Swindale

GRASSES OF THE HAWAIIAN RANGES

Hawaii Agricultural
Experiment Station
Bulletin 82

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HAWAII AGRICULTURAL EXPERIMENT STATION
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GRASSES OF THE HAWAIIAN RANGES

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INTRODUCTION

The Hawaiian rancher is confronted with an ever-increasing number of grasses which have become established on the range. Some of them are relatively widespread and commonly known. Others are of recent introduction and are being propagated in newly plowed and planted fattening paddocks. Some are little-known native species which oftentimes occur in surprisingly localized areas. A few are serious pests.

There are available a number of sources of information regarding range grasses. Of a purely taxonomic nature are Hitchcock's "The Grasses of Hawaii,"[3] "Manual of the Grasses of the West Indies,"[4] and "Manual of the Grasses of the United States."[5] Two bulletins[6, 7] have been issued by the Hawaii Experiment Station, which discuss grasses from the standpoint of their occurrence and value on the range.

As part of a vegetative survey of the local ranches made by Mr. Hosaka (1936-37), collections were made of many grasses now established on the range which are not described in previous publications from Hawaii. The present bulletin describes and illustrates 103 of the most important grasses in Hawaii. Very few of the native species are common on the range, the introduced species being of far greater importance both in point of number and of forage value.

There are many grasses, either recently introduced or slow to become acclimatized, that have not yet established themselves on the ranges; these are not here included. Species that are found outside the general range areas, as in summit bogs, forest reserves, and national parks, are also omitted.

Keys to the tribes and genera are based on the publications mentioned above. The genera are arranged in alphabetic order. The descriptions of the grasses are two-fold: first, a technical description

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[3] HITCHCOCK, A. S., THE GRASSES OF HAWAII, Memoirs Bernice P. Bishop Museum, 8:101-230, illus. 1922.

[4] HITCHCOCK, A. S., MANUAL OF THE GRASSES OF THE WEST INDIES, U. S. Dept. of Agr. Misc. Pub. 243, 439 pp., illus. 1936.

[5] HITCHCOCK, A. S., MANUAL OF THE GRASSES OF THE UNITED STATES, U. S. Dept. Agr. Misc. Pub. 200, 1,040 pp., illus. 1935.

[6] MCCLELLAND, C. K., GRASSES AND FORAGE PLANTS OF HAWAII, Hawaii Agr. Expt. Sta. Bul. 36, 42 pp., illus. 1915.

[7] RIPPERTON, J. C., GOFF, R. A., EDWARDS, D. W., and DAVIS, W. C., RANGE GRASSES OF HAWAII, Hawaii Agr. Expt. Sta. Bul. 65, 38 pp., illus. 1933.

given in fine print which is of use only to the botanist in identifying the species; and second, a popular description of the grass to which is added its origin, value in its native land, occurrence in Hawaii, nature of growth, and value on the range. The technical descriptions were, in the main, made from living plants and herbarium specimens. The information regarding the local value of the different species is the consensus of the various ranchers.

To facilitate the use of the bulletin, each grass has been cross-indexed according to its scientific name, its common name, and any synonyms for either. Technical terms have been eliminated as far as possible from the popular descriptions. A glossary is included which defines all technical terms used (page 135). On pages 126 to 134 is given all information available as to native countries and dates of introduction.

The illustrations were drawn to show the growth habits of the plant as well as the enlarged flower parts. Some of these line drawings were copied, with slight modifications from reproductions in other publications, largely from the U. S. Department of Agriculture bulletins. Others were made from living plants.

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KEY TO THE TRIBES

Spikelets 1- to many-flowered, the reduced florets, if any, above the perfect florets (except in Phalarideae); articulation usually above the glumes; spikelets usually more or less laterally compressed.

Spikelets with 2 staminate, neuter, or rudimentary lemmas unlike and below the fertile lemma; no sterile or rudimentary florets above the terminal perfect floret ..... PHALARIDEAE 7

Spikelets without sterile lemmas below the perfect floret.

Spikelets 1-flowered in groups, the groups racemose along a main axis, falling entire; lemma and palea thinner than the glumes ..... ZOYSIEAE 5

Spikelets not as above.

Spikelets sessile on a usually continuous rachis (disarticulating in *Hordeum*).

Spikelets on opposite sides of the rachis; spike terminal, solitary ..... HORDEAE 2

Spikelets on one side of the rachis; spikes usually more than 1, digitate or nearly so ..... CHLORIDEAE 6

Spikelets pedicellate in open or contracted, sometimes spikelike panicles.

Spikelets 1-flowered ..... AGROSTIDEAE 4

Spikelets 2- to many-flowered.

Glumes as long as the lowest floret, usually as long as the spikelet; lemmas awned from the back (lemmas longer than the glumes and awnless in *Sphenopholis*) ..... AVENEAE 3

Glumes shorter than the first floret; lemmas awnless or awned from the tip or from a bifid apex ..... FESTUCEAE 1

Spikelets with 1 perfect terminal floret (disregarding the staminate and neuter spikelets) and a sterile or staminate floret below, commonly represented by a sterile lemma only; first glume sometimes wanting; articulation below the spikelets, either in the pedicel, in the rachis, or at the base of a cluster of spikelets, the spikelets falling entire, singly, in groups, or together with joints of the rachis; spikelets, or at least the fruits, more or less dorsally compressed.

Glumes membranaceous, the sterile lemma like the glumes in texture.

Fertile lemma and palea thinner than the glumes, sterile lemma awned from the notched summit ..... MELINIDEAE 8

Fertile lemma and palea indurate or at least firmer than the glumes ..... PANICEAE 9

Glumes indurate; fertile lemma and palea hyaline or membranaceous, the sterile lemma like the fertile one in texture; spikelets in pairs, one sessile and perfect, the other pedicellate and usually staminate or neuter ..... ANDROPOGONEAE 10

DESCRIPTIONS OF THE TRIBES AND KEYS TO THE GENERA

1. Festuceae

Spikelets more than 1-flowered, usually several-flowered, in open, narrow, or sometimes spikelike panicles (rarely in racemes); lemmas awnless or awned from the tip, rarely from between the teeth of a bifid apex; rachilla usually disarticulating above the glumes and between the florets.

Lemmas divided at the summit into 9 or more awns; florets falling attached, their awns forming a pappus-like crown; panicles narrow ..... *Pappophorum*
Lemmas awnless or with a single awn.
  Spikelets of two forms, sterile and fertile-intermixed; panicle dense, somewhat one-sided ..... *Lamarckia*
  Spikelets all alike in the same inflorescence.
    Lemmas 3-nerved, the nerves usually prominent ..... *Eragrostis*
    Lemmas 5- to many-nerved, the nerves sometimes obscure.
      Lemmas as broad as long, the margins outspread; florets closely imbricate, horizontally spreading ..... *Briza*
      Lemmas longer than broad, the margins clasping the palea; florets not horizontally spreading.
        Lemmas keeled on the back.
          Spikelets strongly compressed, crowded in one-sided clusters at the ends of the stiff, naked panicle branches ..... *Dactylis*
          Spikelets not strongly compressed, not crowded in one-sided clusters.
            Lemmas awned from a minutely bifid apex (awnless or nearly so in *Bromus catharticus*); spikelets 8 to 40 mm long ..... *Bromus*
            Lemmas awnless; spikelets 3 to 5 mm long ..... *Poa*
        Lemmas rounded on the back, or slightly keeled toward the summit only, awned (awnless in *Festuca elatior*) ..... *Festuca*

2. Hordeae

Spikelets 1- to several-flowered, sessile on opposite sides of a jointed or continuous axis forming symmetrical spikes.

Spikelets placed edgewise to the rachis, solitary at each node of the rachis ..... *Lolium*
Spikelets placed flatwise to the rachis, 1 to 3 at each node of the rachis (sometimes solitary in part of the spike in *Elymus*).
  Rachis disarticulating; spikelets 1-flowered, in 3's, the lateral pair sometimes reduced to awns ..... *Hordeum*
  Rachis continuous; spikelets 2- to several-flowered ..... *Elymus*

3. Aveneae

Spikelets 2- to several-flowered, in narrow or open panicles; lemmas generally shorter than the glumes, usually awned; awns

geniculate, often twisted, rarely straight (lemmas longer than the glumes and awnless in *Sphenopholis*).

Florets 2, one perfect, the other staminate.
Lower floret staminate, the awn twisted, geniculate, exserted....*Arrhenatherum*
Lower floret perfect, awnless; upper floret awned.....*Holcus*
Florets 2 or more, all alike except the reduced upper ones.
Lemmas awnless; spikelets falling entire.....*Sphenopholis*
Lemmas awned; glumes persistent, the florets falling.
Spikelets 2-flowered (sometimes with a rudimentary third floret); lemmas awned from the back.
Spikelets less than 1 cm long.
Lemmas keeled, awned from above the middle; panicle dense....*Trisetum*
Lemmas rounded on the back, awned from below the middle; panicle open.....*Deschampsia*
Spikelets large, the glumes more than 2 cm long.....*Avena*
Spikelets several-flowered; lemmas awned from a deeply bifid apex.....*Danthonia*

4. Agrostideae

Spikelets 1-flowered, usually perfect, in open, contracted, or spikelike panicles, but not in true spikes nor in one-sided racemes.

Articulation below the glumes, the spikelets falling entire; glumes long-awned.....*Polypogon*
Articulation above the glumes.
Glumes longer than the lemma.
Glumes saccate at base; lemma long-awned; panicle contracted, shining.....*Gastridium*
Glumes not saccate at base; lemma awned or awnless; panicle open or contracted.....*Agrostis*
Glumes not longer than the lemma, usually shorter.....*Sporobolus*

5. Zoysieae

Spikelets 1-flowered, in subsessile clusters on a short rachis, the cluster falling entire; glumes covered with hooked spines, forming little burs.

Only Hawaiian genus.....*Tragus*

6. Chlorideae

Spikelets 1- to several-flowered, in 2 rows on one side of a continuous rachis, forming 1-sided spikes or spikelike racemes, these digitate or subdigitate.

Spikelets with more than 1 perfect floret.
Rachis of spike extending beyond the spikelets.....*Dactyloctenium*
Rachis not prolonged.....*Eleusine*

Spikelets with only 1 perfect floret, often with additional sterile florets above.
Spikelets without sterile florets, the rachilla sometimes prolonged.....*Cynodon*
Spikelets with 1 or more sterile florets above the perfect one.....*Chloris*

7. PHALARIDEAE

Spikelets with 1 perfect terminal floret and, below this, a pair of neuter florets (one sometimes obsolete in *Phalaris*).

Spikelets falling entire, the glumes awned.....*Microlaena*
Spikelets not falling entire, the glumes persistent, awnless.
Sterile florets minute, awnless.....*Phalaris*
Sterile florets conspicuous, awned.....*Anthoxanthum*

8. MELINIDEAE

Spikelets disarticulating below the glumes, these very unequal, the first minute, the second and the sterile lemma equal, membranaceous, strongly nerved, the latter bearing a slender awn from the notched summit; fertile lemma and palea thinner in texture, awnless.

Only Hawaiian genus.....*Melinis*

9. PANICEAE

Spikelets with 1 perfect terminal floret, and below this a sterile floret and 2 glumes; fertile lemma and palea indurate or at least firmer than the glumes and sterile lemma, a lunate line of thinner texture at the back just above the base, the rootlet protruding through this at germination; articulation below the spikelet.

Axis thickened and corky, the spikelets sunken in cavities in its joints, these disarticulating at maturity.....*Stenotaphrum*
Axis not thickened, the spikelets not sunken in it.
Spikelets subtended or surrounded by 1 to many bristles or spines (sterile branchlets), these distinct or more or less connate at base, forming a false involucre.
Bristles persistent.....*Setaria*
Bristles falling with the spikelets at maturity.
Bristles not united at base, usually slender, often plumose.....*Pennisetum*
Bristles more or less united at base, forming a bur.....*Cenchrus*
Spikelets not subtended or surrounded by bristles.
Fruit cartilaginous-indurate, not rigid, usually dark-colored; lemma with white hyaline margins, these not inrolled.
Spikelets conspicuously long-silky in slender racemes, these panicled; fruit lanceolate, acuminate.....*Trichachne*
Spikelets with short pubescence or glabrous; fruit elliptic; racemes digitate or subdigitate.....*Digitaria*
Fruit indurate, rigid, not hyaline-margined.
Spikelets solitary, subsessile, placed with the back of the fruit turned away from the rachis; racemes digitate or subdigitate; first

glume wanting ..... *Axonopus*
Spikelets in 2's or 3's or solitary, placed with the back of the fruit turned toward the rachis or pedicellate in panicles.
First glume typically wanting; spikelets planoconvex, subsessile in spikelike racemes..... *Paspalum*
First glume present; spikelets usually in panicles, biconvex.
Glumes or lemmas or both awned or, if short-pointed only, the summit of the sterile palea not enclosed and the spikelets crowded in short racemes.
Spikelets long-silky; first glume minute, remote..... *Tricholaena*
Spikelets not silky, scabrous or hispid; first glume well developed ..... *Echinochloa*
Glumes and lemmas awnless.
Inflorescence a cylindric spikelike panicle; spikelets with a saccate second glume; fruit stipitate, the palea not enclosed at the summit..... *Sacciolepis*
Inflorescence an open or contracted panicle or, if somewhat spikelike, the second glume not saccate; the fruit not stipitate ..... *Panicum*

10. Andropogoneae

Spikelets in pairs along a rachis, the usual arrangement being one pair sessile and fertile, the other pedicellate and staminate or neuter; fertile spikelet consisting of 1 perfect terminal floret and, below this, a staminate or neuter floret, the lemmas thin or hyaline, and 2 awnless glumes, one or usually both firm or indurate.

Fertile spikelet with hairy-pointed callus formed of the attached supporting rachis-joint or pedicel or of the upper part of the peduncle.
Racemes reduced to a single joint, long-peduncled in a simple panicle ..... *Chrysopogon*
Racemes of several to many joints, solitary..... *Heteropogon*
Fertile spikelet without a callus, the rachis disarticulating immediately below the spikelet.
Racemes single, in pairs, digitate, or numerous, sometimes subtended by spathes; lowest pairs of spikelets like the others, one fertile and sessile, the other pedicellate, staminate or reduced; not aromatic..... *Andropogon*
Racemes in pairs, subtended or enclosed by broad spathes, aggregate in compound inflorescences, the spikelets of the lowest pair of one of the racemes alike, staminate or neuter; aromatic..... *Cymbopogon*

DESCRIPTIONS OF GENERA AND SPECIES

AGROSTIS L. BENTGRASS

Spikelets 1-flowered, disarticulating above the glumes, the rachilla usually not prolonged; glumes equal or nearly so, acute, acuminate, or sometimes awn-pointed, usually scabrous on the keel and sometimes on the back; lemma obtuse, usually shorter and thinner than the glumes, awnless or dorsally awned, often hairy on the callus; palea shorter than the lemma, 2-nerved in only a few species, usually small and nerveless.

There are about 120 species of *Agrostis* distributed throughout the cool temperate regions of the world. Eight species are found in Hawaii. They are generally delicate, moderately tall, sod-forming grasses, some producing extensively creeping rhizomes. A few are annuals. The species may usually be recognized by the delicate, open to contracted flowering heads with numerous very small spikelets. Several are extremely important forage plants either in cultivation or on the ranges. They are typically moisture loving and are at their best in moist meadows with relatively rich soil. Some thrive in acid soils where other grasses will not grow.

Two species are important in Hawaiian pastures and they may be recognized by the disarticulating of the florets, leaving the glumes spread in the shape of lobsters' claws.

Lemma pubescent; panicle finely diffuse.....*A. retrofracta*
Lemma glabrous; panicle more or less open but not diffuse.....*A. alba*

Agrostis alba L.

Redtop

Perennial with strong, creeping rhizomes; culms 40 to 80 cm or sometimes as much as 150 cm tall, erect or often decumbent at base; sheaths 3 to 10 cm long, striate; ligule 2.5 to 4 mm long, membranaceous, often lacerate; blades 5 to 15 cm long, 5 to 10 mm wide, scabrous on upper surface, glabrous on lower; panicle 10 to 20 cm long, pyramidal-oblong, often reddish, with ascending or spreading branches; spikelets 2 to 2.2 mm long; glumes acuminate, scabrous on keel; lemma 1.5 to 2 mm long, narrowly ovate, subacute, glabrous; palea 1.2 to 1.5 mm long, glabrous, obtuse. (Fig. 1)

Perennial, usually 1 to 3 feet tall, with strong creeping, underground rhizomes; stems smooth, usually erect but sometimes spreading at the base; leaves 2 to 6 inches long, ⅛ to ¼ inch wide, rough to the touch on the upper surface, smooth on the lower; flowering heads 4 to 8 inches long, commonly reddish, usually with short spreading branches; spikelets not more than 1/16 inch long.

A native of Eurasia introduced in America and an important cultivated pasture and meadow grass in all the cooler parts of the United States. Although not widely planted it is found occasionally in the higher altitudes on all the islands. It does well in the moist higher altitudes on the island of Hawaii and probably warrants greater consideration on Hawaiian ranges. A plant with a similar habit occurs in the pastures, known as *Agrostis stolonifera.*

Fig. 1. *Agrostis alba:* a, spikelet.

Fig. 2. *Agrostis retrofracta:* a, spikelet.

Agrostis retrofracta Willd.

Tufted perennial, 15 to 60 cm tall, erect or often decumbent at base; sheaths glabrous or scabrous; ligule 4 to 7 mm long, lance-acuminate, membranaceous; blades 10 to 20 cm long, 1 to 2 mm wide, scabrous on the upper surface, glabrous beneath; panicle 10 to 30 cm long; branches scabrous, spreading horizontally at maturity; spikelets light green to pale; glumes 2.5 to 3 mm long, acuminate, the keel scabrous; lemma 1.5 mm long, obtuse, pilose, the awn 3 mm long, from about

the middle of the back; prolongation of rachilla about 0.3 mm long, silky pubescent. (Fig. 2)

A tufted, short-lived perennial, ½ to 2 feet tall; leaves 4 to 8 inches long, narrow, flat, rough to the touch; flowering heads 4 to 12 inches long, the very slender branches in whorls, horizonally spreading; spikelets about ⅛ inch long.

Originally described from Australia, but commonly naturalized in Polynesia. It is found on all the islands at middle to high elevations, in dry and well-drained localities. Though it does not produce much forage it is highly relished by grazing animals and in some of the dry, rocky, upland pastures, is a good addition to the vegetation.

ANDROPOGON L. BEARDGRASS

Spikelets in pairs at each node of the articulate rachis of a raceme, one sessile and perfect, the other pedicellate and staminate, neuter, or reduced to the pedicel, the rachis and the pedicels of the sterile spikelets often villous, sometimes conspicuously so; glumes of the fertile spikelets coriaceous, narrow, awnless, the first rounded, flat, or concave on the back, several-nerved, the median nerve weak or wanting; sterile lemma shorter than the glumes, empty, hyaline; fertile lemma hyaline, narrow, entire or bifid, usually bearing a bent and twisted awn from the apex or from between the lobes; palea hyaline, small or wanting; pedicellate spikelet awnless, sometimes staminate and about as large as the sessile spikelet, sometimes consisting of one or more reduced glumes, sometimes wanting, only the pedicel present.

This is a large genus of about 200 species, widely distributed in the warmer parts of the world. The beardgrasses are usually coarse, with solid or pithy stems. Most of them are palatable to livestock when young but soon become tough and coarse. They are found at low elevations, in dry to semi-dry areas. The species may be recognized by the paired spikelets in more or less hairy racemes, these mostly in fan-shaped heads, and by the prominent awns or beards.

There are six species common to the range.

Racemes numerous in a dense silvery silky head.....*A. barbinodis*
Racemes 2 to several (sometimes 1 in *A. nodosus*), digitate.
  Pedicellate spikelet obsolete; racemes 2, delicate, zigzag.....*A. virginicus*
  Pedicellate spikelet about as large as the sessile one; racemes not delicate and zigzag.
    Culms densely pubescent below the flattish scale-like racemes; spikelets closely overlapping, the rachis-joints hidden.....*A. nodosus*
    Culms glabrous below the slender racemes; spikelets not closely overlapping, the hairy rachis-joints visible.
      First glume of sessile spikelet pitted on the back.....*A. pertusus*
      First glume of sessile spikelet not pitted.

Racemes on short peduncles, loosely digitate, hairy but not long-silky ..... *A. annulatus*
Racemes sessile, densely digitate, long-silky ..... *A. sericeus*

Andropogon annulatus Forsk.

Angleton grass

Perennial; culms 50 to 100 cm tall, erect, spreading or ascending from a decumbent base, pilose and sometimes purplish at nodes; sheaths 4 to 8 cm long, striate, glabrous, with conspicuous white collar; ligule 1 mm long, membranaceous; blades 6 to 12 cm long, 3 to 6 mm wide, short-hirsute on the upper surface and with a few long hairs at base, scabrous on lower; racemes 3 to 7, 4 to 7 cm long, purplish, spreading; both pedicellate and sessile spikelets similar to those of *A. sericeus* but with less dense pubescence. (Fig. 4, d)

A robust perennial, 1 to 3 feet tall; stems erect from a spreading and bent base, rather tough and woody, purplish and with long silky hairs at the joints; leaves 2 to 5 inches long, ⅛ to ¼ inch wide, tapering to a fine point, the upper surface sparsely covered with short stiff hairs and with a few long stiff hairs at the base, the under surface slightly rough to the touch; flowering heads of 3 to 7 spreading purplish branches 1 to 2½ inches long, sparsely covered with short hairs and with soft bristles.

Native of Asia and Africa, originally described from Egypt. It has been introduced into tropical America and has been in the Hawaiian Islands since before 1888. At present it is growing only in a few places on the dry ranges at low altitudes on the island of Maui. It is reported to be quite palatable elsewhere. Very little is known concerning its forage value in the Hawaiian Islands, but it appears to be rather tough and woody. It produces a fairly dense sod.

Andropogon barbinodis Lag.

Fuzzy top

Perennial; culms 60 to 120 cm tall, erect or ascending, often branching near base, densely silky-pilose at nodes, otherwise glabrous; sheaths 8 to 12 cm long, usually longer than internodes, the upper shorter, sometimes sparsely long-hispid in the throat, otherwise glabrous, often pinkish or purplish near base; ligule 2.5 to 3 mm long, membranaceous, silky-ciliate; blades 12 to 25 cm long, 3 to 6 mm wide, attenuate, sometimes glaucous, the midrib prominent, scabrous on upper surface, glabrous on lower; panicles 6 to 10 cm long, dense, oblong or flabellate, silky, silvery-white, composed of several to many short-peduncled racemes on an axis 2 to 6 cm long; rachis rather flat, about 0.7 mm wide, silky-pilose; pedicellate spikelet reduced to a single, narrow, subcoriaceous, hirtellous glume 4.5 to 5 mm long, the compressed pedicel about 4 mm long, covered with ascending silky hairs as much as 7 mm long; first glume of sessile spikelet 5.5 to 6 mm long, 9-nerved, long-pilose at base, hirtellous-scabrous on margins of upper part, the apex usually minutely bidentate, subacute; second glume about the same length as the first,

indistinctly nerved, submembranaceous, acute, the margins flat, ciliate, otherwise glabrous and shining; sterile lemma about three-fourths the length of the glumes, glabrous, thin-membranaceous, the apex somewhat obtuse; fertile lemma about 3 mm long, very narrow, not more than 0.2 mm wide, extending into a rather delicate twisted obscurely geniculate awn 2.5 cm long. (Fig. 3)

Perennial; stems erect, 2 to 4 feet tall, often branching at the base, white-bearded at the often purplish joints; leaves 4 to 10 inches long, ⅛ to ¼ inch wide, tapering to slender points, often bluish-green, rough to the touch on the upper surface, smooth on the lower; flowering heads 2 to 4 inches long, compact and fuzzy with long silky hairs and long soft bristles.

A native of southwestern United States and Mexico, whence originally described. It was found growing on the island of Molokai in 1910, and is now rather abundant throughout the dry areas there. and on the dry lava plain near Puuwaawaa, Hawaii. It is drought-resistant and is becoming a favorite grass on dry windswept areas.

Fig. 3. *Andropogon barbinodis:* a, spikelet.

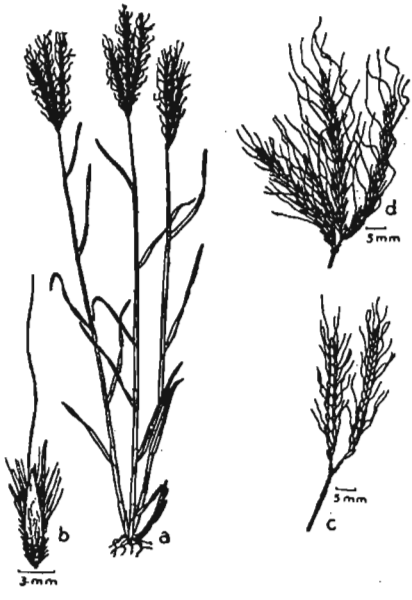

Fig. 4. *Andropogon pertusus:* a, habit; b, spikelet. c, *Andropogon nodosus,* inflorescence. d, *Andropogon annulatus,* inflorescence.

Andropogon nodosus (Willem.) Nash

Wilder grass

Perennial; culms erect from a geniculate base, 75 to 125 cm tall, white-pubescent at the nodes; sheaths glabrous, striate; ligule membranaceous, 0.8 mm long; blades 10 to 20 cm long, 2 to 6 mm wide, scabrous on the upper surface and at first sparsely pilose, becoming glabrous except at base; panicle of 2 to 5 peduncled racemes approximate at the summit of the culm, this and the peduncles densely softly pubescent; racemes flexuous, 3 to 8 cm long; spikelets crowded, the broad glumes of the sessile and pediceled spikelets imbricate; sessile spikelet 4 mm long, short-pilose at base; outer glume broad, oblong, rounded at the apex, sericeous on the lower half, hispidulous on the margin; second glume narrower than the first, about as long, keeled, glabrous on the back, pubescent along the margin; sterile lemma membranaceous, subequal to glumes; fertile lemma narrow, continued into a bronze-brown geniculate awn 1.5 cm long. (Fig. 4, c)

An erect perennial, 2 to 4 feet tall; stems sparingly branching; leaves 4 to 8 inches long, narrow, flat, hairy at the base, the young leaves covered with hairs; flowering heads on long stems, 2- to 5-branched at the top; spikelets broad, overlapping, scale-like, with spreading, brown, twisted awns about ½ inch long.

A native of tropical Asia, introduced into the Islands by G. P. Wilder from the West Indies about 1911. It grows well in many places on Maui and Oahu but thus far it has assumed little importance in pastures.

Andropogon pertusus (L.) Willd.

Pitted beardgrass

Perennial; culms 30 to 80 cm tall, ascending, branching, glabrous, internodes longer than sheaths; sheaths 3 to 7 cm long, striate, glabrous or sometimes pilose at throat and on upper part; ligule 1 mm long, membranaceous, usually erose; blades flat, 5 to 20 cm long, 1 to 4 mm wide, densely pubescent to almost glabrous, striate, usually with prominent midrib and cartilaginous margins; racemes usually 2 to 4, sometimes more, flabellately aggregate on a short axis, 2 to 5 cm long, villous; pedicellate spikelet 3 to 4 mm long, often purple-tinged, scaberulous, the pedicel 3 mm long, densely villous, flattened; sessile spikelet 5 mm long; first glume with a conspicuous pit in the middle, villous on lower half, ciliate-scabrous on upper half, attenuate, often bidentate at apex, subcoriaceous; second glume 5 mm long, apiculate, submembranaceous, keeled, minutely puberulent at apex, otherwise glabrous; sterile lemma minute, hyaline; fertile lemma reduced to a slender geniculate reddish-brown awn 15 to 20 mm long. (Fig. 4, a-b)

Erect perennial, 1 to 3 feet tall; stems usually smooth, often much branched at base; leaves 2 to 8 inches long, 1/16 to 1/8 inch wide, sparsely to densely hairy; flowering heads usually with 2 to 4 short, slender, rather hairy branches arranged on short axis.

A native of the tropics of the Old World, introduced in the West

Indies and in some of the South Sea Islands. In the West Indies it is known as "Barbados sourgrass." It has been collected only recently in isolated spots in low dry pasture near Ulupalakua, Maui; Maunaloa, Molokai; and Mokapu, Oahu. In Australia it is considered a fairly palatable range grass. Its ability to grow in dry situations is a merit worth consideration.

Andropogon sericeus R. Br.

Australian bluegrass

Glaucous perennial; culms 50 to 100 cm tall, erect or somewhat decumbent at base, long silky-pilose at nodes, otherwise glabrous; sheaths 7 to 15 cm long, glabrous; ligule 2 to 3 mm long, membranaceous, lacerate; blades 15 to 45 cm long, 2 to 6 mm wide, attenuate, with a conspicuous midrib, scaberulous and usually with a sparse tuft of long hairs at base; inflorescence slender-peduncled, of 2 to 5 digitate racemes, 3 to 6 cm long; rachis pilose with long silky hairs; pedicellate spikelet neuter, its pilose pedicel about 2 mm long; first glume 3 mm long, 9-nerved, more or less cuneate, obtuse, subcoriaceous, with short appressed hairs at base and long spreading silky hairs on margins and at apex; second glume about 2.5 mm long, truncate, narrow, membranaceous, flat with involute margins, pilose on margins and at apex; first glume of sessile spikelet 3.5 to 4 mm long, 9-nerved, coriaceous, oblong-ovate, obtuse, with short appressed hairs on lower half, papillose-pilose on margins of upper part and in a line across the top slightly below apex with hairs 2 to 3 mm long; second glume as long as the first, subcoriaceous, with 3 converging nerves, acute, more or less keeled, glabrous or with a few long hairs at apex and ciliate, the margins involute; sterile lemma about two-thirds the length of the glumes, thin-membranaceous, acute; fertile lemma 2.5 to 3 mm long, very narrow, not over 0.2 mm wide, extending into a reddish-brown twisted awn 2.5 cm long. (Fig. 5)

An erect perennial, 1 to 3 feet tall, conspicuously bluish-green; stems sometimes slightly bent at the base, long-bearded at the joints; leaves 6 to 18 inches long, ⅛ to ¼ inch wide, usually tapering to slender sharp points, slightly rough to the touch, with prominent mid-veins; flowering heads with 2 to 5 branches, 1 to 2 inches long, the branches usually close together forming compact heads, covered with long silky hairs and bearing long, soft, twisted, reddish-brown bristles.

A native of Australia. It is rather abundant in the lower pastures of the dry regions on the island of Maui. It is very palatable, produces considerable forage, is hardy and fairly drought-resistant, and is proving to be very valuable in dry areas.

Andropogon virginicus L.

Broomsedge

Sparingly tufted perennial; culms 50 to 100 cm tall, erect, simple below, usually freely branching above; sheaths 7 to 12 cm long, glabrous or pilose along

margins, the lower compressed and conspicuously keeled, the upper nearly terete; ligule 0.5 mm long, ovate, ciliate; blades flat or somewhat involute at maturity, 15 to 30 cm long, 1 to 4 mm wide, glabrous on lower surface, scabrous and conspicuously long-pilose toward base on the upper; inflorescence compound, narrow, 60 to 70 cm long, the 2 to 4 racemes 2 to 5 cm long, borne on slender distant branches, subtended by and partially included within an inflated tawny to bronze spathe 4 to 5 cm long; rachis slender, flexuous, long-villous; pedicellate spikelet obsolete, the pedicel villous; sessile spikelet 3 to 3.5 mm long; glumes acuminate, coriaceous, narrow; sterile lemma 2.5 to 3 mm long, hyaline; fertile lemma 3 to 3.5 mm long, hyaline, narrow, apex extended into a delicate scabrous awn 1 to 2 cm long. (Fig. 6)

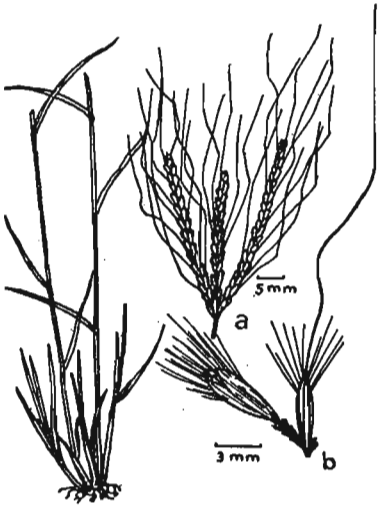

Fig. 5. *Andropogon sericeus:* a, inflorescence; b, spikelet.

Fig. 6. *Andropogon virginicus:* a, floret.

Erect perennial, 1 to 3 feet tall; stems flattened at the base, usually clothed with long hairs along the sides; leaves usually flat but sometimes folded when old, 6 to 12 inches long, the upper sides rough at the base and sparsely clothed with long hairs; flowering heads slender and narrow, with delicate, feathery branches 2 to 2½ inches long, sparsely arranged along the main axes, intermixed with tawny or bronze spathes.

Broomsedge is found in the United States, the West Indies, Central America, and Mexico. It occurs at lower elevations in rather moist open localities on the islands of Oahu and Hawaii, where it affords a certain amount of palatable forage when young but soon

becomes rather tough and woody. The seeds are readily carried by wind by means of the long, feathery flower-stalks that remain attached to the seed. The distribution in the Hawaiian Islands is rather rapid.

ANTHOXANTHUM L. VERNAL GRASS

Spikelets with 1 terminal perfect floret and 2 sterile lemmas, the rachilla disarticulating above the glumes, the sterile lemmas falling attached to the fertile floret; glumes unequal, acute or mucronate; sterile lemmas shorter than the glumes, empty, awned from the back; fertile lemma shorter than the sterile ones, awnless; palea 1-nerved, rounded on the back, enclosed in the lemma.

An unimportant genus containing only about 5 species, all natives of the Old World. The grass may be distinguished by the short, compact, spikelike flowering heads, and by the characteristic odor.

There is only one species in the Islands, *A. odoratum*.

Anthoxanthum odoratum L.

Sweet vernal grass

Perennial; culms 25 to 60 cm tall, tufted, slender, erect, glabrous; sheaths 3 to 8 cm long, striate, glabrous or the basal ones sometimes pubescent on upper part; ligule 1.5 to 4 mm long, conspicuous, membranaceous, sometimes purple; blades 4 to 12 cm long, 2 to 5 mm wide, sparsely pilose, acute; panicles 3 to 7 cm long, 0.5 to 1.5 cm thick, spikelike, long-exserted, brownish-yellow; spikelets 8 to 10 mm long; first glume 4 mm long, broad at base, acute, pointed, 1-nerved, scabrous on nerve; second glume 8 mm long, 3-nerved, scabrous on nerves, scaberulous between them, broad, subcoriaceous with membranaceous margins; sterile lemmas 3 mm long, appressed-pilose with golden hairs, bifid at apex, the first awned from slightly below apex, the awn straight, 6 mm long, the second awned from near base, the awn geniculate, 6 mm long; fertile lemma 2 mm long, broad, enclosed with the two sterile lemmas, coriaceous, glabrous, shining, reddish to dark brown, acute; palea 1.5 mm long, membranaceous, narrow, obtuse, wholly enclosed by the lemma. (Fig. 7)

Perennial fragrant bunchgrass, 1 to 2 feet tall; stems slender, erect, smooth; leaves 1 to 5 inches long, 1/16 to 1/4 inch wide, sparsely clothed with short, rather stiff hairs; flowering heads short, dense, 1 to 2½ inches long, brownish-yellow, ¼ to ½ inch thick, on long slender stalks.

A native of Eurasia, introduced into North America, where it has become rather generally distributed over the cooler regions. It was first collected in the Islands in 1906, and is now found on all the islands in cool moist areas in medium to high altitudes. It is relatively unpalatable and, being very persistent and reseeding readily, is somewhat of a pest in these areas, tending to crowd out more

valuable grasses. In Europe it is sometimes included in meadow mixtures to give fragrance to the hay.

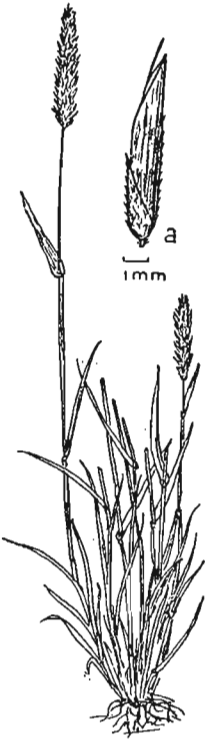

Fig. 7. *Anthoxanthum odoratum:* a, spikelet.

Fig. 8. *Arrhenatherum elatius:* a, spikelet; b, upper floret.

ARRHENATHERUM Beauv.

Spikelets 2-flowered, the lower floret staminate, the upper perfect, the rachilla disarticulating above the glumes and produced beyond the florets; glumes rather broad and papery, the first 1-nerved, the second a little longer than the first and about as long as the spikelet, 3-nerved; lemmas 5-nerved, hairy on the callus, the lower bearing near the base a twisted, geniculate, exserted awn, the upper bearing a short straight slender awn just below the tip.

An unimportant genus containing only a few species, mainly in the temperate regions. They are all rather tall, robust, bunchy perennials with flat leaves and narrow flowering heads.

There is only one species of any importance, *A. elatius*.

Arrhenatherum elatius (L.) Mert. & Koch

Tall oatgrass

Perennial; culms 75 to 150 cm tall, glabrous; sheaths 12 to 15 cm long, striate, glabrous or minutely hispidulous; ligule 1 to 2 mm long, membranaceous, lacerate; blades 10 to 20 cm long, 5 to 10 mm wide, scabrous on both surfaces and often sparsely short-hispid on the upper; panicles 15 to 30 cm long, silvery or purplish with verticillate branches 2 to 3 cm long, spikelet-bearing to the base; spikelets 7 to 9 mm long; glumes minutely scaberulous, broad, acute, the first 4.5 to 5 mm long, the second 8.5 to 9 mm long; lemma of staminate floret 7 to 8 mm long, 5-nerved, scabrous, with hyaline margins and apex, bearing a stout twisted geniculate awn 12 to 12.5 mm long from near base; palea 6 to 7 mm long, scabrous on keels; lemma of perfect floret 7.5 to 8 mm long, scabrous throughout and hispid on lower two-thirds, bearing a delicate straight awn, 1 to 4 mm long, from just below apex; palea 7.5 to 8 mm long, narrow, scaberulous on keels. (Fig. 8)

An erect perennial bunch grass 2 to 5 feet tall; stems smooth; leaves 4 to 8 inches long, ¼ to ½ inch wide, rough on both surfaces and often with short sparse hairs on the upper; flowering heads 6 to 12 inches long, erect and rather loose, shining, silvery or purplish; mature floret about 3/16 inch long, narrow, golden.

A native of Europe, introduced into the United States, where it is sometimes cultivated in the northern humid regions as a meadow grass. It was collected on Hawaii in 1906, and is now found occasionally at medium altitudes on Hawaii, Molokai, Maui, and Lanai.

Avena L. Oats

Spikelets 2- to 3-flowered, the rachilla bearded, disarticulating above the glumes and between the florets; glumes about equal, membranaceous or papery, mostly several-nerved, longer than the lower floret, usually exceeding the upper floret; lemmas indurate, except toward the summit, 5- to 9-nerved, bidentate at apex, bearing a dorsal bent and twisted awn (this straight and reduced in *Avena sativa*).

There are about 50 species of oats, widely distributed throughout the temperate regions. The annual species (oats proper) have open flowering heads with few to many large spikelets. The most important species is the familiar cultivated oat, *Avena sativa*. Several species are important for hay as well as for forage.

There are only 3 species in the Islands, found at low to medium altitudes in semi-dry situations.

Teeth of lemma setaceous; pedicels curved, capillary.....*A. barbata*
Teeth of lemma acute, not setaceous; pedicels thicker.
  Spikelets mostly 2-flowered, the florets not readily separating; awn usually straight or wanting; lemmas glabrous.....*A. sativa*
  Spikelets mostly 3-flowered, the florets readily separating; awn stout, geniculate, twisted; lemmas clothed with stiff brown hairs (hairs sometimes white or scant).....*A. fatua*

Avena barbata Brot.

Slender wild oat

An erect annual; culms 50 to 120 cm tall, rather slender, glabrous, solitary or few; sheaths 8 to 16 cm long, glabrous, the basal often scabrous, striate, loosely clasping the culms; ligule 5 to 10 mm long, membranaceous, conspicuous; blades flat, 10 to 30 cm long, 3 to 7 mm wide, scabrous; panicles 20 to 40 cm long, loose and open with slender branches 4 to 12 cm long; spikelets 2 to 2.5 cm long, on curved capillary pedicels 2 to 3.5 mm long, 2-flowered, the florets readily falling from glumes; glumes 2 to 2.5 cm long, chartaceous, glabrous, 9-nerved, long-acuminate; lemmas 1.5 to 2.2 cm long, 5-nerved, pilose with stiff reddish hairs, coriaceous on lower part, upper part membranaceous, apex bidentate, the setaceous teeth 3 to 4 mm long ending in fine points, the geniculate dorsal awn 3.5 to 4.5 mm long; palea 8 to 9 mm long, ciliate; grain 7 to 8 mm long, narrow, pubescent. (Fig. 9, d)

An erect annual, 2 to 4 feet tall; stems smooth, single or few in a bunch; leaves flat, 4 to 12 inches long, ⅛ to ¼ inch wide, rough to the touch; flowering heads 8 to 16 inches long, loose and open with slender, spreading branches; seeds (including chaff) ⅝ to 1 inch long, covered with long, stiff, reddish hairs.

A native of Europe, abundantly introduced along the Pacific coast of the United States where it is often cut for hay. It was first collected in the Islands in 1906, and is now found occasionally at rather low to medium altitudes on the islands of Oahu, Maui, and Hawaii. It is becoming quite abundant in some areas around Kapapala, Hawaii, and near Makawao, Maui. Although at present it figures but little in the forage make-up of Hawaiian ranges, it is well adapted in the cooler regions at medium altitudes and may in time become important.

Avena fatua L.

Wild oat

Similar to *Avena barbata* but differing in the stouter pedicels, somewhat larger and usually 3-flowered spikelets, deeper brown florets, and the acuminate instead of fine-awned teeth of the lemmas. It is found in localized patches on Hawaii, Maui, and Oahu. (Fig. 9, a-c)

Avena sativa L.

Cultivated oat

Similar to *Avena fatua* but differing in being, usually, more robust; florets not readily separating from the glumes; spikelets commonly 2-flowered; lemmas glabrous; awns short and straight, or wanting. The cultivated oat was reported to have escaped frequently from cultivation on Oahu, Maui, and Hawaii as early as 1888. It is now found only occasionally at medium altitudes on these islands.

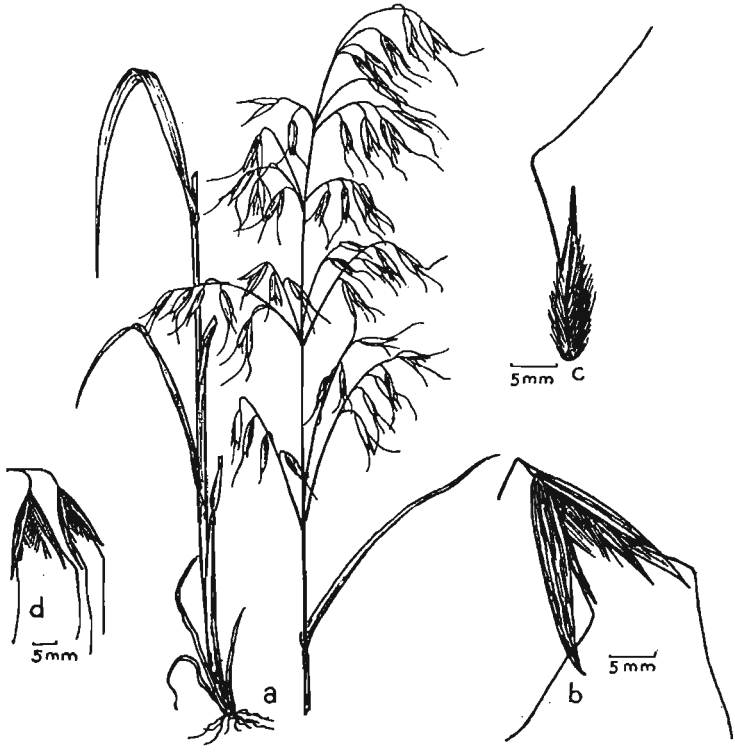

Fig. 9. *Avena fatua:* a, habit; b, spikelet; c, floret. d, *Avena barbata,* spikelet.

AXONOPUS Beauv.

Spikelets depressed-biconvex, not turgid, oblong, usually obtuse, solitary, subsessile, and alternate, in two rows on one side of a 3-angled rachis, the back of the fertile lemma turned from the axis; first glume wanting; second glume and sterile lemma equal, the lemma without a palea; fertile lemma and palea indurate, the lemma oblong-elliptic, usually obtuse, the margins slightly inrolled.

An unimportant genus with about 60 species, mainly in the American tropics. The species are usually creeping or bunchy perennials, rarely annuals, with leaves abruptly rounded at the tips, and with a few to many slender racemes digitate or racemose along the main axis.

There is only one species in the Islands, *A. affinis.*

Axonopus affinis Chase

Narrow-leaved carpet grass

An extensively creeping, stoloniferous perennial; flowering culms ascending

or erect from the creeping base, usually 20 to 50 cm or sometimes as much as 80 cm tall, compressed; sheaths and blades of stolons much shorter than those of the culms; sheaths glabrous or those of the stolons sometimes sparsely hispid on margins, compressed, pale green, those of the culms 6 to 20 cm long, those of the stolons 1.5 to 3 cm long; ligule a ciliate membrane about 0.5 mm long; blades rather stiff, glabrous or those of the stolons often sparsely hispid on margins near base, obtuse, often undulate, flat or occasionally folded, those of the culms 10 to 20 cm long and 3 to 8 mm wide, those of the stolons 3 to 7 cm long; peduncles terminal and axillary, very slender, long-exserted; racemes usually 3, 4 to 10 cm long, 1, rarely 2 or 3, 1 to 4 cm below the terminal pair; spikelets 2 mm long, elliptic, pale green or purplish, the slender flexuous rachis minutely scaberulous, 3-angled; second glume and sterile lemma alike, obtuse or somewhat acute, with 2 to 4 nerves near margin, sparsely appressed-silky along margins and at apex; fertile lemma indurate-coriaceous, usually slightly shorter than glume and sterile lemma, obtuse, glabrous, pale green. (Fig. 10)

An extensively creeping perennial, spreading by long runners that root at the joints, forming dense mats; the whole plant smooth and shiny, except for the joints of the runners which are sometimes sparsely hairy; leaves mostly short, rather stiff, usually 1 to 3 inches, sometimes as much as 8 inches long, ⅛ to ¼ inch wide; flowering stems suberect or erect from the prostrate creeping base, usually 8 to 20 inches, sometimes as much as 30 inches tall with 2 to 4 delicate, spreading racemes 2 to 4 inches long at their tips; spikelets about 1/12 inch long, pale green or purplish, in 2 compact rows on one side of the racemes.

A native of southern United States and tropical America and a common pasture grass in the Gulf States and eastern Texas. It is found rather abundantly in pastures below 2,000 feet on the islands of Hawaii, Molokai, Oahu, and Kauai. Although it is adapted to a rather wide range of soil and moisture conditions, it thrives best in moist situations and suffers from continued drought. It will grow on poor soil and will withstand heavy and continuous grazing, under these conditions forming dense sod. It is fairly palatable but is often objectionable because of its tendency to crowd out more nutritious grasses. Because of its aggressive growth it has proved valuable in certain areas in suppressing guava, a pest in pasture lands. The species has been confused with *A. compressus* (Swartz) Beauv., which has broader leaves and pointed spikelets and which appears to be more palatable to stock.

Briza L. Quaking Grass

Spikelets several-flowered, broad, often cordate, the florets crowded and spreading horizontally, the rachilla disarticulating above the glumes and between

the florets; glumes about equal, broad, chartaceous, with scarious margins; lemmas papery, broad, with scarious spreading margins, cordate at base, several-nerved, the nerves often obscure, the apex obtuse or acutish; palea much shorter than the lemma.

Fig. 10. *Axonopus affinis:* a, spikelet.

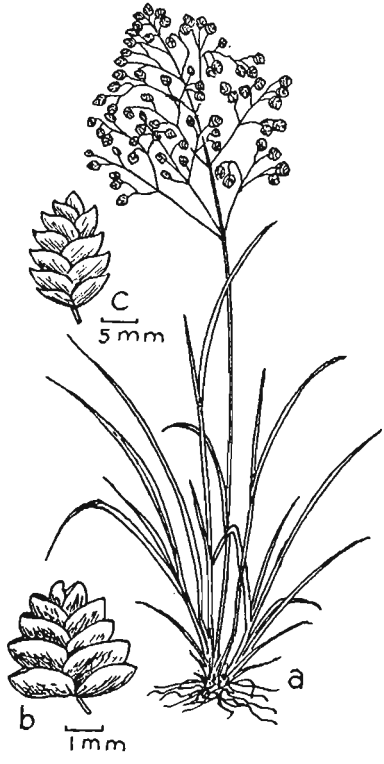

Fig. 11. *Briza minor:* a, habit; b, spikelet. c, *Briza maxima,* spikelet.

An unimportant genus containing about 20 species in the temperate regions. The quaking grasses are ornamentals with showy, open-flowering heads.

Two species are now established in the Islands, at middle elevations in rather moist situations. They may be recognized by the loosely branching flower head with broad nodding spikelets.

Panicle drooping; spikelets 7 to 12 mm wide.....*B. maxima*
Panicle erect; spikelets 4 to 5 mm wide.....*B. minor*

Briza maxima L.

Big quaking grass

Glabrous annual; culms 30 to 60 cm tall, erect or sometimes decumbent at base; sheaths 4 to 8 cm long, usually scarious on margins, basal ones often fibrillose; ligule 3 to 5 mm long, membranaceous; blades 10 to 30 cm long, 3 to 8 mm wide, thin; panicles 5 to 8 cm long, with few spikelets, drooping; spikelets 10 to 20 mm long, 7 to 12 mm broad, 9- to 15-flowered, ovate, on flexuous drooping pedicels; glumes prominently 7-nerved, broad, chartaceous, obtuse, scarious and usually brown or purple on margins, the first 5 to 5.5 mm long, the second 6 to 6.5 mm long; lemmas 8 to 9 mm long, 7- to 9-nerved, chartaceous, cordate at base, acute, usually scarious and brown or purple on margins, pilose on upper part; palea 3 to 3.5 mm long, ciliate on keels, cuneate or obtuse; grain 2.5 to 2.7 mm long, 1.5 to 1.7 mm broad, dark brown, keeled, beaked. (Fig. 11, c)

Smooth annual, 1 to 2 feet tall; stems erect or somewhat spreading at the base; leaves 4 to 12 inches long, thin; flowering heads 2 to 3 inches long, drooping, the spikelets silvery, brownish, or purplish, borne on slender pedicels, the heads nodding and waving in the breeze, hence the name "quaking grass."

A native of Europe, introduced into other countries as an ornamental because of its large showy spikelets. It has only recently been found in the Islands. Stock will graze this grass but it is infrequent on the range.

Briza minor L.

Little quaking grass

Similar to *Briza maxima* but smaller and with much smaller spikelets. (Fig. 11, a-b)

A native of Europe, introduced into certain localities in the United States; very abundant on the Pacific coast, often forming an appreciable part of the spring forage in California. It is now abundant at medium to high altitudes on all the islands of Hawaii. It is not leafy but is quite palatable, reseeds very well, and is fairly persistent.

Bromus L. Bromegrass

Spikelets several- to many-flowered, the rachilla disarticulating above the glumes and between the florets; glumes unequal, acute, the first 1- to 3-nerved, the second usually 3- to 5-nerved; lemmas convex on the back or keeled, 5- to 9-nerved, 2-toothed, awned from between the teeth or awnless; palea usually shorter than the lemma, ciliate on the keels.

The genus contains about 100 species, found mostly in the temperate regions. Ten species are found in Hawaii. Most of the bromes make a relatively rank growth. The leaf blades are usually flat and mostly rather broad. The flowering heads are more or less open with

large spikelets. Most of the species are relished by livestock at certain periods of growth or even throughout the year. Some of the bromegrasses have comparatively large and nutritious seed, which makes them valuable for fattening and for hay. There are a few annuals which, at maturity, have sharp-pointed fruits and long, barbed bristles which penetrate the eyes, nose, and mouth of the animal, often causing serious injury. Considerable work is being done in the selection of superior strains of the bromegrasses.

Seven species and a variety are established on the range, being found from sea level to 8,000 feet elevation, in dry and wet localities.

Spikelets strongly flattened, the lemmas compressed-keeled.
  Lemmas awnless or nearly so.....*B. catharticus*
  Lemmas awned, the awn more than 3 mm long.....*B. breviaristatus*
Spikelets terete before anthesis or somewhat flattened, but the lemmas not compressed-keeled.
  Lemmas more than 3 mm wide, not acuminate, the teeth mostly less than 1 mm long; callus blunt.
    Panicle contracted, rather dense, the branches erect or ascending.
      Lemmas glabrous .....*B. racemosus*
      Lemmas pubescent .....*B. mollis*
    Panicle open, the branches spreading.....*B. commutatus*
  Lemmas less than 3 mm wide, gradually acuminate, bifid, the teeth 2 to 5 mm long; awns usually more than 1.5 cm long; callus sharp-pointed.
    Panicle 10 to 20 cm long, only slightly nodding, fairly open.....*B. rigidus*
    Panicle usually longer, drooping, open.....*B. rigidus* var. *gussonei*

Bromus breviaristatus Buckl.

Short-awned bromegrass

Erect, sparingly tufted perennial; culms 40 to 100 cm tall, glabrous; sheaths 5 to 8 cm long, canescent to densely retrorsely-pilose; ligule 2 to 3 mm long, membranaceous, usually lacerate; blades flat or involute toward tip, 5 to 10 cm long, 1 to 3 mm wide, usually rigidly erect, canescent and with long spreading hairs; panicles 5 to 15 cm long, narrow, erect, the ascending scabrous branches 5 to 12 mm long, usually bearing 1 or 2 spikelets each; spikelets 2 to 3 cm long, 3- to 5-flowered, appressed-puberulent; glumes 8 to 9 mm long; lemmas 9 to 11 mm long, often scarious on margins, with straight awn 3 to 10 mm long; palea 8 to 9 mm long, keeled, ciliate-scabrous on keel, attenuate.

Erect perennial in small bunches, 1 to 3 feet tall; sheaths grayish-hairy; leaves flat but folded near the tips, 2 to 4 inches long, 1/16 to ⅛ inch wide, grayish-hairy, usually rather stiff and erect; flowering heads 2 to 6 inches long, narrow, erect, with very short branches.

A native of the western United States, in dry wooded hills and meadows. It is closely related to *B. catharticus* but is, in general, much smaller. It has recently been found in a few isolated spots in pastures of medium altitudes on the islands of Hawaii and Maui.

Fig. 12. *Bromus catharticus:* a, spikelet.

Bromus catharticus Vahl.

Bromus unioloides H.B.K.

Rescue grass; Bromegrass; Wild oatgrass

Annual, biennial, or short-lived perennial; culms 60 to 150 cm tall, erect or somewhat spreading, glabrous; sheaths 8 to 12 cm long, glabrous to strongly villous; ligule 3 to 5 mm long, membranaceous, sometimes lacerate; blades 15 to 50 cm long, 2 to 8 mm wide, retrorsely scabrous, sometimes sparsely pilose; panicles 15 to 45 cm long, open, often drooping, with scabrous branches 10 to 20 cm long; spikelets 1.5 to 4.5 cm long, 4 to 8 mm wide, 5- to 13-flowered, strongly compressed; glumes acuminate, keeled, scabrous on upper part of keel, usually scarious on margins, the first 8 to 12 mm long, the second 10 to 14 mm long; lemmas 14 to 16 mm long, keeled, scarious on margins, acuminate, green or sometimes purplish, glabrous, scabrous or sometimes pubescent, closely imbricate, concealing the sparsely scabrous or puberulent rachilla joints, awnless or often with awn 1 to 3 mm long; palea 8 to 10 mm long, acute, ciliolate; grain 12 to 14 mm long, narrowly ovate, reddish-brown. (Fig. 12)

Annual, biennial, or short-lived perennial, 2 to 5 feet tall; stems upright, smooth or hairy; leaves rough, sometimes slightly hairy, flat, 6 to 24 inches long, ⅛ to ⅜ inch wide; flowering heads 6 to 18 inches long, usually drooping, with large spikelets.

A native of South America, originally described from Peru. It is cultivated in the southern United States as a winter forage and has become naturalized throughout the Southern States and sparingly northward. It is one of the most valuable forage plants in Hawaii at medium altitudes where the climate tends to be seasonal. Its copious seed crop makes it important as a fattening grass. On the island of Hawaii large areas have been planted to this grass which, by natural reseeding, has become well established. On Maui and Molokai it also does very well at temperate altitudes.

Bromus commutatus Schrad.

Hairy chess

Rather slender annual; culms 30 to 60 cm tall, glabrous, solitary or sparingly tufted; sheaths 6 to 10 cm long, striate, retrorsely pilose; ligule 1 to 1.5 mm long, membranaceous, fimbriate; blades flat, 8 to 15 cm long, 1.5 to 3 mm wide, pilose, abruptly acute or more or less obtuse; panicles 12 to 20 cm long, narrow, pyramidal, more or less drooping, with scabrous rather flexuous branches 4 to 10 cm long; spikelets 2 to 2.7 cm long, 5- to 7-flowered; first glume 4 to 5 mm long, 1- to 3-nerved; second glume 6 to 7 mm long, 3- to 5-nerved; lemmas about 7 mm long, 5- to 7-nerved, rather broad, sparingly scabrous or scaberulous, the awn 5 to 10 mm long; palea 5 to 6 mm long, ciliate on keels; grain 5 to 6 mm long, reddish-brown, pilose at apex. (Fig. 13, e)

A slender annual, 1 to 2 feet tall; stems single or few in a bunch, the sheaths sparsely pilose; leaves 3 to 6 inches long, very narrow, hairy; flowering heads 5 to 8 inches long, often purplish, rather drooping, with slender branches.

A native of Europe, now common in the United States. It is a weedy annual of evidently very recent, accidental introduction in the Islands. It was collected on Maui and Hawaii in 1937 and now occurs only in a small localized patch, but it will probably spread.

Bromus mollis L.

Soft chess

Erect annual; culms 20 to 80 cm tall, pubescent; sheaths 2 to 8 cm long, pilose; ligule 0.5 to 1 mm long, membranaceous, usually lacerate; blades 5 to 25 cm long, pilose; panicles erect, usually 4 to 10 cm long, sometimes reduced to a few spikelets, 2 to 5 mm wide, contracted, with erect-appressed branches 0.5 to 3 cm long; spikelets 8 to 17 mm long excluding awns, 3- to 9-flowered, subcompressed, scabrous-pubescent or pilose; glumes usually hyaline on margins, broad, the first 4 to 6 mm long, 3- to 5-nerved, acute or somewhat obtuse, the second

much broader than the first, 7 to 8 mm long, 5- to 7-nerved, obtuse; lemmas 7 to 9 mm long, 7-nerved, rather thin, usually hyaline on margins and apex, broad, with a usually straight, rather stout awn 6 to 9 mm long; palea 6 to 7 mm long, scabrous on keels; grain 5 to 6 mm long, reddish-brown, compressed-keeled. (Fig. 13, d)

Upright annual, 1 to 3 feet tall; stems softly hairy, single or very few in a bunch; leaves 2 to 10 inches long, ⅛ to ¼ inch wide, softly hairy; flowering heads 1½ to 4 inches long, rather compact and usually narrow, hairy, and with short bristles; seeds flat, about ¼ inch long, reddish-brown. (This species has erroneously been referred to *B. hordeaceus* L.)

A native of Europe, introduced into the United States where it is abundant as a weed in cultivated soil and waste places. It is found occasionally on the islands of Hawaii and Kauai at temperate altitudes. Although it is not abundant where it does grow, it is a rather important part of the pasture mixtures, affording a certain amount of forage quickly after rains.

Bromus racemosus L.

Similar to *B. mollis,* differing from it in the more open panicles and glabrous or scabrous lemmas. (Fig. 13, a-c)

A native of Europe, introduced into the United States, where it is abundant along the Pacific coast. It is found occasionally in pastures at medium altitudes on the island of Hawaii.

Bromus rigidus Roth

Ripgut grass

Annual; culms 40 to 70 cm tall, solitary or sparingly tufted, pubescent for about 15 cm below the panicle; sheaths 2 to 10 cm long, pilose; ligule 2 to 3 mm long, membranaceous; blades flat, 10 to 25 cm long, 2 to 5 mm wide, pilose; panicles 10 to 20 cm long, open, nodding, usually few-flowered; axis and branches pubescent; spikelets 2 to 4 cm long, excluding awns, usually 5- to 7-flowered, compressed; glumes narrowly acuminate, the first 1.5 to 2 cm long, the second 2.5 to 3 cm long; lemmas 2 to 3 cm long, scabrous or puberulent, the teeth 3 to 4 mm long, the straight awn 3 to 5 cm long; grain 1 to 1.5 cm long, narrow, golden-brown. (Fig. 14, a-c)

Annual, 1 to 2 feet tall; stems erect, single or few in a loose tuft, covered with long soft hairs; leaves flat, 4 to 10 inches long, ⅛ to ¼ inch wide, soft-hairy; flowering heads 4 to 8 inches long, open, nodding, with rough branches, ½ to 1 inch long; spikelets 1¼ to 1½ inches long, narrowly V-shaped; seed narrow, ⅜ to ⅝ inch long, golden-brown.

A native of Europe, naturalized in the southwestern United States,

in dry lowlands of southern California forming dense stands over vast areas. It is a troublesome pest in pastures, often causing serious injury to the mouth parts and eyes of grazing animals, and even penetrating the intestines, causing death.

B. rigidus occurs commonly at medium to high altitudes on Hawaii and Maui. It is evidently spreading rather rapidly and, together with the variety below, may become a serious problem in these areas.

Bromus rigidus var. **gussonei** (Parl.) Coss. & Dur.

This variety also occurs in Hawaii. It differs from *B. rigidus* in having a more open flowering head with longer, more drooping branches.

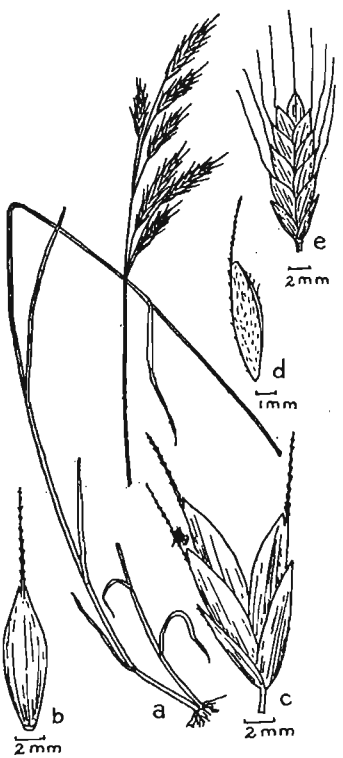

Fig. 13. *Bromus racemosus:* a, habit; b, floret; c, spikelet. d, *Bromus mollis,* floret. e, *Bromus commutatus,* spikelet.

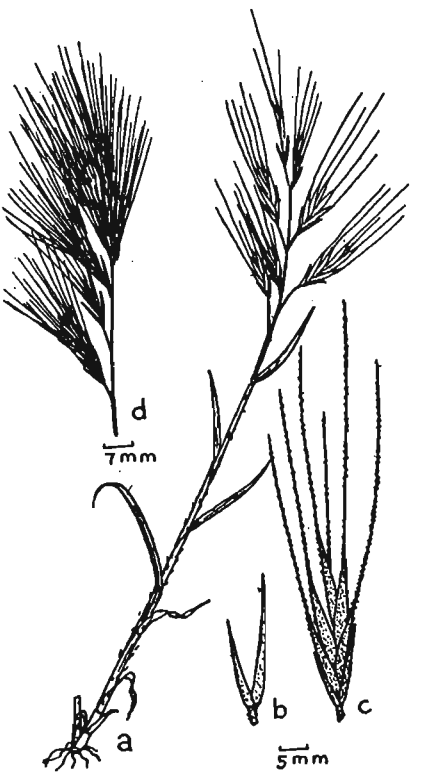

Fig. 14. *Bromus rigidus:* a, habit; b, glumes; c, spikelet. d, *Bromus rubens,* inflorescence.

Bromus rubens L.

Foxtail chess; Red brome

Annual; culms in tufts 15 to 45 cm tall, puberulent below panicle; sheaths pubescent; ligule 0.5 to 1 mm long, membranaceous, erose; blades 4 to 15 cm long, 2 to 5 mm wide, pubescent; panicles 4 to 10 cm long, ovoid, compact, erect, usually reddish-purple; spikelets 1.5 to 2.5 cm long, 4- to 11-flowered; glumes attenuate, awn-pointed, the first 5 to 8 mm long, the second 8 to 11 mm long; lemmas scabrous, 10 to 15 mm long, with teeth 4 to 5 mm long and awn 18 to 22 mm long. (Fig. 14, d)

Upright annual, ½ to 1½ feet tall; leaves 2 to 6 inches long, ⅛ to ¼ inch wide, hairy; flowering heads compact, erect, 2 to 4 inches long, usually reddish-purple with straight bristles about ¾ inch long.

A native of Europe, found abundantly in dry areas in the western United States. It was first collected on Molokai in 1903, and at present is found in very small areas on Hawaii and Molokai, in rather dry situations at lower altitudes. It is a weedy annual of no forage value but fortunately it does not seem very persistent in the Islands so that it probably will never become a serious pest.

Cenchrus L. Sandbur

Spikelets solitary or few together, surrounded and enclosed by a spiny bur composed of numerous coalescing bristles (sterile branchlets), the bur subglobular, the peduncle short and thick, articulate at base, falling with the spikelets and permanently enclosing them, the seed germinating within the old involucre, the spines usually retrorsely barbed.

There are about 25 species of this genus in the warmer parts of both hemispheres, three occurring in Hawaii. They are usually rather low, branching annuals with flat blades and erect spikes of readily deciduous, spiny burs. A few species are perennial. Most of them are good forage grasses before the burs are formed.

Two sandburs are common on the range. These are found in low to middle elevations in rather dry places.

Plant glabrous or pilose only at the base of leaf.....*C. echinatus*
Plant hairy throughout.....*C. echinatus* var. *hillebrandianus*

Cenchrus echinatus L.

Sandbur; Konpeito-gusa

Branching annual; culms 25 to 70 cm tall, decumbent at base, compressed, usually geniculate, often reddish at nodes and lower portion of plant, usually scabrous below panicle, otherwise glabrous; sheaths glabrous or scaberulous, with conspicuous whitish collar, compressed; ligule 1 mm long, densely ciliate; blades flat, 5 to 18 cm long, 3 to 9 mm wide, with rather conspicuous midrib, glabrous or scabrous near tip on lower surface, scabrous and sometimes sparsely pilose at

base on upper surface; racemes 3 to 7 cm long; burs 4 to 7 mm long and as wide or wider, borne loosely and barely touching each other on a rather zigzag rachis with scabrous angles, globular, usually dark red to purple, the obconical base 1 to 2 mm long, tomentulose; lobes deeply cleft, short-tomentose except at apex; basal outer series of bristles 2 to 3 mm long, the inner series rather flattened, short-pilose at base; spikelets 3 to 5 per bur, 4 to 6 mm long; first glume 1 to 1.5 mm long, membranaceous, indistinctly 1-nerved, scale-like, glabrous; second glume 4 to 4.5 mm long, membranaceous, acute, conspicuously 3-nerved, minutely scaberulous; sterile lemma 4.5 to 6 mm long, acuminate, scaberulous, 5-nerved, its attenuate submembranaceous palea of equal length; fertile lemma 5 mm long, 5-nerved, especially strongly so at apex, attenuate, the acuminate palea of equal length; grain 3 to 4 mm long, broadly ovate, usually flattened ventrally, rounded dorsally, pale yellow. (Fig. 15)

Smooth branching annual, bent and spreading at base, growing in clumps; stems 1 to 2 feet tall, usually flattened, dark-green; leaves flat, 2 to 7 inches long, ⅛ to ⅜ inch wide; fruiting stalks spikelike, 1 to 3 inches long, composed of spiny burs; burs about ¼ inch long and as wide or wider, clustered, globular, usually purple, the barbed spines irregular in length and thickness, the inner ones larger than the outer.

Native to the southeastern United States and tropical America; introduced in Malaysia. It was first noticed in the Islands in the neighborhood of Honolulu in 1867. It is rarely found in pastures.

Fig. 15. *Cenchrus echinatus:* a, spikelet.

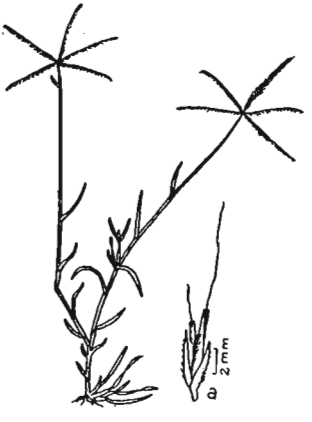

Fig. 16. *Chloris divaricata:* a, spikelet.

Cenchrus echinatus var. **hillebrandianus** (Hitchc.) F. B. H. Brown
Hairy sandbur; Hillebrand's sandbur

This variety differs from *C. echinatus* in that the whole plant is covered with soft hairs.

This is a very common grass in many of the pastures in the drier lowlands. It comes up quickly after rains and produces a quantity of forage when young, but as soon as the burs begin to develop it becomes a pest. In some of the dry areas this is about the only forage available a good part of the year. With age, its burs readily detach from the plant and stick to clothing, wool of sheep, and hair of other animals by their barbed spines.

CHLORIS Swartz FINGERGRASS

Spikelets with 1 perfect floret, sessile, in two rows along one side of a continuous rachis, the rachilla disarticulating above the glumes, produced beyond the perfect floret and bearing 1 to several reduced florets consisting of empty lemmas, these often truncate, and, if more than one, the smaller ones usually enclosed in the lower, forming a somewhat club-shaped rudiment; glumes somewhat unequal, the first shorter, narrow, acute; lemma keeled, usually broad, 1- to 5-nerved, often villous on the callus and villous or long-ciliate on the keel or marginal nerves, awned from between the short teeth of a bifid apex, the awn slender, the sterile lemmas awned or awnless.

There are about 60 species of *Chloris,* mainly in warm regions. They are distinguished by the two to many rather showy, feathery spikes clustered at the summit of the flowering stems. Most of them are of little value for forage and some of them are aggressive weeds.

Six species of *Chloris* are now established in the Islands, found at low elevation in dry areas.

Plants perennial; spikes not feathery.
  Plants with creeping stolons.
    Culms 1 to 1.5 m tall; stolons stout.....*C. gayana*
    Culms not more than 50 cm tall; stolons relatively slender.....*C. divaricata*
  Plants tufted, sometimes short-creeping at base but not stoloniferous.....
    .....*C. truncata*
Plants annual, the culms sometimes decumbent and rooting at base; spikes somewhat feathery.
  Spikes slender, 10 or more; sterile floret narrow, acute.....*C. radiata*
  Spikes thicker, mostly fewer than 10; sterile floret truncate and broadest at summit.
    Spikes pale, ascending; spikelets with 2 awns.....*C. virgata*
    Spikes purplish, flexuous-spreading; spikelets with 3 awns.....*C. inflata*

Chloris divaricata R. Br.

Stargrass

Branching perennial, with creeping stolons; culms 20 to 40 cm long, upright or sometimes prostrate, glabrous; sheaths shorter than internodes, glabrous, usually somewhat keeled, often slightly inflated, sometimes scarious on margins; ligule a row of hairs about 0.5 mm long; blades flat or becoming involute, 4 to 10 cm long, 1 to 2 mm wide, scabrous on upper surface; spikes 4 to 7, 5 to 10 cm long, spreading, slender; spikelets 3 to 4 mm long excluding awns, closely appressed to rachis; glumes narrow, acuminate, with 1 scabrous nerve, the first 1.5 to 2 mm long, the second 3 mm long; lemmas 3 to 3.5 mm long, narrow, attenuate, scaberulous and ciliate on upper part, subcoriaceous, the awn 5 to 6 mm long; rudiment of 1 reduced sterile lemma, narrow, acute, bifid, 1.5 mm long with an awn 1.5 to 2 mm long; palea 2 mm long, narrow, scabrous on keels; grain 2 mm long, golden, narrow, triangular, attenuate at both ends. (Fig. 16)

A creeping perennial with upright flower stalks, freely branching at lower joints, the whole plant smooth; leaves long and narrow; flower stalks 5 to 10 inches long, with 4 to 7 nearly horizontal spikes spreading from a common center, the spikes 2 to 4 inches long, light purplish-green when young, straw-colored when old; spikelets ⅛ inch long, pale, narrow, with slender bristles.

A native of Australia where it is considered a useful forage and range grass, especially in dry regions. In the Hawaiian Islands, stargrass is found chiefly in Honolulu where it is crowding out Bermuda grass from the lawns. It also occurs occasionally in dry areas near Ulupalakua, Maui.

Chloris gayana Kunth

Rhodes grass

Glabrous perennial; culms 50 to 150 cm tall, erect or sometimes procumbent, usually with long, stout, flattened, leafy stolons; lower sheaths about as long as the internodes, the upper somewhat shorter, striate, compressed, keeled; ligule about 0.5 mm long, membranaceous, ciliate; blades 10 to 50 cm long, 3 to 5 mm wide, usually keeled, attenuate, scabrous, sparsely papillose-hispid on upper surface near base; spikes 10 to 15, digitate, 5 to 8 cm long, ascending when young, more or less spreading or sometimes slightly reflexed when mature; rachis slender, scabrous, tomentose at base; spikelets pale-tawny, closely imbricate; glumes narrow, 1-nerved, scabrous on nerves, the first 1.5 to 2 mm long, ovate-elliptic, obtuse or acute, the second 2.5 to 3.5 mm long, elliptic, awn-pointed, the margins scarious, apex acute or bifid; lemmas 3 to 3.5 mm long, broadly elliptic in outline, irregularly rhomboidal in profile, ciliate, long-hispid toward apex, a tuft of white hairs at base, the apex bifid, the straight awn 1 to 5 mm long; palea 3 to 3.5 mm long, submembranaceous, glabrous or sparsely scaberulous on upper part, the apex bifid, often exceeding the lemma; rudiment usually of 2 florets, the lower rather narrow, obtuse, 2 to 2.5 mm long with straight awn 1 to 2 mm long, the upper minute, truncate, broad. (Fig. 17)

An upright vigorous perennial, 2 to 5 feet tall, with long, stout, flat runners, rooting at the joints; leaves 4 to 14 inches long, ⅛ to ¼ inch wide, bright green, tapering to fine points, rough and with long white hairs at the base on the upper sides; flowering stalks slender, erect, the flowering heads with 10 to 15 spreading, finger-like spikes, 1½ to 3 inches long, at the tips of the stems, the spikes erect when young, spreading to drooping at maturity; spikelets light brown with 2 short bristles.

A native of Africa, introduced for forage into many other warm countries, and naturalized throughout tropical America. It is highly valued as a pasture grass. In Australia it is particularly useful in rotational grazing and in hilly country. It has been planted quite widely at low to medium altitudes on all the islands. It is fairly drought-resistant and seems to be well adapted to both wet and dry conditions. Its value as a pasture grass in Hawaii seems to be rather controversial, but it no doubt has a place in the drier areas.

Fig. 17. *Chloris gayana:* a, spikelet.

Fig. 18. *Chloris inflata:* a, spikelet.

Chloris inflata Link

Chloris paraguayensis Steud.

Swollen fingergrass

Annual; culms 30 to 70 cm tall, erect or sometimes decumbent at base and rooting at lower nodes, glabrous, often purple at nodes; sheaths 2 to 6 cm long, compressed, the pinkish or purplish basal ones conspicuously so, much shorter than internodes, usually pilose at the throat, otherwise glabrous; ligule about 0.5 mm long, membranaceous, minutely erose; blades flat, 2 to 12 cm long, or the upper almost obsolete, 1 to 5 mm wide, scabrous on margins and usually sparsely long-pilose on upper surface near base; spikes 2 to 11, 2 to 5 cm long, usually flexuous, purplish; spikelets closely imbricate; glumes narrow, acute, membranaceous except the single green nerve, sometimes awn-pointed, the first 1 to 1.5 mm long, the second 2 to 2.5 mm long; fertile lemma 2 to 2.5 mm long, obovate, keeled, appressed-pilose along keel, long-pilose on margins of upper half, the callus appressed-pilose, the slender awn 5 to 10 mm long; palea 2 to 2.5 mm long, obovate; rudiment of 2 thin, glabrous, truncate, triangular sterile lemmas 1 mm long, one within the other, on a slender glabrous rachilla joint 1 mm long. (Fig. 18)

Annual, 1 to 2 feet tall; stems erect or sometimes bent at the base and rooting at the lower joints, smooth, usually flattened and purple or pink at the base; leaves flat, 1 to 5 inches long, 1/16 to 1/8 inch or rarely as much as ¼ inch wide, usually bluish-green, rough on the edges, often long-hairy near the base on the upper side; flowering heads of 2 to 11 flexuous, purple, finger-like spikes, 1 to 2 inches long at the tips of the stems; spikelets purplish, broad, with 3 slender bristles.

Chloris inflata is a common weed at low altitudes in Mexico, South America, and the West Indies. It is found in pastures, in cultivated fields, and along roadsides at lower altitudes throughout the islands and is very abundant in dry regions. In such places as the Ewa Coral Plain on Oahu, where there is very little rainfall and the soil is shallow, it is the dominant grass. When young, it is grazed by stock, but it soon becomes unpalatable and thereafter is a pest.

Chloris radiata (L.) Swartz

Radiate fingergrass; Plush grass

Loosely tufted annual; culms 25 to 60 cm tall, glabrous, often purplish at nodes, decumbent, usually much branched at base; sheaths 4 to 7 cm long, compressed-keeled, glabrous or scaberulous, light bluish-green or the basal ones occasionally purplish, margins usually hyaline; ligule membranaceous, 0.5 to 1 mm long, usually lacerate; blades 5 to 15 cm long, 3 to 6 mm wide, obtuse, light bluish-green, retrorsely scabrous and usually sparsely long-pilose on upper surface, the marginal nerves rather thick; spikes 10 to 20, slender, 3 to 7 cm long, erect or ascending, subumbellate, compact, silvery or purple-tinged, pubescent at

base, with puberulent rachis; spikelets 3 mm long excluding awns; glumes narrow, acuminate, keeled, apiculate, with 1 conspicuous scabrous green nerve, the first 1.2 to 1.5 mm long, the second 2 to 2.5 mm long; fertile lemma 3 mm long, narrow, compressed, acute, bifid, short-pilose at base, margins slightly involute and short-pilose near tip, the slender awn 7 to 10 mm long, the acute palea 2 to 2.5 mm long; rudiment (1 greatly reduced sterile lemma) mostly included within margins of fertile lemma, 0.5 to 1 mm long, narrow, acute, on a slender rachilla joint 1.5 mm long, the slender awn 2 to 4 mm long. (Fig. 19)

Fig. 19. *Chloris radiata:* a, spikelet.

Fig. 20. *Chloris truncata:* a, spikelet.

Annual, 1 to 2 feet tall; stems smooth, flattened, sometimes purplish at the joints, usually spreading and much branched at the base; leaves 2 to 6 inches long, 1/16 to 1/8 inch wide, with a boat-shaped rounded tip, rough throughout, and usually with a few long hairs near the base on the upper side; flowering heads of numerous delicate finger-like spikes 1 to 3 inches long, close together and upright at the tips of the stems; spikelets slender with delicate bristles.

A native of tropical America and the West Indies. Introduced into the Islands, it is now a common weed along roadsides and is found occasionally in pastures on all the islands at low to medium altitudes. It is a pest in cultivated fields.

Chloris truncata R. Br.

Australian fingergrass

Perennial; culms 15 to 50 cm tall, tufted, erect or often decumbent and rooting at the lower nodes, glabrous; sheaths 5 to 10 cm long, compressed, glabrous or occasionally scaberulous on upper part; ligule a line of hairs about 0.5 mm long; blades 5 to 15 cm long, 1 to 2 mm wide, crowded toward the base, flat or folded, scabrous on margins; spikes 5 to 12, 7 to 20 cm long, finally spreading; rachis slender, pubescent at base, scabrous above; spikelets 2.5 to 3 mm long, narrowly cuneate; glumes narrow, acuminate, the first about 1.5 mm long, the second 2.5 to 3 mm long, hyaline on margins, apiculate; fertile lemma 2.5 to 3 mm long, black when mature, oblong-cuneate, truncate, short-pilose at base, appressed, short-pilose on margins near apex, with purplish awn 8 to 10 mm long; palea 2 to 2.5 mm long, narrow, membranaceous, ciliolate on keels near apex; rudiment 1 to 1.5 mm long, black when mature, cuneate, truncate, with purplish awn 5 to 6 mm long. (Fig. 20)

A smooth perennial often forming a close dense cover, sometimes geniculate and rooting at the lower nodes; stems ½ to 2 feet tall, usually bent, spreading and flattened at the base, sometimes upright; leaves 2 to 6 inches long, 1/16 to 1/8 inch wide, mostly crowded toward the base, often lying flat on the ground, somewhat folded, light green; flowering heads of about 5 to 12 spreading, slender spikes, 3 to 8 inches long; spikelets wedge-shaped and black when mature. *C. truncata* is similar to *C. divaricata* but can be readily distinguished from it by the black, wedge-shaped spikelets.

A native of Australia. It was first reported in Hawaii on the island of Oahu in open grassland in 1915. It is now found also, rather abundantly, in the dry region of Ulupalakua, on Maui. Although it does not produce much foliage, it forms a close, dense cover, seeds freely in certain areas, and is quite drought-resistant. It is no doubt of value on Hawaiian ranges in the arid regions.

Chloris virgata Swartz

Chloris elegans H.B.K.

Feather fingergrass

Annual; culms 25 to 60 cm or as much as 120 cm tall, erect from a spreading base; sheaths glabrous, often inflated; ligule inconspicuous, membranaceous, 0.5 mm long; blades flat, 3 to 10 mm long, 1 to 4 mm wide, upper surface scabrous, lower surface glabrous; spikes usually 5 to 6 in a compact head, erect, 2 to 6 cm long, white to tawny, silky-villous in axils, the rachis scabrous; spikelets

crowded; glumes slender, chartaceous, 1-nerved, acuminate, the first 1.5 to 2 mm long, scabrous on keel, the second 2.5 to 3 mm long, bearing an awn 0.5 to 1 mm long from between the short teeth of a minutely bifid apex; fertile lemma about 3 mm long, the keel humpbacked, ciliate, conspicuously pilose near apex with hairs 2 to 3 mm long, the slender scabrous awn 7 to 9 mm long; rudiment (1 reduced sterile lemma) cuneate, truncate, with delicate scabrous awn 6 to 7 mm long; grain 1.5 to 2 mm long, golden, cylindrical. (Fig. 21)

Fig. 21. *Chloris virgata:* a, floret; b, glumes.

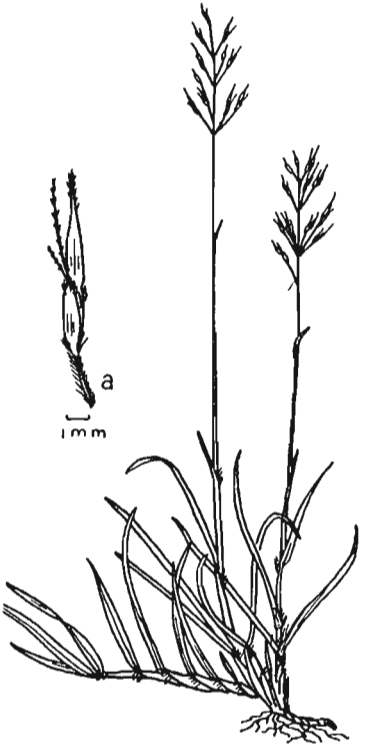

Fig. 22. *Chrysopogon aciculatus:* a, spikelet.

Annual, usually 1 to 2 feet, sometimes to 2½ feet tall; stems usually erect from a spreading base; leaves flat, 1 to 4 inches long, 1/16 to 1/8 inch wide, rough to the touch on the upper surface; flower heads feathery, of 5 or 6 compactly arranged finger-like spikes 2 to 4 inches long; spikelets hairy, with 2 slender bristles.

A native of tropical America, widely distributed in warm regions of both hemispheres. It occurs rather abundantly in the lower dry

sections of Ulupalakua, Kahului, and Kihei, on the island of Maui. A small local patch was found at Hoolehua, Molokai, in 1937 and at Kaunolu, Lanai, in 1938. It may be of value in dry regions in the Islands as it springs up abundantly after rains and affords a substantial amount of forage while young. It may, however, become a pest in areas favorable to growth of better grasses. Although it is highly drought-resistant, it grows to a much greater size in moist areas.

CHRYSOPOGON Trin.

Spikelets narrow-lanceolate, 3 together, terminating the branches of an erect panicle, the central one sessile and perfect, the two lateral ones pedicellate and staminate.

An unimportant genus with about 20 species, mainly in the tropics. They are distinguished by their slender spikelets borne in 3's at the ends of slender, naked branches. Most of the species are practically valueless for forage.

There is only one species of this genus in the Islands, *C. aciculatus.*

Chrysopogon aciculatus (Retz.) Trin.

Rhaphis aciculata (Retz.) Desv.

Pilipiliula; Piipii

Perennial with extensively creeping stolons which are covered with imbricate scalelike old sheaths, sending up numerous sterile leafy shoots; culms 15 to 25 cm tall, ascending or erect from a decumbent base, glabrous, usually simple; leaves mostly crowded near the decumbent base of the culm; sheaths 1 to 3 cm or the uppermost as much as 6 cm long, striate, sometimes purple-tinged, imbricate, sparingly pilose at throat and along margins; ligule a densely ciliate ridge about 0.2 mm long; blades 2 to 8 cm long, 3 to 5 mm wide or the uppermost nearly obsolete, scabrous on margins with distant sharp teeth and sparsely papillose-hispid near base, thin, glossy, often undulate; panicles 3 to 6 cm long, stiffly erect, narrowly elliptic, reddish-purple, the branches 0.5 to 1.5 cm long, slender, stiffly ascending or appressed, some in whorls, others scattered; spikelets in clusters of 3 at the ends of the branches, the cluster 6 to 8 mm long, disarticulating from the pedicel or branch by a long oblique callus extending down one side as a brown appressed-hispidulous ridge 5 mm long, the callus forming a retrorsely bearded or barbed point to the fruit; sessile spikelet 3 to 4 mm long, acute, glabrous, hispidulous-scabrous on the margins above and on the keel of the second glume, the latter awned, the awn about 2 mm long; sterile lemma nearly as long as the first glume; fertile lemma 2.5 to 3 mm long, rather narrow, tapering into an awn 5 mm long; grain oblong, 2 mm long; sterile spikelets on pedicels 2 to 3 mm long, the pedicel hispidulous at the summit; glumes acuminate or awn-pointed, about 5 mm long, scabrous at the tip; lemmas about equal, awnless, shorter than the glumes. (Fig. 22)

An extensively creeping perennial with many rather brittle, leafy stolons rooting at the joints and forming a close, thick mat; leaves flat,

1 to 3 inches long, ⅛ to ¼ inch wide, rough on the edges with rather widely-spaced sharp teeth, a few long stiff hairs near the base on the upper sides, thin and rather wavy, glossy-green; flowering stems bent at the base and with crowded leaves, naked, stiff, and erect above, ending in rigid, erect, reddish-purple, narrow flowering heads, 1 to 2 inches long.

A native of the East Indies, India, and China. It occurs on other islands of the Pacific and has been known in the Hawaiian Islands since the earliest records. It is either native here or of very early introduction. It is now found rather abundantly in open pastures and rocky slopes from sea level to about 2,000 feet on all of the islands. As cattle feed, it is practically worthless. The sharp barbed points of the spikelets are very penetrating and stick readily to clothing and hair of animals.

CYMBOPOGON Spreng. OIL GRASS

Racemes in pairs subtended by spathes, these collected in a compound inflorescence; spikelets in pairs, the lowermost pair of one or both racemes sterile and similar to the pediceled spikelet above; fertile (sessile) spikelets dorsally compressed, flat or dorsally grooved, sharply 2-keeled at the edges; fertile lemma narrow, awned from between 2 teeth or awnless.

There are about 35 species, mainly in the warm regions of the world. They are mostly robust, strong-scented perennials, similar in appearance to *Andropogon*. The two most important species from an economic standpoint are *Cymbopogon citratus* (DC.) Stapf (lemon grass), and *C. nardus* (L.) Rendle (citronella grass) from which the citronella oil of commerce is extracted. These two species are also often cultivated as ornamentals.

There are 3 species of *Cymbopogon* in the Islands. These are found at low elevations in dry to semi-moist situations. Only one occurs on the ranges, *C. refractus*.

Cymbopogon refractus (R. Br.) A. Camus

Barbwire grass; Soap grass

Densely tufted perennial; culms 25 to 75 cm tall, often purple at nodes, glabrous; sheaths 2 to 7 mm long, glabrous, striate, the basal ones usually fibrillose and pink; ligule 1 to 2 mm long, membranaceous, erose; blades 15 to 25 cm long, about 1.5 mm wide, wiry, scabrous; inflorescence 10 to 30 cm long, narrow, rather strict, the racemes rather distantly arranged, partly enclosed in slightly inflated pink or bronze spathes 2 to 3 mm long, the racemes 2 to 3 cm long, slender, erect to reflexed; rachis joints and pedicels flattened, hispid on the angles;

sessile spikelets 4.5 to 5.5 mm long, pilose at base; first glume strongly 9-nerved, acuminate, glabrous, the second slightly shorter, keeled; sterile lemma hyaline, 4 to 4.5 mm long, acuminate; fertile lemma 3.5 to 4 mm long, awnless; pedicellate spikelets about 3.5 to 4 mm long, attenuate, glabrous. (Fig. 23)

A bunchy perennial 1 to 3 feet tall, with tough stems and a dense mass of harsh wiry foliage at base, the leaves 6 to 10 inches long; flowering heads 4 to 12 inches long, narrow, rather stiff and erect, the racemes finally bent backward, one on either side of the stem, resembling barbwire.

A native of Australia where it is reported to be grazed slightly by livestock when young but to be nearly worthless when old. It is of rather recent accidental introduction in the Islands. It is worthless as forage, produces a large quantity of viable seed, is very persistent, and spreads rapidly, crowding out valuable grasses. Although now confined to small areas at lower elevations on the islands of Hawaii, Maui, and Molokai, it may possibly become a serious pest, and the rancher should eradicate it while it is comparatively isolated.

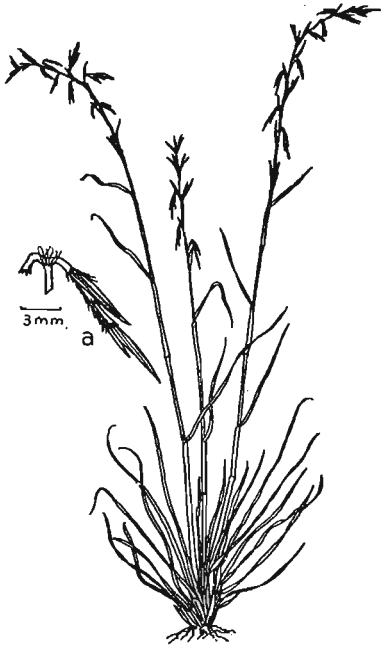

Fig. 23. *Cymbopogon refractus:* a, spikelet.

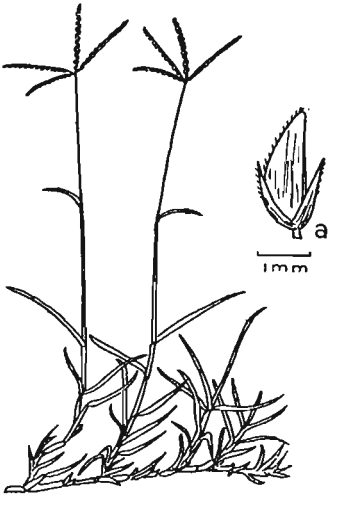

Fig. 24. *Cynodon dactylon:* a, spikelet.

CYNODON L. Rich.

Spikelets 1-flowered, awnless, sessile in two rows along one side of a slender continuous rachis and appressed to it, the rachilla disarticulating above the glumes and prolonged behind the palea as a slender naked bristle, sometimes bearing a rudimentary lemma; glumes narrow, acuminate, 1-nerved, about equal, shorter than the floret; lemma firm, strongly compressed, pubescent on the keel, 3-nerved, the lateral nerves close to the margins.

There are about 9 species of *Cynodon,* found mostly in warm countries. They are mostly low perennials with creeping runners, short leaves, and short slender spikes arranged finger-like at the summits of erect flowering stems. They are all good forage grasses and are in general very vigorous, persistent, and adapted to a wide range of environmental conditions.

There is only one species consisting of two rather well-marked forms established in the Islands, found in dry to semi-dry situations at low to middle elevations.

Cynodon dactylon (L.) Pers.

Capriola dactylon Kuntze

Bermuda grass; Manienie grass; Mahiki; Kebo-gusa

Perennial, extensively creeping by strong flat stolons or by scaly rhizomes; culms 10 to 25 cm long, flattened, glabrous, the vegetative ones prostrate to somewhat ascending, the flowering ones 15 to 40 cm long, erect; sheaths striate, glabrous except for pilose throat, old bladeless sheaths of stolons and lowest one of branches forming conspicuous pairs of scarious persistent bracts 5 to 10 mm long; ligule a ring of conspicuous white hairs 1 to 2 mm long; blades flat, 3 to 10 cm long, 2 to 4 mm wide, often conspicuously distichous and stiff near tips of culms, glabrous with scabrous margins; spikes 4 to 5, digitate, 3 to 6 cm long; spikelets 2 mm long, imbricate; glumes 1.5 mm long, acuminate, scarious on margins, with one conspicuous green scabrous nerve; lemmas 2 mm long, acute, with pubescent keel; palea 2 mm long, narrow, glabrous; grain 1 to 1.5 mm long, ovate to broadly elliptic, reddish-brown. (Fig. 24)

Extensively creeping perennial, rooting at the joints along the surface of the ground or producing scaly underground runners; stems smooth, flattened, usually prostrate but sometimes somewhat upright; leaves narrow, usually 1 to 4 inches long, ¼ to ⅛ inch wide, rough on edges; flowering heads with 4 to 5 short, finger-like spikes at the tips of the stems, standing conspicuously above the main plant body.

Native to the warmer parts of the Old World but now well established in the warmer parts of North and South America as well as generally distributed throughout the tropics. It is the most important pasture grass of the southern United States and is also widely planted

there as a lawn grass. It was introduced into Hawaii about 1835, and by 1888 it had established itself as the most valuable pasture grass of the lower regions. It is now found on all the islands from sea level to 4,000 feet. Because of its drought-resistance, it is particularly adapted to the semi-dry to dry pastures. It is an excellent lawn grass, growing well in full sunlight but dying out in shade.

A robust strain is commonly called giant Bermuda grass or giant mahiki. It is taller, with larger, coarser leaves. It is of comparatively recent introduction but is now found occasionally with the typical form throughout the Islands. In certain districts it appears to be more promising than common Bermuda especially in the very arid localities and in areas near the sea.

DACTYLIS L.

Spikelets few-flowered, compressed, finally disarticulating between the florets, nearly sessile in dense 1-sided fascicles, these borne at the ends of the few branches of a panicle; glumes unequal, carinate, acute, hispid-ciliate on the keel; lemmas compressed-keeled, mucronate, 5-nerved, ciliate on the keel.

A genus of only a few perennial species, natives of Europe and Asia, all good forage grasses.

The one species in the Islands, *D. glomerata,* may be recognized by its flowering head, with few stiff branches with densely crowded flat spikelets at the ends.

Dactylis glomerata L.

Orchard grass; Cocksfoot

Culms tufted, 60 to 120 cm tall, glabrous, erect or often decumbent at base; sheaths 7 to 15 cm long, often keeled, especially when young, glabrous or minutely scaberulous on upper part, striate; blades flat, 10 to 30 cm long, 2 to 8 mm wide, with prominent midrib, scabrous on margins and midrib, otherwise glabrous; panicles 5 to 20 cm long, often purple-tinged, the upper portion with short branches and almost spikelike, the lowest branches as much as 10 cm long and stiffly horizontally spreading but appressed at maturity; spikelets 8 to 10 mm long, 4- to 5-flowered; glumes narrow, carinate, scabrous to hispid on keels, the first 4 to 5 mm long, the second 5 to 6 mm long; lemmas 6 to 8 mm long, subcoriaceous with hyaline margins, keeled, 5-nerved, scaberulous between the nerves, hispid on keel and usually sparsely hispid on margins near apex, mucronate or short-awned; palea 5.5 to 7 mm long, narrow, ciliate on keels. (Fig. 25)

A coarse perennial, growing in large bunches, 2 to 4 feet tall; stems smooth, often flattened, especially when young; leaves flat, 4 to 12 inches long, ¼ to ⅜ inch wide, rough on the edges and along the prominent mid-vein; flowering heads 2 to 8 inches long, stiffly erect, often purple-tinged, with short stiff branches.

A native of Eurasia, widely naturalized in the United States. It is cultivated extensively and highly regarded in Europe both as a forage grass and for hay. It was introduced into the Hawaiian Islands in 1911, and is now fairly abundant at 4,000 to 6,000 feet on the islands of Hawaii, Maui, and Molokai, occupying particularly large areas at these altitudes on Hawaii. It is very nutritious and palatable especially when young. It appears to be hardy, grows well in mixtures with other grasses and with legumes, and would seem to warrant trial at both higher and lower altitudes than those at which it now grows.

Fig. 25. *Dactylis glomerata:* a, spikelet.

Fig. 26. *Dactyloctenium aegyptium:* a, floret; b, spikelet.

DACTYLOCTENIUM Willd.

Spikelets 3- to 5-flowered, compressed, sessile and closely imbricate, in two rows along one side of the rather narrow flat rachis, the end projecting in a point beyond the spikelets; rachilla disarticulating above the first glume and

between the florets; glumes somewhat unequal, broad, 1-nerved, the first persistent upon the rachis, the second mucronate or short-awned below the tip, deciduous; lemmas firm, broad, keeled, acuminate or short-awned, 3-nerved, the lateral nerves indistinct, the upper floret reduced; palea about as long as the lemma; seed subglobose, ridged or wrinkled, enclosed in a thin, early-disappearing pericarp.

An unimportant genus, containing only three species of no economic importance, all natives of the warmer parts of the Old World. Annuals or perennials with flat blades and two to several short, thick spikes, widely spreading and arranged finger-like at the summit of the flowering stems.

There is only one species of *Dactyloctenium* in the Islands, *D. aegyptium*.

Dactyloctenium aegyptium (L.) Richt.

Beach wiregrass

Annual; culms 10 to 30 cm tall, prostrate to ascending; sheaths 2 to 4 cm long, compressed, striate, often with hyaline margins, the lower sometimes purplish, hispid at throat and tuberculate or glabrous below; ligule a ciliate membrane about 1 mm long; blades flat, 3 to 8 cm long, 3 to 5 mm wide, usually pale green or sometimes purplish, firm, densely papillose-ciliate with long hairs on margin, sparsely papillose-hispid on both surfaces; spikes 2 to 5, thick, densely flowered, usually dark brown or purplish when young, digitate at the apex of an erect, long-exserted peduncle; rachis pubescent at base, the apex projecting beyond the spikelets; spikelets 3 to 3.5 mm long, 3- to 5-flowered, compressed, pectinate; glumes 2 to 2.5 mm long, more or less keeled, the first acute, the second mucronate or short-awned; lemmas 2.5 to 3 mm long, broad, keeled, membranaceous, acuminate, usually short-awned; palea slightly shorter than lemma, with scabrous winged keels; grain about 1 mm long, subglobose, rugose, reddish-brown. (Fig. 26)

A weedy annual; stems ½ to 1 foot long, more or less prostrate, smooth; leaves short, hairy, with 2 to 5 short, thick, dark-colored spikes borne at the summits of the erect, naked flowering stems.

Originally described from Africa, common throughout warm regions. Although not widespread, it is often abundant in dry areas near the sea, in waste places, and in pastures on all of the islands. It produces very scant foliage and is valueless for forage.

DANTHONIA Lam. & DC. OATGRASS

Spikelets several-flowered, the rachilla readily disarticulating above the glumes and between the florets; glumes about equal, broad, papery, acute, mostly exceeding the uppermost floret; lemmas rounded on the back, obscurely several-nerved, the apex bifid, the lobes acute, usually extending into slender awns, a stout, flat, twisted, geniculate awn arising from between the lobes.

The genus contains about 50 species widely distributed in the warm and temperate regions. They are all low to moderately tall perennials

with contracted to open flowering heads. Most of them are nutritious forage grasses, can do well in poor soils, and can adjust themselves to extreme rainfall and temperature conditions. When old, they tend to be coarse, fibrous, and somewhat unpalatable to animals, but when young they are excellent forage. The group is important in South Africa and Australia where a great deal of work is being done to develop superior strains.

There are two species in the Islands, both found at high altitudes, in dry rocky places.

Sheaths often pilose; lemmas with two marginal tufts of hairs, but no transverse rings ..... *D. pilosa*
Sheaths usually glabrous; lemmas with two dense transverse rings of silky hairs ..... *D. semiannularis*

Danthonia pilosa R. Br.

Hairy oatgrass

Tufted perennial; culms 50 to 90 cm tall, glabrous; sheaths papillose-hispid, 5 to 10 cm long; ligule a line of hairs 1 to 1.5 mm long; blades flat or rolled at maturity, 3 to 12 cm long, 1 to 3 mm wide, glabrous on upper surface, papillose-hispid on lower; panicles 5 to 8 cm long, with erect scaberulous branches 1 to 2 cm long; spikelets 9 to 11 cm long excluding awns, 3- to 5-flowered; glumes 9 to 11 mm long, glabrous, margins hyaline, the first 7-nerved, the second 5-nerved; lemmas 5 to 6 mm long, with a long, pilose callus and two tufts of long silky white hairs on the margins, one near the base and one about one-third above the base, the apex deeply bifid, the lobes with slender awns, the middle awn 8 to 10 mm long; palea scaberulous, the narrow apex emarginate; grain reddish-brown, 2 to 2.5 mm long, oblong-obovate, dorsally subcompressed. (Fig. 27, a-c)

An erect tufted perennial, 2 to 3 feet tall; sheaths hairy and slightly rough; leaves 1 to 5 inches long, usually more or less folded, usually hairy on the lower side; flowering heads 2 to 4 inches long, narrow, with very short upright branches.

A native of Australia where it is an important pasture grass. In Australia and New Zealand it grows from sea level to 4,000 feet elevation. It forms a close stand even in dry, poor soil, where other grasses do not survive. The light, fluffy seeds are adapted to wind distribution. It was introduced into Hawaii probably about 1910 on the Parker Ranch, and is found commonly at upper altitudes on Hawaii, especially around Humuula Sheep Station. It is palatable to livestock.

Danthonia semiannularis R. Br.

Wallaby grass

Tufted perennial; culms 50 to 100 cm tall, erect, glabrous; sheaths 6 to 12 cm long, pilose at throat, otherwise glabrous, hyaline on margins; ligule a line

of hairs 1 mm long; blades flat or often subinvolute at maturity, 25 to 50 cm long, 1 to 4 mm wide, minutely scaberulous on upper surface, glabrous on lower; panicles 6 to 10 cm long, narrow, with erect scaberulous branches 2 to 4 cm long; spikelets 9 to 11 mm long excluding awns, 2- to 4-flowered; glumes 8 to 11 mm long, 5- to 7-nerved at base, 3-nerved at apex, scaberulous on nerves, lanceolate, acute, often purple-tinged; lemmas 7 to 9 mm long, with a long sharp silky-pubescent callus and two conspicuous rings of silky white hairs, one near the base with hairs about 1 mm long, and one about the middle with hairs 2 to 3 mm long, the apex deeply bifid, the narrow lobes with delicate awns, the middle awn 7 to 9 mm long; palea sparsely ciliate on lower part of keels, the narrow apex truncate. (Fig. 27, d-e)

An erect, rather slender perennial, 2 to 3½ feet tall; stems smooth; leaves flat or sometimes folded at maturity, 10 to 20 inches long, 1/32 to ⅛ inch wide, slightly rough to the touch on the upper sides, smooth

Fig. 27. *Danthonia pilosa:* a, habit; b, florets; c, glumes. *Danthonia semiannularis:* d, florets; e, glumes.

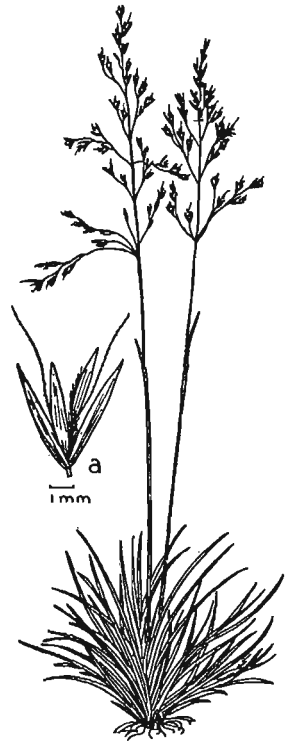

Fig. 28. *Deschampsia nubigena:* a, spikelet.

on the lower; flowering heads 2½ to 4 inches long, narrow, with short upright branches and large hairy spikelets.

A native of Australia where it is much used for grazing sheep. It was introduced into the Islands in 1903, on Molokai. At present it is found only occasionally on Molokai and at the upper altitudes on Hawaii and Maui. Its drawback is that it produces a comparatively small amount of forage.

DESCHAMPSIA Beauv.

Spikelets 2-flowered, disarticulating above the glumes and between the florets, the hairy rachilla prolonged beyond the upper floret as a stipe, this sometimes bearing a reduced floret; glumes about equal, acute or acutish, membranaceous; lemmas thin, truncate and 2- to 4-toothed at summit, bearded at base, bearing a slender awn from or below the middle, the awn straight, bent, or twisted.

A genus of about 40 species, mostly inhabiting cold and temperate regions, a few occurring in the high mountains of the tropics. The species are low or moderately tall annuals or perennials, with shining pale or purplish spikelets in narrow or open panicles. Some are considered good forage.

There is only one species in the Islands, *D. nubigena.*

Deschampsia nubigena Hillebr.

A tufted perennial, 30 to 100 cm tall, glabrous, stiff; sheaths glabrous; ligule 5 to 8 mm long, lance-acuminate, membranaceous; blades 5 to 30 cm long, 0.5 to 1.5 mm wide, folded, glabrous, scabrous on the margin; panicles 5 to 30 cm long, usually open, ovate to oblong, scabrous, the capillary branches in fascicles, some naked at base, some spikelet-bearing near the base; spikelets 4.5 to 5.5 mm long, glabrous; first glume about 3.5 mm long; second glume about 4 mm long, the keel scabrous; lemmas scabrous, about 4 mm long, the callus hairs about 1 mm long; awn from near the base, 6 to 9 mm long, usually bent near the lower third. (Fig. 28)

A bunched upright perennial, 1 to 3 feet tall, smooth; leaves often crowded at base, 2 to 12 inches long, narrow, rolled, smooth; flowering head open to somewhat contracted, with bronze-tinted spikelets about 3/16 inch long, the florets hairy at base and with a slender bristle from near the base.

This is a native species found in dry rocky places above 4,000 feet elevation or in bogs at lower elevations on the different islands. On the dry rocky slopes of Haleakala, Maui, and Mauna Kea and Mauna Loa, Hawaii, it is rather conspicuous grass, growing with *Trisetum glomeratum.* In such places animals seem to eat it to some extent.

DIGITARIA Heister CRABGRASS

Spikelets in 2's or 3's, rarely solitary, subsessile or short-pediceled, alternate in two rows on one side of a 3-angled winged or wingless rachis; spikelets lanceolate or elliptic, nearly planoconvex; first glume minute or wanting; second glume equaling the sterile lemma or shorter; fertile lemma cartilaginous, the hyaline margins pale.

The genus contains about 75 species in both the tropics and the temperate regions. Seven species are now established in the Islands, and are highly regarded as forage grasses. In Africa, they are very numerous and make up an important part of the forage.

Five species of *Digitaria* are found on the range, all at low to middle altitudes in dry to wet localities.

Spikelets about 1.5 mm long, obtuse.
Culms creeping, the sterile shoots with short broad blades 1 to 2 cm long ..... *D. pseudo-ischaemum*
Culms erect, or decumbent at base; blades narrow ..... *D. violascens*
Spikelets about 3 mm long, acute.
Racemes several, erect, remaining close together even at maturity.
Plant glabrous; culms 15 to 20 cm long ..... *D. henryi*
Plant hairy; culms 20 to 150 cm long ..... *D. pruriens*
Racemes spreading at maturity ..... *D. sanguinalis*

Digitaria henryi Rendle

Henry's crabgrass

Prostrate perennial, extensively creeping and rooting at the nodes; culms 15 to 50 cm long, glabrous; sheaths 2 to 5 cm long, distinctly compressed, glabrous; ligule 1 to 2 mm long, membranaceous; blades flat, 4 to 12 cm long, 2 to 7 mm wide, glabrous to sparingly long-pilose; racemes 2 to 4, erect, remaining close together even at maturity, 3 to 6 cm long; rachis scabrous on margins; spikelets 2 to 3 mm long, lanceolate, acute; first glume minute; second glume about two-thirds as long as spikelet, villous on margins; sterile lemma as long as spikelet, 5- to 7-nerved, villous on lateral nerves, its palea wanting; fertile lemma as long as spikelet, pale, acute. (Fig. 29)

Plants creeping and rooting by runners, forming dense mats, each plant often covering an area as much as 2 feet across; stems smooth, usually flattened; leaves flat, dark green or blue green, 1 to 4 inches long, ⅛ to ¼ inch wide, smooth or occasionally sparsely long-hairy on the upper surfaces; flowering heads with 2 to 4 slender finger-like branches, 1 to 3½ inches long, remaining close together, forming compact yet delicate heads, the stems sometimes lying almost flat but usually ascending from the prostrate main body of the plant.

Henry's crabgrass was described from Formosa and is found in China, Indo-China, Samoa, and the Philippines. It is of comparatively recent introduction in the Islands where it is spreading rapidly, already

covering large areas in the moist districts at low to medium altitudes on Maui. It has become very abundant in lawns in Honolulu and is found in some of the lower pastures of Oahu. It is also growing in a small area at Maunaloa, Molokai. Animals have been observed to feed upon it, apparently with great relish. It is said to crowd out Hilo grass (*Paspalum conjugatum*), sensitive plant (*Mimosa pudica*), and even lantana (*Lantana camara*) under certain conditions.

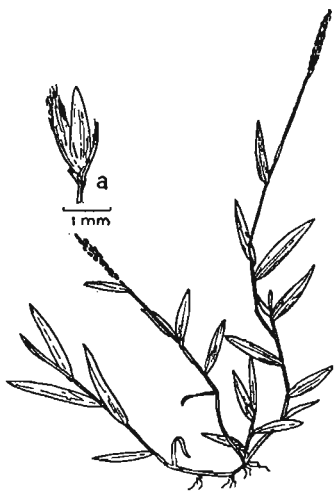

Fig. 29. *Digitaria henryi:* a, spikelet.

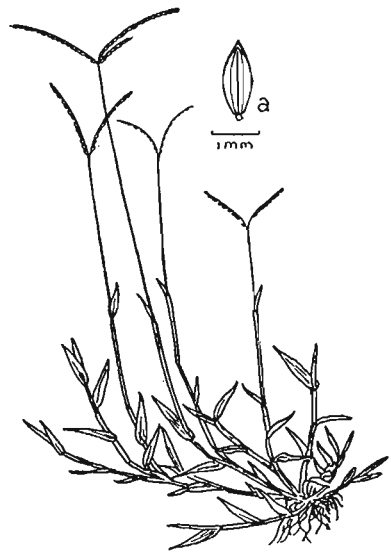

Fig. 30. *Digitaria pseudo-ischaemum:* a, spikelet.

Digitaria pruriens (Trin.) Busse
Syntherisma pruriens Arthur
Kukaipuaa; Crabgrass

Similar to *Digitaria sanguinalis,* with which it is often confused but from which it differs in having erect racemes closely appressed, even at maturity. It is usually more robust and erect, but varies in habit. (Fig. 31, a-b)

Originally described from Hawaii and the Marquesas Islands, and now found throughout Polynesia. It is rather abundant on all the Hawaiian Islands in wet regions of the lowlands. It is occasionally found in arid regions, but here the plants are very small. *D. pruriens* is palatable but does not seem to withstand grazing very well.

Digitaria pseudo-ischaemum Busse

Creeping kukaipuaa

Creeping perennial, with long leafy stolons, usually pilose at nodes; culms 6 to 20 cm long, glabrous, usually erect from the prostrate body of the plant; sheaths 1 to 4 cm long, striate, glabrous, compressed, usually imbricate; ligule 1 to 1.5 mm long, membranaceous, often lacerate; blades flat, 1 to 3 cm long, 3 to 6 mm wide, ovate-lanceolate, abruptly acute, sometimes pilose at the clasping base; racemes 2 to 3, slender, 2 to 4 cm long, digitate; rachis narrowly winged; spikelets about 1.5 mm long, narrow, acute, glabrous; first glume wanting; second glume as long as spikelet, 3-nerved; sterile lemma as long as spikelet, 5-nerved; fertile lemma as long as spikelet, pale. (Fig. 30)

Creeping, matting perennial, with long, leafy runners, rooting at the joints; stems smooth and rather wiry; leaves short, comparatively broad, not more than 1½ inches long and about ¼ inch wide, smooth, rather stiff; flowering heads delicate and erect above the prostrate main body of plant, with 2 to 3 finger-like, short, slender spreading branches at the end of the naked flowering stems.

A native of the East Indies, widely distributed throughout the warm countries. In Hawaii it is fairly common along roadsides and in pastures in wet sections of the lower altitudes. In the Kalapana region of Hawaii it is the dominant grass. It has been confused with *Digitaria longiflora* (Retz.) Pers., of similar habit but with pubescent spikelets.

Digitaria sanguinalis (L.) Scop.

Syntherisma sanguinalis Dulac

Large crabgrass; Kukaipuaa

Annual or short-lived perennial; culms 20 to 90 cm long, often purplish, glabrous, branching and spreading, often rooting at nodes and sometimes forming extensive mats, the flowering culms usually erect, sometimes prostrate or ascending; sheaths 2 to 10 cm long, compressed, striate, sometimes purplish, often glaucous, densely to sparsely papillose-pilose, the upper sometimes nearly glabrous; ligule 2 to 3 mm long, membranaceous, sometimes slightly erose; blades 5 to 15 cm long, 5 to 10 mm wide, scabrous to hispid, often glaucous, sometimes sinuous along margins; racemes usually 3 to 8, 5 to 15 cm long, each with basal pulvinus, digitate or subdigitate; rachis narrowly winged, scabrous; spikelets 3 to 3.7 mm long, on scabrous pedicels 1 to 3 mm long; first glume 0.2 to 0.7 mm long, acute; second glume 2 to 3 mm long, ciliate, narrow, 3-nerved, acute; sterile lemma 3 to 3.7 mm long, flattened with incurved margins, 7-nerved with two outer pairs of nerves approximate and only one on each side of midrib, the internerves with silky pubescence, obscure and appressed when young but spreading when old; fertile lemma 3 to 3.5 mm long, acuminate, rounded on back, pale green to sometimes purplish. (Fig. 31, c-d)

A weedy annual, sometimes perennial, branching and spreading, often rooting at the joints and sometimes forming extensive mats,

occasionally assuming an upright habit; stems 1 to 3 feet long, the sheaths clothed with long, rather stiff hairs, often purplish; leaves 2 to 6 inches long, ¼ to ½ inch wide, rough to the touch and usually clothed with stiff hairs; flowering heads on upright or sometimes almost prostrate stems with 5 to 10 slender, spreading, finger-like branches, 2 to 6 inches long.

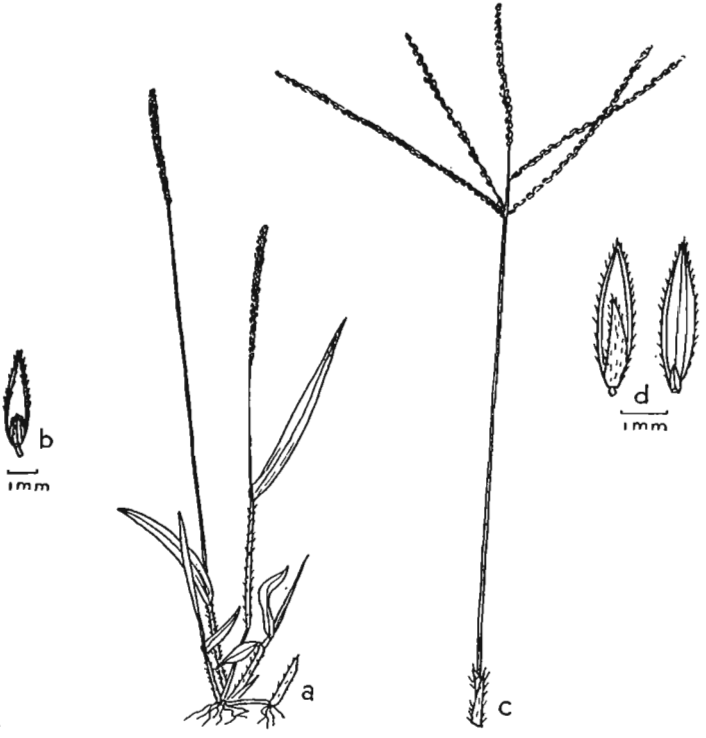

Fig. 31. *Digitaria pruriens:* a, habit; b, spikelet. *Digitaria sanguinalis:* c, inflorescence; d, spikelets.

A native of Europe, widely distributed over the warm and temperate parts of both hemispheres. It was collected in the Hawaiian Islands as early as 1888, and is found on all the islands at lower altitudes, under rather moist conditions. It is a serious weed in cultivated fields but forms a fairly valuable part of the natural pasture mixtures. If not too heavily grazed it seeds freely and will persist. It is most conspicuous just after the rainy season or on a newly plowed pasture.

Digitaria violascens Link

Digitaria chinensis A. Camus; *Syntherisma chinensis* (Nees) Hitchc.

Kukaipuaa; Crabgrass

Annual or sometimes perennial; culms erect or decumbent at base, slender, glabrous, 20 to 60 cm tall, leaves crowded near the base; sheaths compressed, keeled, 1 to 6 cm long; ligule membranaceous, 1 mm long; blades flat, usually 2 to 6 or occasionally as much as 10 cm long, 3 to 6 mm wide, often reddish, glabrous or often scaberulous on margins, occasionally sparingly pilose at base on upper surface; racemes 2 to 9, 3 to 12 cm long, slender, usually digitate at the summit of the culms or sometimes approximate along an axis 2 to 5 cm long, usually spreading or recurved; rachis narrowly winged, 0.5 to 0.7 mm wide; spikelets 1.5 to 1.7 mm long, elliptic, often dark brown, borne in 3's on nearly terete, scabrous pedicels, the longest pedicel 1.5 to 2 mm long, the other two 0.7 to 1 mm and 0.2 to 0.5 mm long, respectively; first glume wanting; second glume 1 to 1.2 mm long, obtuse, 3-nerved, appressed-silky pilose between the nerves; sterile lemma 1.5 to 1.7 mm long, obtuse, 5-nerved, obscurely appressed-silky pilose between the nerves; fertile lemma 1.5 to 1.7 mm long, acute, dark brown; grain 1 to 1.2 mm long, elliptic-ovate, whitish. (Fig. 32)

Annual or sometimes perennial, 1 to 2 feet tall, erect to spreading at the base and forming dense clumps; stems smooth; leaves flat, 1 to 4 inches long, ⅛ to ¼ inch wide, often reddish, usually smooth but often slightly rough on the edges and sometimes with a few long hairs near the base on the upper sides; flowering heads with 2 to 9 slender finger-like branches, 1 to 4 inches long, at the tip of the flowering stem or closely arranged along 1 to 2 inches of the upper part; spikelets very small, dark-colored, closely pressed to the branches.

A native of China, India, and Australia and widely distributed in the American tropics. It was collected in the Hawaiian Islands as early as 1895 and is now fairly abundant on all the islands in moist and semi-dry regions to an altitude of 5,000 feet or more. It is very palatable and fairly persistent, withstands heavy grazing, and grows well in mixture with other grasses.

ECHINOCHLOA Beauv.

Spikelets planoconvex, often stiffly hispid, subsessile, solitary or in irregular clusters on one side of the panicle branches; first glume about half the length of the spikelet, pointed; second glume and sterile lemma equal, pointed, mucronate, or the glume short-awned and the lemma long-awned, sometimes conspicuously so, enclosing a membranaceous palea and sometimes a staminate flower; fertile lemma planoconvex, smooth and shining, acuminate-pointed, the margins inrolled below, flat above, the apex of the palea not enclosed.

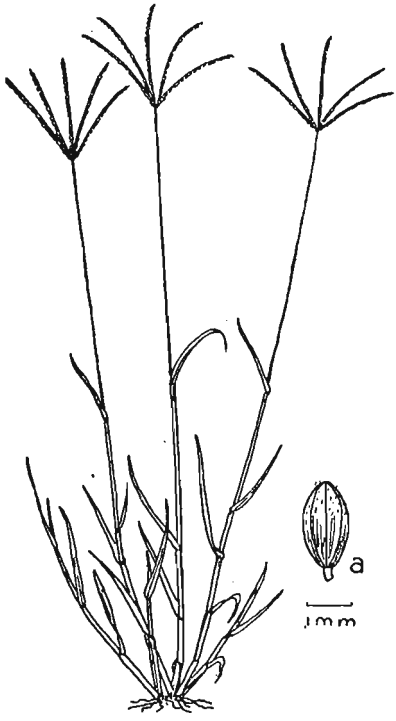

Fig. 32. *Digitaria violascens:* a, spikelet.

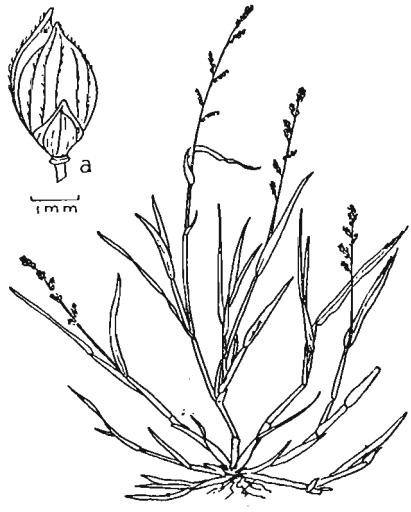

Fig. 33. *Echinochloa colonum:* a, spikelet.

There are about 15 species, mainly in warm countries, usually coarse annuals or perennials. All of the species are grazed by livestock, but they usually grow in sparse stands or in rather inaccessible swampy situations.

There are 4 species in the Islands, usually found in wet places at low elevations. They may be recognized by the prickly spikelets crowded in clusters at the end of the stalk. Of the 4 species, *Echinochloa stagnina* (Retz.) Beauv. seems to have the most use. In tropical Africa, its native home, it is very abundant in moist or swampy situations and is put to many uses. It is reported to yield excellent fodder with a high sugar content, and is used extensively for thatching and calking houses. Near Timbuctu every part of it is utilized. It is burned, and a salt recovered from the ash is used in the manufacture of soap and indigo. The seed is used for food, and sugar is extracted

from the stems. The stems are also sometimes used for the preparation of a beverage resembling cider.

Only one species, *E. colonum,* is important on the ranges of Hawaii.

Echinochloa colonum (L.) Link

Jungle-rice

Tufted annual; culms 20 to 60 cm tall, erect, ascending or decumbent at base, sometimes rooting at lower nodes, often reddish-purple, sometimes conspicuously swollen and often geniculate at nodes, compressed, lower internodes often exposed; sheaths 3 to 7 cm long, compressed, keeled, glabrous; ligule obsolete; blades flat, 4 to 10 cm long, 3 to 8 mm wide, often undulate, acute, sometimes with transverse purple bands, margins occasionally scabrous; panicles usually 5 to 10 or occasionally as much as 15 cm long, green or purple-tinged; racemes several, 1 to 2 cm long, the lower as much as 1 cm apart, the upper crowded; rachis scaberulous; spikelets crowded, usually in about 4 rows, 2.5 to 3 mm long, on very short scaberulous pedicels; glumes hispidulous, ovate, acute, the first 1.2 to 1.5 mm long, 3-nerved, the second 2.5 to 3 mm long, 7-nerved; sterile lemma like the second glume, its glabrous ovate palea about 2 mm long; fertile lemma about 2 mm long, broadly ovate, shining; grain 1.7 to 2 mm long, broadly ovate, flat on one side, whitish. (Fig. 33)

A smooth annual ½ to 2 feet tall, usually prostrate-spreading, sometimes nearly erect; stems flattened, often reddish-purple, usually swollen at the joints; leaves flat, 1 to 4 inches long, ⅛ to ¼ inch wide, rather broad at base and tapering abruptly to a sharp point; flowering heads 2 to 4 or sometimes as much as 6 inches long, with very short compact branches, green or tinged with reddish-purple.

Originally described from India, now widely distributed throughout the warmer parts of both hemispheres. Forms of this species are cultivated in certain parts of tropical Asia and Africa for the seeds, which are used for food. It was early introduced in the Islands, and now occurs on all the islands at low altitudes, growing in very moist, swampy habitats and also in dry open areas, where it is abundant in the rainy season, dying out with the coming of the dry season. It is of little forage value generally but adds to the forage crop in the drier areas, especially after rains.

ELEUSINE Gaertn.

Spikelets few- to several-flowered, compressed, sessile and closely imbricate, in two rows along one side of a rather broad rachis, not prolonged beyond the spikelets; rachilla disarticulating above the glumes and between the florets; glumes unequal, rather broad, acute, 1-nerved, shorter than the first lemma; lemmas acute, with 3 strong green nerves close together forming a keel, the uppermost somewhat reduced; seed dark brown, roughened by fine ridges, loosely enclosed in the thin pericarp.

An unimportant genus containing about 6 species, all native to the Old World. They are rather low-growing annuals with 2 to several comparatively stout, flattened, spreading spikes at the summits of the flowering stems.

There is only one species, *E. indica,* in the Islands.

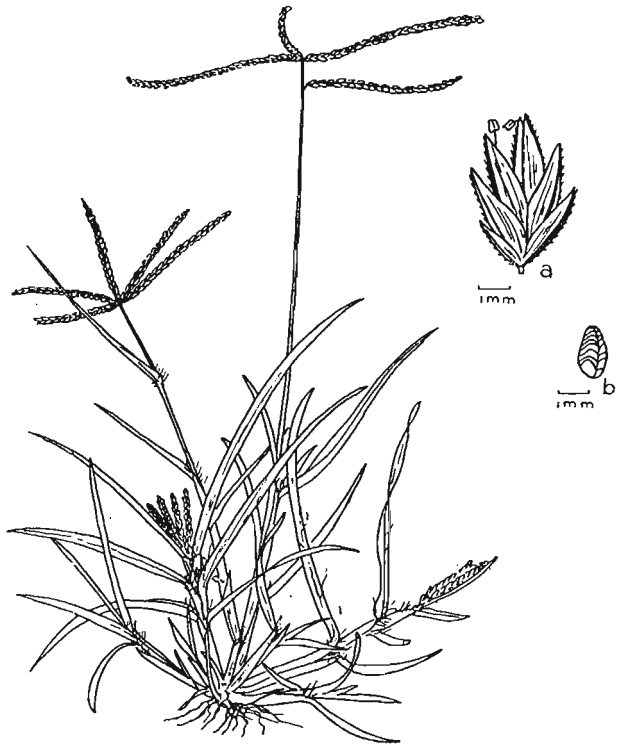

Fig. 34. *Eleusine indica:* a, spikelet; b, seed.

Eleusine indica (L.) Gaertn.

Goosegrass; Wire grass

Annual, usually profusely branched at base, prostrate or ascending; culms 25 to 60 cm tall, pale green, shining, glabrous, conspicuously compressed, tough; sheaths 3 to 9 cm long, conspicuously compressed, striate, keeled, sparsely long-pilose at throat and along margins; ligule 0.2 to 0.5 mm long, membranaceous, truncate or fimbriate; blades 15 to 25 cm long, 4 to 10 mm wide, conspicuously keeled, scabrous on keel and on margins near tip, sparsely long-pilose on upper side with a conspicuous translucent yellow band for 2 to 3 mm from base, ascending to spreading, rounded at base, acute at apex; spikes umbellate, thick, 2 to 6, one often borne 2 to 5 cm below the others, 4 to 10 cm long, 4 to 8 mm wide;

spikelets 5 to 7 mm long, 3- to 8-flowered, glabrous; glumes broad, keeled, hyaline or purple-tinged on margins, the first 2 to 3 mm long, 2- to 4-nerved, the second 3 to 4 mm long, 6- to 9-nerved; lemmas 3 to 3.5 mm long, acute, scaberulous on keel, often with 1 to 2 indistinct nerves on either side; palea 2.5 to 3 mm long, acute; grain 1 to 2 mm long, dark reddish-brown, ridged longitudinally, beautifully striated with concentric rings. (Fig. 34)

An erect to prostrate annual, sometimes perennial, usually growing in tufts and profusely branched at the base, 1 to 2 feet tall; stems flattened, pale green, shining, smooth or sometimes with a few long hairs along the edges; leaves 6 to 10 inches long, boat-shaped, long-hairy at the base, narrow; flowering heads with 2 to 6 flattened, finger-like branches, 2 to 4 inches long; seeds about 1/16 inch long, dark-reddish brown with conspicuous ridges.

A common weed, native to the Old World but long naturalized in the warm regions of the New. It was collected as early as 1840 and is now found occasionally in the semi-dry pastures of the lowlands of several islands. It is very persistent and seems to thrive where it is exposed to severe trampling or where the soil is shallow and poor. Although when young it is eaten to a small extent by stock, it is classed as a weed.

Elymus L. Wild-rye

Spikelets 2- to 6-flowered, sessile in pairs (rarely 3 or more, or solitary) at each node of a usually continuous rachis, the rachilla distorted at base, bringing the florets more or less dorsiventral to the rachis; rachilla disarticulating above the glumes and between the florets; glumes equal, somewhat asymmetric, usually rigid, sometimes indurate below, narrow to subulate, 1- to several-nerved, acute to aristate; lemmas rounded on the back or nearly terete, obscurely 5-nerved, acute or usually awned from the tip.

There are about 45 species, confined to temperate regions. They are usually tall, erect perennials with flat coarse leaves and slender, usually bristly spikes. Generally the foliage of *Elymus* is harsh and only moderately palatable to livestock. Some of the species with creeping underground runners are valuable as soil and sand binders.

There is only one species of this genus established in the Islands, *E. triticoides*.

Elymus triticoides Buckl.

Beardless wild-rye

Perennial with extensively creeping scaly rhizomes; culms 60 to 125 cm tall, usually glaucous; sheaths 15 to 25 cm long, striate, glabrous; ligule 0.5 to 1 mm long, membranaceous, rather erose; blades flat, usually involute toward tip, 15 to 25 cm long, 2 to 6 mm wide, scabrous on upper surface, glabrous on lower; spikes

10 to 18 cm long, erect, usually rather slender, occasionally dense; rachis scabrous; spikelets 1 to 2 cm long, glabrous, 2- to 6-flowered, the florets somewhat persistent, usually in pairs, sometimes single or occasionally three; glumes usually 5 to 12 mm long, but those of the uppermost spikelets much reduced or obsolete, nerveless or sometimes 1- to 3-nerved, sparsely scabrous on upper part especially along nerves and margins, very narrow, acuminate or subulate; lemmas 5 to 15 mm long, faintly 5-nerved, glabrous, tawny or purplish, subcoriaceous, awn-pointed; palea 5 to 7 mm long, subcoriaceous, the keels minutely ciliate, scabrous, puberulent and bifid at apex; rachilla scaberulous. (Fig. 35)

Perennial with long, creeping, scaly, underground rhizomes; stems 2 to 4 feet tall, smooth, bluish-green, erect; leaves 6 to 12 inches long, ⅛ to ¼ inch wide; flowering heads rather dense spikes with large seed.

A native of the western United States in moist or alkaline soil. Although not usually considered good forage, this species is not a pest. It was first collected in Hawaii on Parker Ranch in a local patch in September, 1936.

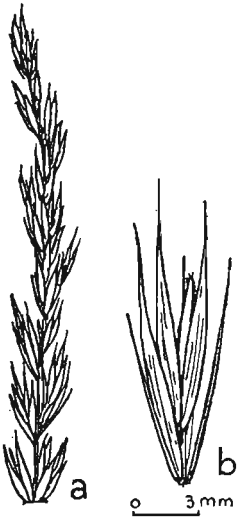

Fig. 35. *Elymus triticoides:* a, inflorescence; b, spikelet.

Fig. 36. *Eragrostis amabilis:* a, spikelet.

ERAGROSTIS Host LOVEGRASS

Spikelets few- to many-flowered, the florets usually closely imbricate, the rachilla disarticulating above the glumes and between the florets, or continuous, the lemmas deciduous, the paleas persistent; glumes somewhat unequal, shorter than the first lemma, acute or acuminate, 1-nerved, or the second rarely 3-nerved; lemmas acute or acuminate, keeled or rounded on the back, 3-nerved, the lateral nerves sometimes obscure; palea usually about as long as the lemma, the keels sometimes ciliate.

Eragrostis contains about 250 species in both temperate and tropical regions, but, in general, they have very little forage value.

There are 19 species of *Eragrostis* in the Islands, only 6 of which are treated here. They are usually found in rather dry situations from sea level to 7,000 feet elevation. The species may be recognized by the flat spikelets of closely imbricate florets.

Plants less than 50 cm tall.
- Perennial; plants prostrate.....*E. brownei*
- Annual; plants erect or ascending.
  - Palea prominently ciliate on the keels, the hairs 0.3 to 0.5 mm long.....*E. amabilis*
  - Palea not ciliate on the keels.
    - Lemmas glandular on the keel.....*E. cilianensis*
    - Lemmas not glandular.....*E. pectinacea*

Plants more than 50 cm tall.
- Creeping rhizomes short and stout, the culms in loose tufts.....*E. atropioides*
- Creeping rhizomes wanting, the culms in compact tufts.....*E. leptophylla*

Eragrostis amabilis (L.) Wight & Arn.

Lovegrass; Hakonokono

Tufted annual; culms 10 to 40 cm tall, glabrous, slender, rather wiry, usually widely spreading and geniculate at base, occasionally upright; sheaths 1 to 3 cm long, shorter than internodes, a conspicuous tuft of hairs, as much as 3 mm long, at summit, usually somewhat flattened; ligule obsolete; blades flat, 4 to 10 cm long, 2 to 6 mm wide, scaberulous on upper surface, glabrous on lower, attenuate; panicle long-exserted, 5 to 15 cm long, ovate-oblong or oblong-lanceolate, narrow but usually open, light green or often reddish-purple, with scabrous spreading or ascending branches 1 to 3 cm long, pilose at base, with spreading hairs 1 to 3 mm long; spikelets 1.5 to 2.5 mm long, 4- to 8-flowered; glumes acute, scabrous on upper part of nerves, the first 0.7 mm long, the second 1 mm long; lemmas 1 mm long, glabrous, ovate, obtuse; palea 0.7 mm long, conspicuously long-ciliate on keels, with hairs 0.3 to 0.5 mm long. (Fig. 36)

Small, rather delicate annual, usually widely spreading at base but sometimes erect; stems ½ to 1½ feet long, delicate but rather wiry; leaves 1½ to 4 inches long, 1/16 to ¼ inch wide, slightly rough on the upper surfaces, smooth on the lower, with tufts of long hairs at the summits of the sheaths; flowering heads 2 to 6 inches long, rather delicate, with short branches and numerous spikelets, often reddish-purple.

Originally described from India, now common in warm regions of both hemispheres. It was collected in the Hawaiian Islands as early as 1888, and is found commonly along roadsides and in pastures at lower altitudes, usually in rather dry localities on all the islands. It often springs up rather abundantly after rain and forms an important forage.

Fig. 37. *Eragrostis atropioides:* a, floret; b, glumes.

Eragrostis atropioides Hillebr.

Hard-stemmed lovegrass

Perennial with hard scaly rhizomes as much as 7 cm long and 5 mm thick; culms 100 to 150 cm tall, glabrous or sometimes scaberulous just below the panicle, hard, loosely tufted, erect; sheaths 4 to 10 cm long, longer than internodes, pilose at throat and along margins, the hairs more conspicuous on sterile shoots; ligule consisting of a dense line of hairs 0.5 to 1 mm long, interspersed with silky hairs 4 to 6 mm long; blades spreading, flat, 30 to 40 cm long, 2 to 6 mm wide, attenuate-setaceous toward the ends, scabrous on upper surface, glabrous on lower; panicle 30 to 50 cm long, 2 to 4 cm wide, erect, narrow, contracted but

scarcely spikelike, the branches several at a node, appressed, 1 to 10 cm long, pilose in the axils; spikelets 8 to 20 mm long, 8- to 25-flowered, linear-oblong, rather turgid, pale green, on short pedicels; both glumes and lemmas early deciduous; glumes ovate-lanceolate, scaberulous on keels, thin, membranaceous, the first 2.5 to 3.5 mm long, the second 3 to 4 mm long; lemmas 2 to 3 mm long, glabrous or minutely scaberulous near apex, 3- to 5-nerved, membranaceous, broad, margins hyaline, apex obtuse and erose, closely imbricate obscuring the pale green or purplish glabrous rachilla; palea 2 to 3 mm long, persistent, rather cuneate, apex obtuse, usually erose, scaberulous on keels; grain 0.7 to 1 mm long, narrowly ovate, dark red. (Fig. 37)

An erect perennial, 3 to 5 feet tall, growing in loose clumps and producing hard, scaly, underground rhizomes as much as 3 inches long and ¼ inch thick; stems glabrous, hard and woody; leaves 12 to 16 inches long, ⅛ to ¼ inch wide at base, tapering to long slender tips, rough on the upper sides, smooth on the lower; flowering heads 12 to 20 inches long, narrow, erect, pale green to brownish purple.

An endemic grass found abundantly at 4,000 feet and above on Hawaii, where it forms an appreciable part of the pasture. It is found occasionally at medium altitudes on Maui. Because of its scaly rhizomes, it is very persistent and will grow on poor shallow soil. It is quite woody and unpalatable.

Fig. 38. *Eragrostis brownei:* a, spikelet.

Eragrostis brownei (Kunth) Nees

Brown's lovegrass; Sheep grass

Tufted perennial; culms 15 to 50 or sometimes as much as 80 cm long, usually prostrate-spreading and decumbent, occasionally nearly erect, glabrous, slender, the uppermost node usually not over 5 cm from base; sheaths 3 to 4 cm long, pilose at throat, otherwise glabrous, the margins membranaceous; ligule a line of

stiff hairs about 0.2 mm long; blades flat, 10 to 25 cm long, 1 to 3 mm wide, mostly crowded at base, glabrous; panicles 5 to 15 cm long, long-exserted with only a few distant scabrous spreading branches 2 to 7 cm long, bearing comparatively few spikelets; spikelets 4 to 8 mm long, about 2 mm wide, 9- to 15-flowered, on pedicels not more than 1 mm long, more or less appressed along branches; glumes subequal, 1.5 to 1.7 mm long, glabrous, acute, the margins hyaline; lemmas 1.7 to 2 mm long, acute, glabrous, closely imbricate; palea slightly shorter than lemma, scaberulous on the keels, persistent; grain 0.7 mm long, ovate, dark red. (Fig. 38)

A vigorous smooth perennial, usually forming compact mats; stems ½ to 2 feet long, usually prostrate-spreading and turning up at the tips or sometimes nearly erect, slender, usually rather wiry; leaves flat, 4 to 10 inches long, 1/32 to 1/8 inch wide, mostly in a dense cluster at the base; flowering heads 2 to 6 inches long, usually on long naked stems, open and with only a few spikelets.

A native of Australia. It was first collected in the Islands in 1906, and is confined to the upper altitudes on Hawaii and Maui. It is very abundant on the Hualalai Mountain and at upper altitudes in Kona where cattle graze it to some extent, although it does not have particularly excellent forage quality.

Eragrostis cilianensis (All.) Link

Stinkgrass

Tufted annual; culms 10 to 50 cm tall, much branched at base, usually spreading but sometimes erect, glabrous, a row of glands below the nodes; sheaths usually somewhat compressed, conspicuously pilose at throat, otherwise glabrous; ligule a line of hairs 0.7 to 1.2 mm long; blades flat, 5 to 12 cm long, 2 to 8 mm wide, dark green, scabrous above, glabrous beneath, with conspicuous tuberculate glands on margins; panicles 5 to 25 cm long, compact to open; spikelets 4 to 12 mm long, 10- to 40-flowered, oblong, compressed, dark green when young, dark gray to tawny or often almost transparent excepting the dark green nerves when mature; glumes broad, acute, often tinged with purple, subequal, the keels sparsely beset with minute glands, the first glume 1 to 1.2 mm long, the second 1.5 to 1.7 mm long; lemmas 2 to 2.5 mm long, acute, scabrous on apex of keel, conspicuously 3-nerved, the keel sparsely beset with minute glands; palea 1.2 to 1.7 mm long, minutely ciliate on keels; grain ovate, punctate, reddish-brown, 1 mm long. (Fig. 39)

Smooth annual, ½ to 2 feet tall; stems erect or often spreading, the foliage beset with glands emitting a disagreeable odor, whence the name "stinkgrass"; leaves flat, 2 to 5 inches long, ⅛ to ⅜ inch wide, dark green; flowering heads 2 to 10 inches long, compact or somewhat open, dark green when young, whitish when old.

A native of Europe, naturalized throughout most warm and temperate countries. It is usually a weed of cultivated fields and along roadsides. It is found occasionally in pastures of lower dry regions on

all the islands, springing up after rains and often producing seeds within a month or so.

Fig. 39. *Eragrostis cilianensis:* a, spikelet.

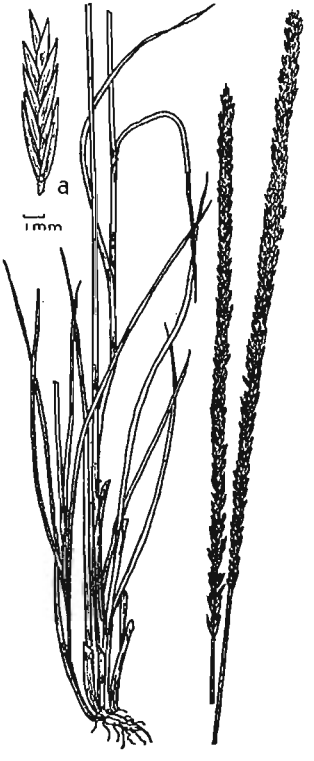

Fig. 40. *Eragrostis leptophylla:* a, spikelet.

Eragrostis leptophylla Hitchc.

Mountain lovegrass

Perennial; culms 60 to 100 cm tall, densely tufted, slender, erect, glabrous; sheaths longer than internodes, 5 to 10 cm long, pilose at throat and along margins, pubescent on collar, otherwise glabrous; ligule a dense line of hairs 0.2 to 0.5 mm long; blades 10 to 25 cm long, involute, 1 to 2 mm wide, tapering to a slender apex, scaberulous on upper surface, long-pilose at base, glabrous on lower surface; panicles 15 to 30 cm long, narrow, erect, spikelike, usually rather dense but sometimes interrupted, with scabrous rachis, the branches sparingly pilose in axils; spikelets 4 to 9 mm long, 4- to 9-flowered, on scaberulous or puberulent pedicels; glumes subequal, 3 to 5 mm long, narrow, attenuate, scaberulous on keel toward apex, the first 1-nerved, the second 3-nerved; lemmas 2 to 3 mm long, rather inconspicuously 3-nerved, acute, minutely scaberulous near apex, closely imbricate, hiding the sparsely pilose rachilla; palea 1.7 to 2 mm long, scaberulous

on keels, usually truncate and erose at apex; grain 0.7 to 1 mm long, narrowly ovate, finely rugose, dark red. (Fig. 40)

An erect perennial growing in large bunches, 2 to 3 feet tall; stems slender, glabrous; leaves 4 to 10 inches long, stiffly upright, folded and tapering to slender points, rough all along the upper sides and usually with rather long hairs at base, smooth on the lower sides; flowering heads 6 to 12 inches long, narrow, erect, spikelike, usually dense.

An endemic grass known only from the island of Hawaii. It is rather abundant in pastures on sandy plains above Waikii where it is very hardy and persistent. It will grow in poor soil, but the whole plant is tough and wiry and is probably of very little forage value.

Fig. 41. *Eragrostis pectinacea:* a, spikelet.

Eragrostis pectinacea (Michx.) Nees

Eragrostis caroliniana (Spreng.) Scribn.

Carolina lovegrass

Annual; culms 15 to 40 cm tall, erect or sometimes decumbent to prostrate-spreading at base, glabrous; sheaths 3 to 6 cm long, sparingly pilose at throat,

otherwise glabrous, the basal ones often purplish; ligule a line of hairs 0.5 to 1 mm long; blades 5 to 18 cm long, 1 to 3 mm wide, scaberulous on upper surface, glabrous on lower; panicles 7 to 20 cm long, diffuse, rather delicate, with scaberulous spreading branches 3 to 7 mm long, pilose in lower axils; spikelets 3 to 8 mm long, 1 to 1.5 mm wide, 5- to 15-flowered, somewhat linear, usually silvery, sometimes purplish, usually appressed along the branches; glumes acute, scabrous on keels, the first 1 mm long, the second 1.5 mm long; lemmas 1.5 to 2 mm long, acute, usually scaberulous on upper part of keels, otherwise glabrous; palea 1.5 mm long, scabrous on keels; grain 1 to 1.2 mm long, obovate, reddish-brown. (Fig. 41)

Annual, ½ to 2 feet tall; stems usually erect but sometimes spreading at base, glabrous, often purplish at the base; leaves 2 to 7 inches long, 1/16 to 1/8 inch wide, slightly rough on the upper sides, smooth on the lower; flowering heads 2 to 7 inches long, 1 to 3 inches wide, rather delicate; seeds small, about 1/32 inch long, reddish-brown.

A native of the United States where it grows in open ground and waste places. It occurs occasionally at lower altitudes, usually in dry areas in pastures and along roadsides, on the islands of Hawaii, Maui, and Oahu. It is a weed but is not a problem on the ranges because it is not persistent.

Festuca L. Fescue

Spikelets few- to several-flowered, the rachilla disarticulating above the glumes and between the florets, the uppermost floret reduced; glumes narrow, acute, unequal, the first sometimes very small; lemmas rounded on the back, membranaceous or somewhat indurate, 5-nerved, the nerves often obscure, acute or rarely obtuse, awned from the tip, or rarely from a minutely bifid apex, or awnless.

The genus contains about 150 species, 5 being found in Hawaii. It is widespread in the temperate regions of both hemispheres. Some of the fescues have abundant, rather fine basal foliage. In some regions fescues are important range grasses.

The perennials—*Festuca elatior, F. ovina,* and *F. rubra*—are all important cultivated forage grasses, especially in Europe. There are numerous weedy annuals, of very little forage value. Some of the fescues are commonly found on the natural ranges in the western United States. A number of the bunchy perennials are the dominant grasses over extensive areas and rank high in palatability. Four species of *Festuca* occur on the Hawaiian ranges at middle elevations in dry and moist localities.

Annual; lemmas with awns more than 6 mm long.
Lemmas ciliate toward the apex.....*F. megalura*
Lemmas not ciliate.....*F. dertonensis*
Perennial; lemmas awnless or with awns less than 2 mm long.
Blades flat, rather soft and lax, mostly more than 3 mm wide.....*F. elatior*
Blades involute or if flat less than 3 mm wide.....*F. rubra*

Fig. 42. *Festuca dertonensis:* a, habit; b, spikelet. c, *Festuca megalura,* spikelet. d, *Festuca rubra,* spikelet.

Festuca dertonensis (All.) Aschers. & Graebn.

Brome fescue

Usually annual but sometimes biennial or short-lived perennial; culms 25 to 60 cm tall, glabrous, erect or sometimes decumbent at base and rooting at lower nodes; sheaths 3 to 8 cm long, striate, glabrous; ligule about 1 mm long, membranaceous; blades flat or involute, 6 to 20 cm long, 1 to 3 mm wide, pubescent on upper surfaces, glabrous on lower; panicles 4 to 12 cm long, narrow, somewhat one-sided, with upright glabrous or minutely scaberulous branches 1 to 3 cm long; spikelets 5 to 12 mm long, 3- to 6-flowered; glumes acute, glabrous, the first 4 to 4.5 mm long, 1-nerved, the second 6 to 7 mm long, 3-nerved; lemmas

6 to 8 mm long, scabrous toward apex, glabrous below, with awns 6 to 12 mm long; palea 5 to 6 mm long, acute, ciliate-scaberulous; grain 4 mm long, rather flattened, obtuse, dark reddish-brown. (Fig. 42, a-b)

Annual, biennial, or short-lived perennial, 1 to 2 feet tall; stems smooth, usually erect but sometimes spreading at the base; leaves flat or sometimes folded, 2 to 8 inches long, 1/32 to 1/8 inch wide, somewhat hairy on the upper sides; flowering heads 1½ to 5 inches long, narrow, with short bristles, somewhat one-sided. This species has been confused with *Festuca bromoides* L., which is not found in the Islands.

A native of Europe, introduced in North and South America. It is found in moist situations at medium altitudes on all the islands and is fairly abundant in certain areas, being grazed by cattle to some extent. It seeds rather abundantly, producing a fair amount of forage in a short time. Although it is often considered a weed in many countries, it seems to have a place in Hawaiian pastures.

Festuca elatior L.

Tall fescue; Meadow fescue

Perennial; culms 60 to 120 cm tall, glabrous; sheaths 8 to 15 cm tall, striate, glabrous or sometimes scaberulous on margins near top, the basal ones fibrillose and usually whitish or sometimes purplish; ligule 1 to 1.2 mm long, scabrous; blades 20 to 45 cm long, 6 to 14 mm wide, firm, acuminate, usually slightly keeled, the margins scabrous; panicles 10 to 25 cm long, erect or somewhat nodding at summit, usually narrow, much branched or nearly simple, the branches ascending, 3 to 5 cm long; spikelets 8 to 14 mm long, 5- to 8-flowered, glabrous; glumes lanceolate, acuminate, the margins scabrous, the first 4 to 5.5 mm long, 1-nerved, the second 6 to 6.5 mm long, 3-nerved; lemmas 7 to 9 mm long, obscurely 5-nerved, oblong-lanceolate, scaberulous on nerves, coriaceous, the margins and apex scarious, acute or awn-tipped; palea 6 to 8 mm long, acute, subcoriaceous, scabrous on keels. (Fig. 43)

A bunchy perennial, 2 to 4 feet tall, forming a rather dense cover; stems smooth, usually whitish or purplish near the base; leaves 8 to 18 inches long, ¼ to ½ inch wide, dark glossy green, somewhat boat-shaped, rough on the edges; flowering heads 4 to 10 inches long, erect or somewhat nodding at the tips, rather narrow and with short, erect branches.

A native of Eurasia, naturalized throughout the cooler parts of North America. It is cultivated for forage and for hay in Europe and to some extent in the United States. There are several varieties and strains of this species. It is palatable and seems to be adapted to a rather wide range of climatic conditions. It is found only occasionally at the higher altitudes on the island of Hawaii, where it has escaped

from experimental grass gardens. It would seem that tall fescue should have a place in pastures at higher altitudes in the Islands.

Fig. 43. *Festuca elatior:* a, spikelet.

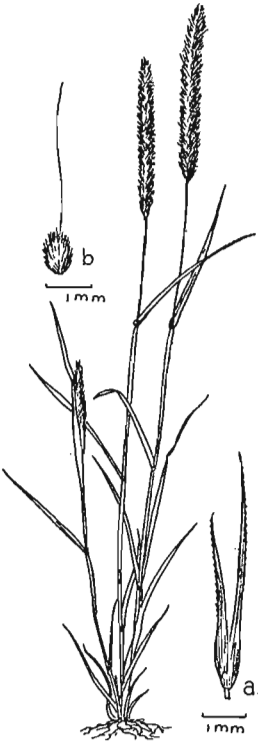

Fig. 44. *Gastridium ventricosum:* a, glumes; b, floret.

Festuca megalura Nutt.

Foxtail fescue

Similar to *F. dertonensis* but differs from it in having much shorter glumes, ciliate lemmas, and usually longer and denser panicles.

A native of western United States and the Pacific slope of South America. It is found occasionally at medium altitudes in moist situations on all the islands but it does not approach the importance of brome fescue on Hawaiian ranges. (Fig. 42, c)

Festuca rubra L.

Red fescue

A rather loosely tufted perennial, occasionally producing short delicate rhizomes; culms 45 to 100 cm tall, glabrous, erect to ascending, reddish or purplish

at base; sheaths 3 to 4 cm long, striate, usually glaucous, the lower often fibrillose; ligule 0.5 mm long; blades 8 to 17 cm long, usually involute, sparsely scabrous on margins and at acute apex; panicles 3 to 20 cm long, usually narrow and contracted with upright or ascending scabrous branches 2 to 4 cm long; spikelets 10 to 15 mm long, including awns, 4- to 7-flowered, usually pale green or glaucous, often purple-tinged; glumes attenuate, sparsely scabrous on upper half of keel, the first 2.5 to 3 mm long, 1-nerved, the second 4 mm long, 3-nerved; lemmas 5 to 7 mm long, glabrous or sometimes scabrous at apex with a scabrous awn 2 to 3 mm long; rachilla scabrous; palea 4 to 5 mm long, acute, scabrous on keels. (Fig. 42, d)

A perennial bunch grass, 1 to 3 feet tall, occasionally with short, rather delicate underground runners; foliage smooth, usually bluish-green; leaves narrow, usually folded, 3 to 6 inches long; flowering heads 2 to 8 inches long, narrow.

A native of Eurasia and North Africa. There are several varieties, some of which are used in forage mixtures and for hay. This species was introduced into the Islands by the experiment station in 1912. Heretofore, it has not been considered a part of the established range cover. Its establishment has been very slow and even now the grass occupies only small areas in the higher altitudes on the islands of Hawaii and Maui. It probably has not been given as much consideration as it deserves on the higher altitude ranges.

GASTRIDIUM Beauv.

Spikelets 1-flowered, the rachilla disarticulating above the glumes, prolonged behind the palea as a minute bristle; glumes narrow, unequal, somewhat swollen at the base; lemma much shorter than the glumes, hyaline, broad, truncate, awned or awnless; palea about as long as the lemma.

The genus contains only 2 species, in temperate regions. They are distinguished by their pale, shining, spikelike flowering heads and flat blades.

There is only one species in the Islands, *G. ventricosum.*

Gastridium ventricosum (Gouan) Schinz & Thell.

Nit grass

Tufted annual; culms 20 to 55 cm tall, glabrous; foliage usually rather scant; sheaths 2 to 7 cm long, glabrous, striate; ligule 6 to 7 mm long, membranaceous, usually lacerate, nerved, scaberulous on the nerves; blades 8 to 25 cm long, 1 to 7 mm wide, scabrous, thin; panicles 4 to 10 cm long, 7 to 12 mm wide, spikelike, narrowly cylindrical, pale green or tawny, shining, dense; spikelets 4 to 6 mm long, slender; glumes slender, attenuate, somewhat swollen and glabrous

at base, keeled and scabrous above, the margins hyaline, the first 4.5 to 5 mm long, the second 6 to 7 mm long; lemmas 1 to 1.2 mm long, broad, truncate with a delicate yellowish awn 5 to 6 mm long; palea 1 mm long, pilose at base, bidentate; grain 1 mm long, reddish-brown, ovate. (Fig. 44)

An erect tufted annual, 1 to 2 feet tall; stems smooth; leaves 3 to 10 inches long, ⅛ to ¼ inch wide, usually scant, rough, rather thin; flowering heads dense, spikelike, 1½ to 4 inches long, ¼ to ½ inch wide, usually pale green and shining; seed very small, about 1/32 inch long, rather oval in shape and slightly flattened with a furrow on one side, reddish-brown.

A native of Europe, introduced in the United States and now a common weed on the Pacific coast. It is found occasionally in pastures at medium altitudes on Maui and Hawaii. Although it is said to be a weed of no forage value, it probably will never become a pest in the pastures as it is an annual and not particularly aggressive.

HETEROPOGON Pers.

Spikelets in pairs, one sessile, the other pedicellate, both of the lower few to several pairs staminate or neuter, the remainder of the sessile spikelets perfect, round, long-awned, the pedicellate spikelets, like the lower, staminate, flat, conspicuous, awnless; glumes of the fertile spikelet equal, coriaceous, the first brown-hirsute, enfolding the second; lemmas thin and hyaline, the fertile one narrow, extending into a strong bent and twisted brown awn; palea wanting; glumes of the staminate spikelet membranaceous, the first green, faintly many-nerved, asymmetric, one submarginal keel rather broadly winged, the other wingless, the margins inflexed, the second glume narrower, symmetric; lemmas hyaline; palea wanting.

A relatively unimportant genus containing about 7 species in warm regions of both hemispheres.

There is only one species in the Islands, *H. contortus*. It may be easily recognized by the long twisted tangled awns.

Heteropogon contortus (L.) Beauv.

Pili grass; Twisted beardgrass; Tanglehead

Tufted perennial; culms 40 to 100 cm tall, erect, glabrous, compressed, often glaucous; sheaths 6 to 10 cm long, compressed, keeled, glabrous or sparsely hispid at throat, usually glaucous; ligule a ciliate membrane 1 mm long; blades flat to subinvolute, 10 to 30 cm long, 3 to 7 mm wide, striate, firm, scabrous, pale bluish-green; raceme solitary at apex of flowering culm, 4 to 7 cm long, one-sided, often slightly nodding, the slender rachis continuous in the lower part bearing the pairs of staminate spikelets, the remainder disarticulating obliquely at the base of each joint, the joint forming a sharp barbed callus below the fertile spikelet, the pedicellate spikelet readily falling; both spikelets of the lower pairs and

the pedicellate spikelets 10 mm long, the first glumes firm, unsymmetrical, papillose-hispid near the margins and the acuminate tip, overlapping and nearly concealing the sessile spikelets; sessile spikelets about 7 mm long, slender, the awns 5 to 12 cm long, bent, flexuous, commonly tangled, appressed-pilose below, scabrous toward the slender tips. (Fig. 45)

Fig. 45. *Heteropogon contortus:* a, floret.

Fig. 46. *Holcus lanatus:* a, spikelet; b, floret.

A branching, erect, shallow-rooted perennial in rather large bunches, 1 to 3 feet tall; stems flattened, rather tough, smooth, pale bluish-green; leaves flat or folded, 4 to 12 inches long, ⅛ to ¼ inch wide, rough to the touch; flowering heads 1½ to 3 inches long, one-sided, often nodding, with conspicuous overlapping scales below and stout brown tangled bristles 2 to 4 inches long.

Widely distributed throughout the warm regions of both hemispheres. It is either a native of the Hawaiian Islands or of very early introduction as it was used by the native Hawaiians for thatching

their houses. At present it is found on all the islands in dry rocky situations at lower altitudes though it seems to be rapidly diminishing in amount in some of these areas, especially on Oahu and Molokai. It is palatable when young, and in dry areas where feed is not abundant it is grazed by cattle when old and dry. Because of its shallow root system it is easily pulled up by grazing animals.

HOLCUS L.

Spikelets 2-flowered, the pedicel disarticulating below the glumes, the rachilla curved and somewhat elongate below the first floret, not prolonged above the second floret; glumes about equal, longer than the 2 florets; first floret perfect, the lemma awnless; second floret staminate, the lemma bearing a short awn on the back.

An unimportant genus containing about 8 species, all bunchy perennials with flat leaves and contracted flowering heads.

There is only one species in the Islands, *H. lanatus*.

Holcus lanatus L.

Notholcus lanatus Nash

Velvet grass; Yorkshire fog; Mesquite

Perennial; culms 30 to 60 cm tall, velvety-canescent; sheaths 6 to 12 cm long, striate, velvety-canescent; ligule 1 to 2 mm long, membranaceous, narrowly lacerate, with short hairs at apex; blades 10 to 20 cm long, 4 to 8 mm wide, velvety-canescent, the midrib prominent; panicles 8 to 15 cm long, contracted, sometimes almost spikelike, occasionally enclosed within uppermost sheath, silvery to purplish; spikelets 4 to 4.5 mm long, short-pedicellate; glumes 4 to 4.5 mm long, keeled, hirsute on keels, scabrous otherwise, the first 1-nerved, 0.5 to 0.7 mm from keel to margin, the second 3-nerved, 1 to 1.2 mm from keel to margin; lemma of perfect floret 2 mm long, rather broad, slightly keeled, hirtellous on keel; lemma of staminate floret 2 to 2.5 mm long, narrow, acute, indistinctly keeled, minutely hirtellous on keel, with a hooklike awn 1.5 mm long; palea 1.7 to 2 mm long, minutely hirtellous at apex. (Fig. 46)

Erect perennial, 1 to 2 feet tall, velvety throughout; leaves 4 to 8 inches long, ⅛ to ¼ inch wide, with prominent midnerves; flowering heads 3 to 6 inches long with short branches, often almost spikelike, silvery to purplish. The velvety hairs on the foliage and the usually silvery head gives the plant a grayish appearance—hence the English name "Yorkshire fog."

A native of Europe, introduced and widespread in the United States where it is occasionally cultivated as a meadow grass on light or sandy soil. On the Pacific coast, where it is very common, and in Australia it is usually regarded as a pest. In the Hawaiian Islands it is considered a good pasture grass. It was first collected in the

Islands in 1903, and is now found at medium to high altitudes on Hawaii, Maui, and Molokai. It is particularly abundant in cool temperate regions on the island of Hawaii. It thrives best in moist areas, but seems to withstand quite varied climatic conditions.

HORDEUM L. BARLEY

Spikelets 1-flowered (rarely 2-flowered), 3 (sometimes 2) together at each node of the articulate rachis (continuous in *Hordeum vulgare*), the back of the lemma turned from the rachis, the middle spikelet sessile, the lateral ones pediceled; rachilla disarticulating above the glumes and, in the central spikelet, prolonged behind the palea as a bristle and sometimes bearing a rudimentary floret; lateral spikelets usually imperfect, sometimes reduced to bristles; glumes narrow, often subulate and awned, rigid, standing in front of the spikelet; lemmas rounded on the back, 5-nerved, usually obscurely so, tapering into a usually long awn.

The genus contains about 25 species widely distributed in both hemispheres, mainly in the cool temperate regions. Three species are found in Hawaii. The barleys may be distinguished by their thick, dense, bristly spikes and flat leaves. In most of the species, the spike readily breaks up into joints. Except for the well-known cultivated barley, *Hordeum vulgare,* the species are of very little value. All of them furnish a certain amount of forage when young but are grazed little after the spikes appear. Many of them are aggressive weeds, and some are injurious to stock because of the sharp-pointed barbed joints, which often pierce the mouth and nose.

Two species of *Hordeum* are found at middle altitudes in rather moist localities on the range, neither in any great abundance.

Glumes, or some of them, ciliate.....*H. murinum*
Glumes not ciliate.....*H. vulgare*

Hordeum murinum L.

Wild barley; Mouse barley

Annual; culms 20 to 60 cm long, glabrous, spreading and often profusely branched; sheaths 4 to 8 mm long, striate, glabrous or sometimes sparsely pilose, the uppermost often inflated, partially enclosing the spike; auricles 2 to 2.5 mm long, rather delicate, usually curved, scarious; ligule about 1 mm long, membranaceous; blades 8 to 20 cm long, 2 to 5 mm wide, glabrous to pilose; spikes 5 to 10 cm long, 1 to 2 cm wide, somewhat compressed with brittle rachis; glumes of central spikelet narrow, fusiform, 3-nerved, scabrous on nerves, long-ciliate on margins with awns 2.5 cm long; glumes of the 2 lateral spikelets unlike, the inner similar to those of central spikelets, the outer setaceous, not ciliate, nerveless, the awn 3.5 to 4 mm long; lemmas 8 to 12 mm long, indistinctly 5-nerved, broad, scabrous at apex, glabrous below, the awn 3.5 to 5 mm long; palea slightly shorter than lemma, narrow, attenuate, sometimes bidentate, ciliate on keels and margins; grain 5 to 7 mm long, golden, compressed, apex obtuse. (Fig. 47, a-b)

Annual, 1 to 2 feet tall; stems smooth to slightly hairy, usually bushy-branched and spreading; leaves smooth or hairy, 3 to 8 inches long, ⅛ to ¼ inch wide; flowering head an upright spike with long, stiff bristles; seeds golden, flattened, about ¼ inch long.

A native of Europe, introduced into the United States where it is a rather generally distributed weed especially abundant on the Pacific coast. It is fairly abundant at medium altitudes on Hawaii and Maui and is found occasionally on Oahu. In some areas it is especially plentiful in the spring, making rapid growth soon after rains, affording a certain amount of forage for short periods while young but becoming worthless as soon as the stiff, bristly flowering heads appear.

Hordeum vulgare L.

Barley

A tufted annual 60 to 120 cm tall, erect; leaves 10 to 20 cm long, 5 to 15 mm wide, scabrous on both surfaces; sheaths glabrous; ligule 1 mm long, membranaceous; spikes 2 to 10 cm long, excluding awns, erect to suberect; glumes divergent at base, narrow, nerveless, gradually passing into a stout awn; awn of lemma straight, 10 to 15 cm long, erect. (Fig. 47, c)

An erect annual, 2 to 4 feet tall; leaves 4 to 8 inches long, slender, flat; flowering heads upright, ¾ to 4 inches long, with stout bristles 3 to 6 inches long.

Barley is a native of the Old World. It is cultivated for the grain but is often seen in pastures. It is occasionally found in pastures on all the islands.

LAMARCKIA Moench GOLDENTOP

Spikelets of two kinds, in fascicles, the terminal one of each fascicle fertile, the others sterile; fertile spikelet with 1 perfect floret on a slender stipe and a rudimentary floret on a long rachilla-joint, both awned, the glumes narrow, acuminate or short-awned, 1-nerved; lemma broader, scarcely nerved, bearing just below the apex a delicate awn; sterile spikelets linear, 1 to 3 in each fascicle, consisting of 2 glumes similar to those of the fertile spikelet, and numerous imbricate, obtuse, awnless, empty lemmas, a reduced spikelet similar to the fertile one borne on the pedicel with one of the sterile ones.

The genus contains only one species, a native of Europe. It is an annual of no economic importance, but often cultivated for ornament.

It may be easily recognized by the purple or straw-colored one-sided flowering head.

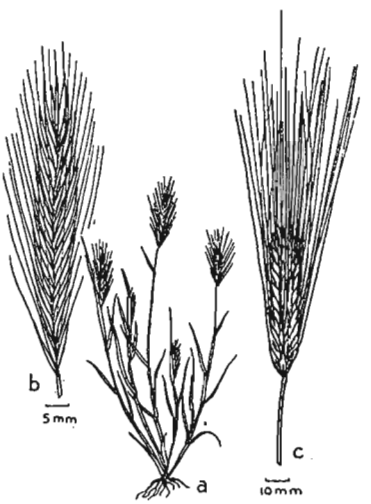

Fig. 47. *Hordeum murinum:* a, habit; b, spike. c, *Hordeum vulgare,* spike.

Fig. 48. *Lamarckia aurea:* a, fertile spikelet; b, sterile spikelet.

Lamarckia aurea (L.) Moench

Goldentop

Annual; culms 15 to 35 cm tall, usually erect, sometimes decumbent at base, sparsely retrorsely scabrous just below the panicle, otherwise glabrous; sheaths 3 to 6 cm long, glabrous, scarious on margins; ligule 5 to 10 mm long, conspicuous, membranaceous; blades 4 to 10 cm long, 2 to 6 mm wide, thin, scaberulous on margins, otherwise glabrous, acute; panicles 3 to 7 cm long, 1 to 2.5 cm wide, oblong, 1-sided, dense, shining golden to purplish with short erect branches and capillary, flexuous branchlets; fascicles of spikelets drooping, the pedicels with a tuft of whitish hairs at base; fertile spikelet 2 to 3 mm long; glumes scabrous, 3 to 3.5 mm long; perfect floret 2.5 to 3 mm long, glabrous, with awn 4 to 6 mm long; rudimentary floret reduced to an awn 5 to 6 mm long; sterile spikelets 5 to 8 mm long; lemmas 2 mm long, obtuse, erose, imbricate, scabrous. (Fig. 48)

Annual, ½ to 1 foot tall; stems smooth; leaves 1 to 4 inches long, ⅛ to ¼ inch wide, slightly rough on the edges, rather soft, rather abruptly pointed; flowering heads 1 to 3 inches long, ½ to 1 inch wide, one-sided, dense, shining, golden or purplish, the drooping spikelets with short, delicate bristles.

A native of the Mediterranean region, introduced in the western United States and northern Mexico where it grows in open ground and waste places. It is sometimes cultivated for ornament. It has only recently been found in a small area on the island of Maui. Although it does not produce enough foliage ever to become important on the ranges, it is not a pest.

LOLIUM L. RYEGRASS

Spikelets several-flowered, solitary, placed edgewise to the continuous rachis, one edge fitting to the alternate concavities, the rachilla disarticulating above the glumes and between the florets; first glume wanting (except on the terminal spikelet and rarely in 1 or 2 spikelets in a spike), the second outward, strongly 3- to 5-nerved, equaling or exceeding the second floret; lemmas rounded on the back, 5- to 7-nerved, obtuse, acute, or awned.

There are about 8 species of ryegrasses, all native to the temperate regions of Europe. They may be distinguished by their slender, usually flat spikes with the spikelets placed edgewise against the rachis. The foliage, especially in young plants, is dark green and conspicuously glossy. The ryegrasses, though few, are among the most important range forage plants. As the result of selection in a number of places, strains are available having wide differences in growth habits and adaptability.

There are 3 species of *Lolium* in the Islands, usually found at middle elevations in rather moist places.

Perennials; glume shorter than the spikelet.
  Lemmas nearly or quite awnless.....*L. perenne*
  Lemmas, at least the upper, awned.....*L. multiflorum*
Annuals; glume as long as or longer than the spikelet.....*L. temulentum*

Lolium multiflorum Lam.

Lolium italicum A. Br.

Italian ryegrass

Short-lived perennial; culms glabrous, sometimes purplish at nodes, 30 to 90 cm tall; sheaths glabrous, 5 to 15 cm long, with rather conspicuous auricles 4 to 5 mm long; ligule 1 to 2 mm long, membranaceous; blades 10 to 30 cm long, 2 to 6 mm wide, scaberulous on upper surface, glabrous on lower; spikes 15 to 25 cm long, erect; spikelets 12 to 25 mm long, 8- to 20-flowered; glume 7 to 10 mm long, strongly 5-nerved, glabrous, subulate; lemmas 6 to 8 mm long, rather indistinctly 5-nerved, glabrous or minutely scaberulous at apex and along margins, with slender awns 2 to 6 mm long; palea 7 to 10 mm long, acute, scabrous on keels. (Fig. 49, a-b)

Short-lived perennial, 1 to 3 feet tall; stems smooth and glossy; leaves usually smooth and glossy but sometimes slightly rough on

the upper sides, 4 to 12 inches long, ⅛ to ⅜ inch wide; flowering head an erect spike 6 to 12 inches long, with short, delicate bristles.

Italian ryegrass is one of the most important European forage grasses, and has been introduced into many temperate countries. It is widely planted in the United States and is highly prized in Australia and New Zealand. It has been planted in the Islands since about 1900, is abundant at medium to high altitudes on Hawaii and Maui, and is found to a lesser extent on the other islands. It is quite palatable, makes a good growth in the temperate areas in pure stands, and does well in certain mixtures.

Lolium perenne L.

Perennial ryegrass

Similar to Italian ryegrass but differs in the smaller, awnless or awn-tipped spikelets and smaller, less robust plants. (Fig. 49, c)

This is also a European forage grass, equal in importance to Italian ryegrass in the United States and New Zealand. It occurs in equal or even greater abundance than Italian ryegrass in the same areas in the Hawaiian Islands. It has the excellent qualities of that species with the added advantage of being a longer-lived perennial.

Lolium temulentum L.

Darnel

Similar to *L. multiflorum* but annual, the seeds larger and plumper, and the glumes much longer, being as long or longer than the spikelet. Darnel is a native of Europe. It is reported to be poisonous to livestock. Its poisonous quality is believed to be due to a narcotic poison in the grain induced by a fungus. It is found only occasionally on the islands of Hawaii and Oahu. (Fig. 49, d)

MELINIS Beauv.

Spikelets small, dorsally compressed, 1-flowered, with a sterile lemma below the fertile floret, the rachilla disarticulating below the glumes; first glume minute; second glume and sterile lemma similar, membranaceous, strongly nerved, slightly exceeding the fertile floret; fertile lemma and palea subhyaline toward summit.

A genus of about 15 species, mostly natives of Africa. They are perennials with slender branching stems that are bent and spreading at the base. Most species have dense flowering heads with small spikelets.

There is only one species in the islands, *M. minutiflora.*

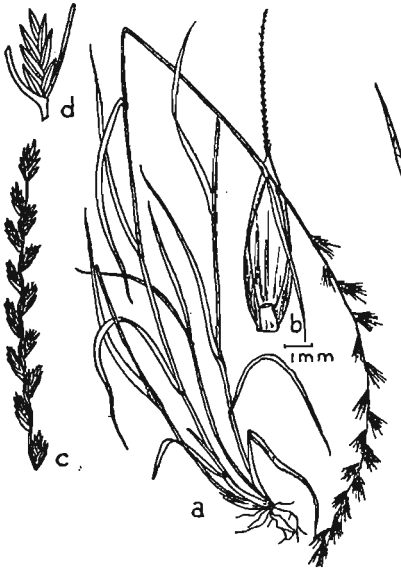

Fig. 49. *Lolium multiflorum:* a, habit; b, spikelet. c, *Lolium perenne,* inflorescence. d, *Lolium temulentum,* inflorescence.

Fig. 50. *Melinis minutiflora:* a, spikelet.

Melinis minutiflora Beauv.

Molasses grass

A freely branching perennial, the culms as much as 1 m long, ascending from a decumbent tangled base; foliage viscid-pubescent, the leaves 10 to 25 cm long, 5 to 10 mm wide; ligule a row of hairs 0.5 to 1 mm long; panicles 15 to 25 cm long, narrow, dark purple when young; spikelets 2 mm long; first glume 0.3 mm long; second glume 0.2 mm long, trifid at apex, scabrous; lemmas 2 mm long, the sterile lemma bifid at apex with a slender awn 1 to 1.5 cm long from between the lobes. (Fig. 50)

A branching, spreading perennial, 1 to 3 feet tall; foliage viscid-hairy, the leaves 4 to 8 inches long, flat; nodes with tufts of long silky hairs; stem rather coarse; flowering heads 6 to 10 inches long, narrow but loose; spikelets about 1/12 inch long with a slender bristle about ½ inch long.

A native of Africa where it is considered a good forage grass. Common in the American tropics, especially in Brazil where it is highly esteemed. In Hawaii it has found the habitat suitable and is spreading in the dry to moderately moist regions at low to middle elevations. The name "molasses grass" refers to the molasses-odor of the viscid foliage.

MICROLAENA R. Br.

Spikelets laterally compressed, with one perfect terminal floret and two sterile lemmas below, disarticulating above the minute glumes; sterile lemmas narrow, firm, awned from the tip; fertile lemma hyaline, compressed, shorter than the sterile lemmas; palea narrow, compressed, nerveless, shorter than the fertile lemma.

A genus of about 10 species, mainly confined to the Pacific basin. All are comparatively low perennials, usually with flat, rather short leaves and narrow, loose flowering heads.

Only one species, *M. stipoides,* is found in Hawaii.

Microlaena stipoides (Labill.) R. Br.

Meadow ricegrass; Weeping grass; Puu lehua

Perennial; culms 30 to 75 cm tall, ascending or erect, usually decumbent at base, glabrous, slender; sheaths 2 to 6 cm long, shorter than internodes, glabrous or retrorsely scabrous; ligule membranaceous, 0.2 to 0.5 mm long; blades flat, 3 to 8 cm long, 2 to 3 mm wide, scabrous on margins, glabrous or scaberulous on the surface; panicles 4 to 10 cm long, narrow, suberect to nodding, usually simple, the rather distant spikelets appressed along the slender main axis, a few short branches below with 2 or 3 spikelets, the spikelets narrow, about 1 cm long excluding awns; pedicels 1 to 2 mm long; glumes membranaceous, nerveless, the first 0.2 to 0.5 mm long, acute, the second 0.5 to 0.7 mm long, acute or bidentate; rachilla somewhat elongate above the glumes and between the sterile lemmas; sterile lemmas alike or usually the lower slightly smaller with a shorter awn, 8 to 10 mm long, rather obscurely 5-nerved, scaberulous on nerves, coriaceous with membranaceous margins and a scabrous awn 8 to 12 mm long from the apex; callus rather conspicuous, pilose with appressed silky hairs about 1 mm long; fertile lemma 5 to 6 mm long, obscurely 7-nerved, somewhat keeled, scabrous on upper part of keel, enclosed within margins of uppermost sterile lemma, apiculate; grain 5 to 6 mm long, narrow, somewhat compressed, yellowish, developing when spikelets are very young. (Fig. 51)

Fig. 51. *Microlaena stipoides:* a, spikelet.

Fig. 52. *Panicum maximum:* a, spikelet.

An erect or suberect perennial, spreading at the base, 1 to 2 feet tall; stems smooth or sometimes slightly rough to the touch; leaves flat, 1 to 3 inches long, about ⅛ inch wide, somewhat rough to the touch especially on the edges; flowering heads 1½ to 4 inches long, narrow, usually nodding and assuming a "weeping" habit.

Originally described from Tasmania, also a native of the Philippines, Australia, and New Zealand. It is probably native to the Islands or at least was of such early introduction as to have become thoroughly naturalized. It is only found on the island of Hawaii at the upper altitudes, growing chiefly on the upper slopes in the Kona District, where it is very abundant. It is very palatable, is persistent, withstands heavy grazing, and reseeds well. Although it is at its

best in moist, rather shady situations, it is reported to be fairly drought-resistant. It is a valuable part of the pasturage where it is now growing and should be worthy of trial elsewhere.

Panicum L. Panic Grass

Spikelets more or less compressed dorsiventrally, in open or compact panicles, rarely racemes; glumes 2, herbaceous, nerved, usually very unequal, the first often minute, the second typically equaling the sterile lemma, the latter of the same texture and simulating a third glume, bearing in its axil a membranaceous or hyaline palea and sometimes a staminate flower, the palea rarely wanting; fertile lemma chartaceous-indurate, typically obtuse, the nerves usually obsolete, the margins inrolled over an enclosed palea of the same texture.

This is the largest genus of grasses, containing about 600 species widely distributed, chiefly in the warmer regions of both hemispheres. They vary from low, delicate annuals to creeping and mat-forming or tall, robust perennials, and are found growing under semi-aquatic to xerophytic conditions, and in soil from high acidity to high alkalinity. They vary in forage value from practically worthless to very good. In general, the larger species when young are relished by stock but become coarse, tough, and rather unpalatable toward maturity. Many of the smaller annuals and perennials are very nutritious forage. Twenty-six species occur in Hawaii.

Nine species of *Panicum* are of importance on the range. They are found at low to high elevations in dry to wet situations. They may be recognized by the dorsiventrally compressed spikelets.

Plants with creeping stolons or rhizomes.
  Leaves 12 to 30 cm long, 8 to 20 mm wide.....*P. purpurascens*
  Leaves 4 to 15 cm long, 2 to 5 mm wide.....*P. repens*
Plants without creeping stolons or rhizomes (short rhizomes in *P. maximum*).
  Culms more than 100 cm tall.....*P. maximum*
  Culms less than 80 cm tall.
    Spikelets glabrous.
      Spikelets about 2 mm long; leaves mostly flat, soft.....*P. xerophilum*
      Spikelets about 3 mm long; leaves usually involute, stiff.....*P. tenuifolium*
    Spikelets hairy.
      Spikelets densely long-villous.
        Culms and leaves glabrous or puberulent, the nodes bearded..*P. ramosius*
        Culms and leaves densely soft-villous.....*P. torridum*
      Spikelets sparsely short-villous or long-villous only at the tip.
        Spikelets 2 to 4 mm long; first glume long pilose on the upper part, hairs 1 to 2 mm long.....*P. pellitum*
        Spikelets 1.5 to 2.2 mm long; glumes pilosulous on the upper part, hairs 0.5 mm long.....*P. colliei*

Panicum colliei Endl.

P. lanaiense Hitchc.

Similar to *Panicum pellitum,* differing in the mostly shorter culms, in the shorter softer pubescence of the foliage, in the smaller panicles with branches spreading at maturity, and smaller spikelets (1.5 to 2 mm long) ; glumes elliptic-ovate, acute, subequal, stiffly pilose on the upper half, the hairs about 0.5 mm long. (Fig. 53, c)

This species is found on the islands of Hawaii, Maui, and Molokai in the same type of habitat as its relative, *Panicum pellitum.*

There is another species, *Panicum pellitoides,* which is occasionally found in the dry pastures of Hawaii. This species is closely related to *Panicum colliei* and *Panicum pellitum.*

Panicum maximum Jacq.

Guinea grass

A tufted, robust perennial from short stout rhizomes; culms 1 to 2.5 m tall, glaucous, densely long-hirsute at the swollen nodes; sheaths 15 to 25 cm long, usually papillose-hirsute, striate, glaucous, brittle, compressed; ligule about 2 mm long, membranaceous, with a dense row of hairs 4 to 6 mm long at base; blades 30 to 75 cm long, 1 to 3.5 cm wide, scabrous on margins and usually long-hirsute at base on upper surface, yellowish-green, with conspicuous midrib; panicles 20 to 50 cm long, 7 to 15 cm wide, the branches 10 to 20 cm long, naked at base, stiffly ascending, the axils pilose, with small pulvinus, the lower branches in whorls; spikelets 3 to 3.5 mm long, glabrous, on pedicels 1 to 2 mm long; first glume 1 to 1.2 mm long, ovate, obtuse, 3-nerved; second glume and sterile lemma as long as spikelet, 5-nerved, acute; fertile lemma 2 to 2.5 mm long, narrowly ovate, acute, pale, finely rugose. (Fig. 52)

A robust perennial, 3 to 7 feet tall, in large bunches with very short, thick rootstalks; stems stout, somewhat flattened, with long hairs at the swollen joints; leaves 10 to 30 inches long, ½ to 1 inch wide, usually erect, yellowish-green, very rough on the edges and usually with long stiff hairs at the base on the upper sides; flowering heads 8 to 20 inches long, 3 to 6 inches wide, with stiffly ascending branches 4 to 8 inches long.

A native of Africa, widely introduced in tropical America where it is one of the most important cultivated forage grasses. It was first accidentally introduced into the Hawaiian Islands "with living plants from abroad" about 1870. Since that time it has been widely planted at lower altitudes on all the islands. Its greatest merit is its ability to grow in dry areas and to withstand long periods of drought. It produces a large crop of forage and although harsh and coarse is

very palatable and nutritious when young. Ranchers are now reclaiming pastures overrun with lantana by planting Guinea grass.

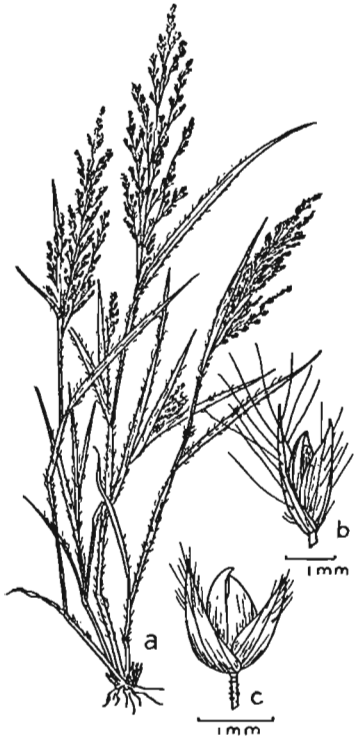

Fig. 53. *Panicum pellitum:* a, habit; b, spikelet. c, *Panicum colliei,* spikelet.

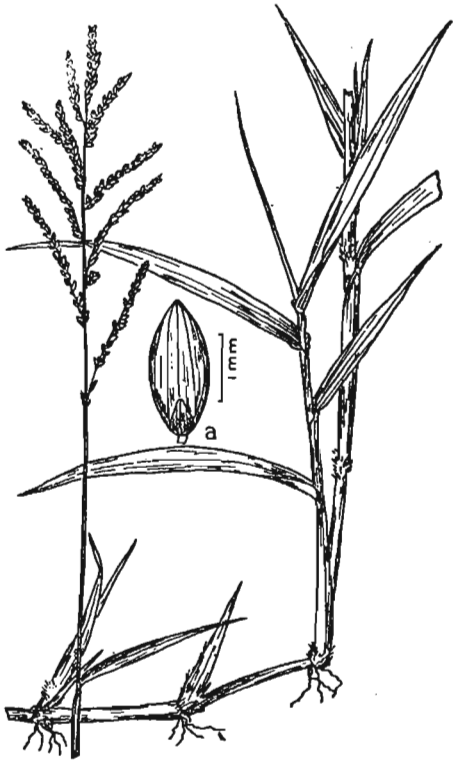

Fig. 54. *Panicum purpurascens:* a, spikelet.

Panicum pellitum Trin.

Annual; culms 20 to 60 cm tall, erect or occasionally decumbent at base, papillose-pilose on upper part and at the nodes; sheaths 3 to 7 cm long, shorter than internodes, densely papillose-pilose, striate; ligule a line of hairs about 1 mm long; blades flat, 5 to 20 cm long, 3 to 6 mm wide, densely long-pilose on both surfaces; panicles 10 to 15 cm long, rather loose, with delicate, ascending, scabrous and sometimes pilose branches 6 to 10 cm long; spikelets 2 to 3 mm long, narrow; glumes subequal, lanceolate, long-acuminate, the first 3-nerved, papillose-pilose on upper part with hairs 1 to 2 mm long, the second 5-nerved, short papillose-pilose with hairs about 0.5 mm long; sterile lemma 1.5 to 2 mm long, indistinctly 7-nerved, acute, glabrous; fertile lemma about 1.2 mm long, narrowly ovate, smooth and shining. (Fig. 53, a-b)

A slender, erect annual, 1 to 2 feet tall, the whole plant densely covered with long, silky hairs; leaves flat, 2 to 8 inches long, ⅛ to ¼ inch wide, rather delicate, tapering to a sharp point; flowering heads 4 to 6 inches long, delicate, with rather feathery branches; spikelets about ⅛ inch long, with long silky hairs toward the tips.

This grass is endemic in the Hawaiian Islands and is found abundantly in dry rocky areas at low altitudes on the islands of Maui and Molokai. It forms a large part of the forage on nearly barren areas where practically nothing else will survive. For this reason it is a valuable asset to Hawaiian ranges, although it is of limited distribution.

Panicum purpurascens Raddi

Panicum barbinode Trin.

Para grass; Panicum grass; California grass

Coarse sprawling robust perennial; culms 2 to 5 m long, trailing and intertwining, forming dense, decumbent colonies, and rooting at lower nodes, rather woody, terete; sheaths 10 to 15 cm long, longer than internodes, striate, papillose-villous; ligule a line of stiff hairs 1 to 1.5 mm long; blades flat, 12 to 30 cm long, 8 to 20 mm wide, rather stiffly spreading, lanceolate, acuminate, somewhat keeled, hispid on both surfaces and retrorsely scabrous on margins; panicles 15 to 30 cm long, oval in outline, the main axis glabrous or sometimes sparsely hispid; branches villous at base, spreading or ascending, subracemose, mostly one-sided, the lower up to 15 cm long; spikelets about 3 mm long, glabrous, often purple-tinged, on hispid pedicels 0.5 to 1 mm long; first glume 1 mm long, indistinctly 1-nerved, ovate, acute; second glume as long as or slightly shorter than spikelet, 5-nerved, acute; sterile lemma as long as spikelet, 5-nerved, acute; fertile lemma 2 to 2.5 mm long, obscurely rugose, somewhat beaked, pale. (Fig. 54)

A spreading, long-lived perennial, rooting at the lower joints; stems 6 to 8 or sometimes as much as 15 feet long, trailing and intertwining, forming dense masses, the joints and sheaths hairy; leaves 4 to 12 inches long, ¼ to ½ inch wide, with stiff hairs at the base; flowering heads 5 to 12 inches long, open, usually purplish, with spikelike spreading one-sided branches.

Widely planted for forage throughout the tropics. In Hawaii it is one of the most important grasses of the lowland pastures, growing luxuriantly in swampy areas. Although it seems to prefer wet localities, it is adaptable to a wide range of moisture conditions. In certain localities it even appears to be fairly drought-resistant. It is utilized both for grazing and as cut forage, and is also extensively planted as a green manuring crop in pineapple fields. Although there is some difference of opinion, on the whole it is highly regarded by ranchmen.

Panicum ramosius Hitchc.

An upright, slender, tufted, branching annual, 20 to 40 cm tall, glabrous, scaberulous or pubescent, the nodes villous; sheaths shorter than the internodes, glabrous; ligule a row of hairs 1 mm long; blades 5 to 10 cm long, 3 to 5 mm wide, linear-lanceolate, papillose to glabrous above, glabrous beneath, scabrous on the margins; panicles 5 to 10 cm long, numerous, contracted, white or tawny, more or less enclosed in the uppermost sheaths, the axis and branches angled, scabrous and somewhat villous; spikelets 4 mm long; glumes subequal, as long as the spikelet, 5-nerved, acuminate, the lower two-thirds densely long-villous, the spreading hairs 1 to 2 mm long; sterile lemma slightly shorter, 7-nerved, appressed-villous toward apex; fertile lemma oblong-elliptic, smooth and shining. (Fig. 55)

Fig. 55. *Panicum ramosius:* a, first glume; b, sterile lemma.

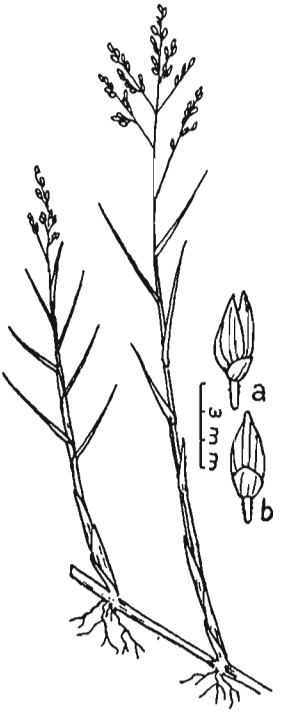

Fig. 56. *Panicum repens:* a-b, spikelets.

An erect, freely branching annual, ½ to 1 foot tall, smooth or slightly hairy, with tufts of soft hairs at nodes; leaves 2 to 4 inches long, narrow, the upper surfaces smooth to sparsely hairy, the under

surfaces smooth; flowering heads 2 to 4 inches long, narrow, dense, whitish, with soft hairs.

A native grass growing in dry rocky places at low elevations on Lanai and Molokai. In such places it grows well and adds to the pasture forage. It is similar to *Panicum torridum* in growth habit but is not so hairy. It has been confused with *P. beecheyi* Hook. & Arn., a rare species with smaller spikelets.

Panicum repens L.

A spreading perennial with stout creeping rhizomes; culms 30 to 80 cm tall, erect, the base clothed with bladeless sheaths; sheaths pilose on the margins; ligule 0.3 mm long, of closely fused hairs; blades 4 to 15 cm long, 2 to 5 mm wide, flat or slightly rolled, pilose on the upper surface toward the base, the lower surface glabrous; panicles 7 to 12 cm long, the branches ascending, usually naked at base, bearing short appressed branchlets with short-pediceled spikelets toward the ends; spikelets 2.5 to 3.5 mm long, glabrous, ovate; first glume about 1.1 mm long; second glume 2.5 to 3.2 mm long; sterile lemma about equal or slightly longer, 5- to 7-nerved; fertile lemma 1.8 mm long, smooth and shining. (Fig. 56)

A spreading, long-lived perennial 1 to 3 feet tall, upright; base covered with smooth scales; leaves 2 to 6 inches long, ⅛ to ¼ inch wide, slightly hairy on the upper surfaces, the lower surfaces smooth; flowering heads 3 to 5 inches long, the branches ascending; spikelets about ⅛ inch long, oval.

Originally described from the Old World. This is the commonest grass around Hilo, Hawaii. It seems to thrive best in moist places. The palatability is not definitely known, but it is considered a poor forage grass.

Panicum tenuifolium Hook. & Arn.

Mountain pili

Perennial; culms 30 to 80 cm tall, usually erect but sometimes slightly geniculate at base, villous at the nodes and pilose below them, otherwise glabrous; sheaths 4 to 8 cm long, papillose-pilose; ligule a line of hairs about 0.5 mm long intermingled with hairs about 2 mm long; blades usually somewhat involute but occasionally flat, 10 to 15 cm long, 1 to 4 mm wide, acuminate, pilose; panicles 10 to 25 cm long, oval, usually open but occasionally rather strict, with ascending branches 3 to 12 cm long; spikelets 2.5 to 3 mm long, glabrous, often purple-tinged, appressed along the branches; glumes 2.5 to 3 mm long, 5- to 7-nerved, acute; sterile lemma 2.5 to 3 mm long, acute, 7-nerved; fertile lemma 1.5 mm long, shining, acute or subacute. (Fig. 57)

Perennial; stems 1 to 3 feet tall from rather knotty bases, erect but sometimes abruptly bent at the base, densely hairy; leaves usually somewhat folded but sometimes flat, 4 to 6 inches long, tapering to

a sharp point, densely hairy throughout; flowering heads 4 to 10 inches long, usually rather open and oval in outline with branches 1 to 4 inches long; seed about 1/32 inch long, oval, shining.

Endemic in the Hawaiian Islands, very abundant at high altitudes on the island of Hawaii and occasionally found on Maui and Lanai. It is a valuable grass on the high altitude ranges in these areas, apparently very palatable and able to grow in rather dry, windswept areas, where the soil is rocky and shallow.

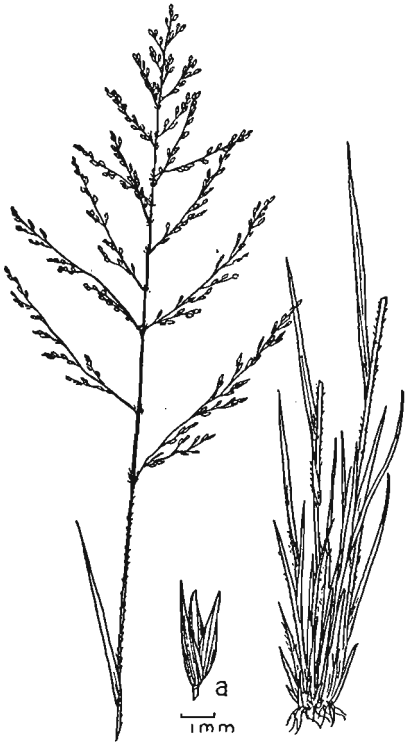

Fig. 57. *Panicum tenuifolium:* a, spikelet.

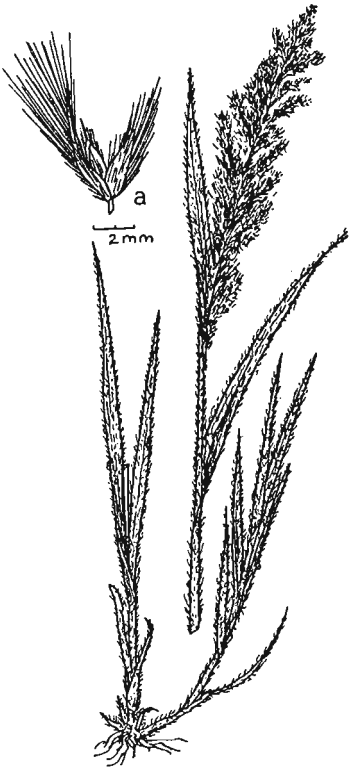

Fig. 58. *Panicum torridum:* a, spikelet.

Panicum torridum Gaud.

Torrid panic grass; Kakonakona

Annual; culms 20 to 60 cm tall, soft-villous with pale yellowish or fawn-colored silky hairs, simple or often much-branched, erect or decumbent at base;

sheaths 4 to 6 cm long, shorter than internodes, usually rather loose, densely soft-villous; ligule a ciliate membrane about 1 mm long; blades flat, 6 to 20 cm long, 4 to 10 mm wide, abruptly acuminate, densely soft-villous on both surfaces; panicles 5 to 15 cm long, elliptic-ovate, rather strict, densely flowered, silky, pale green, yellowish, or tawny, with ascending or appressed branches 3 to 5 cm long; spikelets about 3 mm long; glumes acuminate, equal or the first slightly shorter, 3- to 5-nerved, the second 5- to 7-nerved, both conspicuously papillose-villous with ascending to spreading hairs 2 to 3 mm long; sterile lemma slightly shorter than the first glume, acute, 7-nerved, glabrous or with a few hairs toward the summit; fertile lemma 1.5 mm long, smooth and shining. (Fig. 58)

A rather robust annual, 1 to 2 feet tall, densely covered with long silky, yellowish hairs; stems erect or sometimes slightly bent at the base, sometimes freely branching; leaves flat, 2 to 8 inches long, ¼ to ½ inch wide, tapering to a sharp point, densely velvety; flowering heads 2 to 6 inches long, rather dense and compact, densely covered with long hairs.

Endemic in the Hawaiian Islands, found abundantly in pastures in very dry situations at low altitudes on the islands of Maui, Molokai, and Oahu. Along with other native species of *Panicum,* it forms a valuable part of the forage in dry situations where the introduced species will not survive.

Panicum xerophilum (Hillebr.) Hitchc.

Tufted annual; culms usually 15 to 30 cm or sometimes as much as 65 cm tall, long-villous at nodes and papillose-pilose below, erect, slender; sheaths 2 to 7 cm long, striate, papillose-pilose with long silvery hairs, the basal ones sometimes purplish; ligule a line of silvery hairs 2 to 4 mm long; blades flat, 5 to 20 cm long, 1 to 4 mm wide, attenuate, rather lax, pilose on both surfaces but the hairs longer on upper surface; panicles usually 5 to 15 cm but occasionally as much as 20 cm long, oblong, open, with delicate ascending branches 2 to 7 cm long; spikelets 2 to 2.2 mm long, glabrous, sometimes purple-tinged, appressed along the branches; glumes equal, 2 to 2.2 mm long, acute, the first 3-nerved, the second 5-nerved; sterile lemma 1.7 to 2 mm long, acute, 7-nerved, the margins slightly involute; fertile lemma 1.5 mm long, broadly acute, shining. (Fig. 59)

A freely branching annual, usually ½ to 1 foot or sometimes as much as 2 feet tall; stems slender, densely long-hairy, sometimes purplish at base; leaves flat, 2 to 8 inches long, ⅛ to ¼ inch wide, conspicuously long-hairy on both sides; flowering heads usually 2 to 6 inches but occasionally as much as 8 inches long, oblong, open, sometimes purple-tinged; branches 1 to 4 inches long, delicate.

An endemic annual, rather abundant in the dry areas at low altitudes on the islands of Maui and Hawaii. It is especially plentiful near Kawaihae, Hawaii, and Makena, Maui. In these areas it becomes a rather important part of the forage and, along with *Panicum*

torridum, Panicum pellitum, Panicum colliei, and *Heteropogon contortus,* affords a large part of the available feed.

Fig. 59. *Panicum xerophilum:* a, spikelet.

PAPPOPHORUM Schreb. PAPPUS GRASS

Spikelets 2- to 5-flowered, the upper reduced, the rachilla disarticulating above the glumes but not or only tardily between the florets, the internodes very short; glumes nearly equal, keeled, thin-membranaceous, as long as the body of the florets or longer, 1- to several-nerved, acute; lemmas rounded on the back, firm, obscurely many-nerved, dissected above into numerous spreading awns, the florets falling together, the awns of all forming a pappus-like crown; palea as long as the body of the lemma, the nerves near the margin.

This is an unimportant genus containing but few species of temperate and tropical regions. As a whole they are of very little forage value, although a few of them make up a small part of the forage in poor soil in certain areas in the southwestern United States. They are all bunchy perennials with narrow, spikelike flowering heads.

There is only one species in the Islands, *P. brachystachyum.*

Pappophorum brachystachyum Jaub. & Spach.

Pappus grass

Perennial; culms 20 to 40 cm long, tufted, rather slender but wiry, the internodes puberulent, the nodes pilose; leaves mostly crowded toward the base; sheaths 2 to 4 cm long, shorter than internodes, the basal ones pubescent, the upper glabrous; ligule a dense row of hairs about 0.5 mm long; blades flat or subinvolute, 3 to 7 cm long, 1 to 2 mm wide, striate, subcoriaceous, pubescent on upper surface, glabrous on lower; panicles dense, 8 to 15 mm long, 5 to 6 mm wide, lead-gray; spikelets about 3 mm long, 3-flowered; glumes equal, about 2 mm long, 3- to 5-nerved, scaberulous on keel, somewhat erose at apex; lowermost floret fertile, the lemma 3 mm long, dissected into ciliate awns 2 mm long, the palea 1.5 to 1.7 mm long, broad, bidentate, ciliate on the keels, the grain 1 mm long, broadly ovate, obtuse, reddish brown; lemmas of the other florets dissected into ciliate spreading awns, together forming a pappus-like crown, their paleas minute, the flowers obsolete, the uppermost lemma minute, reduced to awns and borne on a delicate rachilla joint 0.5 mm long. (Fig. 60)

An erect perennial, 1 to 2 feet tall; stems with short hairs at the base and with tufts of long silky hairs at the joints, rather slender but wiry; leaves mostly clustered at the base, 1 to 3 inches long, narrow, usually somewhat folded, tapering to a sharp point, rather leathery, covered with short hairs on the upper sides, smooth on the lower; flowering heads subglobular, compact, 3/8 to 5/8 inch long, borne on long naked stems; spikelets about 1/8 inch long, bristly, with long silky hairs at the base of the florets.

Native of Asia and Africa. It was first discovered in the Islands in a small area in open pasture on the island of Maui in 1937. It has very little forage value, the foliage being scant and the stems rather wiry, but it has the ability to grow in poor soil.

Paspalum L.

Spikelets planoconvex, usually obtuse, subsessile, solitary or in pairs, in two rows on one side of a narrow or dilated rachis, the back of the fertile lemma toward it; first glume usually wanting; second glume and sterile lemma commonly about equal, the former rarely wanting; fertile lemma usually obtuse, chartaceous-indurate, the margins inrolled.

This genus contains about 350 species of wide distribution in both tropical and temperate regions, most abundant in America. They are mainly creeping or bunchy perennials with one to many spikes arranged at the summits or along the main axes of the flowering stems. Several species have considerable forage value. There are 7 species in the Islands.

Four species occur on the range. They are found at low to middle

elevations in usually moist situations. They may be identified by the subsessile spikelets arranged in 2 rows on one side of the rachis.

Racemes 2, conjugate at the summit of the culm, rarely a third below..... ..... *P. conjugatum*
Racemes more than 2, racemosely arranged.
  Spikelets glabrous ..... *P. orbiculare*
  Spikelets hairy.
    Racemes commonly 3 to 5; culms bent at base..... *P. dilatatum*
    Racemes commonly 12 to 18; culms erect..... *P. urvillei*

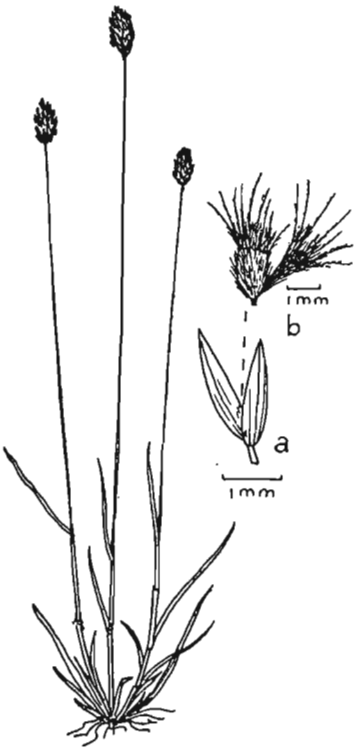

Fig. 60. *Pappophorum brachystachyum:* a, glumes; b, floret.

Fig. 61. *Paspalum conjugatum:* a, spikelet.

Paspalum conjugatum Bergius

Hilo grass; Mau malihini; Niga-gusa

Perennial; culms 30 to 60 cm tall, glabrous, compressed, often reddish-purple, erect from a slightly decumbent base, producing extensively creeping leafy stolons conspicuously pilose at nodes; sheaths 2 to 6 cm long, compressed, usually pilose at throat and along margins at summit; ligule a delicate membrane

0.5 to 1 mm long, a dense line of hairs 1 to 2 mm long back of it; blades 6 to 14 cm long, 5 to 15 mm wide, rather thin, ciliate, scabrous on margins, acute, pale yellowish-green; racemes usually 2, sometimes 3, 6 to 10 cm long, widely divaricate; rachis 1 mm wide, glabrous; spikelets 1.5 mm long, light yellow, ovate, apiculate; second glume and sterile lemma very thin membranaceous, the margins conspicuously silky-ciliate; fertile lemma coriaceous; grain 1 mm long, 1 mm wide, compressed, ovate, whitish. (Fig. 61)

A persistent perennial, extensively creeping by leafy stolons rooting at the joints, these runners flattened, hairy at the joints, often reddish-purple; leaves 2 to 5 inches long, ¼ to ½ inch wide, thin, pale yellowish-green, abruptly tapering to a sharp point, rough on the edges; flowering stems 10 to 25 inches long, erect from the creeping base, with 2 or sometimes 3 widely spreading racemes 2 to 4 inches long; spikelets about 1/32 inch long, flat, silky-hairy on the edges.

Originally described from Dutch Guiana but now found throughout the tropics of both hemispheres. It was first noted near Hilo, Hawaii, in 1840; hence, the common name "Hilo grass." It spreads rapidly and is now abundant on all the islands. It thrives best in moist situations where it is often the dominant grass, covering large areas. It is very persistent and will grow on poor acid soils. It is relatively unpalatable when mature and is reported to disturb the digestion of cattle if eaten in quantity. It is more nutritious when young and can be utilized as a maintenance grass when the more palatable forage is not available. Hilo grass, being very persistent and less palatable than other grasses, has crowded out the more desirable ones in many places.

Paspalum dilatatum Poir.

Dallas grass; Paspalum grass; Australian water grass

Tufted perennial; culms 40 to 120 cm tall, glabrous or sometimes slightly villous at nodes, compressed, erect or ascending from decumbent base, sometimes rooting at lower nodes; sheaths 6 to 15 cm long, compressed, usually long-hispid at throat and along margins near base, the basal ones usually densely hispid; ligule 3 to 5 mm long, membranaceous, conspicuous; blades flat, 10 to 20 cm long, 5 to 15 mm wide, slightly scabrous on margins, acute, with conspicuous slightly keeled midrib; racemes 3 to 5, ascending or drooping, 5 to 8 cm long, long-hispid at base, the axis 6 to 12 cm long, the rachis 1 to 1.5 mm wide, slightly scabrous and sometimes undulate on margins; spikelets 3 to 4 mm long, depressed planoconvex, ovate, with acute apex; second glume and sterile lemma alike, beaked, pilose with long silky hairs on margins and sparsely short-pilose on the back; fertile lemma 2.5 mm long, 2 mm wide, ovate, obtuse, coriaceous-indurate; grain 2 mm long, 1.5 mm wide, broadly elliptic, compressed, reddish-brown. (Fig. 63, c-e)

A perennial growing in large leafy bunches or sometimes forming a rather dense sod; stems 1 to 4 feet tall, usually slightly bent at the base, becoming erect or suberect, smooth, or hairy near the base, sometimes rooting at the lower joints; leaves flat, 4 to 8 inches long, ¼ to ½ inch wide, dark green, rough on the edges, usually with sparse tufts of long rather stiff hairs at the base; flowering stems usually well above the leafy base with 3 to 5 spreading racemes, 2 to 3 inches long, on an axis 2 to 4 inches long; spikelets crowded, about ⅛ inch long, flat, with a fringe of long silky hairs around the edges.

A native of South America, from Brazil to Argentina. It was introduced into the southern United States about the middle of the last century and is now common throughout the Gulf States, where it is considered a valuable pasture grass. It was introduced into the Islands from Australia in 1903 and is now well distributed over all the islands from sea level to 5,000 feet. It thrives under rather humid conditions but does fairly well also in semi-dry areas. It is very palatable and withstands heavy grazing. It is a valuable addition to Hawaiian pastures at lower altitudes.

Paspalum orbiculare Forst.

Ricegrass; Mau laiki; Nedai-gusa

Tufted perennial; culms 60 to 120 cm tall, stout, erect, glabrous, somewhat bulbous at base; sheaths 7 to 14 cm long, glabrous or sometimes sparsely long-hispid at throat, somewhat compressed, basal ones often purplish, usually with very short inconspicuous membranaceous auricles; ligule membranaceous, 1 to 1.5 mm long with a dense row of hairs 1 to 2 mm long back of it; blades flat, 12 to 40 cm long, 3 to 12 mm wide, acute, scabrous, erect or ascending, glaucous on upper surface, the midrib conspicuous on the lower; racemes usually 4 to 6, 2 to 4 cm long, alternate and distant on an axis 4 to 9 cm long, spreading, villous at base, glabrous or sparsely long-pilose in the axils; rachis 1 to 1.5 mm wide, scabrous, usually red on margins; spikelets in pairs, 2 to 2.5 mm long, about 1.5 mm wide, broadly elliptic, closely imbricate, glabrous; second glume and sterile lemma 3-nerved, the midnerve distinct, the marginal nerves rather faint; fertile lemma slightly shorter than the glume and sterile lemma, cartilaginous-indurate, brownish, finely punctate; grain about 1.5 mm long, broadly elliptic, compressed, whitish. (Fig. 62)

A bunchy, coarse, erect perennial, 2 to 4 feet tall; stems smooth, very tough, usually slightly swollen and often purplish at the base, slightly flattened; leaves 4 to 16 inches long, ¼ to ½ inch wide, flat, abruptly tapering to a sharp, rather stiff point, harsh and rather leathery, stiff and erect, rough on the edges, bluish-green on the

upper sides, sometimes with wavy edges; flowering stems naked below with 4 to 6 racemes ¾ to 1½ inches long, the racemes spreading, the flat roundish spikelets reddish-brown when mature.

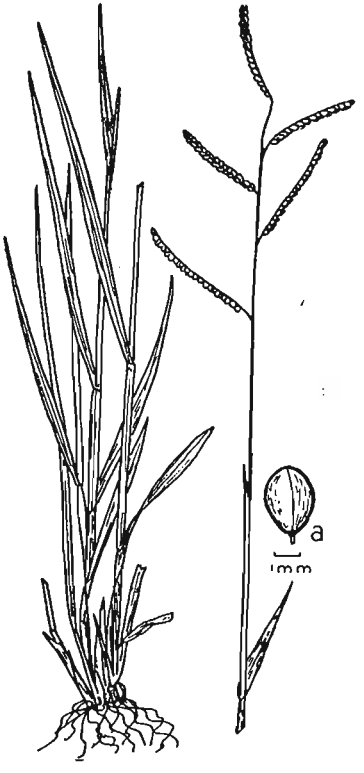

Fig. 62. *Paspalum orbiculare:* a, spikelet.

Fig. 63. *Paspalum urvillei:* a, inflorescence; b, spikelet. *Paspalum dilatatum:* c, inflorescence; d, spikelet; e, habit.

Originally described from the Society Islands, extending throughout Polynesia, Australia, Malaysia and southern China. It may be a native of the Hawaiian Islands but probably was introduced by the early inhabitants; at any rate it has been here since the earliest records and was used by the Hawaiians for thatching their houses when pili grass was not available. It is found abundantly in native pastures on all the islands from low to medium altitudes. It does well on rocky slopes in poor thin soil where few other grasses will grow, particularly in wet sections. It is very persistent and has a

tough root system which makes it difficult to pull up, but is coarse and of little value. By burning over the old grass, new growth quickly develops which is eaten by livestock.

Paspalum urvillei Steud.

P. larranagai Arech.

Vasey grass

A robust densely tufted perennial; culms 1 to 2 m tall, erect, glabrous, thick and rather bulbous at base; sheaths 8 to 27 cm long, striate, somewhat compressed, the lower ones coarsely papillose-hirsute and purple, the upper ones glabrous and green; ligule 8 to 16 mm long, membranaceous, conspicuous; blades 12 to 55 cm long, 5 to 15 mm wide, scabrous on margins and with a dense tuft of long hairs at base; panicles 15 to 35 cm long, with 10 to 20 rather crowded ascending or erect racemes 5 to 12 cm long, hispid at base; spikelets in pairs; second glume and sterile lemma nearly alike, 2 to 3 mm long, slightly apiculate, ovate, thin, 3-nerved, long silky-pilose on margins, the glume appressed silky-pilose on the back; fertile lemma 1.5 to 1.7 mm long, ovate. (Fig. 63, a-b)

An erect, robust, very coarse perennial, growing in large bunches, 3 to 6 feet tall; stems slightly flattened, green and smooth on the upper parts, covered with long stiff hairs that prick the skin, and dark purple on the lower parts, with a thick rather bulbous base; leaves 5 to 22 inches long, ¼ to ½ inch wide, coarse, tough and rather leathery, rough on the edges and with tufts of long, silky hairs at the base; flowering heads 6 to 14 inches long with 10 to 20 rather erect, crowded racemes, 2 to 5 inches long; spikelets about 1/16 inch long, with long silky hairs along the edges.

Originally described from Brazil, and found as far south as Argentina. Introduced in the southern United States, usually found along roadsides and in waste places. It is generally considered a weed but is occasionally cut for hay. It was first collected in the Islands in Manoa Valley, Oahu, in the early part of the twentieth century. It is now found occasionally on the islands of Oahu, Kauai, and Hawaii. The palatability of this grass is unknown to the writers, but it is very coarse, tough, and woody, and would appear to be rather unpalatable.

PENNISETUM L. Rich.

Spikelets solitary or in groups of two or three, surrounded by an involucre of bristles (sterile branchlets), these not united except at the very base, often plumose, falling attached to the spikelets; first glume shorter than the spikelet, sometimes minute or wanting; second glume shorter than or equaling the sterile lemma; fertile lemma chartaceous, smooth, the margin thin, enclosing the palea.

There are about 50 species of *Pennisetum,* mostly in tropical regions, 6 species being found in Hawaii, most of them with flat leaves and dense, bristly, straw-colored terminal spikelike panicles.

Four species of *Pennisetum* occur on the range, at low to middle elevations in dry to semi-moist situations.

Culms 2 to 4 m tall, robust; panicles mostly more than 15 cm long....*P. purpureum*
Culms less than 2 m tall.
  Plants creeping, mat forming.....*P. clandestinum*
  Plants tufted, not mat forming.
    Culms branching from lower and middle nodes; panicle about 1 cm thick .....*P. setosum*
    Culms not branching; panicle 2 to 4 cm thick.....*P. ruppelii*

Pennisetum clandestinum Hochst.

Kikuyu grass

A persistent stoloniferous perennial forming dense sod; culms glabrous, profusely branched; internodes extremely short, not more than 1 to 4 cm long; leaves distichous; sheaths usually compressed, much longer than internodes, densely tuberculate-hispid, the margins hyaline; ligule a line of silky hairs 1 to 2 mm long; blades 6 to 30 cm long, 3 to 6 mm wide, often folded, hispid throughout and scabrous on midnerve and margins; panicles small, terminal, few-flowered, of 3 to 6 fascicles almost wholly included within the sheaths, often only the long-exserted plumose stigmas visible; bristles delicate, scabrous, unequal, the outer set 3 to 5 mm long, the inner 8 to 12 mm long; spikelets short-pediceled, 1 per fascicle; first glume minute or wanting; second glume membranaceous, obtuse; lemmas 15 to 18 cm long, narrow, obtuse or truncate; styles connate, 6 to 7 mm long; stigmas silvery, plumose, 10 to 15 mm long, conspicuously exserted at anthesis; anthers 3, yellow, narrow, on slender filaments 2 to 4 cm long. (Fig. 64)

A vigorous perennial sending out long, strong runners and forming dense mats; stems prostrate or somewhat erect, densely hairy, flattened near the tips; leaves narrow, 2 to 12 inches long, stiffly spreading outward at the tips of the stems, usually boat-shaped, rough, prickly on the midveins and edges and clothed with short hairs throughout.

Native of tropical Africa. It has been introduced into most tropical countries and to some extent into temperate regions for forage. It was introduced into Hawaii from California about 1924. In the Islands it flowers quite profusely at medium altitudes but infrequently at the lower altitudes; so far as is known, it does not produce seed here and is always propagated by cuttings. It is adapted from sea level to 4,000 feet or more. It makes its most vigorous growth in cool moist regions in deep loose soils where it is very persistent, forming a dense sod. It withstands grazing and trampling very well but if not closely cropped it has a tendency to become dry and woody

underneath the rank top growth. Ranchers disagree somewhat as to its value for fattening, some contending that it is too succulent and that animals tire of it, especially in solid stands. It is very aggressive and where it is well adapted tends to choke out most other grasses. One rancher uses it to choke out guava. It is being widely planted because of the rapid rate at which it covers the ground.

Fig. 64. *Pennisetum clandestinum:* a, terminal flower-bearing branch.

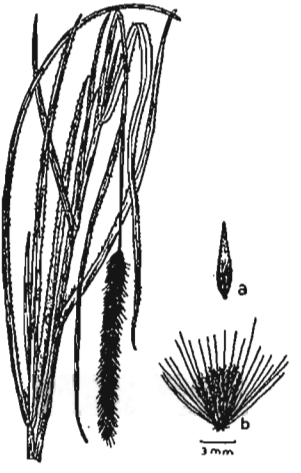

Fig. 65. *Pennisetum purpureum:* a, spikelet; b, fascicle.

Pennisetum purpureum Schumach.

Elephant grass; Napier grass

Robust leafy perennial; culms 2 to 4 m tall, stout, as much as 3 cm thick at base, sometimes branched, often geniculate and spreading at base, hard when mature, glaucous, densely hirsute at nodes, with a conspicuous pubescent prophyllum 3 to 3.5 cm long and two conspicuous rows of translucent bundle scars at the nodes hidden by the sheath; sheaths 15 to 25 cm long, densely papillose-hispid, glaucous, the basal ones purplish, especially on the inside; ligule a line of stiff bristly hairs 4 to 5 mm long; blades 50 to 100 cm long, 2 to 3.5 cm wide, lanceolate, conspicuously scabrous on the margins, scabrous and often sparsely papillose-hispid on the upper surface especially near the base and along the conspicuous

whitish midrib; panicles 20 to 25 cm long, 1.5 to 2 cm thick, cylindrical, stiffly erect, yellowish or tawny with silky-pilose main axis; fascicles sessile, silky-pilose at base; bristles 5 to 10 cm long, delicate, the outer scabrous, the inner sparsely plumose with long silky hairs, usually 2 spikelets per fascicle, one nearly sessile, the other on a pedicel 1.5 to 2 mm long; spikelets 5 to 6 mm long; first glume about 1 mm long, nerveless, hyaline, acute; second glume 3.5 to 4 mm long, acuminate, 1-nerved, scabrous on upper part of nerve and margins; sterile lemma 5 to 6 mm long, acuminate, 5-nerved, scaberulous on upper part; fertile lemma 4.5 to 5 mm long, membranaceous, acuminate, indistinctly 3-nerved, scaberulous on upper part. (Fig. 65)

A rank, robust, leafy perennial, 6 to 14 feet tall; stems erect or often bent and spreading at the base, clothed with long, stiff, bristly hairs, very stout, tough at maturity, purplish near the base, covered with a whitish bloom; leaves 18 to 36 inches long, ¾ to 1¼ inches wide, with a prominent whitish midnerve, very rough on the edges, rough to the touch and often with long stiff hairs on the upper sides, especially near base and along the midnerve; flowering heads narrow, spikelike, soft-bristly, yellow, 8 to 10 inches long.

A native of tropical Africa, introduced into many other tropical countries as a forage grass. It was introduced into Hawaii about 1916 and has met with much favor and is now widely planted at lower altitudes on all the islands, both as a soilage crop and for pasture. It has sparingly escaped from cultivation in these areas. Despite its coarse growth, elephant grass is very palatable and nutritious. It is at its best on deep rich soil in moist areas, but does fairly well on poor soil and under rather dry conditions. It is planted from sea level to 3,000 feet but at the latter altitude growth is slow. It has a large deep root system and produces an immense crop of forage. It tillers extensively, ratoons freely, and withstands grazing well. It seldom produces viable seed in the Islands and is propagated by cuttings.

Pennisetum ruppelii Steud.

Fountain grass

Tufted perennial; culms 60 to 120 cm tall, scabrous above, glabrous below; sheaths long-pilose at throat, otherwise glabrous; ligule a dense row of silky hairs 1 to 1.5 mm long; blades 50 to 60 cm long, more or less involute, 1 to 3 mm wide, scabrous; panicles 15 to 30 cm long, pink to purple, nodding, the rachis pilose, fascicles on plumose pedicels, 2 to 3 mm long, loosely arranged; bristles unequal, the outer 4 to 12 mm long, scabrous, the inner 3 to 4 cm long, sparingly plumose toward base; spikelets 1 to 3 in a fascicle, pedicellate; glumes glabrous, attenuate, the first minute or wanting, the second 2 to 3 mm long; sterile lemma 5 to 6 mm long; fertile lemma 6 to 7 mm long. (Fig. 66, d-e)

Bunchy, erect perennial, 2 to 4 feet tall; stems rather woody, smooth; leaves more or less folded, 1½ to 2 feet long, rough, rather stiff and harsh; flowering heads 6 to 12 inches long, feathery, pink or purple, spikelike, nodding.

A native of Africa, widely introduced as an ornamental. It is abundant on the lava flows near Puuwaawaa, North Kona, Hawaii, where it seems to find the habitat very congenial and is spreading rapidly, covering a large area on these flows in almost pure stands and persisting where nothing else will grow. It is a beautiful grass and spectacular in these barren areas. It is worthless for forage and will probably spread into the valuable pasture lands adjacent if it is not checked. It also occurs in a small area at Kalaheo, Kauai.

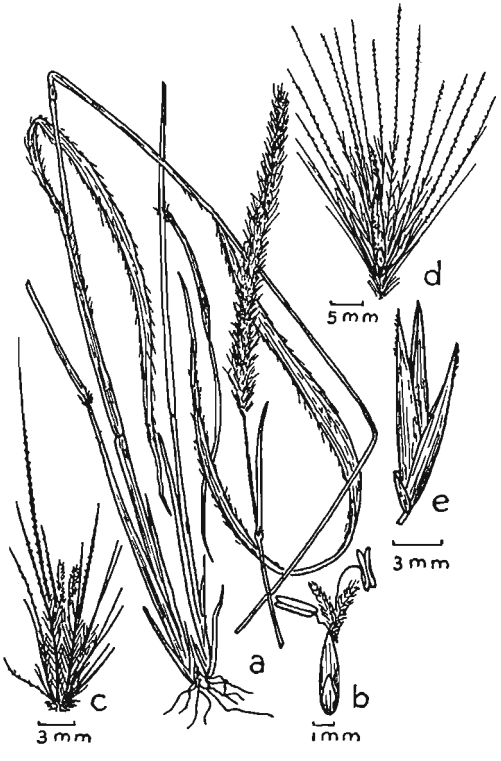

Fig. 66. *Pennisetum setosum:* a, habit; b, spikelet; c, fascicle. *Pennisetum ruppelii:* d, fascicle; e, spikelet.

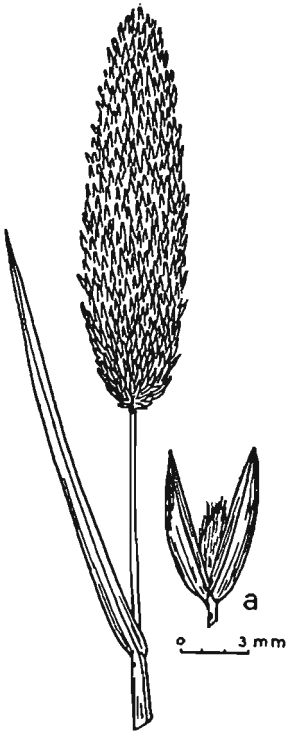

Fig. 67. *Phalaris tuberosa:* a, spikelet.

Pennisetum setosum (Swartz) L. Rich.

Pennisetum purpurascens H.B.K.

Feathery pennisetum

An erect loosely tufted perennial; culms 60 to 150 cm tall, scabrous below the panicle; sheaths glabrous or the lower sometimes pubescent; ligule a conspicuous line of hairs 1 mm long, united at base; blades 6 to 40 cm long, 3 to 15 mm wide, pilose-pubescent on both surfaces, a tuft of silky hairs 5 to 6 mm long at base on upper surface; panicles dense, 13 to 18 cm long, 1 cm thick, excluding the scabrous portion of the long bristles, tawny to purple; fascicles spreading; outer bristles delicate, scabrous, 3 to 4 mm long; inner bristles 15 to 17 mm long, densely silky-plumose on the lower portion and beautifully crimped and matted with those of adjoining ones; spikelet one to fascicle, 3.5 to 4 mm long; first glume minute or obsolete, second glume slightly longer than the sterile and fertile lemmas; fertile floret 2 mm long, readily separating from the spikelets at maturity, indurate, shining, olive-buff. (Fig. 66, a-c)

Erect perennial growing in loose clumps, 2 to 5 feet tall; stems usually smooth, sometimes hairy at the base; leaves hairy all over, with tufts of long silky hairs at the base, 3 to 18 inches long, 1/8 to 5/8 inch wide; flowering heads spikelike, feathery, yellow or purplish with soft woolly bristles.

Native of the West Indies, southern Florida, Central and South America. Since its introduction into the Islands it has spread rapidly along roadsides and cultivated fields at lower elevations in rather dry situations on Oahu and Lanai but as yet has spread but little into the pasture lands so that its forage value is unknown here.

Phalaris L. Canary Grass

Spikelets laterally compressed, with 1 terminal perfect floret and 2 sterile lemmas below, the rachilla disarticulating above the glumes, the usually inconspicuous sterile lemmas falling closely appressed to the fertile floret; glumes equal, boat-shaped, often winged on the keel; sterile lemmas reduced to 2 small usually minute scales (rarely only 1); fertile lemma coriaceous, shorter than the glumes, enclosing the faintly 2-nerved palea.

There are about 20 species of *Phalaris* in temperate regions of both hemispheres. There are 4 species in the Islands. The canary grasses are comparatively rank-growing annuals or perennials, usually with dense, spikelike flowering heads and numerous rather large flat leaves. They are practically all highly nutritious and palatable to livestock. Several of them are valuable forage and hay grasses. *P. canariensis* L. furnishes a large percentage of the canary seed of commerce.

There is only one important species in Hawaii, *P. tuberosa.*

Phalaris tuberosa L.

Large canary grass

Densely tufted robust perennial; culms 60 to 150 cm tall, glabrous, more or less bulbous at base; sheaths 10 to 15 cm long or the basal ones as much as 20 cm long, glabrous or minutely scaberulous, striate, the basal ones very loosely clasping the culm; ligule 7 to 10 mm long, membranaceous, conspicuous; blades 30 to 60 cm long, 5 to 12 mm wide, lax, scabrous on margins and lower surface, glabrous on upper, glaucous; panicles 6 to 10 cm long, about 1.5 cm thick, spikelike, dense; glumes 5 to 6 mm long, strongly keeled, scaberulous on keel, narrowly winged on upper two-thirds, 3-nerved; sterile lemma one, narrow, acuminate, pubescent, about 1.5 mm long; fertile lemma 3.5 to 3.7 mm long, appressed-pilose, acute, ovate-lanceolate, its palea of nearly equal length. (Fig. 67)

A robust perennial, 2 to 5 feet tall, growing in large bunches; stems smooth or slightly rough to the touch, somewhat bulbous at base; leaves flat, 12 to 24 inches long, ¼ to ½ inch wide, usually lax, bluish-green, rough to the touch on the edges and on the lower sides but smooth on the upper sides; flowering head compact, dense, spikelike, 2 to 4 inches long, ½ to ¾ inch thick.

A native of the Mediterranean region, introduced into the Hawaiian Islands for forage around 1916, and now found occasionally in the high, cool, wet districts on all the islands, where it is well adapted and produces a luxuriant crop of forage. It is well liked by all classes of livestock, stools very readily, and quickly recovers after rather heavy grazing if it has first been allowed to establish a good root system.

Poa L. Bluegrass, Meadow Grass

Spikelets 2- to several-flowered, the rachilla disarticulating above the glumes and between the florets, the uppermost floret reduced or rudimentary; glumes acute, keeled, somewhat unequal, the first usually 1-nerved, the second usually 3-nerved; lemmas somewhat keeled, acute or acutish, rarely obtuse, awnless, membranaceous, often somewhat scarious at the summit, 5-nerved (intermediate nerves, that is, the pair between the keel and the marginal nerves, rarely obsolete), the nerves sometimes pubescent.

Poa is one of the most important genera of forage grasses with about 200 species in the temperate and cool regions of both hemispheres. Seven species are found in Hawaii. With but a few exceptions, the species of *Poa* are highly nutritious. The bluegrasses may be distinguished by the peculiar, boat-shaped tips of the leaves. The flowering heads are usually erect and rather pyramidal in shape. There are a few species found on sand dunes and a small number of others grow in rather dry, poor soil. The majority, however, prefer rich,

moist, well-drained soil. They are important constituents of meadows and pastures, especially in Europe.

Two species of *Poa* occur on the Hawaiian range, usually above 2,000 feet elevation.

Culms less than 30 cm tall; lemmas 2 to 3 mm long.....*P. annua*
Culms more than 30 cm tall; lemmas 3 to 3.5 mm long.....*P. pratensis*

Poa annua L.

Annual bluegrass

Tufted annual or occasionally a short-lived perennial, producting short, very slender rhizomes, usually rather delicate but sometimes robust and forming mats; culms 5 to 30 cm tall, glabrous, compressed or occasionally terete; sheaths 1 to 3 cm long, compressed; ligule 1 to 1.5 mm long, entire, membranaceous; blades 3 to 8 cm long, 1 to 3 mm wide, soft, usually lax, glabrous, keeled, often undulate; panicles 3 to 8 cm long, oblong-pyramidal, open or somewhat contracted, with glabrous or sparsely scabrous branches 2 to 3 cm long, the lower usually spreading; spikelets 3 to 5 mm long, 3- to 6-flowered, ovate, compressed, greenish or often tinged with purple; glumes glabrous, green with hyaline white to purplish margins, the first 1.5 to 2 mm long, the second 2 to 3 mm long; lemmas 2 to 3 mm long, acute, strongly villous on lower half of all nerves, arachnoid near base; palea 2 to 2.5 mm long, keeled, strongly villous on keels, acute; grain 2 to 2.5 mm long, elliptic-ovate, yellowish. (Fig. 68, d-e)

A suberect, smooth annual, usually growing in tufts, or occasionally a short-lived perennial, producing short slender underground runners, the plants usually delicate but sometimes forming mats; leaves 1 to 3 inches long, 1/32 to 1/8 inch wide, soft, often wrinkled; flowering heads 1 to 3 inches long, pyramidal, the upper branches rather erect, the lower spreading; floret about ⅛ inch long, usually covered with cobweb-like hairs.

A native of Europe, now naturalized in most temperate regions. It was known to occur in Hawaii as early as 1888, and is now found naturalized on all islands from 2,000 to 6,000 feet elevation or more. It is usually an annual, springing up quickly after rains. It is palatable to stock but produces little forage because of its small size.

Poa pratensis L.

Kentucky bluegrass

Perennial with creeping rhizomes; culms 30 to 100 cm tall, tufted, erect, somewhat compressed, glabrous; sheaths 4 to 10 cm long, slightly compressed, glabrous or the lower ones sometimes scaberulous on upper part; ligule 1 to 2 mm long, membranaceous; blades flat or somewhat folded, 12 to 30 cm long, 2 to 4 mm wide, glabrous, the apex keeled; panicle 6 to 12 cm long, open, pyramidal, the branches 2 to 6 cm long, ascending or spreading, the spikelets crowded near their ends, scabrous, the lowermost ones in whorls of 5; spikelets 3 to 5 mm

long, 3- to 5-flowered; glumes 3-nerved, acute, keeled, sparsely scabrous on upper part of keel, usually scarious on margins, the first 2.5 mm long, the second 3 mm long; lemmas 3 to 3.5 mm long, acute, scarious on margins on upper part, copiously arachnoid at base, silky-tomentose on lower part of keel and marginal nerves, the intermediate nerves glabrous; palea about 3 mm long, scabrous on keels; grain 2 to 2.2 mm long, narrowly cylindrical, reddish-brown. (Fig. 68, a-c)

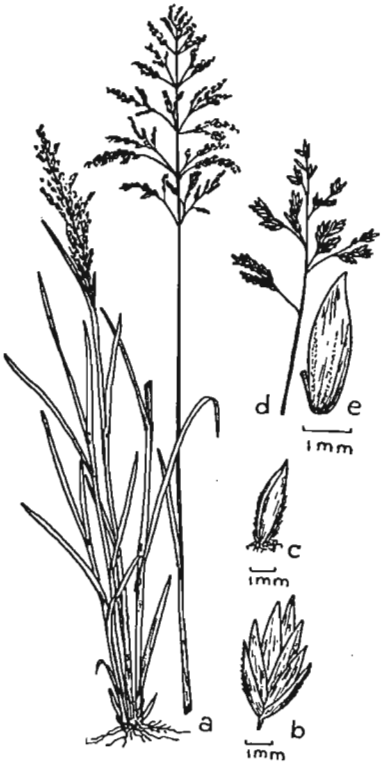

Fig. 68. *Poa pratensis:* a, habit; b, spikelet; c, floret. *Poa annua:* d, inflorescence; e, floret.

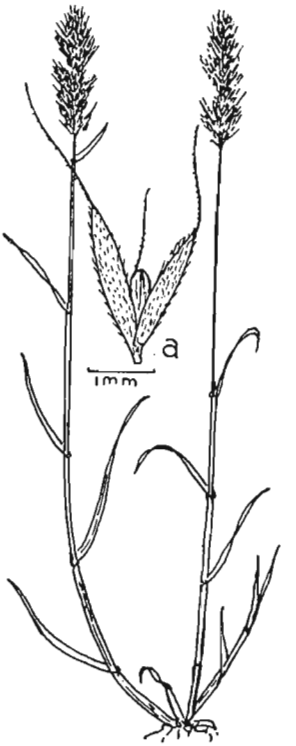

Fig. 69. *Polypogon lutosus:* a, spikelet.

Perennial, 1 to 3 feet tall, with creeping underground runners; stems upright, smooth, somewhat flattened; leaves 5 to 12 inches long, 1/12 to 1/8 inch wide, smooth, flat or sometimes slightly folded; flowering heads 2½ to 5 inches long, open, with spreading branches 1 to 2½ inches long, the lowest ones in whorls of 5.

A native of Europe, widely introduced in the temperate zones and in the tropics at higher altitudes rather generally throughout the

world. It is fairly abundant at higher altitudes on Maui and Hawaii. It is very palatable to all classes of livestock and is one of the most valuable of forage grasses. It has for centuries been highly regarded throughout Europe, especially in mixtures. It is widely naturalized throughout the United States, except in the arid regions, and is commonly cultivated for lawns and pasture. Although this grass does best in rich soil, it can be found growing quite freely in pastures on soils of medium fertility. It is highly prized in certain parts of Europe because of this characteristic. Because of the persistent creeping runners and sod-forming habit, it withstands heavy and continuous grazing and recovers readily following adverse weather conditions.

POLYPOGON Desf.

Spikelets 1-flowered, the pedicel disarticulating a short distance below the glumes, leaving a short-pointed callus attached; glumes equal, entire or 2-lobed, awned from the tip or from between the lobes, the awn slender, straight; lemma much shorter than the glumes, hyaline, usually bearing a slender straight awn shorter than the awns of the glumes.

The genus contains about 10 species widely distributed in temperate and warm regions. Two species occur in Hawaii. Most of the species are annuals with rough flat leaves and bristly, dense, spikelike flowering heads. The group as a whole is unimportant and of very little forage value.

One species is found on the range, *P. lutosus*.

Polypogon lutosus (Poir.) Hitchc.

Ditch polypogon

Tufted perennial; culms 30 to 60 cm tall, glabrous, geniculate at base, rather loosely spreading; sheaths 3 to 10 cm long, striate, glabrous; ligule 4 to 8 mm long, membranaceous, conspicuous, often lacerate; blades 5 to 12 cm long, 2 to 6 mm wide, scabrous; panicles 5 to 10 cm long, oblong, interrupted or lobed, greenish or sometimes purple-tinged; glumes 2 to 3 mm long, scabrous, more or less keeled, acuminate, the awn 3 to 5 mm long; lemma 1 to 1.2 mm long, minutely and delicately toothed at truncate apex, submembranaceous, glabrous, shiny, the delicate awn 2 mm long; palea nearly as long as lemma, minutely bidentate. (Fig. 69)

A rather loose, bunchy perennial, 1 to 2 feet tall; stems smooth, bent at the base and loosely spreading; leaves 2 to 5 inches long, ⅛ to ¼ inch wide, rough to the touch; flowering heads 2 to 4 inches long, spikelike but somewhat interrupted and lobed, greenish or purple-tinged, with short, delicate bristles.

A native of Europe, introduced into the southwestern United States. It was of early accidental introduction in the Islands, first collected about 1870. At present it is found occasionally in rather moist situations at medium altitudes on the islands of Oahu, Maui, and Hawaii. It is a weedy species, valueless for forage, but not a pest in pastures as it is not persistent in the Hawaiian Islands.

SACCIOLEPIS Nash

Spikelets oblong-conic; first glume much shorter than the spikelet; second glume broad, inflated-saccate, strongly many-nerved; sterile lemma narrower, flat, fewer-nerved, its palea nearly as long, often subtending a staminate flower; fertile lemma stipitate, elliptic, chartaceous-indurate, the margins inrolled, the palea not enclosed at the summit.

There are about 30 species, all moisture-loving plants, in warm countries of both hemispheres. The group as a whole is unimportant from a forage standpoint.

There is only one species in the Islands, *S. contracta.* It may be recognized by the dense, rather narrow and short flowering head, and by the somewhat inflated spikelets.

Sacciolepis contracta (Wight & Arn.) Hitchc.

Glenwood grass

Glabrous annual; culms usually 30 to 60 cm or sometimes as much as 100 cm tall, spreading and branching at base; sheaths 3 to 6 cm long, shorter than internodes, striate; ligule reduced to a narrow ridge; blades flat, 3 to 8 cm long, 2 to 6 mm wide, thin; panicles spikelike, narrow, 3 to 7 cm long, 5 to 7 mm thick; spikelets 2.2 to 3.5 mm long; first glume 1 to 1.5 mm long, glabrous to sparsely hispid, broad, subacute, 5-nerved; second glume 2.2 to 3.5 mm long, many-nerved, sparsely hispidulous on upper half, conspicuously saccate, inflated; sterile lemma 1.5 to 1.7 mm long, 7-nerved, sparsely hispid toward apex; fertile lemma acute, shining; grain 0.7 to 1 mm long, ovate, light brown. (Fig. 70)

An upright, smooth, slender annual, usually 1 to 2 feet or occasionally as much as 3 feet tall, each plant producing but few slender stems; leaves 1 to 3 inches long, 1/16 to 1/4 inch wide, thin, flat; flowering heads, narrow, spikelike, 1 to 2 inches long, about ¼ inch thick.

A native of the East Indies. It was first introduced into the Islands in the Glenwood district on the island of Hawaii; hence the name "Glenwood grass." It is now found rather abundantly in moist or wet pastures at low to medium altitudes on all the islands. It is very palatable and, although it does not produce a great amount of foliage,

it is a valuable pasture grass in these areas. In wet districts the spikelets are sometimes proliferous, young plants being produced on the flower head.

Fig. 70. *Sacciolepis contracta:* a, spikelet.

Fig. 71. *Setaria geniculata:* a, spikelet.

SETARIA Beauv. BRISTLE GRASS

Spikelets subtended by one to several bristles (sterile branchlets), falling free from the bristles, awnless; first glume broad, usually less than half the length of the spikelet, 3- to 5-nerved; second glume and sterile lemma equal, or the glume shorter, several-nerved; fertile lemma coriaceous-indurate, smooth or transversely rugose.

There are about 100 species, widely distributed in both temperate and warm regions. Four species occur in Hawaii. They are distinguished by their bristly, usually dense and spikelike flowering heads. In general, they are palatable, some of them constituting an important part of the range forage.

Two species of *Setaria* are found at low elevations in dry to wet localities in Hawaiian pastures.

Bristles below each spikelet 1 to 3, retrorsely scabrous.....*S. verticillata*
Bristles below each spikelet more than 5, antrorsely scabrous.....*S. geniculata*

Setaria geniculata (Lam.) Beauv.

Chaetochloa geniculata (Lam.) Millsp. & Chase

Knotroot bristle grass; Yellow foxtail

Perennial with short branching knotty rhizomes; culms usually 25 to 70 cm or sometimes as much as 100 cm tall, usually erect but sometimes almost prostrate, glabrous, tough; sheaths 4 to 8 cm long, striate, glabrous, usually compressed; ligule a line of short stiff hairs about 0.5 mm long; blades flat, 10 to 20 cm long, 3 to 7 mm wide, scaberulous and usually long-pilose on upper surface near base; panicles 3 to 8 cm long, 4 to 6 mm thick excluding bristles, spikelike, erect, cylindrical, usually obtuse at apex, yellowish or brownish, the axis pubescent; bristles 5 to 8 mm long; spikelets 2 to 2.5 mm long, ovoid, glabrous; glumes obtuse or broadly acute, the first 0.7 to 1 mm long, 3-nerved, the second 1.2 to 1.5 mm long, 5-nerved; sterile lemma 2 to 2.2 mm long, 7-nerved, broadly acute, the margins slightly involute, the palea membranaceous, indistinctly keeled, 2 to 2.2 mm long; fertile lemma 2 to 2.5 mm long, transversely rugose, beaked; grain about 1 mm long, dark brown. (Fig. 71)

A persistent perennial with short, knotty, branching, underground rhizomes; stems usually erect but sometimes almost prostrate, flattened, tough and wiry; leaves flat, 4 to 8 inches long, 1/8 to 1/4 inch wide, rather tough, rough throughout and with long hairs on the upper side near the base; flowering heads erect, dense, bristly, spikelike, rounded at the tips, 1 to 3 inches long, about 1/4 inch thick, yellowish or brownish, usually slightly twisted; seed (mature floret) about 1/16 inch long, wrinkled, plump.

Originally described from the West Indies and found throughout the tropics of both hemispheres. In Hawaii, it is found on all the islands in moist areas at low to medium altitudes. It grows abundantly in almost pure stands on Kauai and in the Kona and Mountain View districts on Hawaii. It is unpalatable and a very serious pest because of its persistent knotty rhizomes and prolific seed habit. The sharp bristles are reported to cause inflammation of the jaw and also of the tongue in grazing animals.

Setaria verticillata (L.) Beauv.

Bristly foxtail

A branching annual, 30 to 80 cm tall, often decumbent at base, glabrous, with long internodes; sheaths 4 to 7 cm long, shorter than internodes, glabrous, keeled; ligule 1 mm long, fimbriate, membranaceous; blades 8 to 20 cm long, 5 to 15 mm

wide, hispidulous; panicles 4 to 12 cm long, 5 to 15 mm wide, cylindric to somewhat tapering upwards, the rachis scaberulous; bristles 4 to 6 mm long, single at base of each spikelet, commonly purple; spikelets 2 mm long, ovate, glabrous; first glume 1 mm long, acute, 1-nerved; second glume 2 mm long, obtuse, 7-nerved; sterile lemma 2 mm long, obtuse, 5-nerved; fertile lemma 1.5 to 1.7 mm long, obscurely 5-nerved, finely rugose. (Fig. 72)

Fig. 72. *Setaria verticillata:* a, spikelet.

An upright, freely branching and spreading annual, 1 to 2½ feet tall, smooth; leaves 3 to 8 inches long, ¼ to ½ inch wide, hairy; flowering head 1 to 4 inches long, bristly.

A native of Europe and Asia, now found throughout warm and temperate regions. In Hawaii it is found abundantly in the drier areas associated with algaroba (*Prosopis chilensis*), koa haole (*Leucaena glauca*), and panini (*Opuntia megacantha*). The seeds germinate quickly after a rain, and the plants form a solid covering in the open and under shade, and furnish good forage.

SPHENOPHOLIS Scribn. WEDGE GRASS

Spikelets 2- or 3-flowered, the pedicel disarticulating below the glumes, the rachilla produced beyond the upper floret as a slender bristle; glumes unlike in shape, the first narrow, usually acute, 1-nerved, the second broadly obovate, 3- to 5-nerved, the nerves sometimes obscure, mostly somewhat coriaceous, the margins scarious; lemmas firm, scarcely nerved, awnless or rarely with an awn from just below the apex, the first a little shorter or a little longer than the second glume; palea hyaline, exposed.

This genus of 6 species is confined to the temperate regions of North America. They are slender perennials with flat blades and narrow, shining flowering heads. All are forage grasses.

One species has been introduced in the Islands, *S. obtusata.*

Sphenopholis obtusata (Michx.) Scribn.

Prairie wedge grass

Erect perennial; culms 30 to 80 cm tall, glabrous; sheaths 8 to 15 cm long, scaberulous; blades flat, 10 to 15 cm long, 3 to 5 mm wide, scabrous; panicles 8 to 18 cm long, 2 to 3 cm wide, erect, spikelike to interrupted; spikelets 2.5 to 3 mm long; first glume 2 mm long, 0.5 mm wide, acute, narrow, with one scabrous nerve, otherwise glabrous; second glume 2 mm long, 2 mm wide, 5-nerved, subcucullate, usually slightly inflated at maturity, scabrous, scarious on margins; lemmas 3 mm long, papillose, scaberulous toward tip; palea 2.5 mm long, hyaline, narrow, not wholly enclosed within the lemma. (Fig. 73)

Erect perennial, 1 to 2½ feet tall; stems slightly rough; leaves flat, 4 to 6 inches long, ⅛ to ¼ inch wide, rough; flowering heads 3 to 7 inches long, green or silvery, shining, spikelike.

Found from Maine to British Columbia and south to Mexico. It is a good forage grass but not abundant enough to be of importance. It has only recently been found in a small area near Kahuku and Kapapala, Hawaii.

SPOROBOLUS R. Br. DROPSEED

Spikelets 1-flowered, the rachilla disarticulating above the glumes; glumes 1-nerved, usually unequal, the second often as long as the spikelet; lemma membranaceous, 1-nerved, awnless; palea usually prominent and as long as the lemma or longer; caryopsis free from the lemma and palea, falling readily from the spikelet at maturity, the pericarp free from the seed, usually thin and closely enveloping it, but readily slipping away when moist.

There are about 150 species in the genus, widely distributed in both tropical and temperate regions. Some are palatable, but generally they are too coarse to afford good forage except while young.

Most of the species are perennial bunch grasses, some have underground runners, and a few are annuals. Most of the species are hardy and persistent, producing an abundance of comparatively viable, long-lived seeds.

Four species of *Sporobolus* are found in the Islands, three of which occur on the range.

Plant 60 cm or more tall.
Panicle compact, spikelike; spikelets 2 to 2.5 mm long.....*S. capensis*
Panicle narrow but loose; spikelets 1.5 to 1.8 mm long.....*S. indicus*
Plant less than 50 cm tall.....*S. diander*

Fig. 73. *Sphenopholis obtusata:* a, glumes; b, floret.

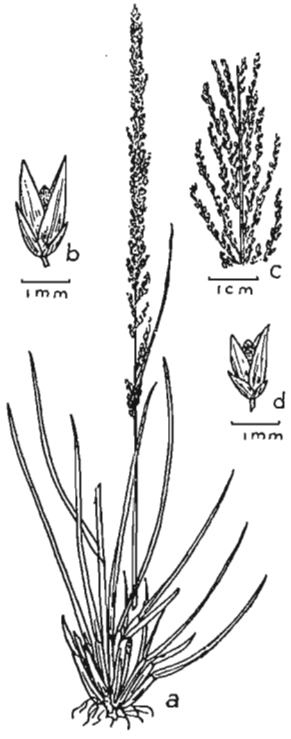

Fig. 74. *Sporobolus capensis:* a, habit; b, spikelet. *Sporobolus indicus:* c, inflorescence; d, spikelet.

Sporobolus capensis (Willd.) Kunth

Rattail grass; Smutgrass

Sparingly or densely tufted perennial; culms 30 to 100 cm tall, wiry; sheaths 4 to 12 cm long, more or less compressed, pilose at throat and along margins,

otherwise glabrous; ligule of stiff hairs not more than 0.2 mm long; blades flat or subinvolute, 10 to 25 cm long, 2 to 5 mm wide at base, tapering to a fine point, glabrous; panicles 15 to 25 cm long, erect, spikelike but sometimes more or less interrupted at base, with very short closely appressed branches, often covered with a black smut; spikelets 2 to 2.5 mm long, glabrous; glumes obtuse or the second sometimes acute, the first about 0.7 mm long, the second about 1.5 mm long; lemma 2 to 2.5 mm long, acute, the palea of equal length; grain 1.2 to 1.5 mm long, obovate, obtuse or truncate, dark red, readily separating from spikelet but often adhering to the panicle for some time after maturity by the mucilaginous pericarp. (Fig. 74, a-b)

A wiry, erect, smooth perennial, 1 to 3 feet tall; stems somewhat flattened, especially at base, very tough; leaves usually somewhat folded, 4 to 10 inches long, 1/16 to 3/16 inch wide at the base, gradually tapering to a fine point, tough and leathery; flowering heads 6 to 10 inches long, erect, spikelike, usually covered with a black smut, and with the small red seed often sticking to the heads long after maturity. This species has been referred to *S. elongatus* R. Br.

A native of Africa, introduced in Australia and New Zealand. It was first collected in the Islands in 1903 and is now abundant in open pasture land from low to medium altitudes on all the Islands. It is relatively unpalatable, but when it is young or when more palatable grasses are not available it is eaten by cattle to some extent. It is very persistent and, because it is avoided by stock, has become the dominant species over some of the range land in cool, moist areas.

Sporobolus diander (Retz.) Beauv.

Indian dropseed

Similar to *Sporobolus indicus* but smaller, the panicle shorter, looser, and more delicate, with branches somewhat spreading. (Fig. 75)

A native of India. It is found in a few small areas in pastures at low altitudes on Oahu, and is a common weed in the lawns in Honolulu.

Sporobolus indicus (L.) R. Br.

Densely tufted perennial; culms glabrous, 60 to 100 cm tall; sheaths striate, 3 to 8 cm long, the basal ones compressed, sparsely pilose at throat and along margins toward the summit; ligule about 0.2 mm long, membranaceous, ciliolate; blades flat to subinvolute, 20 to 35 cm long, 2 to 4 mm wide, sparsely pilose on margins near base, otherwise glabrous, attenuate; panicles 20 to 40 cm long, usually nodding, narrow, with rather densely flowered glabrous or scaberulous branches, 2 to 3 cm long, the axis glabrous; spikelets 1.5 to 1.8 mm long, glabrous, dark gray; glumes obtuse or broadly acute, the first 0.5 mm long, the second 0.7 mm long; lemmas 1.5 to 2 mm long, acuminate or acute, the palea of the same length. (Fig. 74, c-d)

Erect perennial, 2 to 3 feet tall, growing in clumps; stems smooth or sometimes with a few hairs along the edges, usually flattened at the base; leaves 8 to 14 inches long, ⅛ to ¼ inch wide, usually smooth but sometimes with a few long hairs along the edges; flowering heads usually somewhat nodding, narrow, 8 to 16 inches long with slender loosely ascending branches, ¾ to 1¼ inches long.

A native of tropical America, introduced into the Hawaiian Islands rather recently. It is occasionally found on the island of Hawaii, in Kohala District. On Kauai it is rather common from Kapaa to Hanalei. It is found occasionally on Oahu as a weed in lawns and in pastures at low elevations.

This species is often confused with rattail grass.

Fig. 75. *Sporobolus diander:* a, spikelet.

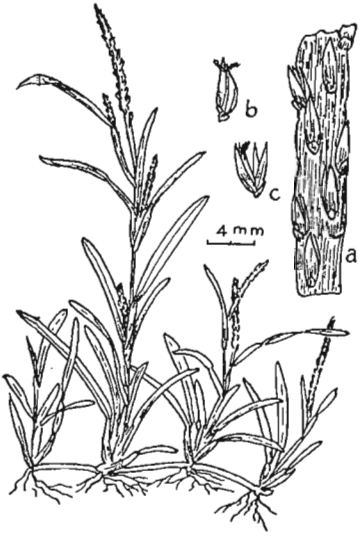

Fig. 76. *Stenotaphrum secundatum:* a, inflorescence; b, floret; c, spikelet.

STENOTAPHRUM Trin.

Spikelets in 2 rows embedded in one side of an enlarged and flattened corky rachis tardily disarticulating toward the tip at maturity, the spikelets remaining attached to the joints; first glume small; second glume and sterile lemma about equal, the latter with a palea or staminate flower; fertile lemma chartaceous.

A genus of about 6 species, in the tropics and subtropics, mostly creeping perennials with rather short, broad, blunt-tipped leaves and short, stiff flowering spikes.

One species is found in the Islands, *S. secundatum.*

Stenotaphrum secundatum (Walt.) Kuntze

S. americanum Schrank

Buffalo grass; St. Augustine grass

Extensively creeping perennial with stolons having long internodes and short leafy branches; culms branched, glabrous, compressed, the ascending flowering shoots 10 to 30 cm tall; leaves subopposite and equitant except in upper part of flowering branches; sheaths compressed, keeled, 3 to 6 cm long, pale at base, usually membranaceous on margins, sparsely villous at throat and on collar, otherwise glabrous; ligule ciliate, usually less than 0.5 mm long; blades 3 to 30 cm long, 3 to 10 mm wide, firm, stiff, glabrous on lower surface, scabrous above, the rounded apex often split; racemes 3 to 8 cm long, terminal and sometimes axillary; spikelets mostly in pairs, rarely solitary or in 3's, the thick-angled pedicels 2 to 4 mm long, the spikelets glabrous, green, often tinged with purple, acute, 5 to 6 mm long; first glume minute, scale-like, up to 1 mm long; second glume and sterile lemma 5 to 6 mm long, the glume 7- to 9-nerved, the lemma faintly 3- to 5-nerved, firm; fertile lemma 4 to 5 mm long, faintly 5- to 7-nerved, abruptly acuminate. (Fig. 76)

A smooth perennial with creeping runners, rooting at the joints; stems branched, pale green at base, flattened, the flowering ones somewhat upright, 4 to 12 inches tall; leaves stiff, usually rather leathery, short, broad and rounded at the tips; flowering heads spikelike, flat, single at the tips of the stems, with the spikelets sunken in the corky axis.

A native of southeastern United States, growing on moist soil near the seashore. It was first collected in the Hawaiian Islands, probably accidentally introduced, in 1816, and is now found from sea level, where it is partially tolerant of salt, to an altitude of about 3,000 feet. It is extensively used as a lawn grass, especially in shade too dense for Bermuda grass. It seldom produces viable seed in the Islands and is usually planted by cuttings. It is generally considered to be low in palatability.

TRAGUS Hall.

Spikelets 1-flowered, in small spikes of 2 to 5, the spikes subsessile, falling entire, the spikelets sessile on a very short zigzag rachis, the first glumes small, thin, or wanting, appressed to the rachis, the second glumes of the two lower spikelets strongly convex with 3 thick nerves bearing a row of squarrose, stout hooked prickles along each side, the two second glumes forming the halves of a little bur, the upper 1 to 3 spikelets reduced and sterile; lemma and palea thin, the lemma flat, the palea strongly convex.

An unimportant genus containing only 3 species, natives of the Old World, all weedy annuals with small spiny burs rather closely arranged along a slender zigzag main axis.

There is only one species in the Islands, *T. berteronianus*.

Tragus berteronianus Schult.

Bur grass

Annual; culms 10 to 25 cm tall, erect to more or less decumbent at base, pubescent below the panicle, otherwise glabrous; sheaths 1 to 3 cm long, glabrous, striate, the uppermost often dilated; ligule a line of hairs 0.5 to 0.7 mm long; blades 1.5 to 2 cm long or the uppermost almost obsolete, 1 to 3 mm wide, thick, firm, the margins cartilaginous and with stiff white hairs; racemes 3 to 7 cm long, 4 to 5 mm thick, spikelike, dense, often enclosed within the uppermost sheaths; rachis slender, pubescent; burs 2 to 3 mm long, beaked, but the apex hardly extending beyond the spines, on pubescent pedicels not more than 0.5 mm long; spikelets 2 per bur; first glumes wanting; second glumes of the two spikelets forming the halves of a bur, convex, with 3 thick nerves bearing a row of stout hooked spines on either side; lemmas 2 mm long, acute, sparsely pubescent on the back; palea 1.5 to 2 mm long, glabrous, acute; grain 1.2 to 1.5 mm long, golden, ovate. (Fig. 77)

Annual, 4 to 10 inches tall; stems smooth, erect or spreading at the base; leaves about ¾ inch long and ⅛ inch wide, thick and tough, bearing stiff, pricklelike hairs on the edges; flowering heads spikelike, consisting of small spiny burs, ⅛ inch long.

This grass is found in the West Indies, southwestern United States, and the warmer parts of South America and Europe. It is a pestiferous annual that has only recently appeared in localized spots in arid situations at the lower elevations on Maui.

TRICHACHNE Nees COTTON GRASS

Spikelets lanceolate, in pairs, short-pediceled, in two rows along one side of a slender rachis; first glume minute, glabrous; second glume and sterile lemma about as long as the fruit, 3- to 5-nerved, copiously silky; fertile lemma cartilaginous, lanceolate, acuminate, usually brown, the flat white hyaline margins broad.

There are about 12 species in this genus, found in the tropics and the warmer parts of the temperate regions. They are all perennials with conspicuous whitish or brownish, silky flowering heads with slender, rather erect branches closely or rather distantly arranged along slender main axes. As a group, the species of *Trichachne* are quite unpalatable.

There is only one species in the Islands, *T. insularis*.

Fig. 77. *Tragus berteronianus:* a, spikelet.

Fig. 78. *Trichachne insularis:* a, spikelet.

Trichachne insularis (L.) Nees

Valota insularis Chase

Sour grass; Puerto Rican grass

Densely tufted perennial; culms 100 to 150 cm tall, erect from a hard scaly pubescent swollen base, glabrous except at base; sheaths 12 to 15 cm long, much longer than internodes, usually papillose-pilose, the hairs 5 to 10 mm long, sometimes papillose only or glabrous, striate, compressed, keeled; ligule 5 to 10 mm long, conspicuous, membranaceous; blades 15 to 50 cm long, 1 to 1.5 cm wide, lanceolate, with conspicuous midrib, scabrous on upper side, glabrous on lower; panicles 15 to 25 cm long, silky, narrow, with slender somewhat nodding branches 7 to 15 cm long; spikelets 3.5 to 4 mm long excluding the hairs, tawny, densely

clothed with long silky hairs; first glume 0.5 to 1 mm long; second glume and sterile lemma subequal, 3- to 5-nerved, densely long-silky, the hairs exceeding the spikelets; fertile lemma 3 to 3.5 mm long, reddish-brown, lanceolate, acuminate; grain compressed-ovoid, beaked at apex, 1.5 mm long, whitish. (Fig. 78)

An upright perennial, 3 to 5 feet tall, spreading at the base and growing in a bunch, stooling very freely; stems tough, somewhat bulbous at the base, usually clothed with long stiff hairs; leaves flat, 8 to 20 inches long, ½ to ¾ inch wide, upper surfaces rough to the touch with depressed midrib, lower surfaces smooth with prominent midrib; flowering heads 8 to 11 inches long, dense, narrow, silky, with many slender, rather drooping branches 3 to 5 inches long.

Occurs throughout tropical and subtropical America and is generally distributed throughout the West Indies. It was accidentally introduced into Hawaii from Puerto Rico. It is very unpalatable to stock and is a serious pest wherever it is found. It is very persistent, stools freely, and produces large quantities of viable hairy seed that are readily distributed by wind. It has become abundant at the lower altitudes on Oahu where it is a serious problem, and has recently been found in small areas on Molokai and Maui.

TRICHOLAENA Schrad.

Spikelets on short capillary pedicels; first glume minute, villous; second glume and sterile lemma equal, raised on a stipe above the first glume, emarginate or slightly lobed, short-awned, covered, except toward the apex, with long silky hairs, the palea of the sterile lemma well developed; fertile lemma shorter than the spikelet, cartilaginous, smooth, boat-shaped, obtuse, the margin thin, not inrolled, enclosing the margins of the palea.

There are about 15 species in this genus, natives of Africa, one widely distributed in warm regions. They are annuals or perennials with rather open, silky flowering heads.

There is one species in the Islands, *T. repens*. It may be recognized by the soft, reddish to pale pink or tawny silky flowering heads.

Tricholaena repens (Willd.) Hitchc.

Tricholaena rosea Nees

Natal redtop; Natal grass

Perennial; culms 75 to 100 cm tall, densely tufted with age, glabrous, subcoriaceous, rather slender, erect from slightly decumbent base which sometimes roots at lower nodes, often much-branched, usually geniculate and sometimes purple at nodes; sheaths 7 to 10 cm or rarely 20 cm long, the lower sometimes papillose-pilose; ligule densely ciliate, 1 mm long; blades flat, 5 to 20 cm long, 2 to 5 mm wide, striate, scaberulous on upper surface, glabrous below, usually glaucous;

panicles 8 to 16 cm long, dark red to purplish when young, fading to silvery or tawny toward maturity, with ascending slender scaberulous branches 3 to 9 cm long; spikelets about 5 mm long, on capillary flexuous or recurved pedicels; first glume 0.5 to 1 mm long, pilose; second glume and sterile lemma 3 to 4 mm long, clothed with silky hairs 3 to 5 mm long, the palea 3 to 4 mm long, short-pilose; fertile lemma 2.5 mm long, short-stipitate; grain narrowly ovate, 1.2 to 1.5 mm long, light brown, smooth. (Fig. 79)

Erect perennial, 2 to 3 feet tall; stems usually much branched, often bent at the base and sometimes rooting at the lower joints, usually bluish-green, often purplish at the joints; leaves flat, 2 to 8 inches long, 1/16 to 3/16 inch wide, slightly rough on the upper sides, smooth on the lower, usually bluish-green; flowering heads 3 to 6 inches long, oval, dark red to purplish when young, fading to silvery when old, the spikelets covered with long hairs that give a feathery appearance to the flowering heads.

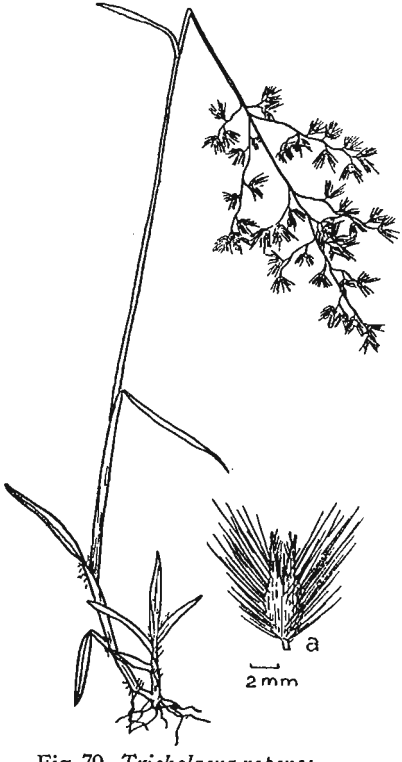

Fig. 79. *Tricholaena repens:* a, spikelet.

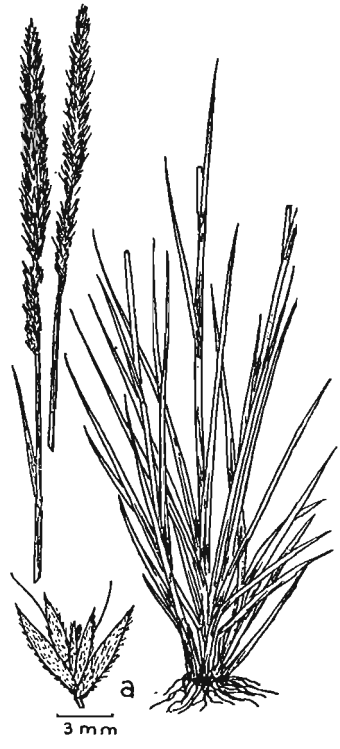

Fig. 80. *Trisetum glomeratum:* a, spikelet.

A native of South Africa, now naturalized in the drier parts of tropical America. It is cultivated as a meadow grass in sandy soil in Florida. It was first found growing in the Hawaiian Islands in 1894, and is now found throughout the Islands in moderately dry locations from sea level to medium altitudes. It is palatable and tender when young but tends to become woody and tough when old. It makes a rapid growth and stools very well, and is valuable in dry areas. It will grow in rocky situations and on soil of low fertility where more valuable grasses will not survive. It does not seem to withstand heavy and continuous grazing, but if allowed to rest it recuperates and reseeds very quickly.

TRISETUM Pers.

Spikelets usually 2-flowered, sometimes 3-flowered, the rachilla prolonged behind the upper floret, usually villous; glumes somewhat unequal, acute, the second usually longer than the first floret; lemmas usually short-bearded at the base, 2-toothed at apex, the teeth often awned, bearing from the back below the cleft apex a straight and included or usually bent and exserted awn.

There are about 65 species of this genus, widely distributed in temperate or mountainous regions. Most of them are perennial bunch grasses with flat leaves and narrow to spikelike shiny flowering heads. Nearly all are of some forage value and a few constitute an important part of the forage on alpine slopes.

There are 2 species in the Hawaiian Islands, both endemic perennials. They occupy dry, rocky places above 4,000 feet elevation. Only one species occurs on the range, *T. glomeratum*.

Trisetum glomeratum (Kunth) Trin.

Heu pueo

Densely tufted perennial; culms 40 to 90 cm tall, erect, robust, glabrous or pubescent; sheaths 7 to 15 cm long, usually loose, especially the lower, glabrous to softly pubescent; ligule 3 to 5 mm long, membranaceous, often lacerate; blades flat, or usually involute toward the stiff subulate point, 10 to 25 cm long, usually 2 to 4 mm or sometimes as much as 6 mm wide, glabrous to pubescent; panicles 12 to 20 cm long, about 1 cm thick, erect, close and spikelike, sometimes interrupted or rather loose; spikelets 4 to 6 mm long, 2- to 3-flowered, compressed, scabrous to villous; glumes about 5 mm long, acuminate, the first very narrow, the second about twice as wide; lemmas 4 to 5 mm long, indistinctly 5-nerved, rather firm, somewhat keeled, awned on the back below the entire or slightly bifid apex, the awn usually bent and 2 to 5 mm long, occasionally obsolete; palea 4 to 5 mm long, membranaceous, acuminate; grain 2.5 to 3 mm long, very slender, cylindrical, attenuate, reddish-brown. (Fig. 80)

Upright, bunchy perennial, 1½ to 3 feet tall; stems glabrous or softly hairy; leaves 4 to 10 inches long, ⅛ to ⅜ inch wide, usually erect, smooth to softly hairy, usually flat but folded near the tips and ending in a sharp, rather stiff point; flowering heads rather narrow, spikelike, 5 to 8 inches long, usually about ½ inch thick, commonly silvery or yellowish, sometimes greenish.

T. glomeratum is an endemic found at higher altitudes on Hawaii, Maui, and Lanai. It is one of the most important grasses on the higher ranges on the island of Hawaii. It is almost the only forage available in some of the areas where the soil is thin and rocky.

NATIVE COUNTRIES AND DATES OF INTRODUCTION OF SPECIES

The approximate date of introduction of a grass into a given locality is important in determining its persistence, rate of spread, and abundance under varying conditions. Some species that have been in the Islands for a hundred years are found on all the islands but are of negligible importance on the range. Others are of comparatively recent introduction and are widespread. These facts take on a special significance when considered in the light of the time elapsed since their introduction.

Herein are given the native countries and dates of introduction of 239 grasses found in Hawaii. Of these, a considerable number are recent station accessions or of only occasional occurrence on the range. Thus far they are of no economic importance and have not been included in the foregoing descriptions of Hawaiian grasses.

Records as to date of introduction are usually incomplete because seeds are often imported by private individuals without passing through plant inspection. Many species, likewise, come in as impurities in seed purchased. Where no record is made of the introduction of a species, the botanist relies on the date on which it was first collected and recorded. In a few instances, species have been known to occur for many years before they were collected and officially recorded, in which cases the probable dates of introduction are given.

Information on the dates of introduction was secured from records and collections in the herbaria of the Hawaii Agricultural Experiment Station, B. P. Bishop Museum, and the Hawaiian Sugar Planters' Association, as well as from private individuals who were responsible for the introduction and collection of certain species.

Botanical Name	Common Name	Native Country	Date of Introduction
Agropyron			
cristatum	Crested wheatgrass	Eurasia	1936[4]
pauciflorum	Slender wheatgrass	Western United States	1911[4]
spicatum	Bluebunch wheatgrass	do	1911[4]
Agrostis			
**alba*	Redtop	Eurasia	1915[2]
canina	Velvet bent	Europe	1912[1]
exarata	Spike redtop	North America	1906[1]
fallax		Hawaiian Islands	
**retrofracta*		Australia and throughout Polynesia	
sandwicensis	Hawaiian bent	Hawaiian Islands	
tenuis	Colonial bent	Europe	1933[4]
verticillata	Water bent	do	1864[1]
Aira			
caryophyllea	Silver hairgrass	do	1906[1]
Andropogon			
**annulatus*	Angleton grass	Old World	1927[4]
**barbinodis*	Fuzzy top	Mexico	1906[1]
furcatus	Bluejoint turkeyfoot	Western United States	1935[4]
intermedius		Australia	1906[1]
**nodosus*	Wilder grass	Asia	1913[2]
**pertusus*	Pitted beardgrass	Old World Tropics	1916[2]
scoparius	Prairie beardgrass	United States	1935[4]
**sericeus*	Australian bluegrass	Australia	1912[2]
**virginicus*	Broomsedge	Eastern United States	1932[1]
Anthoxanthum			
**odoratum*	Sweet vernal grass	Europe	1906[1]
Arrhenatherum			
**elatius*	Tall oatgrass	do	1906[1]
Arundo			
donax	Giant reed	Old World	1906[1]

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Botanical Name	Common Name	Native Country	Date of Introduction
Avena			
**barbata*	Slender wild oat	Europe	1906[1]
**fatua*	Wild oat	do	1906[1]
**sativa*	Cultivated oat	do	1909[1]
Axonopus			
**affinis*	Narrow-leaved carpet grass	Southern United States	1912[2]
Bouteloua			
chondrosioides	Grama grass	Western United States	1937[4]
curtipendula	Side-oats grama	do	1906[1]
eriopoda	Black grama	do	1935[4]
filiformis	Slender grama	do	1937[4]
gracilis	Blue grama	do	1936[4]
hirsuta	Hairy grama	do	1936[4]
parryi	Parry grama	do	1937[4]
rothrockii	Rothrock grama	do	1935[4]
Brachypodium			
distachyon		Europe	1936[4]
Briza			
**maxima*	Big quaking grass	do	1932[1]
**minor*	Little quaking grass	do	1840[1]
Bromus			
**breviaristatus*	Short-awned bromegrass	Western United States	1936[1]
**catharticus*	Rescue grass	South America	1906[1]
**commutatus*	Hairy chess	Europe	1937[1]
molliformis		do	1906[1]
**mollis*	Soft chess	do	1906[1]
**racemosus*		do	1906[1]
**rigidus*	Ripgut grass	do	1906[1]
**gussonei*		do	1906[1]
**rubens*	Foxtail chess	do	1920[1]
sterilis		do	1920[1]
tectorum	Downy chess	do	1888[3]
Buchloë			
dactyloides	American buffalo grass	Western United States	1936[4]

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Botanical Name	Common Name	Native Country	Date of Introduction
Calamagrostis			
expansa	Large Hawaiian reedgrass	Hawaiian Islands	
hillebrandi	Hillebrand's reedgrass	do	
Cenchrus			
agrimonioides	Agrimony sandbur	do	
**echinatus*	Sandbur	Tropical America	1867[3]
**hillebrandianus*	Hairy sandbur	Hawaiian Islands	
pedunculata	Woolly Waianae sandbur	do	
Chloris			
**divaricata*	Stargrass	Australia	1932[1]
**gayana*	Rhodes grass	Africa	1906[1]
**inflata*	Swollen fingergrass	Tropical America	1906[1]
**radiata*	Radiate fingergrass	do	1851[1]
**truncata*	Australian fingergrass	Australia	1906[1]
**virgata*	Feather fingergrass	Tropical America	1916[2]
Chrysopogon			
**aciculatus*	Pilipiliula	East Indies, Hawaiian Islands	
Coix			
lacryma-jobi	Job's tears	East Indies	1895[1]
Cortaderia			
selloana	Pampas grass	South America	1925[3]
Cymbopogon			
citratus	Lemon grass	East Indies	1906[1]
nardus	Citronella grass	India	1936[1]
**refractus*	Barbwire grass	Australia	1936[1]
Cynodon			
**dactylon*	Bermuda grass	Old World	1835[3]
plectostachyum		Africa	1937[4]
Cynosurus			
cristatus	Crested dogtail	Europe	1937[4]
Dactylis			
**glomerata*	Orchard grass	do	1906[1]

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Botanical Name	Common Name	Native Country	Date of Introduction
Dactyloctenium			
**aegyptium*	Beach wiregrass	Old World Tropics	1906[1]
Danthonia			
**pilosa*	Hairy oatgrass	Australia	1910[3]
racemosa		do	1937[1]
**semiannularis*	Wallaby grass	do	1903[3]
Deschampsia			
**nubigena*		Hawaiian Islands	
Digitaria			
**henryi*	Henry's crabgrass	Formosa	1932[1]
microbachne		Probably Philippine Islands	1917[1]
milanjiana		Africa	1935[4]
pentzii		do	1935[4]
**pruriens*	Kukaipuaa	Probably Java or Sumatra	1826[3]
**pseudo-ischaemum*	Creeping kukaipuaa	Java	1906[1]
**sanguinalis*	Large crabgrass	Europe	1864[1]
**violascens*	Kukaipuaa	Tropical Asia	1917[1]
Dissochondrus			
biflorus		Hawaiian Islands	
Echinochloa			
**colonum*	Jungle-rice	India	1864[1]
crusgalli	Barnyard grass	Eastern Hemisphere	1864[1]
stagnina		Africa	1932[1]
walteri		Eastern United States	1935[1]
Ehrhartia			
calycina	Perennial veldt grass	Africa	1936[4]
erecta	Panic veldt grass	do	1936[4]
Eleusine			
**indica*	Goosegrass	India	1840[1]
Elymus			
canadensis	Canada wild-rye	North America	1935[4]
**triticoides*	Beardless wild-rye	do	1936[1]

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Botanical Name	Common Name	Native Country	Date of Introduction
Eragrostis			
abyssinica	Teff	Africa	1906[1]
**amabilis*	Lovegrass	India	1895[1]
**atropioides*	Hard-stemmed lovegrass	Hawaiian Islands	
**brownei*	Brown's lovegrass	Australia	1906[1]
**cilianensis*	Stinkgrass	Europe	1864[1]
curvula		South Africa	1935[4]
deflexa		Hawaiian Islands	
fosbergii	Fosberg's lovegrass	do	
grandis	Large Hawaiian lovegrass	do	
lehmannia		Africa	1935[4]
**leptophylla*	Mountain lovegrass	Hawaiian Islands	
mauiensis	Maui lovegrass	do	
monticola		do	
niihauensis	Niihau lovegrass	do	
**pectinacea*	Carolina lovegrass	Eastern United States	1906[1]
variabilis	Variable lovegrass	Hawaiian Islands	
Eremochloa			
ophiuroides	Centipede grass	China	1920[4]
Eriochloa			
procera	Cupgrass	Tropical Asia	1936[1]
Festuca			
**dertonensis*	Brome fescue	Europe	1860[1]
**elatior*	Tall fescue	do	1911[2]
hawaiiensis	Hawaiian fescue	Hawaiian Islands	
**megalura*	Foxtail fescue	Western America	1860[1]
**rubra*	Red fescue	Europe	1912[3]
Garnotia			
sandwicensis		Hawaiian Islands	
Gastridium			
**ventricosum*	Nit grass	Europe	1906[4]
Glyceria			
fluitans	Mannagrass	Eurasia	1906[1]
Heteropogon			
**contortus*	Pili grass	India, Polynesia	

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Botanical Name	Common Name	Native Country	Date of Introduction
Hilaria			
mutica	Tobosa grass	Western United States, Mexico	1936[4]
Holcus			
**lanatus*	Velvet grass	Europe	1906[1]
Hordeum			
**murinum*	Wild barley	do	1906[1]
nodosum	Meadow barley	Old World	1935[1]
**vulgare*	Barley	do	1906[1]
Hyparrhenia			
rufa		Africa	1933[2]
Isachne			
distichophylla		Hawaiian Islands	
pallens		do	
Ischaemum			
byrone		do	
laxum		Australia	1936[4]
Ixophorus			
unisetus	Mexican grass	Mexico	1921[2]
Lamarckia			
**aurea*	Goldentop	Mediterranean Region	1937[1]
Leptochloa			
virgata	Judd grass	Tropical America	1906[1]
Lolium			
**multiflorum*	Italian ryegrass	Europe	1906[1]
**perenne*	Perennial ryegrass	do	1911[2]
**temulentum*	Darnel	do	1906[1]
Melinis			
**minutiflora*	Molasses grass	Africa	1913[2]
Microlaena			
**stipoides*	Meadow ricegrass	Australia, Polynesia	
Oplismenus			
hirtellus	Basket grass	Tropical America	1841[3]
Oryza			
sativa	Rice	Asia	1856[3]

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Botanical Name	Common Name	Native Country	Date of Introduction
Oryzopsis miliacea		Mediterranean Region	1918[4]
Panicum			
antidotale	Giant panic grass	India	1936[4]
beecheyi	Beechey panic grass	Hawaiian Islands	
caespitosum		Australia	1937[1]
**colliei*		Hawaiian Islands	
cynodon		do	
fauriei	Faurie's panic grass	do	
forbesii	Forbes' panic grass	do	
hillebrandianum	Hillebrand's panic grass	do	
imbricatum		do	
issachnoides		do	
kaalaense	Kaala panic grass	do	
konaense	Kona panic grass	do	
koolauense	Koolau panic grass	do	
**maximum*	Guinea grass	Africa	1880[3]
molokaiense	Molokai panic grass	Hawaiian Islands	
nephelophilum		do	
niihauense	Niihau panic grass	do	
nubigenum		do	
obtusum	Vine mesquite	Southwestern United States, Mexico	1936[4]
pellitoides		Hawaiian Islands	
**pellitum*		Hawaiian Islands	
prolutum	Coolah grass	Australia	1936[4]
**purpurascens*	Para grass	Africa	1902[2]
**ramosius*		Hawaiian Islands	
**repens*	Quackgrass	Old World	1906[1]
reptans		India	1860[3]
**tenuifolium*	Mountain pili	Hawaiian Islands	
**torridum*	Torrid panic grass	do	
virgatum	Switchgrass	United States	1935[4]
**xerophilum*		Hawaiian Islands	

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Botanical Name	Common Name	Native Country	Date of Introduction
Pappophorum			
**brachystachyum*	Pappus grass	Arabia	1936[1]
Paspalum			
**conjugatum*	Hilo grass	American Tropics	1840[3]
**dilatatum*	Dallas grass	South America	1906[1]
distichum	Knotgrass	West Indies	1906[1]
fimbriatum	Panama paspalum	Tropical America	1906[1]
notatum	Bahia grass	do	1913[2]
**orbiculare*	Ricegrass	Probably southern China	Probably by early Hawaiians
**urvillei*	Vasey grass	South America	1906[1]
vaginatum		Tropical America	1937[1]
Pennisetum			
asperifolium		North America	1932[1]
ciliare		Africa	1935[4]
**clandestinum*	Kikuyu grass	do	1924[2]
complanatum		Tropical America	1921[4]
macrostachyum		East Indies	1906[1]
**purpureum*	Elephant grass	Africa	1912[2]
**ruppelii*	Fountain grass	do	1926[1]
**setosum*	Feathery pennisetum	Tropical America	1921[2]
villosum	Feathertop	Africa	1938[1]
Phalaris			
californica	California canary grass	Pacific Coast of United States	1906[1]
minor		Mediterranean Region	1906[1]
paradoxa		do	1906[1]
**tuberosa*	Large canary grass	do	1915[2]
Poa			
**annua*	Annual bluegrass	Europe	1864[1]
bulbosa	Bulbous bluegrass	do	1937[4]
compressa	Canada bluegrass	do	1906[1]
mannii	Mann's bluegrass	Hawaiian Islands	
**pratensis*	Kentucky bluegrass	Europe	1906[3]
sandvicensis	Hawaiian bluegrass	Hawaiian Islands	
siphonoglossa		do	

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Botanical Name	Common Name	Native Country	Date of Introduction
Polypogon			
**lutosus*	Ditch polypogon	Europe	1871[1]
monspeliensis	Rabbitfoot grass	do	1906[1]
Polytrias			
amaura	Java grass	Java	1921[4]
Saccharum			
officinarum	Sugarcane	East Indies	By early Hawaiians
Sacciolepis			
**contracta*	Glenwood grass	do	1906[1]
Schizostachyum			
glaucifolium		Polynesia	
Secale			
cereale	Rye	Europe	1906[1]
Setaria			
**geniculata*	Knotroot bristle grass	Tropical America	1851[1]
lutescens	Yellow bristle grass	Europe	1906[1]
palmifolia	Palmgrass	India	1906[1]
**verticillata*	Bristly foxtail	Old World	1860[3]
Sorghum			
halepense	Johnson grass	Mediterranean Region	1906[1]
vulgare	Sorghum	Africa	1860[3]
Sphenopholis			
**obtusata*	Prairie wedge grass	United States	1935[1]
Sporobolus			
airoides	Alkali sacaton	Western United States	1936[4]
**capensis*	Rattail grass	South Africa	1906[1]
**diander*	Indian dropseed	India	1906[1]
elongatus		Australia	1925[1]
flexuosus	Mesa dropseed	Western United States	1936[4]
**indicus*		Tropical America	1912[3]
poiretii		do	1936[1]
virginicus		do	1864[1]
wrightii	Sacaton	Western United States	1936[4]

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Botanical Name	Common Name	Native Country	Date of Introduction
Stenotaphrum			
**secundatum*	Buffalo grass	Southeastern United States	1816[1]
Stipa			
papposa		Uruguay, Argentina	1936[4]
Themeda			
australis	Kangaroo grass	Australia	1936[4]
gigantea		Philippines	1936[1]
Tragus			
**berteronianus*	Bur grass	Old World	1935[1]
Trichachne			
**insularis*	Sour grass	Tropical America	1906[1]
Tricholaena			
**repens*	Natal redtop	Africa	1895[2]
Trisetum			
**glomeratum*	Heu pueo	Hawaiian Islands	
inaequale		do	
Triticum			
aestivum	Wheat	Asia	1792[3]
Zea			
mays	Corn	America	1792[3]
Zizania			
latifolia	Wildrice	Asia	1936[1]
Zoysia			
tenuifolia	Korean velvet grass	Mascarene Islands	1906[1]

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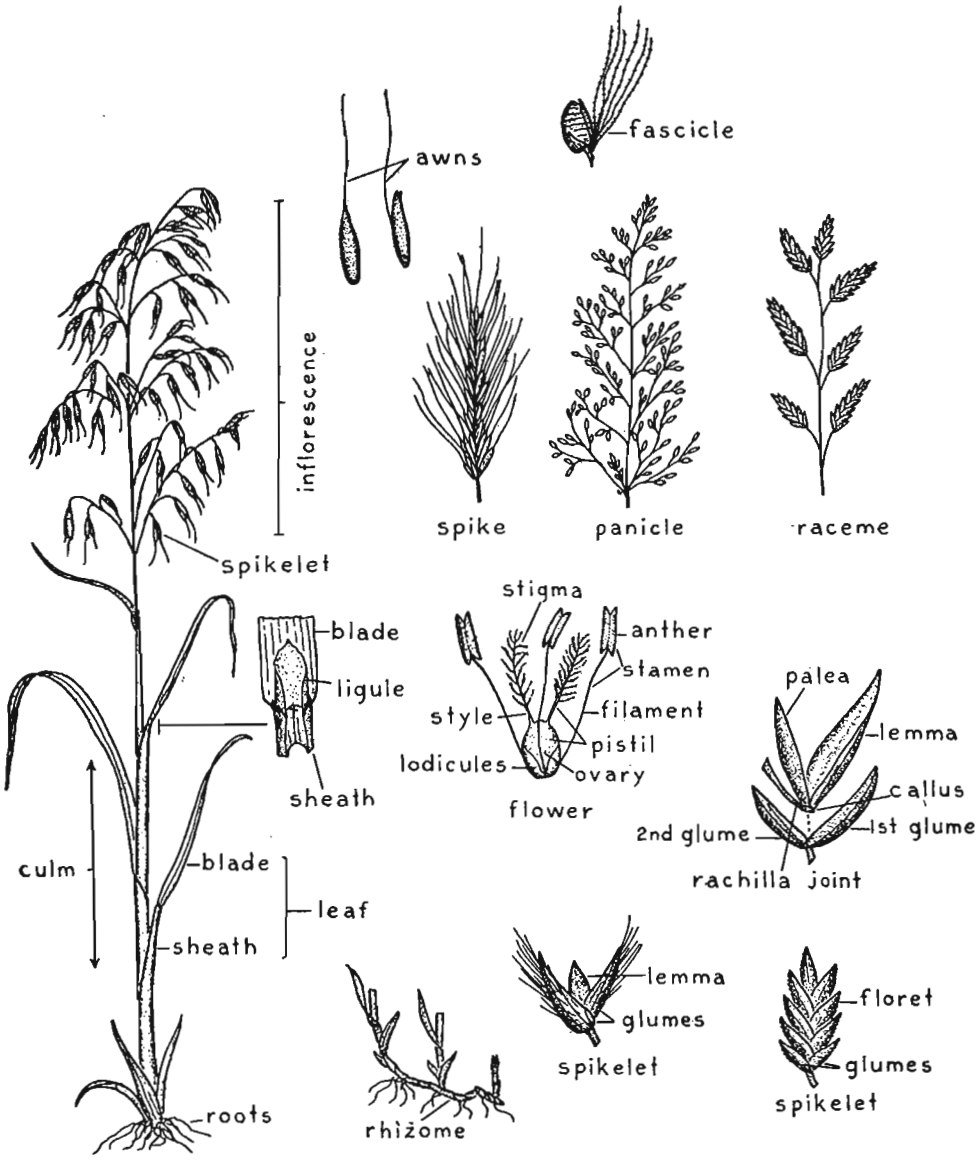
ILLUSTRATED GLOSSARY



GLOSSARY OF BOTANICAL TERMS

ACUMINATE. Gradually tapering to a sharp point.

ACUTE. Rather abruptly tapering to a sharp point.

ANNUAL. A plant completing its life cycle within a year.

AGGREGATE. Concentrated in groups, bunches, or tufts.

ANTHER. Sac-like portion of the stamen containing the pollen.

ANTHESIS. The period in which the flower is open.

APICULATE. Having a minutely pointed tip.

APPRESSED. Lying close to or flat against an organ.

ARACHNOID. Composed of slender entangled hairs; cobwebby.

ARISTATE. Having a beardlike appendage; awned.

ASCENDING. Growing somewhat obliquely or curving upward.

ATTENUATE. Gradually tapering to a slender apex or base.

AURICLES. Earlike appendages at the base of a blade or at the summit of a sheath.

AURICULATE. Provided with earlike appendages.

AWN. A slender, bristle-like appendage.

AXIL. The angle on the upper side between an organ and its axis.

AXIS. The central line running lengthwise through any organ or group of organs; the central support; the main stem of the panicle.

BEAK. A hard prolonged tip, usually applied to ends of seeds and fruits.

BI-. A Latin prefix meaning two.

BIENNIAL. A plant completing its life cycle within 2 years.

BIFID. Two-cleft or two-lobed.

BRISTLE. A stiff slender appendage, like the bristles of a brush.

CALLUS. The basal extension of the mature lemma appearing as a hard, often hairy protuberance.

CANESCENT. With grayish-white covering of soft, short hairs.

CAPILLARY. Very slender; hair-like.

CARINATE. Having a keel.

CARTILAGINOUS. Firm and tough; with cartilage-like texture.

CENTIMETER, (cm). 1/100 of a meter; 0.39 of an inch.

CESPITOSE. Having low stems growing in close clusters, forming tufts.

CHARTACEOUS. Papery or parchmentlike in texture.

CILIATE. Marginally fringed with hairs, like an eyelash.

CILIOLATE. Minutely ciliate.

CLEISTOGAMOUS. Having flowers fertilized by their own pollen within the closed bud.

COLLAR. The area on the outside of the grass leaf at the junction of sheath and blade.

COMPRESSED. Flattened laterally.
CORIACEOUS. Resembling the texture of leather.
CULM. The jointed stem of grass.
CUNEATE. Widening upward from a pointed base; wedge-shaped.
DECIDUOUS. Falling away or subject to fall.
DECUMBENT. Rising upward from a reclining base.
DENTATE. Toothed, usually with the teeth pointed outward.
DEPAUPERATE. Small, usually implying impoverishment; below normal size or dwarfed.
DICHOTOMOUS. Nearly equally two-forked.
DIGITATE. Having several members arising together at the summit of the support; spreading like the fingers of a hand.
DISARTICULATING. Separating at the joints or nodes at maturity.
DISTICHOUS. Arranged in two ranks on opposite sides of the stem.
DIVARICATE. Stiffly spreading at a wide angle.
DORSAL. Borne on or relating to the back of an organ.
ELLIPTIC. Shaped like an ellipse; about one-half as long as broad.
ELONGATE. Long and narrow.
EMARGINATE. Shallowly notched at the apex.
ENDEMIC. Growing only in a particular geographic area.
EROSE. Irregularly notched at apex or on margin, as if gnawed.
EXSERTED. Protruding out of and projecting beyond surrounding organs.
FASCICLE. A small dense cluster or bundle.
FIBRILLOSE. Composed of fibers or fiber-like organs.
FILAMENT. The stalk supporting the anther, the two making up the stamen.
FILIFORM. Long and slender; thread-like.
FIMBRIATE. Fringed along the margins.
FLABELLATE. Fan-shaped.
FLEXUOUS. Bending alternately in opposite directions; zigzag.
FLORET. The lemma and palea with the enclosed flower.
FUSIFORM. Thickest near the middle and tapering toward each end; spindle-shaped.
GENICULATE. Abruptly bent; knee-like.
GLABROUS. Not rough; free from hairs.
GLANDS. Small areas which secrete oil or other products, usually appearing as minute depressions or protuberances.
GLAUCOUS. Covered with a bluish or pale-greenish bloom that rubs off.
GLUMES. The outer bracts at the base of the spikelet.
HIRSUTE. Covered with long stiff hairs.
HIRTELLOUS. Minutely hirsute.
HISPID. Covered with stiff rigid hairs.
HISPIDULOUS. Minutely hispid.
HYALINE. Thin and transparent, or nearly so.

IMBRICATE. Overlapping, like shingles on a roof.

INCLUDED. Enclosed by and not protruding beyond surrounding organs.

INDURATE. Hardened or becoming tough.

INFLEXED. Turned in rather flatly at the margins.

INFLORESCENCE. The flowering part of the plant.

INTERNODE. The portion of a stem between two successive nodes.

INVOLUTE. Rolled inward from the margins.

KEEL. A prominent central dorsal rib or ridge, resembling the keel of a boat.

LACERATE. Irregularly cleft along the margin as if torn.

LANCEOLATE. Broadest below the middle and tapering toward both ends; shaped like a lance-head.

LEMMA. A bract of the spikelet above the glumes, the outer bract subtending the individual flower.

LIGULE. A thin, exserted, collar-like appendage on the inside of the leaf at the junction of the blade and sheath.

LINEAR. Long and narrow, with the sides nearly parallel.

MEMBRANACEOUS (membranous). Thin, soft, and rather pliable; of the texture of a membrane.

METER (m) The standard unit of linear measurement of the metric system; about 39.37 inches.

MIDRIB. The main rib or vein of a leaf.

MILLIMETER (mm). 1/1000 of a meter or 1/10 of a centimeter; 0.039 of an inch.

MUCRONATE. Tipped with a short, sharp, abrupt point.

NEUTER. Sexless, as a flower which has neither stamens nor pistils.

NODE. A joint of the stem where a leaf usually arises.

OB-. A Latin prefix meaning reversed.

OBSOLETE. Not evident or verging upon complete suppression.

OBTUSE. Blunt or rounded at the apex.

OVARY. The basal portion of the pistil which bears the ovules or future seeds.

OVATE. Egg-shaped, with the broader end downward.

OVOID. An egg-shaped solid.

PALEA. The inner bract subtending the individual flower.

PANICLE. A compound flower cluster with a main axis and subdivided branches.

PAPILLOSE. With small nipple-shaped projections.

PEDICEL. The support or stalk of a spikelet.

PEDICELLATE. Borne on a pedicel.

PEDUNCLE. The stalk of an inflorescence.

PERENNIAL. A plant unable to complete its life cycle in 1 year; living longer than a year.

PERFECT. A bisexual flower; having both pistil and stamen.

PERICARP. The wall of the ripened ovary or fruit.

PILOSE. Bearing long soft hairs.

PISTIL. The female or seed-bearing organ of the flower.

PLANOCONVEX. Flat on one side and convex on the other.

PLICATE. Folded into longitudinal plaits.

PLUMOSE. Finely branched, with fine hairs on each side resembling a plume or feather.

PRICKLE. More or less slender, short, sharp, hard outgrowth of the epidermis.

PROCUMBENT. Lying on the ground without rooting at the nodes and with ascending tips.

PUBERULENT. Covered with short, fine or almost imperceptible hair.

PUBESCENT. Hairy; usually a general term for hairiness.

PULVINUS. A cushionlike swelling at the base of branches which causes them to spread.

PUNCTATE. Dotted with minute depressions.

RACEME. An inflorescence with pedicellate spikelets arranged along the side of the rachis.

RACHILLA. A secondary axis; the axis of a spikelet.

RACHIS. The axis of a spike or raceme.

RADIATE. Spreading from or arranged around a common center.

RETRORSE. Directed backward.

RHIZOME. A creeping underground stem.

RHOMBOIDAL. More or less quadrangular with lateral obtuse angles.

RUGOSE. Wrinkled.

SACCATE. Bearing distended, saclike or pouchlike bodies.

SCABROUS. Rough to the touch.

SCARIOUS. Thin, dry, membranaceous, usually translucent; not green.

SCURFY. Appearing as though covered with minute scales.

SESSILE. Without a stalk of any kind.

SETACEOUS. Bristle-like.

SHEATH. The tubular basal portion of the leaf that encloses the stem of a grass.

SINUATE. Having strongly wavy margins.

SPATHE. A large bract enclosing the inflorescence.

SPIKE. A simple inflorescence with sessile or nearly sessile spikelets arranged along the main axis or rachis.

SPIKELET. A small or secondary spike; the unit of the flowering part of a grass.

STAMEN. The male or pollen-bearing organ of a flower.

STERILE. Barren or unproductive; not capable of producing seed.

STIGMA. The part of the pistil that receives the pollen.

STIPE. A minute, stalk-like support of an organ.

STOLON. A trailing or reclining stem rooting on the surface of the ground.

STRIATE. Marked with fine longitudinal lines or stripes.

STRICT. Narrow and stiffly upright.

STYLE. The slender stalk between ovary and stigma.

SUB- A Latin prefix meaning somewhat or nearly.

SUBCUCULLATE. Somewhat hood-shaped.

SUBULATE. Tapering rather abruptly from a broad base to a sharp point; awl-shaped.

TAWNY. Dull yellow with a brown tinge.

TERETE. Slenderly cylindrical.

TOMENTOSE. Densely covered with cottony or woolly hairs.

TOMENTULOSE. Minutely tomentose.

TRUNCATE. Ending abruptly in a nearly square apex, as if cut off at the end.

TUBERCULATE. Bearing small pimple-like projections.

TUFTED. Growing in close clusters.

TUSSOCK. A very dense bunch or tuft.

UNCINATE. Bent or hooked inward at the apex.

UNDULATE. With a wavy surface or margin.

VERTICELLATE. With organs arranged in whorls, as several leaves or branches at a node.

VILLOUS. Covered with long soft hairs.

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