

Early Spring Weeds of No-Till Crop Production



Family name	Common name	
Liliaceae	Star-of-Bethlehem, Wild garlic, Wild onion	2
Poaceae	Annual bluegrass, Carolina foxtail, Downy brome	3
	Foxtail barley, Quackgrass	4
Asteraceae	Butterweed	4
	Cornflower, Dandelion, Fleabanes	5
	Horseweed, Pineapple-weed, Prickly lettuce	6
	Western salsify	7
Boraginaceae	Corn gromwell	7
Brassicaceae	Bushy wallflower	7
	Field pennycress, Shepherd's-purse, Smallflowered bittercress	8
	Tansymustard (or flixweed), Virginia pepperweed, Wild mustard	14
	Yellow rocket	15
Campanulaceae	Venuslookingglass	15
Caryophyllaceae	Common chickweed	15
	Mouseear chickweed	16
Chenopodiaceae	Kochia	16
Geraniaceae	Carolina geranium	16
Lamiaceae	Henbit, Purple deadnettle	17
Onagraceae	Eveningprimrose	17
Plantaginaceae	Plantains	18
Polygonaceae	Broadleaf dock, Curly dock,	18
	Prostrate knotweed, Wild buckwheat	19
Ranunculaceae	Buttercups	19
	Mousetail	20
Rubiaceae	Catchweed bedstraw	20
Scrophulariaceae	Common mullein	20
	Corn speedwell, Purslane speedwell	21
Violaceae	Field pansy	21

Taxonomic key

Grasses and grasslike plants	9
Plants with spines	10
Plants with an ocrea	10
Plants with square stems	10
Plants with milky sap	10
Plants with finely dissected leaves	11
Plants covered with hair	11
Plants that form dense mats	12
Plants with a basal rosette	12

Guide to herbicides	13
--------------------------------------	----

Glossary	22
---------------------------	----

Index	22
------------------------	----

Credits and ordering information	inside back cover
---	-------------------

About this guide

This guide is intended to serve as a practical reference for the identification of common weeds present in no-till production systems. Various winter annual, biennial and perennial species are usually present in sufficient populations in early spring to warrant a burndown herbicide treatment before planting a summer row crop. Proper identification is critical for selecting herbicides and for determining their appropriate application rates.

Numerous plant species are typically present in no-till production fields in the early spring before herbicide applications. Many of these species are winter annuals, which complete their life cycles before summer crops are planted and thus will not pose a direct production problem. However, if they are still actively growing and are not controlled, there will be a rapid increase in the weed seedbank and future populations, which could pose problems with nutrient management and rotation to winter annual or perennial crops. Consultants and extension personnel are routinely requested to identify these species and to provide guidance on management of these fields. Thus, the purpose of this guide is to provide some direction on identification and whether or not it is normally necessary to make a herbicide application for a particular species.

The weeds presented in the following pages are organized by taxonomic plant family. The grasses and grasslike plants — Liliaceae and Poaceae — appear first, followed by the broadleaves. To identify a weed, you may follow either of two routes: (1) start with the taxonomic key on pages 9–12 and proceed to the photographs at the page numbers indicated in the key, or (2) start with the photographs and move to the taxonomic key with the help of the thumbnail symbol beside each description.

Italicized terms throughout the text are included in the glossary.

Using the plant taxonomic key

A simple taxonomic key has been developed to assist in identifying common winter annual and early spring weeds in no-till fields. Look first for the obvious features of the weed, such as square stems, whorled leaves, or the presence of thorns or spines. Then refer to the diagrams in the taxonomic key to identify the plant. The key will refer you to the page in this guide where a short

description and photograph can be found. Some plants that have several distinct features will appear under more than one heading in the key. For obvious reasons, this guide does not contain all plant species that may be encountered in no-till production. If you need assistance in identifying a weed, a sample can be submitted through your local University Outreach and Extension Center to the University Extension Diagnostic Clinic in Missouri or through similar programs in other states.



Field pennycress



**Star-of-Bethlehem
(*Ornithogalum
umbellatum*)**

Similar in appearance to wild onion and wild garlic, star-of-Bethlehem does not have the characteristic odor of onion and garlic. The leaves are grooved and dark green with a prominent white *midrib*. It is also a *bulbous perennial* that dies back in late spring to early summer.



**Wild garlic
(*Allium vineale*)**

Wild garlic is a *bulbous perennial* that emerges in the early spring and dies back in late spring. Leaves are hollow, lack hair and have a strong odor.



**Wild onion
(*Allium canadense*)**

Wild onion is similar in appearance to wild garlic except that the leaves are flattened and not hollow. Its life cycle is a *perennial*.





**Annual bluegrass
(*Poa annua*)**



This clump-type *winter annual* has characteristic “boat-shaped” leaf tips. The leaf blades are flat and smooth on both surfaces and have a light green coloration. The *ligule* is 1 to 2 mm long and membranous. The seed head is a small, open, greenish white *panicle*. It tends to inhabit cool, moist areas and does not tolerate heat.



**Carolina foxtail
(*Alopecurus carolinianus*)**



A *winter annual*, Carolina foxtail is found primarily in moist areas of fallow fields. It has erect stems and flat leaf blades that are 1 to 5 mm wide. A membranous *ligule*, normally 2 to 3 mm long, tapers to a pointed or rounded tip. The seed head, which appears in April and May, is a single *spike* similar to that of timothy.



**Downy brome
(*Bromus tectorum*)
and cheat
(*Bromus secalinus*)**



This *winter annual* has twisted leaves (2–3.5 mm wide) covered with dense, soft hairs on both surfaces. The *ligule* is a short membrane about 1 mm long. The seed head is a drooping green or reddish purple *panicle* and appears from April to early June. Cheat, a closely related species, is similar in appearance, especially in the seedling stage, but becomes less *pubescent* than downy brome as it matures. The sheath of both species is closed to near the top of the collar.





Foxtail barley
(*Hordeum jubatum*)

Foxtail barley has a bluish green appearance. It is a short-lived *perennial* species with flat blades that are 2 to 5 mm wide. The *ligule* is a short truncate membrane less than 1 mm long. The cylindrical seed head contains long *awns*, giving it a "squirrel-tail" appearance. Foxtail barley tends to be most abundant in poorly drained sites with high pH.



Quackgrass
(*Elytrogia repens*)

Quackgrass is a *perennial* that produces an extensive *rhizome* system. The leaf blades are thin, usually ranging from 3 to 6 mm in width. The plant possesses *auricles* that clasp around the stem. The *ligule* is membranous and short, less than 1 mm in length. The presence of leaf hair varies on the upper blade surface; but the lower blade is smooth. The seed head is a long *spike*.



Butterweed
(*Senecio glabellus*)

Butterweed is most commonly found in wet areas. It is an *annual* with smooth and hollow stems. At times there may be hair in the leaf *axils*, giving it a "cobwebby" appearance. The leaves are irregularly and deeply cut to the *midrib* and lack hair. Lower leaves have *petioles* while the upper leaves lack petioles. Often, the foliage turns reddish purple after flowering.

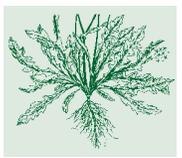




Cornflower
(*Centaurea cyanus*)

Also called bachelor's button, cornflower behaves like a *winter annual*. It appears to be covered with loose, white hair giving it a "cobwebby" appearance. The flowers are usually blue-purple in color.



Dandelion
(*Taraxacum officinale*)

Dandelion is a cool-season *perennial* that forms a large *taproot*. Like wild lettuce, it forms a basal *rosette* of leaves. The leaf margins are very irregular, toothed or wavy with their deep *lobes*. All parts of the plant contain a milky sap. The flower is large and yellow, and the mature seed head has a "puffball" appearance.



Fleabanes
(*Erigeron* spp.)

Several species of fleabane are common to the Midwest. These form a basal *rosette* of leaves before *bolting*. They are variable in their life cycles. Some are *winter annuals* while others behave like *perennials* or *biennials*. Flowers have the characteristic "daisy" appearance.



Horseweed
(*Conyza canadensis*)

Horseweed, also known as marestail, is a *winter annual* or an early-emerging *summer annual* plant. It forms a small basal *rosette* while a seedling. Later, the plant assumes an erect, columnar appearance. The stems and leaves are covered with dense hairs. Leaves lack *petioles* and tend to be long and narrow.



Pineapple-weed
(*Matricaria matricarioides*)

Pineapple-weed is an inconspicuous, low-growing annual weed with finely cut, succulent, hairless leaves. When cut or bruised, the plant has a sweet fragrance. Immature plants form basal rosettes. The conelike flowers are greenish yellow and are borne on short stems.



Prickly lettuce
(*Lactuca semiola*)

Prickly lettuce produces a basal *rosette* of bluish green leaves with very fine prickles along the margins. The plant's most characteristic feature is the prominent *midrib*, which develops a row of spines on the lower leaf surface as the plant matures. When broken, stems exude a milky sap. May be a *summer* or *winter annual* or a *biennial*.

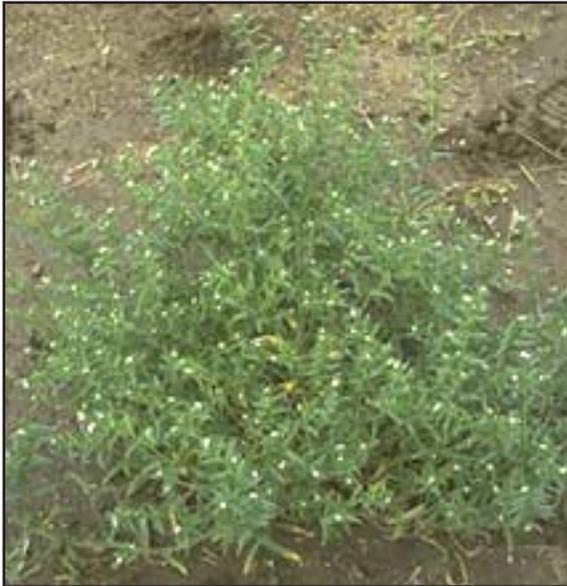




Western salsify
(*Tragopogon dubius*)



Also known as yellow goatsbeard, western salsify is a *biennial* plant with a deep, fleshy *taproot*. Leaves are light green and grasslike with a clasping base that surrounds the stem. Stems are erect and branching. All plant parts contain a milky sap. Large, yellow *ray flowers* are produced in early summer and develop into large "puffball" seed heads that are 2 to 3 times larger than those of dandelion.



Corn gromwell
(*Lithospermum arvense*)



Corn gromwell is a *winter annual* or *biennial* with an erect growth habit. Leaves are alternate, have *entire* margins, lack *petioles* and are hairy on both surfaces. Toward maturity the highly branched plant has a dense appearance. Flowers are small and white.



Bushy wallflower
(*Erysimum repandum*)



Early in its growth stage, this *winter annual* is very inconspicuous, like many of the mustards. The young *rosette* leaves of bushy wallflower are variable; some are toothed into 3 to 4 pairs of *lobes* with a larger *terminal lobe*, while others are *entire*. Leaves on the flowering stalk are more linear with irregular small teeth along the margins. The plant can become dense at maturity, when it produces its yellow flowers, which also have four petals.



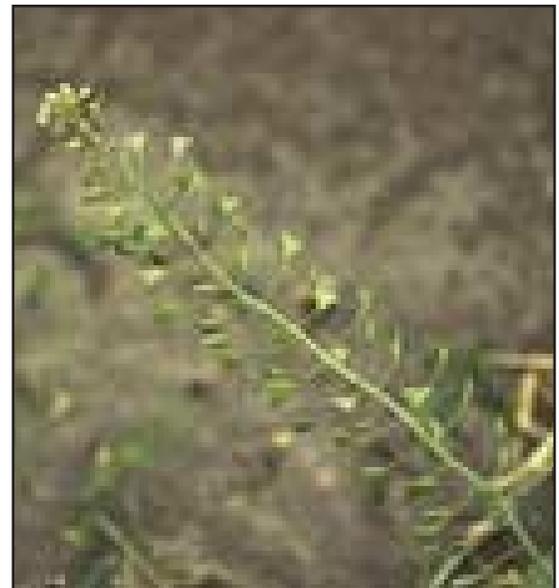
Field pennycress
(*Thlaspi arvense*)

Leaves along the stem of field pennycress lack hair and *petioles*. They have lobes at their bases where they clasp the stem. Crushed vegetation of this *winter annual* has a foul odor. The small white flowers have four petals. The fruit is flat and round with a small notch at its tip.



Shepherd's-purse
(*Capsella bursa-pastoris*)

While in the *rosette* stage, leaves are deeply or irregularly cut, similar to dandelion. Later, leaves along the stem are arrow-shaped. Flowers are small and white with four petals. The most characteristic feature of the plant is the seedpods, which are triangular. Shepherd's-purse is a *winter annual*.



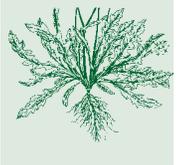
Smallflowered bittercress,
(*Cardamine parviflora*)

The basal leaves of this *winter annual* are deeply cut, giving it the appearance of 3 to 6 pairs of *leaflets*. Leaves have *terminal leaflets* that are rounded. Flowers are small and white with four petals.





Tansymustard
(*Descurainia pinnata*) or
flixweed
(*Descurainia sophia*)



Tansymustard is an erect-growing *winter annual*. In a common variation, hairs on the stem are tipped with *glands*. *Rosette* leaves are divided into small, fine teeth. Late in the season, finely dissected leaves give the plant a fern-like appearance. Flowers are usually yellow-green, sometimes white. Fruit or seedpods are linear and narrow. Flixweed, closely related, has larger seedpods.



Virginia pepperweed
(*Lepidium virginicum*)



This *winter annual* has deeply *lobed* leaves with long *petioles* while in the *rosette* stage. After *bolting*, the basal leaves drop. Leaves produced in the upper portion of the plant lack *petioles* and are long and narrow. The fruit is flat and round and contains a small notch at the tip; it has a pepperlike flavor. Several related pepperweed species with similar fruiting structures also occur in the region.



Wild mustard
(*Brassica kaber*)



Wild mustard is found throughout the Midwest. Leaves are rough-textured and variable. Lower leaves have irregularly *lobed* margins and *petioles*; upper leaves are much smaller and lack *lobes* and *petioles*. Flowers are produced in bright yellow clusters with four petals. It usually behaves as a *winter annual*.





Yellow rocket
(Barbarea vulgaris)



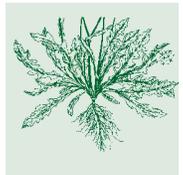
Yellow rocket may occur as a *winter annual* or *biennial* in Missouri. Leaves in the lower portion of the plant have oppositely arranged *lobes* with a large *terminal lobe*. Leaves in the upper stem are smaller and alternately arranged with less conspicuous *lateral lobes*. Like many of the other mustards, yellow rocket has bright yellow flowers with four petals.



Venuslookingglass
(Triodanis perfoliata)



Venuslookingglass, an *annual*, is most often found on nutrient-deficient, sandy soil. Stems contain milky sap; leaves are arranged alternately along the stem and lack *petioles*. The plant is short in stature with an erect growth habit. Flowers have five petals and range from pale to deep purple.



Common chickweed
(Stellaria media)

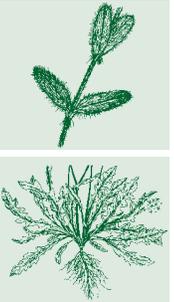


Common chickweed forms mats and can appear as several variations. Some plants have hairy *petioles* while others lack hair. Leaves of the upper stem have no petioles. Leaves are smooth and usually have a light-green appearance. The white flowers with five notched petals are similar to those of mouseear chickweed but are more deeply cut. The life cycle of common chickweed is similar to that of mouseear chickweed.



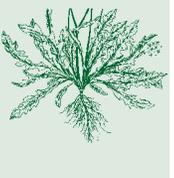
Mouseear chickweed
(*Cerastium vulgatum*)

Mouseear chickweed forms dense mats because of its nature to root at the *nodes*. The small leaves of the plant lack petioles and are densely hairy. The flowers are white and have five notched petals. In cool, moist climates, this species can behave like a *perennial*.



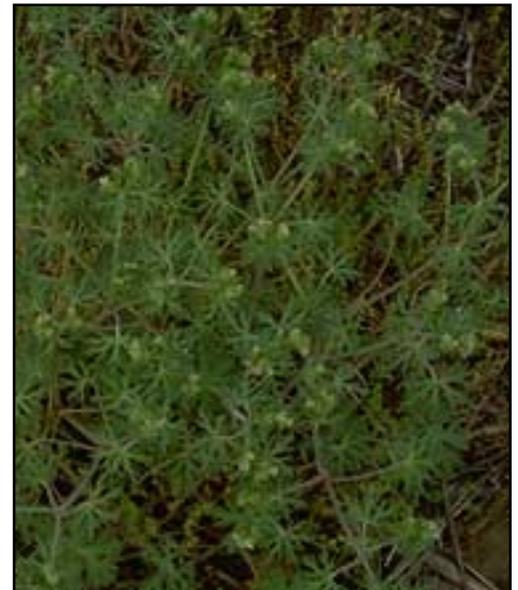
Kochia
(*Kochia scoparia*)

Kochia has a highly branched, shrublike appearance. Several variations exist in the state. The "fire bush" variation has linear leaves that turn a deep purplish red toward maturity. Another has leaves that are broader and hairier, with loosely spreading branches. Leaves on both variations lack *petioles* and are densely *pubescent* as seedlings. Kochia is an early-germinating *summer annual*.



Carolina geranium
(*Geranium carolinianum*)

Carolina geranium produces a *taproot* and generally behaves like a *winter annual*. Its *palmately cut*, rounded leaves are attached to long pinkish brown *petioles* that appear as a "spokelike" arrangement. Both leaves and stems are covered with hairs. Flower color is variable, ranging from pale pink to purple.





Henbit
(Lamium amplexicaule)



Henbit is responsible for painting many fields with a pinkish purple cast in the early spring. It is a *winter annual* with square stems, the upper leaves of which appear to encircle the entire stem. A related species, purple dead nettle, has foliage that is more red in color and more compact in its arrangement along the stems. Both species are rarely greater than 12 inches in height.



Purple deadnettle
(Lamium purpureum)



Purple deadnettle is a relative of henbit and closely resembles it. Both are square-stemmed *winter annuals* that flower in the early spring. The difference between purple deadnettle and henbit is that deadnettle leaves are more densely hairy, *petioled* (in the lower portion of the plant), more triangular in shape, and more tightly compacted in the upper stems. Flowers are light purple in color.



Eveningprimrose
(Oenothera spp.)



Different varieties of eveningprimrose have life cycles that range from *annual* to *biennial* to *perennial*. The leaves are typically alternate with *simple* blades, wavy margins and varying degrees of *pubescence*. In the spring the plant often appears as a basal *rosette*. The stems are later erect, highly branched and hairy, often giving the stem a red appearance. Flowers can be white to reddish yellow.



Plantains (*Plantago* spp.)

Generally speaking, there are two commonly occurring groups of plantains: narrow- and broad-leaved plantains. Depending on the species, the amount of leaf hair will vary. Most species of plantains in Missouri have a well-defined parallel vein pattern in their leaves. Most of the broadleaf species produce a "rat-tail" seed head, while the narrow-leaf species form a shorter "cone-shaped" seed head.



Broadleaf dock (*Rumex obtusifolius*)

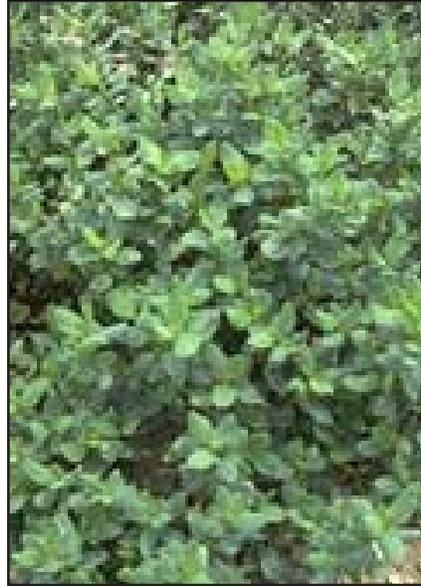
Broadleaf dock has much wider leaves than the more common curly dock. The basal leaves are slightly wavy with reddish veins, and the lobes that join the petiole are heart-shaped. An ocrea is also present. Like curly dock, broadleaf dock is a perennial.



Curly dock (*Rumex crispus*)

Curly dock regenerates from a large, perennial woody taproot and produces a large rosette. Rosette leaves have wavy margins and upon approaching maturity, take on a reddish purple color. Like other members of this plant family, curly dock produces leaves with a membranous sheath, called an ocrea, where they join the main stem. At maturity, flowers and fruiting structures take on a "rust" color.





**Prostrate knotweed,
(*Polygonum
aviculare*)**



Although a member of the same family as the docks, prostrate knotweed may be mistaken for a grassy weed because the leaves are linear as the seedling emerges. It emerges in late winter to early spring but is classified as an early *summer annual* because it germinates in cool temperatures. This weed thrives in compacted areas and forms dense mats. An *ocrea* is evident at the base of the small leaves where they join the stems.



**Wild buckwheat
(*Polygonum
convolvulus*)**



Wild buckwheat, a *summer annual*, is a member of the same family as the docks. However, it can be mistaken for a morningglory because of its heart-shaped or arrow-head leaves and twining growth characteristics. The leaves are alternate, with pointed tips and basal *lobes* directed backward. The flower is greenish white, sometimes purple-spotted. An *ocrea* is present where leaf petioles join the stem. Seeds are triangular.



**Buttercups
(*Ranunculus* spp.)**



About 20 species of plants known collectively as buttercups occur in the Midwest. Many of these occur as *winter annuals*; however, several have a *perennial* life cycle. In general, this group of plants has "crow-foot"-shaped leaves produced on long *petioles*. Stems and petioles may or may not have hair. With one exception, all species of buttercups produce flowers that are shiny yellow with five to seven petals.





Mousetail
(*Myosurus*
minimus)

Mousetail is a small *winter annual* that usually occurs in moist areas of fields. Leaves are distinctly linear and appear to emerge from a central crown, making it easily misidentified as a grassy weed. The flower/fruitlet structures are also linear, upright and rounded, giving it a "mouse-tail" appearance.



**Catchweed
bedstraw**
(*Galium aparine*)

Also known as cleavers because of the many short, hook-like spines on its square stems, catchweed bedstraw is a weak-stemmed *winter annual*. The leaves are narrow and hairy and occur in *whorls* around the stem. Extremely small white flowers are produced in the leaf *axils*. This weed most commonly occurs in moist, shady areas with rich soil.



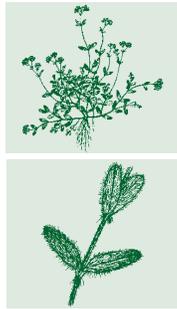
Common mullein
(*Verbascum*
thapsus)

Common mullein is a *biennial* plant, producing a large *rosette* during its first year of growth. The leaves are densely hairy, giving it a fuzzy texture. The dense hair gives the plant a grayish appearance. Flowers produced during its second year of growth are bright yellow and occur on long *terminal spikes*.





Corn speedwell
(Veronica arvensis)



Corn speedwell is a *winter annual* that resembles mouseear chickweed. It also has the small egg-shaped, hairy leaves that grow in mats along the soil surface. It can be distinguished from mouseear chickweed by the presence of notches in its leaves and by alternate leaves on flower stems. Also unlike mouseear chickweed, the flowers are generally blue in color.



Purslane speedwell
(Veronica peregrina)



Purslane speedwell is a *winter annual* like corn speedwell, which it resembles closely. The two can be differentiated by the fact that purslane speedwell lacks hair on its stems and leaves. The smooth variation of this weed has *glandular-hairy* stems.



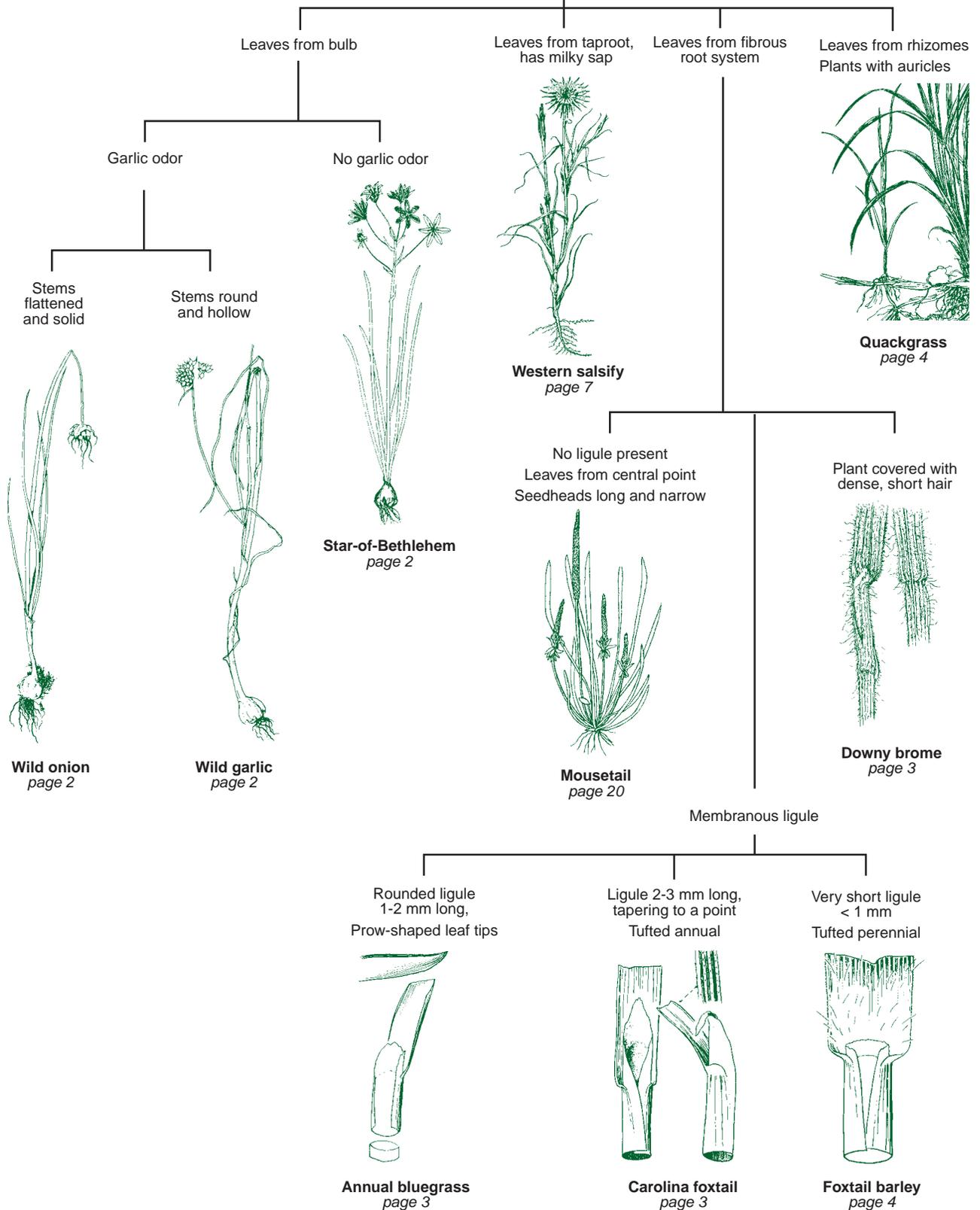
Field pansy
(Viola rafinesquii)

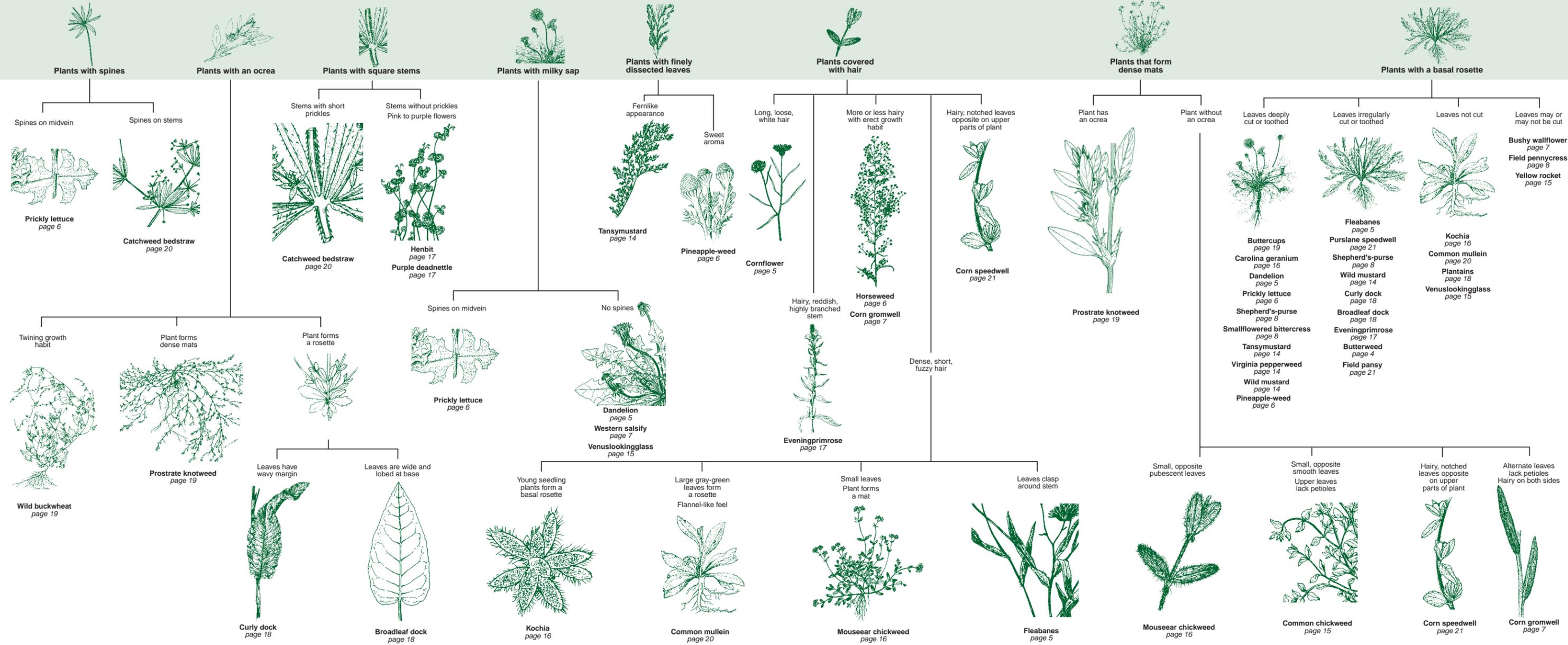


Field pansy, also called Johnny-jump-up, is short in stature with an erect growth habit and a delicate appearance. Flowers are borne on short stalks and may be white with blue veins or entirely bluish to bluish violet. It is a winter annual.



Grasses and grasslike plants





- Annual:** a plant that completes its life cycle during a single growing season.
- Auricle:** in grasses, small appendage found where the blade meets the sheath.
- Awns:** slender bristles.
- Axil:** position between the stem and leaf.
- Biennial:** plant that requires two years to complete its life cycle.
- Bolt:** to produce a stem from a basal rosette.
- Bulbous perennial:** plant which regenerates from year to year from a thickened underground shoot where food is stored.
- Collar:** the outer side of a grass leaf blade at the juncture of the blade and sheath.
- Entire:** a continuous, untoothed margin.
- Gland:** a structure which secretes.
- Lateral lobe:** a projecting segment on the margin of the leaf that is larger than a tooth.
- Leaflet:** one subunit of a compound leaf.
- Ligule:** in grasses, a thin membranous appendage or ring of hairs on the inside of the leaf blade at the junction of the sheath and blade.
- Lobe:** a projecting segment that is larger than a tooth.
- Midrib:** the central vein of a leaf.
- Node:** a place on a stem where a leaf is or has been attached.
- Ocrea:** a papery sheath that encloses the stem at the nodes.
- Palmate:** lobed or divided in a handlike fashion.
- Panicle:** grass seed heads with a main axis and subdivided branches; may be compact or open.
- Perennial:** plants that generally live for more than two years.
- Petiole:** the stalk between the leaf blade and the stem.
- Pubescent:** with hairs.
- Ray:** a single strap-shaped unit of a flower.
- Rhizome:** a creeping underground stem which vegetatively regenerates new growth.
- Rosette:** a circular cluster of leaves radiating from the stem of the plant at the ground.
- Sheath:** in grasses, the lower part of a leaf that encloses the stem and younger leaves.
- Simple:** a leaf blade that is all one unit.
- Spike:** an unbranched seed head.
- Summer annual:** a plant that germinates in the spring or summer and completes its life cycle during a single growing season.
- Taproot:** an enlarged vertical main root.
- Terminal leaflet:** a single subunit that occurs at the tip of the main compound leaf.
- Terminal lobe:** a projecting segment that is larger than a tooth occurring at the tip of the leaf.
- Terminal spike:** an unbranched seed head occurring at the top of the plant.
- Whorl:** three or more leaves per node; in a circle.
- Winter annual:** a plant that germinates in the late summer to early spring, flowers and produces seeds in mid to late spring, after which it dies.

Annual bluegrass	3	Kochia	16
Broadleaf dock	18	Mouseear chickweed	16
Bushy wallflower	7	Mousetail	20
Buttercups	19	Pineapple-weed	6
Butterweed	4	Plantains	18
Carolina foxtail	3	Prickly lettuce	6
Carolina geranium	16	Prostrate knotweed	19
Catchweed bedstraw	20	Purple deadnettle	17
Common chickweed	15	Purslane speedwell	21
Common mullein	20	Quackgrass	4
Corn gromwell	7	Shepherd's-purse	8
Corn speedwell	21	Smallflowered bittercress	8
Cornflower	5	Star-of-Bethlehem	2
Curly dock	18	Tansymustard (or flixweed)	14
Dandelion	5	Venuslookingglass	15
Downy brome	3	Virginia pepperweed	14
Eveningprimrose	17	Western salsify	7
Field pansy	21	Wild buckwheat	19
Field pennycress	8	Wild garlic	2
Fleabanes	5	Wild mustard	14
Foxtail barley	4	Wild onion	2
Henbit	17	Yellow rocket	15
Horseweed	6		

Authors

Fred Fishel
Department of Agronomy, University of Missouri-Columbia

Bill Johnson
Department of Botany and Plant Pathology, Purdue University

Dallas Peterson
Department of Agronomy, Kansas State University

Mark Loux
Department of Horticulture and Crop Science, The Ohio State University

Christy Sprague
Department of Crop Science, University of Illinois at Urbana-Champaign

Production

Extension and Agricultural Information
University of Missouri-Columbia

Garry Brix and Dennis Murphy, illustrators

Dale Langford, editor

Acknowledgments

The authors wish to thank all the external reviewers of this publication for their helpful and constructive comments:

Bill Curran, Pennsylvania State University
Jerry Doll, University of Wisconsin
Bob Hartzler, Iowa State University
J.D. Green, University of Kentucky
Aaron Hager, University of Illinois
Bill Helvey, Lincoln University
Alex Martin, University of Nebraska
Marshal McGlamery, University of Illinois
Leon Wrage, South Dakota State University

Special thanks are extended to Aaron Hager and Marshal McGlamery for also providing additional photographs and critique of the final draft.

Line drawings of cornflower, mousetail, and star-of-Bethlehem are reproduced, with permission, from Julian A. Steyermark's *Flora of Missouri* (1963, Missouri Department of Conservation).



On the cover

Field pennycress in no-till field in early spring, by Garry Brix

Sponsored in part by the Missouri Soybean Merchandising Council and Soybean Farmer Checkoff Dollars.

Published by MU Extension,
University of Missouri-Columbia
© 2000 University of Missouri

This publication was coordinated by *IDEA — Information Development • Expanding Awareness*, a collaborative effort initiated by the North Central Cooperative Extension Services to increase the efficiency and effectiveness of developing, producing, and/or marketing educational products nationwide. Publications are subject to peer review and prepared as a part of Cooperative Extension Activities in cooperation with the Cooperative State Research Education and Extension Services (CSREES)- U.S. Department of Agriculture, Washington, D.C. The following states cooperated in making this publication available. For additional copies contact the publishing university. For copies of this and other North Central Regional Extension resources contact the distribution office of the university listed below for your state. If your university is not listed, contact the producing university (marked with an asterisk).

*University of Missouri Extension Publications 2800 Maguire Columbia, MO 65211-0001 (573) 882-7216	Ohio State University Publications Office 385 Kottman Hall 2021 Coffey Road Columbus, OH 43210-1044 (614) 292-1607
University of Nebraska Dept. of Ag. Comm. 105 Ag. Comm. Building Lincoln, NE 68583-0918 (402) 472-3023	South Dakota State University Ag. Comm. Center Box 2231 Brookings, SD 57007-0892 (605) 688-5628
North Dakota State University Extension Communications Box 5655, Morrill Hall Fargo, ND 58106 (701) 231-7882	*Publishing university

Issued in furtherance of Cooperative Extension work, Acts of Congress of May 8 and June 30, 1914, in cooperation with the U.S. Department of Agriculture and Cooperative Extension Services of Illinois, Indiana, Iowa, Kansas, Michigan, Minnesota, Missouri, Nebraska, North Dakota, Ohio, South Dakota, and Wisconsin.

Programs and activities of the Cooperative Extension Service are available to all potential clientele without regard to race, color, national origin, age, sex, religion, or disability.

In cooperation with IDEA
(Information Development • Expanding Awareness)



North Central Regional Extension Publication No. NCR 614

An Integrated Pest Management publication
Published by MU Extension, University of Missouri-Columbia

10/00/17M