Herbicide Modes of Action (effect on plant growth)

This chart groups herbicides by their modes of action to assist you in selecting herbicides 1) to maintain greater diversity in herbicide use and 2) to rotate among herbicides with different sites of action to delay the development of herbicide resistance.

	Site of Action Group*	Site of Action	No. of Resistant Weed Species in U.S.	Chemical Family	Active Ingredient
Lipid Synthesis Inhibitors	1	**ACCase Inhibitors** (acetyle CoA carboxylase)	15	Aryloxyphenoxy propionate	fenoxaprop fluazifop quizalofop
				Cyclohexanedione	clethodim sethoxydim
Amino Acid Synthesis Inhibitors	2	**ALS Inhibitors** (acetolactate synthase)	38	Sulfonylurea	chlorimuron foramsulfuron halosulfuron iodosulfuron nicosulfuron primisulfuron prosulfuron rimsulfuron thifensulfuron tribenuron
				Imidazolione	imazamox imazaquin imazethapyr
				Triazoloyriidine	flumetsulam cloransulam
	9	**EPSP Synthase Inhibitor** (5-enolpyruvyl-shikimate-3-phosphate	7	None accepted	glyphosate
Growth Regulators (Synthetic auxins)	4	**Specific site unknown**	7	Phenoxy	2,4-D
				Benzoic acid	dicamba
				Carboxylic acid	clopyralid fluroxypyr
	19	**Auxin Transport**	0	Semicarbazone	diflufenzopyr
Photosynthesis Inhibitors	5	**Photosystem II Inhibitors** (different binding than 6 & 7)	22	Triazine	atrazine simazine
				Triazinone	metribuzin
	6	**Photosystem II Inhibitors** (different binding than 5 & 7)	1	Nitrile	bromoxynil
				Benzothiadiazole	bentazon
	7	**Photosystem II Inhibitors** (different binding than 5 & 6)	7	Ureas	linuron

	Site of Action Group*	Site of Action	No. of Resistant Weed Species in U.S.	Chemical Family	Active Ingredient
Nitrogen Metabolism	10	**Glutamine Synthesis Inhibitor**	0	None accepted	glufosinate
Pigment Inhibitors	13	**Diterpene Synthesis Inhibitor**	0	Isoxazolidinone	clomazone
	27	**HPPD Inhibitors**	0	Isoxazole	isoxaflutole
				Triketone	mesotrione tembotrione topramezone
Cell Membrane Disrupters	14	**PPO Inhibitors**	2	Diphenylether	acifluorfen, fomesafen lactofen
				N-phenylphthalimide	flumiclorac flumioxazin
				Aryl triazinone	sulfentrazone carfentrazone
				Trifluoromethyl uracils	saflufenacil
	22	**Photosystem I Electron Diverter**	4	Bipyridilium	paraquat
Seedling Root Growth Inhibitors	3	**Microtubule Inhibitors**	6	Dinitroaniline	ethalfluralin pendimethalin trifluralin
Seedling Shoot Growth Inhibitors	8	**Lipid Synthesis Inhibitors** (not ACCase)	5	Thiocarbamate	butalate EPTC
	15	**Long-chain Fatty Acid Inhibitor**	1	Chloroacetamide	acetochlor alachlor metachlor dimethenamid
				Oxazolinone	pyroxasulfone
				Oxyacetamide	flufenacet

*__Site of Action Group__ is a classification system developed by the Weed Science Society of America.

This table is excerpted with permission from the Corn and Soybean Herbicide Chart (GWC-3), part of the Glyphosate, Weeds, and Crop Series published by Purdue University through a cooperative effort of weed scientists in the 16-state USDA North Central Region.
Contained here are pages 8-10 of the 2016 Guide for Weed, Disease, and Insect Management in Nebraska. The 300+ page guide is available at Marketplace.unl.edu

Classification of Herbicides by Mode and Site of Action and Chemical Family

Herbicides may be classified into families based on how they kill plants (mode of action and site of action) or by chemical similarity. An example of a common commercial herbicide containing the active ingredient is also listed. Please refer to the *Herbicide Dictionary* to identify other commercial herbicides that contain the same active ingredient. In some cases, herbicides from different chemical families have a similar site of action. A knowledge of herbicide families and herbicide mode and site of action will reduce the risk of choosing herbicides that will lead to the development of herbicide-resistant weeds or problems with chemical carryover.

Repeated use of a herbicide or herbicides with the same site of action may lead to selection of herbicide-resistant weeds, or a shift in the weed species present in the field to weeds tolerant to a particular herbicide or herbicide family. For example, repeated use of ALS inhibitors can result in the selection for ALS-resistant weeds. Using both sulfonylurea and imidazolinone herbicides (Classic, Pursuit, etc.) in the same growing season can result in increased carryover problems or possible crop injury. These problems can be lessened by rotating or combining herbicides with different action sites. In the table the site of herbicide uptake is indicated by: R = root uptake; S = shoot uptake; and F = foliage uptake. Letter sequence indicates the primary order of herbicide uptake. Repeated use of herbicides with a common mode and site of action pose the highest risk of an additive effect which can lead to resistant weed development, additional carryover, or more crop injury. Refer to the journal, *Weed Technology*, 11: 384-393 (1997) for additional information on herbicide classification.

Common Name — Trade Name — Site of Uptake

Lipid Synthesis Inhibition

Group 1. ACCase inhibition

1. Aryloxyphenoxypropionates (FOPs)
   - clodinafop propargyl — Discovery — F
   - diclofop — Hoelon — F
   - fenoxaprop — Acclaim Extra — F
   - fluazifop-P — Fusilade DX — F
   - pinoxaden — Axial — F
   - quizalofop-P — Assure II — F
2. Cyclohexanediones (DIMs)
   - clethodim — Select Max — F
   - sethoxydim — Poast — F
   - tralkoxydim — Achieve — F

Amino Acid Synthesis Inhibition

Group 2. ALS-AHAS inhibition

1. Imidazolinones
   - imazamethabenz — Assert — R/F
   - imazamox — Raptor — F/R
   - imazapic — Plateau — R/F
   - imazapyr — Arsenal — R/F
   - imazaquin — Scepter — R/F
   - imazethapyr — Pursuit — R/F
2. Sulfonylureas
   - bensulfuron — Londax — F/R
   - chlorimuron — Classic — F/R
   - chlorsulfuron — Glean/Telar — F/R
   - ethametsulfuron — Muster — F
   - foramsulfuron — Option—F
   - halosulfuron — Permit — F/R
   - iodosulfuron — Autumn — F
   - metsulfuron — Ally/Escort — F/R
   - nicosulfuron — Accent — F
   - primisulfuron — Beacon — F/R
   - prosulfuron — Peak — F/R
   - rimsulfuron — Matrix — F/R
   - sulfometuron — Oust — F/R
   - sulfosulfuron — Maverick
   - thifensulfuron — Harmony — F/R
   - triasulfuron — Amber — F/R
   - tribenuron — Express — F/R
   - triflusulfuron — Upbeet — F
3. Triazolopyrimidine
   - chloransulam methyl — FirstRate — F/R
   - florasulam — R/F
   - flumetsulam — Python — R/F
   - pyroxsulam — PowerFlex — F/R
4. Pyrimidinyloxybenzoic acid
   - bispyribac-sodium — Velocity — F
5. Triazolones
   - flucarbazone — Everest — F/R
   - propoxycarbazone-sodium — Olympus — F/R
   - thiencarbazone-methyl — Corvus — F/R

Group 9. EPSP synthetase inhibition

- glyphosate — Roundup/Touchdown — F

Seedling Growth Inhibition

Group 3. Microtubule assembly inhibition

1. Dinitroanilines
   - benfluralin — Balan — S/R
   - ethalfluralin — Curbit/Sonalan — S
   - oryzalin — Surflan — S
   - pendimethalin — Prowl — S
   - prodiamine — Barricade — S
   - trifluralin — Treflan—S
2. Pyridines
   - dithiopyr — Dimension — R/F
3. Benzamides
   - pronamide — Kerb — S/R
4. Benzoic acids
   - DCPA — Dacthal — R

Group 15. Long-chain fatty acid inhibitor

1. Chloroacetamides
   - acetochlor — Harness/Surpass NXT — S/R
   - alachlor — Intrro — S/R
   - dimethenamid — Outlook — S/R
   - metolachlor — Dual — S/R
   - propachlor — Ramrod — S/R
2. Oxyacetamides
   - flufenacet — Define — S/R
3. Acetamides
   - napropamide — Devrinol — R/S
4. Oxazoles
   - pyroxasulfone — Zidua — S/R

Seedling Growth Inhibition *(continued)*

Group 16. Lipid synthesis inhibition (not ACCase)
1. Benzofuranes
ethofumesate — Nortron SC — S/R

Group 8. 1. Phosphorodithionates
bensulide — Betasan — R
2. Thiocarbamates
butylate — Sutan + — S/R
cycloate — Ro-Neet — S/R
EPTC — Eradicane — S/R
triallate — Far-Go — S/R

Group 19. Auxin transport inhibition
1. Phthalamates
naptalam — Alanap — R/F
2. Semicarbazone
diflufenzopyr — Distinct — F

Cell Wall Synthesis Inhibition

Group 21. Benzamides
isoxaben — Gallery — R/S

Group 20. Nitriles
dichlobenil — Casoron — R/F

Growth Regulators

Group 4. Synthetic auxins
1. Phenoxyacetic acids
2,4-D — many — F/R
2,4-DB — Butyrac — F
dichlorprop — many — F
MCPA — many — F/R
mecoprop — many — F
2. Benzoic acids
dicamba — Banvel/Clarity — F/R/S
3. Pyridine carboxylic acids
aminopyralid — Milestone — F/R
clopyralid — Stinger — F/R
fluroxypyr — Starane — F
picloram — Tordon — F/R
triclopyr — Garlon — F/R
4. Quinoline carboxylic acids
quinclorac — Paramount — F/S
5. Pyrimidine carboxylic acids
aminocylopyrachlor — Imprelis — F/R

Photosynthesis Inhibition (Photosystem II) — Classes differ in binding behavior

Group 5. C_1 class
1. Triazines
ametryn — Evik — R/F
atrazine — AAtrex — R/F
prometon — Pramitol — R/F
simazine — Princep — R
2. Triazinones
hexazinone — Velpar — R/F
metribuzin — Sencor—R/F
3. Phenylcarbamates
desmedipham — Betanex — F
phenmedipham — Spin-Aid — F
4. Uracils
bromacil — Hyvar — R
terbacil—Sinbar — R
5. Pyridazinones
pyrazon — Pyramin — R/F

Group 7. C_2 class
1. Phenylureas
diuron — Karmex — R
linuron — Lorox — R/F
siduron — Tupersan — R
tebuthiuron — Spike — R

Group 6. C_3 class
1. Benzothiadiazinones
bentazon — Basagran — F
2. Nitriles
bromoxynil — Buctril—F
3. Phenylpyridazine
pyridate — Tough — F

Cell Membrane Disruption

Group 14. PPO inhibition
1. Diphenylethers
acifluorfen — Blazer — F
fomesafen — Reflex/Flexstar — R/F
lactofen — Phoenix/Cobra — F
oxyflurofen — Goal — R/S
2. N-phenylphthalimides
flumiclorac — Resource — F
flumioxazin — Valor — S/F
3. Triazinones
sulfentrazone — Authority/Spartan — R
carfentrazone ethyl — Aim — F
4. Thiadiazoles
fluthiacet methyl — Cadet — F
5. Phenylpyrazoles
pyraflufen-ethyl — Vida — F
6. Trifluoromethyl uracils
saflufenacil — Kixor — R/F/S

Group 22. Photosystem I electron diversion
1. Bipyridyliums
diquat — Reward — F
paraquat — Gramoxone — F

Unclassified Cellular pH alteration
1. Fatty acids
pelargonic acid — Scythe — F

Carotenoid Biosynthesis Inhibition (Pigment Inhibitors)

Group 12. Phytolene desaturase inhibition
1. none accepted
fluridone — Avast — S/R
2. pyridazinone
norflurazon — Zorial — S

Group 27. 4-HPPD inhibition
1. Callistemones
mesotrione — Callisto — F/R
tembotrione — Laudis — F/R
2. Isoxazoles
isoxaflutole — Balance Flexx — R/F
3. Pyrazolones
pyrasulfotole — Huskie — F/R
topramezone — Armezon/Impact — F/R

Group 13. Diterpene synthesis inhibitor
1. Isoxazolidinone
clomazone — Command — R/S

Unknown site of action
1. Triazole
amitrole — Amitrole — F

Nitrogen Metabolism Inhibition

Group 10. Glutamine synthetase inhibition
1. glufosinate — Liberty — F

Unclassified or Unknown

1. Organoarsenical
DSMA — many — F
MSMA — many — F
2. Other
endothall — Aquathol — R/F
difenzoquat — Avenge — F
fosamine — Krenite — F