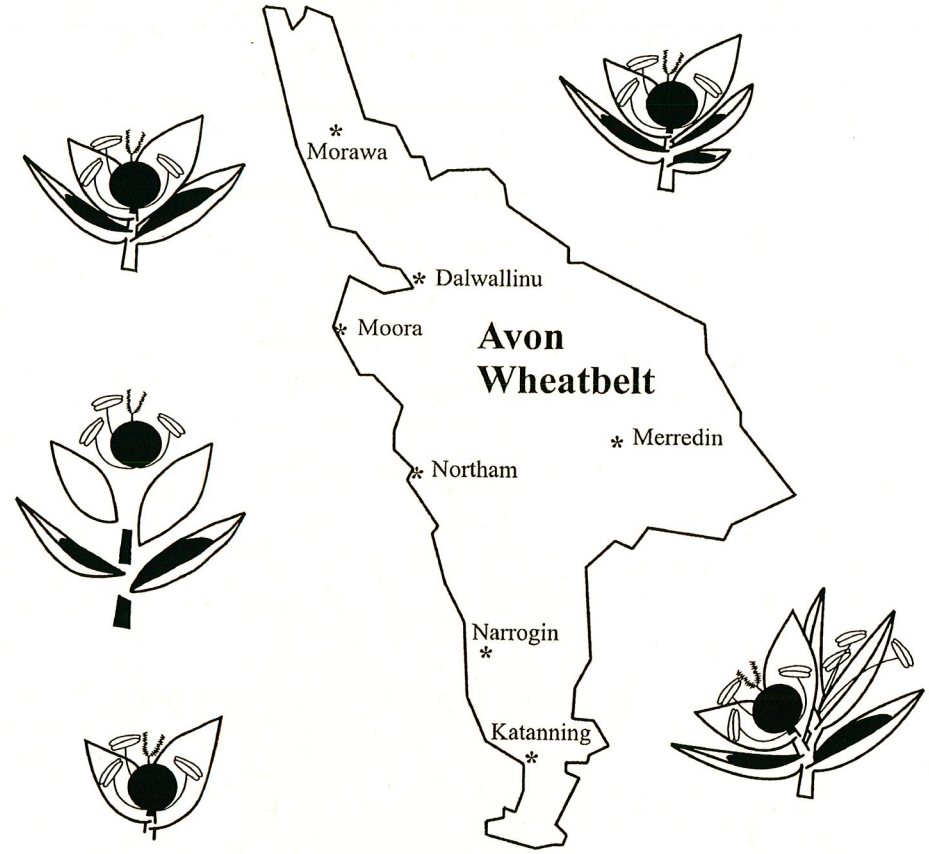

An Illustrated Key to the PERENNIAL GRASSES of the Avon Wheatbelt Western Australia

Alexander R. Williams

An **Illustrated Key** to the **Perennial Grasses** of the Avon Wheatbelt of Western Australia

by

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Department of Conservation and Land Management
Perth

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Bentley Delivery Centre, WA 6983

CONTENTS

Preface

Plant taxonomy, the study and process of naming and classification, is often a mystery to the uninitiated. It seems to be steeped in jargon, slow to produce results and there is a false perception that taxonomists change the names of plants too frequently.

The real story in Western Australia is that herbarium studies have been caught short by a downturn in funding and other support leaving a huge task to unravel old names and publish necessary new ones. The flora is richer than most people realise and it is very difficult to identify species of vascular plants. There remains so much to be done by a diminishing supply of trained taxonomists who seek to underpin conservation of WA's biodiversity.

Grasses pose a special problem. They are difficult to identify because they lack large flower parts, are highly modified for wind pollination and as a result are not often attractive. Despite their lack of general appeal their often densely tufted growth form, deep roots in the case of perennials, varying degrees of salt tolerance and high productivity provide particularly important conservation values. The native WA grasses tend to grow as perennial tufts that offer shelter and an indirect or direct source of food for many native animals.

Most conservationists cannot easily separate native grasses from the weedy ones so this identification guide provides a long needed guide to these important organisms. This guide to the perennial native grasses of the Wheatbelt of WA is published by the CALM Herbarium to address the long felt need to be able to identify grasses so that we can learn more about the conservation role of native flora.

Alexander Williams, a "volunteer" herbarium botanist, has applied his long-term interest in grasses and used his considerable illustration skills to produce this valuable publication. His aim to provide a useful learning tool for interested members of the community has come to fruition and it is hoped that it is a precursor to more such guides to assist conservation.

Dr Neville Marchant
director, Western Australian Herbarium
Perth, February 7, 2001

Introduction

The purpose of this booklet is to raise awareness of perennial grasses as important players in the rehabilitation of wheatbelt land. If you are interested in replanting trees to reverse the effects of soil salinisation and erosion then please also consider replanting perennial grasses. They are a crucial part of the natural environment that is often overlooked.

On every continent grasses are the foundation of the human food chain (wheat, rice, maize etc) and the mainstay of our farming and grazing industries. Yet they remain notoriously difficult to identify, even for professional botanists. This is largely due to their small and obscure flower structure and the specialised terms that are required to describe them.

This booklet has been prepared with the layman in mind. It uses only the most obvious and easily accessible characters to identify the species and the important information at each step is illustrated.

We have the resources to restore our land and create a sustainable lifestyle for ourselves and our descendants. Grasses are one of those precious resources. Let's use them well!

HOW TO USE THIS KEY

You will need the **flowering head** (inflorescence) and **a whole stem with leaves and the leaf and stem bases**, and the **root system** if it has a bulb or a rhizome. To avoid killing the plant it is often possible to remove part of the tussock.

A **hand lens, magnifying glass** or **stereo-microscope** will be needed to see the small features of the flowers. A pair of fine **tweezers**, a **needle** and a **sharp blade** are helpful for pulling the flowers apart (dissecting them). If the specimen is dry and too brittle to dissect then soak it for a few minutes in water that has had a drop of detergent added. Always examine more than one example of the character you are looking at to get an idea of the range of variation.

Study the page entitled "**CHARACTERS USED IN THIS KEY**" to get a feel for what you will be looking at. The **glumes** and the **fertile lemma(s)** are the most important characters to look for. Also, find the **GLOSSARY** that follows, so you will know where to look to check the meaning of technical words.

The key begins on page 1, entitled "**KEY TO THE FOUR TYPES OF INFLORESCENCE**". Decide which group your specimen belongs to then go to the appropriate **GROUP KEY** on the following pages.

The **GROUP KEYS** are set out in dichotomous format, which means that at each numbered step you have to make only one decision between only two choices. In each case the same number is attached to both options of the couplet and they occur next to one another on the page. For example, the third couplet in **GROUP 1** is "3. Spikelets with more than one fertile lemma ...5" and the alternative is "3. Spikelets with only one fertile lemma ...4". What you have to do at this step is to identify the fertile lemma(s) and count them. If there is more than one, then you jump to step 5. Step 5 is flagged with "...FROM 3" to show you where you need to jump to, or conversely, where you jumped from, in the case where you need to work backwards through the key to recall the choices you have already made. If there is only one fertile lemma, then you continue on to step 4.

Work through the choices in the **GROUP KEY** until you reach a **genus name** printed in *italics*. Then go to the alphabetically listed **GENUS KEYS** and follow the same dichotomous key procedure to find the **species**. When only one species is listed for a genus in the wheatbelt area it is identified in the **GROUP KEY** and does not appear in the alphabetically listed **GENUS KEYS**.

The **DISTRIBUTION** of the species is given in brackets underneath or beside each species name. Three botanical regions are recognized in WA (Southwest, Eremaean & Kimberley – see Location Map). For simplicity, only four kinds of distributions are recognized in this book:-

Southwest = restricted mainly to the Southwest
Eremaean = occurs mainly in the Eremaean region but with some occurrences in the wheatbelt
Southwest & Eremaean = distributed across these two regions
Statewide = occurs throughout the state.

Only current scientific names are used in the keys. An index of scientific names, common names and obsolete scientific names is given at the back of the book. Introduced plants are distinguished by a leading asterisk (*).

If your specimen does not match the description or the illustration, then try starting again, or perhaps just browse through the whole book. The more you look at grasses, and the more you look at different kinds of grasses, the better you will be able to distinguish their features. Then, after browsing, try the keys again.

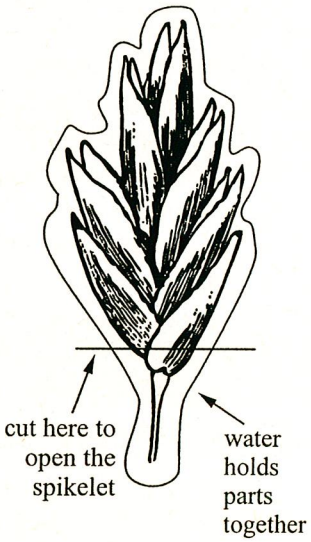
If you still cannot obtain a name for your specimen then check that it is a perennial grass. Perennial grasses will have some old stems or roots left over from the previous year's growth. Annual grasses will have recently germinated from seed and will have fairly small and shallow root systems and no persistent stems from the previous year. Species whose status as perennials is doubtful have been included in the key for the sake of completeness.

If you are convinced it is a perennial and cannot identify it, please obtain a duplicate complete specimen, with details of the location (with a map reference or latitude and longitude if possible), date of collection, collectors name, soil type, habitat (topography & other vegetation), and habit (erect or prostrate, clumped, spreading etc), and send it to the WA Herbarium, Locked Bag 104, Bentley Delivery Centre, WA 6983.

NOTE: This key is artificially designed to distinguish the species recorded from the Avon Wheatbelt of WA only.

Practical Hint

To open a spikelet for closer study it is sometimes useful to cut it with a sharp blade just above the glume base (or the lemma base for floret study). To prevent the pieces flying apart, mount the specimen in a drop of (detergent+) water.



LOCATION MAP

There are three botanical regions in Western Australia. The Kimberley Region in the north, the Eremaean Region in the centre, and the South West Region in the south. The Avon Wheatbelt is a botanical district within the South West Region.

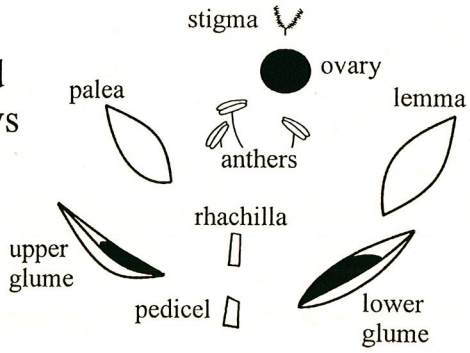
State map by Paul Gioia, WA Herbarium

CHARACTERS USED IN THIS KEY

FLOWER STRUCTURE

The grass flower is a structure called a "spikelet", and looks something like this:

An expanded version shows the parts



The lemma, palea and the sexual parts make up a "floret":

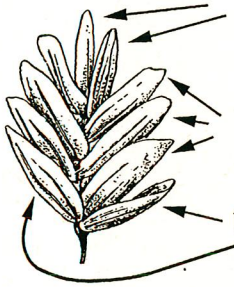
A floret, like this, that contains both male (anther) and female (ovary) parts is called a "fertile floret".

In this book the palea and the sexual parts are not used; only glumes and lemmas are used. Lemmas are called "fertile lemmas" if they contain both male and female parts, or "sterile lemmas" if they are empty or contain only male parts. Sterile florets (with sterile lemmas) are quite common.

This spikelet has a sterile floret (just a lemma only) below a single fertile floret.

And this spikelet has a sterile floret (lemma, palea & anthers) above a single fertile floret.

This spikelet has several florets.

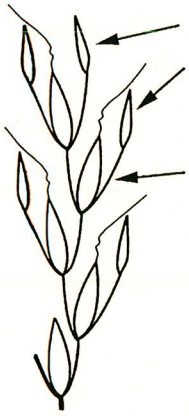


the upper florets are sterile

the lower florets are fertile

there are never more than two glumes

Sometimes spikelets are arranged in alternating pairs, like this:



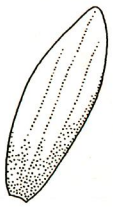
the upper spikelet, with the long pedicel, is sterile

the lower spikelet, with no pedicel, is fertile (notice the awn emerging from its apex)

CHARACTERS USED IN THIS KEY Cont.

The glumes and lemmas are the most important characters in this key!

look for nerves on the back

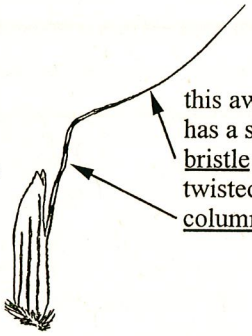


sometimes the central nerve is thickened (keeled)

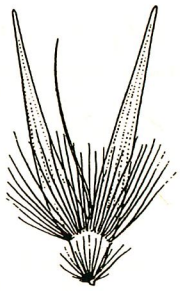
the central nerve might also be extended beyond the apex (called a "mucro")

it could have a straight, terminal awn

or the awn could arise from the back



or there could be lobes or hairs



INFLORESCENCE TYPES

This key starts from the way the spikelets are arranged in the flower head (which is called the "inflorescence").

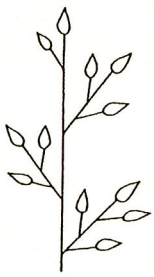
The simplest inflorescence is a spike

Spike

if the spikelets occur on branches it is a raceme

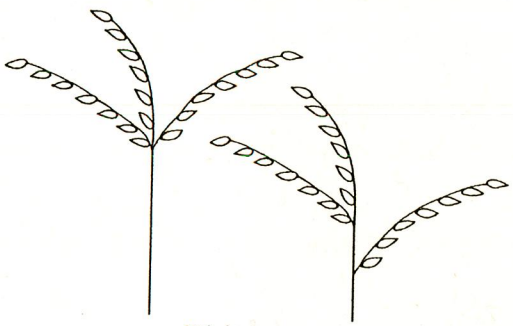
Raceme

if the primary branches are also branched it is a panicle



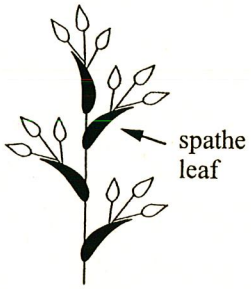
Panicle

one-sided spikes can occur in a finger-like (digitate) pattern



Digitate compound of one-sided Spikes

a specialised leaf, called a "spathe", may clasp the base of a group of spikelets

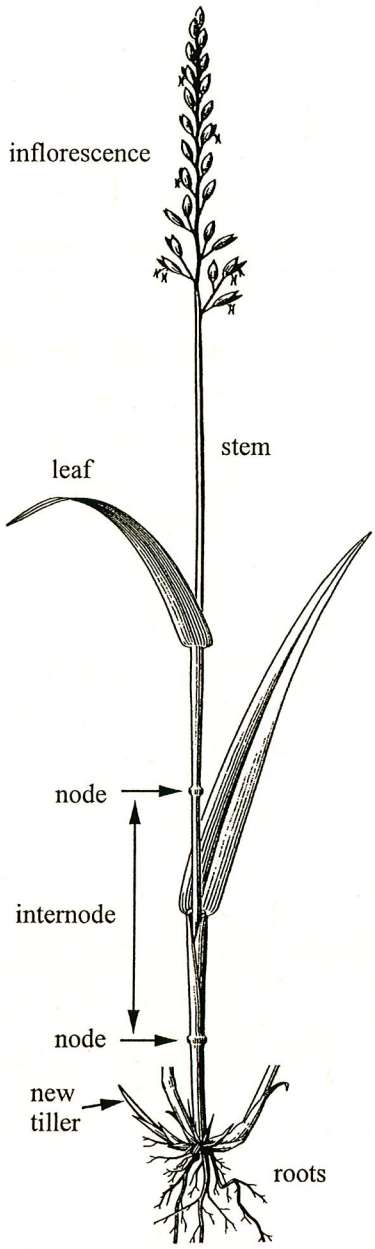


Spatheate Panicle

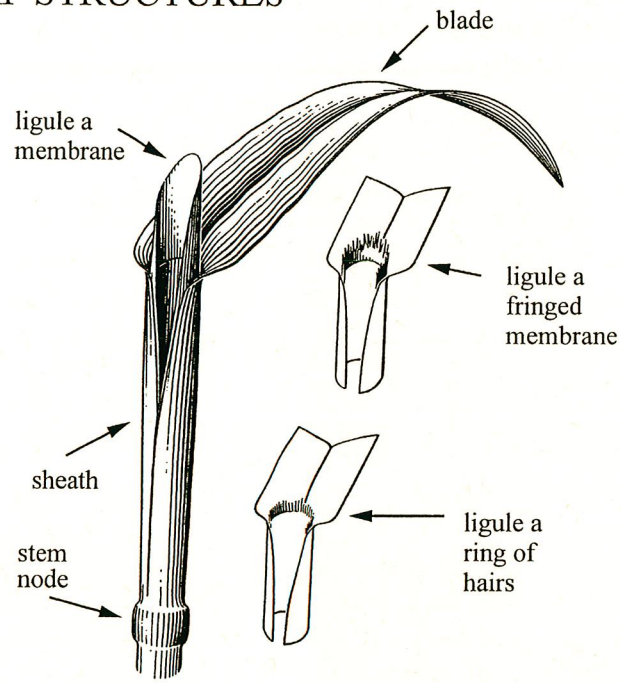
CHARACTERS USED IN THIS KEY Cont.

VEGETATIVE CHARACTERS

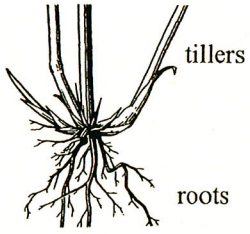
Most grass plants consist of several stems (called tillers), each one of which has the same basic structure as shown at right. At maturity, each tiller ends in an infloresence.



LEAF STRUCTURES

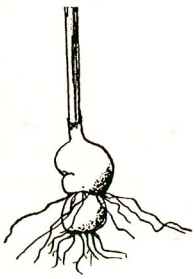


ROOT SYSTEMS

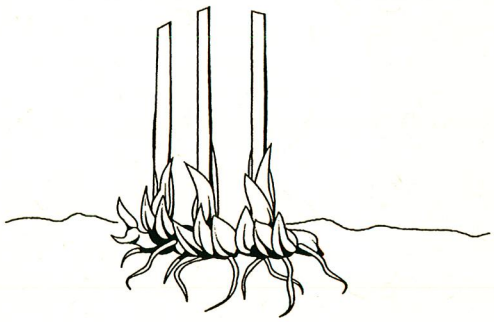


A tussock

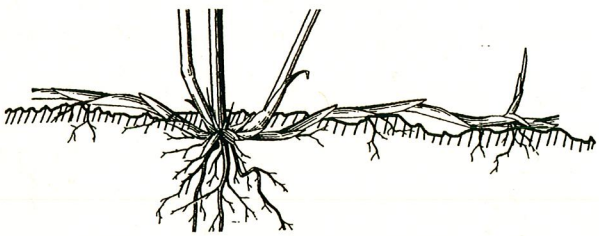
Root nodules produced by enlargement of the lower internodes of the stem



A root bulb produced by enlargement of the lower leaf sheaths



A rhizome is an underground stem that produces new roots and tillers at the nodes



A stolon is an above-ground stem that produces new roots and tillers at the nodes

GLOSSARY

* : an asterisk is appended to the names of introduced plants to distinguish them from native plants (e.g. **Ehrharta calycina*)

anther: the organ in which the pollen is produced.

apex: the top of an organ

aromatic: containing fragrant oils that can be smelled when the leaf is crushed.

auricle: an ear-like outgrowth at the top of the leaf sheath on some grasses.

awn: a long narrow projection from the back or tip of the glumes and/or lemmas in some grasses.

blade: the upper part of the grass leaf that extends outwards from the stem and lower sheath, usually flat but sometimes rolled.

bract: a general name for the structures that enclose the reproductive organs in the grass flower. The glumes, lemma and palea are all bracts.

bristle: the upper part of an awn, beyond the column

callus: in grasses, the hardened, usually hairy base of the dispersal unit, usually a floret or whole spikelet.

column: the lower part of an awn, sometimes twisted or otherwise distinct from the upper part, which is called the bristle.

coma: a tuft of hairs.

compound: consisting of two or more equivalent units.

dichotomous: divided or arranged into two parts.

digitate: having parts arranged like the fingers on a hand.

entire: having an undivided outline without any incisions or teeth.

eremaean: belonging to the desert.

exserted: protruding beyond some potentially enclosing organ.

fertile lemma: a lemma that subtends male and female reproductive organs (ovary and anthers) and is capable of producing a seed. (see **sterile lemma**)

floret: one of the small reduced flowers of the grasses, consisting of the lemma and palea and their contents (stamens and ovary – if present).

glabrous: without hairs.

globular: 3-dimensional rounded shape approximately circular in outline.

glume: one of the two bracts at the base of the grass spikelet, called the lower and upper glumes, due to their position on the rachilla.

inflorescence: the whole flowering portion of the grass plant; types of inflorescences are classified according to the position of the spikelets in relation to the axis and to each other.

involucre: a whorl of bracts surrounding the base of a spikelet or inflorescence.

keel: a prominent longitudinal ridge on a glume or lemma, like a keel on a boat.

lanceolate: shaped like a spear-head; tapering at both ends but broadest below the middle.

lateral: to the side.

lemma: the lower of the two bracts enclosing a grass floret, usually enclosing the palea, and the reproductive organs (anthers and ovary).

ligule: outgrowth from the inner junction of the grass leaf sheath and blade, often membranous, sometimes represented by a fringe of hairs.

linear: an organ shape – long & narrow, with approximately parallel sides.

marginal: on the margins or perimeter, the outer edges.

membrane: a thin sheet-like structure

minute: very small

mucro: a stiff or sharp, short projection of the midvein terminating a glume or lemma

mucronate: having a mucro

nerve: narrow vein-like thickening running partly or wholly the length of a floral bract.

node: the joint in a grass stem, usually thickened and wider than the internode portion of the stem

ovary: the female organ which when fertilized produces the seed.

palea: the upper of the two bracts enclosing a grass floret, usually enclosing the anthers and ovary.

panicle: an inflorescence in which there is both primary and secondary branching from the main axis.

pedicel: the stalk of an individual spikelet. adj. **pedicellate**

prostrate: lying flat on the ground.

raceme: an inflorescence with a single main axis and flowers (spikelets) on the ends of short primary branches.

rachilla: the main axis of a spikelet, to which the florets are attached.

rachis: the main axis of the inflorescence.

rhizome: an underground creeping stem consisting of a series of internodes and nodes with roots and shoots growing off them.

scabrous: rough to the touch because of numerous tiny stiff projections.

sessile: without a stalk.

sheath: the lower part of the grass leaf that clasps the stem.

spathe: a bract or leaf that sheathes the base of an inflorescence or group of spikelets.

spike: an unbranched inflorescence with flowers (spikelets) attached directly to the main axis.

spikelet: the basic unit of the grass flowerhead, generally composed of 2 glumes and one or more florets.

sterile lemma: a lemma that is empty or that subtends only male reproductive parts (anthers) and is thus not capable of producing seed. (see **fertile lemma**)

stigma: the feathery organ projecting from the top of the ovary that receives the pollen.

stolon: a horizontal stem that grows above ground and produces roots and shoots at the nodes.

terminal: at the apex, the top or furthermost end.

tiller: a single stem of a grass plant.

transverse: going across the body of an organ

whorl: an arrangement of leaves, bracts or floral parts in a circle around a stem.

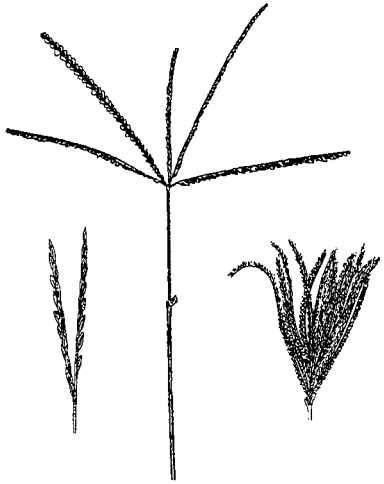
Key to the Four Types of Inflorescence

Group 1

A Single Spike or
Spike-like Panicle

Amphipogon
Austrodanthonia
Cenchrus
Elymus
Enneapogon
Eriachne
Glyceria
Lolium
Monachather
Neurachne
Paspalidium
Pennisetum
Phalaris
Setaria
Spartochloa
Sporobolus
Thyridolepis
Triodia
Tripogon
Triraphis

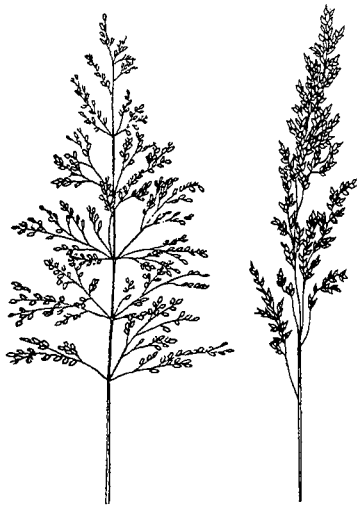
Group 2



A Compound of
one-sided Spikes

Chloris
Cynodon
Enteropogon
Eustachys
Paspalum

Group 3



A Panicle

Amphibromus
Aristida
Austrodanthonia
Austrostipa
Dactylis
Ehrharta
Eragrostis
Eriachne
Festuca
Glyceria
Leptochloa
Melinus
Monachather
Panicum
Paspalidium
Piptatherium
Poa
Puccinellia
Sorghum
Spartochloa
Sporobolus
Triodia

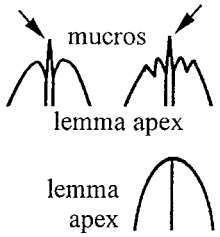
Group 4

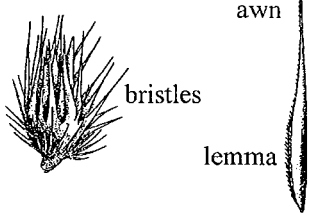
A Spatheate Panicle

Cymbopogon
Hyparrhenia
Themeda

GROUP KEYS

Group 1 A Spike or Spike-like Panicle





1. Lemma with awns or a mucro, or spikelet enclosed by numerous bristles ...15

1. Lemma without awns or a mucro ...2

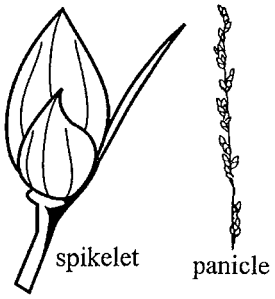
2. Spikelets with hairs anywhere or with bristles below the glumes ...7

2. Spikelets without hairs or bristles below the glumes ...3

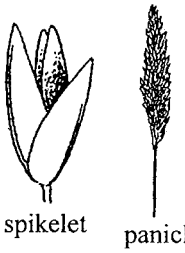
3. Spikelets with more than one fertile lemma ...5

3. Spikelets with only one fertile lemma ...4

4. Glumes 3-5-nerved, not keeled; spikelets sub-terminal on branches *Paspalidium constrictum* (Southwest & Eremaean)

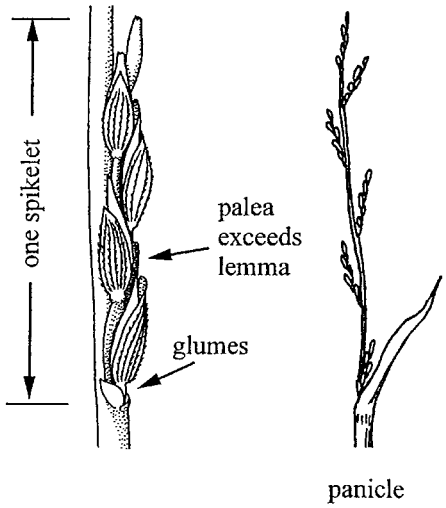


4. Glumes 1-nerved, with a keel; spikelets terminal on branches *Sporobolus virginicus* (Statewide)



...FROM 3

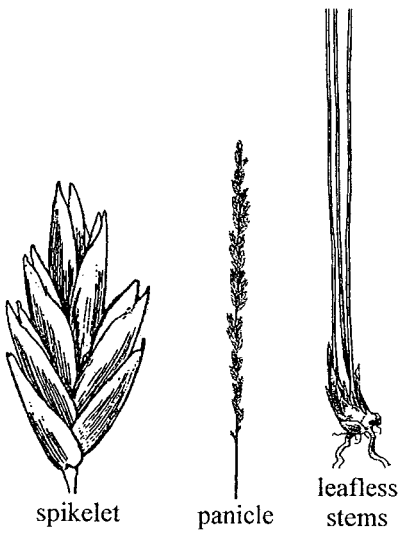
5. Glumes tiny (0.5-2.5mm long), palea exceeds lemma *Glyceria drummondii* (Southwest) (Rare & endangered)



5. Glumes >4mm long; lemma equals or exceeds the palea ...6

6. Leaves well developed; spikelets partly sunken into either side of the main axis **Lolium perenne* (Southwest)

6. Leaves reduced or absent, stems reed-like; spikelets on short branches of the main axis *Spartochloa scirpoidea* (Southwest)



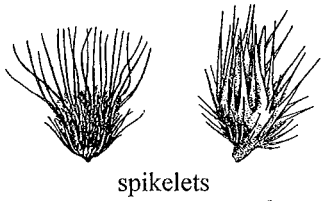
Group 1 A Spike or Spike-like Panicle Cont.

...FROM 2

7. Spikelets without bristles below glumes ...10

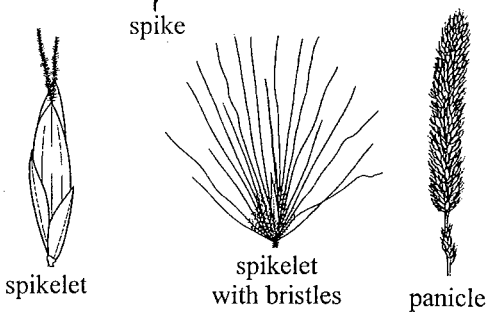
7. Spikelets with bristles below the glumes ...8

8. Bristles fused together at the base *Cenchrus*



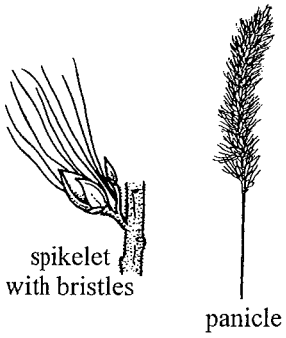
8. Bristles free to the base ...9

9. Bristles falling with the spikelet *Pennisetum*



9. Bristles remaining on the stem

**Setaria sphacelata* (Southwest)

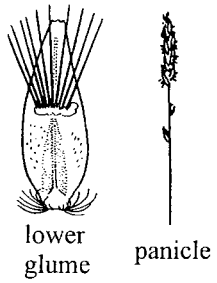


...FROM 7

10. Spikelets with no hairs on glumes but with hairs on lemmas ...12

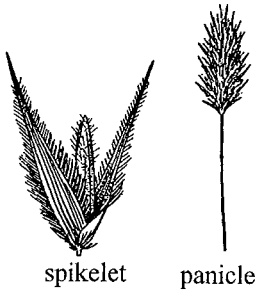
10. Spikelets with hairs on glumes ...11

11. Lower glume with a transverse row of hairs on the back *Thyridolepis*



11. Lower glume with hairs only on the margins

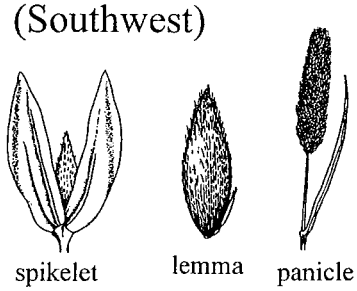
Neurachne alopecuroidea (Southwest)



...FROM 10

12. Spikelets with one fertile lemma

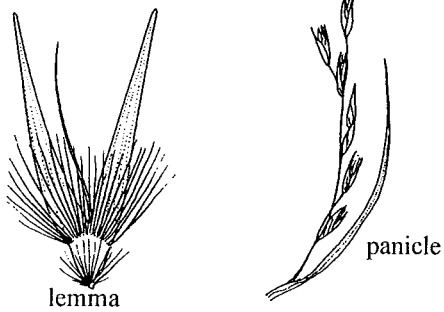
**Phalaris aquatica* (Southwest)



12. Spikelets with 2 or more fertile lemmas ...13

13. Lemma with a horizontal row of long hairs

Monachather paradoxus (Southwest & Eremaean)

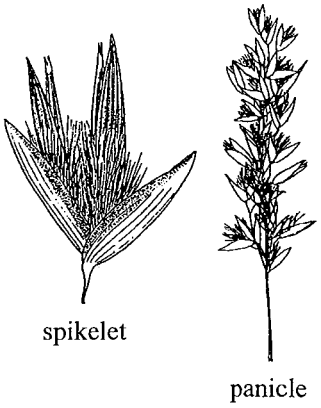


Group 1 A Spike or Spike-like Panicle Cont.

13. Lemma hairs not in a horizontal row ...14

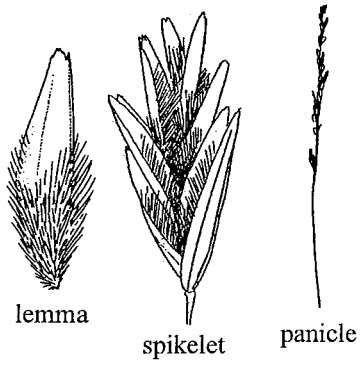
14. Spikelets with 2 fertile florets;
leaves without sharp points

Eriachne ovata
(Southwest & Eremaean)



14. Spikelets with >4 fertile florets;
leaves rigid with sharp points

Triodia



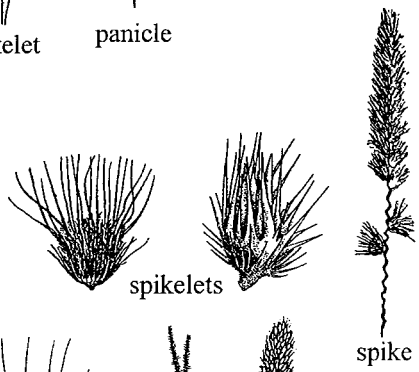
...FROM 1

15. Spikelets not enclosed in bristles ...17

15. Spikelet enclosed in bristles ...16

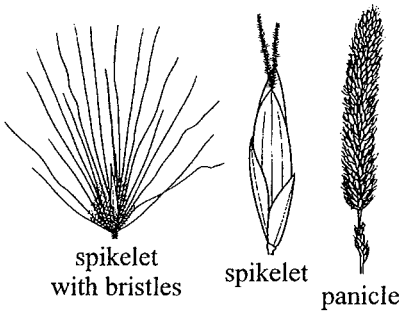
16. Bristles fused together at the base

Cenchrus



16. Bristles free to the base

Pennisetum



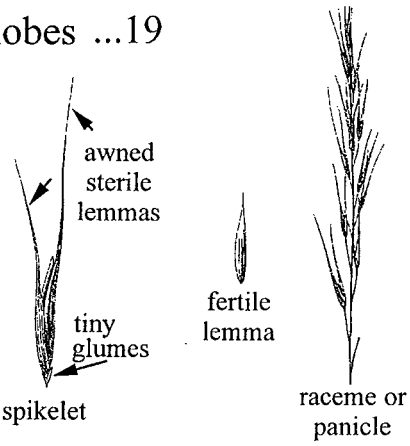
...FROM 15

17. Lemma apex divided into 2 or more lobes ...19

17. Lemma not lobed,
with a single terminal awn ...18

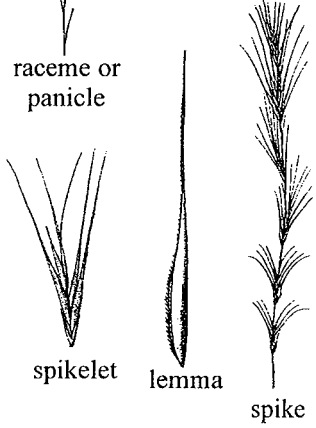
18. Spikelets with two awned lemmas

Microlaena stipoides
(Southwest)



18. Spikelets with six or more awned lemmas

Elymus scaber
(Southwest)

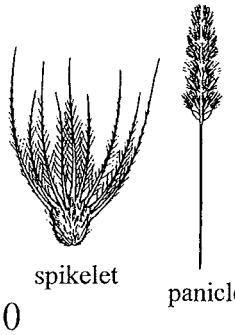


Group 1 A Spike or Spike-like Panicle Cont.

...FROM 17

19. Lemmas with 9 lobes

Enneapogon



19. Lemmas with 2 or 3 lobes ...20

20. Lemmas with deep lobes and/or long awns ...21

20. Lemmas with a mucro that exceeds the small lobes

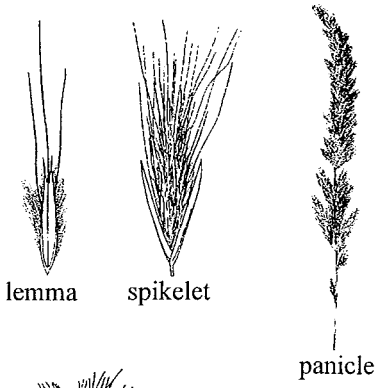
Tripogon loliiformis
(Statewide)

21. Lemma with a horizontal row of long hairs ...23

21. Lemma glabrous or with hairs not in a horizontal row ...22

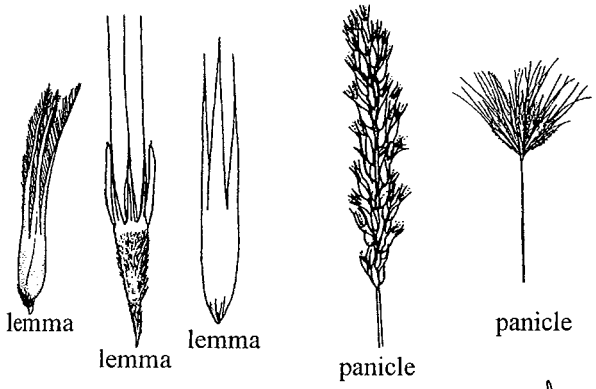
22. Lemmas with two short lobes and a central awn and two lateral awns

Triraphis mollis
(Eremaean)



22. Lemmas with 3 lobes; awns, where present, all terminal

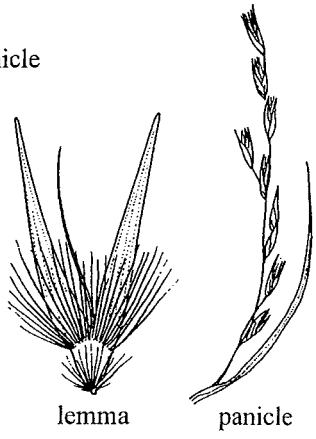
Amphipogon



...FROM 21

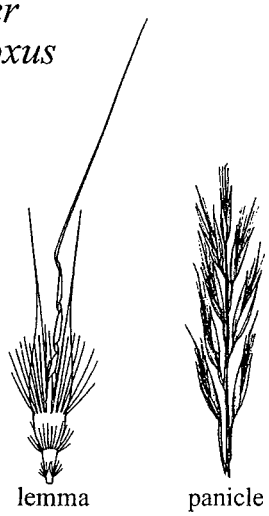
23. Glumes with no keel; ligule a membrane

Monachather paradoxus
(Southwest & Eremaean)



23. Glumes with a keel; ligule a fringe of hairs

Austrodanthonia



Group 2 Compound One-Sided Spikes

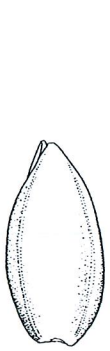
1. Spikelets with awns or hairs ...3

1. Spikelets without awns or hairs ...2

2. Glumes as long as lemma

**Paspalum vaginatum*

(Southwest)



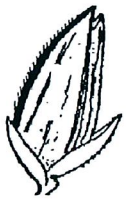
spikelet

compound spike

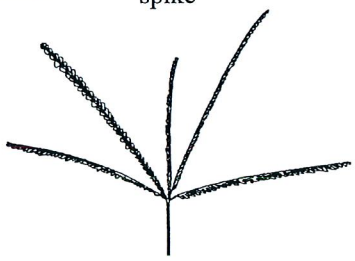
2. Glumes shorter than lemma

**Cynodon dactylon*

(Statewide)

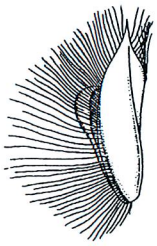


spikelet

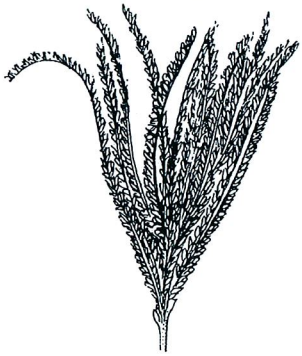


compound spike

3. Lemma with a marginal fringe of long hairs



lemma



compound spike

Eustachys distichophylla

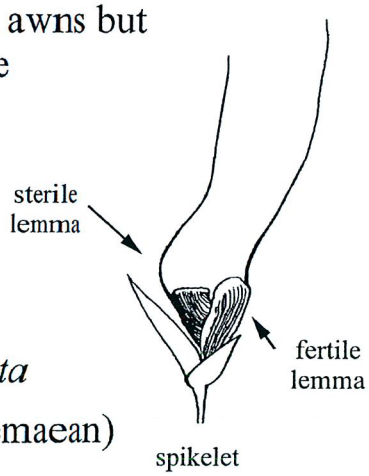
(Southwest)

3. Lemma with long awns but no marginal fringe of long hairs ...4

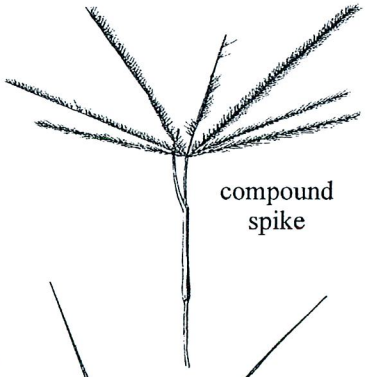
4. Lemma apex broad & blunt

Chloris truncata

(Southwest & Eremaean)



spikelet

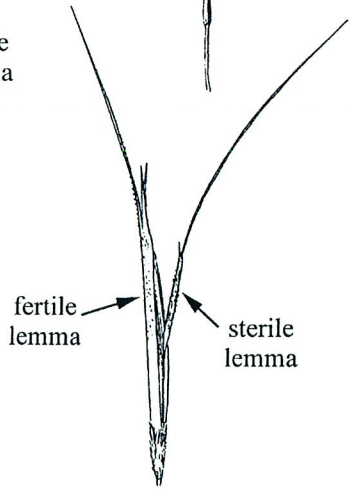


compound spike

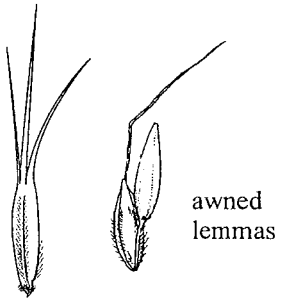
4. Lemma apex narrow and pointed

Enteropogon acicularis

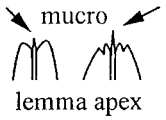
(Statewide)



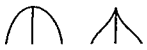
Group 3 A Panicle



1. Lemma with awns or a mucro ...16



1. Lemma without awns or a mucro ...2



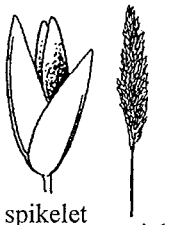
2. Two or more fertile lemmas per spikelet ...7

2. Only one fertile lemma per spikelet ...3

3. Spikelets with hairs ...6

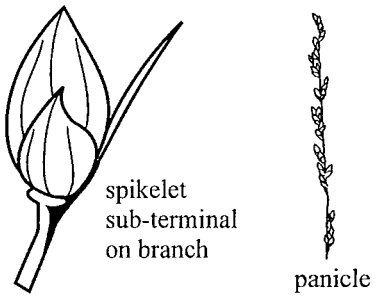
3. Spikelet hairless ...4

4. Glumes 1-nerved, with a keel *Sporobolus virginicus* (Statewide)



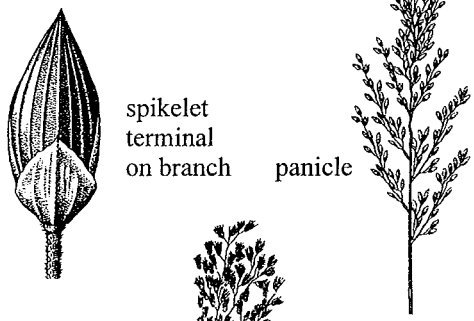
4. Glumes 3-9 nerved, with no keel ...5

5. Spikelet-bearing branches ending in a bristle *Paspalidium constrictum* (Southwest & Eremaean)



5. Spikelet-bearing branches ending in a spikelet

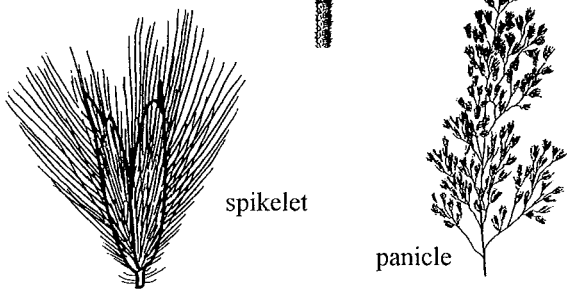
**Panicum antidotale* (Southwest)



...FROM 3

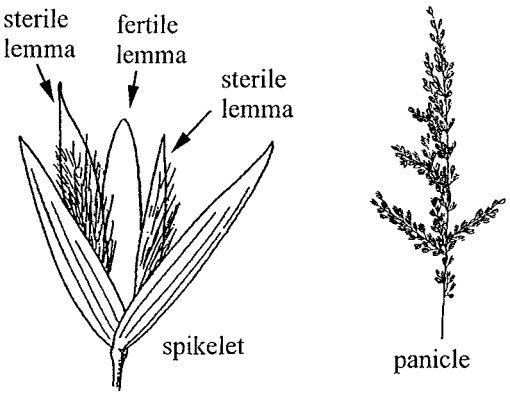
6. Hairs on glumes

**Melinis repens* (Southwest)



6. Hairs on sterile lemmas

**Ehrharta calycina* (Southwest)



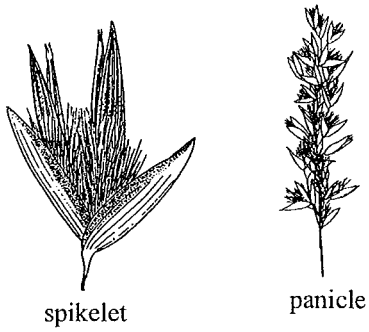
GROUP 3 A Panicle Cont.

7. Lemmas hairless ...12

7. Hairs on lemmas ...8

8. Two fertile lemmas per spikelet

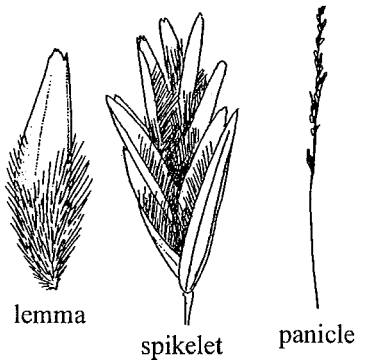
Eriachne ovata
(Southwest & Eremaean)



8. 4-15 fertile lemmas per spikelet ...9

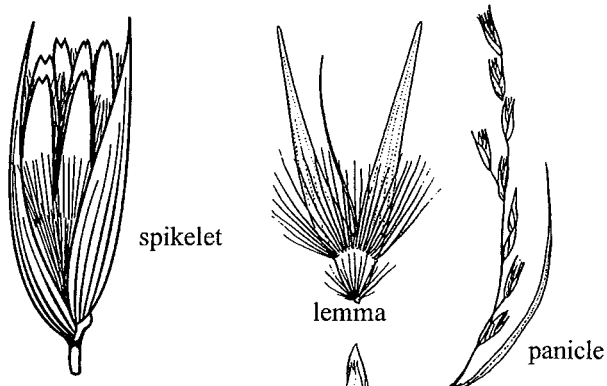
9. Leaves hard and needle-sharp pointed; ligule of hairs *Triodia*

9. Leaves not hard and sharp pointed; ligule a membrane ...10



10. Glumes 7-11-nerved, longer than the florets

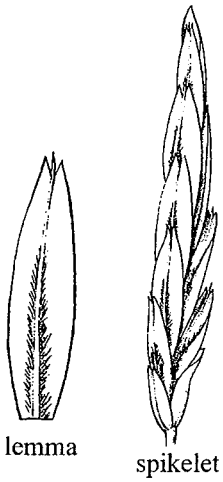
Monachather paradoxus
(Southwest & Eremaean)



10. Glumes 1-5-nerved, shorter than the spikelet ...11

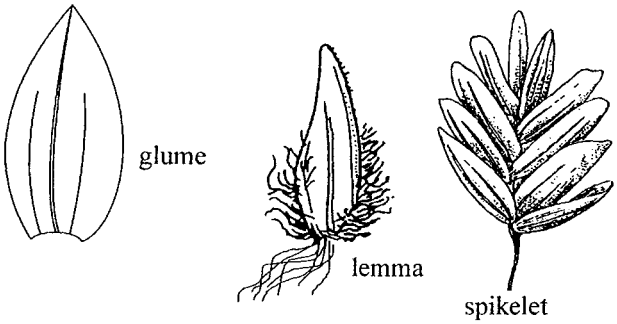
11. Glumes 1-nerved; lemmas usually with a mucro

Leptochloa fusca (Statewide)



11. Glumes 3-5-nerved; lemma apex entire

Poa

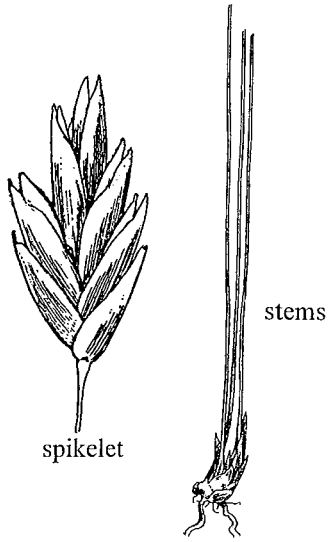


GROUP 3 A Panicle Cont.

...FROM 7

12. Leaves reduced or absent, stems reed-like

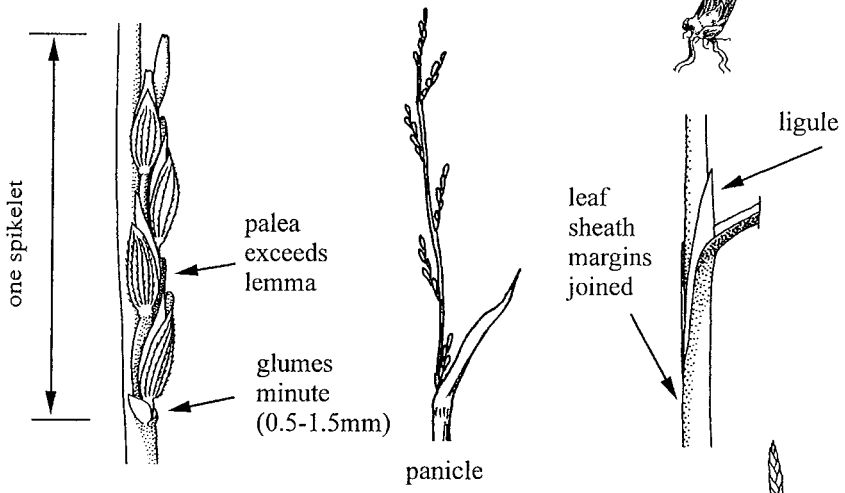
Spartochloa scirpoidea (Southwest)



12. Leaves well developed ...13

13. Palea exceeds lemma; Leaf sheath margins joined

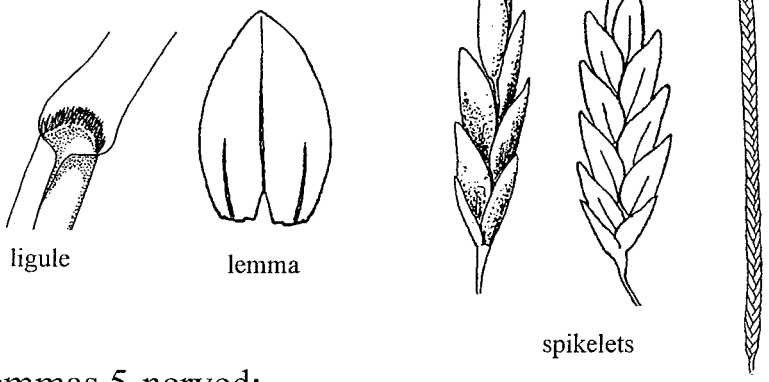
Glyceria drummondii (Southwest) (Rare & endangered)



13. Lemmas exceed palea; leaf sheath margins free ...14

14. Glumes with 0-1 nerves; lemma 3-nerved; ligule of hairs

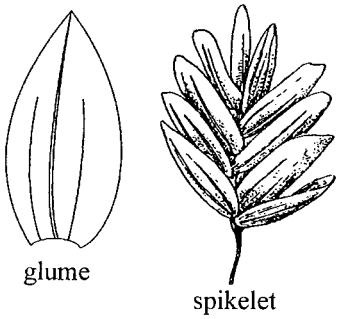
Eragrostis



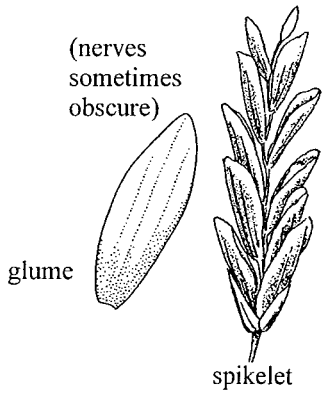
14. Glumes with 3-5 nerves; lemmas 5-nerved; ligule a membrane ...15

15. Glumes and lemmas keeled

Poa



15. Glumes and lemmas not keeled *Puccinellia*



Group 3 A Panicle Cont.

...FROM 1

16. Lemmas with awns ...20

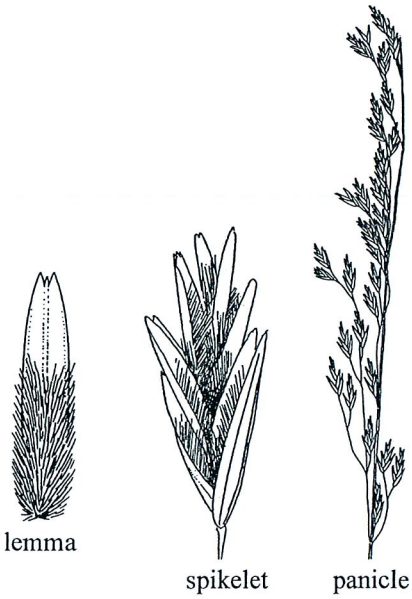
16. Lemmas with a mucro ...17

17. Lemmas glabrous or scabrous, not hairy ...19

17. Lemmas hairy towards the base ...18

18. Glumes 3-5-nerved; leaves hard and needle-sharp pointed

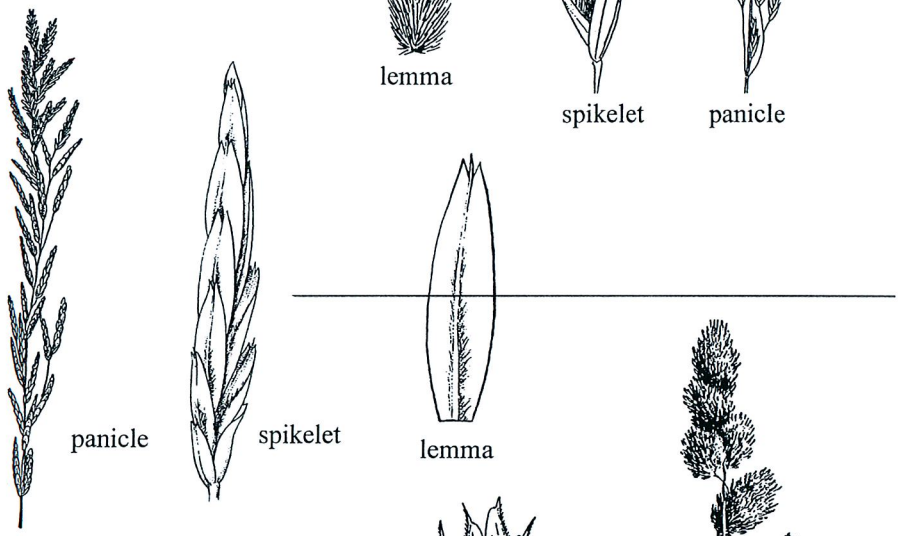
Triodia



18. Glumes 1-nerved; leaves not hard or needle-sharp pointed

Leptochloa fusca

(Statewide)

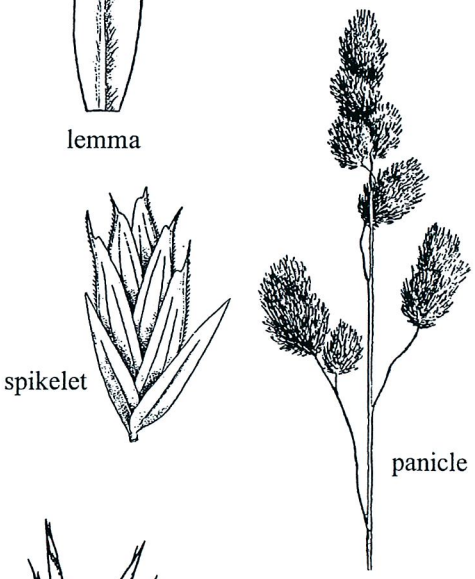


...FROM 17

19. Spikelets in globular clusters

**Dactylis glomerata*

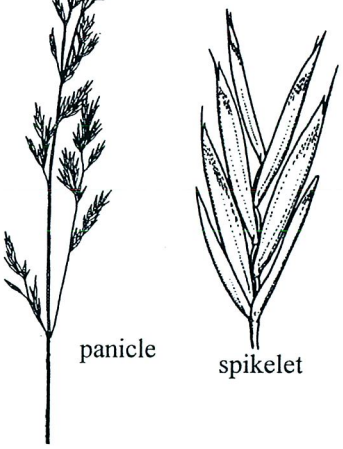
(Southwest)



19. Spikelets not in globular clusters

**Festuca arundinacea*

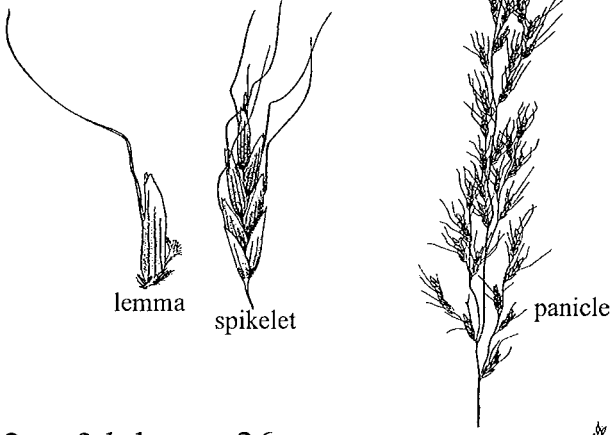
(Southwest)



Group 3 A Panicle Cont.

...FROM 16

20. Awn arising from the back of the lemma — *Amphibromus nervosus* (Southwest)

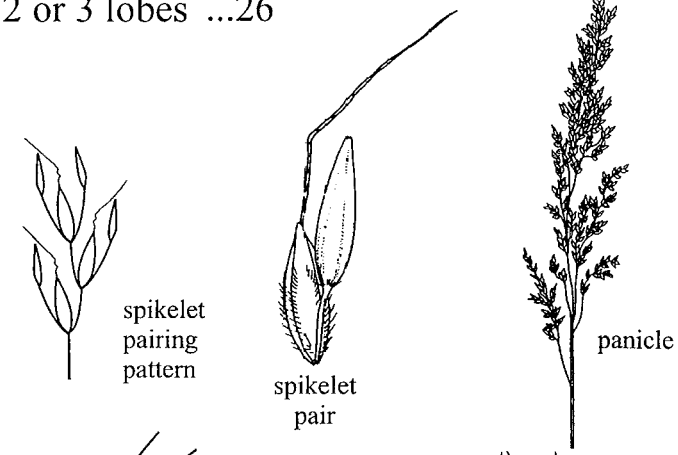


20. Awns terminal or set between two terminal lobes ...21

21. Lemma apex deeply divided into 2 or 3 lobes ...26

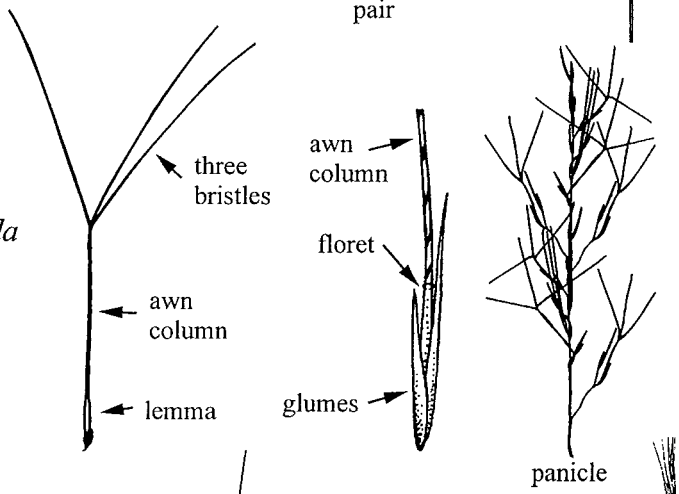
21. Lemma apex entire, with a single terminal awn ...22

22. Spikelets in pairs, only the lower one awned and fertile — **Sorghum halepense* (Southwest)



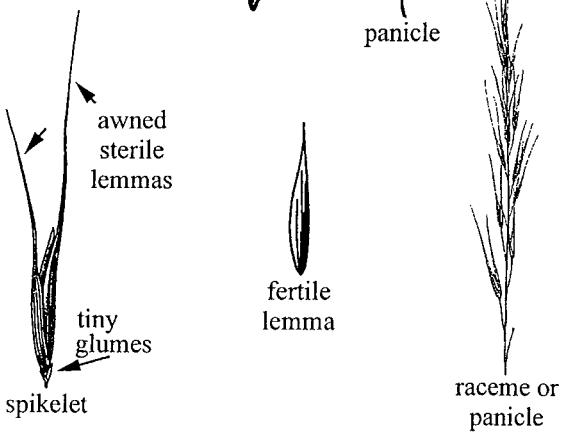
22. Spikelets borne singly ...23

23. Awn divided into three — *Aristida*



23. Awn not divided ...24

24. Glumes tiny (0.5-2mm long), much shorter than the lemmas — *Microlaena stipoides* (Southwest)



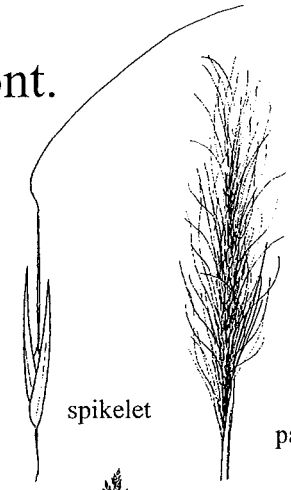
24. Glumes longer than the lemmas ...25

Group 3 A Panicle Cont.

25. Lemma base sharply pointed

Austrostipa


lemma


spikelet

panicle

25. Lemma base not sharply pointed

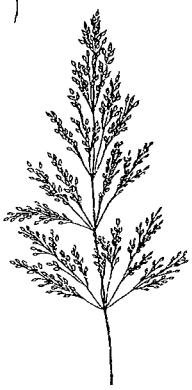
**Piptatherum miliaceum*

(Southwest)


awn fragile & falls at maturity

lemma


spikelet


panicle

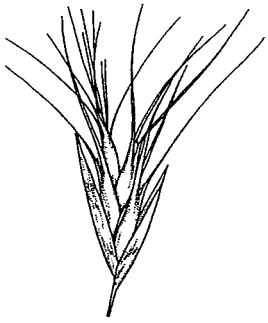
...FROM 21

26. Lemma with a horizontal row of long hairs at the base of the lobes ...27

26. Lemma hairs not in a horizontal row or lemma glabrous

Triodia

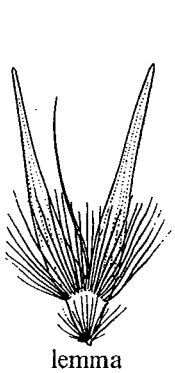

lemma


spikelet


panicle

...FROM 26

27. Glumes with no keel; ligule a membrane


lemma


panicle

Monachather paradoxus

(Southwest & Eremaean)


lemma


panicle

27. Glumes keeled; ligule a fringe of hairs

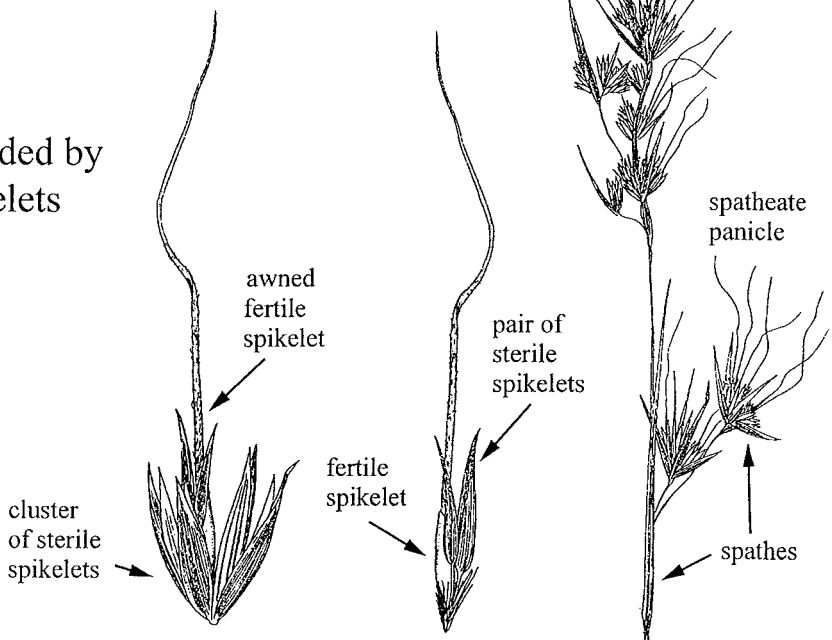
Austrodanthonia

Group 4 Spatheate Panicles

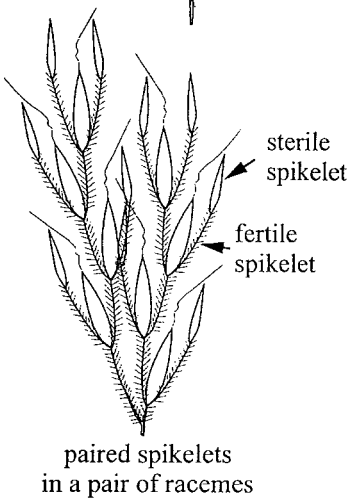
1. Fertile spikelet surrounded by a cluster of sterile spikelets

Themeda triandra

(Statewide)

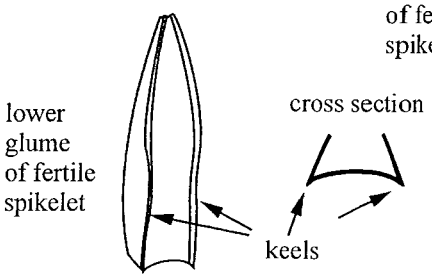


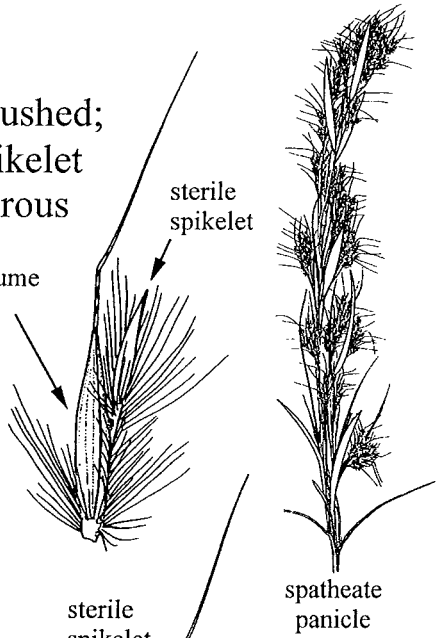
1. Fertile spikelet accompanied by just one pedicellate sterile spikelet and the spikelet pairs arranged in a pair of racemes ...2



2. Leaves aromatic when crushed; lower glume of fertile spikelet 2-keeled and mostly glabrous

Cymbopogon

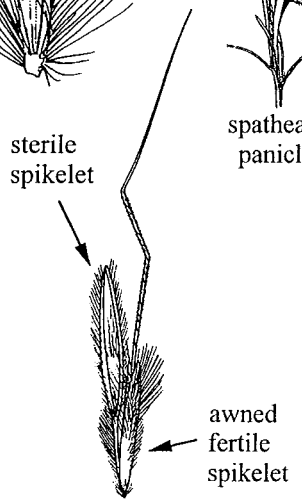


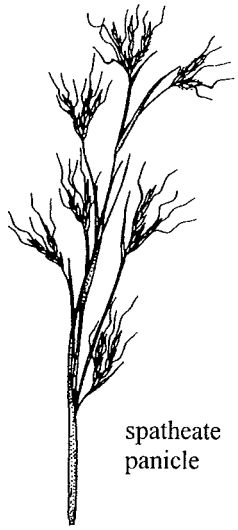


2. Leaves not aromatic; lower glume of fertile spikelet hairy & not keeled

**Hyparrhenia hirta*

(Southwest)



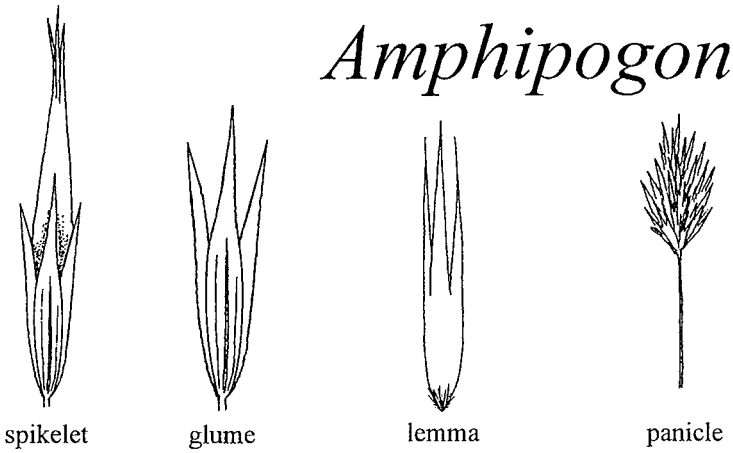


GENUS KEYS

Amphipogon

1. Glumes 3-lobed

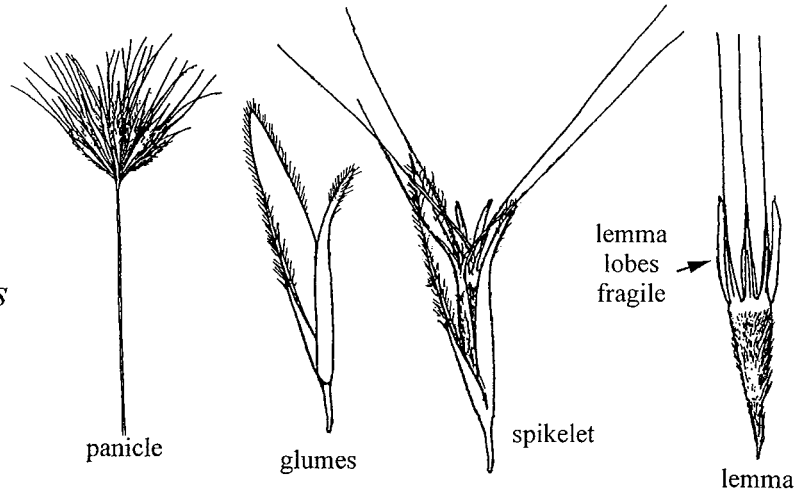
A. debilis
(Southwest)



1. Glumes entire ...2

2. Lemma lobes with scabrous, terminal awns

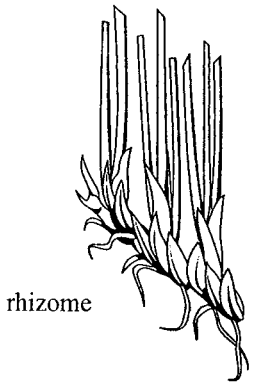
A. turbinatus
(Southwest)

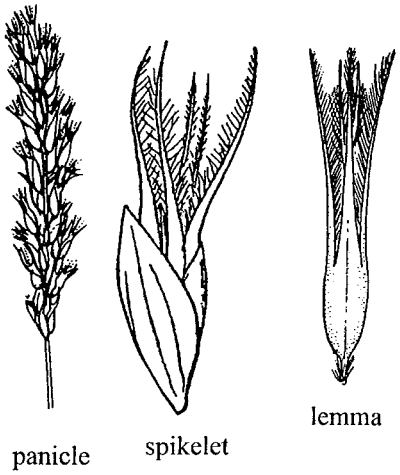


2. Lemma lobes hairy and tapering gradually to a point ...3

3. Panicle narrow-cylindrical (20-60mm x 5-10mm); glumes scabrous, not hairy; rhizome usually ascending, with stems clustered together

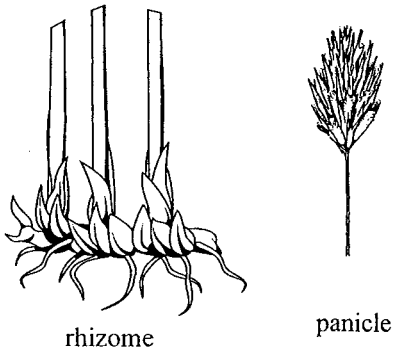
A. caricinus
(Statewide)



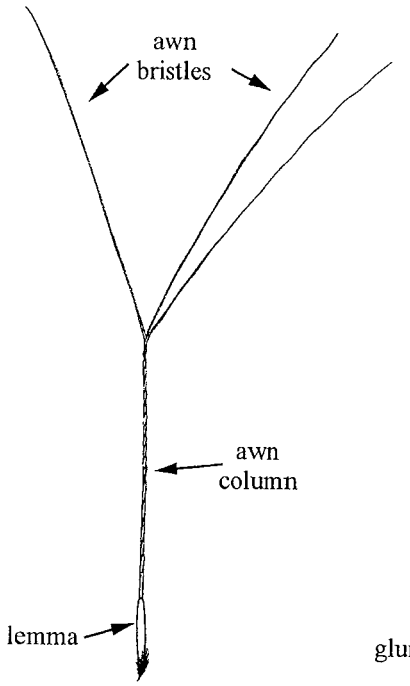


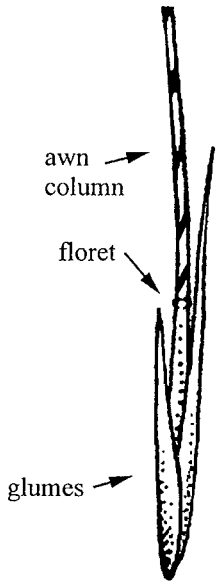
3. Panicle ovoid (10-20mm x 10-15mm); glumes hairy; rhizome usually horizontal & stems separate

A. strictus
(Southwest & Eremaean)

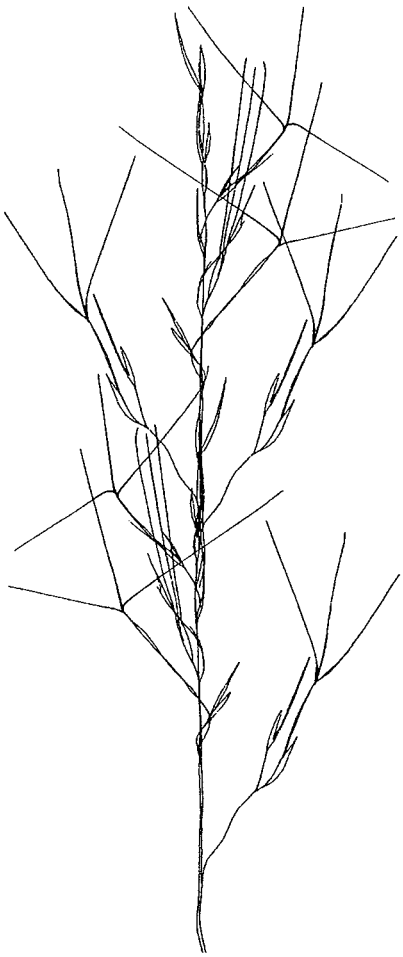


Aristida





spikelet

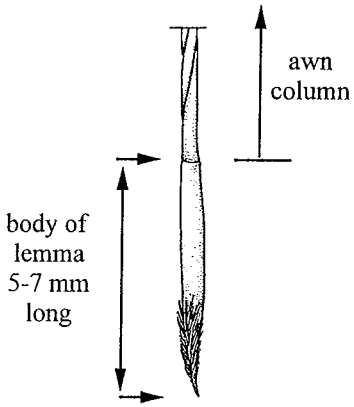


panicle

1. Body of lemma 5-7mm long,
often brownish when mature;
awn column 7-26mm; stems +/- wavy

A. contorta

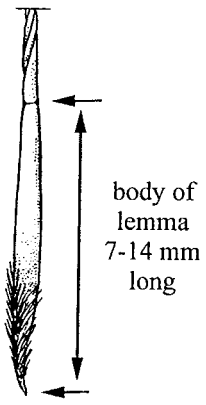
(Statewide)



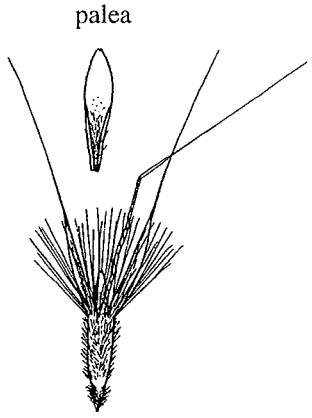
1. Body of lemma 7-14mm long,
often purplish when mature;
awn column 18-57mm;
stems +/- straight

A. holathera

(Statewide)



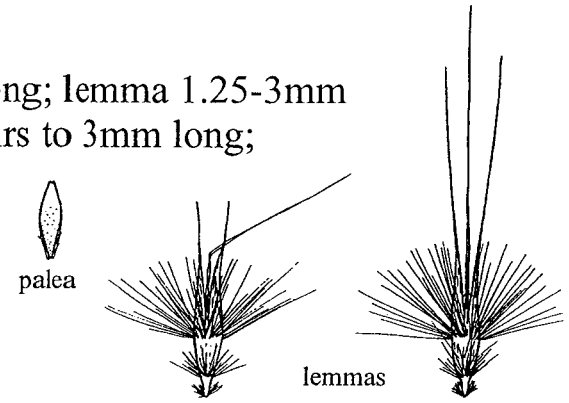
Austrodanthonia



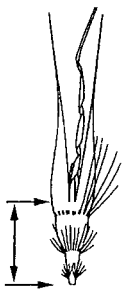
1. Lemma hairs not restricted to transverse rows ...4

1. Lemma hairs only in transverse rows ...2

2. Glumes 8-14mm long; lemma 1.25-3mm long with upper hairs to 3mm long; palea 2.5mm long

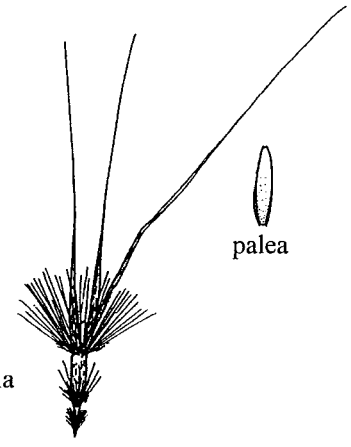


A. setacea
(Southwest)

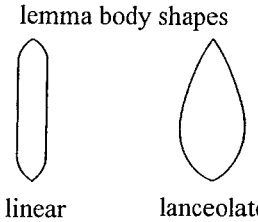


2. Glumes 14-25mm long; lemma >3mm long with upper hairs >3mm long; palea 3-5mm long ...3

3. Body of lemma linear, about 3.5mm long; upper hairs to 4mm long; palea 3mm long



A. acerosa
(Southwest)

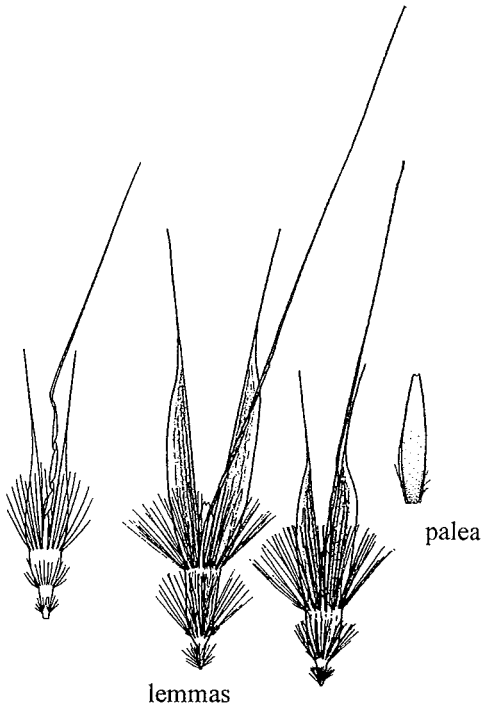


Austrodanthonia Cont.

3. Body of lemma lanceolate,
   4-6mm long;
   upper hairs 4-5mm long;
   palea 4-5mm long

   A. caespitosa (Southwest & Eremaean)

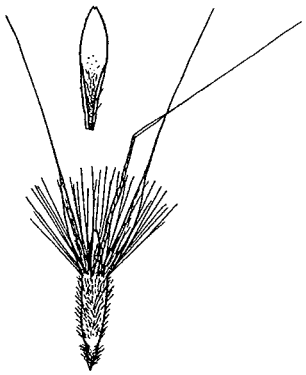
   (a very variable species)



...FROM 1

4. Body of lemma >3mm long

   A. occidentalis (Southwest)



4. Body of lemma <3mm long

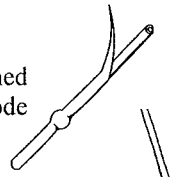
   A. setacea (see above)

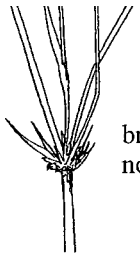
Austrostipa

An extremely variable genus. A table of character ranges is included following the key. Data taken from Vickery et al. (1986) and Jacobs & Everett (1996).

1. Stems not branched at the nodes ... 4

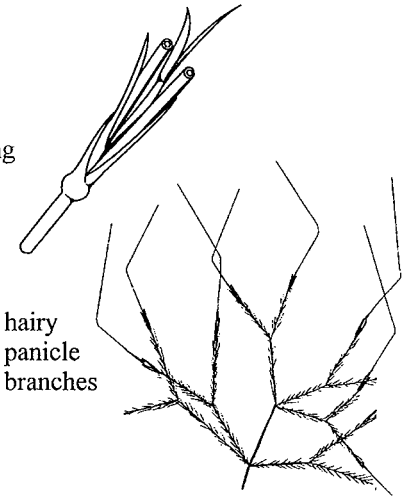
1. Stems branched at the nodes ...2





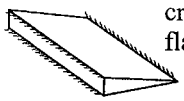
2. Panicle branches with hairs 1.5-2mm long

A. elegantissima (Southwest & Eremaean)

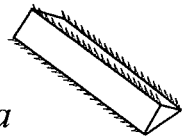


2. Panicle branches glabrous or scabrous ...3

3. Awn 60-90mm long, the bristle flattened *A. platychaeta* (Eremaean)

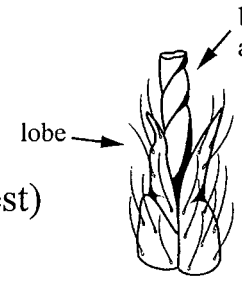


3. Awn 35-50mm long, the bristle rounded (triangular), not flattened *A. pycnostachya* (Southwest)



...FROM 1

4. Lemma apex with narrow, pointed, translucent lobes 1-2.5mm long; stems and leaves narrow, erect and rush-like *A. juncifolia* (Southwest)

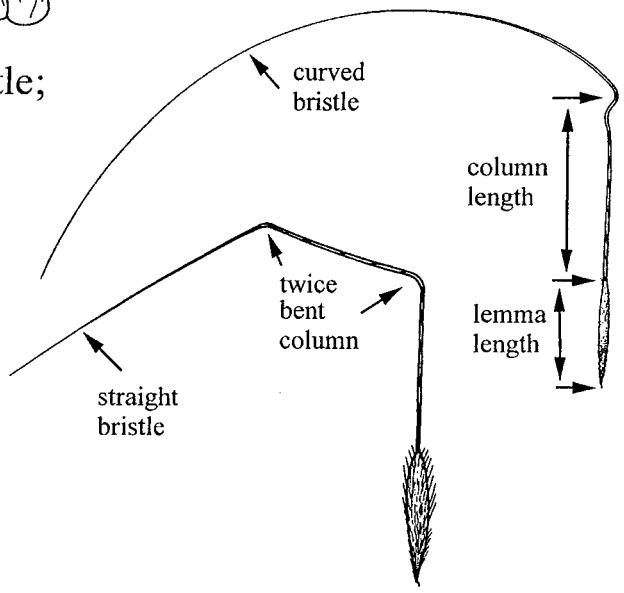


lemma apex with translucent lobes

4. Lemma apex lobes, if present, less than 0.8mm long; stems and leaves not rush-like ...5

lemma apex without lobes

5. Awn sickle-shaped, with a curved bristle; lemma narrow & needle-like, evenly covered with white hairs ...6

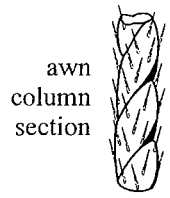


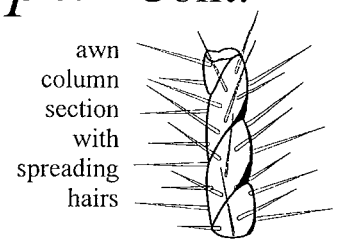
5. Awn bent twice, bristle straight, or if curved then lemma not evenly covered with white hairs ...13

Austrostipa Cont.

6. Awn column hairs 0.25-1.5mm long, spreading away from the awn ...10

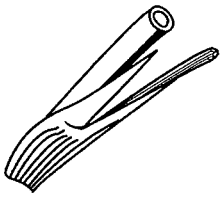
6. Awn column hairs ⩽0.2mm long, and lying close to the awn ...7

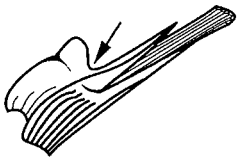

awn column section


awn column section with spreading hairs

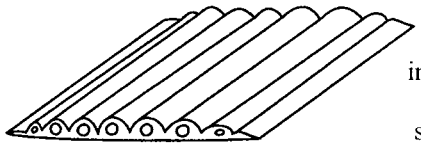
7. Panicle short (<14cm long) dense & spike-like; ligule 3-7mm long; roots with a short rhizome
A. pycnostachya (Southwest)

7. Panicle up to 55cm long; ligule <3mm long (to 4mm in *A. scabra*); no rhizome ...8


ligule in junction between leaf sheath and blade


if the ligule is between large sheath lobes then measure the lowest point

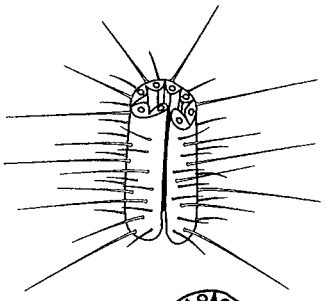
8. Leaves coarse, blades 1-3mm wide, up to 40cm long, inrolled & erect or open and wavy *A. nitida* (Eremaean)


section of open leaf

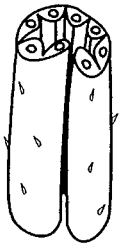

inrolled leaf section

8. Leaves fine, blades 0.6-1.2mm wide, up to 25cm long, inrolled and usually wavy (not erect and straight) ...9

9. Leaf sheaths and blades with spreading hairs >0.5mm long *A. trichophylla* (Southwestern & Eremaean)


section of inrolled leaf with spreading hairs

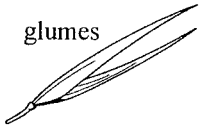
9. Leaf sheaths & blades glabrous or hairs ⩽0.2mm long *A. scabra* (Eremaean)


section of inrolled leaf with tiny hairs

...FROM 6

10. Longest glume 14-20mm long; lemma 7-8mm long; awn 70-100mm long & strongly curved
A. tenuifolia (Southwest & Eremaean)

10. Longest glume 8-14mm long; lemma 4-7mm long; awn 38-90mm long & gently curved ...11


glumes

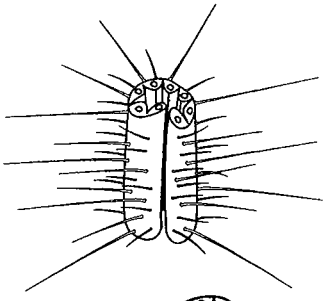
Note: Glume tips are very fragile; length refers to intact glume only

Austrostipa Cont.

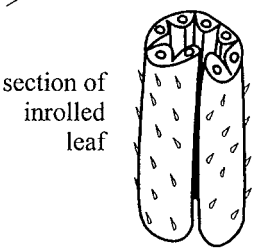
11. Leaf blades erect & broad, 2-6mm wide (0.8-2mm if inrolled) *A. drummondii* (Southwest)

11. Leaf blades usually wavy & fine, 0.3-0.6mm wide, usually inrolled ...12

12. Leaf blades with spreading hairs; awn column to 10mm long; glumes unequal lengths *A. trichophylla* (Southwestern & Eremaean)



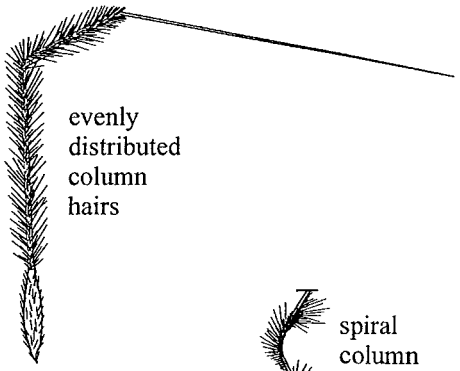
12. Leaf blades mostly glabrous or scabrous; awn column 11-14mm; glumes +/- equal length *A. variabilis* (Southwest & Eremaean)



...FROM 5

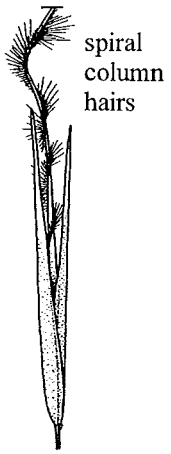
13. Column of awn glabrous or with hairs <0.2mm long, or if hairs longer then mature lemma covered with brown hairs ...16

13. Column of awn with hairs >0.3mm long; lemma hairs white ...14



14. Column hairs 0.3-1mm long, evenly distributed (not appearing to spiral) *A. semibarbata* (Southwest)

14. Column hairs 1-4mm long, mainly along the ribs, producing a spiral ...15

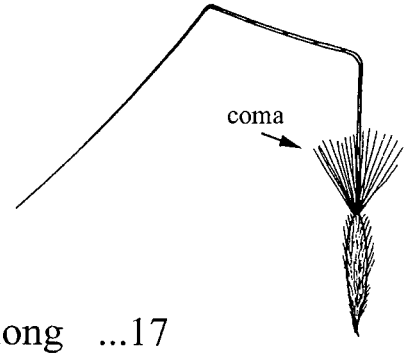


15. Shorter glume 10-15mm long; floret 5-7mm long *A. hemipogon* (Southwest)

15. Shorter glume 15-20mm long; floret 7.5-8.5mm long *A. mollis* (Southwest)

...FROM 13

16. Glumes broad, inflated around the lemma; lemma apex with coma 2-5mm long *A. blackii* (Eremaean)

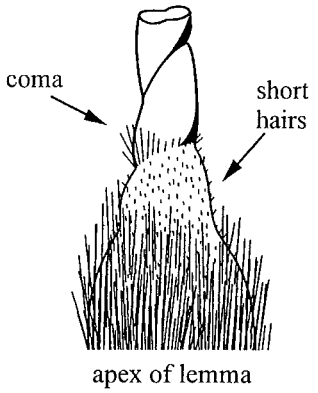


16. Glumes narrow; coma if present <1.5mm long ...17

Austrostipa Cont.

17. Tussock short, with a large inflorescence many times longer than the leaves; lemma hairs white; coma absent ...19

17. Tussocks not many times smaller than inflorescence; lemma hairs generally becoming reddish-brown at maturity, sometimes with a patch of short hairs below the apex; coma hairs up to 1.5mm long ...18



18. Lower glume 8-12mm long; column of awn scabrous or with hairs 0.05-0.1mm long
    A. puberula (Southwest & Eremaean)

18. Lower glume 15-25mm long; column of awn with hairs 0.2-0.4mm long
    A. eremophila (Eremaean)

...FROM 17

19. Leaf sheaths hairy (at least the lower ones)
    A. macalpinei (Southwest)

19. Leaf sheaths glabrous or minutely scabrous
    A. compressa (Southwest)

Austrostipa

Character Ranges (arranged by Subgenus)

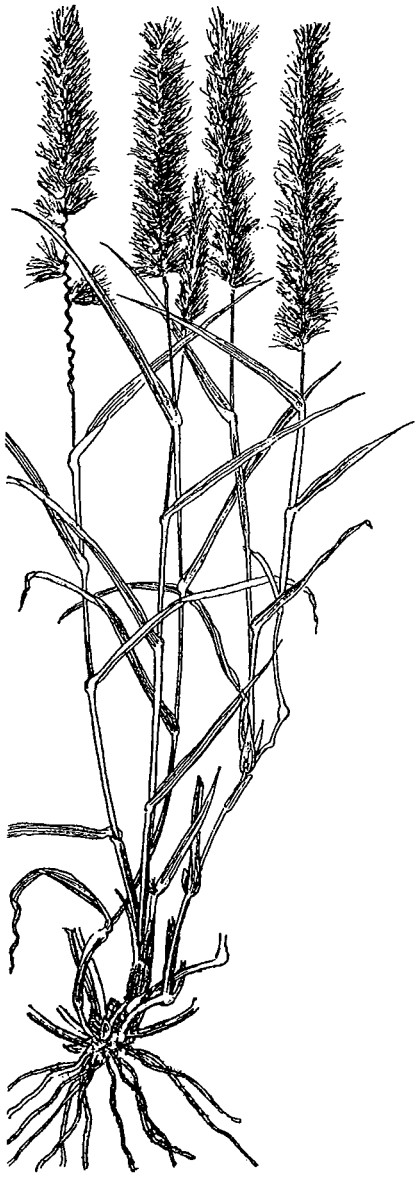
Species	Longest glume mm	Lemma +callus mm	Column length mm	Column hair length mm	Awn length mm	Ligule length mm	Other Features
Subgenus **Austrostipa** Column of the awn with long hairs; lemma usually without a coma							
hemipogon	15-20	5-7.5	10-20	0.5-4	30-60	1.5-3	column hairs in a spiral
mollis	15-20	7.5-9	20-35	0.6-2	60-100	0.3-3	column hairs in a spiral
semibarbata	18-27	9-11.5	30-40	0.3-1	70-110	1-1.5	leaf blades & sheaths scabrous
Subgenus **Arbuscula** Stems usually branched; leaves with long ligules; panicles large, sparse & spreading							
pycnostachya	10-14	4-6	8-15	0.05	35-50	3-7	short, dense inflorescence
platychaeta	7-15	4.5-6	10-15	≤0.1	60-90	1-6	flattened bristle
Subgenus **Longiaristatae** Forms very small (perennial?) tufts with large flowering heads; lemma pale, awn long, ±straight							
macalpinei	13-22	7-8	14-40	0.05	60-200	1-15	hairy leaf sheaths
compressa	13-21	6.5-8.5	20-40	0.05-0.2	80-140	4-11	glabrous or scabrous leaf sheaths
Subgenus **Lobatae** Lemma with long, acute lobes at the apex, and a coma							
juncifolia	10-12	6.5-9	10-20	0.1-0.2	25-50	2.5-8	occurs on margins of salt lakes or in saline depressions

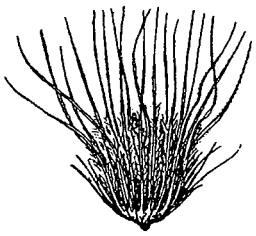
Continued ...

Species	Longest glume mm	Lemma +callus mm	Column length mm	Col. hair length mm	Awn length mm	Ligule length mm	Other Features
Subgenus **Falcatae** Awn sickle-shaped, with a curved bristle; lemma narrow & needle-like							
drummondii	7-12	4-7	11-21	0.3-1.5	40-90	0.4-0.8 (-4)	leaf blades & sheaths broad & hairy
nitida	8-13	4-6	10-13	0.1-0.3	45-70	0.3-1.5	inflorescence ±contracted
scabra	8-15	4-6.5	5-15	0.1-0.2	30-70	0.3-1.5	ligules long; leaves fine; inflorescence ±contracted
trichophylla	9-14	3.8-6.5	6-10	0.15-0.4	38-75	0.5-1	leaves fine & hairy
variabilis	10-15	4.5-7	11-14	0.2-0.5	50-90	0.5-1 (-2)	column densely pubescent
tenuifolia	13-20	7-9	11-20	0.2-0.6	70-120	0.8-1	auricles hairy
Subgenus **Ceres** Glumes broad and inflated around the floret; lemma with a coma & a short, strongly angled callus; panicle expanded with long branches							
blackii	10-20	5-8	13-20	<0.1	28-50	0.3-1.5	leaf blades & sheaths hairy
Subgenus **Eremophilae** Lemma & lemma hairs brown at maturity; lemma with a short coma							
eremophila	15-25	6-9.5	15-38	0.2-0.5	50-110	0.5-1.5	lemma apex appearing shorn or glabrous
puberula	8-14	4-6.5	15-20	0.05-0.1	25-65	0.2-0.5	lemma apex appearing shorn or glabrous
Subgenus **Petaurista** Panicle large, pyramid-shaped, breaks off as a whole for dispersal; panicle branches hairy; stems branched at the nodes							
elegantissima	7-12	4.5-10	8-20	0.1-0.2	20-50	2-3	panicle branch hairs 1.5-3mm

Cenchrus

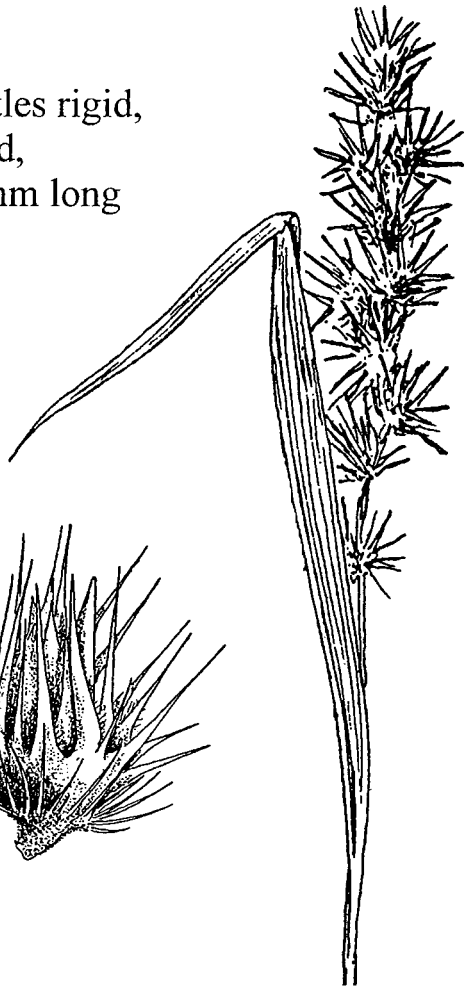
1. Bristles flexible, narrow, 8-16mm long

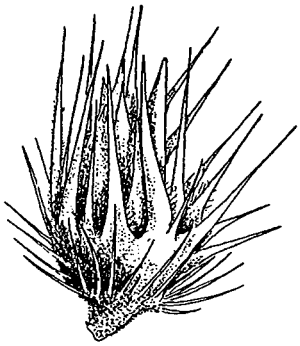




**C. ciliaris*
(Statewide)

1. Bristles rigid, broad, 2-5mm long

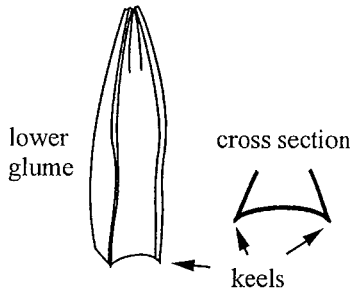




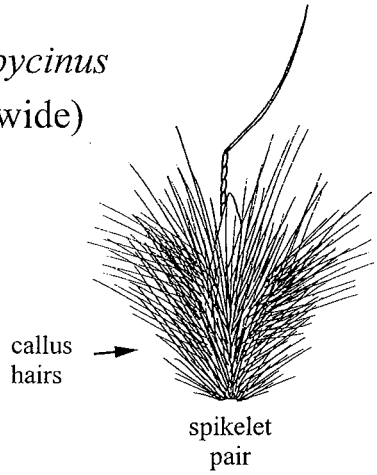
**C. echinatus*
(Statewide)

Cymbopogon

1. No nerves between the keels of the fertile floret (except in the upper part); callus hairs nearly as long as the spikelet; spathes with hairs near the base and on the margins

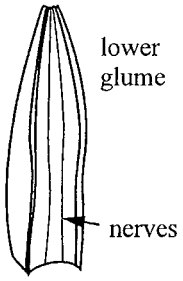


C. bombycinus
(Statewide)



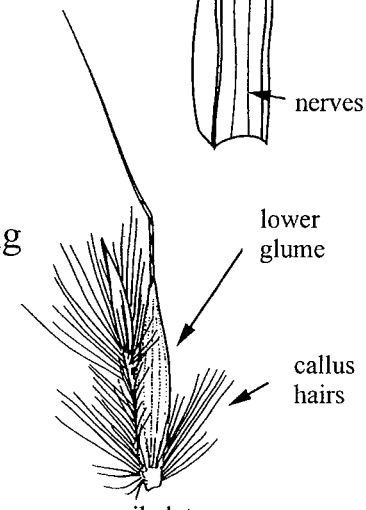
spatheate inflorescence

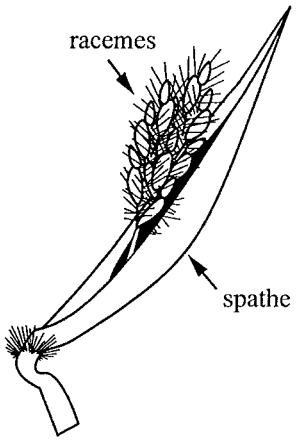
1. At least 2 prominent nerves between the keels of the lower glume of the fertile floret; spathes glabrous ...2



2. Awns 12-20mm long; mature racemes erect; callus hairs less than half as long as the fertile spikelet

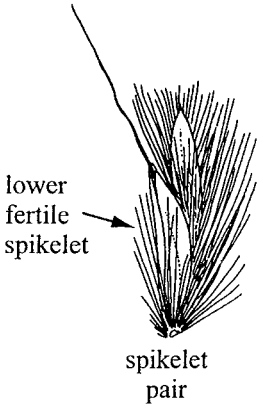
C. ambiguus
(Statewide)

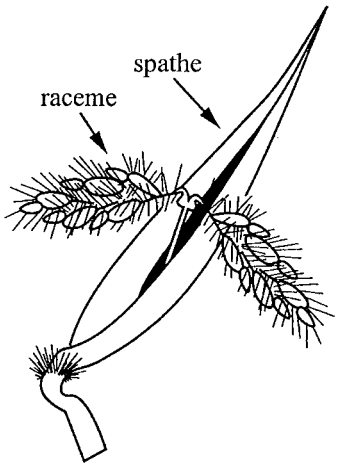




2. Awns 6-8mm long; mature racemes bent backwards; callus hairs more than half as long as the fertile spikelet

C. obtectus
(Statewide)

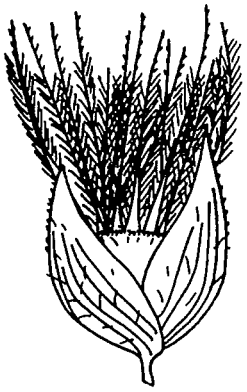




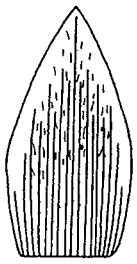
Enneapogon

1. Panicle 3-9cm long;
   lower glume with 11-23 nerves;
   lemma nerves obscure

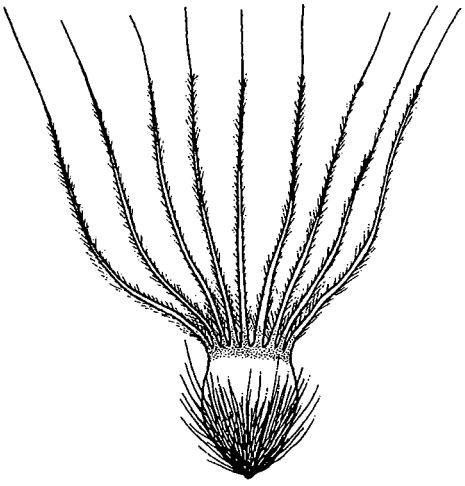
E. avenaceus
(Southwest & Eremaean)



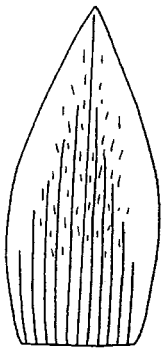
spikelet



lower glume

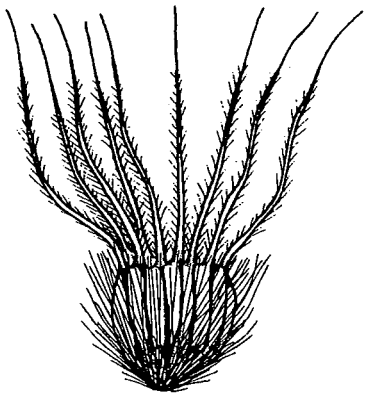


lemma

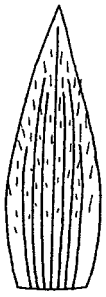


upper glume

1. Panicle 1-2cm long;
   lower glume with 5-7 nerves;
   lemma nerves prominent



lower glume

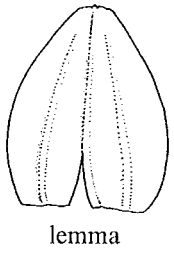


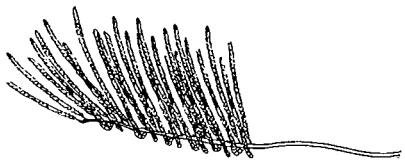
upper glume

E. caerulescens
(Eremaean)

Eragrostis

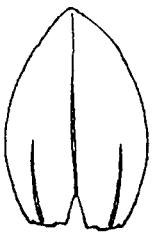
1. Panicle contracted and spike-like; spikelets with 9-81 florets; lateral nerves on lemma more than half as long as lemma ...4

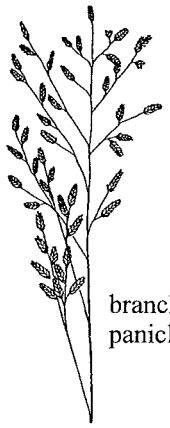

lemma


spike-like panicle on a prostrate stem


contracted panicle

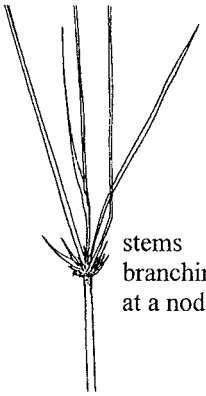
1. Panicle open or conspicuously branched; spikelets with 4-24 florets; lateral nerves on lemma up to half as long as lemma ...2

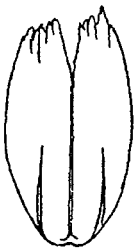

lemma

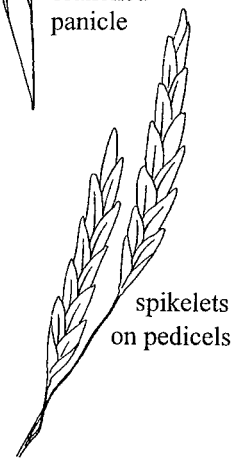

branched panicle

2. Stems cane-like, much branched, 1-3 metres tall

E. australasica (Eremaean)


stems branching at a node

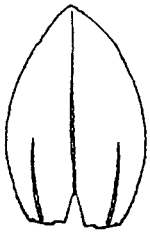

lemma


spikelets on pedicels

2. Stems grass-like, with few or no branches, up to 120cm tall ...3

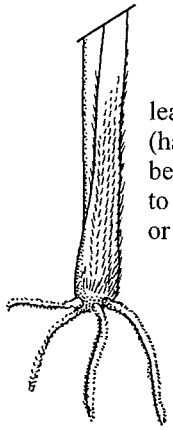
3. Stems 30-120cm high; ligules 0.3-1mm long; spikelet 1-1.5mm wide

**E. curvula* (Southwest & Eremaean)


lateral nerves may be hard to see

lemma

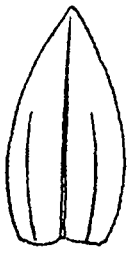

spikelet


leaf sheath (hairs may be restricted to margins or base)

3. Stems 10-60cm high; ligules 0.1-0.3mm long; spikelet 1.5-3mm wide

E. brownii (Southwest)


spikelet


lemma

Eragrostis Cont.

...FROM 1

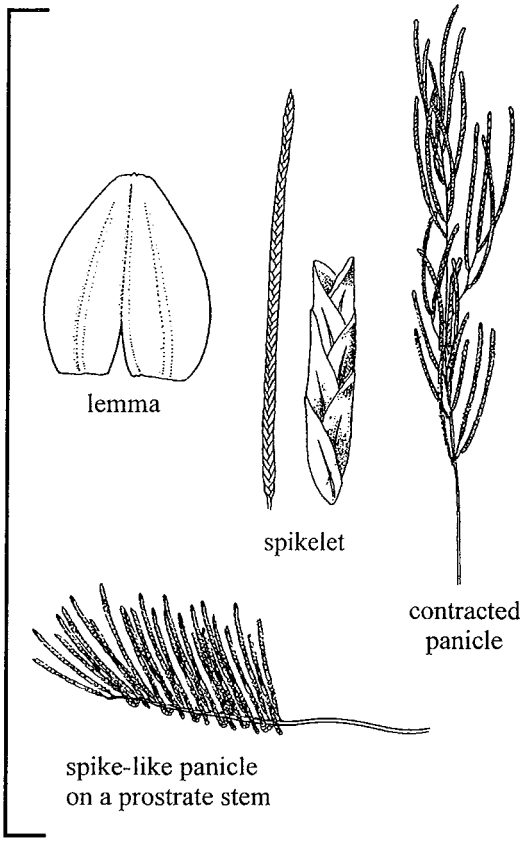
4. Spikelet 0.7-2.5mm wide

E. dielsii
(Southwest & Eremaean)

these two species are very similar

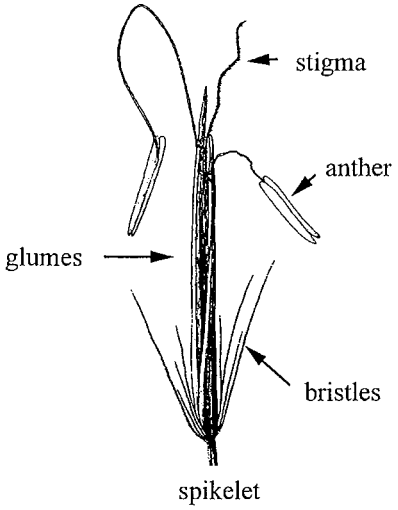
4. Spikelet 0.4-0.7mm wide; whole plant very slender

E. pergracilis
(Eremaean)



Pennisetum

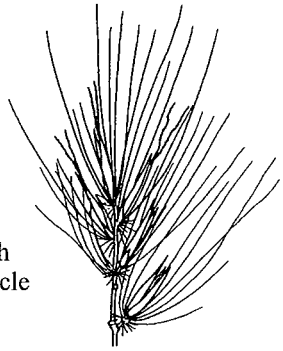
1. Inflorescence small with few spikelets partially hidden within a terminal leaf sheath; bristles shorter than spikelet



**P. clandestinum*

(Southwest)

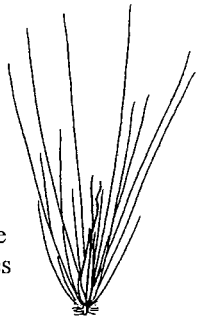
1. Inflorescence a large aerial spike-like panicle with numerous spikelets; bristles longer than spikelets ...2

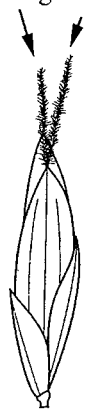


2. Central axis of the panicle hairy; spikelets 4-7mm long, with separate stigmas

**P. setaceum*

(Southwest & Eremaean)

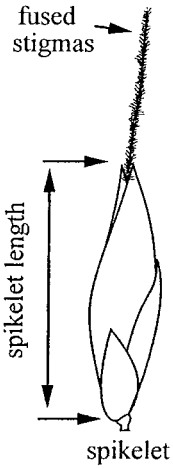


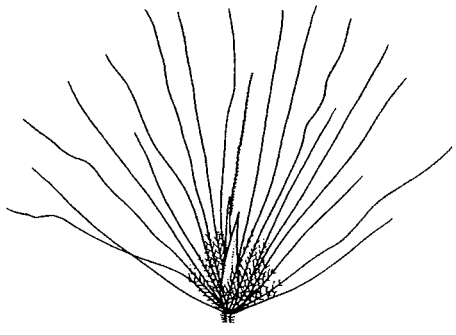


2. Central axis glabrous, scabrous or spasely hairy; spikelets 9-14mm long with stigmas fused into one

**P. villosum*

(Southwest)



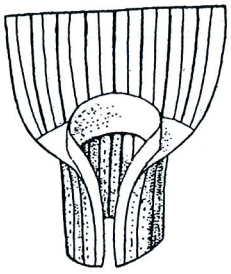


Poa

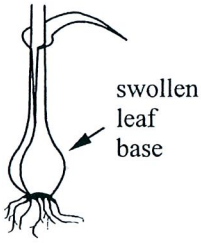
1. Stem/leaf bases not swollen; ligule <1mm long; long hairs at base of lemma

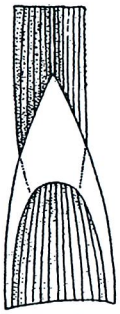
**P. pratensis*

(Southwest)



1. Stem/leaf bases swollen; ligule >2mm long ...2

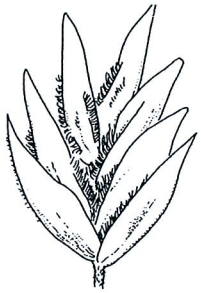


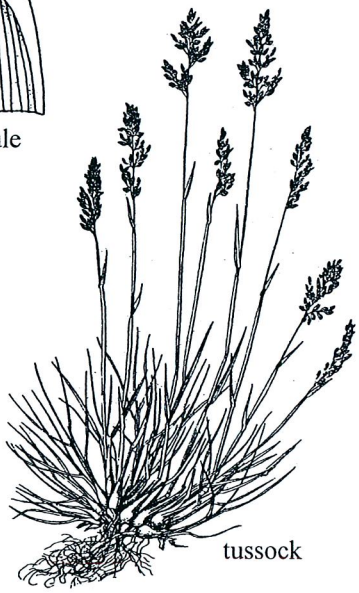


2. Panicle 2-6cm long; lemma 2.5-3.5mm long, with acute apex and long hairs at base; leaf bases swollen to produce a single bulb; leaf blades smooth

**P. bulbosa*

(Southwest)

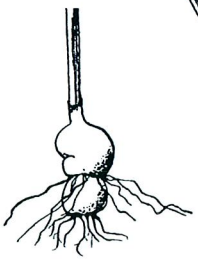


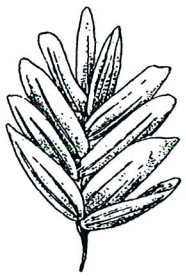


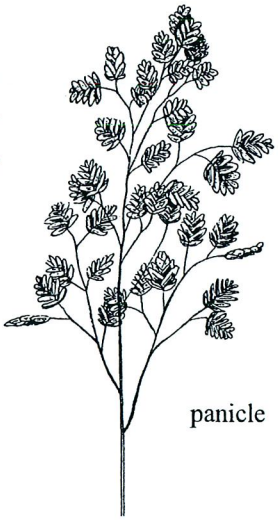
2. Panicle 8-20cm long; lemmas 3-7mm long, with obtuse apex and no long hairs at the base; basal stem internodes swollen, producing one or more nodules and/or a branching rhizome; leaf blades scabrous

P. drummondiana

(Southwest)



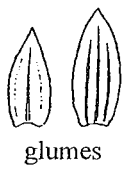




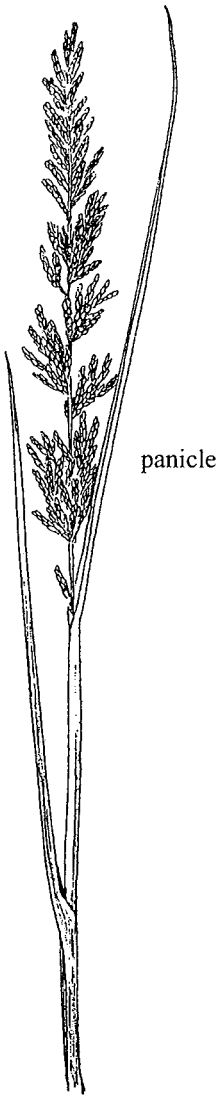
Puccinellia

1. Lateral branches of panicle short, producing a crowded inflorescence, 5-15cm long, embraced at the base by a subtending leaf; lower glume more than half the length of the upper glume

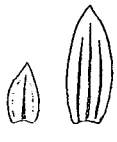
P. stricta
(Southwest)


glumes


spikelet

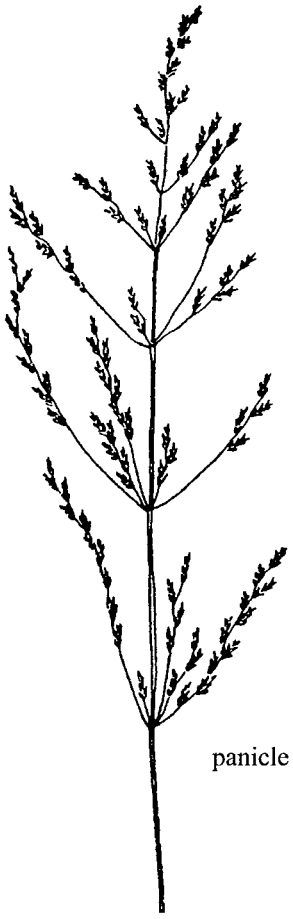

panicle

1. Lateral branches of panicle elongated, producing an open inflorescence, 20-30cm long, exserted well above the terminal leaf; lower glume about half the length of the upper glume


glumes

**P. ciliata*
(Southwest)

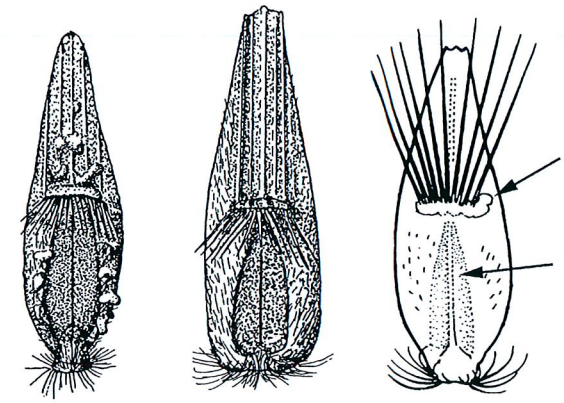

spikelet


panicle

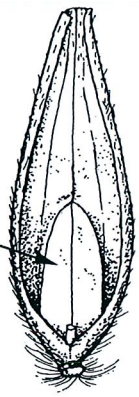
Thyridolepis

1. Panicle 2-4cm long;
   lower glume with 9-29 bristles
   on transverse ridge;
   long fine hairs on upper glume

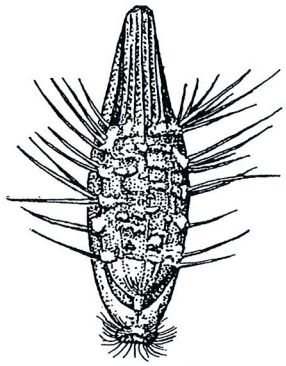
T. mitchelliana
(Eremaean)



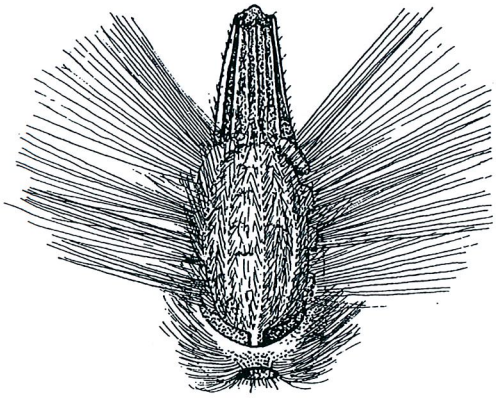
lower glume variants



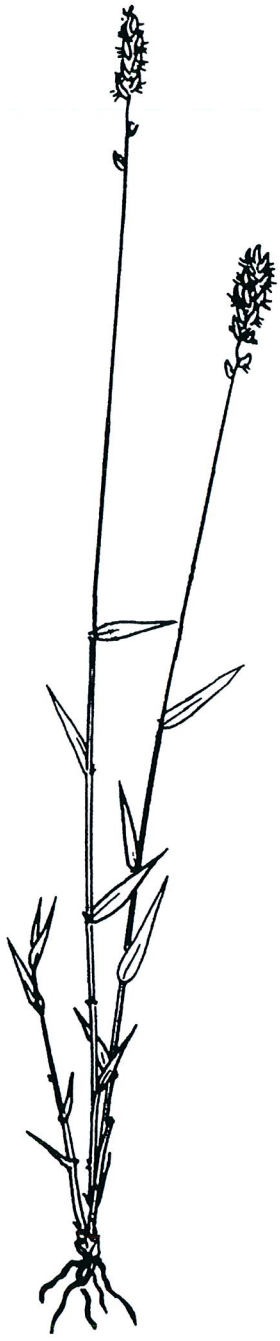
lower
glume
from
inside



upper glume from
the lower part of
the panicle



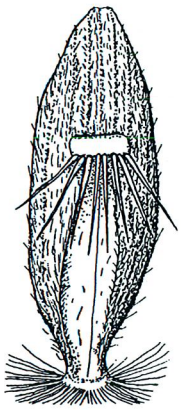
upper glume from
the upper part of
the panicle



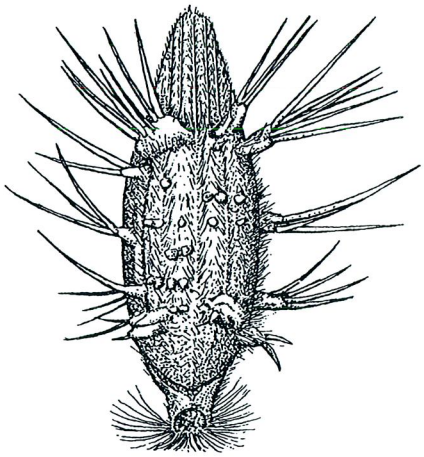
whole
plant

1. Panicle 5-9 cm long;
   lower glume with 5-10 bristles
   on transverse ridge; long fine
   hairs absent from upper glume

T. multiculmis
(Eremaean)



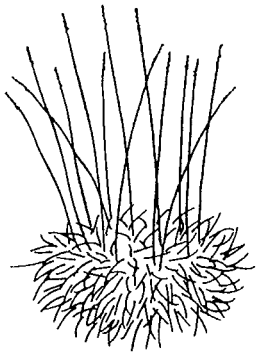
lower
glume

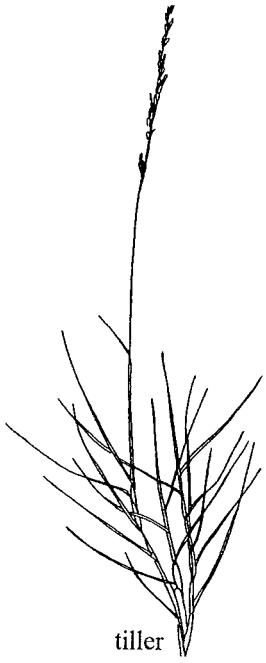


upper
glume

Triodia

hummock grasses (spinifex)





tiller

1. Lemma awnless, or with a small mucro

   T. scariosa
   (Eremaean)

1. Lemma 3-awned ...2
2. Leaf blades 2-8cm long; plant 20-70cm tall; panicle 7-10cm long

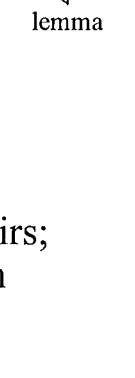
   T. rigidissima
   (Eremaean)

2. Leaf blades 15-60cm; plant 60-250cm high; panicle 15-60cm long ...3

3. Leaf sheaths woolly with hairs; middle lobe of lemma + awn 12-23mm long

   T. danthonioides
   (Southwest)

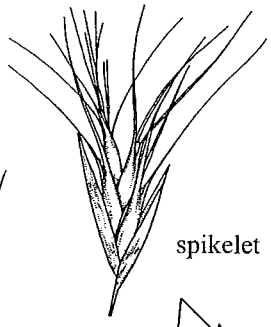
lemma



lemma

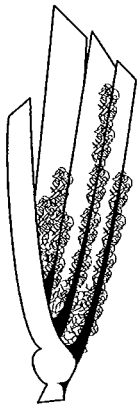
spikelet

panicle



spikelet

lemma



leaf sheath bases

3. Leaf sheaths glabrous, or with some basal hairs (mostly straight, not woolly); middle lobe of lemma + awn 2.5-13mm long ...4

Perth 00387436

lemma

4. Lemma mid-lobe + awn 2.5-6mm long; lemma body with lines of hairs either side of midvein, on lateral veins and on margins

   T. dielsii (Southwest)

4. Lemma mid-lobe + awn 10-13mm long; lemma body with no hairs on lateral veins

   T. longipalea (Southwest)

Perth 00386855

lemma

Acknowledgements

Many of the illustrations in this work were taken from or based on Gardner (1952), Gardner's original drawings held at the WA Herbarium, and Paterson (1992). Some were taken with permission from Harden (1993), and some came from taxonomic journals where illustrations were included. Some are my own original drawings. All illustrations were checked against herbarium collections and edited and retouched as necessary to achieve taxonomic accuracy and print quality. The keys were compiled from various sources:- the illustrations and herbarium specimens; the original taxonomic descriptions and revisions cited below; Simon (1993); DELTA databases compiled by Watson & Dallwitz (1998) and Clayton (1999) with special assistance from Mike Choo who developed CALM's Integrated DELTA System; other staff at the WA Herbarium, notably Dr. Terry Macfarlane. Terry Macfarlane, Neville Marchant and Mike Hislop provided comments on the manuscript.

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INDEX

As our knowledge of plants increases some species names have to be changed to properly reflect their relationships with other species. Current scientific names are written in italics. Names used in Gardner (1952) that have since changed have their former scientific names included in Roman type. Common names recommended by Bennett (1993) are given as direct equivalents with their scientific names. Common names that are **not** recommended are included via a "*see*" or "*see also*" reference to their recommended common name. Alien species are marked with a leading asterisk (*).