DYMID <sup>®</sup> ENIDE <sup>®</sup>	preplant or postplant pre-emergence, particularly effective on annual grasses	Generally incorporated, preemergence under sprinklers.	Solanaceae and Compositae families
	pronamide (15 ppm) LD <sub>50</sub> = 8350	KERB <sup>®</sup>	pre or early postemergence in lettuce, alfalfa preemergence	Residual in mineral soils 4 months to 6 months, cereal grains and grassy crops sensitive. Good on spotted spurge.	Compositae family: (groundsel, pineappleweed), puncturevine
	napropamide (73 ppm) LD <sub>50</sub> = 5000	DEVRINOL <sup>®</sup>	tree crops, tomatoes, ornamentals and asparagus	Injurious if deep incorporated, long residual, shows promise on yellow nutsedge.	hairy nightshade, ground-cherry, henbit, Russian thistle, fleabane, vinegarweed.



### Substituted Anilines

General characteristics: Medium to long residual (4-18 months), low solubility in water, relatively volatile, excellent annual grass control, soil applied (incorporated), symptoms--root inhibition and stunting. Weak on plants of Compositae, Cruciferae, Solanaceae, and Leguminosae families.

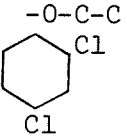
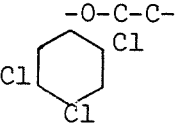
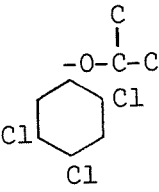
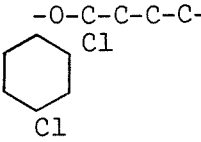
BASIC STRUCTURE	EXAMPLES (water sol.)	TRADE NAMES	USES	PERFORMANCE	TOLERANT SPECIES
	benefin (70 ppm) LD <sub>50</sub> = 5000	BALAN <sup>®</sup>	lettuce, annual grass control in turfgrasses, alfalfa	Soil persistence may limit certain crops in rotation.	Compositae: sunflower, groundsel
	butralin (1 ppm) LD <sub>50</sub> = 2500	AMEX <sup>®</sup> 820	soybeans, ornamentals, experimental on tomatoes and cucurbits	Shorter residual than trifluralin.	Cruciferae: mustard, London rocket, shepherdspurse Solanaceae: ground cherry, nightshade Leguminosae: burclover
	dinitramine (1 ppm) LD <sub>50</sub> = 3000	COBEX <sup>®</sup>	cotton, soybeans	Greater herbicidal activity, but shorter residual than trifluralin. More phytotoxic to nightshade group.	
	fluchloralin LD <sub>50</sub> = 6400	BASALIN <sup>®</sup>	cotton		
	pendamethalin (<.5 ppm) LD <sub>50</sub> = 1250	PROWL <sup>®</sup>	cotton, corn preemergence in North Central states		

Substituted Anilines (continued)

BASIC STRUCTURE	EXAMPLES (water sol.)	TRADE NAMES	USES	PERFORMANCE	TOLERANT SPECIES
	oryzalin (85 ppm) LD <sub>50</sub> = 10,000	SURFLAN®	tree crops and vines, ornamentals	May be incorporated by overhead water.	Compositae: sunflower, groundsel Cruciferae: mustard, London rocket, shepherdspurse Solanacea: ground cherry, nightshade Leguminosae: burclover
	isopropalin (<0.5 ppm) LD <sub>50</sub> = 5000	PAARLAN®	tobacco tomatoes (removed from market 1973)	Less dependent on rapid soil incorporation. May be watered in. Strongly absorbed.	
	nitralin (0.6 ppm) LD <sub>50</sub> = 2000	PLANAVIN®	preplant pre- emergence con- trol in annual crops and in established perennial crops		
	trifluralin (<1 ppm) LD <sub>50</sub> = 5000	TREFLAN®	"	Requires soil incorporation within 24 hours. Strongly adsorbed in soil. Very toxic to fish.	
	profluralin (0.1 ppm) LD <sub>50</sub> = 2200	TOLBAN®	cotton, soybeans, beans, some vegetable and ornamental crops.	Very similar to trifluralin in per- formance. Requires soil incorporation.	
	prosulfalin (516 ppm) LD <sub>50</sub> = >2000	SWARD®	turf	Medium residual (4 to 6 months)	
	ethafluralin (0.3 ppm) LD <sub>50</sub> = 10,000	SONALAN®	dry beans	Greater activity on nightshade species than other dinitro- anilines.	
	prodiamine (<1 ppm) LD <sub>50</sub> = 15,380	RYDEX®	experimental for tree crops, vines and ornamentals	May be incorporated by overhead water.	

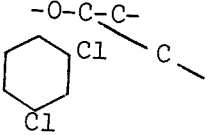
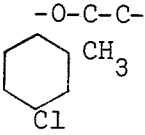
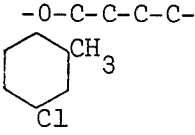
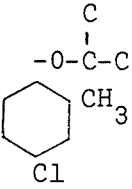
## Phenoxy Compounds

General characteristics: Short soil residual (1-4 months) moderately volatile, controls broadleaf plants (foliage applied), symptoms twisting of petioles, leaf epinasty. Danger of drift and with some formulations volatility problems.

BASIC STRUCTURE	EXAMPLES (water sol.)	TRADE NAMES	USES	PERFORMANCE	TOLERANT SPECIES
	2,4-D ( 600 ppm) LD <sub>50</sub> = 375-500	many	broadleaved weed control in grain crops, pastures, turf and rangeland	Some volatility problems with esters. Soil residual 1-2 mo. drift is a major hazard.	most grasses, swamp smartweed, knotweed when past 2-3 leaf stage, fiddleneck
	2,4,5-T (238 ppm) LD <sub>50</sub> = 485-500	many	brush control on pasture and rangeland (foliage translocated or basal sprays)	Volatility and drift are primary hazards. Soil residual 2-4 mo.	most grasses
	silvex (2,4,5-TP) (180 ppm) LD <sub>50</sub> = 650	SILVEX <sup>®</sup> WEEDONE <sup>®</sup> (2,4,5-TP) KURON <sup>®</sup>	brush control (foliage translocated or basal sprays) poison oak and broadleaf weed control in turf-grass.	Volatility and drift are primary hazards. Soil residual 2-4 mo.	most grasses, Stoloniferous grasses more sensitive
	2,4-DB (essentially insoluble in water) LD <sub>50</sub> = 1960	BUTOXONE <sup>®</sup> BUTYRAC <sup>®</sup>	broadleaved weed control in seedling legumes	Poor results under cold temperatures. Converts to 2,4-D in susceptible plants and in soil, residue in soil 1-2 mo.	most grasses, legumes, and other broadleaved weeds (cheeseweed)

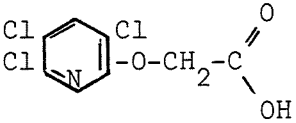
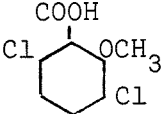
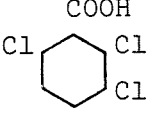


Phenoxy Compounds (continued)

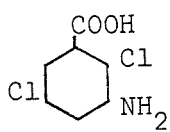
BASIC STRUCTURE	EXAMPLES (water sol.)	TRADE NAMES	USES	PERFORMANCE	TOLERANT SPECIES
	dichlorprop (2,4-DP) (710 ppm) LD <sub>50</sub> = 800	PROPI-RHAP <sup>®</sup> VISKO-RHAP <sup>®</sup> BRUSHKILLER 170 <sup>®</sup>	brush control	Similar to 2,4-D but effective on oaks.	most grasses and some brush species
	MCPA (essentially insoluble in water) LD <sub>50</sub> = 800	several	broadleaved weed control in grain crops, pastures, and some legumes	Similar to 2,4-D but more selective, i.e., rice, oats and ladino clovers.	most grasses and some legumes
	MCPB (essentially insoluble in water) LD <sub>50</sub> = 700	CAN-TROL <sup>®</sup> THISTROL <sup>®</sup>	Canada thistle in small grains and peas	Similar to 2,4-D but more selective on legumes.	most grasses and legumes
	mecoprop (600 ppm) LD <sub>50</sub> = 650	MCPP	Control of broadleaves (clover, etc.) in turfgrass. Safer on bentgrass than others in this group.	Similar to 2,4-D.	turfgrasses

Chlorinated benzoic acid derivatives

General characteristics: Short (chloramben, 1-2 mo.) to long residual--12-24 + months, relatively nonvolatile, controls broadleaf plants (soil applied and/or foliage applied) (except chloramben) symptoms, twisting of petioles, leaf epinasty, hazard from drift.

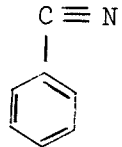
BASIC STRUCTURE	EXAMPLES (water sol.)	TRADE NAMES	USES	PERFORMANCE	TOLERANT SPECIES
	triclopyr (430 ppm) LD <sub>50</sub> = 713	GARLON <sup>®</sup> 3A	foliage trans-located sprays for brush on non-crop land.	Soil persistence in 4-6 mo. range.	
	dicamba (4500 ppm) LD <sub>50</sub> = 1028	BANVEL <sup>®</sup>	foliage trans-located spray for broadleaved weeds in small grains, corn, sorghum, grasses, and turf. Foliage or soil treatment for perennial weeds on noncrop land.	Major hazards are drift and soil residual.	dandelion and plantain tolerant to dosages used on grass turf. Swamp smartweed, perennial peppergrass
	2,3,6-TBA PBA (8400 ppm) LD <sub>50</sub> = 750	BENZAC <sup>®</sup> 1281 BENZAC <sup>®</sup> 354	soil residual treatment for perennial broadleaved weeds on noncrop land.	Soil residual to 2 years is major hazard.	grasses have some tolerance

Chlorinated benzoic acid derivatives (continued)

BASIC STRUCTURE	EXAMPLES (water sol.)	TRADE NAMES	USES	PERFORMANCE	TOLERANT SPECIES
	chloramben (700 ppm) LD <sub>50</sub> = 3500	AMIBEN® VEGIBEN®	a soil incorporated selective treatment. Pre-emergence in squash, soybeans, established tomatoes and lima beans.	Soil residual 1-2 months. Controls nightshade family of weeds.	controls only limited number of broadleaved species; better for grass control

Nitriles (alkyl cyanides)

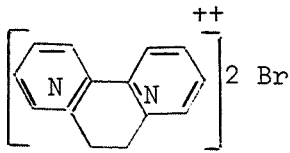
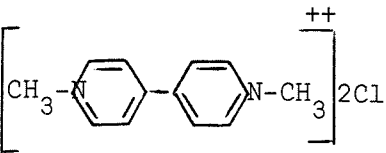
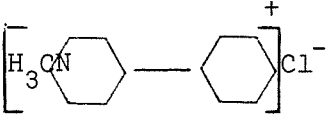
General characteristics: Short (bromoxynil) to medium (dichlobenil) soil residual, better broadleaf than grass control.

BASIC STRUCTURE	EXAMPLES (water sol.)	TRADE NAMES	USES	PERFORMANCE	TOLERANT SPECIES
	<p>dichlobenil (18 ppm) LD<sub>50</sub> = 2460</p> <p>bromoxynil (&lt; 200 ppm) LD<sub>50</sub> = 440</p>	<p>CASORON<sup>®</sup></p> <p>BROMINAL<sup>®</sup> BUCTRIL<sup>®</sup> NU-LAWN<sup>®</sup></p>	<p>tree and vine crops, ponds, buckhorn plantain, <u>Equisetum</u> control, some ornamentals</p> <p>selective foliar contact herbicide in cereals and turf</p>	<p>Relatively high vapor pressure, w.p., must incorporate, general annual weed control; promising on bindweed and nutsedge. Ladino clover and trefoil fairly resistant.</p> <p>Fiddleneck control in cereals, control of seedling broadleaf weeds in young grass turf.</p>	<p>marestail, puncturevine, annual grasses</p> <p>most grasses, pigweed, chickweed somewhat resistant</p>



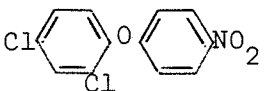
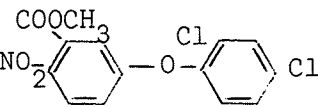
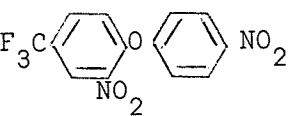
## Dipyridylum

General characteristics: No soil activity, binds to soil, no antidote, foliage applied or in water, no appreciable translocation, possible drift hazard.

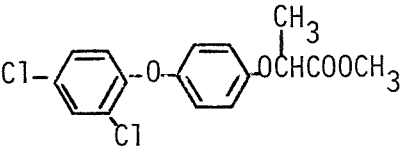
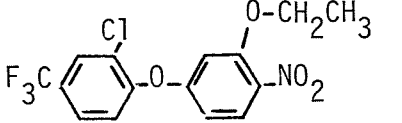
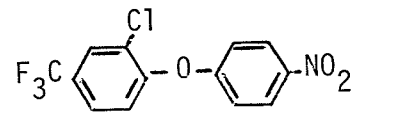
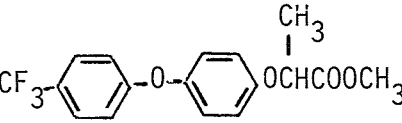
BASIC STRUCTURE	EXAMPLES (water sol.)	TRADE NAMES	USES	PERFORMANCE	TOLERANT SPECIES
	diquat (soluble) LD <sub>50</sub> = 230	ORTHO DIQUAT®	submersed aquatic weed control. Edging of ornamentals.	Deactivated in muddy water or in presence of heavy algal bloom. Highly active on <i>Elodea</i> , biodegrades slowly, strongly adsorbed.	chara and other submersed algae
	paraquat (soluble) LD <sub>50</sub> = 157	PARAQUAT®	nonselective contact herbicide	Used with a surfactant. Destroys green tissue including green stems of young trees or vines. Paraquat corrosive to aluminum. Biodegrades slowly, strongly adsorbed. Drift hazard to susceptible crops.	cheeseweed, knotweed, filaree, <i>Fluellin</i> , and older plants of many species.
	cyperquat (GCP 6134) LD <sub>50</sub> = 267		compound shelved	Excellent knockdown in certain crops: onions, turf with suppression of nutsedge regrowth.	

Biphenyl ethers

General characteristics: Relatively insoluble in water, low volatility. Usually soil surface activity.

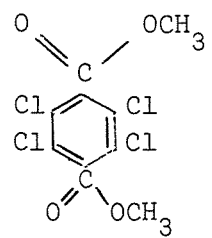
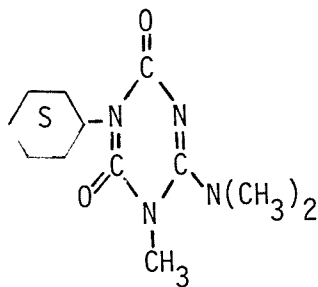
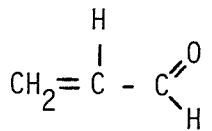
BASIC STRUCTURE	EXAMPLES (water sol.)	TRADE NAMES	USES	PERFORMANCE	TOLERANT SPECIES
	nitrofen (insoluble) LD <sub>50</sub> = 2630	TOK <sup>®</sup>	pre or early postemergence annual weed control in onions, cruciferous crops (cabbage, brussels sprouts) and ornamentals, promising for canarygrass in wheat and barley	Effective early post-emergence short residual, may be deactivated by cultivation. Good performance under sprinkler irrigation although excess water at first irrigation may injure plants (girdling).	mustard, chickweed, groundsel, some annual grasses
	bifenox (0.35 ppm) LD <sub>50</sub> = 6400	MODOWN <sup>®</sup>	postemergence broadleaf control in cereals, soybeans, corn		
	fluorodifen (< 2.0 ppm) LD <sub>50</sub> = 15,000	PREFORAN <sup>®</sup>	soybeans, beans	Similar to nitrofen but greater activity, pre-emergence or very early postemergence.	crucifers

Biphenyl ethers (continued)

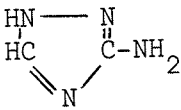
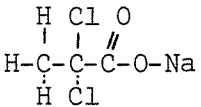
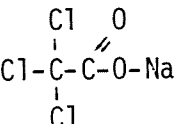
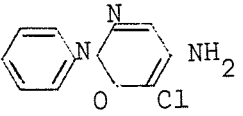
BASIC STRUCTURE	EXAMPLES (water sol.)	TRADE NAMES	USES	PERFORMANCE	TOLERANT SPECIES
	diclofop (HOE 23408) (50 ppm) LD <sub>50</sub> = 2176	HOELON™	pre or post-emergence promising for wild oat, rye-grass, and canary-grass in wheat and barley. Also watergrass in beans and sugar beets		Most broadleaves
	oxyfluorfen (RH 2915) (<0.1 ppm) LD <sub>50</sub> = >5000	GOAL®	experimental in orchard, vine crops, ornamental and turf	Excellent control of Compositae family weeds, cheeseweed.	Most grasses
	nitrofluorfen (RH 2512) LD <sub>50</sub> = 1000-2500		experimental in crucifer crops		
	HOE 29152 (1.4 ppm) LD <sub>50</sub> = 400		promising pre or post for grass control in broad-leaved groups especially sugar beets. Not safe to small grains.		Most broadleaves



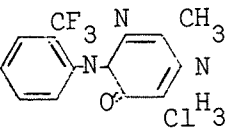
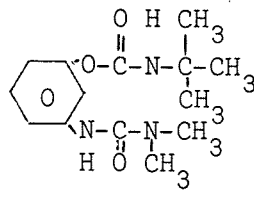
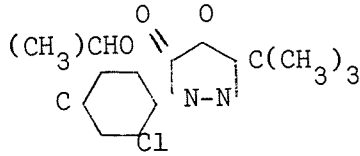
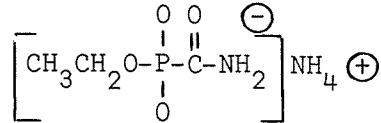
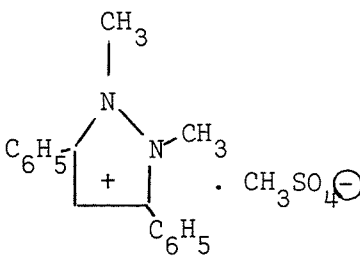
Miscellaneous

BASIC STRUCTURE	EXAMPLES (water sol.)	TRADE NAMES	USES	PERFORMANCE	TOLERANT SPECIES
	<p>DCPA (<math>&lt; 1</math> ppm) <math>LD_{50} = 3000</math></p>	<p>DACTHAL<sup>®</sup> KEM-KRAB<sup>®</sup></p>	<p>preemergence annual weed control in grass turf, onions, cotton, garlic, and most ornamentals, seed alfalfa</p>	<p>Very low solubility, 0.5 ppm, must be incorporated mechanically or by leaching. Pre- emergence use under sprinklers, more predictable control in lighter soils.</p>	<p>ground cherry, burclover, shepherdspurse, legumes, groundsel, burning nettle, pigweed</p>
	<p>(32,000 ppm) <math>LD_{50} = 1690</math></p>	<p>VELPAR<sup>®</sup></p>	<p>noncrop areas</p>		<p>some conifers at low rates</p>
	<p>acrolein <math>LD_{50} = 46</math></p>	<p>ACROLEIN<sup>®</sup></p>	<p>nonselective aquatic herbicide in flowing water.</p>	<p><u>TOXIC TO FISH.</u></p>	

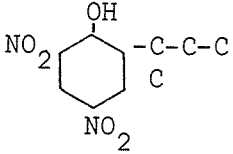
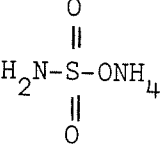
Miscellaneous (continued)

BASIC STRUCTURE	EXAMPLES (water sol.)	TRADE NAMES	USES	PERFORMANCE	TOLERANT SPECIES
	<p>amitrole (280,000 ppm) LD<sub>50</sub> = 24,600</p> <p>amitrole + ammonium thiocyanate LD<sub>50</sub> = 5000 - 14,700</p>	<p>AMITROL® 90® AMIZOL®</p> <p>AMITROL-T® CYTROL®</p>	<p>foliage treat- ments for cattail, horsetail rush, hoarycress, poison oak and general annual weeds</p>	<p>Translocates readily. Apply with a surfactant.</p>	<p>dallisgrass, johnsongrass, nutsedge, swamp smartweed, bindweed</p>
	<p>dalapon (900,000 ppm) LD<sub>50</sub> = 9330</p>	<p>DOWPON®</p>	<p>foliage treat- ments for grass control and cattail</p>	<p>Applied with a surfactant, rapid breakdown in moist, warm soil.</p>	<p>knotgrass, bulrush, nutsedge, most broadleaves</p>
	<p>TCA (13.06 x 10<sup>6</sup> ppm) LD<sub>50</sub> = 5000</p>	<p>TCA®</p>	<p>soil applied for grass control</p>	<p>Little or no adsorp- tion in soils, leaches readily, difficult to control excessive leaching.</p>	<p>many broadleaves</p>
	<p>pyrazon (300 ppm) LD<sub>50</sub> = 2500-4200</p> <p>pyrazon + dalapon</p>	<p>PYRAMIN®</p> <p>PYRAMIN PLUS®</p>	<p>preemergence and postemergence broadleaf weed control in sugar beets</p>	<p>Excess irrigation may cause injury to seed- ling sugar beets.</p>	<p>grasses, pigweed, lambsquarters</p>

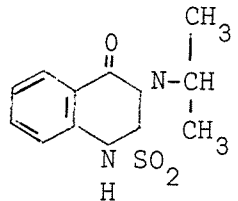
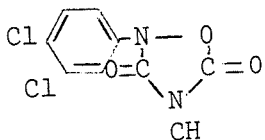
Miscellaneous (continued)

BASIC STRUCTURE	EXAMPLES (water sol.)	TRADE NAMES	USES	PERFORMANCE	TOLERANT SPECIES
	<p>norflurazon (40 ppm) LD<sub>50</sub> = 8000</p>	<p>SOLICAM<sup>®</sup> ZORIAL<sup>®</sup> EVITAL<sup>®</sup></p>	<p>cotton, cran- berry, tree crops</p>	<p>Grass control, injures bermudagrass. Best control when rainfall or irrigation follows surface application.</p>	<p>knotweed, spurge, pigweed</p>
	<p>karbutilate (325 ppm) LD<sub>50</sub> = 3000</p>	<p>TANDEX<sup>®</sup></p>	<p>soil applied for noncrop areas, granule applica- tion for stump removal of woody species</p>	<p>Long soil residual.</p>	
	<p>oxadiazon (RP-17623) (0.7 ppm) LD<sub>50</sub> = 8000</p>	<p>RONSTAR<sup>®</sup></p>	<p>soil applied pre or early post in orchard, vine- yards, preemer- gence crabgrass control in turf</p>	<p>Leaches slowly, need irrigation or winter rainfall.</p>	<p>chickweed</p>
	<p>DPX-1108 LD<sub>50</sub> = 24,4000</p>	<p>KRENITE<sup>®</sup></p>	<p>experimental brush control in noncrop areas</p>	<p>Low toxicity to fish and birds. Best on deciduous species.</p>	
	<p>difenzoquat (sol.) LD<sub>50</sub> = 460</p>	<p>AVENGE<sup>®</sup></p>	<p>wild oat control in cereals, post- emergence</p>	<p>Good wild oat control in wheat and barley at 3-5 leaf stage wild oats. May injure some wheat varieties.</p>	<p>broadleaves</p>

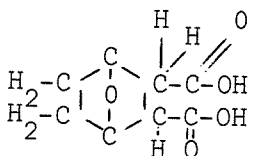
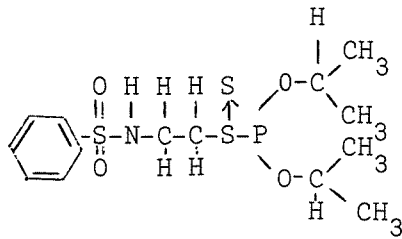
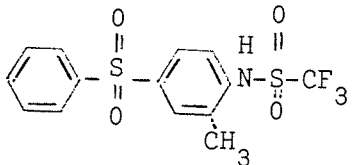
Miscellaneous (continued)

BASIC STRUCTURE	EXAMPLES (water sol.)	TRADE NAMES	USES	PERFORMANCE	TOLERANT SPECIES
$\text{H}_2\text{SO}_4$	sulfuric acid 1 oz. oral (lethal to humans)		selective spray in onions and in orchards	Formulations: available as commercial acid. Hazardous: highly cor- rosive to metal, skin and clothing. Soil residual - combines immediately with soil or with plant tissue.	grasses, sowthistle, established shepherdspurse
	weed oils	AVON ANNALOS <sup>®</sup> 7 WEED KILLER GENERAL WEED OIL <sup>®</sup> RICHFIELD A <sup>®</sup> HYKIL <sup>®</sup> SELECTIVE <sup>®</sup> WEED OIL STODDARD <sup>®</sup> SOLVENT	general weed control, selec- tive control in carrots, onions, cotton, celery	General contact weed oils are used straight or diluted with water and used as emulsions. May be fortified. Selective weed oils are used straight.	some Composites (groundsel, wild lettuce) and some plants in carrot family.
	dinoseb LD <sub>50</sub> = 58 *skin absorbed	DOW GENERAL <sup>®</sup> SINOX <sup>®</sup> GENERAL <sup>®</sup> PREMERGE <sup>®</sup> SINOX PE <sup>®</sup> DOW SELECTIVE <sup>®</sup> SINOX W <sup>®</sup>	general weed con- trol, fortifiers for weed oils, selective in grains, onions, etc. and pre- emergence	Formulation: NH <sub>4</sub> salt, sol. amine salts, sol. parent phenol EC. Used as foliage contact sprays or selective soil treatments. Soil residual 2-4 weeks. May girdle young trees.	broadleaf species as a group more susceptible than grasses
	AMS (684,000 ppm) LD <sub>50</sub> = 3900	AMMATE <sup>®</sup> AMMATE X <sup>®</sup>	contact kill of woody plants	Formulations: dry crystals. Used as con- tact spray has limited translocation. Hazards - corrosive. Soil residues 1-2 months.	resprouting woody species unpredictable

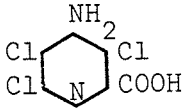
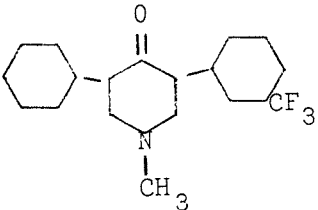
Miscellaneous (continued)

BASIC STRUCTURE	EXAMPLES (water sol.)	TRADE NAMES	USES	PERFORMANCE	TOLERANT SPECIES
$\text{NaClO}_3$	sodium chlorate ( $1.5 \times 10^6$ ppm) $\text{LD}_{50} = 5000$	ATLACIDE <sup>®</sup> SODIUM CHLORATE <sup>®</sup>	soil treatment for perennial weeds	Formulation: dry crystals or powder. Used as soil residual herbicide. Hazards - inflammable when mixed with organic matter. Soil residue-to 2 years or more.	white top
$\text{Na}_2\text{B}_4\text{O}_7$	borates (59,300 ppm) $\text{LD}_{50} = 2000$	BORASCU <sup>®</sup>	soil treatment for perennial weeds	Formulations: dry usually used in mixtures with other herbicides. Used as soil residual herbicides. Hazards-none. Soil residual - to 2 years or more.	white top, bromegrasses
$\text{HO}-\overset{\text{O}}{\parallel}{\text{C}}-\text{CH}_2-\underset{\text{H}}{\text{N}}-\text{CH}_2-\overset{\text{O}}{\parallel}{\text{P}}-\text{OH}$	glyphosate (10,000 ppm) $\text{LD}_{50} = 4320$	ROUNDUP <sup>®</sup>	perennial, herbaceous weeds, experimental for woody plant con- trol, or directed spray in orchards and vines.	Controls perennial weeds, translocated.	filaree, large Russian thistle, <i>Equisetum</i> (horsetail), large lambs- quarters, some conifers, algerian ivy
	bentazon (500 ppm) $\text{LD}_{50} = 1100$	BASAGRAN <sup>®</sup>	soybeans, beans, turf	Postemergence control of broadleaf weeds	grasses
	methazole (1.5 ppm) $\text{LD}_{50} = 1350$	PROBE <sup>®</sup>	cotton	Preemergence control of broadleaf weeds. Short residual.	somewhat weak on grasses and clovers.

Miscellaneous (continued)

BASIC STRUCTURE	EXAMPLES (water sol.)	TRADE NAMES	USES	PERFORMANCE	TOLERANT SPECIES
	buthiazole (VCS 5026) (3400 ppm) LD <sub>50</sub> = 2279	RAVAGE <sup>®</sup>	noncrop areas		
	endothall LD <sub>50</sub> = 38-51(acid) 182-197(Na salt) 206 (amine salt)	sodium and potassium salts AQUATHOL <sup>®</sup> ENDOTHAL <sup>®</sup>	aquatic weeds, desiccant grass control in turf- grass, sugar beets	Controls pondweeds, milfoil, coontail and burreed; annual blue control in turfgrass, desiccant for cotton, in static water only, warm water fish TLM 220-680 ppm	<i>Elodea</i> , duckweed, algae, grasses
	bensulide (25 ppm) LD <sub>50</sub> = 770	BETASAN <sup>®</sup> PREFAR <sup>®</sup>	turfgrass, dichondra, cucurbits, cotton, lettuce, several other vegetable crops	Preemergence grass control.	<i>Veronica</i> , many broadleaves
	perfluidone (60 ppm) LD <sub>50</sub> = 633	DESTUN <sup>®</sup>	cotton (nutsedge control)	Must be followed by sprinkler irrigation.	

Miscellaneous (continued)

BASIC STRUCTURE	EXAMPLES (water sol.)	TRADE NAMES	USES	PERFORMANCE	TOLERANT SPECIES
	<p>picloram (430 ppm) LD<sub>50</sub> = 8200</p>	<p>TORDON<sup>®</sup> TORDON<sup>®</sup> 22K TORDON<sup>®</sup> BEADS TORDON<sup>®</sup> 10K PELLETS</p>	<p>broadleaved weeds and brush on non- crop land, as foliage trans- located sprays and as soil residual treat- ments</p>	<p>Soil residual to 2 years or more is major hazard.</p>	<p>grasses and Cruciferae (mustard)family to low rates</p>
	<p>fluridone (EL 171)</p>		<p>experimental for annual and per- ennial weeds in cotton, aquatic areas</p>	<p>Soil residual very long - especially active preemergence on grasses (annual and johnsongrass). Very non-toxic to fish.</p>	

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