

T H E S I S

SEEDLING CHARACTERS OF RANGE

AND

PASTURE GRASSES

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Submitted by

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for the Degree of Master of Science

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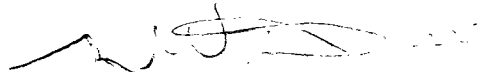
February 19, 1927

This is to certify that
Walter S. Ball has a reading
knowledge of scientific German.

(Signed) Elvie E. Bell
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THIS THESIS HAS BEEN APPROVED AND RECOMMENDED FOR
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Walter S. Ball

INTRODUCTION

The seedling characters of our important range grasses have been little used as a means of identification by those engaged in grazing work. The main interests have been centered on the mature grass, the flowers and type of inflorescence being used as the determining factors in the identification. Carrier (1), McAlpine (7), Percival (9) and Ward (11) have worked out keys for the identification of young grasses in other localities while Stebler and Schroter (10) have described and illustrated the vegetative characters of the common hay and pasture grasses in Europe. At present, however, seedlings of most western species have not been described at all and there is no way to determine them at this stage.

The need for such information is very essential to the reconnaissance man or student of grazing conditions since so many of the ranges are overgrazed and the grasses not allowed to mature. They are thus found only in the seedling

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or very short stage and are difficult to determine. The identification of the seedlings is necessary in reseeding experiments in order to know the seed that grow without watering until the end of the season or until maturity. Further, such information would be especially helpful in ecological quadrat work and range management.

It is the purpose of this thesis to describe and figure the seedling characters of the more important range grasses of Colorado and briefly give their palatability and forage value. A key for identification of these grasses is also presented, based on striking differences of seedling characteristics. As these studies are on economic species of range grasses coupled with the fact that more characters have been considered than have heretofore been taken into consideration by other workers, it is hoped that the descriptions and key will be of material assistance in range improvement studies.

METHODS AND MEANS OF CARRYING ON THE WORK.

In beginning studies of the seedling characteristics those forage grasses most commonly found in Colorado and the adjoining states were selected. Only a few that are considered weeds were studied, these being palatable when young.

The seed were collected in different parts of the

state from the plains at 4,500 feet to the foothills and mountains 7,500 feet to 8,000 feet in elevation. Both the short and tall grasses were included also those used for irrigated pastures. Where there was any doubt as to the species, the seeds were carefully identified by Miss Anna M. Lute, state seed analyst.

The seeds were planted in pots in the greenhouse and allowed to grow to seedling stage (3 to 4 inches) or until 3 to 4 leaves were out. Several seedlings were compared with some of the same species which were growing outside of the greenhouse, there were no differences found. Apparently growing them in the greenhouse did not change the characteristics. The first leaf in most cases was selected to determine the characters of each grass. The work differing in this respect from that of others who did not state precisely which leaves were used for their studies. The selection was made because the first leaf is most likely to be the last blade of grass eaten by stock.

Each grass was carefully studied with the aid of the hand lens and in some cases the binoculars, thus determining every visible character such as leaf rolled or folded in bud, the color of first sheath, whether hairy or glabrous; the blade, both upper and lower surface, margin, veins, width and average length; texture of blade; the ligule, whether

toothed, entire or hairy, length and texture; the collar, whether broad or narrow, divided or continuous, prominent or conspicuous and the color of roots, whether fine or coarse.

The camera lucida was used in making the detailed drawings of ligule, collar and leaf in bud.

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KEY FOR IDENTIFICATION OF RANGE AND PASTURE GRASSES
IN SEEDLING STAGE.

I. Leaves folded in the bud

- 1a. Blades hairy on either upper or lower surface
 - 2a. Hairs on upper and lower surface (1) *Hordeum jubatum*
 - 2b. Hairs only on lower surface
 - 3a. Ligule deeply lobed in center, midrib prominent (2) *Sitanion hystrix*
 - 3b. Ligule not lobed in center, midrib not so prominent (3) *Koeleria cristata*
- 1b. Blades not hairy on either surface
 - 4a. Ligule entire or minutely toothed
 - 5a. Stems strongly compressed (4) *Poa compressa*
 - 5b. Stems not compressed, if so, slightly
 - 6a. Ligule truncate or rounded
 - 7a. Blade constricted near tip, margin toothed (5) *Poa pratensis*
 - 7b. Blade not constricted, margin entire (6) *Lolium perenne*
 - 6b. Ligule wedge-shaped or acute
 - 8a. Midrib doubled (7) *Poa trivialis*
 - 8b. Midrib single (8) *Poa nemoralis*
 - 4b. Ligule coarsely toothed or lobed
 - 9a. Ligule dividing in center forming two halves
 - 10a. Stems flattened (9) *Dactylis glomerata*
 - 10b. Stems not flattened (10) *Andropogon Hallii*
 - 9b. Ligule not divided into two halves
 - 11a. Margin of leaf blade at collar hairy
 - 12a. Seven prominent veins, tuft of short hairs at collar (11) *Bulbilis dactylodes*
 - 12b. Five veins, long hairs at collar (12) *Bouteloua hirsuta*
 - 11b. Margin of leaf blade at collar not hairy
 - 13a. Blade rolled, collar divided (13) *Festuca rubra*
 - 13b. Blade not rolled, collar continuous (14) *Festuca ovina*

II. Leaves rolled in bud.

- 14a. Blades hairy .
 - 15a. Surface on margin at collar long hairs
 - 16a. Blade 5-veined or less
 - 17a. Ligule deeply divided in center (15) *Bromus tectorum*.

- 17b. Ligule not deeply divided in center.
- 18a. Collar narrow, only midrib running thru
 - (16) *Bromus pumillianus*
- 18b. Collar wide, all veins run thru
 - (17) *Bromus inermis*
- 16b. Blades more than 5-veined
 - (18) *Panicum capillare*
- 15b. Surface or margin at collar only short hairy
- 19a. Collar divided only by midrib.
 - (19) *Elymus triticoides*
- 19b. Collar divided by all veins
 - (20) *Agropyron Smithii*
- 14b. Blade not hairy on either surface
 - 20a. Long hairs on margin of blade at collar
 - 21a. Ligule very hairy
 - (21) *Panicum virgatum*
 - 21b. Ligule not hairy
 - 22a. Narrow deeply toothed ligule
 - (22) *Stipa Nelsoni*
 - 22b. Broad shallowly toothed ligule
 - (23) *Stipa vaseyi*
 - 20b. No hairs on blade margin or if any, short
 - 23a. Margin of blade entire or only a very few short teeth at base of blade.
 - 24a. Blade constricted near tip
 - (24) *Festuca elatior*
 - 24b. Blade not constricted near tip
 - 25a. Ligule very narrow
 - (25) *Agropyron repens*
 - 25b. Ligule broad
 - 26a. Few very short hairs on margin at base of blade
 - (26) *Agrostis maritima*
 - 26b. Margin at base of blade entire, no hairs.
 - (27) *Agrostis alba*
 - 23b. Margin of blade not entire
 - 27a. Ligule broad, shallowly toothed
 - 28a. All veins running thru collar
 - (28) *Phleum pratense*
 - 28b. All veins not running thru collar
 - 29a. Collar divided into wedge-shaped halves by midrib.
 - (29) *Agrostis vulgaris*

- 29b. Collar only narrowed at midrib.
(30) *Lolium italicum*
- 27b. Ligule deeply toothed, narrow or broad.
 - 30a. Collar continuous
 - 31a. Collar conspicuous, only mid vein running through
 - 32a. Broad, long pointed ligule
(31) *Arrhenatherum elatius*
 - 32b. Moderately broad, not long pointed
(32) *Agropyron spicatum*
 - 31b. Collar not conspicuous, all veins running thru
 - 33a. Ligule with many fine teeth
(33) *Calamovilfa lingifolia*
 - 33b. Ligule with four large teeth, these with fine teeth
 - 34a. Double veins forming midrib
(34) *Agropyron tenerum*
 - 34b. Midrib not doubled
(35) *Elymus canadensis*
- 30b. Collar not continuous
(36) *Andropogon nutans*

Hordeum jubatum L. Squirreltail grass

General Description

This is a native of the Rocky Mountain region. Can be used for forage only before seeding, is not considered a forage of any great importance. This grass is a troublesome weed in Colorado, Utah and other states. It has long, soft bearded spikelets maturing early. Commonly found with alfalfa and maturing before the alfalfa. When squirreltail is very abundant the first crop of alfalfa is rendered practically worthless, the awned spikelets being very injurious to stock.

Palatability - 15 to 25 percent for cattle; 10 to 20 percent for sheep.

Food value - has not been worked , it being a grass of minor importance.

Seedling characteristics

Leaf - folded in bud.

Sheath of first leaf - glabrous light brownish green, covered with fine hairs, length of opening wedge 3 to 4 mm.

Base of first leaf - upper surface, 5 veins all rather prominent, 1 pair on each side of midrib, light lines between veins seen with direct light, surface covered with short hairs. Lower surface, shiny, only midrib prominent, covered with dense short hairs.

Margin - hairy

Veins - 5, 1 pair on each side of midrib

Width - 1/2 mm., 1 cm. above collar

Length - 40 to 50 mm.

Shape and color - short narrow linear leaves, tip folded to form keel. Light or chromium green.

Texture - soft

Ligule - translucent, irregularly toothed membrane about 1/2 mm. long, teeth prolonging into fine hairs.

Collar - divided by midrib, very prominent broad and almost white, margin straight, covered with dense short hairs.

Auricles - none

Roots - white, fine

Most distinguishing characteristics.

1. Linear light green leaf - midrib prominent, others in pairs.
2. Conspicuous light lines seen by direct light.
3. Both surfaces of blade densely covered with short, rather stiff hairs.
4. Rather long irregularly toothed ligule.

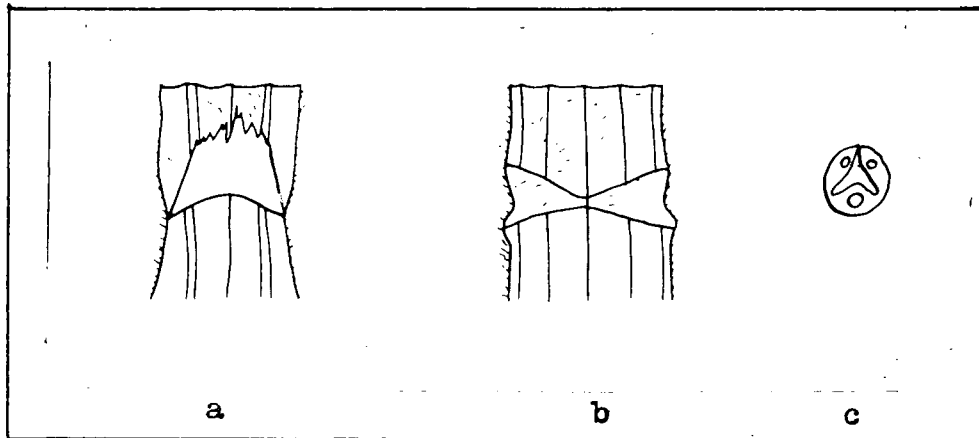


Fig. (1). Detailed drawing of Hordeum jubatum . X 25

a. detail of ligule of first leaf

b. detail of collar of first leaf

c. section through older leaf.

Sitanion hystrix (Nutt.) J. G. Smith. Bottle-bush, Squirreltail

General Description.

It is found from the Great Plains to the Pacific coast and is considered by J. G. Smith as worthless, but it has been found that the leafage is palatable to cattle and sheep while young or until the troublesome awns make their appearance. It has slender stems, erect or ascending 4 to 12 inches high, the base forming dense spreading tufts. The mature plant having rather long awns which are injurious to stock if eaten.

Palatability - for cattle, 15 to 25 percent; 10 to 20 percent for sheep.

Food value - has not been determined but it is rather low.

Seedling characteristics

Base of first sheath - glabrous, shiny, light purple, almost pink.

Sheath of first leaf - dark greenish purple, covered with very short, fine hairs, opening wedge 6 mm. long.

Blade of first leaf - upper surface glabrous, papillae all veins prominent, light shiny green, light lines seen by transmitted light; lower surface, midrib prominent. Entire surface covered with short stiff hairs.

Margin - finely toothed, teeth stiff, pointing upward.

Veins - 5 all prominent on upper surface

Width - 1mm., 1 cm. above collar

Length - 70 to 80 mm.

Color and shape - Chromerum green, flat linear leaves
acute slightly keeled tip.

Texture - ridged

Ligule - irregularly toothed membrane, teeth retooled
at apex, 3/4 mm. margin finely haired.

Collar - prominent, divided by midrib, hairy, margin
wavy.

Auricles - none

Roots - white fine

Nothing found on seedling characters by others.

Most distinguishing characteristics.

1. Stiff, rigid texture of leaves
2. Short Stiff hairs on lower surface
3. Ligule deeply lobed in middle, smaller lobes
finely toothed.
4. Irregularly shaped collar divided by midrib.

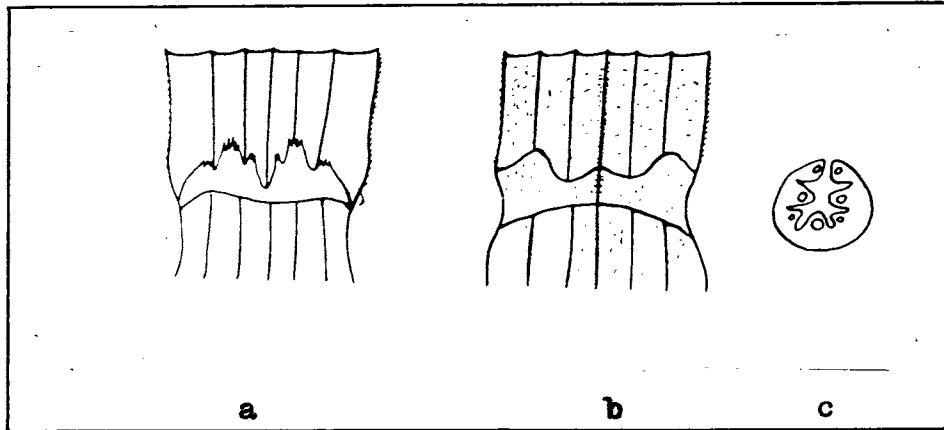


Fig. (2) Detailed drawing of Sitanion hystrix. X25

- a. detail of ligule of first leaf
- b. detail of collar of first leaf
- c. section through older leaf

Koeleria cristata (L.) Pers. Mountain June-grass.

General Description.

This is a native in North America and is a good forage grass, is a constituent of much of the native pastures throughout the Western states, has a very expanded range. Is a perennial bunchgrass, variable in appearance which would be expected from its enormous range. Stems are erect, 1 to 1½ feet high. Leaves are mainly basal and usually numerous. Does well in dry to moist soils, on prairies and mountains at elevations from 4,000 to 10,000 feet.

Palatability - 80 to 90 percent for cattle; 55 to 65 percent for sheep.

Food value - 2.8 pounds crude protein per 100 pounds green material. 25.6 pounds digestible nutrients per 100 pounds.

Seedling characteristics.

Leaf-folded in bud

Base of first sheath - light green, almost white, with very fine hairs.

Sheath of first leaf - light green, fine hairs seen with lens. Length of opening wedge 4 mm.

Blade of first leaf - upper surface, glabrous, a prominent pair of veins on each side of prominent midrib, light shiny green; lower surface, covered with short fine hairs with only midrib rather inconspicuous.

Margin - narrow, scarious border with numerous short fine hairs.

Veins - 5 in all, midrib prominent, 1 pair on each side.

Width - less than 1 mm., 1 cm. above collar

Length - 40 to 50 mm.

Color and shape - parrot green; narrow and linear, acuminate tip forming keel. Thick slightly v-shaped in cross section.

Texture - soft and yielding, white.

Ligule - glabrous irregularly toothed, white membrane less than 1/2 mm. long.

Collar - hairy , divided by mid-vein, margin straight

Auricles - none

Roots - tan colored, fine

No detail work on seedling characters found.

Most distinguishing characteristics.

1. Leaves light green color, short and narrow.
2. Hairs on lower surface of leaf and glabrous on upper, veins only prominent on upper.
3. Ligule short, white and finely toothed.
4. Collar rather rather inconspicuous, all veins running through.

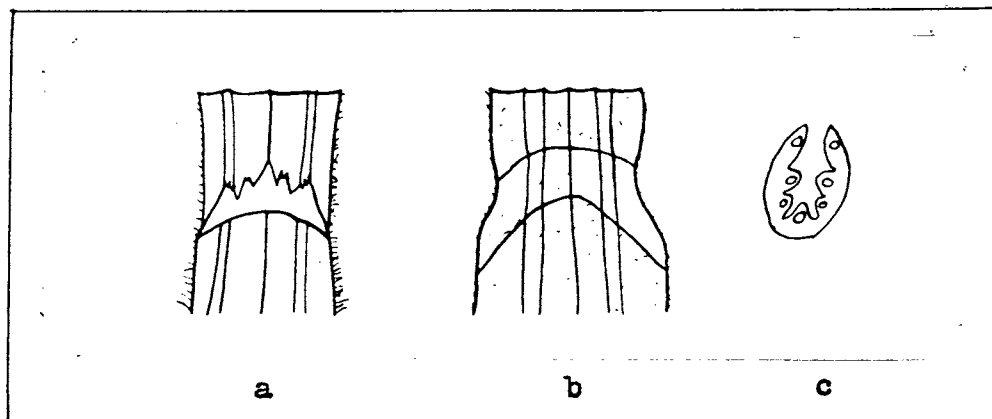


Fig. (3). Detailed drawing of Koeleria cristata. X25

- a. detail of ligule of first leaf
- b. detail of collar of first leaf
- c..section through older leaf.

Poa compressa L. Canada Blue-grass.

General Description

This is a native of the Old World, is very widely distributed. Is an important pasture grass, often cut for hay but better adapted for pasture. It has the ability to grow on poor soils and produce small crops of hay and good pasturage under conditions where other grass will scarcely thrive. It will withstand heavy grazing and its stem remains green, which gives late fall forage. This grass is a perennial and produces abundant root stalk, forming tough sod. The whole herbage is pale, glaucous, stems very compressed. Is adapted to about the same conditions as Kentucky Blue-grass, only that it is more resistant to summer heat and drought. More abundant in eastern Canada and Northeastern United States, but it occurs as far south as central Alabama.

Palatability - 85 to 95 percent for cattle; 70 to 80 percent for sheep.

Food value - crude protein 1.3 pounds per 100 pounds green material; 19.4 pounds per 100 of digestible nutrients of green material.

Seedling characteristics

Leaf - folded in bud

Base of first sheath - white with little tinge of purplish brown.

Sheath of second leaf - pale green to white, glabrous, length of opening wedge 4 to 7 mm., strongly compressed.

Blade of second leaf - upper surface smooth, glabrous, only midvein prominent, light shiny green or bluish green ; lower surface, smooth, glabrous, midrib and two outer veins prominent , midrib veing very prominent, bluish-green.

Margin - No scarious border, smooth except a few mm. from collar when there are fine retrorse teeth.

Veins - 5, midveinpronounced, rest very inconspicuous at base.

Width - 2mm., 1 cm. above collar. L

Length - 95 to 120 mm.

Shape - V-shaped in cross section, acuminate margin, tip forming keel.

Texture - a little wiry.

Ligule - not toothed, very minute hairs, membranous, entire and acute. 5 to 1 mm. long, white.

Collar - divided by midvein, a little lighter green than blade. Rather inconspicuous, very narrow, slightly wavy, and glabrous.

Auricles - none

Roots - whitish color, fine, and root stalks formed.

As determined by others - practically the same but not so much detail.

Most distinguishing characteristics

1. Compressed leaves
2. Bluish-green color
3. Leaf v-shaped, tip forming keel
4. Rather acute white ligule.

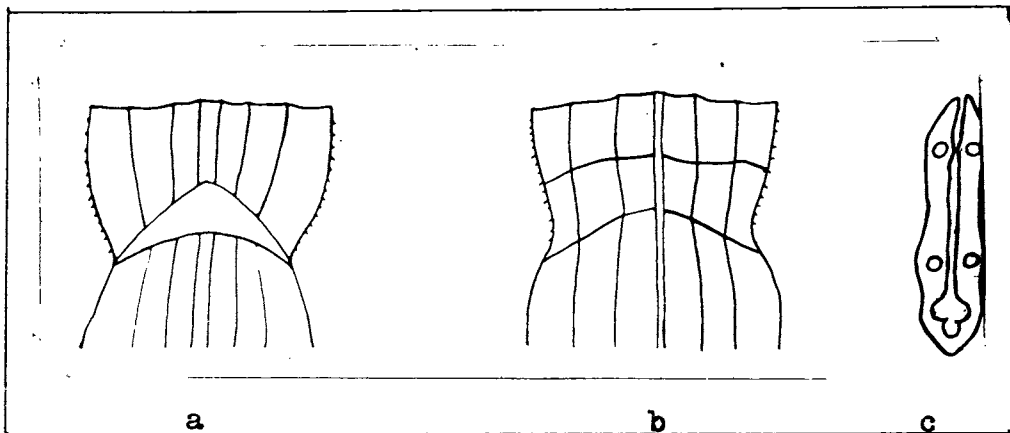


Fig. (4). Detail drawing of Poa compressa X 25.

- a. detail of ligule of second leaf
- b. detail of collar of second leaf
- c. cross section through older leaf

Poa pratensis L. Kentucky blue-grass.

General Description

This grass is considered one of the most important forage grasses, cultivated for pastures and farming, also a large part of the forage on mountain meadows of the west. It is a perennial, native of Europe, may be native of North America. Grows from a few inches to 2 feet or more in height, from slender creeping rhizomes forms tufts. Is adapted primarily to temperate regions of relatively high humidity, but succeeds well in arid regions under irrigation. Is markedly resistant to cold, it languishes during summer weather and even with abundant moisture, shows little vigor during hot months of July and August.

Palatability - for cattle 85 to 95 percent; 70 to 80 percent for sheep.

Food value - crude protein 2.3 pounds, total digestible nutrients in 100 pounds is 18.5 pounds green material.

Seedling characteristics

Leaf - folded in bud

Base of first sheath - white with little tiny of purple.

Sheath of second leaf - purple at base extending up mid-rib 5 to 7 mm. length of opening 4 to 6 mm.
very pronounced.

Blade of second leaf - upper surface, smooth, glabrous, 4 ridges, 2 prominent forming midrib, light shiny green; lower surface, smooth glabrous, minute papillae midrib very prominent, two other veins less prominent, a darker green.

Margin - very minute retrorse teeth on narrow, scarious border.

Veins - 5 midvein very prominent

Width - about 1.5 mm., 1 cm. above collar

Length - 45 to 70 mm.

Shape - acuminate margin, slight constriction 4 to 15 mm. from tip, folded inward forming keel.

Texture - soft.

Ligule - margin hair-like, hairs more noticeable at each end, entire concave truncate, white to pale green. About 1 mm. long.

Collar - Narrow , divided by midrib a little lighter green than blade, not very pronounced, wavy and glabrous.

Auricles - none

Roots - light tan and fine

About the same characters found by other workers.

Most distinguishing characteristics.

1. Two prominent veins forming midrib.
2. Minute retrorse teeth or scarious border
of blade
3. Slight constrictionof blade near tip and tip
of blade forming keel.
4. Truncate ligule, hairs at each end.

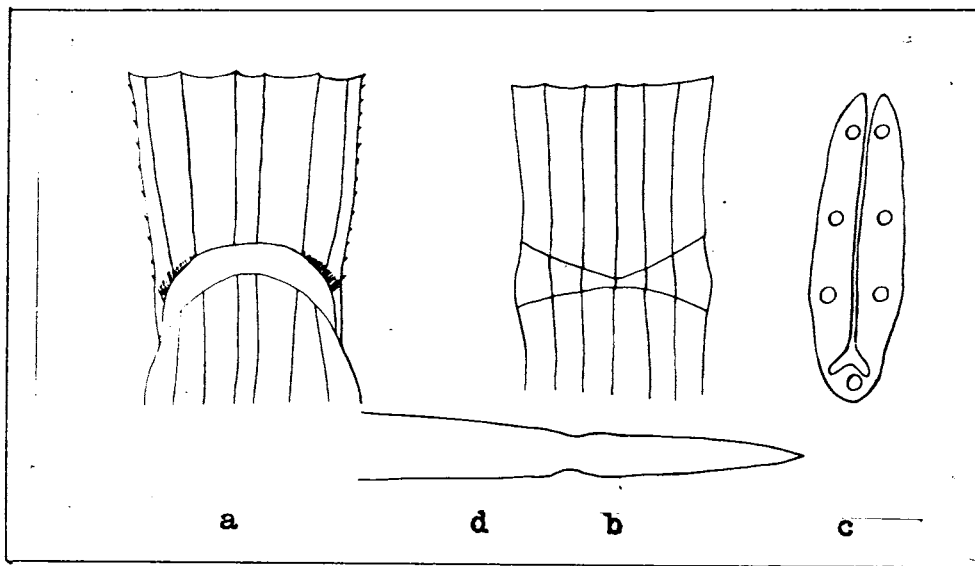


Fig. 5). Detailed drawing of Poa pratensis X 25

- a. detail of ligule of second leaf
- b. detail of collar of second leaf
- c. cross section through an older leaf
- d. constriction near tip of leaf.

Lolium perenne. L. Perennial rye-grass.

General Description

Occurs naturally in all of temperate Asia and in North Africa. Is the oldest cultivated grass for forage. It is of much importance in Europe but in this country it has not won a place. This is a short-lived, rapid growing perennial living only two years on poor land, but will do better under favorable conditions. Culms grow in tufts, erect, smooth, 1 to 2 feet tall. It is primarily adapted to moist regions, with mild winter climate. It thrives best on rich, moist, well drained soil, does not do well on sandy soil.

Palatability - 75 to 85 percent for cattle; 35 to 45 percent for sheep.

Food value - 1.7 pounds crude protein per 100 pounds and 15.8 pounds digestible nutrients per 100 pounds.

Seedling characteristics.

Leaf-folded in bud

Base of first sheath - coleoptile purple, slightly flattened.

Sheath of first leaf - very light green almost white, glabrous and shiny, length of opening wedge 3 to 4 mm. long.

Blade of first leaf - upper surface glabrous, grass green color, 3 to 4 light green lines on each side of rather prominent midrib very shiny, midvein rather prominent.

Margin - thin scarious

Veins - 5 midvein prominent, others inconspicuous

Width - 3/4 to 1 mm., 1cm. above collar

Length - 70 to 90 mm.

Shape - narrow, linear, acute point slightly keeled.

Texture - soft.

Ligule - glabrous membrane, truncate, toothed near center.

Less than 3/4 mm. long

Collar - prominently divided by midrib, straight glabrous

Auricles - none

Roots - brown, fine, no root stalks.

Described by L. Carrier as having auricles and prominent veins.

Most distinguishing characteristics.

1. Very narrow leaves and stems
2. Ligule truncate, often with rather prominent teeth near center.
3. Shininess and glabrous
4. Upper surface of first leaf shows 3 to 4 lines in direct light (not transmitted).
5. Minute white, narrow papillae on upper surface of first blade.

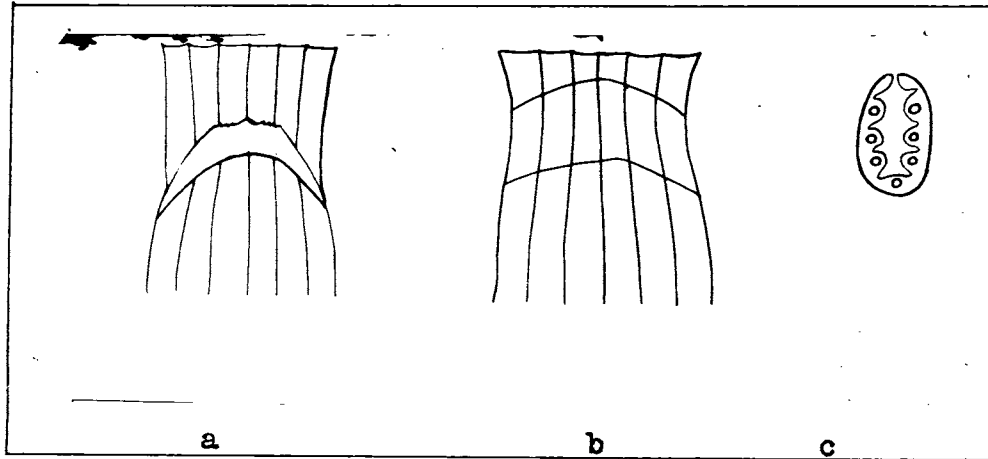


Fig. (6). Detailed drawing of Lolium perenne X 25.

- a. detail of ligule of first leaf
- b. detail of collar of first leaf
- c. cross section through an older leaf

Poa trivialis L. Rough-stalked meadow-grass.

General Description.

This grass is a native to Europe and in northern Europe is an important pasture grass. Has been spreading rapidly in the United States as a cultivated pasture grass. It has a rough stem and puts out numerous stolons, it also possesses rootstocks. Is adapted to moist soil of most of the Kentucky blue-grass regions, Southward it tends to suffer from the heat. Is the best of all grass for shady lawns, making a dense carpet. In the northern states it is utilized as pasture.

Palatability - for cattle 85 to 95 percent; 70 to 80 percent for sheep, cattle eat it greedily.

Food value - about the same as that of Poa pratensis.

Seedling characteristics

Leaf - folded

Base of first sheath - very light to pink at ground.

Sheath of second leaf - pale green, glabrous, length of opening wedge 2.5 to 3.5 mm. compressed.

Blade of second leaf - upper surface, smooth, glabrous, midrib very prominent, minute papillae, light green color; lower surface, smooth, glabrous, midrib very prominent, very shiny light green color.

Margin - minute teeth seen only with high power lens along base of blade.

Veins - 5, midrib very prominent

Width - about 1.5 mm., 1 cm. above collar.

Length 50 to 80 mm.

Shape - acuminate margin, tip slightly folded forming keel.

Texture - soft, yielding

Ligule - long, glabrous, entire, concave membrane, white translucent.

Collar - divided by midrib but not prominent, wavy, glabrous

Auricles - none

Roots - light tan and fine

Differences found by L. Carrier - ligule toothed at apex, sheaths rough to touch.

Most distinguishing characteristics.

1. Very shiny, green color of lower surface of leaf.
2. Long ligule, point acute
3. Tip of blade acute just slightly folded forming keel.
4. Broad collar divided by midrib which is not very pronounced.

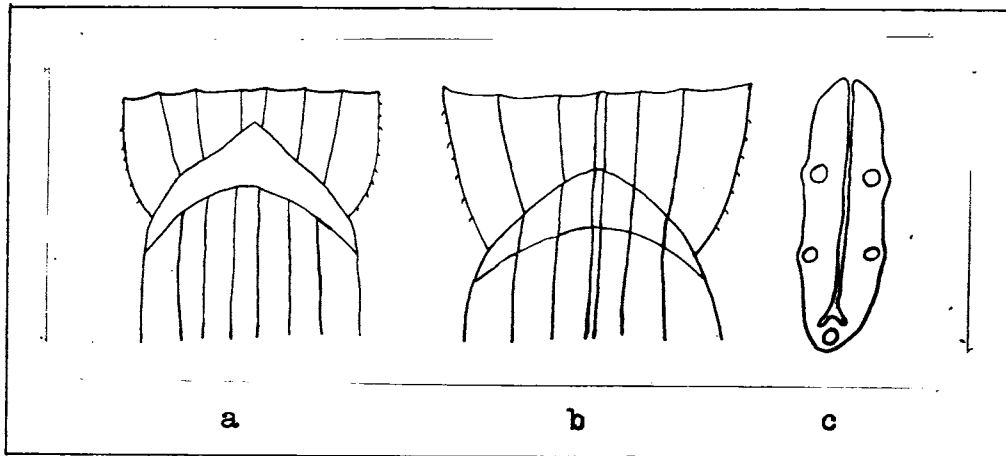


Fig. (7). Detailed drawing of Poa trivialis X 25.

a. detail of ligule of second leaf

b. detail of collar of second leaf

c. cross section through an older leaf

Poa nemoralis L. Wood meadow-grass.

General Description.

This grass is a native of Eurasia and North America. Is not of very much importance in this country, the rough stalk meadow-grass having taken its place. It is found growing wild in woodlands, being especially adapted to shade. Is more adapted to northern parts of the United States and up into Alaska over to Newfoundland.

Palatability - about the same as the other Poas.

Food value - about the same as Poas mentioned

Seedling characteristics.

Leaf - folded in bud

Base of first sheath - yellowish-green

Sheath of second leaf - pale green, glabrous, margin scarious, length of opening wedge 6 to 10 mm. slightly compressed.

Blade of first leaf - upper surface smooth, glabrous, only midrib prominent, rather dark green; lower surface slightly scarious, midrib very prominent, light line on both surfaces.

Margin - finely serrated, pointed upward, rough to touch

Veins - 5, only midrib prominent at base

Width - 2 to 3 mm., 1 cm. above collar

Length - 50 to 60 mm.

Shape - acuminate margin, slightly concave, tip boat-shaped or keeled

Texture - slightly ridged.

Ligule - not toothed but margin finely haired, membrane acute about 1/4 mm. long, white almost transparent.

Collar - narrow divided by midrib, pale green to almost white, slightly wavy, glabrous.

Auricles - none

Roots - light tan, fine, no root stalks.

Very few characters have been worked out by others, none different than mentioned.

Most distinguishing characteristics.

1. Culms and sheaths compressed
2. Tip keeled or boat-shaped
3. Yellowish-green in color
4. Rather acute white ligule
5. Teeth on margin of blade pointing upward
6. No Rhizomes

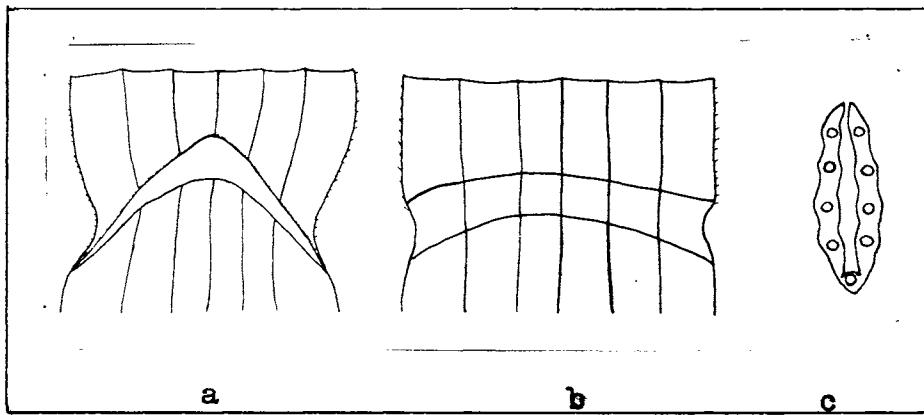


Fig. (8) Detailed drawing of Poa nemoralis X 25.

- a. detail of ligule of first leaf
- b. detail of collar of first leaf
- c. section through older leaf

Dactylis glomerata L. Orchard-grass.

General Description

This grass is native throughout Europe excepting in the northern most portions. It is about fourth or fifth in importance among cultivated perennial hay grasses in America. It is most important in the south-central states, both for hay and pastures. This grass succeeds very well in shade, it is strictly a temperate plant; will withstand longer seasons of heat than timothy, and is also more easily injured by winter cold. Therefore being better adapted southward than north.

Palatability - highly palatable before flowering, but greatly reduced when old. It is a perennial in large tufts, without creeping root stocks, culms erect and smooth, grows from 2 to 4 feet high.

Food value - 1.7 pounds crude protein, 16.1 pounds of digestible nutrients per hundred pounds green material.

Seedling characteristics.

Leaf - folded in bud

Base of first sheath - pale brown, almost white, strongly compressed.

Sheath of first leaf - light green, margin scarious, glabrous , opening wedge 9 to 10 mm. long.

Blade of first leaf - upper surface dull green, midrib prominent, glabrous; lower surface glabrous, midvein prominent, lower part of blade usually more or less folded.

Margin - very minutely toothed

Veins - 5, midvein more prominent.

Width - $1\frac{1}{2}$ to 2 mm., 1 cm. above collar

Length 40 to 50 mm.

Shape - leaf broad, compressed at base, boat-shaped tip, midrib forming keel, finely toothed.

Texture - soft

Ligule - glabrous, finely toothed, divided in middle forming two lobe-like membranes, about $\frac{3}{4}$ mm.

Collar-divided by midrib but not very prominent, straight glabrous

Auricles - none

Roots - tan, fine, no rootstalks.

Described by L. Carrier - ligule very long, often lacerate (not divided).

Most distinguishing characteristics

1. Base of sheath, culm strongly compressed almost white.
2. Broad leaf, boat-shaped tip, midrib forming keel, finely toothed.

3. Ligule divided in middle forming two lobes
4. Leaves glabrous, no hairs
5. Very vigorous and robust.

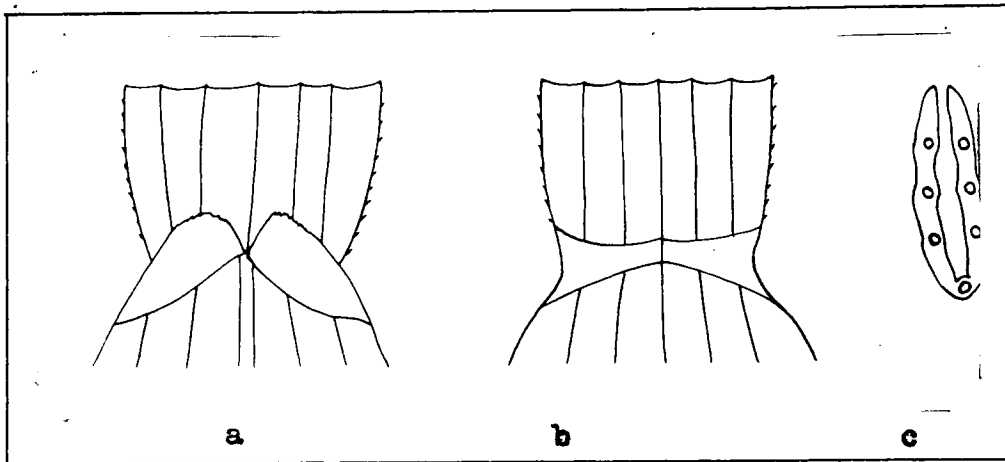


Fig. (9). Detailed drawing of Dactylis glomerata X 25
a. detail of ligule of first leaf
b. detail of collar of first leaf
c. cross section through an older leaf

Andropogon Hallii Hack. Turkey foot.

General Description .

Its range is in the sandhill district of Nebraska, Kansas and Oklahoma and into eastern Colorado. It is not an exceptionally good forage plant but is eaten to a slight extent by cattle and horses. It makes good hay, however, and is often cut for that purpose. It is a very coarse grass, yellowish-green, growing 3 to 6 feet tall. Often from creeping root stocks. Leaves smooth, 1 foot long or less, blades wide below. Found usually on dry sandy soils of plains and foothills. Frequently being the most conspicuous feature of the vegetation.

Palatability - rather low, about same the year round

Food value - has not been worked out

Seedling characteristics

Leaf - folded in bud

Base of first sheath - glabrous, deep red almost purple

Sheath of first leaf - glabrous, dark red, color extending thru collar into leaf following midvein, length of opening wedge 1 cm. having scarious margin.

Blade of first leaf - upper surface glabrous, all veins equally prominent, a dull green; lower surface glabrous and shiny, midrib most prominent and red-purplish-green surface.

Margin - finely toothed along narrow scarious border

Veins - 5, prominent in 1st leaf, many in older ones.

Width - more than 2 mm., 1 cm. above collar

Length - 15 to 20 mm.

Shape and color - acuminate tip forming keel, very broad, short leaf; elm green color.

Texture - slightly rigid

Ligule of second leaf - glabrous translucent membrane

divided into two lobes, each lobe being 1 mm. or more in length, teeth of lobes long, prolonging into long hairs. Ligule of first leaf in many cases found to be very much reduced and truncate or absent.

Collar - very inconspicuous, only slight indication of color on each edge of blade, glabrous.

Auricles - none

Roots - tan, rather coarse with root stalks.

Not found described in seedling stage.

Most distinguishing characteristics

1. Leaves short and broad, with purplish-green color extending up lower surface.
2. Older leaves numerously veined
3. Ligule of first leaf reduced and truncate or absent
4. Ligule of second leaf 2-lobed, teeth prolonging into long hairs.
5. Collar inconspicuous.

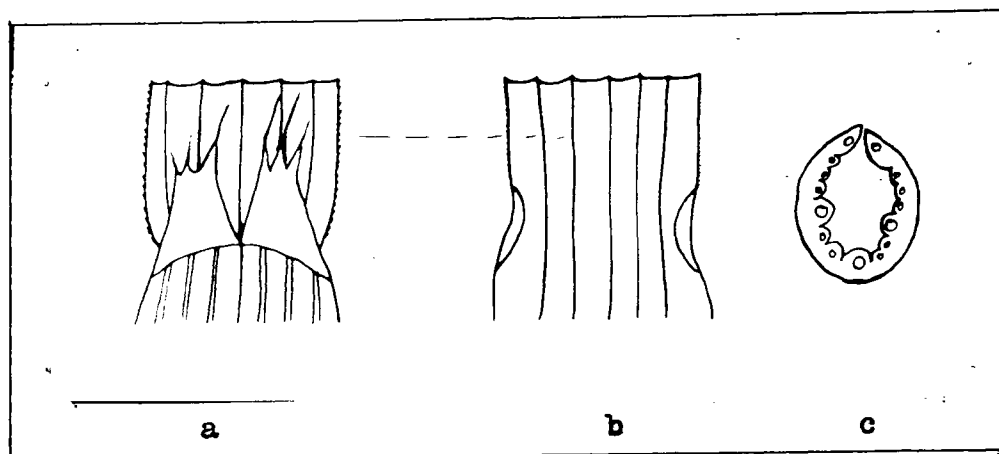


Fig. (10). Detailed drawing of Andropogon Hallii X 25

- a. detail of ligule of second leaf
- b. detail of collar of second leaf
- c. section through older leaf.

Bulbilis dactyloides (Nutt.) Raf. Buffalo-grass

General Description

This grass is found on the great plains from Montana to Mexico and is dominant over the greater parts of this "short-grass" country and is one of the most important grazing grasses of this region. It is a low stoloniferous perennial that forms a firm sod. In this grass the staminate and pistillate flowers are formed. The staminate inflorescence consists of 2 or 3 short 1-sided spikes on a culm, a few inches high; the pistillate spikes are hidden among the leaves near the ground.

Palatability - 85 to 95 percent for cattle; 65 to 75 percent for sheep.

Food value - contains 3.8 pounds crude protein per 100 pounds of fresh material and 49.5 pounds digestible nutrients per 100 pounds.

Seedling characteristics

Leaf - folded in bud

Base of first sheath - glabrous, greenish-white, slightly compressed.

Sheath of first leaf - glabrous, white at base but getting green near collar, length of opening wedge 5 mm.

Blade of first leaf - upper surface glabrous, light lines between seen by direct light; lower surface glabrous, fine papillae, all veins prominent.

Margin - finely toothed rough to touch

Veins - 7, all prominent

Width - less than 1mm., 1 cm. above collar

Length - 15 to 20 mm.

Shape and color - short narrow leaf, slightly folded
to form V, in cross section. Tip keeled, Cedar
green color.

Texture - soft

Ligule - white, glabrous, regularly toothed membrane, fine
teeth forming hairs 1/2 mm. long.

Collar - divided by midrib, very prominent, a tuft of hairs
at each side, glabrous.

Auricles - none

Roots - light tan and fine

No seedling characteristics found as worked by others.

Most distinguishing characteristics.

1. Short, narrow leaves. 7 prominent veins, light
lines seen by direct light. Tip keeled.
2. Regularly toothed ligule, margin finely haired
3. Prominent collar with tuft of hair on each side
4. Stoloniferous habit.

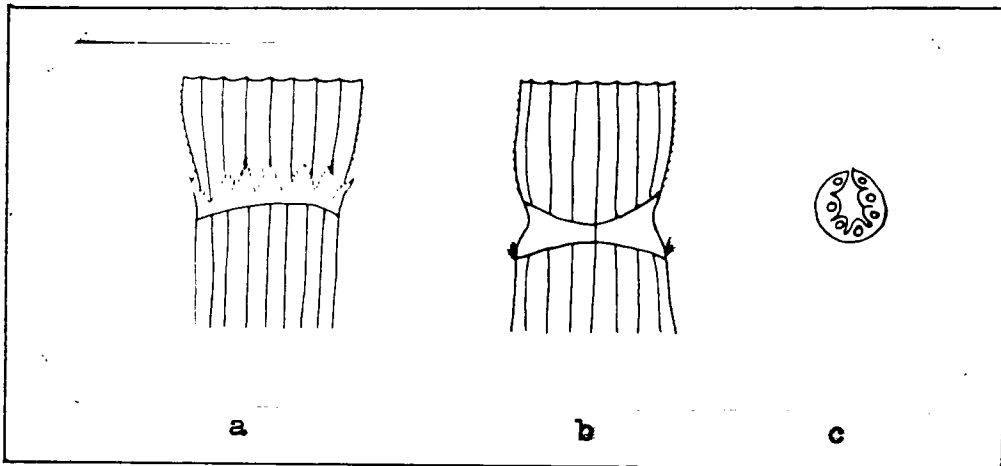


Fig. (11). Detailed drawing of Bulbilis dactyloides X 25

a . detail of ligule of first leaf

b. detail of collar of first leaf

c. section through older leaf.

Bouteloua hirsuta Lag. Black grama .

General Description

It is a native of America and found especially abundant in the southwestern United States and on the Mexican plateau. This is a very important grazing grass, is a perennial, tufted grass growing erect from 6 to 18 inches high. Grows on dry slopes of high mesas, but reaches its best development upon stable sandy loam soil, in Colorado up to 7,000 feet.

Palatability - 85 to 95 percent for cattle; 65 to 75 percent for sheep.

Food value - crude protein 2.1 pounds per 100 pounds green material. 18.7 pounds per hundred digestible nutrients.

Seedling characteristics

Leaf - folded in bud

Base of first sheath - glabrous, light pink to tan.

Sheath of first leaf - dark red to purple, glabrous and prominently veined. Length of opening wedge 28mm.

Blade of first leaf - upper surface glabrous, fine papillae, all veins prominent with white lines between as seen by direct light; lower surface dull , not shiny, prominent papillae, slightly rough , veins all prominent with light lines between as seen by direct light.

Margin - finely toothed, seen by aid of lens

Veins - 5, veins all prominent

Width - less than 1 mm. 1 cm above collar

Length - 15 to 20 mm.

Color and shape - cedar green; narrow short leaves,
with very acute tip

Texture - slightly rigid.

Ligule - a very finely toothed membrane, teeth prolonging
into hairs, less than 1/4 mm., long hairs on each
side of ligule.

Collar - divided by midrib, prominent, glabrous, about 1/4
mm. wide.

Auricles - none

Roots - white, rather coarse

Seedling characteristics not worked out by others.

Most distinguishing characteristics.

1. Narrow, short, prominently veined leaf, with
finely toothed margin
2. Conspicuous white lines between veins as **seen**
by direct light.
3. Finely toothed ligule prolonging into hairs
4. Rather wide, conspicuous collar, divided only
by midrib.

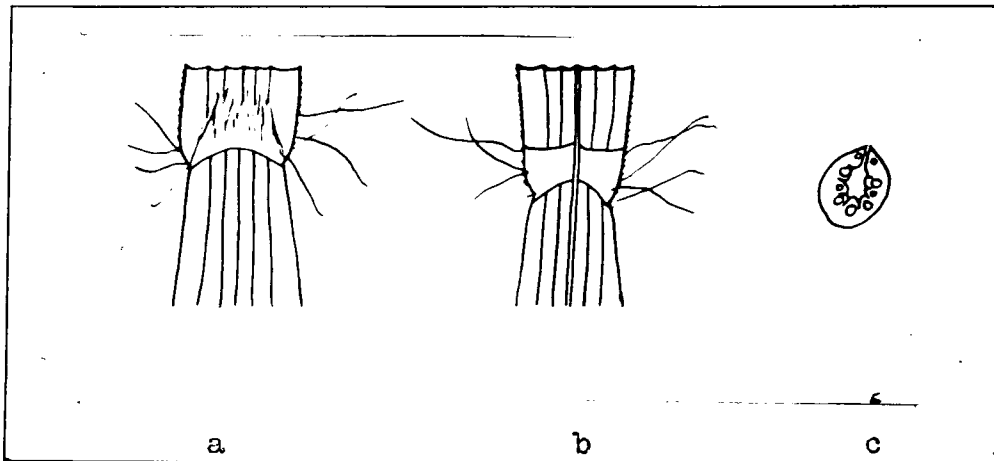


Fig. (12). Detailed drawing of Bouteloua hirsuta X 25.

- a. detail of ligule of first leaf
- b. detail of collar of first leaf
- c. section through older leaf.

Festuca rubra L. Red fescue.

General Description.

This grass occurs naturally in Europe, Asia and North America. In North America it ranges from Greenland southward near the coast to Virginia, from Alaska to California and New Mexico. Under favorable conditions it is considered a good pasture and hay grass. It requires cool temperate weather and moist sandy soil. It is a long-lived perennial, forms dense growth on moist sandy soil and will grow to height of two feet or more.

Palatability - 75 to 85 percent for cattle; 65 to 75 percent for sheep.

Food value - contains 1.8 pounds of crude protein per 100 pounds and a total of 20.9 pounds of digestible nutrients per 100 pounds green material.

Seedling characteristics

Leaf - folded in bud

Base of first sheath - light purple

Sheath of first leaf - pale purple up from base 4 mm.

length of opening wedge 1.5 to 2 mm., glabrous, midrib finely toothed.

Blade of first leaf - upper surface, fine papillae, 3

prominent ridges, dark green; lower surface smooth, glabrous, midrib very prominent, dark shiny green.

Margin - finely toothed pointing toward tip, rough to touch by tongue.

Veins - 4, all rather prominent on upper surface only.

Midrib prominent on lower surface.

Width - about 1 mm., 1 cm. above collar

Length - 35 to 65 mm.

Shape - V-shaped in cross section, linear and thick, acuminate, constriction 3 to 5 mm. from tip; tip keeled .

Texture - rather soft.

Ligule - irregular , finely haired membrane about 1/5 mm. long.

Collar - continuous pale green, margin straight, glabrous

Auricles - none

Roots - tan color, rather coarse.

Difference seen by others

Ligule acute - L. Carrier

Most distinguishing characteristics

1. Peculiarly shaped ligule
2. Peculiarly shaped collar
3. Early and abundant tillering
4. Very narrow and rather thick blade somewhat folded.

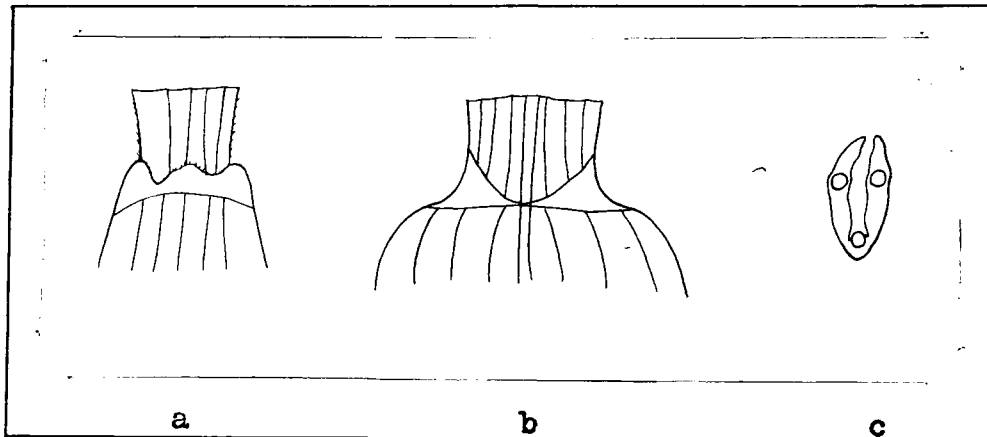


Fig. (13). Detailed drawing of Festuca rubra X 25.

- a. detail of ligule of first leaf
- b. detail of collar of first leaf
- c. section through older leaf.

Festuca ovina L. Sheep fescue.

General Description

This is a tame grass, cultivated for lawns and pastures. A native of North America. Common from British Columbia to Colorado and California. Is a short, rather fine leaved perennial, too short to cultivate for hay but will withstand early grazing and a great deal of trampling, as it has abundant deep, strong roots and is never injured by uprooting. Forms dense tufts 6 to 2 feet high. Its climatic requirements are rather wide, will do well wherever it is possible for agriculture, North of latitude 40 degrees . It does very well on poor stony or sandy land.

Palatability - 75 to 85 percent for cattle; 65 to 75 percent for sheep.

Food value - crude protein 1.8 pounds; total digestible nutrients in 100 pounds green material, 20.9 pounds.

Seedling characteristics

Leaf - folded in bud

Base of first sheath - pink to light reddish-purple

Sheath of second leaf - border on margin pink from base up, 5 to 8 mm., length of opening wedge 4 to 5 mm. long, very fine scattered hairs on veins, especially near base. Sheath of each tiller with short somewhat retrorse hairs on the 3 veins.

Blade of second leaf - upper surface smooth, glabrous, 5 ridges, green minute papillae, light green; lower surface smooth, glabrous, only midrib prominent, surface slightly shiny, dark or bluish-green.

Margin - minute teeth or narrow scarious border, teeth growing toward tip are prominent can be seen with hand lens.

Veins - 5, not very prominent on upper surface, midrib on lower surface minutely toothed upward.

Width - about 1 mm., at 1 cm. above collar

Length - 45 to 72 mm.

Shape - linear and thick, prominently folded to form, v-shape in cross section, minute boat-shaped (keel shaped) tip, with minute projections on upper surface acute.

Texture - membranous

Ligule - membranous, laciniate with narrow hair-like lobes, truncate. Very pale green, almost white, very short.

Collar - continuous, very narrow and not very prominent, margin irregular, glabrous except along midrib.

Auricles - none

Roots - tan to light brown, rather fine

Difference determined by L. Carrier

Auricles short, obtuse.

Most distinguishing characteristics

1. Early tillering into 3 to 6 tillers
2. Thick leaf blade partly folded to form V in cross section.
3. Veins on lower surface of blade and sheath with short retrorse hairs.
4. Ligule broken into hairs at tip.
5. Tip of blades boat-shaped, acute.

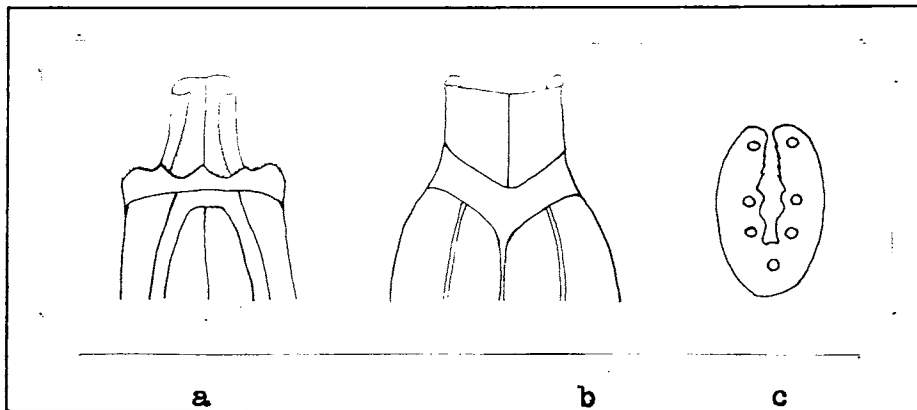


Fig. (14). Detailed drawing of Festuca ovina X 25

a. detail of ligule of second leaf

b. detail of collar of second leaf

c. cross section through an older leaf.

Bromus tectorum L. Downy brome-grass.

General Description

Most of the brome grasses have been introduced from Europe and in many places considered weeds. This species being an annual. It is considered a good grazing plant while young but after it goes to seed is often considered injurious to stock. This grass thrives on all open ground at lower altitudes, in spring and early summer, and on the approach of summer's dry season, they ripen their seed and turn brown. They often cover vast areas and have become a great pest.

Palatability - 25 to 35 percent for cattle; 15 to 25 percent for sheep.

Food value - 2.9 pounds of crude protein per 100 pounds and 18.3 pounds of digestible nutrients per 100 pounds of fresh material.

Seedling characteristics

Leaf-rolled in bud

Base of first sheath - light purple, glabrous not hairy

Sheath of first leaf - light green color, very hairy

hairs about 1 mm. long, length of opening wedge 4 mm.

Blade of first leaf - upper surface glabrous, fine

papillae 5 veins all rather prominent, light lines as seen by direct light. Lower surface very hairy, hairs 1 mm. long, midvein more prominent.

Margin - hairy

Veins - 5, all rather prominent

Width - 1.5 mm., 1 cm. above collar

Length - 65 to 75 mm.

Shape and color - flat, broad blade rather acute,
boatshaped tip. Spinach green color.

Texture - soft and yielding

Ligule - toothed, glabrous, teeth prolonging into hairs,
white membranous, acute about 3/4 mm. long.

Collar - divided by midrib. Margin wavy but rather incon-
spicuous , hairy.

Auricles - none

Roots - fine, tan to light brown in color.

No characters found by others different than mentioned.

Most distinguishing characteristics

1. Ligule divided in middle forming two acute teeth
with reduced one on each side.
2. Very hairy from base to tip of blade on lower
surface hairs about 1 mm. long
3. Leaf flat and long. 5 veins all prominent.
4. Prominent light lines between veins as seen with
direct light.

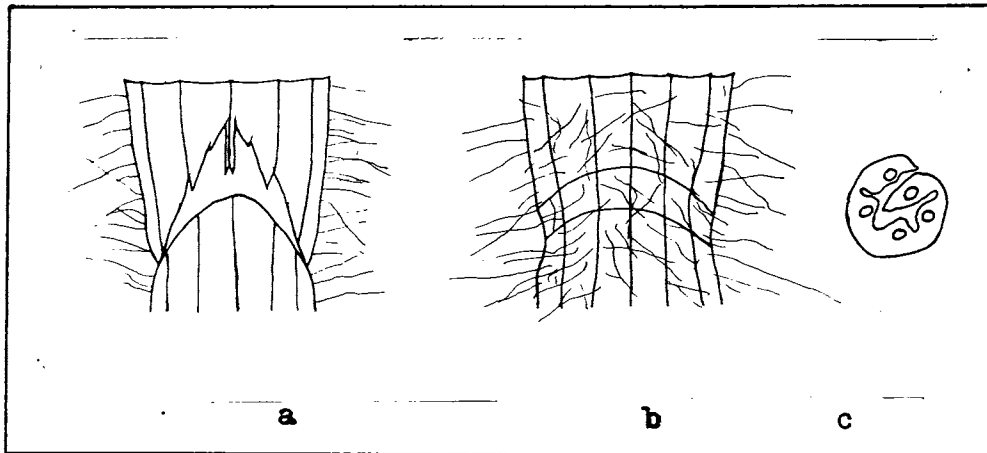


Fig. (15). Detailed drawing of Bromus tectorum X 25

- a. detail of ligule of first leaf
- b. detail of collar of first leaf
- c. cross section through an older leaf

Bromus pumpillianus Scribn. Pumpilly brome-grass

General Description.

This grass is found from New Mexico and Central Arizona to South Dakota and Alaska. It is much relished by all classes of stock and is among the most valuable of brome grasses.

Is a stout erect perennial with creeping root stocks, stems are smooth sometimes finely haired. Will thrive on variety of soil types of average moisture conditions, being common throughout the Rocky Mountains.

Palatability - 75 to 85 percent for cattle; 45 to 55 percent for sheep.

Food value - 2.9 pounds crude protein per 100 pounds green material; 18.3 pounds digestible nutrients per 100 pounds.

Seedling characteristics.

Leaf - rolled in bud

Base of first sheath - glabrous, light pink to purple

Sheath of first leaf - light to dark green, brownish toward base, fine hairs less than 1/2 mm. , length of opening wedge 2 1/2 mm.

Blade of first leaf - smooth, glabrous, veins all rather prominent; lower surface, fine hairs 1/2 mm. or less , midrib more prominent.

Margin - hairy and retrorsely toothed

Veins - 5 in all, midrib more prominent, white line
dividing midrib on upper surface.

Width - 1 to 1.5 mm., 1 cm. above collar

Length - 75 to 90 mm.

Shape and color - grass green, flat and linear, tip
acuminate, not keeled.

Texture - soft.

Ligule - truncate membrane about 1 mm. long, translucent
finely toothed, teeth forming hairs at tip.

Collar - divided by midrib, light green all the way across,
wavy, less than 1/2 mm. wide, and hairy.

Auricles - none

Roots - light tan and fine, creeping root stalks.

Nothing found on seedling characters of this grass.

Most distinguishing characteristics.

1. Rather long, truncate finely toothed ligule (1 mm.)
2. Long hairs on lower surface glabrous on upper
3. White line dividing midrib on upper surface
4. Tip of blade acuminate, not keeled.

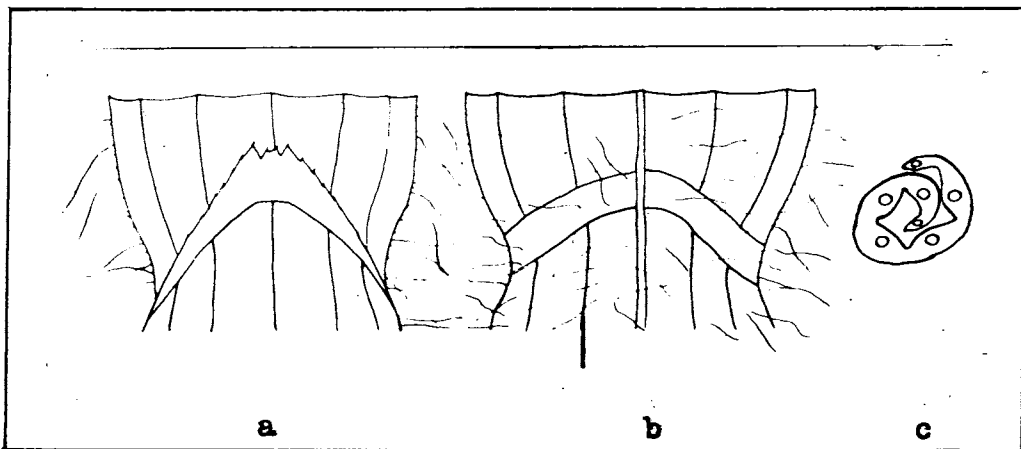


Fig. (16). Detailed drawing of Bromus pumilliamus X 25

- a. detail of ligule of first leaf
- b. detail of collar of first leaf
- c. section through older leaf

Bromus inermis Leyss. Hungarian or awnless brome-grass.

General Description.

Is a native of Europe and extends through Siberia to China. This grass is better adapted for pasture purposes than for hay. In semi-arid conditions it is the best pasture grass for cultivated lands yet discovered. It will withstand drought as well as alfalfa, the root habits prohibits uprooting and will withstand trampling. This is a long-lived perennial grass, enduring, according to Werner, twelve to thirteen months. Each plant produces many under-ground root stalks. It grows to the height of about 4 feet under favorable conditions. Each plant may possess from 100 to 200 culms, basal leaves numerous. Adapted to regions of rather low rainfall and moderate summer temperature. Prefers rich loam and clay loam but does well in sandy soil.

Palatability - 65 to 75 percent for cattle; 35 to 45 percent for sheep.

Food value - 2.9 pounds crude protein per 100 pounds and 118.3 pounds digestible nutrients per 100 pounds green material.

Seedling characteristics.

Leaf - rolled in bud

Base of first sheath - short, purplish-brown, especially at base and the veins.

Sheath of first leaf - purplish-brown, hairs just below collar, decreasing near base, hairy outside, glabrous inside, length of opening 3 to 4 mm.

Blade of first leaf - upper surface glabrous, 4 veins, 3 rather prominent, spinach green color; lower surface, hairs very prominent from base to tip. 1 to 1.5 mm. long.

Margin - minute teeth, upward

Veins - 5, rather prominent

Width - 1.5 to 2 mm., 1 cm. above collar

Length - 80 to 110 mm.

Shape - flat , acuminate tip forming keel.

Texture - soft

Ligule - toothed, hairy , about 1/2 mm. long, membrane; teeth slightly longer at center than on sides.

Collar -slightly divided by midrib, not prominent, glabrous

Auricles - none

Roots - nearly white, fine also rootstalks

It is not described by Carrier and Hitchcock, describes it as mature plant, not seedling

Most distinguishing characteristics.

1. Hairs very prominent on lower surface of leaf from base to tip , upper surface glabrous or just slightly hairy. Second leaf may be glabrous on both surfaces.

2. Very fine teeth on margin pointed upward.
3. Leaves flat, acuminate tip, boat-shaped or keeled.
4. Ligule hairy truncate and irregular
5. Much variation in hairiness.

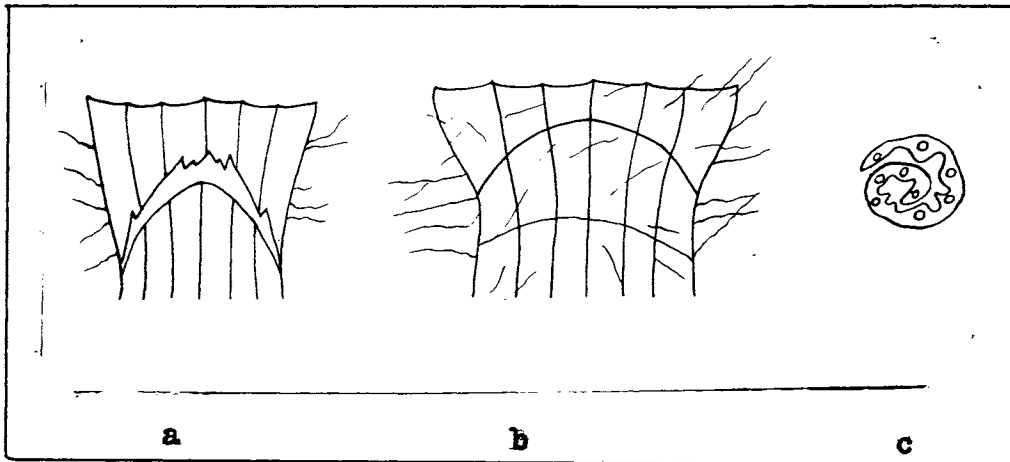


Fig. (17). Detailed drawing of Bromus inermis X 25

- a. detail of ligule of first leaf
- b. detail of collar of first leaf
- c. cross section through an older leaf

Panicum capillaria L. Old Witch-grass

General Description

Found rather widely distributed over the United States more common east of the Mississippi River. Is not of much importance as a forage crop as it is considered a weed. It is an erect growing plant from 9 to 18 inches tall. Panicles widely spreading. Found usually on dry soils and in cultivated fields coming in as a weed.

Palatability - 40 to 50 percent for cattle; 10 to 20 percent for sheep.

Food value - 4.7 pounds crude protein; 53.5 pounds digestible nutrients per 100 pounds green material.

Seedling characteristics -

Leaf - rolled in bud

Base of first sheath - light green, glabrous and shiny.

Sheath of first leaf - light green, covered with short hairs 1 mm. long, length of opening wedge 7 mm.

Blade of first leaf - upper surface glabrous, shiny, veins equally prominent, light lines between as seen by transmitted light; lower surface covered with fine hair, all veins prominent.

Margin - finely toothed upward rough to touch

Veins - 11, all prominent

Width - 4 mm., 1 cm. above collar

Length - 10 to 15 mm.

Shape and color - short flat acuminate pointed leaf.
spinach green color.

Texture - soft.

Ligule - glabrous, finely toothed membrane, margin finely haired.

Collar - very inconspicuous, all veins running through, hairy.

Auricles - none

Roots - white fine

No seedling characters found by others.

Most distinguishing characteristics.

1. Short broad leaf, upper surface smooth, lower hairy.
2. 11 veins all equally prominent, with light lines between as seen by transmitted light.
3. Very inconspicuous ligule, short and finely toothed margin of teeth hairy.
4. Inconspicuous collar, all veins running through.

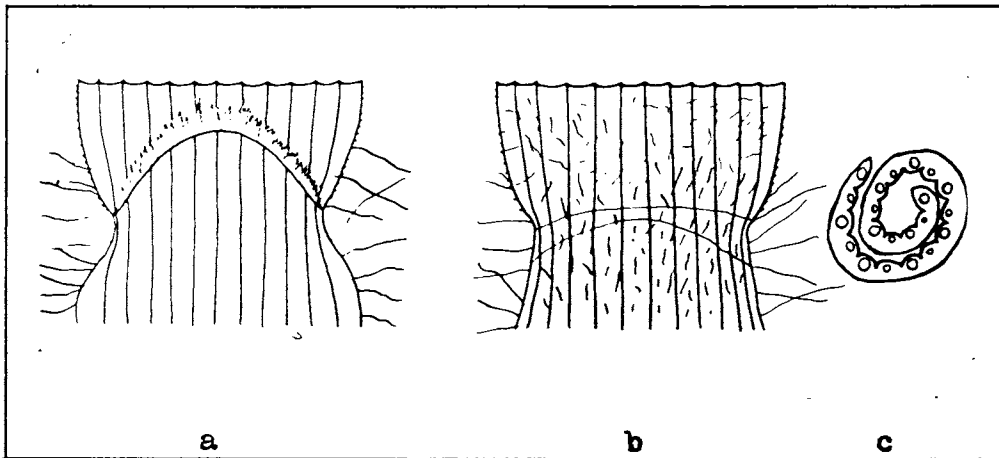


Fig. (18). Detailed drawing of Panicum capillaria X 25.

- a. detail of ligule of first leaf
- b. detail of collar of first leaf
- c. section through older leaf

Elumus triticoides Buckl. Wheat lyme-grass

General Description

This grass is a native, perennial, of this country and is an important grass from the hay standpoing and is also used a great deal for forage. It is a grass having root stocks, grows to the height of 20 to 25 inches. Due to its habit of growth and having root stocks it is not so easily killed out.

Palatability - 75 to 85 percent for cattle; 35 to 45 percent for sheep.

Food value - 2.1 pounds crude protein per 100 pounds green material; 13.6 pounds digestible nutrients per 100 pounds.

Seedling characteristics.

Leaf - rolled in bud

Base of first sheath - glabrous, a dark brownish purple

Sheath of first leaf - brownish-purple, prominent hairs narrow scarious border. Length of opening wedge 6 to 7 mm.

Blade of first leaf - upper surface yellowish green, 5 veins only three prominent. Glabrous, light lines seed by transmitted light; lower surface covered with prominent hairs, all veins rather prominent.

Margin - prominently toothed upward

Veins - 5, all rather prominent.

Width - 1 mm., 1 cm. above collar

Length - 60 to 70 mm.

Shape and color - long flat rather narrow, forming
acute tip. Vendene yellow in color.

Texture - rather stiff and rigid

Ligule - regularly toothed membrane usually 5 prominent
teeth, these retoothing prolonging into 5 hairs
membrane less than 1 mm. long.

Collar - divided by midrib, is wide and rather pronounced
Color from sheath extending into collar,
prominent hairs.

Auricles - none

Roots - white fine, gives rise to rootstalk.

Has not been worked out in detail by any worker found.

Most distinguishing characteristics.

1. Yellowish-green leaf, veins all rather prominent.
Light lines between as seen by transmitted light.
Acute tip and margin toothed pointing upward.
2. Ligule less than 1 mm. long, with regular prominent
teeth.
3. Lower surface covered with short hairs.
4. Collar wide and conspicuous.

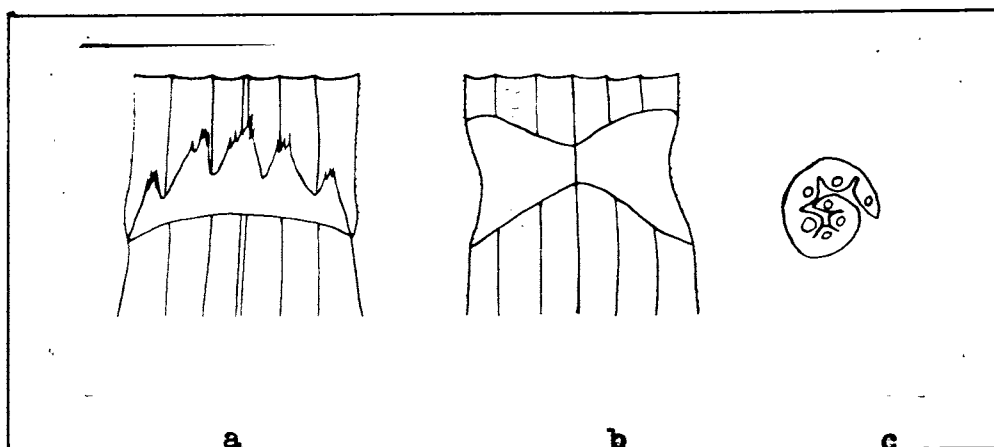


Fig. (19). Detailed drawing of Elymus tridicoides. X 25

a. detail of ligule of first leaf

b. detail of collar of first leaf

c. section through older leaf

Agropyron Smithii Rydb. Western wheat-grass.

General Description.

Is a native of practically all of the region west of the 98th meridian, from Saskatchewan to Mexico. Has properties to be a valuable hay crop especially for horses. Almost equalling timothy. This grass is often called blue stem due to the blue-green color of the herbage. Is resistant to both drought and alkali, but is seldom abundant except where the ground is naturally or artificially irrigated. The grass has rather stiff leaves similar to slender wheat, possesses creeping root stalks but has never been reported troublesome as a weed.

Palatability - 85 to 95 percent for cattle; 65 to 75 percent for sheep.

Food value - 2.2 pounds crude protein to 100 pounds green material and 27.4 pounds of digestible nutrients per 100 pounds green material.

Seedling characteristics.

Leaf - rolled in bud.

Base of first sheath - brownish-purple , glabrous.

Sheath of first leaf - glabrous, brownish-green, narrow scarious margin, length of opening wedge 7 mm. rather pronounced.

Blade of first leaf - upper surface bluish-green, papillae 3 veins only midvein prominent. Lower surface finely haired , very short but can be seen without lens.

Only midrib prominent.

Margin - finely toothed or haired

Weins - 3 only midrib prominent

Width - 1mm., 1 cm. from collar

Length - 60 to 70 mm.

Shape and color - narrow linear, thick tip slightly
folded forming acute point; light bluish-green.

Texture - somewhat stiff and rigid.

Ligule - prominently toothed membrane, teeth prolonging
into hairs, 1 mm. long.

Collar - divided by midrib very inconspicuous. Does not
extend across black, margin straight, covered with
short prominent hairs.

Auricles - none

Roots - white, fine, rootstalk present.

Similar characters found by others.

Most distinguishing characteristics.

1. Linear, thick, bluish-green leaves.
2. Prominent ligule, 1 mm. long, conspicuous teeth
3. Midrib very prominent on both upper and lower
surface.
4. Lower surface with prominent short stiff hairs
5. Collar very inconspicuous.

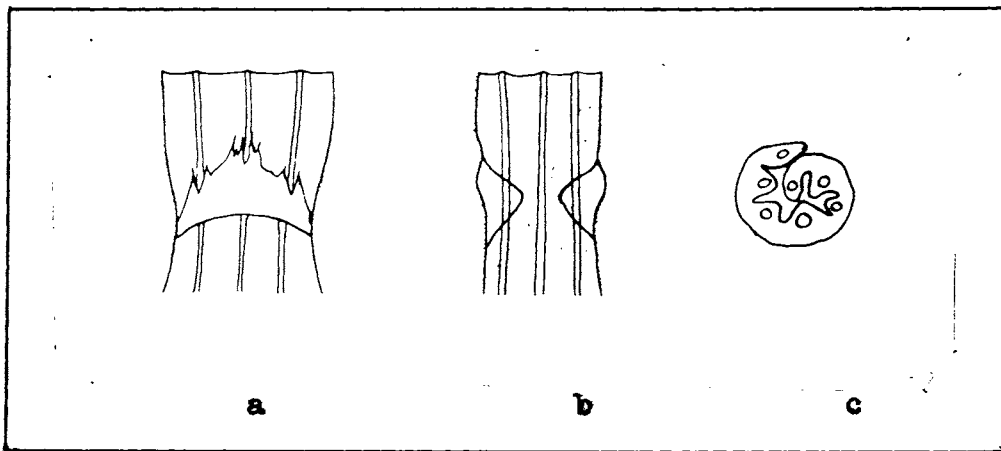


Fig. (20). Detailed drawing of Agropyron Smithii. X 25.

- a. detail of ligule of first leaf
- b. detail of collar of first leaf
- c. section through older leaf

Panicum virgatum L. Switch-grass.

General Description

Found generally all over North America, South into Central America and as far as Costa Rica. When young this grass afford good grazing, but when old or matured the stems become hard and practically worthless for fodder. On good land it is very productive. Is a perennial which grows from 2 to 7 feet high, producing numerous scaly creeping root stalks, commonly purple tinge; stems in large to small clumps or even solitary unbranched, robust, tough and hard. Grows in moist or dry soils, mostly common in meadows, along banks of streams in marshes and on moist prairie lands.

Palatability - 40 to 50 percent for cattle; 10 to 20 percent for sheep.

Food value - 4.7 pounds crude protein per 100 fresh material and 53.5 pounds of digestible nutrients per 100 pounds of fresh material.

Seedling characteristics.

Leaf - rolled in bud

Base of first sheath - glabrous, light pink

Sheath of first leaf - glabrous, reddish-purple, length of opening wedge 9 mm., hairs from second sheath extend through opening.

Blade of first leaf - upper surface shiny, glabrous, all veins equally prominent, light lines between as seen by direct light; lower surface glabrous, fine papillae, veins equally prominent with light

lines as seen by direct light.

Margin - finely toothed on narrow scarious border,
hairs long, at and below collar.

Veins - 7, all prominent.

Width - $2\frac{1}{2}$ mm., 1 cm. above collar

Length - 25 to 30 mm.

Shape and color - broad flat leaf, acuminate, tip
keeled. Light cress green in color.

Ligule - finely haired, less than $1/2$ mm. long.

Collar - very inconspicuous, divided by all the veins,
glabrous.

Auricles - none

Roots - tan, coarse, root stocks.

About same characters as found by others.

Most distinguishing characteristics.

1. Short flat leaf, 7 veins on first leaf, more on older ones.all equally prominent.
2. Sheath red, with long hairs from collar to base.
3. Ligule a fringe of fine hairs
4. Collar broad but inconspicuous.

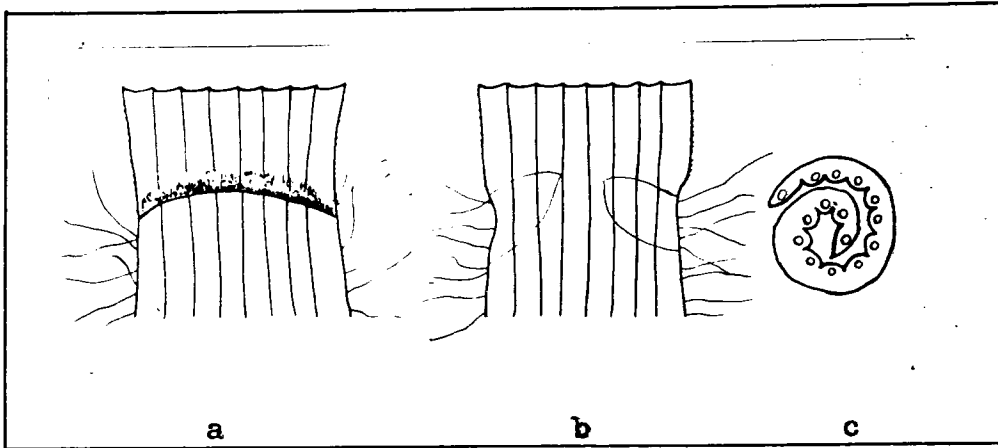


Fig. (21). Detailed drawing of Panicum virgatum. X 25.

- a . detail of ligule of first leaf
- b. detail of collar of first leaf
- c. section through older leaf.

Stipa nelsonii Scribn. Nelson's porcupine-grass.

General Description.

This grass is found from Washington and Oregon through Idaho and Utah to Colorado and Wyoming. It is only considered to be good for forage while young or the first part of the season, due to its twice bent awn formed at maturity. It grows usually in small tufts smooth and stout, 2 to 4 feet high. It thrives very well in dry, subalpine situations and also on wooded mountains on summer ranges, but may occur scatteringly in the desert ranges.

Palatability - 50 to 60 percent for cattle; 40 to 50 percent for sheep.

Food value - 2.0 pounds per 100 crude protein; 26.5 pounds per 100 of digestible nutrients.

Seedling characteristics.

Leaf-rolled in bud

Base of first sheath - glabrous, dark purple

Sheath of first leaf - glabrous, dark green same color as leaf, length of opening wedge 7 mm.

Blade of first leaf - upper surface dull dark green, papillae, 3 veins more prominent than others, light lines as seen by transmitted light; lower surface shiny green, midrib prominently border with fine teeth.

Margin - prominently toothed upward

Veins - 5 in first leaf but many in older ones.

Width - 1 mm., 1 cm. above collar.

Length - 55 to 60 mm.

Color and shape - Forest green; broad flat leaf, many leaves have slight constriction near tip. Tip acute not definitely keeled.

Texture - slightly rigid.

Ligule - glabrous, short irregular membrane less than 1/4 long, a tuft of hairs at each side.

Collar - very inconspicuous, all veins running through.

Auricles - none

Roots - light tan, fine.

No detail work done by others on this grass.

Most distinguishing characteristics.

1. Sheath of first leaf same color as leaf.
2. Older leaves many veined, all prominent on upper surface.
3. Teeth along midrib on under surface. Also margin of leaf toothed.
4. Very short many toothed ligule with tuft of hairs on each side.
5. Collar inconspicuous, does not extend to midvein.

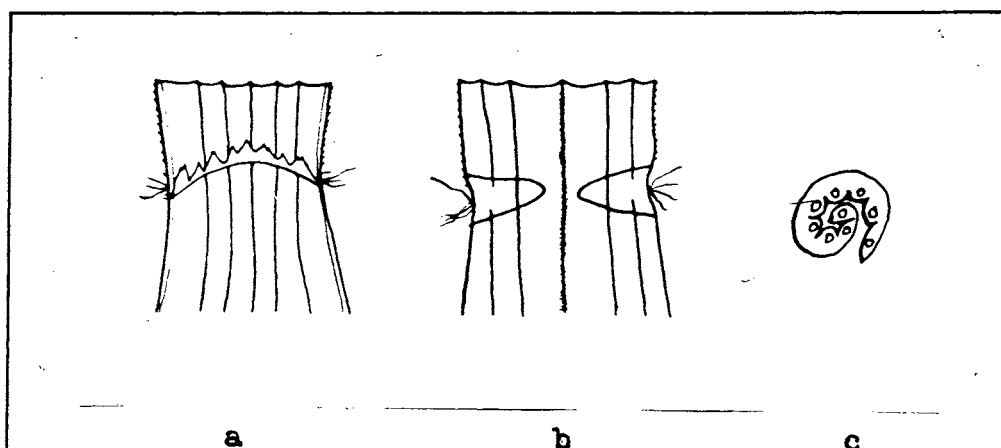


Fig. (22). Detailed drawing of Stipa nelsoni. X 25.

- a. detail of ligule of first leaf
- b. detail of collar of first leaf
- c. section through older leaf

Stipa vaseyi Scribn. Sleepy-grass.

General Description.

This grass is found more abundant in Colorado and New Mexico, is typically a southwestern grass. Is not considered a grass of any importance since it has a narcotic effect on horses. Although in years when forage was scarce it has been reported as being closely grazed. It has stout erect stems, 3 to 6½ feet high, powdery haired below the nodes and bright green in color.

Palatability - if plants are very low and only eaten when starved to it.

Food value - has not been worked out due to unimportance.

Seedling characteristics.

Leaf - rolled in bud.

Base of first sheath - pale green, glabrous

Sheath of first leaf - brownish-green at base to a green color near collar, glabrous, length of opening wedge 3 to 4 mm.

Blade of first leaf - upper surface glabrous, with prominent papillae, veins all prominent with light lines between as seen by direct light; lower surface glabrous, all veins prominent, midrib slightly more pronounced, light lines as seen by direct light.

Margin - fine teeth seen with lens.

Veins - 5, all prominent

Width - less than 2 mm., 1 cm. above collar

Length - 65 to 70 mm.

Shape and color, acute tip, long fold not keeled, narrow and linear; cedar green in color.

Texture - soft.

Ligule - glabrous, finely toothed acuminate membrane, translucent, less than 1/2 mm. long. Membranous hairs on each side of ligule 1 cm. in length.

Collar - glabrous very inconspicuous, only shown a little at edge of blade, veins all running thru.

Auricles - none

Roots - dark tan, fine.

Not considered by other workers cited.

Most distinguishing characteristics.

1. Leaves with acute tip, veins prominent on both upper and lower surfaces.
2. Short inconspicuous ligule with longhairs on each side.
3. Collar almost absent, veins all running thru.

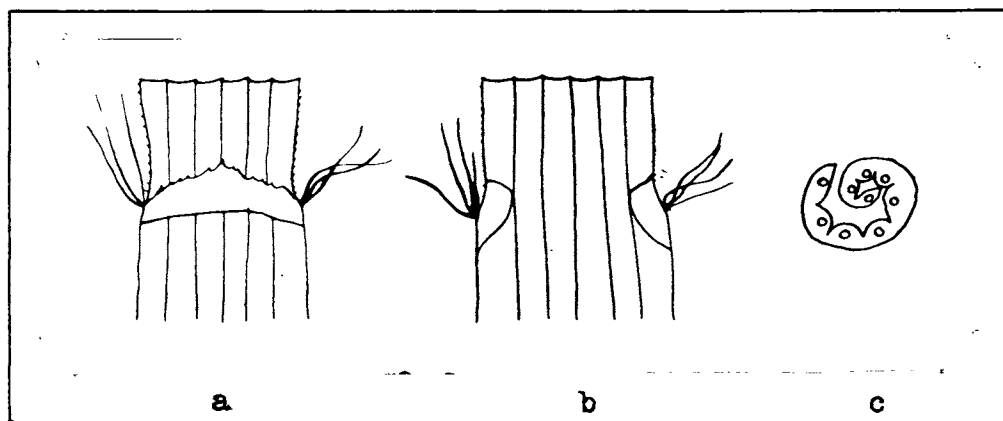


Fig. (23). Detailed drawing of Stipa vaseyi. X 25.

- a. detail of ligule of first leaf
- b. detail of collar of first leaf
- c. section through older leaf.

Festuca elatior L. Meadow fescue.

General Description.

This grass occurs naturally all over Europe and in much of the temperate Asia. It is a tame type of grass, good for pasture and very often cultivated for hay. Is perennial, grows from 1 to 3 feet high. Is better adapted to humid regions especially in Tennessee, Missouri and eastern Kansas, prefers rich moist or even wet soils but does not do so well in sandy land. It is considered especially valuable for fattening cattle. The texture is soft, hay is somewhat stemmy.

Palatability - 75 to 85 per cent for cattle; 65 to 75 percent for sheep.

Food value - 1.6 pounds crude protein and 17.7 pounds of digestible nutrients per 100 pounds green material.

Seedling characteristics.

Leaf - rolled in bud.

Base of first sheath - purplish-brown to reddish-purple.

Sheath of second leaf - narrow scarious border on margin,
length of opening wedge 3 to 4 mm. glabrous,
minute papillae.

Blade of second leaf - upper surface smooth and glabrous,
7 prominent ridges or nerves, white spaces between,
not shiny, minute papillae; lower surface smooth

and glabrous, only midvein prominent entire surface shiny, very minute papillae.

Margin - narrow , scarious, border slightly rough to touch.

Veins - 7, very prominent on upper surface but not on lower, except midrib.

Width - 2mm. , at 1 cm. above collar, leng

Length 79 to 99 mm.

Shape - acuminate margin, constricted plainly 8 to 20 mm from tip, base narrowed slightly at upper limit of collar.

Texture - soft and yielding.

Ligule - minute irregular teeth, often 1 at each end and

one in the middle, glabrous, truncate membranous, white, less than 1/4 mm. wide, margin slightly wavy.

Auricles - none

Roots - pale tan, fine.

Differences as described by L. Carrier, collar broad, continuous, veins seen in pairs.

Most distinguishing characteristics.

1. Constriction near tip of blade.
2. Shiny under leaf surface and dull upper.
3. Veins prominent above but not below
4. No hairs.
5. Short, truncate, minutely toothed ligule.

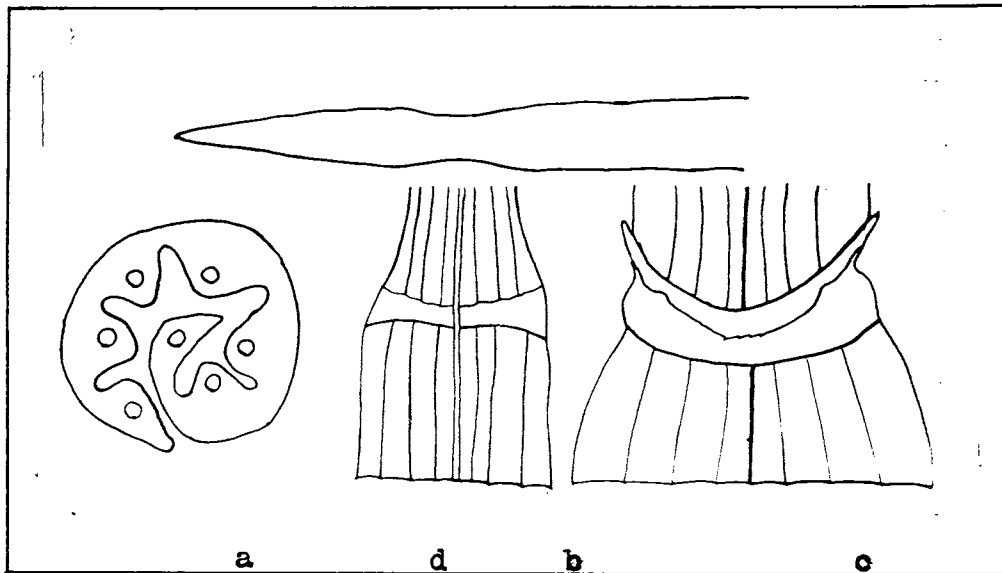


Fig. (24). Detailed drawing of Festuca elatior X25

- a. detail of ligule of second leaf
- b. detail of collar of second leaf
- c. cross section through an older leaf
- d. constriction near tip of leaf.

Agropyron repens (L.) Beauv. Quack -grass.

General Description

Also called couch, vetch, quitch or quack grass. Is a native of Europe, introduced in mixed grass seeds. Extends from Maine to Washington, most abundant east of 100th meridian. Is a much better hay than pasture plant. If plowed under it produces an abundant yield and can be pastured if care is taken not to over-graze. This grass is considered a weed due to its long creeping sharp pointed root stalks which extend in the upper foot of soil, to a distance of as much as 50 feet. The leafy stems are usually 2 to 4 feet high when fully matured. It is best adapted to a temperate, humid climate.

Palatability - 85 to 95 percent for cattle; 65 to 75 percent for sheep.

Food value - 2.2 pounds of crude protein per 100 pounds and 15.1 pounds digestible nutrients per 100 pounds green grass.

Seedling characteristics.

Leaf - rolled in bud.

Base of first sheath - light purple to brownish, short,
not compressed.

Sheath of first leaf - pale pink to brownish color, fine
seen with aid of lens, can be seen sometimes without,
length of opening 5 to 7 mm.

Blade of first leaf - upper surface finely haired near ligule, getting less hairy toward tip, a parrot-green color, veins inconspicuous, hairs shorter and on upper surface ; lower surface hairs dense near collar, midrib rather prominent, hairs very short and in lines parallel with length of leaf, hairs less than .3 mm. long.

Margin - minute teeth turned upward very inconspicuous.

Veins - 5, midvein more prominent.

Width - 1.5 mm., 1 cm above collar; length 80 to 100 mm.

Shape - linear, acute, rather thick.

Texture - soft.

Ligule - margin finely haired, irregularly toothed, membrane, truncate very short, less than 1/2 mm. long.

Collar - divided by midvein, more conspicuous border on sides than in middle, margin straight.

Roots - light tan, fine also root stalks.

Auricles - none

As determined by others.

Auricles slender and claw-like. L. Carrier

Hitchcock's description is of mature grass.

Most distinguishing characters.

1. Sheath of first leaf short, hairy and colored pink to brownish.
2. Upper surface of blade finely haired near ligule
lower surface of blade with longer hairs and in lines. Hairs seen only with lens, not shown in drawing.
3. Margin finely toothed upward, inconspicuous.
4. Ligule irregular, truncate and short
5. Leaves long narrow and acute.

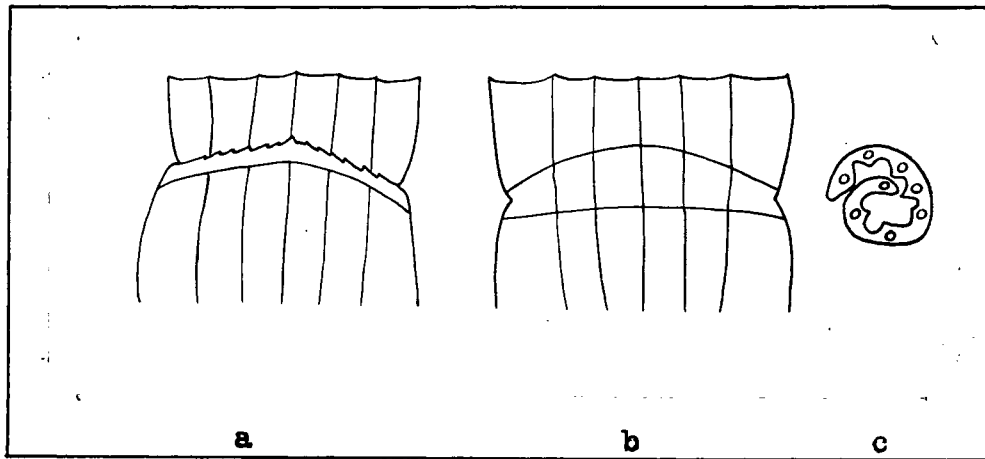


Fig. (25). Detailed drawing of Agropyron repens X 25.

- a. detail of ligule of first leaf
- b. detail of collar of first leaf
- c. cross section through an older leaf.

Agrostis maritima (var. alba). (Lam.) G. F. Mey. Creeping bent

General Description

This grass is native along the North Atlantic coast of America and Europe, and the Pacific coast from central California to British Columbia. Is the coarsest form of the Agrostis but is used a great deal for forage. Is commonly found along the coasts and is a marsh grass, for this reason being coarser than the red tops or other Agrostis.

Palatability - 70 to 80 percent for cattle; 50 to 60 percent for sheep.

Food value - 1.5 pounds of crude protein per 100 pounds fresh material. 20.2 pounds of digestible nutrients per 100 pounds.

Seedling characteristics.

Leaf - rolled in bud

Base of first sheath - brownish-purple, glabrous, coleoptile absent.

Sheath of first leaf - brownish-purple, glabrous, opening wedge 5 to 6 mm. long.

Blade of first leaf - glabrous, fine papillae, midrib most prominent, light lines on each side as seen by transmitted light; lower surface smooth, glabrous, midrib pronounced, light lines prominent.

Margin - narrow scarious broader, fine teeth near collar seen with aid of lens.

Veins - 5, only midrib prominent.

Width - about $3/4$ mm., 1 cm. above collar

Length - 45 to 50 mm.

Shape and color - grass green; narrow, short leaves,
tip acuminate, compressed to form keel.

Texture - soft.

Ligule - toothed, glabrous, translucent membranous 3
prominent teeth, one slightly longer, $3/4$ mm.

Collar - divided, almost white all the way across,
straight, less than $1/2$ mm. wide, glabrous.

Roots - almost white, fine, rootstalk present.

Did not find described by others in seedling stage.

Most distinguishing characteristics.

1. Narrow rather fine short leaves.
2. Brownish-purple sheaths at base , color extending
up sheath 12 mm. or more.
3. Rather long 3-toothed ligule
4. Creeping or stoloniferous stems.

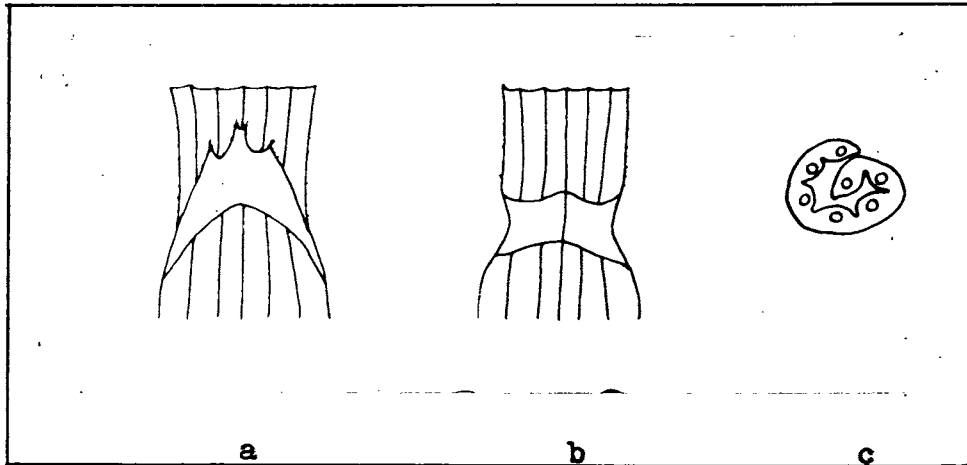


Fig. (26). Detailed drawing of Agrostis martinia X 25.

- a. detail of ligule of first leaf
- b. detail of collar of first leaf
- c. section through an older leaf

Agrostis alba L. Redtop.

General Description.

This grass is a native of Europe but became important in America before it did there. Is probably the third or fourth most important perennial grass in America used for both pastures and hay. Redtop probably has the widest range of climatic soil adaptation of any of the grasses. It thrives best in wet or moist soils, shows no marked preference for soil types. If growing isolated, makes tufts 1 to 3 feet in diameter, usually about 30 inches high. Has vigorous root stalks, shallow and 2 to 6 inches long. Under lawn conditions it is a short lived grass.

Palatability - 70 to 80 percent for cattle; 50 to 60 percent for sheep.

Food value - 1.9 pounds crude protein to 100 pounds fresh material; 23.3 pounds digestible nutrients per 100 pounds.

Seedling characteristics.

Leaf - rolled in bud.

Base of first sheath - glabrous, brownish-purple.

Sheath of first leaf - dark reddish-purple, glabrous,
length of opening wedge 5 mm.

Blade of first leaf - upper surface fine papillae, rather shiny green, midrib very prominent; lower surface smooth, glabrous, rather shiny, only midrib prominent

Margin - smooth, entire

Veins - 5, only midrib prominent

Width - 1/2 to 3/4 mm., 1 cm. above collar.

Length - 50 to 60 mm.

Shape and color - narrow linear, leaves acute, tip forming keel; spinach green.

Texture - soft.

Ligule - glabrous, translucent to white, membrane divided into 3 larger teeth, each being retooined 1 to 1½ mm. long.

Collar - divided by midrib, white; rather prominent, wavy less than 1/2 mm. wide, glabrous.

Auricles - none

Roots - very light tan, fine, rhizomes present.

Characters found by others

Margin rough - L. Carrier.

Most distinguishing characteristics.

1. Long, sharply toothed ligule
2. Dark reddish purple sheath, color extending up from base 12 to 14 mm.
3. Narrow prominent collar
4. Rather dark shiny leaves with vein rather prominent on upper surface
5. Rhizomes.

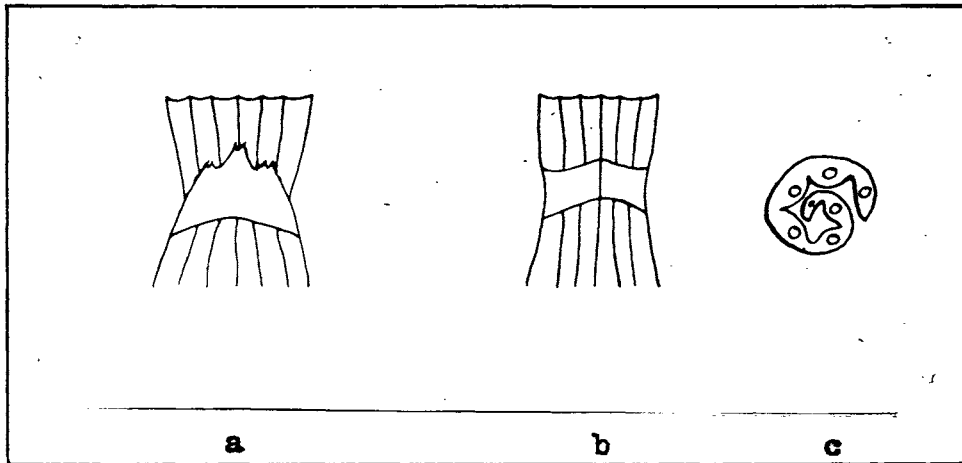


Fig. (27). Detailed drawing of Agrostis alba X 25

a . detail of ligule of first leaf

b. detail of collar of first leaf

c. section through older leaf.

Phleum pratense L. Timothy.

General Description.

This is a native of Europe and is one of our most important cultivated meadow grasses. Is used for hay extensively as well as meadow pastures. It is a perennial, culms in tufts somewhat bulbous at base, erect, smooth, grows to 2 to 3 feet high. Timothy is a northern grass and does not succeed in the United States south of latitude 36°, excepting at higher elevations. It is more cold-resistant than most cultivated grasses and will survive winters when other hardy grasses are destroyed, best adapted to clay or loam soils. Not very drought-resistant.

Palatability - 80 to 90 percent for cattle; 70 to 80 percent for sheep.

Food value - 1.5 pounds crude protein per 100 pounds and 22.2 pounds digestible nutrients in 100 percent green material.

Seedling characteristics.

Leaf - rolled in bud

Base of first sheath - light purple to light green, not compressed.

Sheath of first leaf - pale yellowish-green, glabrous, length of opening wedge 8 to 10 mm.

Blade of first leaf - upper surface fine papillae, 3 veins

all prominent, light lines between; lower surface
glabrous, midrib prominent.

Margin - toothed, very fine and scattered.

Veins - 3, all rather prominent

Width - 2 mm., 1 cm. above collar.

Length - 50 to 70 mm.

Shape - rather broad flat leaf, keeled at tip.

Texture - soft.

Ligule - irregularly toothed, white membrane, slightly
hairy, teeth larger in middle 1/2 to 3/4 mm. long.

Collar - straight, glabrous, divided by veins all running
thru, rather inconspicuous, almost same color as blade.

Auricles - none

Roots - light tan, fine, no rootstalks.

As described by others

Collar broad and continuous - L. Carrier

Blade rough on margin.

Most distinguishing characteristics.

1. All 3 veins rather prominent on upper surface
glabrous and rather shiny.
2. Rather broad, bluish-green blade with rather
strongly keeled tip
3. Irregularly toothed ligule, 12/ to 3/4 mm. long.
4. Inconspicuous collar all the veins running thru.

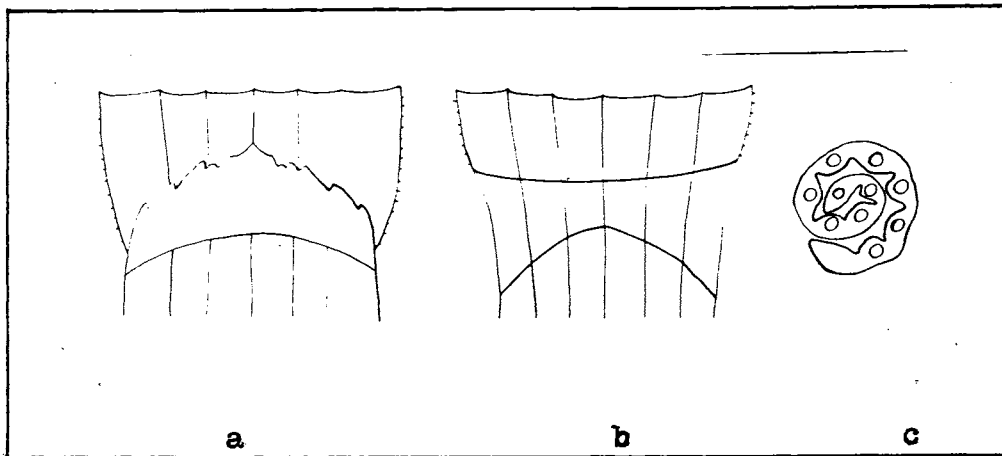


Fig. (28). Detailed drawing of Phleum pratense X 25.

a. detail of ligule of first leaf

b. detail of collar of first leaf

c. cross section through an older leaf.

Agrostis vulgaris Withering. Rhode Island bent or fine Bent.

General Description.

This grass is a native of Europe. Is most common and abundant in this country in New England, and New York. It extends southward to Virginia and westward to Pacific coast. Has been a valuable pasture grass since first mentioned, 1747 by Eliot. This grass is adapted to well drained soils. It thrives equally well on clay and sandy soils. In the open it forms dense masses of turf 1 to 3 feet in diameter. In the shade its stoloniferous habits are more pronounced than in the open. It sometimes grows to 18 inches in height.

Palatability - 70 to 80 percent for cattle; 50 to 60 percent for sheep.

Food value - 2.0 pounds of crude protein per 100 pounds of green material and 25.1 pounds digestible nutrients per 100 pounds.

Seedling characteristics

Leaf - rolled in bud.

Base of first sheath - glabrous pale green, almost white.

Narrow scarious border, length of opening wedge 4 to 5 mm.

Blade of first leaf - upper surface light green, midrib prominent, light lines seen by direct light, surface glabrous; lower surface dark shiny green, only midrib prominent.

Margin - finely toothed, upward, rough to touch.

Veins - 5 in all, only midrib prominent.

Width - 1/2 to 3/4 mm., 1 cm. above collar.

Length - 50 to 60 mm.

Shape and color - long narrow blades, slight constriction near tip; tip being acute and keeled. Light green.

Texture - soft.

Ligule - glabrous irregularly toothed, truncate, membrane 3/4 mm. teeth very short, translucent.

Collar - divided by midrib, almost white and rather prominent margin straight and glabrous.

Auricles - none

Roots - light tan fine, stoloniferous.

Did not find it described in seedling stage by others.

Most distinguishing characteristics.

1. Narrow rather long rather narrow leaf with slight constriction near tip, tip keeled.
2. Rather long truncate ligule with short irregular teeth
3. Base of sheath not colored
4. Tillering and stoloniferous habits.

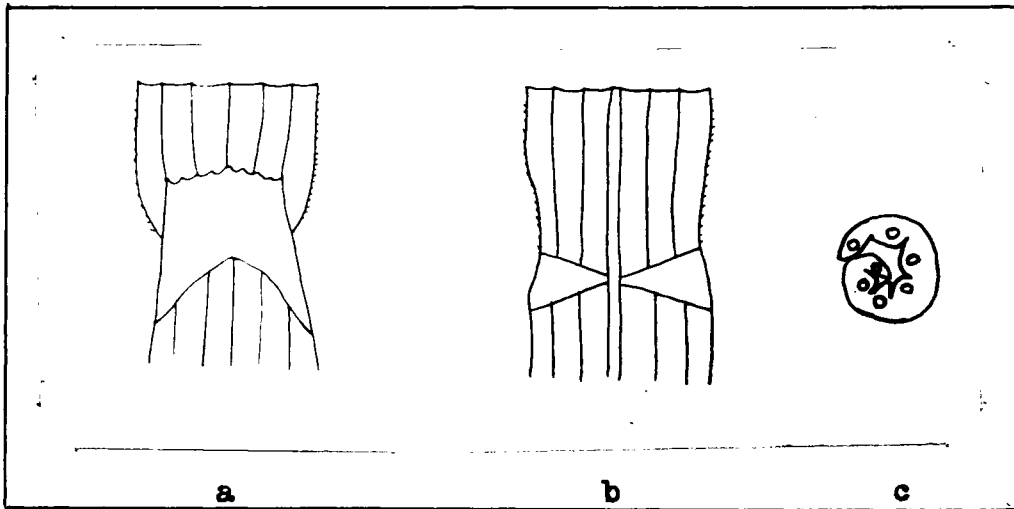


Fig. (29). Detailed drawing of Agrostis vulgaris X 25.

- a. detail of ligule of first leaf
- b. detail of collar of first leaf
- c. cross section through an older leaf

Lolium italicum L. Italian rye-grass.

General Description.

This grass is a native of southern Europe, northern Africa and Asia minor. It is not an important grass from the grazing standpoint but for hay it is very important. It is remarkable for the number of cuttings that can be made under favorable conditions during each season. It is a short-lived grass, seldom living over two years, is a very rapid growing grass and will recover promptly after cutting. This grass is primarily adapted to moist regions with mild winter temperature. In North America it does best in the Atlantic states and on the Pacific coast.

Palatability - 75 to 85 percent for cattle; 35 to 45 percent for sheep.

Food value - 1.8 pounds crude protein per 100 pounds and 16.1 pounds of digestible nutrients per 100 pounds of fresh green grass.

Seedling characteristics

Leaf - rolled in bud

Base of first sheath - purple to brownish-green.

Sheath of first leaf - midrib not prominent, forms white line along each side of ridge. Length of opening wedge 5 to 7 mm. long. Margin scarious border.

Blade of first leaf - upper surface smooth, glabrous, 5 prominent ridges; lower surface, glabrous smooth, 5 ribs , midrib prominent, rather shiny.

Margin - entire narrow, scarious

Veins - 5, all rather prominent

Width - 3 mm., 1 cm. above collar

Length - 90 to 120 mm.

Shape - tip acute, blade linear and flat.

Texture - soft.

Ligule - irregular and glabrous, thin and transparent membrane, truncate less than .5mm. long.

Collar - divided by midrib, almost white.

Some characters found by others.

Most distinguishing characteristics.

1. Shiny dark green blade.
2. Veins all prominent
3. Tip acute not keeled
4. Ligule short
5. Narrow scarious, margin of blade finely toothed.

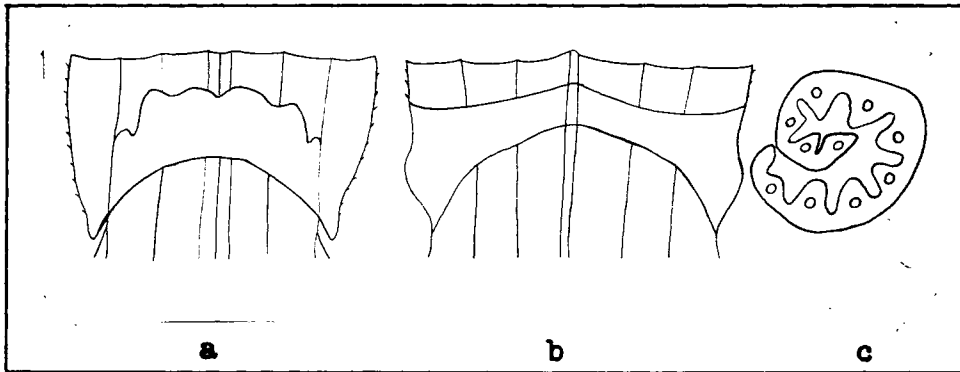


Fig. (30). Detailed drawing of Lolium italicum X 25.

- a. detail of ligule of first leaf
- b. detail of collar of first leaf
- c. section through an older leaf

Arrhenatherum elatius (L.) Beauv. Tall oat-grass.

General Description

This grass is a native of southern Europe and northern Africa. Tall oat grass is not an important grass in America but is in Europe. It is a tall perennial with narrow panicles of spikelets. Culms erect, often cultivated as a meadow grass but in many places is considered a weed. It will not endure very cold weather, but will withstand a great deal of summer heat. Is one of the most drought-resistant grasses being cultivated. Will yield well on very poor land providing it is well drained. Will not do well in wet places.

Palatability - 65 to 75 percent for cattle; 55 to 65 percent for sheep.

Food value - 1.1 pounds per 100 pounds crude protein and 15.3 pounds per 100 pounds digestible nutrients.

Seedling characteristics.

Leaf-rolled in bud.

Base of first sheath - yellowish green.

Sheath of first leaf - midrib and two outer ribs purple,

8 to 10 mm. up from base, length of opening wedge

10 to 15 mm.

Blade of first leaf - upper surface - fine papillae, midrib prominent; lower surface smooth, glabrous, 3 prominent veins.

Margin - very finely toothed pointing upward , rough to touch, border scarious.

Veins - 3, prominent

Width - 2 mm., 1 cm. above collar

Length - 60 to 90 mm.

Shape, tip keeled , blade flat and long

Texture - slightly rigid.

Ligule - irregularly toothed, glabrous membrane 1 mm. long, thin and white almost transparent.

Collar - divided by midrib, green almost continuous, rather inconspicuous, margin wavy, finely papillae.

Auricles - none

Roots - light tan and fine.

Differences determined by others

Nerves in pairs, not prominent - L. Carrier

Leaves scabrous on both surfaces - Hitchcock.

Most distinguishing characteristics.

1. Light green color
2. Culms and sheath slightly compressed
3. Only 3 veins in first leaf
4. Early and abundant tillering
5. Long ligule, prominent wedge-shaped point at center.
Often on each side.
6. Rapid growth in height.

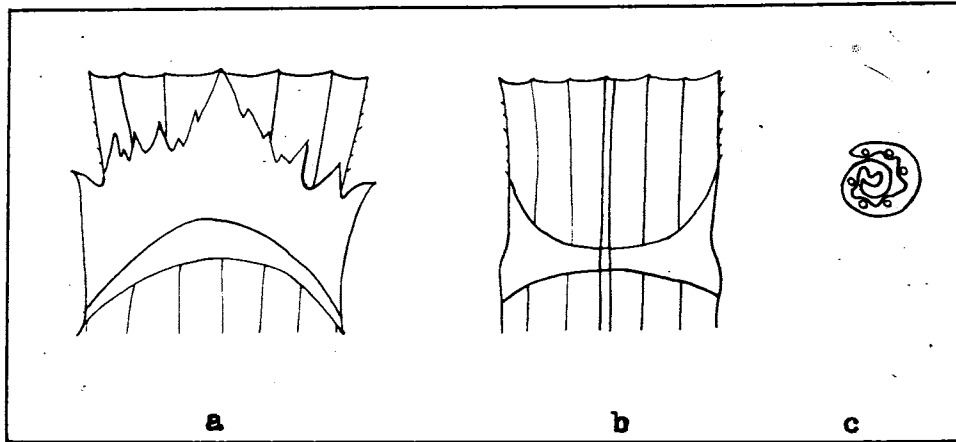


Fig. (31). Detailed drawing of Arrhenatherum elatius X 25

- a. detail of ligule of first leaf
- b. detail of collar of first leaf
- c. section through an older leaf

Agropyron spicatum (Pursh.) Scribn. and Smith.

Blue bunch wheat-grass.

General Description.

Called bunch grass or more distinctly blue bunch wheat grass. It is a native of this country and is common in the Columbia Basin where it is one of the chief range grasses. Is of especial value as a forage grass. This is a bunch grass without rootstalk, having slender, usually bluish colored stems. In arid places it seldom gets over 12 to 18 inches high but will attain a height of 3 feet on rich soils. It does well on dry hills and mountains between 5,000 and 6,000 feet.

Palatability - for cattle 85 to 95 percent; for sheep 65 to 75 percent.

Food value - 2.2 pounds crudeprotein to 100 pounds fresh material; 27.4 pounds of digestible nutrient per 100 pounds.

Seedling characteristics.

Leaf - rolled in bud.

Base of first sheath - glabrous , dark brownish-purple

from base to collar, length of opening wedge 1 cm. long.

Blade of first leaf - upper surface glabrous, fine papillae

all veins rather prominent, dark green; lower surface glabrous shiny, only midvein prominent, light lines on each side as seen by transmitted light.

Margin - finely toothed upward, rough to touch.

Veins - 5, all prominent

Width - 1mm., 1 cm. above collar.

Length - 60 to 70 mm.

Color and shape - civit green; flat rather broad leaf,
veins very prominent on older leaves, tip acute
just slightly keeled.

Texture - slightly stiff and rigid.

Ligule - glabrous, prominently toothed white membrane less
than 1/2 mm. long.

Collar - very prominent divided by midvein glabrous,
margin straight.

Auricles - none

Roots - very light tan - almost white, fine.

No work found on seedling characters.

Most distinguishing characteristics.

1. Dark green, leaf prominently toothed margin
2. White ligule deeply cleft forming large teeth
or lobes with apex of each finely toothed.
3. Veins all prominent on upper surface only midrib
on lower.
4. Collar very conspicuous.

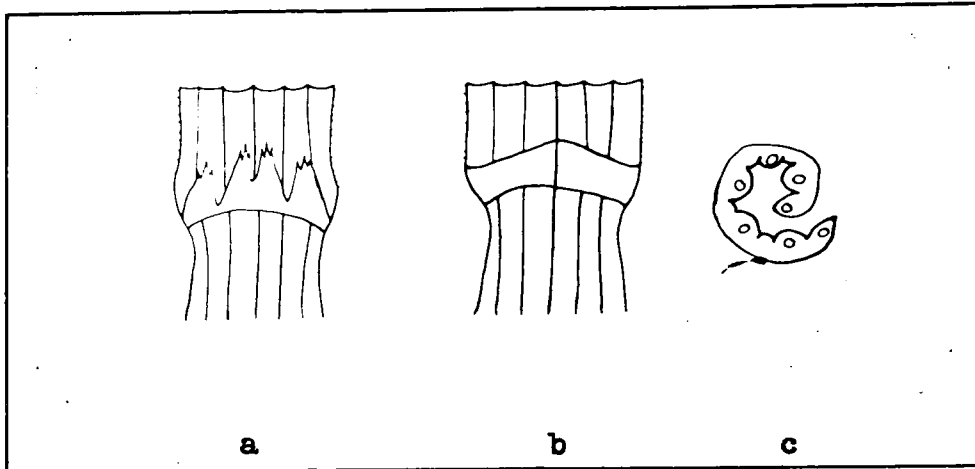


Fig. (32). Detailed drawing of Agropyron spicatum. X25

a. detail of ligule of first leaf

b. detail of collar of first leaf

c. section through older leaf.

Calamovilfa longifolia (Hook) Hack. Sand-grass.

General Description.

Found more commonly in ranges from west Ontario to Maine, east Montana to extreme northeast New Mexico, Kansas, and northern Indiana. It is a coarse grass and not considered an especially good forage grass but is often used for hay. It has solitary, erect stout smooth stems 2 to 6 feet high. Does best in sandy and dry sterile soil at elevations up to about 5,000 feet.

Palatability - 10 to 20 percent for cattle; 0 to 10 percent for sheep.

Food value - is rather low and has not been worked out, not an important grass.

Seedling characteristics.

Leaf - rolled in bud.

Base of first sheath - glabrous, light tan, almost white.

Sheath of first leaf - dark purple, glabrous, opening wedge
11 mm. very conspicuous.

Blade of first leaf - upper surface glabrous, all veins prominent with light lines between as seen by direct light; surface rather shiny; lower surface shiny, all veins prominent with light lines between as seen by direct light.

Margin - narrow, scarious border finely toothed upward.

Veins - 5, all prominent.

Width - 1mm., 1 cm. above collar

Length - 45 to 55 mm.

Color and shape, grass green; narrow linear leaves with acute tip forming slight keel.

Texture - rigid.

Ligule - irregularly toothed, translucent membrane about 1/2 mm. long, many teeth prolonging into hairs.

Collar - inconspicuous divided by all the veins, glabrous.

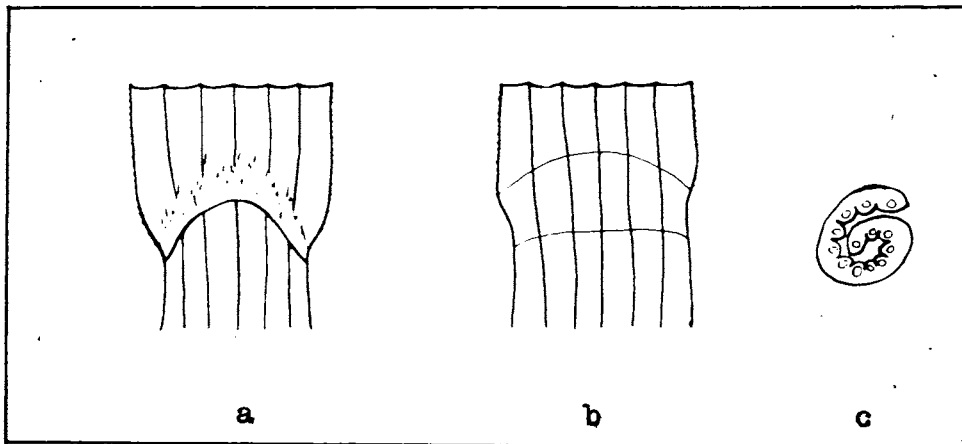
Auricles - none

Roots - white and fine, has stout horizontal root stalks.

Seedling characteristics not worked by others.

Most distinguishing characteristics.

1. Sheath of first leaf dark purple from base to collar opening wedge very pronounced.
2. Light lines prominent seen by direct light on both upper and lower surface.
3. Ligule irregularly toothed, teeth prolonging into hairs, collar very inconspicuous.
4. Long hairs on sheath of second leaf.



Fib. (33). Detailed drawing of Calumovifla longifolia X25

a. detail of ligule of first leaf

b. detail of collar of first leaf

c. section through older leaf

Agropyron tenerum Vasey. Slender wheat-grass.

General Description.

This is the only grass that is a native of America that has proven valuable under cultivation. Very important as a hay crop and is also a good pasture grass. This is strictly a bunch grass with numerous slender erect stems 2 to 4 feet high with narrow, flat rather stiff leaves. Root system found to be quite deep. Was first brought into cultivation about 1895.

Palatability - 85 to 95 percent for cattle; 65 to 75 percent for sheep.

Food value - 2.2 pounds crude protein per 100 pounds green material and 27.4 pounds digestible nutrients per 100 pounds.

Seedling characteristics.

Leaf - rolled in bud.

Base of first sheath - from a light purple at base to a brown near collar, glabrous, length of opening wedge 4 to 6 mm.

Blade of first leaf - upper surface glabrous, 5 veins all prominent also prominent light lines between veins as seen by direct light; surface shiny; lower surface smooth and glabrous, all veins rather prominent, midvein more so, dark shiny green.

Margin - very finely toothed on narrow scarious border
seen with lens.

Veins - all rather prominent

Width - 1 to $1\frac{1}{2}$ mm., 1 cm. above collar

Length - 65 to 75 mm.

Shape and color - chromium green; acute tip not
prominently keeled, narrow and linear.

Texture - a little stiff and rigid.

Ligule - toothed, glabrous membrane, 4-lobed each lobe
finely pointed prolonging into hairs, less than $1/2$
mm. long, translucent.

Collar - divided but not very prominent, margin straight
and glabrous.

Auricles - none

Roots - light tan, fine.

Most distinguishing characteristics.

1. Truncate, prominently toothed ligule
2. Color of sheath extending up to first leaf
3. All veins prominent on upper surface with light
lines as seen by direct light.
4. Rather stiff, erect, acutely pointed blade.

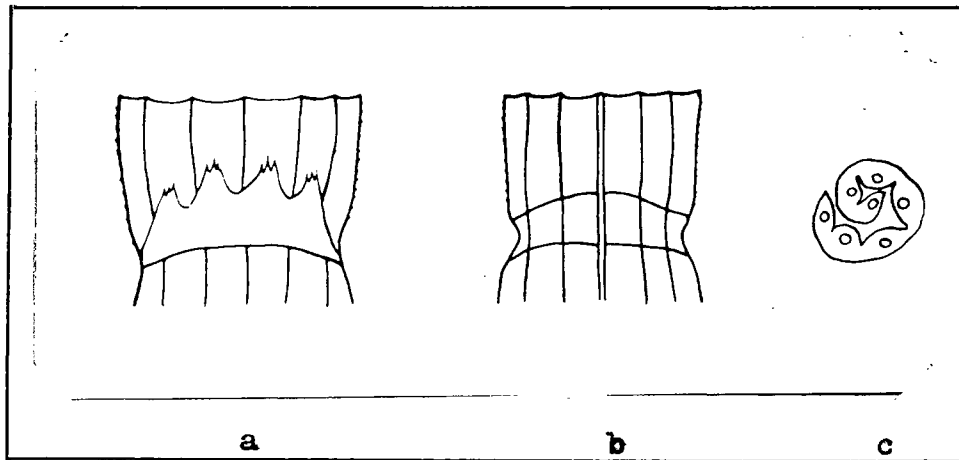


Fig. (34). Detailed drawing of *Agropyron tenerum* X25
a. detail of ligule of first leaf
b. detail of collar of first leaf
c. section through an older leaf.

Elymus canadensis L. Wild rye

General Description.

The grass is considered a good hay crop and is a native of Europe also used as forage crop when young, not so palatable when older. The habits of this grass are very similar to the other members of the genus. It being a stout stemmed grass growing from 15 to 30 inches high. Grows usually in bunches but does not have root stalks. Is found across continent northward and southward through our range to New Mexico and Texas.

Palatability - 75 to 85 percent for cattle; 35 to 45 percent for sheep.

Food value - 2.1 pounds crude protein per 100 pounds green material; 13.6 digestible nutrients per 100 pounds.

Seedling characteristics.

Leaf - rolled in bud.

Base of first sheath - glabrous, purplish green color prominent along veins

Sheath of first leaf - glabrous, dark purplish green, fine papillae, length of opening wedge 2 to 3 mm.

Blade of first leaf - upper surface, 5 veins dark green ridges, light lines between as seen by direct light. Lower surface glabrous, dark green, midrib more prominent.

Margin - finely toothed upward seen with lens.

Veins - 5, all prominent on upper surface.

Width - 2 mm., 1 cm. above collar

Length - 40 to 50 mm.

Shape and color - rather short, flat broad leaf , folded

to form keeled or boat-shaped tip. Spinach green.

Texture - rough.

Ligule - regularly toothed membrane less than 1/2 mm.

long, teeth prolonging into fine hairs, membrane white.

Collar - divided by midrib but very inconspicuous margin
wavy and glabrous.

Auricles - none

Roots - light tan, fine no rootstalks.

Nothing found by others.

Most distinguishing characteristics.

1. Leaf dark green, broad, 5 prominent veins, keeled tip.
2. Short but prominently toothed ligule.
3. Purple sheath of first leaf very conspicuous.
4. Has tillering habits of growth.

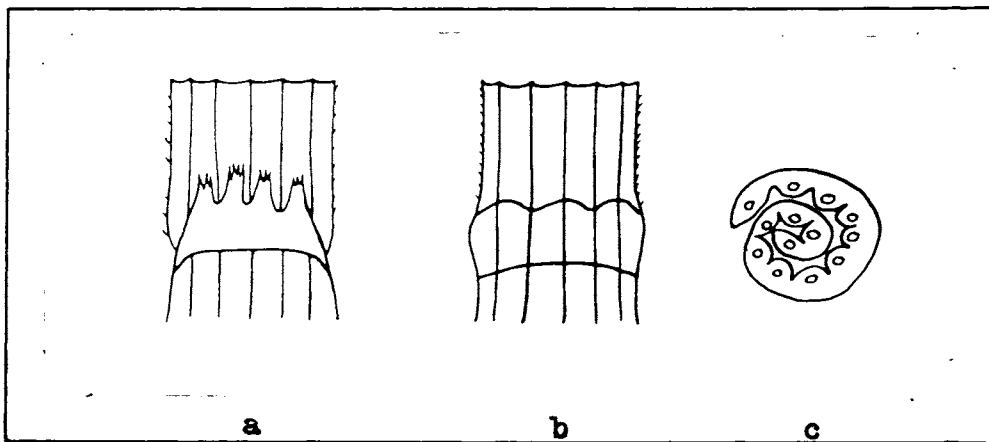


Fig. (36). Detailed drawing of *Elymus canadensis*. X. 25

a. detail of ligule of first leaf.

b. detail of collar of first leaf

c. section through an older leaf

Andropogon nutans (L.) Nash Indian-grass.

General Description.

This species is found in prairie and open wood lands throughout the eastern United States and southwestward to Arizona and Mexico. It is common constituent of prairie hay in the eastern part of the great plains. It is a tall erect grass 3 to 8 feet tall, with handsome bronze-colored panicles as much as a foot long. Generally in dry soil, it thrives best on rich prairie bottoms.

Palatability - 65 to 75 percent for cattle; 45 to 55 percent for sheep.

Food value - 3.1 pounds crude protein per 100 pounds green material; 47.9 pounds digestible nutrients per 100 pounds green material.

Seedling characteristics.

Leaf - rolled in bud

Base of first sheath - glabrous, scarlet red.

Sheath of first leaf - glabrous, scarlet red, extending through collar, then along margin of leaf to tip.

Length of opening wedge 6 mm.

Blade of first leaf - upper surface glabrous, midrib most prominent, all veins rather inconspicuous light lines as seen by transmitted light; lower surface glabrous, 3 ribs equally prominent.

Margin - very finely toothed upward, rough to touch.

Veins - 5, not especially prominent.

Width - 1p mm., 1 cm. above collar.

Length - 25 to 30 mm.

Shape and color - smooth flat leaf, with long acute point, parrot green color, blended with scarlet.

Texture - rather soft.

Ligule - glabrous finely toothed membrane, very much reduced less than 1/2 mm. long.

Collar - glabrous, very inconspicuous, all veins running through .

Auricles - none

Roots - tan, fine.

No work found on seedling characteristics.

Most distinguishing characteristics.

1. Smooth reddish-green leaf with long acute tip, sheath scarlet.
2. Ligule finely toothed, much reduced, very inconspicuous.
3. Collar very inconspicuous.
4. Veins rather inconspicuous

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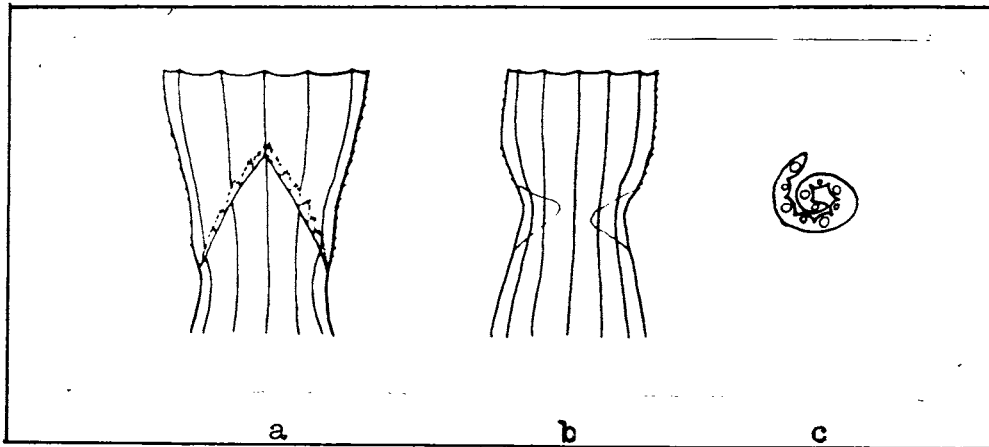


Fig. (36). Detailed drawing of Andropogon nutans. X25

- a. detail of ligule of first leaf
- b. detail of collar of first leaf
- c. section through older leaf