Contents Weed Guide (WG)

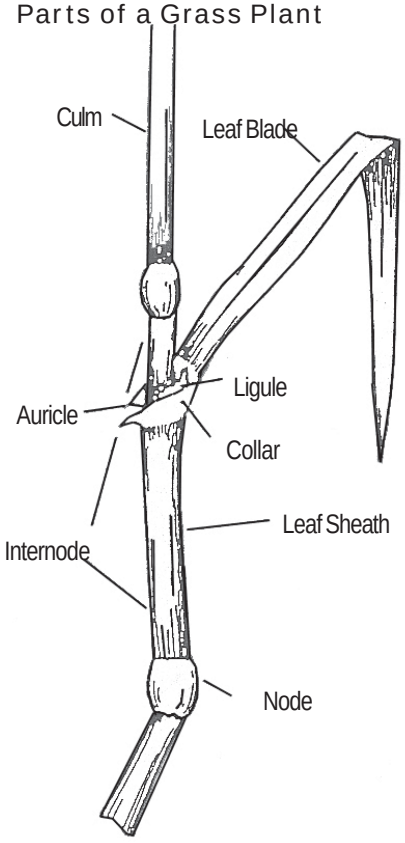
Weed Identification Section

Herbicide Injury Section

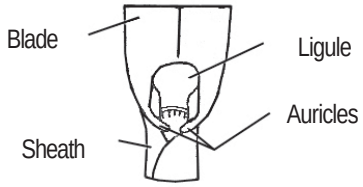
Monocot
Weed Seedling Identification Key

Monocot seedling identification can be challenging. Careful attention to detail is required. Check the drawings for key terms and structures that you need to know to successfully identify plants in this group. Then examine the leaf collar, leaf blade, leaf sheath and shoot of the weed in question and follow the key on the next page.

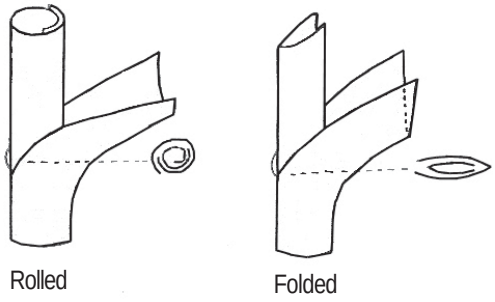
Parts of a Grass Plant



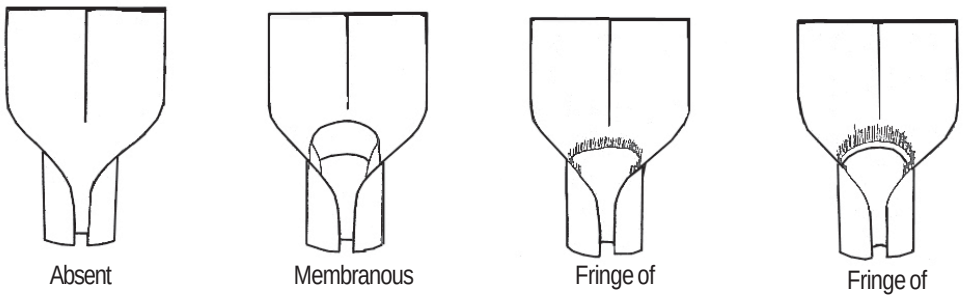
Terminology of Grass



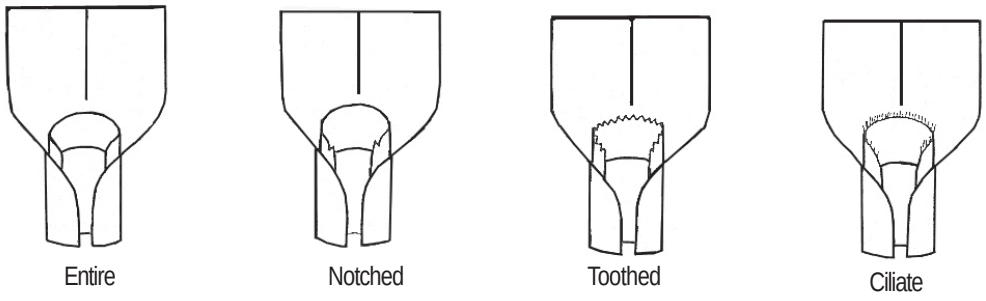
Leaf Arrangement in Young



Ligule Types



Ligule Margins



Monocot Weed Identification Key

Grass and grass-like weeds pose some of the greatest challenges in weed identification. Accurate identification, even at the difficult seedling stage, is however crucial to formulating a successful weed management strategy. Although this key is not all inclusive (it covers 14 grasses and 1 sedge), these are the grasses which predominate Wisconsin agriculture. To use this key, begin by determining the absence or presence of a ligule (diagrams defining identification terminology can be found on the back side of this page), checking for hairs on the leaf blade and sheath, and then determining if any of the confirming traits are present. This key is meant to be a quick and concise identification tool. If you are left with any question concerning the identification of a weed, consult one of the many in-depth weed identification guides readily available today.

Ligule	Hairs present on: Blade	Sheath	Confirming Traits	The Weed Is…
none	no	no	Triangular stems, 3-ranked waxy leaves, tubers at end of rhizomes	**Yellow Nutsedge**
none	no	no	Stem sharply flattened, leaf collar yellowish	**Barnyardgrass**
hairy	long wiry hairs at base of blade	no	Stem flattened, cylindrical seed heads with yellowish awns	**Yellow Foxtail**
hairy	no	occasionally on sheath margin	Stem flattened with purplish bases, common on sandy soils, twisted leaves & spiny fruit	**Sandbur**
hairy	no	margin – yes surface – rarely	Seed head tapers at tip, purple & white biotypes exist (rare)	**Green Foxtail**
hairy	short hairs on entire upper surface	margin – yes surface – rarely	Large drooping seedheads	**Giant Foxtail**
hairy	few hairs on blade near ligule	sheaths of first tillers hairy	Prominent midrib white on older plants, stem bases often purplish	**Fall Panicum**
hairy	very hairy upper and lower surface	covered with bristly hairs	Rounded stems, open panicle seed head with very small seeds	**Witchgrass**
hairy	some hairs on both leaf surfaces	covered with bristly hairs	Tan to black shiny seeds, often attached to root	**Wild Proso Millet**
hairy	short hairs on both upper & lower surface	covered with short, fine hairs	First leaf relatively wide, 90^0 to stem, stem nodes swollen, one leaf margin often wrinkled	**Woolly Cupgrass**
membranous (very short)	no	sheaths hairy in spring	Whitish-yellow leaf collar with clasping auricles, long rhizomes	**Quackgrass**
membranous	no	no	Jagged ligule, wire-like stems with narrow leaves, short scaly rhizomes, plant appears bushy	**Wirestem Muhly**
membranous	yes	yes	Flattened stems, low spreading growth, roots at nodes	**Large Crabgrass**
membranous	sparse if present	sparse if present	Lighter green, smaller and less hairy than large crabgrass	**Smooth Crabgrass**
membranous initially (hairy later)	no	no	Stems round, leaf blades wide, large black & shiny seeds often attached to root	**Shattercane**

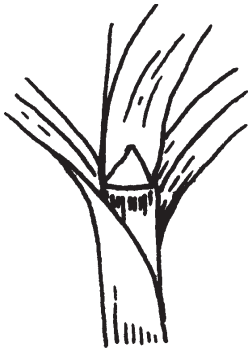
D.J. Heider. University of Wisconsin Integrated Pest Management Program

Identification of Common Wisconsin Weeds

Annual & Perennial Monocots

SEDGE FAMILY

Yellow nutsedge (44)



stems: triangular, nodeless and solid

leaves: 3-ranked, shiny and waxy; basal and involucral

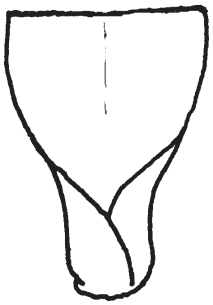
flowers: small, yellowish to yellowish-brown

rhizomes: 4" - 12" long tubers formed at the end of rhizomes

other: seeds brownish, 3 sided; perennial

GRASS Family

Barnyardgrass (23)



stems: flattened; base often purplish

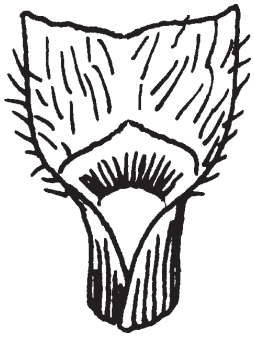
leaves: smooth; occasionally few hairs in leaf collar area

ligule: absent

other: seed head has awns that vary in length

GRASS FAMILY

Yellow foxtail (36)



stems: flattened; base often reddish

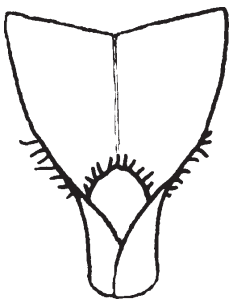
leaves: long hairs on upper surface at base of blade

ligule: hairy

other: seed head is yellowish color, bristly, cylindrical and erect

GRASS FAMILY

Sandbur (20)



stems: flattened; base often reddish

leaves: smooth, twisted

ligule: hairy

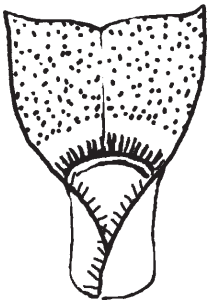
other: found mostly on sandy soil; fruit a spiny bur

Numbers in parentheses denote pages in *Weeds of the North Central States* that describe the weed.

Annual & Perennial Monocots

GRASS FAMILY

Giant foxtail (35)



stems: rounded to slightly flat

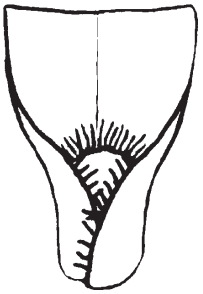
leaves: short hairs on upper surface only; hairy sheath margin

ligule: hairy

other: seed head is large and drooping

GRASS FAMILY

Green foxtail (38)



stems: rounded to flattened

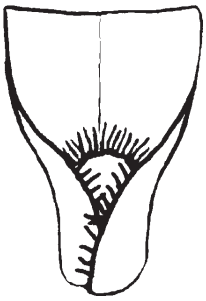
leaves: no hairs on blade; hairy sheath margin

ligule: hairy

other: seed head usually smaller than giant foxtail; larger at base and tapering at tip.

GRASS FAMILY

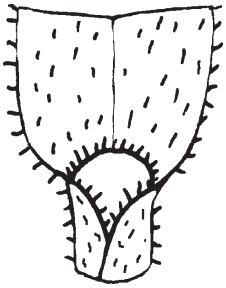
Green/white robust foxtail (38)



Plants usually larger than green foxtail; no hair on blade; large, drooping seedheads with purple or white bristles

GRASS FAMILY

Witchgrass (31)



stems: rounded; semi-decumbent

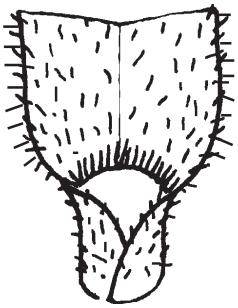
leaves: sheath and blade very hairy

ligule: hairy

other: seed head on open panicle with very small seeds

GRASS FAMILY

Wild proso millet (33)



stems: rounded, with many tillers

leaves: hairy blades, always on top, sometimes below; sheath always bristly hairy

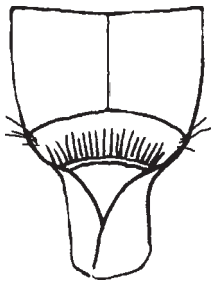
ligule: hairy

other: relatively large tan to black shiny seeds

Annual & Perennial Monocots

GRASS FAMILY

Fall panicum (32)



stems: rounded, with a reddish-purple base

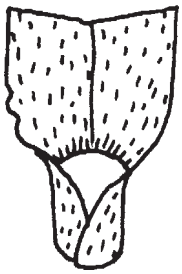
leaves: first leaf swaths hairy; later smooth; sheath margin smooth; few hairs at blade base; prominent midrib

ligule: hairy

other: seeds smaller than wild proso millet

GRASS FAMILY

Woolly cupgrass (26)



stems: rounded stems with swollen nodes

leaves: blades & sheath finely pubescent; blade wrinkled on one edge

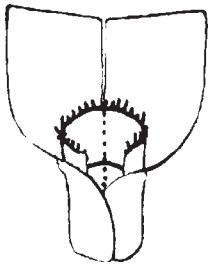
ligule: hairy, short

seeds: large straw-colored seeds

seed head: composed of several branches *(rachis)*

GRASS FAMILY

Shattercane (39)



stems: rounded, large and with many tillers

leaves: sorghum-like; white midrib above and prominent below

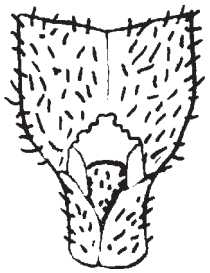
ligule: membranous with hairs on top by midseason

seed head and seeds: panicle inflorescence, a panicle; relatively large black, shiny seeds

other: grows 4-8 feet tall; if rhimomes found, it is sorghum almum

GRASS FAMILY

Large Crabgrass (22)



stems: rounded to flattened, decumbent and branched

ligule: membranous

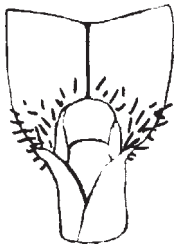
leaves: sheath & blade hairy

seedhead: a branched finger-like structure; seeds flattened against branches

other: roots often form at nodes

GRASS FAMILY

Smooth Crabgrass (22)



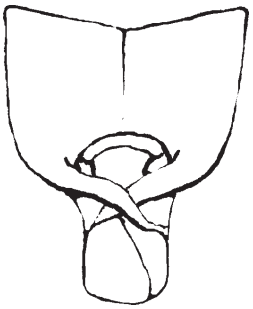
Similar to large crabgrass but few if any hairs on leaf sheath and blade;

smaller; lighter green color

Annual & Perennial Monocots

GRASS FAMILY

Quackgrass (14)



stems: rounded

leaves: sheath hairy early

ligule: membranous; very short and hard to see

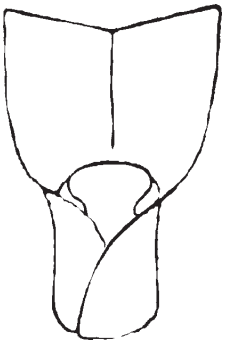
auricles: clasping *(Barley & wheat have also)*

rhizomes: long, whitish, slender

other: perennial, cool season

GRASS FAMILY

Wirestem muhly (29)



stems: rounded; wiry

leaves: numerous, relatively short, narrow, pale green

ligule: membranous; easily visible

auricles: absent

rhizomes: short, scaly, irregularlly shaped; short internodes = many buds

other: perennial, warm season; prolitic seed producer

Identification of Common Wisconsin Weeds

Annual Broadleaves

Jerry Doll, UW Madison Agronomy

Buckwheat Family

Wild buckwheat (51)*

cotyledon:	oblong-oval with granular-waxy surface
ocrea:	at leaf axils; small
stems:	trailing vines
leaves:	heart-shaped with pointed tips
flowers:	greenish-white, small and inconspicuous
seeds:	3-sided

Buckwheat Family

Pennsylvania smartweed (52)

cotyledon:	lanceolate to oblong, rounded tips
ocrea:	at leaf axils; smooth top
stems:	reddish, branched swollen nodes
leaves:	rounded at base; pointed at tip
flowers:	pink, terminal flower clusters
other:	seed black, shiny, flattened, circular with pointed tip

Buckwheat Family

Ladysthumb smartweed (52)

cotyledon:	lanceolate to oblong, rounded tips
ocrea:	at leaf axils; hairy top
stem:	reddish with swollen nodes; branched
leaves:	pointed at both ends, often have “thumb print”
flowers:	pink, terminal flower clusters
other:	seeds black, most triangular

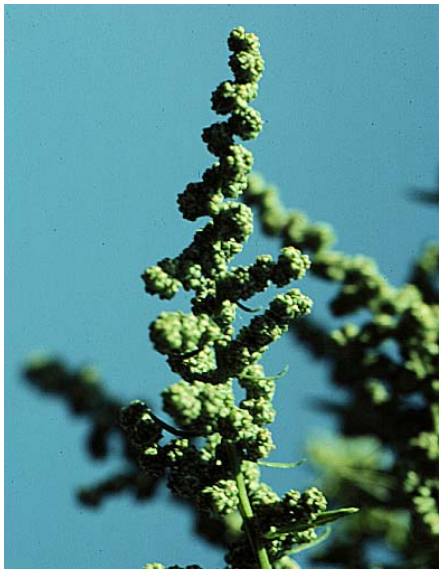
* Numbers indicate the page in *Weeds of the North Central States* that describes the plant.

Annual Broadleaves

Goosefoot Family

Common lambsquarters (57)

cotyledon:	linear, small
leaves:	often have whitish, 'mealy' covering; shape is triangular or "goosefoot" shaped
stems:	have reddish streaks, branched
seed:	shiny, black, disk-shaped, 1/16 inch in diameter
other:	many biotypes, some resistant to herbicides



Pigweed Family

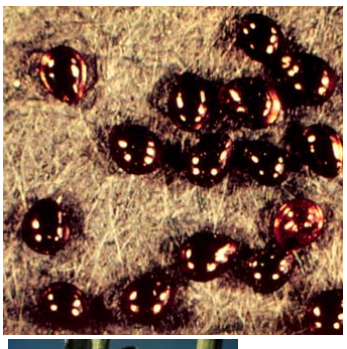
Redroot pigweed (65)

cotyledon:	linear, smooth
root:	often reddish-pink taproot
leaves & stems:	notch in tip of first leaves; finely pubescent; reddish-purple color on underside of leaves
seed head:	somewhat spiny, small, black, shiny seeds
other:	also called rough pigweed

Pigweed Family

Smooth pigweed (64)

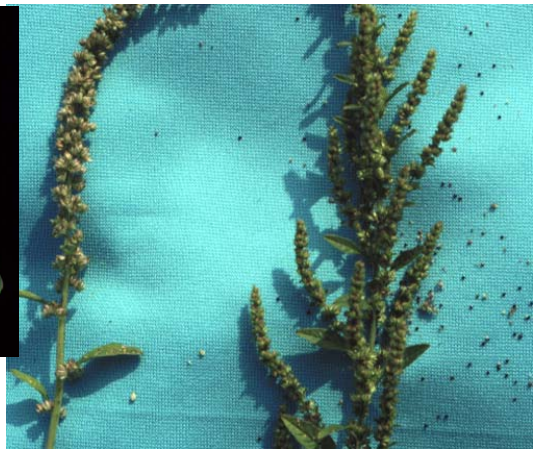
cotyledon shape:	linear, smooth
root:	often reddish pink taproot
leaves & stems:	generally smooth
seed heads:	longer than redroot pigweed ; rarely branched
other:	resistant biotypes



Annual Broadleaves

Pigweed Family
Waterhemp

cotyledon shape:	linear; egg-shaped
leaves:	nick in tip of first leaves; long-petioled; 3 to 6 in. long; somewhat shiny
stems:	smooth, often with colored stripes
infloresence:	small greenish flowers, male and female flowers on separate plants
other:	several species of waterhemp in the region; resistant biotypes


Purslane Family
Purslane (71)

cotyledon:	linear or oblong, smooth
leaves:	fleshy, rounded, opposite
stems:	fleshy, prostrate, reddish, branched
flowers:	5 yellow petals; small; numerous
seeds:	small, flattened, oval, glossy black
other:	plants can establish from stem pieces



Mustard Family
Wild mustard (89)

cotyledon:	heart or kidney-shaped; smooth
leaves and stems:	few bristly hairs
lower leaves:	large, triangular and lobed (not to midrib)
upper leaves:	reduced in size; no petioles
flowers:	4 bright yellow petals
seed pods:	“beak” of seed capsule 1/3 length of whole capsule; open to release round seeds



Annual Broadleaves

Mustard Family

Wild radish (100)

cotyledon:	heart or kidney-shaped, smooth
lower leaves:	rounded lobes often reach to midrib
stems & leaves:	stiff, scattered hairs
flowers:	4 yellowish-white petals; sometimes with purplish veins
seed pods:	form constrictions and break into small segments with seed inside
other:	fruits contaminate oats and barley grain

Mustard Family

Shepherd's purse (91)

cotyledon shape:	ovate to rounded
rosette leaves:	starlike branched hairs on upper surface; leaf lobes point to leaf tip
stalk/stems:	elongated stalk; leaves clasp stem
flowers:	small with 4 white petals
seed pod:	small, triangular-shaped

Mustard Family

Field pennycress (104)

cotyledon:	round, bluish-green
leaves:	rosette and stem leaves; ear-like lobes that clasp stems on upper leaves
flowers:	flowers with 4 white petals; in clusters
seed pod:	notch in top of pod and flat wing around edge
other:	garlic-like odor in crushed leaves and stems

Annual Broadleaves

Mallow Family

Velvetleaf (122)

cotyledon:	round or heart-shaped
leaves:	very large, heart-shaped, softly hairy
stem:	pubescent
flowers:	yellow with 5 petals
seed capsules:	13-15 segments; resembles "butterprint"

Nightshade Family

Jimson weed (157)

cotyledon:	lanceolate, smooth
leaves:	ovate (egg-shaped) with pointed tip lobes; wavy margins
stems:	hollow, purplish, and smooth
flower:	white tubular flowers
seed capsules:	spiny, golf ball sized with many seeds
other:	strong, foul odor in leaves and stems; poisonous

Nightshade Family

Eastern black nightshade (162)

cotyledon:	ovate, smooth, small
leaves:	purplish color on underside; often with "shot holes"
stems:	erect or spreading; widely branched
flowers:	5 white reflexed petals
fruits:	green, turning black at maturity; contaminate harvested products

Annual Broadleaves

Nightshade Family

Hairy nightshade

cotyledon:	ovate, hairy
leaves:	ovate to nearly triangular; finely hairy, especially veins & margins
stems:	finely hairy
flowers:	3-9 flowers on short stalk; 5-petaled; white or tinged with purple
fruit:	turns yellowish brown when ripe

Gourd Famliy

Bur Cucumber (178)

cotyledon:	large; spoon-shaped, thick with dense short hairs
stem:	long, ridged vines; sticky-hairy; branched tendrils allow plants to climb over crops
leaves:	3 to 5 shallow lobes (pentagon-shaped), alternate, petioled
flowers:	male and female flowers arise at separate axils; 5 greenish-white fused sepals and petals
fruits:	in clusters of 3 to 20 egg-shaped, barbed, prickly pods; each pod with one seed

Composite Family

Common ragweed (181)

cotyledon:	oval to spatulate, thick
leaves:	lacy, finely divided, opposite initially, then alternate; first leaves with 5 lobes
stems:	rough, hairy and branched
flowers:	male flowers in terminal clusters; female flowers in leaf axils

Annual Broadleaves

Composite Family

Giant ragweed (183)

cotyledon:	oval to spatulate
leaves:	opposite, large and 3-5 lobed; upper leaves often simple; roughly hairy
stems:	woody and 1-2 inches thick; tough, hairy; 6-14 feet tall
flowers:	male flowers in terminal clusters; female flowers in leaf axils

Composite Family

Horseweed (204)

cotyledon:	round to ovate
leaves:	many leaves, no petioles; hairy; entire or toothed
stems:	covered with bristly hairs; branched at top
flowers:	many small flowers on axillary branches
other:	also called marestail; common in no-till sites

Composite Family

Galinsoga (210)

cotyledon:	oval to squarish, hairy; abruptly tapered at base
leaves:	opposite, toothed
stems:	branched, hairy
flowers:	4-5 white ray flowers surrounding yellow disk flowers

Annual Broadleaves

Zomponte Family

Prickly Lettuce (224)

cotyledon:	ovate to spoon-shaped
first leaves:	rosette of pale green leaves; no spines
later leaves:	lobed with spiny edges and spines on midrib of underside of leaves; leaf bases clasp the stem
stem:	hollow; top very branched when mature
flowers:	pale yellow flower heads that release seeds attached to a pappus
other:	leaves and stems with milky sap

Composite Family

Cocklebur (240)

cotyledon:	lanceolate, thick
leaves:	large, triangular and lobed; 3 prominent veins
stems:	rough texture, dark purple spots
stem & leaves:	sandpaper-like textured surface
flowers:	small, male and female separate but borne together in clusters in axils of upper leaves

Biennial Broadleaves

Composite Family

Burdock (187)

taproot:	large, thick, and fleshy
rosette leaves:	huge with heart-shaped base; white-woolly below
stem leaves:	alternate, prominent veins
stem:	tough; much branched
flowers:	red-violet color; 3/4 - 1 inch across
fruit:	a bur with hooked spines

Biennial Broadleaves

Composite Family

Musk thistle (199)

leaves: smooth, waxy; grey-green margin with a white, hairless midrib; spiny edges that extend down stem

stems: spiny from leaf bases except right below flower head

flowers: 1 ½ to 2 inches in diameter; rich pink color; head often tips downward

Composite Family

Plumeless thistle (198)

leaves: leaves deeply divided; hairy esp. lower surface midrib; decurrent

stems: spiny from base to flower head due to decurrent leaves

flowers: ¾ to 1 ½ inches in diameter; pinkish

Composite Family

Bull thistle (202)

leaves: deeply cut, spiny margins with a wrinkled surface; hairy

spines: prominent; needle-like

stems: spiny with decurrent leaves (extend down the stem)

flowers: 1 – 2 inches in diameter; are flask-shaped; pink to pink-lavender

Perennial Broadleaves

Horsetail Family

Horsetail (11)

spreads:	by spores and rhizomes
fertile stems:	stems hollow, not branched; easily separated joints
vegetative stems:	“leaves” in whorls at joints; looks like small pine trees
other:	most common in wet areas

Buckwheat Family

Curly dock (55)

taproot:	fleshy, branched, and yellow
ocrea:	long; prominent
basal leaves:	6-12 inches with wavy edges
stems:	smooth, erect, reddish
flowers:	small greenish becoming reddish brown at maturity, found in dense clusters on branches at tip of stem

Pink Family

White cockle (74)

leaves:	hairy and opposite, with no petiole; softly hairy
stems:	softly hairy
flowers:	white; male & female parts on separate plants (dioecious)
fruit:	seed pods with 10 short teeth

Perennial Broadleaves

Mustard Family

Yellow rocket (86)

rosette leaves:	pinnate with large terminal lobe
stem leaves:	smooth with waxy surface
upper leaves:	clasp stem
flowers:	4 yellow petals, similar to wild mustard but smaller

Mustard Family

Hoary alyssum (87)

stem/leaves:	grey-green in color; rough hairs on whole plant
flowers:	white with 4 deeply-divided petals
fruit:	seed pods small with short “beak”

Spurge Family

Leafy Spurge (118)

roots:	deep and spreading
stems:	smooth
leaves:	alternate, strap-shaped, ¼ inch wide, usually drooping
flowers:	small and borne above greenish-yellow bracts
fruit:	explode when ripe, shooting 3 seeds, from parent plant
other:	all plant parts have milky sap

Perennial Broadleaves

Dogbane Family

Hemp dogbane (134)

roots: deep and branched

leaves: opposite, narrow and pointed tips

stems: smooth, reddish

flowers: 5 greenish white petals that are slightly longer than green sepals

fruits: long, slender pods; occur in pairs

other: all plant parts have milky ap

Milkweed Family

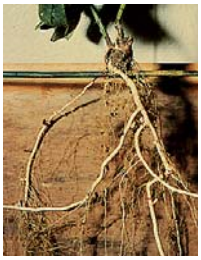
Common Milkweed (137)

roots: deep and branched

leaves: opposite, thick, oblong, rounded tips, prominent veins

flowers: pink to white in large many-flowered ball-like clusters at tip of stem and in axils of upper stems

other: all plant parts have milky sap



Morningglory Family

Field bindweed (139)

roots: deep and spreading

stems: trailing or climbing

leaves: “arrowhead”-shaped leaves with 3 “points”

flowers: white or pink, funnel-shaped, 1 inch or less in diameter, found in axils of leaves

other: flower stalks have 2 stipules below flowers

Perennial Broadleaves

Morningglory Family
Hedge bindweed (140)

roots:	deep and spreading
stems:	trailing or climbing (similar to field bindweed)
leaves:	“arrowhead”-shaped leaves with 5 “points”
flower stalks:	no stipules below flowers
flowers:	large, 1 ½ to 2 inches, white or pinkish

Nightshade Family
Horsenettle (160)

root:	spreading, deep with adventitious buds
leaves:	with yellow prickles on the petioles, veins and midribs; hairy; oblong with wavy edges (like oak leaf)
stems:	with sharp, stout spines; simple or branched
flowers:	potato-like with 5 fused white to purple petals; prominent anthers
fruits:	smooth green berries to 0.5" diameter, becoming yellow; become wrinkled and hang on plants most of winter
other:	plants poisonous

Plantin Family
Blackseed Plantin (171)

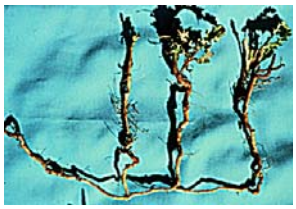
root:	fibrous, tough
leaves:	in rosette, broad, ovate with 3 to 5 prominent veins; smooth; petioles purplish; egg-shaped, wavy margins
flowering stems:	leafless with many small inconspicuous flowers
other:	broadleaf plantain similar but lacks purple petioles and has smaller leaves

Perennial Broadleaves

Composite Family

Canada thistle (200)

roots:	deep and branched
stems:	smooth
leaves:	crinkled edges and spiny margins; smooth
flowers:	pink to purple, flash-shaped rarely white, ¾ inches wide; male and female flowers on seperate plants



Composite Family

Perennial SowThistle (234)

roots:	spreading; shoots arise from buds
leaves:	prickly toothed, lobed; milky sap
stems:	milky juice; hollow; branch near top
flower heads:	branched with yellow ray flowers
seeds:	ribbed; with feathery pappus

Composite Family

Dandelion (237)

roots:	deep taproot with many buds
leaves:	lobes point to base of plant;watery, milky juice
flowers:	bright yellow with many seeds
seeds:	ribbed with barbs to aid in soil penetration; pappus aids in seed

Key Characteristics of Several Plant Families

A. Amaranthaceae (Pigweed Family) pigweeds, waterhemp

1. annual herbs
2. alternate or opposite leaves
3. inflorescences dense and spike-like
4. flowers small
5. sepals 3-5
6. petals - none
7. stamens -5
8. fruits - achene or capsule-like

B. Apocynaceae (Dogbane Family) dogbanes

1. perennial herbs, milky sap in all plant parts
2. stems branched, smooth, fibrous
3. leaves opposite, simple, entire
4. inflorescence terminal or axillary cymes
5. petals and sepals - 5 each
6. fruit - long, slender follicles borne in pairs, often curved
7. seed with pappus

C. Asclepiadaceae (Milkweed Family) milkweeds

1. perennial herbs or vines, most with milky sap in all plant parts
2. stems unbranched
3. leaves opposite or whorled, simple, entire
4. inflorescence terminal or axillary globe-like clusters (umbels)
5. petals and sepals - 5 each; individual flowers have hour-glass shape
6. fruit - a large, cigar-shaped follicle or pod; often in pairs
7. seed with pappus

D. Caryophylaceae (Pink Family) chickweed, white cockle

1. herbs
2. annual or perennial
3. opposite entire leaves without petioles
4. nodes usually swollen
5. inflorescences typically cymes
6. flowers - prefect
7. sepals - 5, petals - 5
8. stamens, usually 10
9. fruits - capsules, usually toothed at apex when open

E. Chenopodiaceae (Goosefoot Family) lambquarters, kochia

1. succulent plants
2. simple, entire or lobed leaves
3. leaves often mealy in appearance
4. flowers in dense axillary clusters
5. flowers greenish
6. sepals - 5, no petals
7. stamens - 5
8. fruits achene-like

F. Convolvulaceae (Morningglory Family) bindweeds, dodder

1. twining herbaceous vines
2. sap sometimes milky
3. leaves alternate and simple, frequently heart or arrow-shaped
4. sepals - 5
5. petals - 5, almost always completely united
6. stamens - 5
7. fruits - capsules

G. Compositae/Asteraceae (Aster Family) very large

1. leaves usually alternate, sometimes opposite or whorled
2. petals - 5,4,or none, in florescene a head of several to >100 flowers
3. ligulate(ray) or tubular(disc) flowers, or both
4. head subtended by involucrae bracts
5. pappus of crown-like ridges, scales, awns or bristles
6. fruits achenes

H. Cruciferae (Mustard family) mustards, wild radish, shepherd's purse

1. leaves mostly alternate
2. inflorescences racemes
3. sepals - 4, petals - 4
4. stamens - 6 (4 long and 2 shorter)
5. fruits, 2-celled siliques

I. Cyperaceae (Sedge Family) nutsedge

1. annual or perennial herbs
2. triangular solid stems
3. 3-ranked leaves with closed sheaths
4. inflorescences, spikes or panicles
5. style - 1, stigmas - 2 or 3
6. fruits - achenes

—continued on back

J. Euphorbiaceae (Spurge Family)
prostrate spurge, leafy spurge

1. annual or perennial herbs
2. mostly with milky juice (sap)
3. alternate, opposite, whorled leaves
4. inflorescences commonly cymes
5. flowers unisexual and highly variable
6. sepals variable or none
7. petals usually absent
8. stamens - 1 to many
9. fruits usually capsules
10. an extremely variable family

K. Gramineae/ Poaceae (Grass Family)

1. leaves - alternate, parallel veined; with sheath and blade
2. true stems - round or oval, usually hollow between nodes
3. flowers - in spikelets, no petals, 3 or 6 anthers
4. inflorescence - a spike, panicle or raceme

L. Labitae (Mint Family)
healall, henbit, creeping charlie

1. annual or perennial
2. mostly aromatic (odor)
3. square stems and opposite or whorled simple leaves
4. flowers 2-lipped
5. sepals - 5, petals - 5
6. stamens - 2 or 4 (unequal pairs if 4)
7. fruits - 4 nutlets

M. Leguminoseae (Pea Family)
clovers, black medic

1. alternate, usually compound leaves
2. leaves bear stipules
3. inflorescences mostly racemes
4. flowers mostly perfect and irregular
5. sepals usually 5, often united
6. petals - 5, the upper the largest
7. stamens, mostly 10
8. fruits, legumes (true pods)

N. Malvaceae (Mallow Family)
velvetleaf, mallows

1. common in warm climates
2. leaves alternate and usually large, often palmately lobed
3. sepals - 5
4. petals - 5
5. stamens - many
6. fruits - mostly capsules

O. Plantaginaceae (Plantain Family)
plantains

1. annual or perennial herbs
2. basal leaves only
3. inflorescences - bracted spikes
4. flowers small
5. sepals - 4, united
6. petals - 4, papery
7. stamens - 2 or mostly 4
8. fruits - circumscissile capsules

P. Polygonaceae (Buckwheat Family)
smartweeds, knotweeds

1. alternate simple leaves
2. swollen nodes usually
3. ocrea, covering at nodes
4. sepals 2-6 commonly petal-like
5. petals - none
6. stamens - 4-9
7. fruits - achenes, commonly triangular

Q. Solonacae (Nightshade family)
nightshades, groundcherry, jimson weed

1. leaves alternate
2. many species with rank-smelling foliage
3. some species mildly or severely poisonous
4. flowers tomato or potato-like
5. petals and sepals - 5 each
6. fruit - a many-seeded berry; sepals enclose the fruit in groundcherry
7. fruit of jimsonweed golf ball sized capsule covered with blunt spines.

Useful Plant Identification Books

By Jerry Doll and Chris Boerboom, Extension Weed Scientists, University of Wisconsin. Revised October 2001.

Identification of Mature Weeds

Weed identification is a constant challenge for many of us. The best first step to plant ID is to have the appropriate reference materials on hand. Here are those that we find of most help in identifying weed samples.

Books

Weeds of the North Central States. 303 pages with black and white line drawings of mature plants and key features of 230 species. Complete key based on flower color. Available through any County Extension Office. $10.00.

A Field Guide to Wildflowers. 420 pages arranged by flower color. Each chapter with some drawings in color. Available in the Nature section of most bookstores. Paperback. Approximately $18.00.

Weeds of Nebraska and the Great Plains. New and totally revised edition of Nebraska Weeds. Produced in 1994. Excellent color photos and black and white line drawings of 265 species (and descriptions of an additional 125 species) on nearly 600 pages in a hardbound book. Available from the Nebraska Dept. of Agriculture, Bureau of Plant Industry, P.O. Box 94756, Lincoln, NE 68509. $25.00 (includes shipping).

Ontario Weeds. Contains excellent black and white line drawings of 315 species with 28 pages of color plates, each with six pictures in excellent detail. The color photos are grouped so that similar species are on the same page to facilitate easy comparisons of those that look alike. This book is an excellent match for Wisconsin's weed spectrum. Available from the Publications Ontario, 50 Grosvenor St., Toronto, Ontario M7A 1N8, Canada (phone 416-326-5300). The current price is $15.00, add $1.80 for shipping and handling. Order Publication No. 505.

Weeds of the Northeast. It contains nearly 300 species, some of which are not found in either the Weeds of the North Central States or Ontario Weeds. This is one of the few books to include woody species, which are more common with CRP land and increasing no-till acreage. The book contains five "short cut identification tables" that identifies weeds with special characteristics and a standard dichotomous key for all species that is based on vegetative characteristics. Each weed has four or more colored pictures, a narrative (including a useful description of how to distinguish from similar weeds), and line drawings of key characteristics of certain weeds. It is available from Gemplers (phone 1-800-382-8473). The book sells for $32.00 plusshipping and handling fee.

Weeds of the West. A new book from the Western Weed Science Society contains excellent color photographs of nearly 300 species of weeds. Each species is presented with three colors pictures and an easy to read narrative gives the descriptions, habitats and characteristics of each weed. The title is "Weeds of the West" and thus it is no surprise that less than half of the weeds are common in Wisconsin. Nevertheless, for $22.50 (softbound) or $30 (hardbound), this 650 page book is a bargain and it will make a nice addition to your weed ID reference library. Checks should be made payable to the Univ. of Wyoming and orders are then sent to: U.W. Coop Extension Service, Bulletin Room Univ. of Wyoming, PO Box 3313, Laramie, WY 82071-3313.

CD-ROM

Weeds of the United States. 1995. Contains excellent color photos and descriptions of common weeds of the U.S., tutorials, help screens, and other features. Cost is $90.00 or $81.00 each for two or more copies. Order from the Southern Weed Science Society, 1508 West University Avenue, Champaign, IL 61821.

Weed Seedling Identification

Fewer guides are available for weed seedling identification, even though the seedling stage requires accurate identification for selection of proper herbicides or control methods.

Annual Broadleaf Weed Identification (NCR 90) and Annual Grass and Perennial Weed Identification (NCR 92), which have photographs and descriptions of the mature stage of the same species. The bulletins are available through any County Extension Office for 65 cents each.

Common Weed Seedlings of the North Central States. This is a nice 22 page bulletin that includes 18 grasses, 1 sedge, and 36 broadleaf weeds. It has a simple key for the grasses and a brief description of each weed. Each weed has a sharp color photograph of the seedling plus two smaller photographs of key features. The bulletin (NCR No. 607) is available through any County Extension Office for $3.00 each.

Weed Seed Identification

An Illustrated Taxonomy of Weed Seeds. This book is the best available for weed seed identification. It contains species in 40 plant families common throughout the Midwest. The illustrations are excellent color photographs of seeds magnified two to six times and are accompanied be a detailed and easy-to-use taxonomic key. Anyone doing weed seed bank work, those participating in crop and weed science contests, instructors of weed science courses, personnel in certified seed laboratories, and anyone with an interest in weed seed identification should have this unique book. It is available from the North Central Weed Science Society, 1508 W. University Ave., Champaign, IL 61821-333. Single copies are $20 (includes shipping).

Weed Seeds of the Great Plains. An excellent reference with 290 species, many common to Wisconsin. The first section, has a list of 22 general characteristics seeds may have. Once you have

determined which group a seed belongs to, the subgroup section narrows the choices down to 3 to 10 species. From there, you go to the plant family for a detailed, species by species description of each entry. The final section has superb color pictures of the seeds for each species. Seeds are magnified 2 to 10 times and show great detail. An illustrated glossary at the end of the book gives a definition of all possible seed shapes and shows an outline and cross-sectional view of each one. The book is available from University Press of Kansas, 2501 West 15th St., Lawrence KS 66049-3904 (phone 913-864-4154). Single copies are $25, plus shipping/handling ($3.00 first book by mail/$3.50 by UPS, 50¢ for each additional copy).

Poisonous Plant Reference Books

People are frequently concerned about possible effects of plants on animal health. In recent years, horses seem to be of particular concern in this regard. Here are a couple of useful references on poisonous plants that you may find helpful. Contact the publishers for current prices.

Poisonous Plants of the Central US. H. A. Stephens. 1980. It contains 165 pages and includes black and white photos of several aspects (leaves, seeds, whole plants, etc.,) of many poisonous species. Order from University Press of Kansas, 2501 West 15th St., Lawrence KS 66049-3904 (phone 913-864-4154).

Poisonous Plants of Pennsylvania. R. J. Hill and D. Folland. 1986. It has 175 pages and covers more than 100 species with information on plant identification (including black and white line drawings), plant characteristics, poisonous parts and principles, symptoms of poisoning, and treatment. Order from State Bookstore, 1825 Stanley Dr., Harrisburg, PA 17103. Prepayment is required.

Pasture Plants Toxic to Livestock in Michigan. This 8 page publication is general in nature and gives a description of the plant, the dangerous times of the year, the habitat and distribution, the animals affected and the toxic principles and effects for 23 weeds. These species could also be found in Wisconsin. It also has a table listing crop plants that can possibly be poisonous. Extension bulletin E-1725 available from Michigan State Univ. Coop Exten. Ser., 10-B Agricultural Hall, East Lansing, MI 48824-1039.

Plants Poisonous to Livestock. This 14 page bulletin is similar to the one above and is available from the Univ. of Minn., Coop. Exten. Ser., Publications Office, St. Paul, MN 55108. Ask for bulletin AG-FO-5655-D. Phone 612-625-8173.

The Challenge of Diagnosing Herbicide Injury

Chris Boerboom, University of Wisconsin Extension Weed Scientist

The potential for herbicides to injure crops is real. In most cases, the herbicides that we use are selective, meaning the herbicide only damages weeds and not the crop. The reason for this selectivity is often based on metabolism. The crop is able to metabolize or convert the herbicide into non-toxic chemicals before the herbicide damages the crop plant. For a weed that cannot metabolize the herbicide rapidly, the herbicide is in the plant long enough to damage a chemical process in the plant and kill the weed. There are many factors that can stress a crop plant and cause a normally "safe" herbicide to injure the crop. For example, cold weather can slow the crop's ability to metabolize certain herbicides and hot, humid weather may aid greater herbicide uptake and cause damage from other herbicides. Of course, over-application, drift, carryover, and many other factors can also cause injury.

During your careers, you will be called to trouble shoot why a crop is growing poorly or to confirm a claim of herbicide injury. Herbicides are usually near the top of the suspect list because they are easy to blame and there's a chance the grower may receive compensation. If you are called upon, you have two challenges. First determine what caused the crop injury and then determine how a grower can avoid the problem in the future. Some cases will be simple to solve while others will be more difficult. Before jumping to a hasty conclusion, make sure you have considered all of the evidence. All of the evidence should support the same conclusion. In a tough situation, review the information in the figure below to see if the different facts stack up to support the conclusion that a certain herbicide has caused the injury. After organizing your thoughts in this pattern, it is also easier to help a farmer find a solution to the herbicide problem because you know which variables can be adjusted to prevent the problem in the future.

Field conditions

Be aware of the different conditions that exist in the field. Some of these will cause variation in crop growth by themselves and other can interact with a herbicide and cause or increase herbicide injury. Several clues also become apparent when inspecting the overall field site. The following sections list many factors that can either support or refute a herbicide injury claim.

Weather conditions

Frost, sun scald, sandblasting, and drought are several weather conditions that cause injury by themselves. Know the type of injury they cause and locations in the field where these conditions are more likely to occur. For example, frost can look like injury from certain contact herbicides, but frost can be localized in low areas, especially on peat or muck soils. Check local weather records for this information.

Certain weather creates conditions where herbicides can cause injury. Drought slows herbicide degradation and favors carryover of previously applied herbicides. Heavy rain or irrigation after application of soil active herbicides can leach the herbicide into contact with germinating crop seedlings. Cold, wet soils and cool temperatures can slow the crop's ability to metabolize a herbicide. Hot and humid conditions favor rapid herbicide uptake and activity, which may cause greater injury from postemergence herbicides.

Agronomic conditions

Take note of the cropping system where the poor growth is occurring. Knowing the previous crop helps to determine whether or not herbicide carryover should be considered. No-till fields are more prone to frost even though neighboring tilled fields have not frosted. Check planting depth, which can affect crop safety or can cause herbicide-like symptoms. Also check for soil crusting and compaction. Knowledge of tillage operations and their direction may help explain certain patterns in a field.

Make sure there aren't other problems limiting crop growth like limited fertility, improper soil pH, disease, or insect pests. Soil fertility tests or submitting plant samples for diagnosis of diseases are very inexpensive if you can correct a problem.

Be sure to ask about insecticide use because organophosphate insecticides can interact with several herbicides and cause crop injury. Take note of the variety or hybrid because it may be more sensitive to the herbicide or the variety may just have poor vigor.

Application patterns

When visiting a field, try to walk most of the field looking for patterns. Look from a distance and check different angles. Herbicide injury should be more severe where the spray boom overlapped or where the sprayer may have slowed. These patterns may match herbicide application from the current year or from last year. If the injury follows the spray pattern, double check that the equipment, the spray boom for example, had that width.

Be cautious if the pattern of the injury symptoms don't match the application patterns. See if the injury patterns match with other field operations. Herbicide drift generally tapers off going away from the field edge, whereas herbicide carryover or spray tank contamination are often more uniform across a field.

Soil conditions

Try to match the injury patterns to soil texture, soil organic matter, or the elevation in the field. Soil active herbicides are more active on coarse textured soils and soils with lower organic matter. High soil pH can increase the chance of carryover injury from certain herbicides.

Certain areas of the field may have non-herbicide problems. Ridges and hill tops are more likely to be drought stressed. Frost is more likely in low ground.

Plant injury symptoms

When a herbicide is suspected of causing injury, make sure that the injury symptoms match the key symptoms for that herbicide family. Don't forget to bring a shovel and water to dig, wash and examine the roots for symptoms. If you are trying to determine which herbicide is the culprit, try evaluating the herbicide by the following types of action to narrow down the list of suspects. An excellent reference for evaluating injury symptoms according to herbicide family is "Herbicide Mode of Action and Injury Symptoms", bulletin number NCR377.

Preemergence or postemergence activity

Look at the crop and weeds that grew. Was damage occurring before or shortly after emergence? Soil active herbicides can stop emergence by inhibiting shoot growth or root growth. As a result, crop stands may be thin. Dig up plants that didn't emergence and look for symptoms. Other herbicides are taken up by the roots and the effects are seen shortly after the seedlings come in contact with sunlight. Generally, soil active herbicides will cause injury before or shortly after emergence. Remember a heavy rain may leach a soil active herbicide down to the roots and the injury could then show up after emergence.

Crops or weeds injured from postemergence herbicides will emerge normally and should have a full stand. Injury from postemergence herbicides may occur on leaves that were fully expanded or new growth.

Contact or systemic activity

Contact herbicides do not move within a plant. Their damage is normally limited to existing leaves and new growth is generally unaffected. This type of action makes injury from certain contact herbicides look similar to frost injury.

Systemic herbicides move in the plant. Systemic herbicides taken up by the roots can move either to expanded leaves or to the growing point, depending on the herbicide family. Symptoms from postemergence systemic herbicides often develop first at the growing point. (The growing point of a broadleaf plant is at the top of the plant and the growing point of a grass is at the base of the youngest leaves). Older leaves may show little if any damage.

Herbicides from certain families like the triazines will show systemic action if taken up by the roots and contact action if applied postemergence.

Grass or broadleaf activity

Another quick way to narrow down the list of possible herbicides is to classify the action based on the spectrum of plants affected. Most herbicides have activity primarily on either grasses or broadleaves. Only a couple are truly nonselective like Roundup or Gramoxone.

Confirming facts

While all of the previous information can support a herbicide injury case, the following facts can really tie it all together.

Known herbicide use

Note all of the herbicides and adjuvants, their rates, and when they were applied. Were any unusual tank mixtures applied or was the adjuvant rate and type appropriate for the weather conditions? Check which herbicides were applied last year. If possible, check the amount of herbicide purchased versus the acreage treated to verify that the correct rate was applied. Know the symptoms associated with these herbicides. Remember that almost anything is possible. The spray tank could have been contaminated with another herbicide or a residual herbicide may have been applied by a previous landowner. A herbicide may have been used, but not disclosed by the owner.

To help confirm that a herbicide is causing the problem from over-application or carryover, soil or plant tissue samples can be collected for analysis. Several commercial laboratories can analyze these samples for a fee. If possible, take a representative sample from an unaffected area to compare against the injured area. The test results alone may not conclusively show that the herbicide caused the injury, but the results will show whether or not the herbicide was present and its general level.

Plant growth in check areas

Finally, search the field for possible check areas or spray skips. How does the growth of the crop and weeds in these areas compare to injured areas. These skips can help sort out herbicide injury from carryover, drift, or an application made this year.

Advise on responding to complaints

Here are a few words of advice when called upon to diagnose potential herbicide injury. Try to make your visit to the field in a timely manner before injury symptoms become more difficult to interpret. Take written notes on the information that you receive and the observations you make. If possible, take a few photographs of the symptoms and field. These will help to jog your memory at a later date if needed. Although you were requested to make a judgement by one party, remain neutral and objective until you feel confident in your conclusions. Don't be forced into making an opinion before you are ready. Remember that you can always seek other expert opinion in subject areas where you feel less comfortable.

Herbicide Mode of Action and Injury Symptoms (North Central Regional Publication 377)

Definitions

Mode of action: sequence of events from absorption of the herbicide into the plant until it dies.
Contact herbicide: only injury treated tissue and do not move in plant (non-mobile).
Systemic herbicide: herbicide translocates from site of uptake to other plant parts (mobile).
Epinasty: injury symptom when plant parts are bent or twisted
Chlorosis: injury symptom where leaves or stems turn yellow
Necrosis: injury symptom where leaf or stem tissue dies and turns brown
Callus tissue: mass of plant cells that form on a wounded surface

A. Growth regulator herbicides: cause unregulated growth

- mimic natural growth regulators (hormones)
- selective to_____ and are systemic
- symptoms appear first in_____leaves and growing _____.

1. Phenoxy acetic acids (2,4-D, 2,4-DB and MCPA)

Broadleaves:
- twisting and bending of stems and leaves (epinasty)
- callus tissues; "strapping" of leaves

Grasses:
- onion leafing or buggy whipping
- stalk bending and_____.
- fused_____.
- twisted flag leaves and infertile florets in small grains

2. Benzoic acids (Banvel and Clarity)

- on broadleaves, similar to phenoxys with more cupping; velvetleaf leaves cup upward; soybean leaves puckered;
- tobacco, soybean, grapes and tomatoes are very sensitive

3. Pyridines (Stinger, Crossbow, Confront and Garlon)

- similar to symptoms above

B. Amino acid synthesis inhibitors: stops production of amino acids needed for proteins and enzymes

1. ALS inhibitors

a. Imidazolinones (Pursuit, Raptor, Scepter, Arsenal):

Grasses:
- stunted plants with interveinal .
- root inhibition, pruning of lateral roots, few root hairs

Broadleaves:
- stunting to death of terminal growing point
- back-side of soybean leaves may have_____ leaf veins

b. Sulfonylureas

Accent, Beacon, Exceed, Permit for: _____.

Classic, Pinnacle, Reliance for : _____.

Express, Harmony Extra, Peak for: _____.

- symptoms similar to those for imidazolinones

c. Sulfonamides (Broadstrike, Python, FirstRate)

- symptoms similar to those for imidazolinones

2. Glyphosate (Roundup, Touchdown)

- nonselective, non-residual, applied postemergence
- foliage turns yellow, sometimes purple, then brown
- symptoms appear slowly, especially in cool weather

C. ACCase inhibitors: stops synthesis of fatty acids needed for cell membranes and new plant growth (Poast Plus, Assure II, Fusilade, Fusion, Select)

- applied postemergence; affect only grasses
- systemic; move rapidly to growing points
- growing point_____and leaves pull easily from shoot
- symptoms appear in 5 to 14 days

D. Seedling growth inhibitors: interfere with plant growth during germination and emergence, generally must be absorbed from the soil

1. Dinitroanilines: inhibits cell division, especially in roots (Treflan, Prowl, Balan, Sonalan)

- stunted plants
- grass shoots may turn _____ in color
- short, thick roots; clubbed root tips
- broadleaves may have swollen, cracked _____or callus tissue on stems at the soil surface

2. Seedling shoot inhibitors: interferes with lipid synthesis

a. Chloroacetamides (Lasso, Dual, Frontier, Surpass, Harness)

- stunting of grass shoots; leafing out underground
- grasses with "buggy whip" effect
- broadleaves with crinkled leaves and shortened mid-vein, giving a " _____ " effect

b. Thiocarbamates (Eradicane, Eptam, Sutan+)

- grasses with "buggy whip" effect
- broadleaves may have a "bud seal" effect where opposing leaves are stuck together

E. Photosynthesis inhibitors: stops electron transport during photosynthesis which leads to an accumulation of membrane destroying compounds

1. Mobile: If soil-applied, herbicides are xylem mobile; if applied postemergence, they act as contact herbicides

a. Triazines (atrazine, Bladex, Sencor, Lexone, Velpar)

b. Substituted ureas (Lorox, linuron)

- symptoms develop first in the_____and _____leaves
- chlorosis and necrosis of leaf margins of broadleaves
- chlorosis and necrosis of leaf tips of grasses

2. Non-mobile: contact action only (Basagran, Buctril)

- most active on broadleaves
- sprayed leaves become chlorotic or necrotic; spotting or speckling of leaves common
- oils & additives enhance injury
- recovery is rapid; new leaves after application are uninjured

F. Cell membrane disrupters: postemergence contact herbicides; produce membrane destroying compounds; fast-acting

1. Bipyridyliums: creates free radicals from photosynthesis (Gramoxone Extra, Diquat)

- nonselective, nonresidual, applied postemergence
- leaves become limp with water-soaked appearance and then become necrotic
- particle drift appears as speckling of leaves and stems

2. Glufosinate: inhibits glutamine synthetase and causes ammonia to accumulate (Liberty)

- nonselective, applied postemergence
- leaves turn chlorotic, then necrotic

3. PPO inhibitors: inhibits protoporphyrinogen oxidase (Authority, Blazer, Cobra, Flexstar, Reflex, Resource)

- primarily broadleaf herbicides, but can affect grasses
- initial symptom may be bronzing; reddish-colored spots on leaves
- leaves turn chlorotic, then necrotic
- soybeans usually recover; new leaves after application are uninjured
- hot weather and additives increase risk of injury

G. Pigment inhibitors: prevent plants from forming chlorophyll (Balance, Command)

- plants are "whitened/bleached", especially new growth
- Command vapor or particle drift will bleach sensitive plants; Balance is not volatile
- Command injured plants usually recover
- _____ ,_____and_____ are very sensitive to Command

Herbicide Mode of Action Key for Injury Symptoms

This key is designed to help you determine which herbicides may be responsible for suspected herbicide injury. This key uses herbicide mode of action because herbicides with the same mode of action cause similar symptoms. After reaching a specific mode of action, you can check if any of the herbicides from that group are the culprit. Also, remember to observe weeds for injury symptoms.

This key is based on three traits of injury symptoms, which can be used to distinguish different herbicide modes of action.
1—If the plant absorbed the herbicide from the soil or if it was absorbed postemergence.
2—If the herbicide translocated to growing points (root tips or meristems) or if the herbicide had contact activity.
3—If the herbicide is selective for grasses or broadleaves or is nonselective.

Injured at Emergence
(soil-applied herbicide or carryover)

Roots Normal, Damaged Shoots

Roots Damaged (stunted plants)

Clubbed root tips

Grasses most sensitive
Seedling Root Growth Inhibitor
(Prowl, Treflan)

Pruned roots
Short, slender lateral roots

Broadleaf weeds often more sensitive than grass weeds
ALS Inhibitor
(FirstRate, Python, Pursuit, Spirit, etc.)

Root proliferation
Short, thickened roots

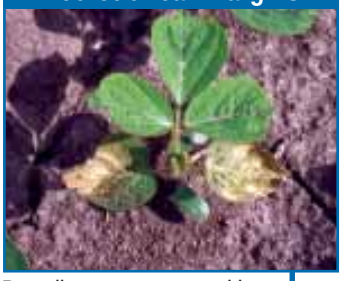
Broadleaves more sensitive than grasses
Growth Regulator
(Banvel, Clarity, Distinct, 2,4-D, etc.)

White, bleached leaves

May include malformed leaves

Grasses and/or broadleaves affected
Pigment Inhibitor
(Balance, Callisto, Command)
Mimic: low rate of glyphosate on seedling corn

Chlorotic / necrotic leaf margins



Broadleaves more sensitive than grasses
Photosynthesis Inhibitor
(atrazine, Sencor, etc.)

OR

Chlorotic veins

PPO Inhibitor
(Authority, Valor, etc.)

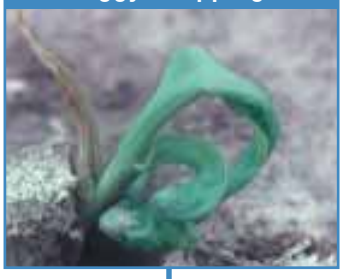
Deformed leaves

Onion leafing

Epinasty

Broadleaves more sensitive than grasses
Growth Regulator
(Banvel, Clarity, Distinct, 2,4-D, etc.)

Leafing out / buggy whipping



Drawstring

Grasses more sensitive than broadleaves
Seedling Shoot Growth Inhibitor
(Define, Dual, Harness, Outlook, etc.)

Injured after Emergence
(postemergence application, tank contamination, drift)

Translocating herbicide
New leaves (meristem) injured, older leaves not injured

Intermediate
White, bleached leaves

Pigment Inhibitor
(Balance, Callisto, Command)

Contact activity
Older leaves injured, new leaves not injured

Broadleaves more sensitive than grasses
Photosynthesis Inhibitor
(atrazine, Buctril, Basagran, etc.)
or
PPO Inhibitor
(Aim, Cobra, Flexstar, etc.)

Nonselective
Cell Membrane Disrupter
(Gramoxone Max, Diquat)
or
Glufosinate
(Liberty)

Leaf cupping, strapping, epinasty

Broadleaves affected more than grasses
Growth Regulator
(Clarity, Distinct, 2,4-D, etc.)

New leaves chlorotic, plants stunted

Grass meristems rot

Only grasses affected
ACCase Inhibitor
(Assure, Poast, Select, etc.)

Chlorotic, crinkled leaves, shortened internodes

Chlorosis, reddened veins

Broadleaves and/or grasses affected
ALS Inhibitor
(Accent, Option, Steadfast, Classic, Harmony GT, Raptor, etc.)

Variable injury, chlorosis, purpling, necrosis

Nonselective
Glyphosate
(Roundup, Touchdown, etc.)

Integrated Pest Management Program

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