# SOIL QUALITY-AGRONOMY

Technical Note No.5

## HERBICIDES

United States
Department of
Agriculture

Natural
Resources
Conservation
Service

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Technical
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This is the fifth technical note in a series of Agronomy technical notes on the effects on soil quality. This technical note 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 of 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.

For filing purposes, the Soil Quality Institute recommends filing under Water Quantity and Quality portion of Section II of the Field Office Technical Guide.

### Herbicide Uses 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. This usage has 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
- primary use,
- behavior in plants,
- fate in environment,
- hazards and
- leaching information

by families. Within each family, the name of 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 a 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, the entire group has $LD_{50}$ of greater than 3000. It is mentioned once for the entire group within the Chloroacetamide family.

## Use of "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, the Volatility/ Solubility section, states that this group needs incorporation to prevent losses by volatility. The planner can use this type of information to direct the producer to another herbicide family when switching to no-till that would prevent incorporation by tillage. Another example, the Hazard section states that Thiocarbamates can exhibit "soil conditioning" with repeated use of 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 Potential Soil-Pesticide Interaction Ratings (SPISP) can provide environmental sensitive information such as high potential for leaching, especially when working with sandy soils with a shallow water table. SPISP I is from 1988 list sent to field offices (see references) to provide leaching potential information. SPISP II is was an updated list developed in 1990 (see references). These ratings are national lists developed to give leaching information for specific herbicides. If local Technical Guide has ratings specific for location or state that differ from these national ratings, then use those ratings unless this information is current.

## 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). "Herbicides" table does not need updating every time there is herbicide market change. 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 specific label directions on the herbicide container. This technical note is also on the Soil Quality Institute's HomePage on the WWW at URL:

http://www.statlab.isastate.edu/survey/SQI/sqihome.shtml

References:

1. Goss D. "Soil-Pesticide Interaction Ratings", Soil Conservation Service, Field Office Technical Guide Section II, 1988. Available from NRCS field offices.

2. Goss D., Wauchope R. D. " The SCS/ARS/CES Pesticide Properties Database II: Using it with soils data in a screening procedure" Proceedings of the Third National Research Conference on Pesticides, Nov. 8-9, 1990 Richmond Virginia. Weigmann D. L. editor.

3. Wehtje Glenn. Agronomy 614, Use of herbicides in agriculture, compilation of lectures, 1996. Auburn University.

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| Herbicide Family | Name/Products | Primary Use | Application | Behavior in Plants: | | | Volatility/Solubility | Fate in Environment | Hazards | Leaching Potential SPISP I Rating | Surface Loss Potential SPISP I Rating | Leaching Potential SPISP II Rating | Surface Loss Potential SPISP II Rating |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Translocation | Mode of Action | Selectivity | | | | | | | |
| 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, $LD_{50}$>10000 | small | large | small | medium |
| | 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 | $LD_{50}$-1300 | small | large | small | medium |
| | 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 | | small | medium | small | medium |
| | 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 | | small | large | small | medium |
| | 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 | $LD_{50}$-10000 | small | large | small | medium |
| Triazines | Atrazine "AAtrex" | All are used for broad leaf control, applied, corn/sorghum | Soil applied | Root absorbed from soil, translocated through xylem | Inhibits photosynthesis | 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 $LD_{50}$>5,000 | large | medium | large | large |
| | Cyanazine "Bladex" | Corn/sorghum, broadleaf control | Soil applied | Root absorbed from soil, translocated through xylem | Inhibits photosynthesis | Selective for broadleaf control | Solubility 171 ppm | Less longevity at lower pH , can be persistent at neutral pH | $LD_{50}$-334 Cyanazine is being volunteered to be taken off market by 1999 | medium | medium | medium | medium |
| | Simazine "Princep" | Corn/sorghum, broadleaf control | Soil applied | Root absorbed from soil, translocated through xylem | Inhibits photosynthesis | Selective for broadleaf control | Solubility 4 ppm | Less longevity at lower pH , can be persistent at neutral pH | Carry over,, Leaching with alkaline soils $LD_{50}$>5,000 | large | medium | large | large |
| | Hexazione "Velpar" | Forestry, broadleaf control | Soil applied | Root absorbed from soil, translocated through xylem | Inhibits photosynthesis | Selective for broadleaf control | Solubility 33000 ppm | Less longevity at lower pH , can be persistent at neutral pH | Carry over,, Leaching with alkaline soils $LD_{50}$-1690 | large | medium | large | large |
| | Prometon "Primatol" | Soil sterilant (non crop) | Soil applied | Root absorbed from soil, translocated through xylem | Inhibits photosynthesis | Selective for broadleaf control | Solubility 750 ppm | Less longevity at lower pH , can be persistent at neutral pH | Carry over,, Leaching with alkaline soils $LD_{50}$-2280 | large | large | large | large |

| Herbicide Family | Name/Products | Primary Use | Application | Behavior in Plants: | | | Volatility/Solubility | Fate in Environment | Hazards | Leaching Potential SPISP I Rating | Surface Loss Potential SPISP I Rating | Leaching Potential SPISP II Rating | Surface Loss Potential SPISP II Rating |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Translocation | Mode of Action | Selectivity | | | | | | | |
| | Prometryn "Caparol" | Cotton, soybeans, and horticulture crops, broadleaf control | Soil applied | Root absorbed from soil, translocated through xylem | Inhibits photosynthesis | 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 LDso-3750 | medium | large | medium | large |
| | Metribuzin "Sencor/Lexone" | Soybeans, broadleaf control | Soil applied | Root absorbed from soil, translocated through xylem | Inhibits photosynthesis | 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 LDso-4750 | large | medium | large | large |
| Substituted Ureas | Fluometuron "Cotoran" | Broadleaf control, cotton, used for overlay treatments | Soil applied | Root absorbed from soil, translocated through xylem | Inhibits photosynthesis | 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 LDso-1,000+ | large | medium | large | large |
| | Diuron "Karmex" | Broadleaf control, cotton | Soil applied | Root absorbed from soil, translocated through xylem | Inhibits photosynthesis | Selective for broadleaf control | Low solubility due to high soil absorption | Microbial degradation generally last only one season | LDso-1,000+ | medium | large | medium | large |
| | Linuron "Lorox" | Soybeans ,broadleaf control | Soil applied | Root absorbed from soil, translocated through xylem | Inhibits photosynthesis | Selective for broadleaf control | Low solubility due to high soil absorption | Microbial degradation generally last only one season | Most post activity LDso-1,000+ | medium | large | medium | large |
| | Tebuthiuron "Spike" | Soil sterilant, brush control/rangeland | Soil applied | Root absorbed from soil, translocated through xylem | Inhibits photosynthesis | Nonselective, soil sterilant | Very water soluble | Most resistent of group | Leached in soil LDso-1,000+ | small | large | extra small | large |
| 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 photosynthesis | Selective by placement | Some solubility, Solubility 813 ppm | Persistent, 6 months to 1 year | Injury to roots due to excessive leaching, LDso>5,000 | large | medium | large | large |
| | Terbacil "Sinbar" | Orchards, control of small germinating plants, high rates can become soil sterilants | Soil applied | Root absorbed from soil, translocated through xylem | Inhibits photosynthesis | Selective by placement | Solubility 710 ppm | Persistent, 6 months to 1 year | LDso>5,000 | large | medium | large | large |
| 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 | LDso-5400 | small | large | extra small | large |
| 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 | LDso-1620 | small | medium | small | medium |

| Herbicide Family | Name/Products | Primary Use | Application | Behavior in Plants: | | | Volatility/Solubility | Fate in Environment | Hazards | Leaching Potential SPISP I Rating | Surface Loss Potential SPISP I Rating | Leaching Potential SPISP II Rating | Surface Loss Potential SPISP II Rating |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Translocation | Mode of Action | Selectivity | | | | | | | |
| Chloroacetamides | 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 | Crop injury without safener, all low in acute toxicity, $LD_{50}$>3000 | medium | medium | medium | medium |
| | 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 | | small | medium | small | large |
| | 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 | | small | medium | small | medium |
| | 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 | medium | medium | medium | medium |
| | 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 | | large | medium | large | large |
| | 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 | | medium | medium | medium | medium |
| Other Amides | Propanil "Stam" | Post emergence in rice | Foliar applied in the second leaf stage | Absorbed by leaf, translocation is minimal | Inhibits photosynthesis | Mostly grasses | Moderate solubility | 8-12 weeks, microbially degraded rapidly | None | small | small | small | medium |
| | 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 | | medium | large | medium | large |
| | Pronamide "Kerb" | Annual grasses and some broadleaf control in blueberry, legumes, lettuce, tree fruits, vine crops, and | 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 | large | medium | large | large |

| Herbicide Family | Name/Products | Primary Use | Application | Behavior in Plants: | | | Volatility/Solubility | Fate in Environment | Hazards | Leaching Potential SPISP I Rating | Surface Loss Potential SPISP I Rating | Leaching Potential SPISP II Rating | Surface Loss Potential SPISP II Rating |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Translocation | Mode of Action | Selectivity | | | | | | | |
| Thiocarbamates | 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 | Soil conditioning can occur with the use of 5 consecutive years (excess microbial breakdown) LD50>1500 for group | small | medium | small | large |
| | 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 | | small | large | small | large |
| | 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 | | medium | medium | medium | large |
| | 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 | | small | medium | small | medium |
| | 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 | | medium | medium | medium | medium |
| | 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 | | small | medium | small | medium |
| | 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 | | medium | small | medium | medium |
| | 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 | | small | medium | small | medium |
| | 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 | | small | medium | small | medium |
| 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 | Acid- medium Amine-medium Ester- medium | small small medium | Acid- medium Amine-medium Ester-medium | medium medium medium |

| Herbicide Family | Name/Products | Primary Use | Application | Behavior in Plants: | | | Volatility/Solubility | Fate in Environment | Hazards | Leaching Potential SPISP I Rating | Surface Loss Potential SPISP I Rating | Leaching Potential SPISP II Rating | Surface Loss Potential SPISP II Rating |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Translocation | Mode of Action | Selectivity | | | | | | | |
| | 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. | Acid- large Amine- large Ester- large | medium medium medium | Acid- large Amine- large Ester- large | medium medium large |
| | 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 | | Acid- small Amine- medium Ester- small | medium small medium | Acid- small Amine- medium Ester- small | large medium medium |
| | 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 | | Ester- small Amine- large | large small | Ester- small Amine- large | medium medium |
| 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 | $LD_{50}$-2900, very mobile but not a threat to groundwater due to degradation by microbes | Salt- large | small | large | medium |
| 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 | $LD_{50}$-8200, high propensity to be leached due to water solubility and persistence in soil | Salt- large | small | large | large |
| | 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 | $LD_{50}$-2140 | Amine- large Ester- medium | small large | Amine- large Ester- medium | large large |
| | 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 | | Amine- large | small | Amine- large | medium |
| Bipyridyliums | 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 | This group is most acutely toxic herbicides in use, $LD_{50}$-120/230 | small | large | extra small | small |
| | 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 | This group is most acutely toxic herbicides in use, $LD_{50}$-120/230 | small | small | extra small | small |

| Herbicide Family | Name/Products | Primary Use | Application | Behavior in Plants: | | | Volatility/Solubility | Fate in Environment | Hazards | Leaching Potential SPISP I Rating | Surface Loss Potential SPISP I Rating | Leaching Potential SPISP II Rating | Surface Loss Potential SPISP II Rating |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Translocation | Mode of Action | Selectivity | | | | | | | |
| | 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 | This group is most acutely toxic herbicides in use, $LD_{50}$-120/230 | small | large | extra small | small |
| Diphenyl Ethers | 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 | $LD_{50}$-1540, some in group have been identified as low grade carcinogens, Acifluorfen is corrosive to eye tissue | large | medium | medium | medium |
| | 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 | $LD_{50}$-5960 | nominal | medium | small | small |
| | 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 | $LD_{50}$-1860 | medium | medium | large | large |
| | 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 | $LD_{50}$>5,000 | small | large | extra small | small |
| 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 | small | large | small | large |
| | 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 | | small | large | small | large |
| Cyclohexanediones "Dims" | Sethoxydim (Poast) | Grass control in agronomic and horticulture crops | Foliar applied | Very fast translocation through xylem and pholem | Inhibits lipid synthesis | Grass control | None | Rapid microbial degradation approximately 2 weeks | Cannot mix with other chemicals in tank (antagonism) | small | medium | small | medium |
| | Clethodim (Select) | Cotton, soybeans, and horticulture crops | Foliar applied | Very fast translocation through xylem and pholem | Inhibits lipid synthesis | Grass control | None | Rapid microbial degradation approximately 2 weeks | | unknown | small | unknown | unknown |
| Aryloxyphenoxy Propionates "Fops" | Diclofop "Hoelon" | Wheat/barley and soybeans | Foliar applied | Very fast translocation through xylem and pholem | Inhibits lipid synthesis | Grass control | Very low solubility | Rapid microbial degradation approximately 2 weeks | Most narrow range of activity, grass control in wheat/barley | small | large | extra small | medium |

| Herbicide Family | Name/Products | Primary Use | Application | Behavior in Plants: | | | Volatility/Solubility | Fate in Environment | Hazards | Leaching Potential SPISP I Rating | Surface Loss Potential SPISP I Rating | Leaching Potential SPISP II Rating | Surface Loss Potential SPISP II Rating |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Translocation | Mode of Action | Selectivity | | | | | | | |
| | Fluazifop "Fusilade 2000" | Grass control in broadleaf crops and horticulture crops | Foliar applied | Very fast translocation through xylem and pholem | 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) | small | large | small | medium |
| | Fenoxaprop "Whip, Acclaim, Bugle" | Grass control in broadleaf crops and horticulture crops | Foliar applied | Very fast translocation through xylem and pholem | Inhibits lipid synthesis | Grass control | Very low solubility | Rapid microbial degradation approximately 2 weeks | | nominal | large | small | medium |
| | Quizalofop "Assure" | Grass control in broadleaf crops and horticulture crops | Foliar applied | Very fast translocation through xylem and pholem | Inhibits lipid synthesis | Grass control | Very low solubility | Rapid microbial degradation approximately 2 weeks | | medium | medium | medium | medium |
| | Haloxyfop "Verdict" | Grass control in broadleaf crops and horticulture crops | Foliar applied | Very fast translocation through xylem and pholem | Inhibits lipid synthesis | Grass control | Very low solubility | Rapid microbial degradation approximately 2 weeks | | large | medium | large | large |
| Imidiazolinones | Imazapyr "Arsenal" | Right of ways and pines | Can be root absorbed, soil applied, but does better foliar applied | Translocation through xylem and pholem | 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 LDso > 5,000 for group | large | medium | large | large |
| | 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 pholem | 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 | large | small | large | large |
| | 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 pholem | 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 | large | small | large | large |
| | Imazamethabenz "Assert" | Post emergence, wild oats control in wheat | Can be root absorbed, soil applied, but does better foliar applied | Translocation through xylem and pholem | 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 | | | | | |
| | Imazameth "Cadre" | Post emergence, broadleaves in peanuts | Can be root absorbed, soil applied, but does better foliar applied | Translocation through xylem and pholem | 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 | | | | | |
| Sulfonylureas | Chlorsulfuron "Glean" | Broadleaves in wheat, barley, and oats | Can be root absorbed, soil applied, but does better foliar applied | Translocation through xylem and pholem | 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 | Resistance by weeds due to one mode of action LDso>4,000 for group | large | medium | large | large |
| | Triasulfuron "Amber" | Broadleaves in wheat and barley | Can be root absorbed, soil applied, but does better foliar applied | Translocation is normally through pholem | 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 | | large | medium | large | large |

| Herbicide Family | Name/Products | Primary Use | Application | Behavior in Plants: | | | Volatility/Solubility | Fate in Environment | Hazards | Leaching Potential SPISP I Rating | Surface Loss Potential SPISP I Rating | Leaching Potential SPISP II Rating | Surface Loss Potential SPISP II Rating |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Translocation | Mode of Action | Selectivity | | | | | | | |
| | Thifensulfuron "Pinnacle" "Harmony" | Broadleaves in soybeans; wheat and barley | Can be root absorbed, soil applied, but does better foliar applied | Translocation is normally through pholem | 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 | | medium | medium | medium | medium |
| | Metsulfuron "Ally, Escort" | Broadleaves in wheat and barley | Can be root absorbed, soil applied, but does better foliar applied | Translocation is normally through pholem | Inhibits the synthesis of branched chain amino acids | Broadleaf control | Same as chlorsulfuron | | | large | medium | large | large |
| | Tribenuron "Express" | Broadleaves in wheat, rye, and barley | Can be root absorbed, soil applied, but does better foliar applied | Translocation is normally through pholem | 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 | | medium | medium | medium | medium |
| | Bensulfuron "Londax" | Broadleaves and grass in rice | Can be root absorbed, soil applied, but does better foliar applied | Translocation is normally through pholem | 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 | | small | medium | small | medium |
| | 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 pholem | 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 | | medium | medium | medium | large |
| | Chlorimuron "Classic" | Broadleaves in soybeans, some in peanuts | Can be root absorbed, soil applied, but does better foliar applied | Translocation is normally through pholem | 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 | | large | medium | large | large |
| | Prosulfuron "Peak" | Broadleaves in corn, sorghum, and small grains | Can be root absorbed, soil applied, but does better foliar applied | Translocation is normally through pholem | 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 | | | | | |
| | Nicosulfuron "Accent" | Grass control in corn | Can be root absorbed, soil applied, but does better foliar applied | Translocation is normally through pholem | 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 | | large | small | large | medium |
| | Primisulfuron "Beacon" | Grass control in corn | Can be root absorbed, soil applied, but does better foliar applied | Translocation is normally through pholem | 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 | | large | medium | large | large |