HERBICIDES

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Natural Resources Conservation Service

Soil Quality Institute
411 S. Donahue Dr.
Auburn, AL 36832
334-844-4741
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This is the fifth in a series of Soil Quality-Agronomy technical notes on the effects of land management on soil quality. This information is general and covers broad application.

Introduction

The Natural Resources Conservation Service promotes sustainable use of private land by providing information, delivering technical assistance, and encouraging voluntary adoption of conservation measures by private landowners. The enclosed herbicide information provides general information about specific herbicide groups. The purpose of this information is to provide field offices with a quick reference for herbicide behavior and use. The list does not encompass all herbicides, but it does cover many herbicides that are used today. The field office can use the "Herbicides" table for general planning purposes when discussing conservation systems.

Herbicide Use and Families

The use of pesticides in the United States is approximately 1,100,000 pounds per year. Herbicides account for 64 percent of total usage, insecticides 18 percent, and fungicides 8 percent. These levels have been fairly stable for the last ten years. Currently, the bulk of U.S. agriculture is driven by less than 100 compounds. In order to work with farmers to encourage adopting conservation practices, NRCS needs to be equipped to address herbicide related issues.

Herbicides are listed by family or group in the "Herbicides" table. This will enable field employees to learn for each family its:

- primary use,
- behavior in plants,
- fate in the environment,
- hazards, and
- leaching and runoff information.

Within each family, the name of a product is given by common name, followed by trade name. It is impractical to remember all herbicides, but by understanding the behavior of each herbicide family, field offices can provide technical information on herbicides within conservation planning.

In many instances, information about an herbicide family will be given at the top of each respective table, which will apply for all herbicides listed in the respective family. For example under Hazards, the Chloroacetamides can cause crop injury without a safener, and the entire group has an LD 50 of greater than 3000. This is mentioned once for the entire group within the Chloroacetamide family.

Use of the “Herbicides” Table

A field office employee can use information from “Herbicides” in conservation planning. For instance, if a farmer is considering converting to a no-till system and has traditionally used Thiocarbamates, use the Volatility/ Solubility section to learn that this group needs incorporation to prevent losses by volatility. The planner can then direct the producer to another herbicide family that does not require incorporation by

tillage. Another example: the Hazard section states that Thiocarbamates can exhibit "soil conditioning" with repeated use for 5 consecutive years. Soil conditioning is when soil microbes adapt themselves to the herbicide in order to rapidly degrade it to the point that weed control is of insufficient duration. This information is helpful with addressing weed infestations due to using the same herbicide in a continuous monoculture system and may lead the producer to a conservation cropping rotation system.

Additional Information

Other information needed includes a general knowledge of selectivity of herbicide families to prevent carry over problems if one is recommending converting from a monoculture to a conservation crop rotation system. Fate in Environment, Hazards, and Leaching and Runoff Potential (SPISP ratings) can provide environmentally sensitive information, such as indicating a high potential for leaching when working with sandy soils with a shallow water table. The SPISP II ratings are an updated list originally developed in 1990 (see references). These ratings are national lists developed to give leaching information for specific herbicides. If available in a local Technical Guide, use current local ratings specific to a location or state, rather than the national ratings.

Summary

"Herbicides" is general information to give the planner a reference for herbicide behavior and use. It discusses the herbicide families and unclassified herbicides like Glyphosate (Roundup). The "Herbicides" table does not need updating every time there is change in the herbicide market. However, as new families are marketed or new hazard and/or selectivity information are available, the table can be revised. If specific information is needed for a specific herbicide, direct the farmer to either the local Extension office or the label directions on the herbicide container. This technical note is also on the Soil Quality Institute's home page at: http://soils.usda.gov/sqi

References:

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Herbicides Table to Accompany Soil Quality Agronomy Technical Note #5

USDA-NRCS Soil Quality Institute, Updated 2001

Name/ Products	Primary Use	Application	Behavior in Plants:			Volatility / Solubility	Fate in Environment	Hazards	SPISP II Rating		
			Translocation	Mode of Action	Selectivity				Leaching potential	Solution runoff potential	Adsorbed runoff potential
Dinitroanilines (DNAs)											
Benefin "Balan"	Control of small germinating seedlings controls grasses	Pre-plant, incorporated in the top 2 inches. Also can be applied as a granular in lawns	None, root absorbed kills germinating plants	Inhibits mitosis (cell division)	Selective for small germinating grasses	Volatile, not soluble	Microbial degradation over a few months	Goosegrass has developed resistance, LD50>10000	low	inter-mediate	high
Pendimethalin "Prowl"	Control of small germinating seedlings controls grasses	Not as volatile can be used in "no-till"	None, root absorbed kills germinating plants	Inhibits mitosis (cell division)	Selective for small germinating grasses	Low volatility	Microbial degradation over a few months	LD50-1300	low	inter-mediate	high
Oryzalin "Surflan"	Control of small germinating seedlings controls grasses	Dependent on soil moisture, can be used in "no-till"	None, root absorbed kills germinating plants	Inhibits mitosis (cell division)	Selective for small germinating grasses	Non-volatile, the most water soluble of DNAs	Microbial degradation over a few months		low	inter-mediate	low
Ethalfluralin "Sonalan"	Control of small germinating seedlings controls grasses	Root absorbed, soil applied as pre-plant, incorporated in the top 2 inches	None, root absorbed kills germinating plants	Inhibits mitosis (cell division)	Selective for small germinating grasses	Volatile	Microbial degradation over a few months		low	inter-mediate	high
Trifluralin "Treflan"	Most volatile, pre-plant incorporated	Most volatile, pre-plant incorporated	None, root absorbed kills germinating plants	Inhibits mitosis (cell division)	Selective for small germinating grasses	The most volatile of DNAs	Microbial degradation over a few months	LD50-10000	low	inter-mediate	high
Triazines											
Atrazine "AAtrex"	All are used for broad leaf control, applied, corn/sorghum	Soil applied	Root absorbed from soil, translocated through xylem	Inhibits photo-synthesis	Selective for broadleaf control	Non-volatile, group varies in solubility Solubility 33 ppm	Less longevity at lower pH , can be persistent at neutral pH	Carry over,, Leaching with alkaline soils LD50>5,000	high	high	inter-mediate
Cyanazine "Bladex"	Corn/sorghum, broadleaf control	Soil applied	Root absorbed from soil, translocated through xylem	Inhibits photo-synthesis	Selective for broadleaf control	Solubility 171 ppm	Less longevity at lower pH , can be persistent at neutral pH	LD50-334 Cyanazine is being volunteered to be taken off market by 1999	inter-mediate	inter-mediate	low
Simazine "Princep"	Corn/sorghum, broadleaf control	Soil applied	Root absorbed from soil, translocated through xylem	Inhibits photo-synthesis	Selective for broadleaf control	Solubility 4 ppm	Less longevity at lower pH , can be persistent at neutral pH	Carry over,, Leaching with alkaline soils LD50>5,000	high	high	inter-mediate

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Hexazione "Velpar"	Forestry, broadleaf control	Soil applied	Root absorbed from soil, translocated through xylem	Inhibits photo-synthesis	Selective for broadleaf control	Solubility 33000 ppm	Less longevity at lower pH , can be persistent at neutral pH	Carry over,, Leaching with alkaline soils LD50-1690	high	high	inter-mediate
Prometon "Primatol"	Soil sterilant (non crop)	Soil applied	Root absorbed from soil, translocated through xylem	Inhibits photo-synthesis	Selective for broadleaf control	Solubility 750 ppm	Less longevity at lower pH , can be persistent at neutral pH	Carry over,, Leaching with alkaline soils LD50-2280	high	high	inter-mediate
Prometryn "Caparol"	Cotton, soybeans, and horticulture crops, broadleaf control	Soil applied	Root absorbed from soil, translocated through xylem	Inhibits photo-synthesis	Selective for broadleaf control	Solubility 48 ppm	Sensitive to pH, less life in lower pHs, fairly resistant in soil	Carry over,, Leaching with alkaline soils LD50-3750	inter-mediate	high	inter-mediate
Metribuzin "Sencor/ Lexone"	Soybeans, broadleaf control	Soil applied	Root absorbed from soil, translocated through xylem	Inhibits photo-synthesis	Selective for broadleaf control	Solubility 1220 ppm	Sensitive to pH, less life in lower pHs, fairly resistant in soil	Carry over,, Leaching with alkaline soils LD50-4750	high	high	low
Substituted Ureas											
Fluometuron "Cotoran"	Broadleaf control, cotton, used for overlay treatments	Soil applied	Root absorbed from soil, translocated through xylem	Inhibits photo-synthesis	Selective for broadleaf control	Low solubility due to high soil absorption	Microbial degradation generally last only one season	Carry over, can be soil sterilant at high rates LD50-1,000+	high	high	inter-mediate
Diuron "Karmex"	Broadleaf control, cotton	Soil applied	Root absorbed from soil, translocated through xylem	Inhibits photo-synthesis	Selective for broadleaf control	Low solubility due to high soil absorption	Microbial degradation generally last only one season	LD50-1,000+	inter-mediate	high	inter-mediate
Linuron "Lorox"	Soybeans, broadleaf control	Soil applied	Root absorbed from soil, translocated through xylem	Inhibits photo-synthesis	Selective for broadleaf control	Low solubility due to high soil absorption	Microbial degradation generally last only one season	Most post activity LD50-1,000+	inter-mediate	high	inter-mediate
Tebuthiuron "Spike"	Soil sterilant, brush control/rangeland	Soil applied	Root absorbed from soil, translocated through xylem	Inhibits photo-synthesis	Nonselective, soil sterilant	Very water soluble	Most resistent of group	Leached in soil LD50-1,000+	very low	high	inter-mediate

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Uracils											
Bromacil "Hyvar"	Orchards, control of small germinating plants, high rates can become soil sterilants	Soil applied	Root absorbed from soil, translocated through xylem	Inhibits photo-synthesis	Selective by placement	Some solubility, Solubility 813 ppm	Persistent, 6 months to 1 year	Injury to roots due to excessive leaching, LD50>5,000	high	high	inter-mediate
Terbacil "Sinbar"	Orchards, control of small germinating plants, high rates can become soil sterilants	Soil applied	Root absorbed from soil, translocated through xylem	Inhibits photo-synthesis	Selective by placement	Solubility 710 ppm	Persistent, 6 months to 1 year	LD50>5,000	high	high	inter-mediate
Glyphosate											
Roundup	Non-selective, broad spectrum plant control	Foliar applied	Translocated by xylem and phloem, translocation is excellent	Inhibits synthesis of aromatic amino acids	Non-selective	None	Tightly adsorbed to soil and rapidly degraded by microbes, thus no soil activity	LD50-5400	very low	high	high
Glufosinate Ammonium											
Liberty	Orchards and nurseries, Non-selective, broad spectrum plant control	Foliar applied	Contact, very little translocation	Prevents ammonia from being detoxified	Non-selective	None	Tightly adsorbed to soil and rapidly degraded by microbes, thus no soil activity	LD50-1620	low	inter-mediate	low
Chloroacetamides								Crop injury w/out safener, all low in acute toxicity, LD50>3000			
Acetochlor "Harness"	Pre-plant, control of small plants, corn	Soil applied	Soil applied translocated by xylem and phloem	Possibly inhibits lipid synthesis (unclear)	Selective for control of germinating grasses and some broadleaves	Moderate solubility, non-volatile	1-8 weeks persistent, mostly microbially degraded		inter-mediate	inter-mediate	low

Name/ Products	Primary Use	Application	Behavior in Plants:			Volatility / Solubility	Fate in Environment	Hazards	SPISP II Rating		
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Butachlor "Machete"	Pre-plant, control of small plants,used outside U.S. on rice	Soil applied Root and shoot absorbed	Translocated by xylem and phloem	Possibly inhibits lipid synthesis (unclear)	Selective for control of germinating grasses and some broadleaves	Moderate solubility, non-volatile	1-8 weeks persistent, mostly microbially degraded		low	high	low
Propachlor "Ramrod"	Pre-plant, control of small plants, corn, soybeans, pumpkins, peas, sorghum, etc.	Soil applied, root and shoot absorbed	Translocated by xylem and phloem	Possibly inhibits lipid synthesis (unclear)	Selective for control of germinating grasses and some broadleaves	Moderate solubility, non-volatile	1-8 weeks persistent, mostly microbially degraded		low	inter-mediate	low
Alachlor "Lasso"	Pre-plant, control of small plants, corn, peanuts, sorghum, soybeans, sunflowers, etc.	Soil applied, root and shoot absorbed	Translocated by xylem and phloem	Possibly inhibits lipid synthesis (unclear)	Selective for control of germinating grasses and some broadleaves	Moderate solubility, non-volatile		Possible carcinogen, some Alachlor in water supplies, Alachlor is banned in Florida	inter-mediate	inter-mediate	low
Metolachlor "Dual"	Same as Alachlor but with less rates	Soil applied, root and shoot absorbed	Translocated by xylem and phloem	Possibly inhibits lipid synthesis (unclear)	Selective for control of germinating grasses and some broadleaves	Moderate solubility, non-volatile	1-8 weeks persistent, mostly microbially degraded		high	high	inter-mediate
Dimehenamid "Frontier"	Corn and soybeans, pre-plant, control of germinating plants	Soil applied, root and shoot absorbed	Translocated by xylem and phloem	Possibly inhibits lipid synthesis (unclear)	Selective for control of germinating grasses and some broadleaves	Moderate solubility, non-volatile	1-8 weeks persistent, mostly microbially degraded		inter-mediate	inter-mediate	low
Other Amides											
Propanil "Stam"	Post-emergence in rice	Foliar applied in the second leaf stage	Absorbed by leaf, translocation is minimal	Inhibits photo-synthesis	Mostly grasses	Moderate solubility	8-12 weeks, microbially degraded rapidly	None	low	inter-mediate	low

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Napropamide "Devrinol"	Annual grasses and some broadleaf control in ornamentals, tomatoes, grapes, and tree fruits	Preemergence soil applied, root and shoot absorbed	Translocated by xylem and phloem	Similar to Chloroactamides	Annual grasses and some broadleaf control	Moderate solubility, non-volatile	8-12 weeks, microbially degraded rapidly		inter-mediate	high	inter-mediate
Pronamide "Kerb"	Annual grasses and some broadleaf control in blueberry, legumes, lettuce, tree fruits, vine crops, and ornamentals	Preemergence soil applied	Translocated by xylem and phloem	Similar to Chloroactamides and also inhibits mitosis	Annual grasses and some broadleaf control	Moderate solubility, non-volatile	8-12 weeks, microbially degraded rapidly	Possibly Carcinogenic	high	high	inter-mediate
Thiocarbamates								Soil conditioning (excess microbial breakdown) can occur with 5 consecutive years of use. LD50>1500 for group			
Butylate "Sutan+"	Annual grasses and some broadleaf control in corn	Pre-plant incorporated	Translocated by xylem and phloem	Inhibits lipid synthesis which inhibits cuticle formation	Annual grasses and some broadleaf control	Highly volatile, requires incorporation	Subject to leaching,extremely easily degraded by microbes		low	high	low
Triallate "Far-go"	Wheat, control of wild oats	Pre-plant incorporated	Translocated by xylem and phloem	Inhibits lipid synthesis which inhibits cuticle formation	Selective for control of germinating grasses and some broadleaves	Highly volatile, requires incorporation	Subject to leaching, extremely easily degraded by microbes		low	high	high

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Cycloate "Ro-neet"	Annual grasses and some broadleaf control inbeets and spinach	Pre-plant incorporated soil applied, root and shoot absorbed	Translocated by xylem and phloem	Inhibits lipid synthesis which inhibits cuticle formation	Selective for control of germinating grasses and some broadleaves	Highly volatile, requires incorporation	Subject to leaching, extremely easily degraded by microbes		inter-mediate	high	low
EPTC "Eptam"	Annual grasses and some broadleaf control in corn, snapbeans, lima beans, and other legumes	Pre-plant incorporated soil applied, root and shoot absorbed	Translocated by xylem and phloem	Inhibits lipid synthesis which inhibits cuticle formation	Selective for control of germinating grasses and some broadleaves	Highly volatile, requires incorporation	Subject to leaching, extremely easily degraded by microbes		low	inter-mediate	low
Molinate "Ordram"	Annual grasses and some broadleaf control in rice	Pre-plant incorporated soil applied, root and shoot absorbed	Translocated by xylem and phloem	Inhibits lipid synthesis which inhibits cuticle formation	Selective for control of germinating grasses and some broadleaves	Highly volatile, requires incorporation	Subject to leaching, extremely easily degraded by microbes		inter-mediate	inter-mediate	low
Vernolate "Vernam"	Annual grasses and some broadleaf control in soybeans, peanuts, tobacco, and sweet potatoes	Pre-plant incorporated soil applied, root and shoot absorbed	Translocated by xylem and phloem	Inhibits lipid synthesis which inhibits cuticle formation	Selective for control of germinating grasses and some broadleaves	Highly volatile, requires incorporation	Subject to leaching, extremely easily degraded by microbes		low	inter-mediate	low
Metham "Vapam"	Soil fumigant	Pre-plant incorporated soil applied, root and shoot absorbed	Translocated by xylem and phloem	Inhibits lipid synthesis which inhibits cuticle formation	Nonselective, soil fumigant	Most volatile of group	Subject to leaching, extremely easily degraded by microbes		inter-mediate	inter-mediate	low
Thiobencarb "Bolero"	Grass control in rice	Pre-emergence through post-emergence	Translocated by xylem and phloem	Inhibits lipid synthesis which inhibits cuticle formation	Grass control	Most different one in group	Subject to leaching, extremely easily degraded by microbes		low	inter-mediate	low

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Pebulate "Tillam"	Annual grasses and some broadleaf control in tomatoes, sugarbeets, and tobacco	Pre-plant incorporated soil applied, root and shoot absorbed	Translocated by xylem and phloem	Inhibits lipid synthesis which inhibits cuticle formation	Selective for control of germinating grasses and some broadleaves	Most volatile of group	Subject to leaching, extremely easily degraded by microbes		low	inter-mediate	low
Phenoxy Carboxylic Acids											
2,4-D	Broadleaf control, in grasses	Foliar applied	Translocated by xylem and phloem	Inhibits lipid synthesis which inhibits cuticle formation	Broadleaf control	Ester formulations are volatile, salt formulations are water soluble	Rapid microbial degradation in 1-4 weeks	Possible cancer risk LD-50-1200, Ester formulations have drift risks	inter-mediate	inter-mediate	low
2,4,5-T	Broadleaf control in forestry	Foliar applied	Translocated by xylem and phloem	Inhibits lipid synthesis which inhibits cuticle formation	Broadleaf control	Ester formulations are volatile, salt formulations are water soluble	Slightly longer persistence than 2 CL forms (2,4-D)	Dioxin is a by-product in production of tri-chlorine phenoxys, used in other countries, Trichlorine structures (2,4,5-T) lost their registration in the U.S.	high	inter-mediate	low
2,4,D-B	Broadleaf control in legumes	Foliar applied	Translocated by xylem and phloem	Inhibits lipid synthesis which inhibits cuticle formation	Broadleaf control	Ester formulations are volatile, salt formulations are water soluble	Rapid microbial degradation in 1-4 weeks		low	high	low

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MCPA	Broadleaf control in young cereal grains	Foliar applied	Translocated by xylem and phloem	Inhibits lipid synthesis which inhibits cuticle formation	Broadleaf control	Ester formulations are volatile, salt formulations are water soluble	Rapid microbial degradation in 1-4 weeks		low	inter-mediate	inter-mediate
Benzoics											
Dicamba "Banvel"	Broadleaf control in small grains and turf	Foliar applied	Translocated by xylem and phloem	Hormone disrupter, growth regulator	Broadleaf control	Soluble as salt form	Mobile in soil but is easily degraded by microbes	LD50-2900, very mobile but not a threat to groundwater due to degradation by microbes	high	inter-mediate	low
Picolinic Acids											
Picloram "Tordon"	Broadleaf control-perennial brush on pasture, range, and forestry	Foliar applied	Translocated by xylem and phloem	Hormone disrupter, growth regulator	Broadleaf control	High solubility	Very slow microbial degradationand some photodecomposition, Picloram is persistent for a year or more	LD50-8200, high propensity to be leached due to water solubility and persistence in soil	high	high	inter-mediate
Triclopyr "Garlon"	Broadleaf control-perennial brush on pasture, range, and forestry	Foliar applied	Translocated by xylem and phloem	Hormone disrupter, growth regulator	Broadleaf control	High solubility	Very persistent but slighly less than picloram	LD50-2140	high	high	inter-mediate
Clopyralid "Stinger"	Broadleaf control in cereal grains, corn, pastures, and rangeland	Foliar applied	Translocated by xylem and phloem	Hormone disrupter, growth regulator	Broadleaf control	High solubility	Very persistent but slighly less than picloram		high	inter-mediate	low

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Bipyridyliums								This group is most acutely toxic herbicides in use, LD50-120/230			
Paraquat	Broad spectrum, non-selective, weed control	Foliar applied, post-emergence	None, contact	They pull electrons to themselves causing membrane collapse, quick death	Nonselective	Fully water soluble but tightly adsorbed by soil, non-volatile	As cations they are quickly and irreversibly adsorbed to negative charged soil colloids, thus no soil activity		very low	low	high
Paraquat "Starfire"	Peanuts for escaped grasses	Foliar applied, post-emergence	None, contact	They pull electrons to themselves causing membrane collapse, quick death	Nonselective	Fully water soluble but tightly adsorbed by soil, non-volatile	As cations they are quickly and irreversibly adsorbed to negative charged soil colloids, thus no soil activity		very low	low	high
Diquat	Broad spectrum, non-selective, weed control, desiccant for crops and aquatic weed control	Foliar applied, post-emergence	None, contact	Similar to Paraquat	Nonselective	Fully water soluble but tightly adsorbed by soil, non-volatile	As cations they are quickly and irreversibly adsorbed to negative charged soil colloids, thus no soil activity		very low	low	high
Diphenyl Ethers								LD50-1540, some in group have been identified as low grade carcinogens.			
Acifluorfen "Blazer"	Broadleaf control in soybeans	Foliar applied, postemergence	Limited, behaves like a contact herbicide	Similar to Paraquat	Broadleaf control	None	Chemical and microbial degradation, herbicides are tightly bound to soil thus minimal carry over risk	Corrosive to eye tissue	inter-mediate	inter-mediate	low

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Lactofen "Cobra"	Soybeans, cotton, and pines, broadleaf weed control	Foliar applied, postemergence	Limited, behaves like a contact herbicide	Similar to Paraquat	Broadleaf control	None	Chemical and microbial degradation, herbicides are tightly bound to soil thus minimal carry over risk	LD50-5960	low	low	inter-mediate
Fomesafen "Reflex"	Soybeans, broadleaf weed control	Foliar applied, postemergence	Limited, behaves like a contact herbicide	Similar to Paraquat	Broadleaf control	None	Chemical and microbial degradation, herbicides are tightly bound to soil thus minimal carry over risk	LD50-1860	high	high	inter-mediate
Oxyfluorfen "Goal"	Pines, orchards, and vegetables	Preemergence to postemergence	Limited, behaves like a contact herbicide	Similar to Paraquat	Broadleaf control	None	Chemical and microbial degradation, herbicides are tightly bound to soil thus minimal carry over risk	LD50>5,000	very low	low	inter-mediate
Organic Arsenicals											
DSMA	Grasses in cotton and turf	Foliar applied, postemergence	Limited, behaves like a contact herbicide	Unclear, inhibits ATP synthesis	Annual grasses	Very water soluble 340000 ppm	Microbial degradation and soil adsorption thus minimal carry over risk	Possible arsenic, pentoxide and oxide buildup in soil	low	high	high
MSMA	Grasses in cotton and turf	Foliar applied, postemergence	Limited, behaves like a contact herbicide	Unclear, inhibits ATP synthesis	Annual grasses	Very water soluble 1040000 ppm	Microbial degradation and soil adsorption thus minimal carry over risk		low	high	high
Cyclohexanediones "Dims"											
Sethoxydim (Poast)	Grass control in agronomic and horticulture crops	Foliar applied	Very fast translocation through xylem and phloem	Inhibits lipid synthesis	Grass control	None	Rapid microbial degradation approximately 2 weeks	Cannot mix with other chemicals in tank (antagonism)	low	inter-mediate	low
Clethodim (Select)	Cotton, soybeans, and horticulture crops	Foliar applied	Very fast translocation through xylem and phloem	Inhibits lipid synthesis	Grass control	None	Rapid microbial degradation approximately 2 weeks		low	inter-mediate	low

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Aryloxyphenoxy Propionates "Fops"											
Diclofop "Hoelon"	Wheat/barley and soybeans	Foliar applied	Very fast translocation through xylem and phloem	Inhibits lipid synthesis	Grass control	Very low solubility	Rapid microbial degradation approximately 2 weeks	Most narrow range of activity, grass control in wheat/barley	very low	inter-mediate	inter-mediate
Fluazifop "Fusilade 2000"	Grass control in broadleaf crops and horticulture crops	Foliar applied	Very fast translocation through xylem and phloem	Inhibits lipid synthesis	Grass control	Very low solubility	Rapid microbial degradation approximately 2 weeks	All of group are toxic to fish, cannot mix with other chemicals in tank (antagonism)	low	inter-mediate	inter-mediate
Fenoxaprop "Whip, Acclaim, Bugle"	Grass control in broadleaf crops and horticulture crops	Foliar applied	Very fast translocation through xylem and phloem	Inhibits lipid synthesis	Grass control	Very low solubility	Rapid microbial degradation approximately 2 weeks		low	inter-mediate	inter-mediate
Quizalofop "Assure"	Grass control in broadleaf crops and horticulture crops	Foliar applied	Very fast translocation through xylem and phloem	Inhibits lipid synthesis	Grass control	Very low solubility	Rapid microbial degradation approximately 2 weeks		inter-mediate	inter-mediate	high
Haloxyfop "Verdict"	Grass control in broadleaf crops and horticulture crops	Foliar applied	Very fast translocation through xylem and phloem	Inhibits lipid synthesis	Grass control	Very low solubility	Rapid microbial degradation approximately 2 weeks		high	inter-mediate	inter-mediate
Imidiazolinones											
Imazapyr "Arsenal"	Right of ways and pines	Can be root absorbed, soil applied, but does better foliar applied	Translocation through xylem and phloem	Inhibits the synthesis of branched chain of amino acids	Nonselective	Non-volatile and some solubility	Adsorption is affected by aluminum and iron in soil than by clay and organic matter, subject to microbial degradation except in cool temperatures	Carry over in more northern climates LD50 > 5,000 for group	higjh	high	inter-mediate
Imazaquin "Scepter"	Pre-plant incorporated, pre-plant and post-emergence control of broadleaves in soybeans in the southern U.S.	Can be root absorbed, soil applied, but does better foliar applied	Translocation through xylem and phloem	Inhibits the synthesis of branched chain of amino acids	Broadleaf control	Non-volatile and some solubility	Adsorption is affected by aluminum and iron in soil than by clay and organic matter, subject to microbial degradation except in cool temperatures	Marketed in south due to warmer temperatures and more Al and Fe in soil	high	high	inter-mediate

Name/ Products	Primary Use	Application	Behavior in Plants:			Volatility / Solubility	Fate in Environment	Hazards	SPISP II Rating		
			Translocation	Mode of Action	Selectivity				Leaching potential	Solution runoff potential	Adsorbed runoff potential
Imazethapyr "Pursuit"	Post-emergence, broadleaves in soybeans (north) and peanuts	Can be root absorbed, soil applied, but does better foliar applied	Translocation through xylem and phloem	Inhibits the synthesis of branched chain of amino acids	Broadleaf control	Non-volatile and some solubility	Adsorption is affected by aluminum and iron in soil than by clay and organic matter, subject to microbial degradation except in cool temperatures	Marketed in north because microbial degradation is easier than with Scepter	high	high	inter-mediate
Imazamethabenz "Assert"	Post-emergence, wild oats control in wheat	Can be root absorbed, soil applied, but does better foliar applied	Translocation through xylem and phloem	Inhibits the synthesis of branched chain of amino acids	Wild oats in wheat	Non-volatile and some solubility	Adsorption is affected by aluminum and iron in soil than by clay and organic matter, subject to microbial degradation except in cool temperatures.		high	inter-mediate	low
Imazameth "Cadre"	Post-emergence, broadleaves in peanuts	Can be root absorbed, soil applied, but does better foliar applied	Translocation through xylem and phloem	Inhibits the synthesis of branched chain of amino acids	Broadleaf control	Non-volatile and some solubility	Adsorption is affected by aluminum and iron in soil than by clay and organic matter, subject to microbial degradation except in cool temperatures		high	inter-mediate	low
Sulfonylureas								Resistance by weeds due to one mode of action LD50>4,000 for group			
Chlorsulfuron "Glean"	Broadleaves in wheat, barley, and oats	Can be root absorbed, soil applied, but does better foliar applied	Translocation through xylem and phloem	Inhibits the synthesis of branched chain amino acids	Broadleaf control	Fairly mobile in soil due to pH and pressure of Aluminum (Al) and Iron (Fe), more mobile at higher pHs and absence of Al and Fe, not expected to reach ground water due to raped degradation and low rates	Microbial and chemical degradation, relatively rapid. However, can carry over if rates are exceded. Trace amounts can be significant due to extreme bioactivity		high	high	inter-mediate

Name/ Products	Primary Use	Application	Behavior in Plants:			Volatility / Solubility	Fate in Environment	Hazards	SPISP II Rating		
			Translocation	Mode of Action	Selectivity				Leaching potential	Solution runoff potential	Adsorbed runoff potential
Triasulfuron "Amber"	Broadleaves in wheat and barley	Can be root absorbed, soil applied, but does better foliar applied	Translocation is normally through phloem	Inhibits the synthesis of branched chain amino acids	Broadleaf control	Same as chlorsulfuron	Microbial and chemical degradation, relatively rapid. However, can carry over if rates are exceded. Trace amounts can be significant due to extreme bioactivity		high	high	inter-mediate
Thifensulfuron "Pinnacle" "Harmony"	Broadleaves in soybeans; wheat and barley	Can be root absorbed, soil applied, but does better foliar applied	Translocation is normally through phloem	Inhibits the synthesis of branched chain amino acids	Broadleaf control	Same as chlorsulfuron	Microbial and chemical degradation, relatively rapid. However, can carry over if rates are exceded. Trace amounts can be significant due to extreme bioactivity		inter-mediate	inter-mediate	low
Metsulfuron "Ally, Escort"	Broadleaves in wheat and barley	Can be root absorbed, soil applied, but does better foliar applied	Translocation is normally through phloem	Inhibits the synthesis of branched chain amino acids	Broadleaf control	Same as chlorsulfuron			high	high	inter-mediate
Tribenuron "Express"	Broadleaves in wheat, rye, and barley	Can be root absorbed, soil applied, but does better foliar applied	Translocation is normally through phloem	Inhibits the synthesis of branched chain amino acids	Broadleaf control	Same as chlorsulfuron	Microbial and chemical degradation, relatively rapid. However, can carry over if rates are exceded. Trace amounts can be significant due to extreme bioactivity		inter-mediate	high	low
Bensulfuron "Londax"	Broadleaves and grass in rice	Can be root absorbed, soil applied, but does better foliar applied	Translocation is normally through phloem	Inhibits the synthesis of branched chain amino acids	Broadleaf control	Same as chlorsulfuron	Microbial and chemical degradation, relatively rapid. However, can carry over if rates are exceded. Trace amounts can be significant due to extreme bioactivity		low	inter-mediate	low

Name/ Products	Primary Use	Application	Behavior in Plants:			Volatility / Solubility	Fate in Environment	Hazards	SPISP II Rating		
			Translocation	Mode of Action	Selectivity				Leaching potential	Solution runoff potential	Adsorbed runoff potential
Sulfometuron "Oust"	Non-selective in pines; selective grass control in warm-season turf	Can be root absorbed, soil applied, but does better foliar applied	Translocation is normally through phloem	Inhibits the synthesis of branched chain amino acids	Broadleaf control	Same as chlorsulfuron	Microbial and chemical degradation, relatively rapid. However, can carry over if rates are exceded. Trace amounts can be significant due to extreme bioactivity		inter-mediate	high	low
Chlorimuron "Classic"	Broadleaves in soybeans, some in peanuts	Can be root absorbed, soil applied, but does better foliar applied	Translocation is normally through phloem	Inhibits the synthesis of branched chain amino acids	Broadleaf control	Same as chlorsulfuron	Microbial and chemical degradation, relatively rapid. However, can carry over if rates are exceded. Trace amounts can be significant due to extreme bioactivity		high	inter-mediate	low
Prosulfuron "Peak"	Broadleaves in corn, sorghum, and small grains	Can be root absorbed, soil applied, but does better foliar applied	Translocation is normally through phloem	Inhibits the synthesis of branched chain amino acids	Broadleaf control	Same as chlorsulfuron	Microbial and chemical degradation, relatively rapid. However, can carry over if rates are exceded. Trace amounts can be significant due to extreme bioactivity		low	inter-mediate	low
Nicosulfuron "Accent"	Grass control in corn	Can be root absorbed, soil applied, but does better foliar applied	Translocation is normally through phloem	Inhibits the synthesis of branched chain amino acids	Grass control	Same as chlorsulfuron	Microbial and chemical degradation, relatively rapid. However, can carry over if rates are exceded. Trace amounts can be significant due to extreme bioactivity		high	high	low
Primisulfuron "Beacon"	Grass control in corn	Can be root absorbed, soil applied, but does better foliar applied	Translocation is normally through phloem	Inhibits the synthesis of branched chain amino acids	Grass control	Same as chlorsulfuron	Microbial and chemical degradation, relatively rapid. However, can carry over if rates are exceded. Trace amounts can be significant due to extreme bioactivity		high	high	low