

**TABLE 11.1.** Common weeds in conservation tillage systems

Winter annuals	Summer annuals	Perennials
Carolina geranium	Common cocklebur	Bermudagrass
Cutleaf evening primrose	Crabgrass	Common pokeweed
Horseweed/marestail	Goosegrass	Johnsongrass
Pepperweed	Morningglory	Milkweed
Ryegrass	Pigweed	Morningglory
Wild mustard	Prickly sida	Nutsedge
Wild radish	Sicklepod	Trumpet creeper

**TABLE 11.2.** Common weeds that have demonstrated resistance to various herbicide mode of action groups

Weed name	Mode(s) of action resistant to <sup>1</sup>	Example herbicides from this group
Horseweed/marestail	2: ALS inhibitors 5: Photosystem II inhibitors 7: Photosystem II inhibitors 9: EPSP synthase inhibitors 22: Photosystem I inhibitors	Chlorsulfuron Atrazine Chlorotoluron Glyphosate Paraquat
Italian ryegrass	1: ACCase inhibitors 2: ALS inhibitors 3: Mitosis inhibitors 15: Mitosis inhibitors 9: EPSP Synthase inhibitors	Sethoxydim Chlorsulfuron Benzamide Acetamide Glyphosate
Wild mustard	2: ALS inhibitors	Chlorsulfuron
Common cocklebur	2: ALS inhibitors	Chlorsulfuron
Crabgrass	1: ACCase inhibitors 4: Synthetic auxins	Sethoxydim 2,4-D
Palmer amaranth (pigweed)	2: ALS inhibitors 3: Mitosis inhibitors 5: Photosystem II inhibitors 9: EPSP synthase inhibitors 14: Protox inhibitors 27: Carotenoid biosynthesis inhibitors	Chlorsulfuron Benzamide Atrazine Glyphosate Oxyfluorfen Topremazone
Waterhemp	2: ALS inhibitors 4: Synthetic auxins 5: Photosystem II inhibitors 9: EPSP synthase inhibitors 14: Protox inhibitors 27: Carotenoid biosynthesis inhibitors	Chlorsulfuron 2,4-D Atrazine Glyphosate Oxyfluorfen Topremazone
Prickly sida	2: ALS inhibitors	Chlorsulfuron
Johnsongrass	1: ACCase inhibitors 2: ALS inhibitors 3: Mitosis inhibitors 9: EPSP synthase inhibitors	Sethoxydim Chlorsulfuron Benzamide Glyphosate
Nutsedge	2: ALS inhibitors	Chlorsulfuron

Source: [5]

<sup>1</sup>Mode of action groups are according to the Weed Science Society of America classification system.

**TABLE 11.3.** Pre-cropping plan for remediation and restoring weedy unproductive fields, in transition to conservation tillage production of cash crops

Season	Production practice	Expected results (effects)
<b>Year one</b>		
Early to mid-spring	Flail mow (1–3 times) all existing vegetation: pasture, cover crop, cash crop, weeds	Kill weeds; reduce weed seed production
Late spring, summer	Deep till (chisel, subsoil, plow); incorporate summer residues; employ stale seedbed techniques (6–12 weeks) using flamers, herbicides <sup>1</sup> or cultivators to kill weed seedlings	Alleviate soil compaction <sup>2</sup> ; kill weeds and reduce weed seedbank; deepen rooting zone (increase the effective soil profile)
Summer, fall	Apply and incorporate soil amendments (manure, compost, lime, fertilizers) based on detailed soil analysis; drill a cover crop of winter rye plus hairy vetch or Austrian winter peas	Increase active soil organic matter (SOM) and balanced nutrient availability; reduce nutrient leaching
<b>Years two and three</b>		
Mid-spring	Flail mow and shallow incorporate weed and cover crop residues	Increase active SOM; reduce weed seedbank
<b>Option when weed levels and soil health are adequate</b>		
Late spring	Seed summer cover crop of foxtail millet and cowpea	Grow high-biomass cover as mulch for production of fall broccoli; reduce growth of summer weeds
Mid-summer	Kill foxtail millet/cowpea cover crop; plant broccoli in killed mulch, using no-till equipment to establish broccoli transplants	Grow high-quality fall broccoli; minimize production of weed seeds
<b>Option when additional remedial practices are needed</b>		
Mid- to late-summer	Employ stale seedbed techniques (6–12 weeks) or drill summer cover crops (foxtail millet/cowpea, buckwheat, etc.)	Prevent production of weed seeds; reduce weed seedbank
<b>After using stale seedbed techniques</b>		
	Zone-drill (strip interseed) forage radish in grow zones and winter rye in alleyways	Grow high-biomass cover in preparation for planting spring vegetables next year
	<b>OR</b> drill perennial legume sods (alfalfa, red clover, white clover) that will grow over the next 12–18 months	Grow high-biomass sods in preparation for producing vegetables next summer or the following spring
Early fall	After employing stale seedbed techniques or growing summer cover crops, drill winter cover crops (winter rye or triticale, plus hairy vetch or Austrian winter peas)	Increase SOM; reduce weed seed production; produce N and mulch for next year's summer vegetables; reduce nutrient leaching

Source: [13]

<sup>1</sup> In all situations outlined above, growers have the option to apply either organic or chemical fertilizers and herbicides to increase and maintain soil fertility levels and to kill weeds and cover crops.

<sup>2</sup> With compacted soils, growers can opt to erect permanent raised beds to improve drainage and deepen the effective soil profile.

TABLE 11.4. Herbicides for use in reduced-tillage corn production

Herbicide		Application timing	Weed species controlled
Common name	Trade name <sup>1</sup>		
Glufosinate	Liberty <sup>®</sup>	Preplant burndown	Emerged weed species
Glyphosate	Roundup WeatherMAX <sup>®</sup>		
Paraquat	Gramoxone <sup>®</sup>		
2,4-D	Agri Star <sup>®</sup> 2,4-D		
Atrazine	Aatrex <sup>®</sup>	Preplant or PRE <sup>2</sup>	Broadleaves such as kochia ( <i>Kochia scoparia</i> ); suppression of foxtail ( <i>Setaria</i> spp.), velvetleaf ( <i>Abutilon theophrasti</i> ). Can also be applied POST
Flumioxazin	Valor <sup>®</sup>		Broadleaf species such as horseweed ( <i>Conyza canadensis</i> ); suppression of grass species such as panicum ( <i>Panicum</i> spp.) and goosegrass ( <i>Eleusine indica</i> )
Pendimethalin	Prowl <sup>®</sup>		Germinating, small-seeded grass and broadleaf species such as crabgrass ( <i>Digitaria</i> spp.) and common lambsquarters ( <i>Chenopodium alba</i> )
S-metolachlor	Dual Magnum <sup>®</sup>		Grass and broadleaf species such as foxtail and <i>Amaranthus</i> spp.
Carfentrazone	Aim <sup>®</sup>	POST <sup>3</sup>	Certain broadleaf weed control; tank mix with atrazine or dicamba
Bromoxynil	Buctril <sup>®</sup>		Broadleaf weeds such as burcucumber ( <i>Sicyos angulatus</i> ), giant ragweed ( <i>Ambrosia trifida</i> )
Dicamba	Banvel <sup>®</sup>		Annual broadleaf species as well as certain perennial species such as dock ( <i>Rumex</i> spp.) and wild onion ( <i>Allium</i> sp.)
Mesotrione	Callisto <sup>®</sup>	POST	Broadleaf species such as wild mustard ( <i>Sinapis arvensis</i> ), nightshade ( <i>Solanum</i> spp.) and Canada thistle ( <i>Cirsium arvense</i> )
Tembotrione	Laudis <sup>®</sup>		Broadleaf and grass species such as common chickweed, purple deadnettle ( <i>Lamium purpureum</i> ), <i>Amaranthus</i> spp., and large crabgrass ( <i>Digitaria sanguinalis</i> )
Ametryn	Evik <sup>®</sup>	POST-directed spray	Grass species such as Texas panicum, goosegrass and foxtail

TABLE 11.4 continued

Herbicide		Application timing	Weed species controlled
Common name	Trade name <sup>1</sup>		
Linuron	Lorox®		Broadleaf and grass species such as dog fennel, common ragweed ( <i>Ambrosia artemisiifolia</i> ), velvetleaf and annual ryegrass ( <i>Lolium multiflorum</i> )
<i>Clearfield Corn</i>			
Imazethapyr + Imazapyr	Lightning®	POST	Broadleaves, grasses and sedges such as kochia, ragweed, quackgrass ( <i>Elytrigia repens</i> ) and nutsedge ( <i>Cyperus</i> spp.)
<i>LibertyLink Corn</i>			
Glufosinate	Liberty®	POST	Broadleaf and grass species; ragweed, horseweed, johnsongrass seedlings
<i>Roundup Ready Corn</i>			
Glyphosate	Roundup WeatherMAX®	POST	Nonselective control of some broadleaf and grass species
Glyphosate + s-metolachlor + atrazine	Expert®	PRE or POST	Annual broadleaves and grasses; perennials such as quackgrass, dandelion ( <i>Taraxacum officinale</i> ) and Canada thistle

<sup>1</sup>Trade names listed are representative of available herbicides. Inclusion of a particular product does not imply endorsement by the USDA, the SARE program or the authors. Exclusion does not imply a negative evaluation.

<sup>2</sup>PRE: pre-emergence.

<sup>3</sup>POST: post-emergence.

TABLE 11.5. Herbicides for use in reduced-tillage cotton production

Herbicide		Application timing	Weed species controlled
Common name	Trade name <sup>1</sup>		
Dicamba	Banvel®	Preplant burn-down	Emerged weed species
Flumioxazin	Valor®		
Glufosinate	Liberty®		
Glyphosate	Roundup WeatherMax®		
Paraquat	Gramoxone®		

Herbicide		Application timing	Weed species controlled
Common name	Trade name <sup>1</sup>		
Clomazone	Command®	Preplant or PRE <sup>2</sup>	Grasses and broadleaves such as crabgrass ( <i>Digitaria</i> spp.), panicum ( <i>Panicum</i> spp.), velvetleaf ( <i>Abutilon theophrasti</i> ) and Florida beggarweed ( <i>Desmodium tortuosum</i> )
Fluometuron	Cotoran®		Grasses and broadleaves such as signalgrass ( <i>Brachiaria</i> sp.), horseweed ( <i>Conyza canadensis</i> ) and sicklepod ( <i>Senna obtusifolia</i> )
Pendimethalin	Prowl®		Grass and broadleaf species such as foxtail ( <i>Setaria</i> spp.), panicum, and <i>Amaranthus</i> spp.
Prometryn	Caparol®		Annual grass and broadleaves such as groundcherry ( <i>Physalis</i> sp.), Florida pusley ( <i>Richardia scabra</i> ) and panicum
S-metolachlor	Dual Magnum®		Grass and broadleaves such as barnyardgrass ( <i>Echinochloa crus-galli</i> ), crabgrass and Florida pusley
Clethodim	Select®	POST <sup>3</sup>	Grass species such as crabgrass, panicum and foxtail
Quizalofop	Assure®		Annual and perennial grasses such as foxtail, goosegrass ( <i>Eleusine indica</i> ) and bermudagrass ( <i>Cynodon dactylon</i> )
Sethoxydim	Poast®	POST	Grass species such as foxtail, crabgrass and panicum
Trifloxysulfuron	Envoke®		Broadleaf and grass species such as coffee senna ( <i>Senna occidentalis</i> ), barnyardgrass and Florida beggarweed
Diuron	Direx®	POST-direct sprayed	Broadleaf and grass species such as sicklepod, velvetleaf and crabgrass
Linuron	Linex®		Broadleaves and grasses such as morningglory, Florida pusley and panicum
MSMA	Target®		Grass and broadleaf species such as crabgrass, Florida beggarweed and <i>Amaranthus</i> spp.
<i>LibertyLink Cotton</i>			
Glufosinate	Liberty®	POST	Broadleaf and grass species such as <i>Amaranthus</i> spp., morningglory and goosegrass
<i>Roundup Ready Cotton</i>			
Glyphosate	Roundup WeatherMax®	POST	Grass and broadleaf species such as Florida beggarweed, crabgrass, foxtail, groundcherry and velvetleaf

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<sup>2</sup>PRE: pre-emergence.

<sup>3</sup>POST: post-emergence.

Herbicide		Application timing	Weed species controlled	
Common name	Trade name <sup>1</sup>			
Glufosinate	Liberty®	Preplant burn-down	Emerged weed species	
Glyphosate	Roundup WeatherMax®			
Paraquat	Gramoxone®			
2,4-D	Agri Star® 2,4-D			
Clomazone	Command®	PRE <sup>2</sup>	Grasses and broadleaves such as crabgrass ( <i>Digitaria</i> spp.), panicum ( <i>Panicum</i> spp.), velvetleaf ( <i>Abutilon theophrasti</i> ) and Florida beggarweed ( <i>Desmodium tortuosum</i> )	
Dimethenamid	Outlook®		Grass and broadleaf species such as foxtail ( <i>Setaria</i> spp.), panicum and <i>Amaranthus</i> spp.	
Flumioxazin	Valor®		Broadleaf species such as horseweed ( <i>Conyza canadensis</i> ); suppression of grass species such as panicum and goosegrass ( <i>Eleusine indica</i> )	
Imazaquin	Scepter®		Broadleaf and grass species such as morningglory ( <i>Ipomoea</i> spp.), velvetleaf and foxtail	
Metribuzin	Sencor®		Broadleaf and grass species such as <i>Amaranthus</i> spp. and broadleaf signalgrass ( <i>Brachiaria platyphylla</i> )	
Pendimethalin	Prowl®		Grass and broadleaf species such as panicum and <i>Amaranthus</i> spp.	
S-metolachlor	Dual Magnum®		Grass and broadleaves such as barnyardgrass ( <i>Echinochloa crus-galli</i> ), crabgrass and Florida pusley ( <i>Richardia scabra</i> )	
Bentazon	Basagran®		POST <sup>3</sup>	Broadleaf weeds such as coffee senna ( <i>Senna occidentalis</i> ) and velvetleaf
Chlorimuron	Classic®			Broadleaf weeds such as Florida beggarweed and morningglory
Cloransulam	FirstRate®		Broadleaf weeds such as common cocklebur ( <i>Xanthium strumarium</i> ) and velvetleaf	
Fluazifop	Fusilade®		Annual and perennial grass species such as crabgrass and bermudagrass ( <i>Cynadon dactylon</i> )	
Imazethapyr	Pursuit®		Broadleaf and grass species such as morningglory and crabgrass	
Lactofen	Cobra®		Broadleaf species such as croton ( <i>Croton</i> spp.) and Florida beggarweed	
Sethoxydim	Poast®		Grass species such as foxtail, crabgrass and panicum	

Herbicide		Application timing	Weed species controlled
Common name	Trade name <sup>1</sup>		
<i>LibertyLink Soybean</i>			
Glufosinate	Liberty <sup>®</sup>	POST	Broadleaf and grass species such as <i>Amaranthus</i> spp., morningglory and goosegrass
<i>Roundup Ready Soybean</i>			
Fomesafen + Glyphosate	Flexstar <sup>®</sup>	POST	Broadleaf and grass species such as morningglory, velvetleaf and broadleaf signalgrass
Glyphosate	Roundup WeatherMax <sup>®</sup>	POST	Grass and broadleaf species such as Florida beggarweed, crabgrass and groundcherry

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<sup>2</sup>PRE: pre-emergence.

<sup>3</sup>POST: post-emergence.



Herbicide		Application timing	Weed species controlled
Common name	Trade name <sup>1</sup>		
Imazapic	Cadre <sup>®</sup>	POST <sup>3</sup>	Broadleaf and grass species such as morningglory, <i>Amaranthus</i> spp. and crabgrass
Imazethapyr	Pursuit <sup>®</sup>		Broadleaf, grass and sedge species such as Florida pusley ( <i>Richardia scabra</i> ), crabgrass and nutsedge ( <i>Cyperus</i> spp.)
Paraquat	Gramoxone <sup>®</sup>		Grass and broadleaf species
Sethoxydim	Poast <sup>®</sup>		Grass species, foxtail and panicum
2,4-DB	Butyrac <sup>®</sup>		Broadleaf species such as velvetleaf and prickly sida ( <i>Sida spinosa</i> )

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<sup>2</sup>PRE: pre-emergence.

<sup>3</sup>POST: post-emergence.

**TABLE 11.8.** Herbicides for use in reduced-tillage wheat production

Herbicide		Application timing	Weed species controlled
Common name	Trade name <sup>1</sup>		
Carfentrazone	Aim <sup>®</sup>	Preplant burn-down	Non-selective control of emerged broadleaves and grasses
Glufosinate	Liberty <sup>®</sup>		
Glyphosate	Roundup WeatherMax <sup>®</sup>		
Paraquat	Gramoxone <sup>®</sup>		
Chlorsulfuron + Metsulfuron	Finesse <sup>®</sup>	PRE or POST <sup>2</sup>	<i>Bromus</i> species, annual ryegrass ( <i>Lolium multiflorum</i> ) kochia ( <i>Kochia scoparia</i> )
Pyrasulfotole + Bromoxynil	Huskie <sup>®</sup>	Early POST	Emerged broadleaf seedlings such as dandelion ( <i>Taraxacum officinale</i> ); suppression of established dandelion and henbit ( <i>Lamium amplexicaule</i> )
Thifensulfuron + Tribenuron	Harmony <sup>®</sup> Extra	POST	Actively growing broadleaves, wild garlic ( <i>Allium vineale</i> ); suppression of Canada thistle ( <i>Cirsium arvense</i> )
<i>Clearfield wheat</i>			
Imazamox	Beyond <sup>®</sup>	POST	Broadleaves henbit and chickweed ( <i>Stellaria media</i> ), grasses barnyardgrass ( <i>Echinochloa crus-galli</i> ) and jointed goatgrass ( <i>Aegilops cylindrica</i> ), volunteer cereals (non-Clearfield types)

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<sup>2</sup>PRE: pre-emergence.

<sup>3</sup>POST: post-emergence.