
APPENDIX 9

HERBICIDE BASICS

Herbicides are often used to control weeds as part of an overall weed management plan. Various herbicides differ in the way they affect plants and by what types of plants they may control. Consequently, herbicides are grouped into different classes based on their mode-of-action, or the manner in which the herbicide affects a plant. Herbicides that have the same mode-of-action will have the same translocation (movement) pattern and produce similar injury symptoms (Ross and Childs 1996). Also, herbicides that have the same mode-of-action will often have similar selectivity on crops and weeds.

In the following discussion, herbicides are first divided between foliar-applied herbicides (post-emergence) and then those that are applied to the soil (pre-emergence). Foliar-applied herbicides are those in which the chemical is applied directly to the leaves of the plant. The foliar-applied herbicides are then classified by their translocation pattern, or how they move through a plant. Each translocation group is subdivided into specific mode-of-action groups that are further divided into herbicide chemistry groups. The soil-applied herbicides are divided into mode-of-action and herbicide chemistry groups.

FOLIAR-APPLIED HERBICIDES

The following foliar-applied herbicides have been divided into three categories according to how they move through a plant.

1. Downwardly mobile (symplastically translocated) herbicides move from the leaf to the growing points of a plant.
2. Upwardly mobile herbicides (apoplastically translocated) herbicides move upward through the transpiration stream of the plant.
3. Contact herbicides (non-translocated) react rapidly at the point of contact and do not move through the plant's internal systems.

DOWNWARDLY MOBILE HERBICIDES (SYMPLASTICALLY TRANSLOCATED)

These herbicides are designed to move from the source of sugar production (leaves) to the actively growing parts of the plant (points of energy use). These herbicides interfere or completely eliminate plant growth. Downwardly mobile herbicides can be divided into four different chemistry groups:

1. Auxin Growth Regulators

Auxin growth regulators are used for control of annual and perennial broadleaf plants in grass crops and non-crop situations. Bending and twisting of leaves and stems is evident

almost immediately after application (Ross and Childs 1996). Delayed symptoms include misshapened leaves, stems, flowers, and abnormal roots (Ross and Childs 1996). These herbicides are highly non-specific and injury to non-target plants can be a problem. Examples of common auxin growth regulators include picloram, dicamba, and 2,4-D.

2. Amino Acid Inhibitors (Aromatic)

Amino acid inhibitors are used to control annual grasses, cool-season grasses and certain broadleaf plants. Glyphosate and sulfosate are the two main compounds with this mode-of-action. These herbicides are effective only when applied to foliage, as they are rapidly deactivated in the soil. They are relatively non-selective herbicides, but several glyphosate-tolerant crops are currently being marketed or tested.

3. Amino Acid Inhibitors (Branched-chain)

This second type of amino acid inhibitor includes several different chemistry groups. These herbicides stunt root growth, which in time starves the plant. Complete symptom development is very slow and may take over three weeks (Ross and Childs 1996). These herbicides are used pre- and post-emergence on broadleaf weeds and annual grasses in crop and non-crop situations. Examples of branched-chain amino acid inhibitors include imazapyr, chlorsulfuron, nicosulfuron, and metsulfuron.

4. Grass Meristem Destroyers

Grass meristem destroyers are used for the selective removal of most grass species from any non-grass crop. There is also some selectivity between grass species. These herbicides cause the discoloration and the disintegration of meristematic tissue at and above the nodes of plants. Leaves yellow, redden, and sometimes wilt (Ross and Childs 1996). Grass meristem destroyers should be used early post-emergence on annual grasses and post-emergence but before the boot stage (the stage just prior to inflorescence emergence) on established perennial grasses (Ross and Childs 1996). Examples of grass meristem destroyers include fluazifop, quizalofop, and sethoxydim.

UPWARDLY MOBILE HERBICIDES (APOPLASTICALLY TRANSLOCATED)

Photosynthetic Inhibitors

These herbicides move upward through the transpiration stream of the plant. Symptoms develop from the bottom to the top on plant shoots (Ross and Childs 1996). Chlorosis first appears between leaf veins and along the margins which is later followed death of the tissue (Ross and Childs 1996). Any potential control of established perennials must come from continued soil uptake and not movement downward through the plant from the shoots (Ross and Childs 1996). These herbicides typically have excellent soil activity and are used pre- and post-emergence in certain annual and established perennial crops. They are also used in non-crop areas for general vegetation control. Examples of photosynthetic inhibitors include atrazine, metribuzin, and tebithuron.

CONTACT HERBICIDES (NON-TRANSLOCATED)

Cell Membrane Destroyers

Herbicides in this group result in the rapid disruption of cell membranes and very rapid kill of plants. The compounds penetrate the cytoplasm, and destroy the cell membranes almost immediately. The rapid disruption of the cell membranes prevents translocation to other region of the plant (Ross and Childs 1996). Severe injury is evident hours after application and maximum kill is attained in a week or less. Partial coverage of a plant with spray results in spotting or partial shoot kill (Ross and Childs 1996). These herbicides are non-selective and damage to non-target species is a common problem. Examples of cell membrane destroyers include paraquat and glufosinate.

SOIL-APPLIED HERBICIDES

ROOT INHIBITORS

These herbicide groups have little or no foliar activity and are mostly applied pre-emergence for control of seedling grasses and some broadleaf plants in certain crops. These herbicides inhibit the steps in plant cell division responsible for chromosome separation and cell wall formation (Ross and Childs 1996). Roots appear club-shaped. Examples of root inhibitors include trifluralin and pendithalin.

SHOOT INHIBITORS

Shoot inhibitor herbicides are commonly applied pre-emergence for control of seedling grasses, some broadleaf plants, and some perennials from tubers and rhizomes (Ross and Childs 1996). Injury appears as malformed, dark-green shoots and leaves on injured young plants (Ross and Childs 1996). Shoot inhibitor herbicides are generally used in crops. Example of shoot inhibitors include alachlor and butylate.

REFERENCE:

Ross, M.A. and D. J. Childs. 1996. Herbicide mode-of-action summary. Cooperative Extension Service Publication WS-23, Purdue University, West Lafayette, IN.
<http://www.agcom.purdue.edu/AgCom/Pubs/WS/WS-23.html>

List of herbicides and their corresponding trade names and premix trade names.

*Indicates Federal Restricted Use Pesticide

Herbicide Classification	Chemical Name	Herbicide Trade Name	Premix Trade Name
Growth Regulators			
	2,4-D	2,4-D	Curtail, Landmaster, Esteron 99
	MCPP	mecoprop	
	MCPA	MCPA	Bronate, Cheyenne
	dicamba	Banvel	Dakota, Stampede
	picloram*	Tordon	Fallow Master, Marksman, Resolve, Curtail, Broadstrike Plus Corn
	clopyralid	Stinger, Lontrel	
	triclopyr	Garlon, Turflon	
Amino Acid Inhibitors			
	imazapyr	Arsenal, Contain, Chopper	Squadron, Tri-Scept
	chlorsulfuron	Glean, Telar	Gemini, Lorox Plus
	nicosulfuron	Accent	Top Hand
	sulfometuron	Oust	
	primisulfuron	Beacon	Finesse
	chlorimuron	Classic	Canopy, Concert
Grass Meristem Destroyers			
	Fluazifop-p	Fusilade 2000, Fusilade DX	Tornado, Fusion
	quizalofop	Assure II	
	clethodim	Select	
	sethoxydim	Poast, Poast plus, Ultima	
Cell Membrane Destroyers			
	paraquat*	Gramaxone, Cyclone	
	glufosinate	Ignite, Rely, Finale, Liberty	

Herbicide Classification	Chemical Name	Herbicide Trade Name	Premix Trade Name
Photosynthetic Inhibitors			
	atrazine*	Aatrex, Atrazines	Bicep, II, Lite
	simazine*	Princep	Extrazine II
	cyanazine*	Bladex	Buctril+Atrazine
	metribuzin	Lexone, Sencor	Bullet, Contour
	hexazinone	Velpar	
	tebuthiuron	Spike	
	linuron	Lorox, Linex	
Root Inhibitors			
	trifluralin	Treflan	
Shoot Inhibitors			
	butylate	Sutan	
	alachlor*	Lasso, Micro-tech, Partner	
Amino Acid Derivatives			
	glyphosate	Roundup, Rodeo	Bronco, Landmaster

Mention of organizations, companies, trade names or commercial products does not constitute their endorsement by the State of Colorado.

