

A Field Guide and Key to Fifteen Grass Seedlings

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Abstract

Identification of grasses without floral parts can be a challenge. Students are often frustrated with vegetative plant parts that appear to be very similar. In prairie restoration, the ability to identify grass species in the seedling stage is necessary to determine if a planting has been successful. Fifteen common native and introduced grasses were grown in the greenhouse and analyzed as seedlings. Using the most conspicuous morphological features, a key and field guide were developed to identify these desirable and weedy grasses. Students in basic turfgrass or ecology classes, as well as restorationists, can use this information to identify these grasses in their vegetative state in the field.

INTEREST in native plants and prairie restoration has increased the need to identify grasses. This is especially critical in evaluating a successful planting. Because few prairie grasses flower the year of seeding, evaluating young plantings requires identification in the seedling and juvenile phases. Most identification keys for grasses are based on unique floral structures (Hitchcock, 1950) because vegetative characteristics are not as definitive, and for a given species may vary due to genetic differences or environmental conditions (Hitchcock et al., 1969; Harrington, 1977; Pohl, 1978).

Hitchcock et al. (1969) developed a vegetative key to the grasses of the Pacific Northwest that focused on gross morphological features, relying heavily on ligules. Looman (1992) used vegetative, habitat, and life cycle characteristics to distinguish prairie plants of Canada. Burr and Turner (1933) included an anatomical key in their guide to British grasses, with diagrams of stem cross-sections. Harrington (1977) has an illustrated glossary and practical ideas to aid in identification of grasses. Nittler and Kenny (1975) and Fermanian et al. (1989) have described grass morphological characteristics under stress and for teaching identification, respectively.

Many of these existing keys, however, are lengthy and require using a dissecting microscope. This is time-consuming and often impractical for field use. The objective of this project was to develop a key and an easy-to-use field guide for identifying common native grass seedlings and introduced grasses or weeds of the Northern Great Plains.

Methods and Materials

The 15 species of grasses studied are listed in Table 1. Nomenclature follows Gleason and Cronquist (1991). The native grasses are common in tallgrass restorations. The introduced species are often present in the seedbanks of this region.

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Table 1. Native and weedy grasses included in the vegetative identification key and field guide.

Scientific name	Common name	Native or introduced
<i>Andropogon gerardii</i> Vitm.	Big bluestem	Native
<i>Bouteloua curtipendula</i> (Michx.) Torr.	Sideoats grama	Native
<i>Bromus inermis</i> Leys.	Smooth brome	Introduced
<i>Bromus kalmii</i> A. Gray	Kalm's brome	Native
<i>Digitaria sanguinalis</i> (L.) Scop.	Crabgrass	Introduced
<i>Echinochloa crusgalli</i> (L.) P. Beauv.	Barnyardgrass	Introduced
<i>Elymus canadensis</i> L.	Canada wildrye	Native
<i>Elymus trachycaulus</i> (Link) Gould	Slender wheatgrass	Native
<i>Elytrigia repens</i> (L.) Nevski	Quackgrass	Introduced
<i>Panicum capillare</i> L.	Witchgrass	Native
<i>Panicum virgatum</i> L.	Switchgrass	Native
<i>Poa pratensis</i> L.	Kentucky bluegrass	Introduced
<i>Schizachyrium scoparium</i> (Michx.) Nash	Little bluestem	Native
<i>Setaria viridis</i> (L.) P. Beauv.	Green foxtail	Introduced
<i>Sorghastrum nutans</i> (L.) Nash	Indiangrass	Native

Native grass seed was obtained from Prairie Restorations, Princeton, MN. Seed of the introduced grasses was collected within 48 km (30 miles) of St. Paul, MN.

In February through May 1998, seeds were sown in flats and placed in a greenhouse at the University of Minnesota, St. Paul. No stratification or other preseeding treatment was done. Seedlings were transplanted into 10-cm diameter (4-inch) pots after they had at least one true leaf. As seedlings developed they were observed, photographed, and pressed. All observations were made on seedlings <10 wk old.

Photographic equipment included a Wild Leitz MPS46/52 photoautomat mounted on a Wild Leitz M3Z stereomicroscope (magnification: 10×, 16×, 25×, 40×); a Canon EOS Rebel X camera with 35- to 80-mm zoom lens; and a Hoya 52 mm +4 magnifying lens attachment.

Many of the grasses in this study were also compared to field grown material. Important distinguishing characteristics (auricles, ligules, rolled, or folded shoots) did not differ between greenhouse and field-grown specimens. Three minor differences were observed. First, field-grown specimens tended to have shorter internodes, which gave the plants a stockier, stronger appearance than greenhouse plants. Second, color variation such as pink, maroon, or purple was more evident in field-grown plants. And lastly, plants in the field were sometimes more hairy.

Key and Field Guide

An understanding of grass terminology is necessary for using the key. The stem of a grass plant is called a *culm* (Fig. 1); however, young seedlings that have not developed nodes and internodes are referred to as *shoots* in this key. A culm may have *tillers*—stems that are generally erect. Two types of nonaerial stems are also common in grasses: *rhizomes* or underground stems, and *stolons* or stems that trail along the surface of the ground and root at the nodes. A culm consists of *nodes* (or joints); *internodes* (area between joints); and *leaves*. Each leaf consists of a *sheath* (portion that encircles the culm) and a *blade*. The junction of the sheath and the blade is referred to as the *collar*. The collar usually includes a *ligule* and sometimes includes *auricles* (Fig. 2).

The key distinguishes 15 native and weedy grasses by vegetative characteristics (Fig. 3). The two-page field guide consists of a modified version of the key (Fig. 4) and a summary of important characteristics for each species (Fig. 5).

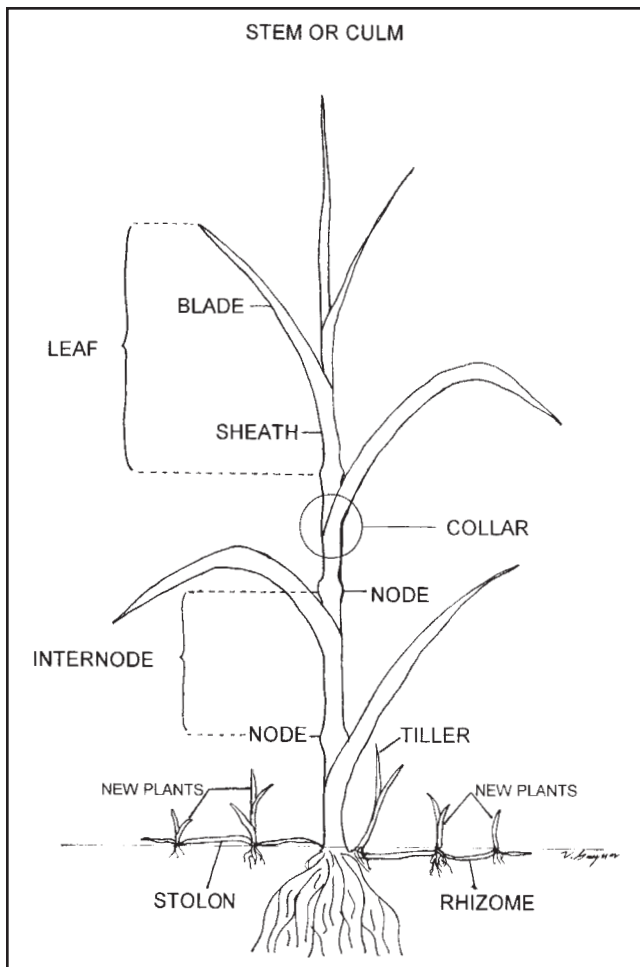


Fig. 1. Vegetative structures of a grass plant, useful in identification of seedlings or before flowering.

Because this study investigated only 15 species, the user must be careful not to force a plant to fit a description. The key ideally should be used on plants with three to six leaves. The use of a hand lens is helpful, but not required. This key was developed using plants from the Upper Midwest. Due to ecological variation, the key may not be as useful in another geographic region because the morphological features may vary.

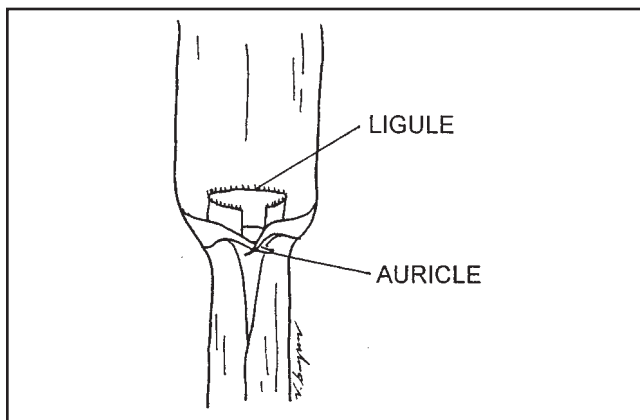


Fig. 2. Collar of grass plant showing ligule and auricle.

Characteristics Used in the Key

Identification of grass seedlings requires observation of several different features. This key begins with large features and easy-to-distinguish characteristics. For example, in little bluestem [*Schizachyrium scoparium* (Michx.) Nash] the flatness of the lower stems is a readily visible characteristic. In Canada wildrye (*Elymus canadensis* L.) the claw-like clasping auricle is a notable feature. These primary features are important to learn to successfully use the field key.

Auricle. Auricles are very distinct in some grasses. Claw-like clasping auricles in particular are easy to see (Fig. 6). Even for a species with auricles, not every leaf will have auricles so it is important to check several leaves. In addition, these structures are delicate and easily broken (Hitchcock et al., 1969).

Leaf Arrangement. As grass leaves unfold, they vary by being *rolled in the bud* or *folded in the bud*. This refers to the new emerging leaves, near the top of the culm. The lengthwise edge of a young leaf—not the tip of the leaf—will seem to unroll smoothly (Fig. 7) or it will have the creases of a fold, with the margins touching each other (folded in the bud). Leaves are often cut and viewed from above to show the leaf arrangement in a circular (rolled) or V (folded) pattern.

Shoot. In young grass seedlings, it can be useful to distinguish between cylindrical and flat shoots. When viewing the stem, consider the lower portion, near the base of the plant. A cylindrical shoot rolls or twirls easily between thumb and finger, a flat shoot does not (Fig. 8). Some species are distinctly and consistently flat or cylindrical, others are not as distinct. As plants mature, shoot flatness is generally less pronounced and may not be a useful distinguishing characteristic.

Ligule. The shape, color, and margin of a ligule are usually consistent, and very useful identifying characteristics for a species; however, the length of the ligule may vary (Looman, 1992; Hitchcock et al., 1969). Hitchcock et al. (1969) has excellent illustrations of ligules and auricles. Ligules are usually visible with the naked eye; however, a dissecting scope may be necessary to see the details. In this study, ligules were used as a later step in classification. Four ligule classifications were used.

1. *Absent*—Ligule is absent or difficult to detect.
2. *Membrane*—The ligule is a membranous tissue (Fig. 9, 10).
3. *Fringe of hairs*—With the naked eye the ligule appears to be a fringe of hairs. These hairs may actually arise from a very short strip of membranous tissue (Fig. 11).
4. *Membrane with hairs*—The ligule consists of a strip of membranous tissue with a fringe of hairs, both the tissue and the hairs are visible.

Trichomes/Hair. Hairiness is generally avoided in identification keys because of variability within a species or environment. However, some hair patterns should be noted. Long hairs may protrude from pustules along the leaf margins (Fig. 9, 12). If the light is adequate, the hairs and pustules can be seen in the field with the naked eye. Other species may have hairs spaced along the sheath margin (Fig. 6), or abundant hairs at the collar (Fig. 11).

Identification Key for Fifteen Native and Introduced Grass Seedlings

Claw-like auricles present on at least some leaves _____		2
2	Hairs present along sheath margin _____	<i>Elymus canadensis</i>
2	No hairs along sheath margin _____	3
3	Auricles prominent; forms sod; long white or yellow rhizomes on older plants _____	<i>Elytrigia repens</i>
3	Auricles sometimes rudimentary; bunch form; long rhizomes not present _____	<i>Elymus trachycaulus</i>
Claw-like auricles not present _____		4
4	Sheaths are flattened, not cylindrical _____	5
5	New leaves folded in half lengthwise _____	6
6	Culms usually bright green, no hairs at ligule _____	<i>Poa pratensis</i>
6	Culm base often tinged pink or maroon; first tillers often fan out from crown in a plane, _____	<i>Schizachyrium scoparium</i>
5	New leaves not folded in half, they are rolled _____	7
7	Ligule absent _____	<i>Echinochloa crusgalli</i>
7	Ligule present _____	8
8	Leaf blade wide (width:length ratio often 1:10 to 1:15) _____	<i>Digitaria sanguinalis</i>
8	Leaf blade long and narrow _____	<i>Andropogon gerardii</i>
4	Sheaths cylindrical, not flattened _____	9
9	Margin of leaf blade has long hairs protruding from pustules _____	10
10	Leaf blade wide (width:length ratio often 1:10 to 1:15) _____	<i>Panicum capillare</i>
10	Leaf blade long and narrow _____	11
11	Plant dark green; leaves very narrow _____	<i>Bouteloua curtipendula</i>
11	Plant medium green or blue green _____	<i>Andropogon gerardii</i>
9	Margin of leaf blade without pustules _____	12
12	Ligule consists of long hairs _____	13
13	Sheath hairy _____	<i>Panicum capillare</i>
13	Sheath not hairy _____	14
14	Leaf blade wide (width:length ratio often 1:10 to 1:15) _____	<i>Setaria viridis</i>
14	Leaf blade long and narrow _____	<i>Panicum virgatum</i>
12	Ligule consists of membrane (may be fringed with short hairs) _____	15
15	Sheath is tubular, partially or entirely closed _____	16
16	Both sheath and blades with many fine hairs, densely hairy _____	<i>Bromus kalmii</i>
16	Sheath with fine hairs; blade appears smooth _____	<i>Bromus inermis</i>
15	Sheath not tubular, it is open or has overlapping margins _____	17
17	Leaf blade wide (width:length ratio often 1:10 to 1:15) _____	<i>Digitaria sanguinalis</i>
17	Leaf blade long and narrow _____	18
18	Claw-like or rudimentary auricles _____	<i>Elymus trachycaulus</i>
18	No claw-like auricle; ligule tall and stiff _____	<i>Sorghastrum nutans</i>

Fig. 3. Seedling identification key for nine native prairie grasses and six nonnative grasses distinguished by vegetative characteristics.

Color. Color varies within a species and can change with environment; thus, it is generally avoided as a descriptor. However, in the field many people use color as an aid, especially if they have a single seed source. In this study, sideoats grama [*Bouteloua curtipendula* (Michx.) Torr.] was dark green; Kentucky bluegrass (*Poa pratensis* L.) was bright green; and young Kalm's brome [*Bromus kalmii* (A.) Gray] seedlings were olive green.

Rhizome. Rhizomes are usually absent on young plants and seedlings must be pulled from the soil to determine

whether they are present. Therefore, in the key, rhizomes were used only when a plant could not be distinguished by other characteristics.

Sheath. A closed or open leaf sheath can be a useful identification characteristic. Sheaths may be overlapped on very young seedlings and open with age. A *closed sheath* is tubular with overlapping margins. An *open sheath* appears to be split or cut, the leaf margins do not overlap. Varieties of the same species can differ in this characteristic.

VEGETATIVE GUIDE TO SELECTED GRASSES

1. Are claw-like auricles present? → GO TO A
2. If not, are stems flattened? → GO TO B
3. If not, are stems cylindrical? → GO TO C

DESCRIPTION OF TRAITS

Auricles Clasping claw-like auricles are present. They should be easily visible with naked eye. Check several leaves since some may be without auricles.

Flat or cylindrical? Are stems and sheaths flat or cylindrical? A cylindrical sheath should twirl smoothly between thumb and third finger.

Folded or rolled? Newly emerging leaves will be folded in half within the sheath or they will be rolled in the sheath. Look at the lengthwise edge of the leaf blade to determine if the shoots are folded or rolled.

Pustules Some plants have pustules along the margin of the leaf blade. Protruding from each pustule is a long hair. Pustules and hairs are visible to the naked eye if lighting is adequate.

Ligule The ligule may be a membrane, long hairs, or a membrane with hairs. A few grass species have no ligule.

Sheath Below the collar, the sheath may be open, have overlapping margins, or it may be a closed tube (tubular).

Leaf width Leaf width described by the width:length ratio of the leaf blade. A leaf that is 1 cm. wide and 10 cm long would be 1:10. Wide leaves -- 1:5, 1:10, 1:15; narrow leaves -- 1:20, 1:25, 1:30, etc.

A. CLAW-LIKE AURICLES PRESENT

- A. Hairs on sheath margin *Elymus canadensis*
- B. No hairs on sheath margin
 1) Auricles prominent; sod forming; long white or yellow rhizomes on older plants *Elytrigia repens*
 2) Auricles sometimes rudimentary; bunch form; long rhizomes not present *Elymus trachycaulus*

B. NO AURICLES, STEMS ARE FLATTENED

- A. New leaves folded in half lengthwise
 1) Culms bright green *Poa pratensis*
 2) Base of culms often tinged pink or maroon *Schizachyrium scoparium*
- B. New leaves not folded, rolled
 1) Ligule absent *Echinochloa crusgalli*
 2) Ligule present
 a) Leaf blade wide *Digitaria sanguinalis*
 b) Leaf blade long and narrow *Andropogon gerardii*

C. NO CLAW-LIKE AURICLES, STEMS ARE CYLINDRICAL

- A. Leaf blade margin has pustules with long hairs
 1) Leaf blade wide *Panicum capillare*
 2) Leaf blade long and narrow
 a) Plant dark green; leaves very narrow *Bouteloua curtipendula*
 b) Plant medium green or blue green *Andropogon gerardii*
- B. Leaf blade margin without pustules
 1) Ligule consists of long hairs
 a) Sheath hairy *Panicum capillare*
 b) Sheath not hairy
 i) Leaf blade wide *Setaria viridis*
 ii) Leaf blade long and narrow *Panicum virgatum*
 2) Ligule consists of membrane
 a) Sheath tubular
 i) Sheath and blade with many fine hairs *Bromus kalmii*
 ii) Sheath with fine hairs, blade smooth *Bromus inermis*
 b) Sheath not tubular
 i) Leaf blade wide *Digitaria sanguinalis*
 ii) Leaf blade long and narrow
 a) Claw-like or rudimentary auricles *Elymus trachycaulus*
 b) No claw-like auricle, tall stiff ligule *Sorghastrum nutans*

Fig. 4. Vegetative guide to selective grasses.

KEY FEATURES OF SPECIES

Native Grasses

Andropogon gerardii - big bluestem

- Shoot rolled in bud (but may be creased)
- Long hairs protrude from small pustules spaced along lower portion of leaf blade (not as distinct as *B. curtipendula*)
- Stems cylindrical or flattened
- Ligule - membrane

Elymus canadensis - Canada wildrye

- Claw-like clasping auricles
- One margin of sheath has hairs
- Stems cylindrical, shoot rolled in bud
- Ligule - membrane

Panicum virgatum - switchgrass

- Stems cylindrical, shoot rolled in bud
- Older culms may have thick patch of hair above ligule otherwise blades generally without hairs
- Ligule - fringe of long hairs fused at base

Bouteloua curtipendula - sideoats grama

- Long hairs protrude from pustules spaced along lower portion of leaf blade margin
- Stems cylindrical
- Shoot rolled in bud
- Dark green color
- Ligule - membrane with short hairs

Elymus trachycaulus - slender wheatgrass

- Claw-like clasping auricles or rudimentary or absent
- Stems cylindrical, shoot rolled in bud
- Ligule - membrane
- Tufted form, may have short rhizomes

Schizachyrium scoparium - little bluestem

- Stems flattened, shoot folded in half in bud
- Base of stems generally pink or maroon
- Ligule - membrane; front edges pull collar shut
- On young plant new tillers often fan out in a plane

Bromus kalmii - Kalm's brome

- Very young seedling often olive green
- Stems cylindrical or flattened, shoot rolled in bud
- Very soft fine hairs, often feels silky
- Ligule - short membrane, base arches in inverted V
- Tufted, tillers grow in cluster unlike *B. inermis*
- Upper sheath is tubular

Panicum capillare - witchgrass

- Stems cylindrical, shoot rolled in bud
- Ligule - long hairs fused at base
- Sheaths and blades hairy, sheath margin not hairy
- Leaf blades often wide, blades widest at base
- Hairs protrude along lower portion of leaf blade

Sorghastrum nutans - Indian grass

- Stems cylindrical, shoot rolled in bud
- Ligule - tall stiff membrane, may be notched on older stems
- Ligule margin often appears to be part of sheath margin

Introduced Grasses

Bromus inermis - smooth brome

- Stems cylindrical, shoot rolled in bud
- Soft fine hairs, fewer hairs than *B. kalmii*
- Tillers grow out away from first stem, unlike *B. kalmii*
- Ligule - short membrane, base often arches in inverted V
- Auricles usually absent, sometimes rudimentary
- Upper sheath is tubular

Echinochloa crusgalli - barnyardgrass

- Stems flattened, but thick and wide
- Shoot rolled in bud
- Ligule absent
- Leaves and stems without hairs

Poa pratensis - Kentucky bluegrass

- Stems flattened
- Shoot folded in half in bud
- Rhizomes
- Bright green or lime green color

Digitaria sanguinalis - crabgrass

- Stems flattened (may appear cylindrical), shoot rolled in bud
- Leaf blades wide
- Ligule - membrane
- Internodes not covered by sheath on older stems

Elytrigia repens - quackgrass

- Claw-like clasping auricles
- Long white or yellow rhizomes on older plants
- Stems cylindrical, shoot rolled in bud
- Ligule - membrane
- Lower sheaths usually with hairs, blades usually without

Setaria viridis - green foxtail

- Stems cylindrical, shoot rolled in bud
- Leaf blades wide, leaf blade widest at middle
- Ligule - long hairs fused at base
- Hairs at collar margin
- One margin of sheath has hairs

Fig. 5. Key features of species.



Fig. 6. Canada wildrye, collar of seedling leaf. Identifying characteristics include the claw-like claspings auricles, membranous ligule, and hairs along the margin of one leaf sheath.



Fig. 8. Little bluestem seedling. Shoots are flat at the base of the plant and on young seedlings may fan out in a plane.



Fig. 7. Green foxtail [*Setaria viridis* (L.) P. Beauv.], seedling. The leaf is rolled in the bud.



Fig. 9. Big bluestem (*Andropogon gerardii* Vitm.), collar of seedling leaf. Identifying characteristics include lack of auricles, membranous ligule, pustules with a single hair along margin of leaf.



Fig. 10. Indiangrass [*Sorghastrum nutans* (L.) Nash], collar of seedling leaf. The ligule in this species is a stiff membrane and is often described as a *rifle-sight*.



Fig. 11. Switchgrass (*Panicum virgatum* L.), collar of seedling leaf. The ligule consists of long hairs and the area above the ligule is very hairy.

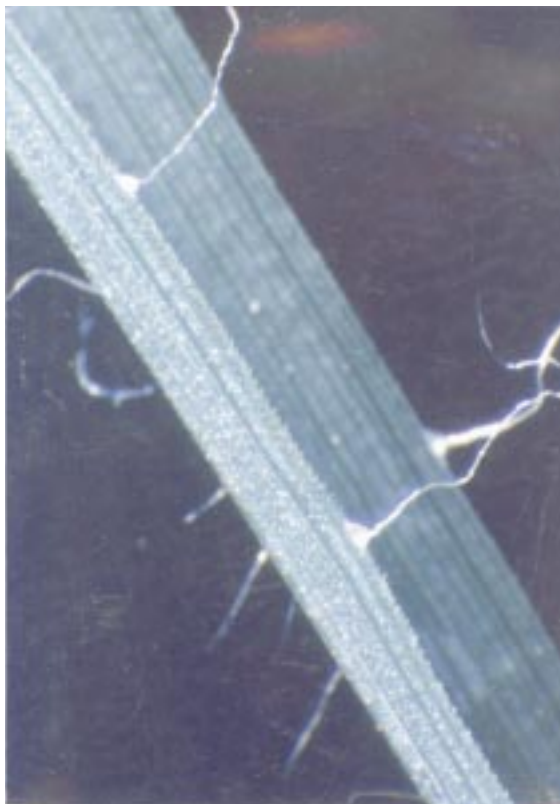


Fig. 12. Sideoats grama [*Bouteloua curtipendula* (Michx.) Torr.], section of seedling leaf blade. Pustules are spaced along the leaf blade margins, with a single hair protruding from each pustule.

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