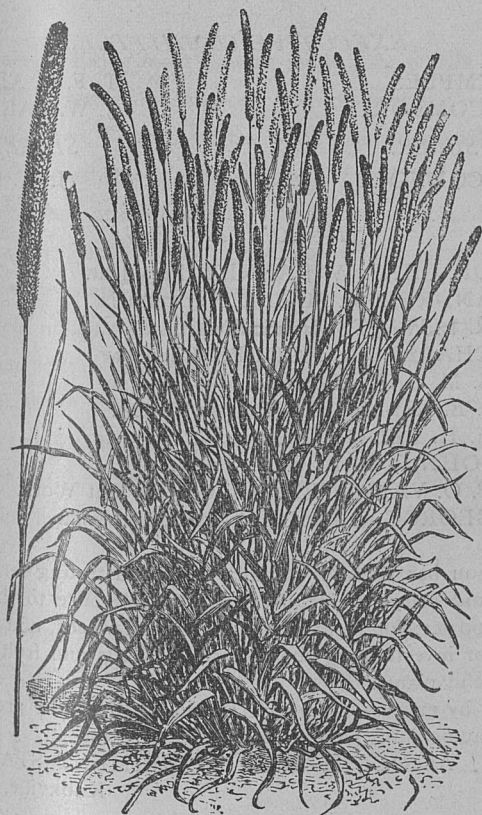


UNIVERSITY OF TENNESSEE
Agricultural Experiment Station
BULLETIN



Phleum pratense.—Timothy.

VOL. XI.

JUNE, 1898.

No. 2.

GRASSES AND FORAGE PLANTS

By J. B. KILLEBREW, A.M., Ph.D.

PART I.—DOMESTICATED GRASSES

KNOXVILLE, TENN.
THE UNIVERSITY PRESS
1899

THE AGRICULTURAL EXPERIMENT STATION

OF THE UNIVERSITY OF TENNESSEE.

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The Station has facilities for analyzing and testing fertilizers, cattle foods, milk and dairy products; seeds with reference to their purity or germinating power; for identifying grasses and weeds, and studying forage plants; for investigating the diseases of fruits and fruit trees, grains and other useful plants.

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Knoxville, Tennessee.

 The Experiment Station building, containing its offices, laboratories and museum, and the plant house and horticultural department, are located on the University grounds, fifteen minutes walk from the Custom House in Knoxville. The Experiment farm, dairy barn, stables, milk laboratory, etc., are located one mile west of the University, on the Kingston pike. Farmers are cordially invited to visit the buildings and experimental grounds.

Bulletins of this Station will be sent, upon application, free of charge, to any Farmer in the State.

NOTE.

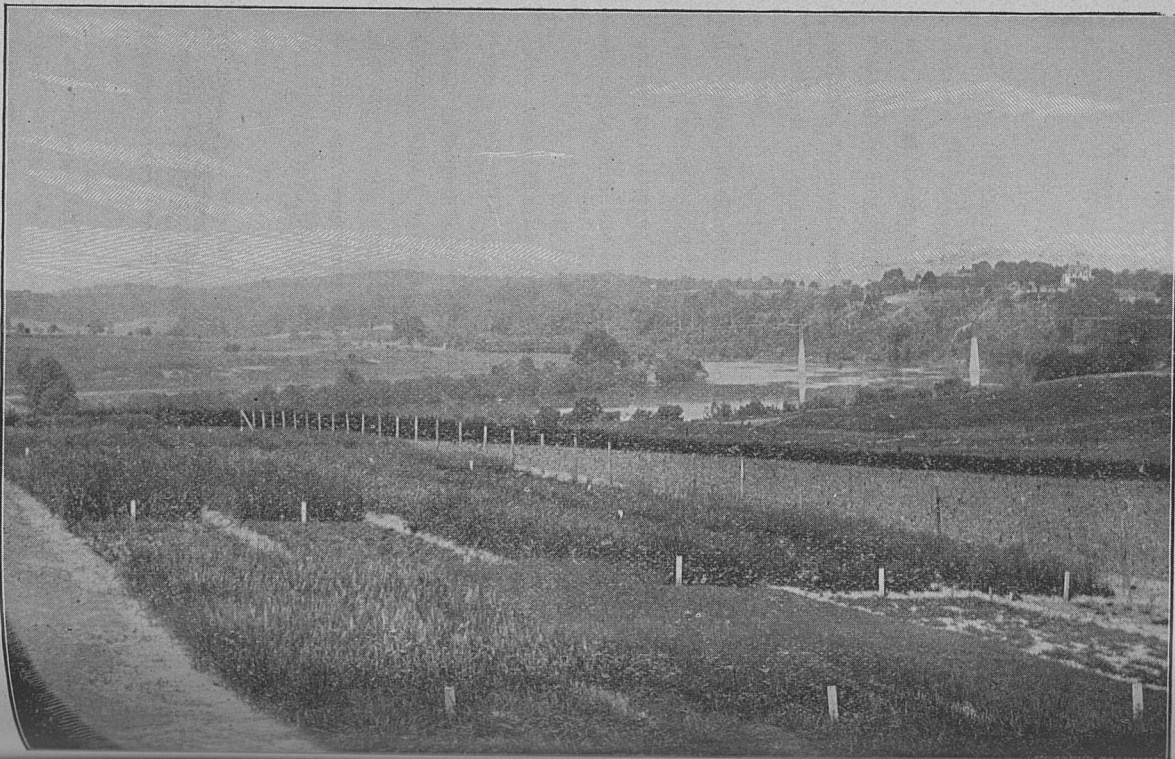
The Tennessee Experiment Station published, in 1892 and 1894, two bulletins on The Grasses of Tennessee, from the pen of Prof. F. Lamson-Scribner, at that time Botanist of the Station, now Agrostologist of the United States Department of Agriculture. Part I. of this work was a handy reference book of information as to the general character and quality of our grasses; Part II. was a handbook of the grasses of the State, with full descriptions and illustrations.

The present publication is the first of a series of bulletins which will discuss the methods of cultivating and using the domesticated grasses and forage plants of Tennessee, of establishing and maintaining permanent meadows and of harvesting and using the various kinds of forage. It is designed thus to complete the former series.

The Station has been fortunate in securing, to prepare this new series, the services of Col. J. B. Killebrew, A. M., Ph. D., probably the greatest authority in the South upon the culture and uses of grasses and forage plants, whose work on the grasses and forage plants of Tennessee, published in 1878, now entirely out of print, remained until the present time the best manual on the subject. The present work gives the result of twenty years' additional study and experience in the cultivation of grasses and forage plants.

The analytical engravings of grasses in this Bulletin were made by Prof. F. Lamson-Scribner. A few of the larger cuts are from Scribner's translation of Haeckel's "True Grasses." The half tone engravings are from Tennessee and Southern sources.

CHAS. W. DABNEY, President.



PREFACE.

This is a practical work on grasses, prepared by a practical man, for practical farmers. The basis of the work is the author's experience on his own farm, supplemented by his observations of the making of meadows and pastures in nearly every state and territory in the Union. This experience and these observations have been fortified by a diligent study of the literature on grasses in this country, and from Great Britain as well.

Among the works, which have afforded him the greatest aid are the bulletins issued by the United States Department of Agriculture, and by the various experiment stations. He is especially indebted to F. Lamson-Scribner, probably the most accomplished agrostologist in America, for many years botanist of the Tennessee station, now of the United States Department of Agriculture. The works of Rev. C. W. Howard, of Georgia; of Dr. Phares, of Mississippi; of Dr. Gattinger, of Tennessee; of Prof. J. Stanton Gould, of New York; of Prof. C. L. Flint, of Massachusetts; of Prof. Beal, of Michigan; of Edmund Murphy, of Ireland and Margaret Flues, of England, have been freely consulted, and to all of them the writer acknowledges his indebtedness for valuable, practical suggestions. In addition to these the agricultural reports of the various states have been consulted. The old files of the "Rural Sun" contain many admirable articles on the grasses, and these have been frequently used.

The author hopes that this work will meet the demands of many farmers of Tennessee, who are anxious to enter more extensively upon the cultivation of the grasses, and that it will supplement the excellent scientific work already done by our Experiment Station to the great benefit of agriculture in Tennessee.

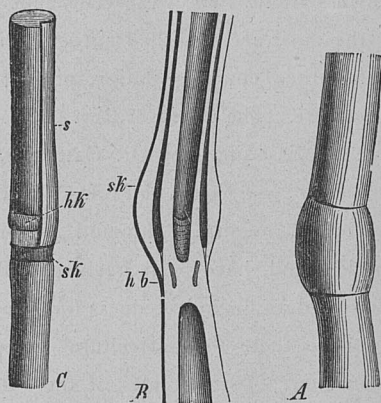
J. B. KILLEBREW.

GRASSES AND FORAGE PLANTS.

INTRODUCTION.

No vegetable products of the soil are of such transcendent importance to mankind as are the grasses. Included in the family of grasses are all the cereals that furnish the important bread-grains upon which the largest number of the population of the globe subsists. The animals, domestic and wild, that furnish meat for the sustenance of the most civilized portion of the human family feed upon grasses. Indeed it is difficult to see how the people of our planet could survive the entire destruction of the grass family.

The vast importance of grasses in the creation of wealth is difficult to estimate. The annual production of hay in the United States according to the eleventh census was 66,831,480 tons, grown on 52,948,797 acres.

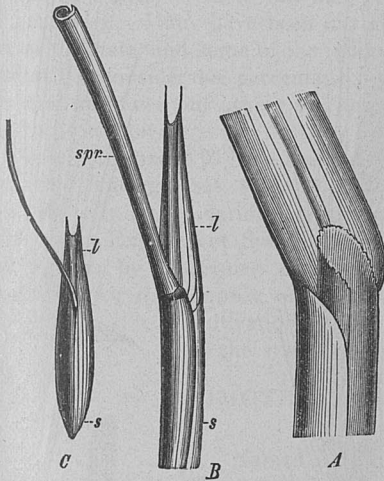


A. Fragment of culm of wheat with sheath-node, somewhat bent. B. Longitudinal section of the same; sk, sheath-node; hb, point of insertion of the sheath. C. *Andropogon*; the sheath is removed on the left side in order to show the culm-node, hk; sk, sheath-node.

having a farm value, taking the average of four years, of \$514,602,000. There is no crop that surpasses the hay crop in value. The corn crop follows one year with another, runs nearly equal in value. The wheat crop follows with an annual value for a full crop of \$425,000,000. This is followed by the cotton crop, the value of which rarely exceeds \$300,000,000. But in this estimate of the value of grass to the country no account has been taken of the value of pastures. In area, the pasture grasses occupy at least two acres to one of meadow grasses, and the value of their annual production cannot be less than that of the meadows. This will make the total approximate value of the grass crop \$1,029,204,792. The making of

"two blades of grass to grow where only one grew before" is the most certain road to wealth and commercial supremacy. But even corn and wheat are the matured fruit of the grasses, as well as oats, rye, barley, rice and nearly all other bread-grains that enter into the commerce of the country. Exclude the grasses from agriculture and the value of farm products would be reduced fully five-sixths.

HOW TO TELL A GRASS.—At the very outset several important questions likely to be asked by the unscientific farmer, should be answered. How shall I tell a grass? What are its most distinguishing characteristics? How shall I separate it from other forms in the vegetable kingdom? Without attempting to instruct such a farmer in the science of botany a few elementary principles may be laid down, which will aid him in determining a grass from other lowly forms of vegetable life and may lead him to a more extensive study in this delightful field of inquiry.



Point of separation of the sheath (s) and blade (spr). A. In *Dactylis glomerata* L. B. In *Ammophila arundinacea* Host. l. Ligule. C. Flowering glume of *Bromus Alopecurus* Poir.

1—A true grass, with rare exceptions, has either a hollow stem; or it is filled with pith, like Indian corn or broom grass, commonly called "broom sedge."

2—A cross section of the stem is circular or elliptical, but generally round.

3—The stem or stalk or culm of a grass is divided into sections and the continuity of the hollow in the stalk is broken by cross partitions. These partitions are located at the *nodes*. The parts of the stalk between the nodes are called joints or internodes. In other words the stalk or culm is separated like pipe stems or fishing poles by the intervention at intervals of a solid partition, which partition closes the tube.

4—The leaves of grasses are always alternate, that is, only one at a joint. The leaves have a sheath that encloses the stem, but this sheath

is never a solid cylinder. It is split or open on the side opposite the leaf. The blade of the leaf is narrow, and its nerves or veins are parallel to each other, forming raised ribs on the underside that run the whole length of the leaf. In grasses the third leaf overhangs the first and the fourth overhangs the second. In sedges the fourth leaf will stand over the first and the fifth over the second. This is an easy way of distinguishing a grass from a grass-like sedge. Another important thing to remember is that sedges always have closed sheaths.



Rye.



Barley.

Two useful plants in the family of grasses.

PART I.

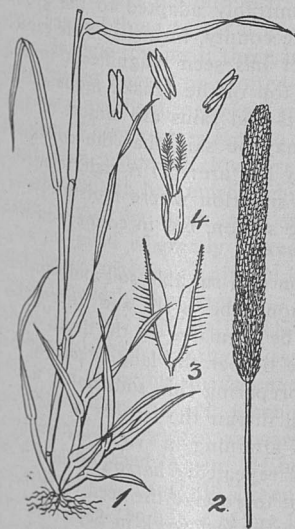
DOMESTICATED GRASSES.

Between the Mississippi River and Atlantic ocean there are known to exist about 295 species of grasses indigenous to the soil. Between the Mississippi River and the Rocky Mountains there are 190 species, 60 species belonging to that region exclusively. This makes a total of 355 species of grasses from the Rocky Mountains to the Atlantic ocean. There are 250 that have been found between the Pacific ocean and the Rocky Mountains, many of which are common to the other sections of country. It may, with confidence, be said that there are not less than 350 grasses indigenous to the United States. Nearly one-half of these are found within the State of Tennessee. Many have been introduced and are cultivated in every part of the state, and some of the indigenous grasses also have been domesticated. A considerable percentage of them are valuable for making pastures and meadows but others are unmitigated pests and worthless for any purpose whatever.

Out of all this number of grasses, 29 have been selected for discussion in detail in this bulletin. The grasses selected have, in nearly every instance, been tested not only in the various experiment stations in the south and especially at our Experiment Station at Knoxville, but they have been successfully grown by the farmers of the state. A few grasses have been mentioned, not for the purpose of recommending them for cultivation, but to warn the farmers of the state against them.

TIMOTHY — (*Phleum pratense*.)— (Meadow Grass.)

Named for Timothy Hansen, of North Carolina, who introduced it into this country from England in 1720. Timothy has become the most popular, the best known and the most profitable hay grass in the United States. This popularity is due not altogether to its superiority in nutritive elements, but largely also to the fact that it makes the standard hay of commerce, with which all other kinds are compared. It is sold in all the markets of the country, and its price is quoted in all the leading commercial journals. In buying this hay therefore, one knows precisely what he is paying for. He knows how much to feed



Timothy—*Phleum pratense*.

1. The base of plant.
2. Inflorescence.
3. Empty glumes.
4. Floret.

and what result to expect from it. It is graded like cotton, tobacco and wheat, and it is the only hay that is in universal demand. For this reason, more than for any other, it is the most profitable, because the sale of it is most certain.

SOILS—Timothy is a perennial grass and grows best upon a moist, tenacious, rich soil. It does not thrive on high, dry or sandy lands, however fertile they may be. The best situation is valley land having a soil rich in calcareous matter and humus, not too loose or friable but with a sufficiency of clay in its composition to make it reasonably compact. Timothy starts slowly in the spring and it does not take so rank a hold upon the soil as many other meadow grasses do. It is not suited for pasturage, for it has but little aftermath and the tramping of stock soon destroys it.

In Tennessee the best lands for its growth are found in the valley of East Tennessee upon calcareous soils, in the Central limestone basin of Middle Tennessee, and in the northern and western counties of West Tennessee. Many of the bottom lands on the Cumberland River and its tributaries are eminently adapted to its growth. It is unfitted generally for the dry and cherty lands of the Highland Rim. The conditions favorable for its growth, however, may be found in the elevated basins of Montgomery, Robertson and Stewart counties, as well as those in Franklin, Warren and other counties lying at the western base of the Cumberland Mountains where the soils have a large content of the carbonate of lime. On all the bottom lands lying on the streams of those counties suitable soils are found, except where there is a predominance of sand and gravel. Many of the bottoms lying on little Tennessee River in East Tennessee and on Pigeon River are admirably adapted to the growth of timothy. Powell's Valley, in Claiborne county, furnishes soils capable of growing very large crops. The writer has seen magnificent timothy meadows in the elevated coves near the top of the Unaka mountains in Johnson and Carter counties, where mists and rains are almost of daily occurrence in summer. In general it may be said that the conditions most favorable for the growing of timothy hay are: (1) A rich, tenacious, calcareous soil with some humus; (2) a situation where moisture is retained in the soil throughout the growing season, but in connection with good drainage.

PREPARATION—After the selection of a suitable soil and situation for the growth of timothy, the land should be well and thoroughly broken. The depth of the plowing must be regulated by the depth of the soil. On deep, rich, alluvial bottoms the deeper the land is plowed the better. Care, however, must be taken in preparing thin soils not to throw too much clay to the surface, for this will impair the fertility of the seed bed and prevent the young plants from attaining a vigorous vitality. When the soil has been well broken, and repeatedly harrowed until it is thoroughly pulverized, it is in a condition to receive the seed. The best time for sowing this grass in Tennessee is the last week in September or the first week in October, after the dry hot weather has been tempered by cool nights, heavy dews and frequent rains. It is best not to sow the seed until the ground is moistened by rain, otherwise the heavy dews may

cause the seed to germinate when the hot suns of mid-day are likely to destroy the young plants.

The quantity of seed to be sown is regulated somewhat by the character of the soil. On rich, heavy, deep soils a third of a bushel to the acre will not be too much; on thin light soils, two gallons per acre will be ample. The seed may be sown with a drill and probably it will increase the future crop for the land to be afterwards rolled. The sowing may be done by hand, the width of the spaces sown being regulated by stakes. Eight feet is as wide a space as one should attempt to sow. It is best to sow the land with one-half of the seed and then cross-sow it. This will insure a more even distribution of the seed. After sowing a light drag brush or roller, or both, should be run over the land so as to slightly bury the seed and produce rapid germination. The drag brush used for this purpose should be light.

The best crop to precede timothy is tobacco, or some clean-hoed crop. The next best is a crop of millet or Hungarian grass sown in the summer and harvested in September. This leaves the land clean and free from any noxious vegetation. Many persons, after the removal of the millet, do not rebreak the land but harrow it well and immediately sow the timothy seed. With such preparation they claim they are able to secure a better stand than in any other manner. This result is no doubt largely dependent upon the character of the soil.

Timothy rarely does well when sown with wheat or rye in the fall, or with oats in the spring. The only reason assigned for thus sowing it is that it saves one preparation of the land, but in trying to economize in this work it often follows that the wheat crop is injured, while the timothy crop is put off one year and frequently completely fails. It is a most unusual thing to get a good stand of timothy when it is sown with grain; in thus sowing it there is great danger of entirely losing the seed or of having a meadow spotted with many vacant places.

Many excellent meadows are made by sowing with the timothy seed a gallon of herd's grass seed to the acre with a slight sprinkling of clover seed. One gallon of clover seed for ten acres will be sufficient. The hay thus mixed has more richness or nutriment, has a better flavor, is more relished by stock, and, indeed, is a complete food. At the same time the yield is greatly increased. The amount of clover will not be sufficiently large to impair the keeping qualities of the hay or to make it easily injured by dampness.

CUTTING AND CURING—The best time for cutting timothy to make the largest quantity of sweet hay is when it has stopped blooming and a few of the blooms begin to fall. The best cutting stage is limited, extending from the time when the first blooms begin to fall to the time when the first dry spot appears above the first joint and half the blossoms have turned brown. If mowed before the blooms begin to fall the vitality of the plant will be endangered. If mowed after the stalk has become hard, the hay is of but little value for the nourishment of animals. Cut at the right stage, every part of the plant is palatable to stock. The culm or stem, which forms such a large proportion of the whole at this period, is soft and tender and the blades are green and succulent through-

out. If the time of cutting is deferred until the seed begins to ripen many of the blades will be dry and the stalk will be yellow and hard for a considerable portion of its length. It will be woody, indigestible as food, and a great part of its value will be lost. When timothy is over-ripe it has very little more value than oat-straw for feeding. When cut in its prime it has no superior as a hay.

Timothy hay cures quickly. It should remain in the sun only long enough to assure it against mould. After it is well wilted it must be raked into wind-rows and afterwards made into small cocks four feet in diameter at the base and about five feet high, well pointed and rounded off at the top. Within a day or two, the hay will be cured sufficiently to put into permanent ricks or stacks, or to be stored in an open shed, from which it may be baled and sent to market. If a rain should unfortunately fall while the hay lies in wind-rows or in cocks, wetting it to a considerable depth, it must be immediately opened to the sunlight until it is dried out. It is best for the quality of the hay that not a single drop of rain fall upon it and that it be cured, as far as possible, with the least amount of sunshine. This method will make sweet, fragrant and nutritious hay of prime quality with excellent color.

When the saving of seed is the main object, timothy should not be cut until the heads are fully ripe. A good thick stand of timothy upon rich land should yield from eight to twelve bushels of seed to the acre, weighing 45 pounds to the bushel, which is the legal weight in Tennessee. Of timothy seeds there are about 75,000 in an ounce.

Heavy rains or strong winds are to be feared after the heads are fully ripe, for they beat out the seeds and largely diminish the yield. In cutting timothy for seed the self-binder should be used, and the grass tied up in bundles like wheat or oats, and put up in shocks where it must remain for two weeks or more, until it is dried thoroughly and is ready for the thresher. The fewer times the bundles are handled, after being fully dried, the less will be the loss of seed.

The yield of timothy hay on fertile valley lands sometimes reaches three or four tons an acre. It often attains a height of five feet with heads from eight inches to a foot in length. A bottom field lying on Red river in Montgomery county was sown by the writer in 1858 with a mixture of timothy and herd's-grass. It was sown the latter part of September. The following summer thirty tons of excellent hay was sold from ten acres and two or more tons were retained for home consumption. The soil of this meadow was a calcareous loam with a deep red, well-drained, unctious, clayey subsoil. The meadow lasted for twelve years and yielded heavy crops of hay every year, until it was finally plowed up to give place to a tobacco crop.

Timothy is thought to be a great exhauster of the soil. This is doubtless true, but its capacity in this respect is not greater than that of Indian corn, wheat or tobacco. It has been well said that a crop that does not exhaust the soil is not worth gathering; that it is impossible to get from the soil something for nothing. The duty of every farmer is to restore to the soil, by commercial fertilizers or by home-made manures, some of the valuable nutritive elements that are taken from it by the crops.

STACKING OR RICKING HAY—There is no particular skill required in making stacks. A pole about twelve or fifteen feet long should be planted firmly in the ground. Around this a platform for the foundation of the stack should be built. This should be ten or twelve inches high and as broad as the proposed diameter of the stack. The bottom of the stack or rick should cover this platform completely and for the height of six or eight feet the stack should be broadened out so as to throw any rain that may fall upon it outside of its base. The most convenient size of stack for a majority of farmers is one that will contain four or five wagon loads of hay, a quantity that may be hauled up in a day or conveniently accommodated in the stock barn. When a stack is once broken the whole of it must be carried to shelter or it is liable to be caught and injured by rain. In stacking, the hay should be compacted around the pole and practice alone will teach one how to preserve the symmetry of the stack and give to it the lines of beauty and utility. The handrake must be used in combing down the sides of the stack.

A rick may be made of any required length with a width at the base of from 12 to 15 feet. This width should be gradually increased to the height of seven feet or more. No poles are necessary in the making of a rick, but a good substantial platform for the hay to rest upon is necessary. The width of the rick after the height of seven or eight feet should be gradually contracted like the roof of a house. The rake should be freely used in combing the sides. It is necessary when first put up to secure the top against strong winds by passing grass ropes over the rick and fastening them to the ground on each side. These ropes must be put at intervals of six or eight feet throughout the entire length of the rick. After the hay has been well settled, the ropes may be dispensed with.

The use of hay knives, which have recently been introduced, enables the farmer to haul away just such quantities of hay from his rick as he may desire. With these knives a vertical section is cut from one end cleanly and evenly from the top to the bottom of the rick. The introduction of hay knives has made the rick more popular than the stack.

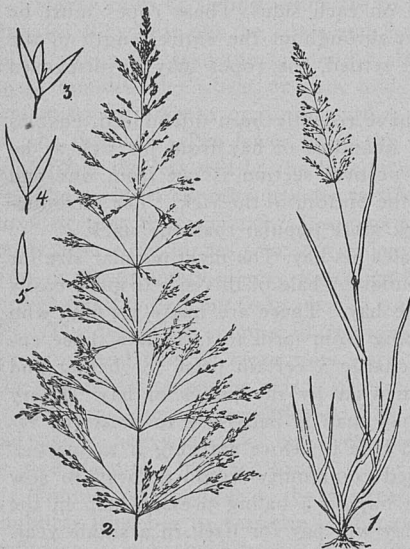
Every large hay-grower now bales his hay. The most popular size for a bale is one that will weigh 100 pounds. A bale of this size is more easily handled, and thus adds value to the hay. There are many persons who make a business of baling hay, going from farm to farm like those engaged in threshing wheat. They charge a certain price for baling and furnishing the wire, regulated somewhat by the prices of hay. Every farmer who raises more timothy hay than is necessary to meet the requirements of his own farm should bale it before carrying it to market. The farmers in every thickly settled community would do well to sow timothy enough to justify them in buying a baling press, which in the marketing of 300 or 400 acres of hay will pay for itself in a single year. The press could also be used in baling clover hay and wheat straw, the latter being worth when baled, four dollars per ton or more.

A FEW PRECAUTIONS—(1) Do not sow without testing beforehand the power of germination in the seed.

- (2) Do not sow anything but clean seed. Examine for noxious seeds with a magnifying glass.
- (3) Do not sow when the soil is very dry and cloddy.
- (4) Do not cover the seeds to a greater depth than one-fourth of an inch. When covered 2 inches very few, if any, will germinate.
- (5) Do not pasture a timothy meadow at any time; the destruction of the bulbous roots will soon exterminate the grass.
- (6) Do not cut the grass below the first joint.
- (7) Do not forget that blue-grass is the arch enemy of a timothy meadow. Therefore never permit stock from a blue grass pasture to roam over a timothy meadow.
- (8) Do not fail to exterminate all bunches of "broom-sedge" and all "yellow dock" that may appear in the meadow during the summer. Never let these go to seed.
- (9) Above all do not forget to top dress your meadow with suitable manure in the fall of the year and with superphosphate in the spring. Feed your meadow and it will feed you.

HERD'S GRASS, RED TOP, FINE BENT, FIORIN, (*Agrostis alba* or *Agrostis vulgaris*).—(Pasture and Meadow.)

Recent botanical investigations have determined the fact that herd's grass is greatly modified by climate, soil and situation. The most appropriate name for it is probably *agrostis polymorpha*, on account of the many forms which it assumes when subjected to different conditions.



Herd's Grass, Red Top—*Agrostis alba*.

2. Panicle. 3. Spikelet. 4. Empty glumes.
5. Flowering glume.

whatever name it may be designated in various localities it is one of the most useful agricultural grasses of the south. It will grow upon every soil, and will give more general satisfaction to the farmer than any other grass. It is scattered over the whole state of Tennessee. The writer has seen it growing luxuriantly upon the highest mountains of East Tennessee, as well as in the deepest valleys; on the sandstone soil of the Cumberland table-land, and upon the cherty soils of the highland rim. It sparkles in the beauty of its verdure on the limestone soils of the central basin and acquires its largest growth in the sandy river and creek basins of West Tennessee. There is no place in

Tennessee in which it does not prove a profitable grass to the farmers.

Even upon the galled and worn-out soils, if sown and top dressed with a small quantity of stable manure, it will be a powerful factor in the reclamation of the soil and at the same time it will yield a large amount of good grazing. It is not only a good meadow grass but it is one of our best pasture grasses. Grazing indeed is almost necessary for its perpetuation and preservation. It loves a moist soil best and on swampy places that are unfit for the growth of almost any other useful grass, herd's grass will thrive in the greatest vigor.

PERMANENT AND ADAPTED TO EVERY SOIL—By all odds it is the most permanent grass for all soils. Blue grass is very dainty in the selection of its soil. Timothy must have moist and rich but not wet soils. Clover even, the greatest of our forage plants, will only grow well upon rich calcareous loams but herd's grass is a universal feeder and as such is of use to every farmer, whatever may be the character of his soil or the location of his farm.

In a wet soil, especially, herd's grass sends out its long creeping roots and takes full possession. It assumes in such situations a stoloniferous form, that is to say it sends out shoots from the base, which take root at every joint and produce a thick dense sod. A pasture of herd's grass where it is well set is much valued by dairymen everywhere for it will bear tramping and will continue its growth for a longer period during the year than almost any other grass. When the grass has been cut for hay its aftermath makes the very best late summer and fall pastures.

A HAY AND PASTURE GRASS—It does not rank as high as timothy as a hay grass but as a combined hay and pasture grass it deservedly stands at the head of all economic grasses in Tennessee. When sown upon lands inclined to be wet it often attains a height of four feet. The writer has seen it growing in the sandy creek bottoms in Carroll county five feet high and so rank as to yield three tons of hay to the acre. Usually upon uplands it will attain to a height of from two to three feet. When in full bloom its purplish or brownish panicles present by their feathery undulations a most charming sight.

WHEN AND WHERE TO SOW—Herd's grass may be sown in the fall or in the spring. It may be sown alone or with a nurse crop, as wheat, barley, rye or oats. If the farmer should desire to sow it for a meadow it is best sown alone, about the first of October, upon land well pulverized by plowing and frequent harrowing. One bushel of seed in the chaff is not too much to sow to the acre. Of clean seed half that quantity evenly distributed will be ample. For the making of hay it should not be sown upon uplands, unless the soil is very fertile or the land freshly opened to cultivation. While it is the best of all grasses for pastures upon thin soils, it yields upon such soils but a small quantity of hay.

In England it is supposed to grow best on sandy soils, and such is the experience of the farmers in West Tennessee, but in other parts of the state the best results are obtained by sowing it upon a deep calcareous loam. It makes a fair meadow grass upon the sandy soils of the Cumberland table-land, but the places for such meadows are usually selected in creek basins where the sandy soils are moist. Notwith-

standing this grass prefers a wet soil, it has the ability to withstand severe droughts even when sown upon dry uplands. It will retain its verdure late in the fall and even in winter when it has not been pastured during the summer or cut for hay. Under these conditions the old grass falls down and forms a protection for the young sprigs which keep green during severe frosts and hard freezes. Good winter pastures of this grass are especially valuable for ewes at lambing time, the green grass producing a copious flow of milk when the young lambs most need it.

Herd's grass is often sown with other grasses and leguminous plants, and especially with timothy and clover. These additions largely increase both the quantity and quality of the hay, but they do not permanently benefit the pasture, as the clover, being a biennial plant, soon disappears and timothy cannot survive the heavy tread of cattle or the compact tramping of sheep.

For stopping gullies no grass except the Bermuda is equal to herd's grass. Like Bermuda-grass it will send its long rhizomes down the sides of the gullies which take root at every joint and will, in a short time, cover the silty deposits in the bottom of the gullies. This mat of grass will catch and hold the soil carried by the water after a rain, thus gradually building up the bottom until it can be crossed with a plow.

WHEN TO CUT FOR HAY—The proper time for harvesting herd's grass so as to secure the best quality of hay is when in full flower or as soon thereafter as possible. When seed is the main object it should not be cut until fully ripe. It is more easily cured than almost any other hay grass. Cut in the morning of a clear day after the dew has been dissipated by the warmth of the sun it should be ready, unless very heavy, to be raked up into windrows in two hours, and put into cocks in the late afternoon. Remaining in cocks for another clear day it may be stacked or ricked without the least danger from over-heating or fermentation in the stack. If there should be any doubt in this respect it must be watched, however, for a day or two, and if an undue amount of heat should be generated the stack should be torn down. Rarely is this necessary and care should be taken not to put the hay in stacks until it is fairly well cured. The less the hay is exposed to the sun the better and sweeter it will be. Mr. P. H. Marbury, of Warren county, Tennessee, who for many years was a most successful cultivator of this grass, thus gives his experience with it:

"As a meadow or grazing grass it is very valuable. It yields on good soil from a ton to one and one-half tons of superior hay, the stems and blades much fewer and somewhat softer than timothy. I prefer it to timothy—my stock prefer it. For grazing it is very valuable. Upon land where limestone is absent it flourishes, has greater tenacity of life, makes a sod almost impervious to hoof and tooth—in fact it is the blue-grass of the mountain district. We have but little lime in our soils and therefore blue-grass does not grow well. For a meadow I prepare the soil well with plow and harrow and sow one bushel of clean seed per acre, one-half one way and then sow the other half across the first so as to avoid leaving spaces unoccupied. A light brush may be dragged over it or not, as is preferred. I prefer to leave it without brush or roller. The roller is better than a brush; in fact it prepares the surface well for

the mower or scythe. If sown alone the first of October, a crop of hay the next season may be cut perhaps equal to any it will ever afterward yield and worth more than a crop of wheat or corn.

"The time to cut for hay is just before the seeds ripen, but if seeds are desired let them ripen, and, if cut immediately, it will still make fine hay. For pastures I would advise a mixture of orchard grass with it. Orchard grass grows well in the same soil with herd's grass."

The seed of herd's grass is very easily saved. The grass may be cut with a self-binding reaper when the seed attains maturity. The bundles may be put into shocks without caps and the seed will be dry enough in a few days to thresh. It is difficult to separate the chaff from the seed as the seed is very light but the stand will be just as good to sow the seed in the chaff as to have it clean. Herd's grass seed in the chaff sells low and there should be no stint in the sowing. Some people recommend the sowing of two or three bushels to the acre and even as high as four when a dense sod is wanted in a lawn or pasture. The experience of the writer is that one bushel to the acre in the chaff is sufficient when sown for pasture upon land thoroughly prepared.

ORCHARD GRASS—(*Dactylis glomerata*).—(Pasture and Hay.)

Orchard grass is diffused extensively all over Europe, from Norway and Russia to Portugal and is also found growing in Northwestern Africa, in India and in Asia Minor. It is cultivated with profit in all the states east of the Mississippi river that lie between 35 and 47 degrees north latitude, and in nearly every state between the Mississippi river and the Rocky Mountains. In New York it is the favorite grass. It

was known in England for many centuries but its good qualities were not appreciated until it was introduced into that country from Virginia in 1764 by the Society of Arts. It is a very hardy perennial, a vigorous grower and flourishes as well in the shade as in the sunshine. Owing to this habit of the grass it takes the name of orchard grass in the United States. In England it is called cock's-foot. It is grown with success in woodland pastures, having generous soils.

SOILS — Orchard grass grows upon every soil not saturated with water. Its preference is an alluvial soil, moderately dry, porous and with a considerable amount of sandy material in it. Stiff, clayey



Orchard Grass—*Dactylis glomerata*.
2. Inflorescence. 3. Upper leaf. 4. Spikelet. 5. Empty glumes. 6. Floret, with stamens and pistil.

soils, retentive of moisture, do not suit it so well. Upon this class of soils the roots acquire such a feeble hold that they are liable to be thrown out by winter freezes. In England, however, Mr. Wheeler, a writer on grasses, recommends it among those grasses suited "for a poor stiff soil or a dry subsoil."

Mr. Edmund Murphy, of Ireland, states that it is most advantageously used in the sandy soils of Norfolk.

It will grow well upon a soil naturally sterile, provided it is top-dressed with stable manure. Upon freshly cleared lands where there is a considerable amount of virgin mold it grows with a surprising luxuriance, getting a good start early in the spring and growing successive crops until fall. One of its chief merits lies in the earliness and rapidity of its growth, furnishing a grateful bite to horses, sheep and cattle long before any other grass. It retains its verdurous appearance during the hot days of August when grown upon a rich deep loam.

As a hay grass it does not rank high in the estimation of Tennessee farmers. Upon good soils it attains a usual height of three feet but sometimes reaches four and even five feet. The stalks when grown on rich soils are coarse and woody, unless the grass is very thick. As a hay, unless cut very early, it is not relished by stock to the same extent as clover, timothy or herd's grass hay. Nevertheless it makes, upon good soils, a large quantity of medium quality. If cut before the leaves begin to be embrowned or to dry up and before the seed begins to form it is greatly relished by stock, though it is deficient in nutritive matter.

The Woburn experiments developed some interesting facts pertaining to this grass. Grown upon a rich, sandy loam, and cut the middle of April the green grass weighed 10,209 pounds per acre, in which there were 1,190 pounds of nutritious matter. Cut, when in full bloom, the green produce weighed 27,905½ pounds. It lost in dessication 16,045 pounds, or a little more than half, and furnished 1,089 pounds of nutritious matter. After the seeds were fully ripe, the green produce weighed less by 1,361 pounds per acre, but there were 1,415 more pounds of dry hay, with an excess of nutritive extract of 363 pounds. The aftermath, however, was not so good, and in the loss of this the advantage of an increased yield of hay was counterbalanced.

Its best record as reported by Sinclair was 27,905 pounds of green grass; 11,860½ pounds of hay and 11,910 of green aftermath per acre. The following account of the extraordinary productiveness of this grass is given by Mr. Falla, nurseryman and seedsman, of Newcastle-upon-Tyne, in the *Quarterly Journal of Agriculture*:

On the 30th of April he weighed the produce of a square yard, and found it to be 16 pounds or 34½ tons per acre; the second crop of this yard was cut again on the 10th of June, and weighed 8 pounds. The third crop was cut on the 10th of September and weighed 10 pounds—in all equal to 73 tons as the year's produce. He remarks that it was, in every case, weighed on a dry day.

HOW AND WHEN TO SOW—The land if inclined to be tenacious or stiff in its character should be well broken in the fall, rebroken the following March or April and thoroughly harrowed just before sowing

until the top is as mellow as garden mold. If a sandy soil is selected it will not benefit it or render it more pulverulent by plowing it in the fall. When the soil becomes dry enough to plow the land should be prepared and the seed should be sown before a rain compacts the land.

Orchard grass always does best in Tennessee when sown early in the spring. From the 15th of March to the 15th of April is the best time. Not less than two to three bushels of seed should be sown to the acre. As the seeds are large a light harrow must be dragged over the land after sowing so as to cover them well. The greatest objection to this grass is its tendency to grow in stools or tussocks leaving large bare interspaces. To correct this habit a fine toothed harrow should be run over the pasture every spring and wherever there is a vacant place more seed should be sown and carefully covered. A roller run over the pasture when the land is wet represses this tendency to form tussocks. Mr. Edmund Murphy recommends the sowing of ten pounds of red clover per acre as a preventive of this proclivity.

Orchard grass is a very vigorous grower, surpassed in this respect by but few in the whole catalogue of domestic grasses. It is succulent and nutritious and when mowed it requires only a few days of moist weather to bring out its verdant blades in as great beauty and vigor as ever. It will bear more grazing than almost any other grass because of this rapid growth. Tramping does not seem to affect it in any other way than by inducing a tussocky growth. Two or three crops of it may be cut in one season when grown on a deep, rich and moist soil but after each cutting it should be top-dressed with superphosphate of lime or with stable manure.

Mr. W. D. Gallagher gives the following directions for sowing orchard grass: "Plow the land deep, pulverize the soil well, be generous as to the quantity of seed, let the seed be good, sow it evenly, give the land as good treatment afterwards as is given to meadow lands in timothy."

VIRTUES OF ORCHARD GRASS—Orchard grass is a long liver and will be victorious in a contest for supremacy in the pasture over other grasses provided always that its tendency to grow in tufts be counteracted. Mr. L. F. Allen, of New York, a farmer and stock grower of national reputation, testifies to the fact that he has had it growing in one field for a period of forty years with continuous mowing and pasturing. He says that if cut at the right stage it is just as good for any kind of animal as timothy hay.

Mr. T. A. Cole, of the same state, says that after twenty years of experience he has settled down upon orchard grass as possessing greater merits than any other for both pasture and meadow, for fattening animals or for dairy stock. Of its value for dairy purposes he says: "When cut for hay just before it blooms and cured with as little sun as possible it will make more milk than any other variety known to me; if left to ripen, it is worthless."

When grown for hay therefore it may be cut and cured before clover, timothy or herd's grass is ready for the mower and in this there is a great advantage. The yield of hay on fertile land is two tons to the acre.

As to its capacity for furnishing grazing Col. Bowman, writing from

the blue grass region of Kentucky, says: "Owing to its capacity to resist drought and in consequence of its rapid growth it will yield more pasture than the best blue grass sod."

Its superiority to timothy lies in the great value of its aftermath. It will improve under depasturing when a timothy meadow subjected to the same treatment would be destroyed. It also makes an excellent winter pasture. Prof. Phares, of Mississippi, an expert writer on grasses, says he prefers orchard grass to any other grass.

Mr. Howard in his manual on grasses thinks it stands in importance for the climate of Georgia, second only to meadow-oat grass for hay and winter pastures. Where hay is the object he recommends that meadow-oat grass and orchard grass be sown with red clover and white, as each of the four blossoms at the same time. The cultivation of orchard grass and meadow-oat grass he thinks cannot be too strongly recommended for the south.

Hon. N. B. Dudley, of Logan county, Kentucky, a most successful stock-grower, has this to say of orchard grass:

"Orchard grass with a good stand on medium to good land will furnish more grazing than any other of the grasses in common use. It starts on its spring growth sooner, is less affected by a summer's drought and grows later in the fall than any other grass. It is the best yard grass for farmers who love large yards and many shade trees. But to get the most benefit from it, it should be grazed hard enough to keep the blades short and tender. If they are permitted to grow long they become tough and rough to the mouths of stock.

It is not a sod grass like blue, herd's and Bermuda grass. It is more like timothy, growing its tillers from the parent plant, each tiller having a bulbous quality at its base and it should never be grazed hard enough for these bulbs to be eaten by stock for that would soon destroy the stools from which they grow.

Orchard grass does very little towards reseeding or thickening itself on the ground. The stools seem to love to have a little neutral territory around themselves. Good farmers usually sow blue and herd's grass to fill these spaces and some sow timothy also because it gives a mowing the next summer. Stock should be kept off of orchard and blue grass for two winters after seeding.

It is the nature of orchard grass to grow blade in the fall and seed stock in the spring. It should therefore have a good holiday in the fall. Orchard grass is not one of the best hay grasses. The seed stalk will get hard whether it is cut early or late but a very fine hay can be had by sowing with it the common or medium red clover. They are ready for the mower at the same time. I have seen its blades four feet long and the stand of grass seriously injured because it was neither mowed nor grazed. I love orchard grass because it will grow well on land where blue grass would be too dwarfish for profit."

SAVING SEED—When seed is the object the grass should be cut with a self-binding reaper and tied up in bundles as wheat or oats. The bundles are put up in shocks without being capped. They should remain in this condition until dry enough to thresh, which will be in three or four

weeks. They should be threshed from the wagon and some care must be exercised in hauling the bundles to the thresher, otherwise many of the seed will be lost by shattering. The yield upon rich soils is fifteen bushels to the acre. It is put up in eight bushel sacks and the weight is 14 pounds to the bushel.

Lawes and Gilbert, by selecting the best seed and sowing for several years none but the best for several generations, established a new variety which they called giant cock's-foot. The seed of this weighs only 10 pounds to the bushel, and there are only 34,000 seed to the ounce in place of 40,000 of the ordinary orchard grass. This so-called giant orchard grass is not in any respect superior to the common variety.

It may, with confidence be said of orchard grass that it will suit the ordinary Tennessee farmer better than any other grass for all purposes except herd's grass, and it may with safety be recommended. It soon arrives at maturity. It thrives upon almost every soil and in every variety of situation. It produces an immense amount of herbage and hay. It grows very rapidly and is a favorite with all kinds of cattle, especially when grown in the sunshine. It is found in the best English and American pastures. It does not impoverish the soil and is not hard to destroy when the land is wanted for other crops.

Summing up the merits of this grass it may be said:

1. It is better suited to every variety of soil than any other except herd's grass. The writer has seen it growing with vigor on mountain heights and in valley plains, on sandy loams and calcareous soils; on the coarse sandstone soils of the Cumberland Mountain, and on the tertiary loess and alluvium of West Tennessee, as well as upon the cretaceous sands of that division. He has grown it with success upon the siliceous soils of the rimlands, and has seen it enliven the landscape of the Central Basin with its mantle of verdure. It is best adapted to the sandy loams of West Tennessee and to the lands of the Central Basin having a porous subsoil. On lands having a tenacious clay foundation, the roots are checked in their descent, and the growth is not so luxuriant; nor is the duration of the pasture so great.

2. It will grow with greater rapidity than any other grass and for this reason will sustain a larger number of stock. It is excellent for soil-ing purposes.

3. It will grow in the shade. This quality will enable the farmers to utilize their woodlands as pasture, and so make them a source of profit.

4. It will resist drought better than almost any other grass. The hot summers make this a very valuable quality in any grass. Often in July and August the pastures become so parched as to afford but a small amount of grazing. Orchard grass then comes to the rescue and supplies the deficiency.

5. It is both a pasture and a hay grass. After a crop of hay has been taken off in May or June, the aftermath will furnish a good pasture throughout the remainder of the summer. A prominent sheep raiser of Tennessee who has been carrying a thousand sheep or more, says that during the summer it will carry double as many sheep as blue grass, acre for acre; but that blue grass will furnish more and better winter grazing.

6. It may be sown in the spring or fall with small grain or alone. It is best not to sow it with grain, as the extra production of grass, when sown alone, is worth more than the grain and grass grown together. It may be mown as hay or cut with reapers or cradles, and bound in sheaves like oats.

MEADOW FOXTAIL—"MOUNTAIN TIMOTHY."—(*Alopecurus pratensis*.)—(Meadow and Pasture.)

This grass is one of the earliest in making its appearance in the spring. Its tall culms and club-like panicles are charming in their robes of golden anthers. They are so much earlier than the panicles of other grasses that they readily attract attention. In England this grass is in almost every pasture, and in many pastures famous for their richness and luxuriance it is the principal grass. It blossoms in Tennessee in March and early April.

SOILS SUITED FOR ITS GROWTH—It grows best on rich, moist, strong soils. A calcareous loam with a loose gravelly subsoil is well suited for it also, but it will thrive upon all soils except the dryest sands. It may be grown with success in every part of the state, even upon the Cumberland tableland, wherever the underlying subsoil is clayey and retentive of moisture.



Meadow Foxtail—*Alopecurus pratensis*.

2. Inflorescence. 3. Upper leaf. 4. Spikelet.
5. The awned flowering glume, the stamens and stigmas projecting from the apex.

Prof. Beal says "it is quite common at elevations of from five to seven thousand feet above the sea, growing in rich soils along mountain streams and frequenting the so-called mountain meadows." "For the more elevated meadows of the Rocky Mountain region and for northern latitudes there is no grass that so highly commends itself as this for hay and summer grazing."

This grass would do best in Tennessee in the moist and cool climate of the Unaka mountains. The rich soils of the sheltered valleys and coves of that region, and also that upon the "Balds," are probably better suited for its growth than any other soils and situations in the State. In England it is a great favorite in the sheep breeding districts. It very much resembles timothy in general appearance, but while the head of timothy is rough and harsh to the touch that of the meadow foxtail is soft and velvety, but broader and shorter. The hay, however, is much lighter than that of timothy, while the bulk may be greater. Its chief value in

Tennessee is for pasturage, because of its earliness and the rapidity of its growth, resembling in these particulars orchard grass. It excels timothy for pastures as much as timothy excels it for hay. Like most grasses its greatest nutritive value is attained when in full bloom. When cut at that period it loses over 70 per cent. in drying and contains when green 4.32 per cent. of albuminoids as against 3.79 per cent. for timothy cut at the same stage.

One great drawback to the introduction of this grass is the length of time (three to four years) it requires to be firmly established, but it is well adapted to permanent pastures and many mountain districts in the state could be greatly benefited by its introduction. It is a long liver, a quick grower, and furnishes a very nutritious and palatable herbage. It requires about three bushels of seed to the acre to insure a good stand but it is best to sow it with other grasses. The land may be prepared and the seed sown in the fall. In the moist climate of the Unaka mountains it may be sown either in the spring or fall. The plant at first is very feeble and should only form one of the grasses in a pasture. After two or three years it makes the principal grass.

Mr. Taunton, of England, thus speaks of its durability and good qualities:

"In the dry soil, in the course of seven or eight years, it became much weakened; but in a meadow on the clay with a dark moory mould on the surface, it maintained its size, frequently as well or better than any other grass; and where I had sown it on deep loamy sand where springs rise, there its produce was extremely luxuriant, insomuch, that I, this year, sold the crop standing at the rate of 8 pounds sterling (\$40) per acre. No manure had ever been given to this land since the grass seeds were sown seven years ago, other than the irregular irrigation produced by the winter springs; yet it most completely covered the ground. One character particularly attracted my attention; namely, that although it stood late in the summer—not having been cut until late in July, and after the seed had fully ripened—none of the lower leaves had decayed or withered, whereas those of the cock's-foot and fescue and some others were quite dead. This experiment proves to what a valuable purpose any tract of springy, moist, loamy sand may be converted by sowing it down with a selection of grasses, in which the foxtail should predominate.

This grass must not be confounded with the foxtail (*setaria viridis*) that springs up in the fields of Tennessee after oat and wheat harvest. This foxtail is nothing but a troublesome weed.

TALL MEADOW FESCUE—RANDALL GRASS—EVERGREEN GRASS—(*Festuca elatior* var. *pratensis*.)—(Meadow and Pasture.)

This is a most valuable grass and well suited to many of the soils of Tennessee. It is a perennial and flourishes best on moist lands rich in humus. It is good for permanent pastures or meadow, producing when cut in flower a large amount of excellent hay which Mr. Sinclair values next to the meadow foxtail. As a hay grass it is superior to the meadow foxtail. It is common throughout Great Britain, Lapland, Norway, Swe-

den, Germany, France and as far South as Italy. It grows all over the United States. It was first domesticated in 1820. It is inclined to grow in tufts or bunches like orchard grass.



Fall Meadow Fescue.—*Festuca elatior*.
2. Panicle. 3. Upper leaf. 4. Spikelet.
5. Empty glumes. 6. Flowering glume.

The roots are stout and the leaves are from one to two feet long. This grass often grows to the height of five feet in suitable situations and soils and makes excellent winter pastures from Virginia and Kentucky southward. It grows vigorously on the mountain lands of upper East Tennessee and is highly prized for its good grazing qualities during the spring, summer and fall months, even extending far into winter, notwithstanding the rigor of the weather upon these chilly heights. It has taken various names; in Virginia it is "Randall grass;" in North Carolina "evergreen grass." In the mountain lands of Virginia, a writer says: "The variety of forage best adapted to sheep-grazing on the mountain lands is the 'Randall,' a tall, coarse grass, growing freely on the rocky soil to a height of six feet, remaining green and affording fine herbage all the winter."

From the limited cultivation this grass has received in Tennessee it seems to be adapted rather to moist low lands than to uplands, though I have seen it growing on some of the high ridges of East Tennessee, at least 1,500 feet above the sea. There, on good soils, it thrives luxuriantly, and makes a very superior pasture. Some of this grass was sown in Davidson county as early as 1850 upon the farm once owned by Col. D. H. McGavock. The place selected for sowing was low, wet and almost marshy. The same spot is yet green with it, still flourishing in the greatest vigor, furnishing more grazing according to Col. McGavock, than any other grass. The roots penetrate much deeper than the roots of bluegrass, descending indeed, as deep as red clover. In consequence of this it bears droughts remarkably well. Nor do overflows affect it, but seem rather to add to its vigorous vitality.

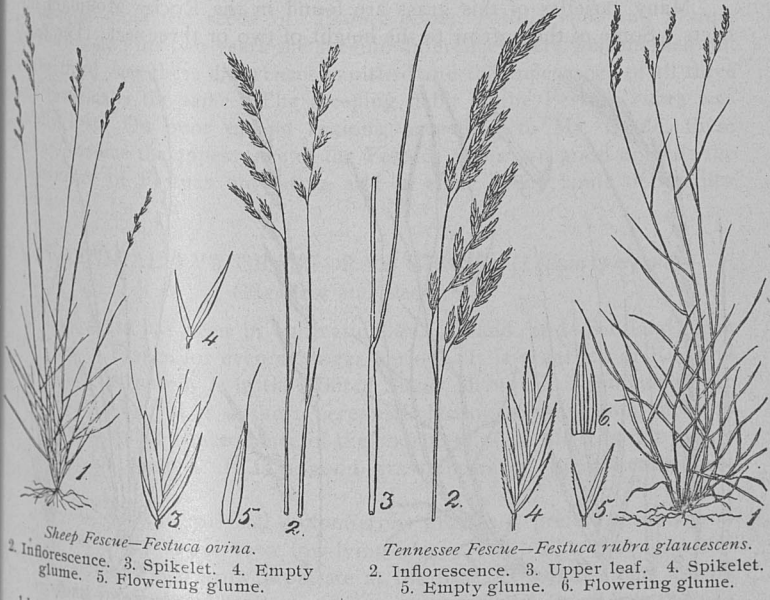
A small plat of upland was also sown, but it disappeared in about five years. Its disappearance, however, was hastened by the presence of the army worm.

In Europe this grass is one of the standard meadow grasses and might be found by further experiment to form a fine addition to the list here. Its name of evergreen originated from its habit of remaining green

under the snow, affording fine croppings for cattle. It will grow on a greater elevation than the blue grass.

Meadow fescue grass does not attain its full productive capacity until the third or fourth year, so that while its durability in the soil is great it may not be depended upon for a quick meadow or pasture. It will yield the first year from one to one and a half tons of hay when sown upon congenial soil, and twice that amount the second year. The seed weighs from 12 to 16 pounds to the bushel and three bushels are required to the acre. Prepare the land and sow at the same time of the year and in the same manner pointed out for the sowing of blue grass. In sowing it for pasture it is usual to mix it with other fescue grasses.

This grass has never received the attention in the south it justly merits. It is greatly relished by all herbivorous animals. It is a vigorous grower, resembling in this particular, after being well established,



blue grass, though it takes two or three years to reach the condition of its greatest fruitfulness. It is fairly nutritious both in its green and cured state.

SHEEP FESCUE—(*Festuca ovina*.)—(Pastures.)

This is a very hardy perennial and deserves mention in this bulletin because it will grow on thin, dry, siliceous soils and thus fills a want in those regions of Tennessee that are destitute of good grass lands and are now practically without grasses. On the sandy soils of the Cumberland table-land and on the siliceous soils of the Highland Rim and on the sandy areas of the cretaceous formation of West Tennessee this grass would prove a boon. The gravelly ridges of East Tennessee could also

be made good sheep walks if set with it. Sheep are very fond of it and hence its name.

Its panicles are narrow; its leaves are short, bristle-like and tufted and have a grayish color tinged with red. It forms a profuse foliage in bunches and makes excellent pastures for sheep and cattle where other grasses will not grow.

This grass constitutes the great bulk of the grazing grasses in the sheep pastures of the Highlands of Scotland. It is believed by the shepherds in that region to be more nutritious for sheep than any other. In the arid plains of Asia it is often the only grass upon which the wandering tribes can subsist their cattle and sheep.

Linnaeus asserts that sheep have no fondness for hills without it. Where all other vegetation parches up it will grow. Its short and dense turf when sown thick makes it well suited for lawns. The aftermath in a lawn cannot be surpassed.

Many varieties of this grass are found in the Rocky Mountain districts. Some of these grow to the height of two or three feet. The usual



Rat's-tail Fescue—Festuca myurus.
2. Inflorescence. 3. Upper leaf. 4. Spikelet.
5. Empty glumes. 6. Flowering glume.

Small Fescue—Festuca tenella.
1. Panicle. 2. Spikelet. 3. Empty glumes. 4. Flowering glume.

height of this grass on thin soils rarely exceeds eight inches. The weight of a bushel of seed is 14 pounds. Two or three bushels to the acre is not too much to secure a sufficient density of turf for lawns or pastures. The seed sells for about \$2.00 per bushel.

OTHER FESCUE GRASSES.

Tennessee fescue, *Festuca rubra glaucescens*, is a perennial and is strongly recommended for worn out soils and hill-sides. It has a creeping habit and makes a good turf, close and fine leaved, remaining green

throughout the year. It is not easily affected by either drought or cold. It will grow well on dry sandy soils and may be a valuable acquisition for the Cumberland mountains.

Festuca myurus (rat's-tail-fescue) and *tenella* (small fescue) are both annual grasses which grow on dry sandy soils six inches to a foot in height, and, as they appear early in the spring, they make a good sheep pasture.

Festuca duriuscula, hard fescue, is a variation of the sheep fescue and will thrive on poor sandy soils. It is of but little value where the soil is fertile enough to produce better grasses. But for its hardy nature and its adaptability to unfavorable situations it would not be mentioned.

Differences in soil and situation cause these species to run into several varieties and the narrow leaved species seem to lose their individuality when grown on like soils and under similar conditions. Prof. Buckman of the Royal Agricultural College at Cirencester sowed in experimental plots the seeds of *Festuca ovina*, *Festuca rubra* and *Festuca duriuscula* and for two years the specific differences were well marked but in the third year these differences vanished and the appearance of all three was practically the same. The creeping habit of the *Festuca rubra* was totally lost. On poor upland regions, according to Mr. Gould, these fescues assume the appearance of the *Festuca ovina*; on good uplands the appearance of *Festuca duriuscula* and in river valley lands of *Festuca rubra*.

PERENNIAL RYE GRASS—RAY GRASS—(*Lolium perenne*)— (Meadow and Pasture).

This grass has been in cultivation in England and Scotland since 1667 and in France for even a longer period. It is regarded in England very much as timothy is in the United States, though it is difficult to see the reason why. It is a short perennial, lasting usually from three to seven years and in consequence of the shortness of its life it is not highly esteemed for pasture. It is a good grass, however, for alternate husbandry.

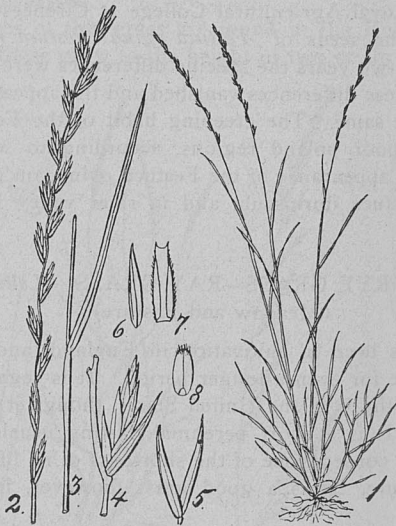
SOILS—Like nearly all stoloniferous grasses it prefers a moist soil and is especially suited to a low-lying clayey soil. The roots put out several stems, which grow prostrate at the base. Upright stems ascend from each joint of the prostrate stem, attaining a height of from two to three feet. The stem is stiff; the spike is flattened and it is not an attractive grass in appearance, but it has a full green tint except at the joints of the stem, where it sometimes takes on a brownish hue. It has a vigorous habit, starting early in the season and flowering early. It requires one to two bushels of seed to sow an acre. It may be sown either in the fall or spring when the land is in good condition. The preparation of the land is the same as that for orchard grass.

Prof. Beal does not think it well adapted to a southern climate as it cannot bear great heat. It must have a cool climate and a moist soil. These conditions of growth are found among the high mountains of East Tennessee and I have no doubt it would grow with great luxuriance in

the moist soils of the elevated valleys and coves found among the Unai mountains.

On fertile soils it will yield about 40 bushels of seed to the acre and the seed weighs 25 to 30 pounds per bushel. It cannot be called an economical grass for pastures or meadows. Its shortness of life makes the sowing of it for permanent pastures or meadows very bad husbandry. The sowing of it is only a little more economical than the sowing of an annual. And yet for a three years rotation it will be found very useful.

Mr. Edmund Murphy, a close observer of the habits of this grass says: "In laying down some hundred of acres with this grass alone or in mixture with others my experience fully bears out the justice of the charge of bad husbandry in sowing it for permanent meadows or pastures. Nor is the want of durability its only bad property. It is perhaps the most exhausting of all the grasses on land, nearly as much so indeed.



Perennial Rye Grass—Lolium perenne.

2. Inflorescence—a spike. 3. Upper leaf.
4. Spikelet, with a portion of the rhachis.
5. Empty glumes of the terminal spikelet.
6. Floral glume. 7. Palea. 8. Caryopsis.

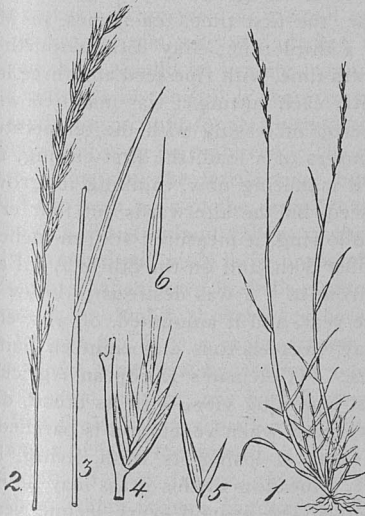
when permitted to form its seed, as a crop of corn (wheat). In dry soil or in almost any kind of soil, should dry weather set in after it has been cut, an almost total failure of the aftergrass will be the result. Its greatest value appears to be for sowing with clover, on land intended to remain only two or three years in grass; with this view, and when sown at the rate of one bushel per acre, with 20 pounds of red clover; or two bushels of rye grass, and 14 pounds of red clover on deep rich ground, enormous crops are produced. When the intention is to leave the land only one year in grass, the Italian rye grass is greatly to be preferred."

According to the Woburn experiments it is very low in its nutritive elements. It ranks low as to the quantity and quality of its produce and

in its aftermath it is the very lowest in the scale of cultivated grasses. Compared with orchard grass its nutritive power is as five to eighteen; to meadow foxtail, five to twelve; to meadow fescue, five to seventeen. Nevertheless it is a useful grass in a mixture and will furnish the earliest of grazing. It possibly may be recommended for culture in Tennessee only on the soils of the Unaka mountains and on the moist low clayey lands adjoining the lake districts of West Tennessee.

ITALIAN RYE GRASS—(*Lolium Italicum*.)—(Soiling and Hay).

This is a sub-perennial grass and is esteemed among the very best of the short-lived grasses. Its period of duration is two to three years. It gives more abundant crops of a better quality than perennial rye grass. It is characterized by Flint as being the "greatest glutton of all the grasses;" will endure any amount of forcing by irrigation, by timely rains, and by manuring. It will withstand a drought remarkably well, notwith-



Italian Rye Grass—*Lolium Italicum*.

2. Spike. 3. Upper leaf. 4. Lateral spikelet, with a portion of the rhachis. 5. Empty glumes of the terminal spikelet. 6. Floral glume.

standing its capacity for absorbing moisture from the earth. It has within the past fifty years been introduced into America from Europe where it is claimed to be more universally adapted to all kinds of climates than any other domesticated grass.

SOILS—Italian rye-grass reaches its highest perfection on moist, rich, alluvial lands and calcareous loams where the soil is in good tilth. It is not recommended for permanent pasture or meadow but owing to its rapidity of development it is of the greatest value when an early crop of forage is desired. With proper manuring it is said that it may be cut within three to four weeks after seeding. A succession of crops may be

cut every four or five weeks during the season. This quickness of growth makes it stand in the first rank as a soiling grass. For dairymen living near a city it is of especial value as the green food produces a rich flow of milk at a very small cost. One and a half to two bushels of seed, weighing 20 pounds to the bushel, is about the proper quantity to sow on an acre of land. Prepare the land and sow in the same manner as orchard grass. It is, however, better when sown in the fall, about the first of October. It may be considered a very valuable grass for Tennessee and indeed for the south generally. It has been fully tested in Georgia and in Tennessee, and it has in every instance given satisfactory results.

It gives a fine color to the butter of the milch cows fed on it, and they eat it with great relish. It withstands the hottest suns of summer as well as the frosts of the severest winter. It must be sown alone, as it will quickly choke and destroy clover or other grasses. Its yield per acre, according to received authority, is something immense. Mr. Dickens, of England, sowed it on a stiff, clay soil, well-manured, cut it ten times during one year; the first time, ten inches, in March; April 13th, again, and May 4th, a third time; May 25th, a fourth time; June 14th, again; July 22nd, a sixth time, with ripe seed and three loads of hay to the acre. Immediately after each cutting it was manured with liquid manure, the produce of each crop increasing with the temperature of the atmosphere, from three-quarters of a load, the first cutting, to three loads the last. He discontinued manuring now, thinking its growth would be terminated in bearing seed, but he afterwards cut four crops from it. On the 26th of January following, it measured sixteen inches in height. The last cutting was October 30th, and on the 8th of April a crop twenty-two inches high was cut from it. "I was desirous to know the exact amount taken per acre for the year, and it amounted, on a careful measuring and weighing of green hay, thirteen tons and eighteen hundred and twenty-seven pounds per acre." (Coleman's European Agriculture.)

It presents a most charming view, with its broad, dark green foliage, and especially in a dry year, when vegetation is parched up all around, it does not show any signs of losing its fresh, living, luxuriant growth. Although of short life, a meadow of this grass may be made perennial by scattering fresh seed over the ground every second year and scratching it with a harrow having sharp teeth. Its unusual ability to withstand the vicissitudes of heat and cold makes it a desirable grass for any thirsty soil, as well as for moist soils. It might possibly be a valuable addition to the soils of the western portions of our state. At least it is worthy of a trial.

Mr. Gould thinks the valuable qualities of this grass may be summed up as follows: "Its habit of coming early to maturity. Its rapid reproduction after cutting. Its wonderful adaptation to all domestic animals which is shown by the extreme partiality they manifest for it, either alone or when mixed with other grasses; whether when used as green food for soiling, as hay, or as pasturage, in which latter state its stems are never allowed to ripen and wither like other grasses." Its beneficial influence on the dairy, not only augmenting the flow of milk, but improving the flavor of the cheese and butter. Its uncommon hardness and capacity to withstand for vicissitudes of both wetness and dryness."

PEARL OR CAT TAIL MILLET—(*Pennisetum typhoideum*)—(Annual Hay Grass.)

This is a hardy annual and may be cut two or three times during the season. It grows usually to the height of six or eight feet. It has dense heads, six to twelve inches long and a half inch or more in thickness. The stalks are coarse and hard to cure. When cut before the stalks harden and the seeds ripen it makes a vast quantity of forage that is readily eaten by all herbivorous animals. It requires plenty of heat and a rich soil to bring it to maturity. The experiment made with it on the Centennial grounds in Nashville in 1897 proves that it is a vigorous grower, a gross feeder and a princely looking grass, towering high above all other grasses except sorghum and teosinte. The head resembles a mammoth head of timothy.

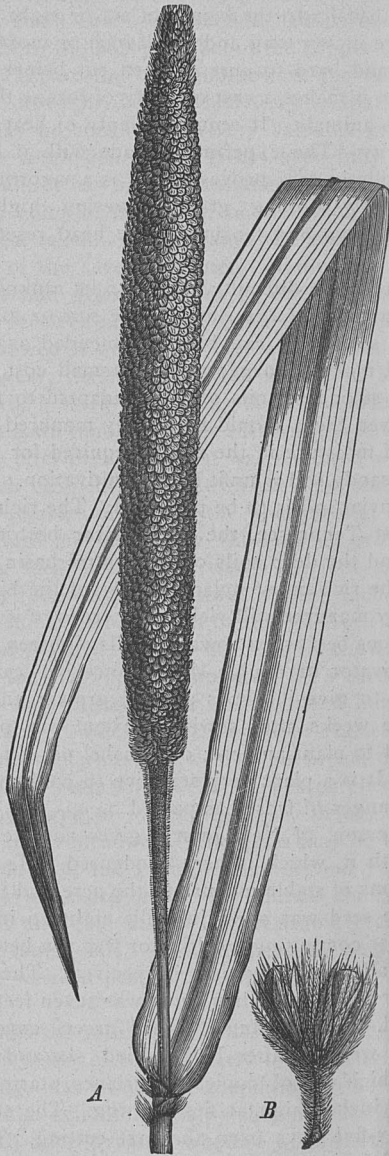
The hay is cured with difficulty, owing to its rankness and coarseness. It requires a great deal of exposure to the sun or air before it can be stored away with safety. It can be recommended as a forage plant on the ground that it makes a large yield at a small cost.

SOILS—The strongest soils only are adapted to the growth of this rank feeder and even these should be heavily manured to secure the best results. Plenty of moisture in the soil is required for its growth and for that reason a dry sandy soil is unfit for its cultivation. A deep calcareous loam or a rich alluvial soil is to be preferred. The rich lands in the loess formation of West Tennessee, the fertile river bottoms of Middle and East Tennessee and the deep soils of the central basin are all well suited to its growth. The rich moist upland valleys of the highland rim deeply plowed and heavily manured will yield large crops of it.

Pearl millet does best when sown in drills eighteen inches apart. The running of a cultivator or double shovel once between the rows is sufficient cultivation to give it. It is a rapid grower and will overlap the rows within three weeks after sowing. About one peck of seed when drilled is sufficient to plant an acre; one bushel per acre is required when sown broadcast. It is a plant very sensitive to cold and it should not be planted until all danger of frost has passed.

Mr. P. Henderson, of New Jersey, gives an interesting account of his experience with it, which is here condensed. He prepared the land by applying ten tons of stable manure to the acre and then plowing it ten inches deep. The seed was sown in drills eighteen inches apart on the 15th of May. After coming up a cultivator was run between the rows one time which was all the cultivation it received. The first cutting was made 46 days after planting. When cut it was seven feet high and covered the whole ground. This cutting weighed green, gave a yield of thirty tons to the acre; weighed after being dried, six and a half tons. The second growth, which was of tropical luxuriance, started at once from the stubble left three inches high at first cutting. The second cutting was August 15th, forty-five days from the first cutting. The height of this was nine feet and it weighed at the rate of forty-five tons to the acre, green, and eight tons dried. The third crop was cut October 1st, which weighed ten tons green and one and a half tons dried. The cool weather of autumn sensibly affected its growth. The aggregate yield from one

sowing was ninety-five tons, in 135 days, of green fodder, which made sixteen tons when dried. It should be cut for hay when the heads first appear.



Pearl or Cat-tail Millet—Pennisetum typhoideum.

As to its feeding value it is about equal to corn fodder. Cattle, horses and sheep are very fond of it both green and dry. It has probably

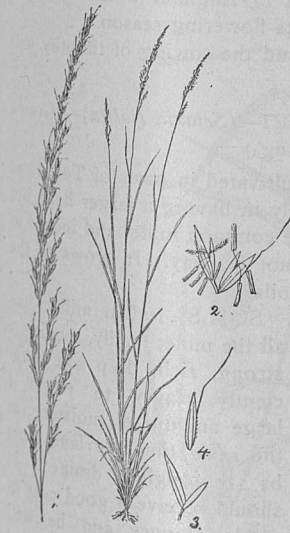
the largest productive capacity, when grown upon highly manured lands, of any forage crop now grown. While the fodder is coarse it is highly nutritious. The only difficulty is to cure it sufficiently to prevent it from fermenting and moulding. It will grow and flourish wherever Indian corn may be grown. The weight of the seed is fifty pounds per bushel.

MEADOW OAT GRASS OR EVERGREEN—(*Arrhenatherum elatius*.)—(Meadow and Pasture.)

This grass is equally valuable for making hay, for pasturage and for soiling. It produces an immense amount of foliage and its aftermath is about as heavy as the first crop. Having characteristics and adaptability similar to those of the oat, it has been widely distributed in the United States from New England to Georgia. It was introduced into this country from England where it is highly prized for its good quali-

ties. It is a favorite grass in France and the south of Europe generally. It is an object of admiration to all lovers of the grasses, by reason of its great height, its gracefully bending panicles, its purplish anthers, its flag-like leaves hanging in graceful arches beneath the panicle, the green of which contrasts with the purple of the anthers and the violet of the flowering glumes making altogether a rare picture of grace and beauty.

SOILS—This is one of the grasses that will grow best on dry sandy soils, and is a great acquisition therefore to those sections of Tennessee where sandstone soils predominate. It may be grown on the Cumberland table-land with success. Although it prefers sandy soils it will thrive upon any rich, dry, well-drained land. It is a very



Meadow Oat Grass or Evergreen—*Arrhenatherum elatius*.

1. Panicle.
2. Spikelet, with the empty glumes removed.
3. Empty glumes.
4. Awned floral glume.

hardy perennial and will resist equally the heat of summer and the cold of winter. In Southern latitudes it is green throughout the year and hence the name evergreen. In a favorable season two crops of hay may be harvested from the same sowing in one year.

The best time for sowing in the latitude of Tennessee is in March or April, or it may be sown in the fall from the middle of September to the last of October. As this grass has a tendency to grow in tussocks like orchard grass plenty of seed, not less than two bushels, should be sown to the acre.

Mr. Edwin Montgomery, of Mississippi, writes to the American

Agriculturist that many persons in his locality state if they were restricted to one grass, tall meadow oat grass would be the one selected.

Mr. Jared G. Smith, Assistant Agrostologist of the United States Department of Agriculture, says it is one of the best drought-resistant cultivated grasses, but he does not recommend that it be sown alone unless it is grown for seed only. "The forage," he says, "is bitter and not readily eaten by cattle except where it occurs in small quantities mixed with other grasses. However, the hay is of fine quality and is relished by stock."

It grows rapidly and comes into blossom early. The best time for cutting it is during its period of inflorescence. It likes heat and will grow with more vigor on southern than on northern slopes. An excess of moisture soon destroys it. Well drained lands should therefore be selected for its cultivation. The seed weighs ten pounds to the bushel.

Mr. Sinclair says it is subject to rust in England which does not appear on the blades however, until after its flowering season.

The directions for preparing the soil and the sowing of timothy will apply to the seeding of this grass.

ITALIAN, GERMAN OR GOLDEN MILLET—(*Setaria Italica*)—(Grown for Hay and Soiling.)

This is an annual and is extensively cultivated in parts of Tennessee for hay. It differs from German millet only in having a larger head but less dense. It is considered superior to the common millet and indeed to all other kinds for soiling purposes but not for hay. It grows to the height of from three to five feet on good soils.

SOILS—Italian millet, like all the millet family, requires a strong, rich, deep soil, sufficiently clayey to retain a large amount of moisture; at the same time the land must be thoroughly drained. It should receive a good coat of stable manure and be well broken in the winter and plowed again in the spring and frequently harrowed. If the earth is fine and lightly compacted. All rank growth of vegetable matter turned under before sowing is decidedly injurious. Such vegetable matter makes the land dry and thirsty and too porous. On land so prepared failures will result in four cases out of five.



Italian Millet—*Setaria Italica*.

2. Inflorescence. 3. Upper leaf. 4. Spikelet, with two bristles. 5. Spikelet laid open.

A clayey soil in a moist situation, enriched by the application of well rotted stable manure, kept in good tilth, that has been deeply and well

broken the previous winter, and upon which all vegetation has been kept down by frequent plowings or harrowing, are the most favorable conditions for the growth of a large crop of millet. Upon land so prepared one bushel of seed to the acre will be sufficient. The ground should not be dry or wet when it is sown. If too dry many of the seeds will perish near the surface; if too wet the land will be compacted and the crop will "french" or turn yellow. After sowing, harrow well with a light harrow



German Millet—*Setaria Italica* var.

a, b, Spikelet and "beards," c. Seed.

(U. S. Dept. Agric.)

or run a drag brush over the land, or use a smoothing harrow. Millet may be sown at any time in the latitude of Tennessee from the first of April until the 15th of August. One good soaking rain after sowing will assure an abundant crop. It is a very rapid grower and a rank feeder. It will be ready for the mower within fifty to sixty days after it is sown.

Millet must be cut when it begins to head and before it blooms. To put off the time of harvesting until the seeds are ripe will be to ruin the

hay, for when cut at this stage it is not only worthless for forage or hay but the abundance of seed renders it dangerous for feeding to horses, as it will affect their kidneys in a very marked degree. The hay is cured and treated in the same way as timothy hay but a little more time is required to cure it properly. The less millet is exposed to the sun after it is cut the better will be the hay. The yield of hay on very fertile well prepared land, is as much as three to five tons per acre.

For raising seed run light parallel rows three feet apart and drill the seed with a tin cup or an oyster can having three or four holes punched in the bottom with an eight penny nail. Walk rapidly holding the cup over a row and the seed will be distributed about thick enough. Cover slightly and when the seed germinates and before it comes up run over the land with a light harrow. Cultivate between the rows with a double



Millets.

1. Italian or Common Millet. 2. Hungarian Millet. 3. German or Golden Millet (varieties of Italian.) (U. S. Dept. Agric.)

shovel plow, one plowing being all that is necessary. The millet should be thinned to a mere thread of plants. Cut when the seed is in the dough state with a self-binding reaper. Put the bundles in shocks and thresh when the heads are thoroughly dry. The yield is frequently from 30 to 40 bushels of choice seed to the acre.

Italian millet, and indeed every kind of millet, is very exhausting to the soil, especially if the seed is permitted to ripen.

This grass is of great value to the renter who has rarely the opportunity of continuing in possession of the land long enough to sow a meadow and reap the benefit of it. But for the proprietor who has suit-

ble soils there is no excuse for not providing himself with the best hay the climate and soil can afford, and there are plenty of good grasses to suit almost every variety of soil in the state of Tennessee. If a farmer who is a landowner, wishes to indulge the pride, and it is an economical pride, of having fat horses, sleek cattle, and plenty of bacon, let him at once see to his meadows, for a good meadow is next to a corn-crib to prepare pork for the smoke-house, as well as to fatten all kinds of stock. A crop of millet is a good forerunner for a meadow as it destroys all the noxious weeds, and leaves the land in fine condition for timothy or herd's grass.

Italian millet is sometimes called Missouri millet and Tennessee millet, there being a slight variation induced by differences in soil and climate.

HUNGARIAN MILLET OR HUNGARIAN GRASS—(*Setaria Italica* var. *Germanica*).—(Grown for Hay and Soiling).

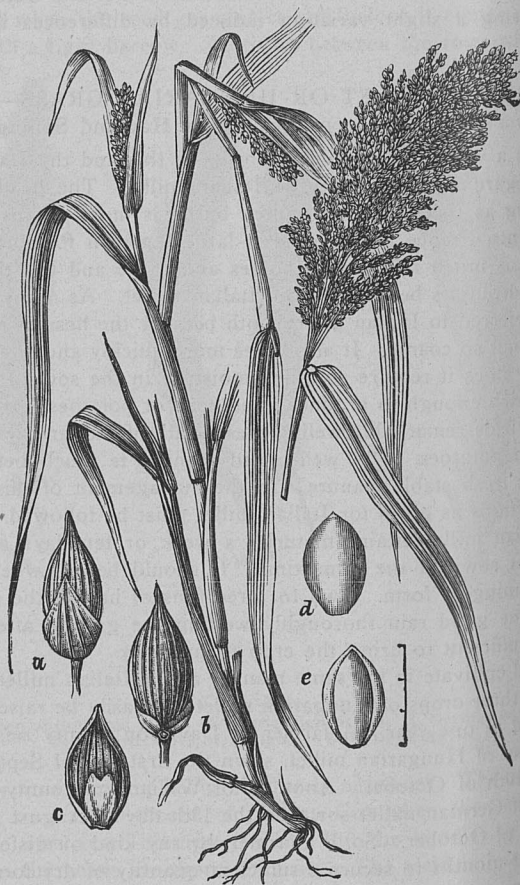
There is a very slight difference between this and the Italian millet. Botanists regard it as a variety of Italian millet. The head is not so large or long as that of Italian millet, but it is more compact. It was introduced into France in 1815 and is largely grown for forage in that country. It is much relished by horses and cattle and has the capacity of resisting droughts better than the Italian millet. As a hay grass it is probably preferred to Italian millet, both because the head is smaller and the straw is not so coarse. It also cures more quickly and does not grow so rank, nor does it require so much moisture in the soil. It will grow on any soil rich enough to produce good corn or potatoes. If sown after potatoes it yields remarkably well and especially if the land was manured when put in potatoes. Old well-rotted manure is much better for its growth than fresh stable manure. In the management of this grass the same instructions as given for Italian millet must be followed.

Hungarian millet attains maturity a week or ten days earlier than Italian millet sown at the same time. It should be cut when the seed is just beginning to form. Two to three tons of hay to the acre is not unusual. One good rain thoroughly wetting the ground after the seed is sown is sufficient to bring the crop to maturity.

For seed cultivate in the same manner as for Italian millet. Two or three crops of Hungarian millet can easily be raised from the same ground in one year. A farmer of Davidson county raised a most excellent crop of Hungarian millet, sown the first day of September and cut on the 10th of October. Another, of Williamson county, secured a good crop of German millet sown on the 13th day of August and cut on the 12th day of October. So, if a farmer, by any kind of misfortune, fails in the earlier months to secure a sufficient quantity of dry forage for his stock, he can, as a dernier resort, start very late in supplying himself, by crops of this grass. Should it be desired to use the hay as a green forage, it can be cut three times at least, provided it is done before it begins to throw up the seed stalks. It is a common custom in the southern states to use it in this manner instead of buying the expensive baled hay of the north.

COMMON OR BROOM CORN MILLET—(*Panicum miliaceum*.)—(Grown
for Hay and Soiling.)

The heads of common millet are large, open and nodding, resembling broom-corn in general appearance. This grass is used for the same purposes, and cultivated in the same manner and upon like soils, as Italian millet and Hungarian grass. It will yield from sixty to seventy bushels of seed per acre. Cut after the seed is ripe it is valueless as food for any kind of stock.



Broom Corn Millet—*Panicum miliaceum*.

a, b, c, Spikelet and Chaff. d, e, Two views of Seed.
(U. S. Dept. Agric.)

GAMA GRASS—SESAME GRASS—(*Tripsacum dactyloides*)—(For Hay and Soiling.)

Gama grass merits more attention from Tennessee farmers than it has ever received. It is one of the largest and most beautiful perennial grasses grown in the South, reaching oftentimes a height of seven feet. When young and succulent it is eaten with avidity by stock and makes from its rapid growth a good soiling or forage crop or material for the

silos. Its leaves are very large, equal in size to the leaves of Indian corn. It has very strong creeping root stocks, which are as large as those of cane roots, but close grazing will destroy the grass in a few years.

Gama grass may be cut three or four times a year and though in its native state it grows in swamps, it will thrive almost equally well on dry or sandy ridges. It will grow where timothy or orchard grass will not, and consequently it is well suited to a large section of our State. The quantity of hay taken from one acre is simply enormous, resembling very much corn-fodder. As a hay it is fully equal to corn-fodder, and it can be saved at one-tenth the labor required to save fodder.



Gama or Sesame Grass—*Tripsacum dactyloides*.

2. Inflorescence. 3. Base of the female inflorescence. 4. Upper leaf. 5. Male or staminate spikelet. 6. Female spikelet in section. 7. Female spikelet expanded.

It is very nutritious and succulent when cut green. The great mass of roots will serve to open, loosen and improve the land upon which it grows. It should never be allowed to shoot up the seed stem when desired for hay.

It is with difficulty the seed can be made to vegetate and therefore it must be propagated by slips from the roots. Prepare the land well, lay off the furrows with a bull-tongue plow two feet apart, and drop small pieces of root about one foot apart in the furrow, covering with a board. The creeping roots will soon meet, and the ground is quickly turfed with the grass. It should be planted early in September. Of course, the richer the land, whether upland or bottom, the greater the yield. Poor land rarely makes better crops of anything than fertile land. I have seen this grass growing with great luxuriance in Montgomery county, Tenn.

TEOSINTE—(*Euchlaena Mexicana*, *E. luxurians*.)—(Grown for Fodder.)

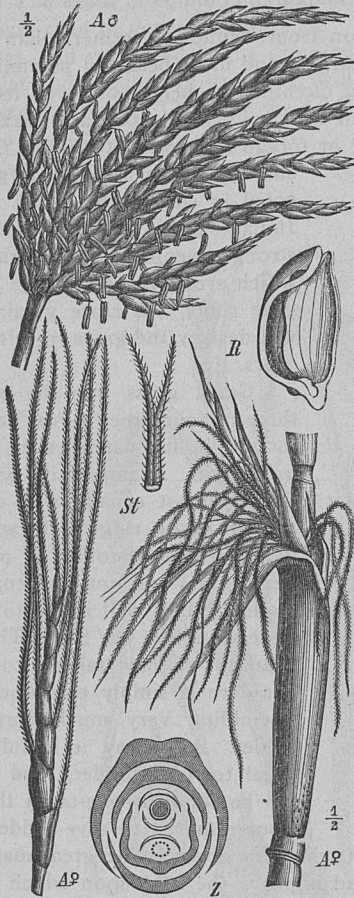


Fig. 32.

Teosinte—*Euchlaena Mexicana*, *E. luxurians*.

The uppermost cut in the figure shows the male inflorescence reduced one-half; to the right below is shown the female inflorescence mostly concealed within the sheathing leaf; to the left below is shown a single female spike. *R.* A joint of the rachis of the female spike. *St.* Terminal portion of the stigma.

The soil for its growth must be deep, moist and fertile. Any soil suitable for corn will produce teosinte. It is one of the rankest feeders of all the grasses. Dairy men living near a city would find it valuable as a soiling crop for cutting green and feeding to milch cows. The stalks are very tender and are eaten greedily by cattle, whether green or dry. It is a difficult matter to cure this grass properly and many other grasses adapted to the soils of Tennessee are to be preferred to it for making winter feed for stock. It may be cut with corn knives in the fall.

This is an annual grass and in the luxuriance and largeness of its growth it much resembles Indian corn. It attains a height upon fertile soils of from eight to twelve feet. It is of tropical origin and was introduced into the United States probably from Central America or Mexico, or from both.

It has been successfully grown at the Experiment Station at Knoxville, and is regarded as one of the most prolific forage plants known to agriculture. Stock is very fond of it, and it will yield twenty or more tons of green forage per acre. It will bear cutting several times during the year but some authorities believe that the best results will be obtained from a single cutting just before frost. It tillers greatly, as many as fifty stalks having been observed as springing from the same root. The Agricultural Department at Washington recommends that teosinte be planted in drills three feet apart and thinned to a foot apart in the rows. One pound of seed is sufficient to plant an acre. One drawback to this grass is that it does not mature its seed in Tennessee, and very rarely north of Southern Florida.

and set up in shocks. It has very little, if any advantage over corn when the latter is cut and put up before the blades are dry. Teosinte harvested in the same way would probably have its greatest value and be most easily saved at the smallest cost for labor. It is superior to corn as a forage crop only in its capacity of giving a greater yield.



Teosinte—*Euchlœna Mexicana*, *E. luxurians*.

Showing its robust character and habit of throwing up many stalks or culms from a single root.

SUGAR SORGHUM—CHINESE SUGAR CORN—(*Sorghum saccharatum*.)—(Hay, Pasture, Forage, Silo and for the Manufacture of Syrup.

Fifty years ago sugar sorghum or Chinese sugar-corn, was unknown in the United States. It is now grown to a greater or less extent in every southern state, all through the western states and as far north as Pennsyl-

vania and New York and even in Canada. At first it was grown only for the manufacture of syrup. It was soon discovered, however, that stock of all kinds ate it with a decided relish and that it kept them fat. About 1880 it first began to be grown in Tennessee as food for cattle. It is now grown extensively for forage in every part of the State and by many farmers it is regarded as far superior to corn fodder for feeding cattle. It certainly abounds in fat-making elements. The seed in India and in other tropical regions is largely employed by the inhabitants as food and it is asserted by high authority that more people subsist upon it and kindred species than upon any other cereal. While wheat makes the best bread sorghum seed, Kaffir-corn, Durra-corn and other like species can be produced cheaper and is the chief "staff of life" among the poorer classes in the Orient. In Tennessee the grain has rarely been employed for human food, but it has been fed to all kinds of live stock and it is especially valued for feeding poultry.



Seedhead of
Amber-Orange
Sorghum.
(U. S. Dept.
of Agric.)

VARIETIES, SOILS AND CULTIVATION.—

There is a vast number of varieties and sub-varieties of sorghum. Originally there were two leading kinds, the Chinese sugar cane and the Inphee, known as the red and the black, or the Chinese and the African. For the manufacture of sugar, probably the Inphee cane is superior, but for the manufacture of syrup, the Chinese is preferred. These varieties have been modified by cultivation and climate and from them have originated several that are regarded for specific purposes much better than the two great original varieties. The variety called amber is most widely distributed and is used for forage purposes in almost every state where sorghum is cultivated. What is known as the early amber is used both for forage and for pasture. The *amber variety* is very sweet, very early, not very rank and therefore is better adapted for making a coarse kind of hay. The orange varieties are said to come next to the amber varieties in point of popularity and usefulness. These are coarser than the amber varieties. They do not grow so rapidly or mature so quickly and are therefore not so much used for early feeding or for hay. They are said, however, to be better for soiling purposes and for the silo. Other varieties are known as Folger's early, Coleman and gooseneck. For summer pasturage Folger's early is said to be an excellent variety.

Sorghum will thrive to some extent on the poorest soils. When the earth is parched up by drought it maintains its fresh, green color and continues to grow. However, it will thrive better on rich, calcareous and alluvial soils, and though the juice may have more water, when grown on such soils it will make far more syrup. The roots of sorghum penetrate the soil deeper probably than any other cereal and consequently deep plowing in the preparation of the soil is highly important to make a full crop. Not only should the plow be used, but the subsoiler also. On

good land it grows to a height of 15 to 18 feet; on poor, badly prepared land, it stops at five or six feet. Because it will grow on poorer land than other plants is no evidence that poor land is better for it. On gravelly or sandy subsoils, the roots will go four or five feet deep, and on this kind of land, if rich, it will make far more syrup and of a better quality. For syrup making it should be planted in drills three feet apart. In four or five days the young and tender plants come up, looking very much like



Seedheads of Sorghum—Collier variety, one of the best.
(U. S. Dept. Agric.)

grass. Young sorghum grows rapidly, and soon outstrips the weeds. When three or four inches high, it should be chopped and thinned out, and but little more work need be done to it. Two or three plowings are all it should receive, as the roots penetrate the ground so thickly the plant will receive more injury than benefit if plowed after it is three or four feet high. Besides, by that time the ground is so shaded by lateral branches and suckers that the weeds will effect no material injury.

Much difference of opinion existed at first, and still exists, as to the best time of cutting so as to get the largest amount of good syrup. Some assert it should be harvested when the seeds are in the milky state, others when they are fully matured. A slight degree of frost does not injure it, and this has caused the loss of many a crop, for whenever it freezes, fermentation ensues, and it will not make syrup at all; or if it does it is black and has a disagreeable odor. But repeated experiments have demonstrated the fact that early cut cane makes the best and cleanest molasses.

AS A FORAGE AND SOILING CROP—But it is rather as a forage crop that the methods of cultivating and curing this plant properly belong in this bulletin. Its uses are almost as various as those of Indian corn itself. As has already been stated, it is greedily eaten in all stages by stock of every kind. The seeds are abundant and one acre of good sorghum will make from forty to sixty bushels of seed. The heads can be cut from the stalks and stored for use, taking care to spread them out until they are dry, when they make good food for cattle, horses, sheep, hogs and poultry. When ground into flour they make good bread. Both the seeds and the expressed juice have been extensively used in distillation, large quantities of alcohol and sorghum brandy being annually made from them. During the civil war it formed almost the only resource of the South for whisky, all other kinds of grain being in too much demand for distillers to use them.

But probably it possesses more good qualities as a green soiling plant than any other. Let it be sown on good land, either broadcast or thickly drilled with a seed drill, from April to July, with about one bushel of seed to the acre, and the amount of forage will be immense. It will yield from 20 to 30 tons of green fodder to the acre, which, when dry, will make four to six tons of the sweetest and best of hay, and stock will eat up the last vestige of it.

HARVESTING AND CURING—The most difficult thing in connection with the growing of sorghum for hay, is to cure it properly. When sown broad-cast upon a rich soil using three bushels or more of seed per acre or when drilled with a wheat drill using a like amount of seed, it makes such a rank growth that it is a troublesome task to cut and save it. If the seed is sown thick enough so that the stalks will be small, the crop may be cut with a mower. If the stalks are large, a corn knife will have to be used or a corn harvester. Some farmers use the self-binder in cutting the crop but in this case the height of the stalks must not be over five or six feet.

The proper time for cutting is when the heads begin to flower. Then it should be cut and bundled as corn fodder, or it may be left spread on the ground, if the weather is good, for several days, and it will be dry enough to store but not in too large a bulk. Its stems are so full of juices that it will not cure quickly. The juices in it, however, will sugar in a few days when it will keep as well as timothy. It possesses fattening qualities in an eminent degree and nothing like it was ever used for improving a drove of mules. If the farmer has a drove of mules or herd of cattle or milch cows or flock of sheep it can be fed to them from the time

it is two feet high and they will eat it with avidity. By the time a field is gone over, it will be ready to cut again, as the root freely throws up new suckers and will continue to do so until stopped by the frost. Thus, as many as three crops of it, if sown early can be cut in Tennessee as a soiling crop, before it is destroyed by the cold. Or if it is not wanted as



Sorghum Growing on the Station Farm, University of Tennessee.
(U. S. Dept. Agric.)

green forage, it can be cut at blossoming for hay, at least twice without resowing. And the second crop will be as good as the first.

After lying on the ground for three or four days it may be gathered and shocked like corn, if the stalks are large, but if they are small they

may be raked up and put into cocks from which, after remaining for a few days, the hay may be hauled to a shelter or put into stacks and topped off with fodder, rye straw, herd's grass or timothy hay. It will be necessary if the crop is very rank to turn it over on the ground so that all parts of it may, as far as possible, be equally exposed to the sun.

The difficulty of curing is greatly increased during rainy weather, as under such a condition the stalks are apt to blacken and ferment. Some farmers find the best way to preserve it from fermentation is to make alternate layers of sorghum and dry wheat straw, the latter readily absorbing any undue moisture which may remain.

For a long time the farmers objected to growing it extensively because they believed it to be a very exhaustive crop to the soil. This is true when the seeds are permitted to ripen fully. In fact the experience of the writer is that if left to ripen seed it exhausts soils more than the growth of corn or wheat. But when sorghum is cut just as the head begins to blossom and before the draughts are made upon the soil for maturing the seed, it injures the soil less than probably any other crop yielding as much forage. In many parts of Tennessee where there are fields well suited for the growing of sorghum the same land is planted with it for several years in succession without showing any diminution in the quality or quantity of the forage produced. It is claimed by some observant farmers that the land is benefited by the deep growing roots through their agency in permitting the soil to be thoroughly aerated. Very little injury is done to the soil by removing the crop in an early stage of development. Many farmers claim that when planted late with cowpeas or other field peas and cut before the seeds are matured, the land is left in excellent condition.

Mr. Bulow, of South Carolina, in speaking of sorghum, says:

"I rely almost entirely on early amber sorghum as forage for my sheep and cattle. I cultivate it in three-foot rows and sow the seed rather thick. About the time the heads begin to get hard, cut and put up in shocks and bind tightly at the top and it can remain in the fields for three or four days, as we have but little rain during the fall months."

Mr. Thompson, of Georgia, says:

"Sorghum makes good roughness. Plant thick in the drill, cultivate it, cut it and shock until cured. Make the shocks small; when partly cured put two to four together. Sow about one and one-half bushels of seed to the acre and mow and cure like millet."

In Texas the hay is often baled from the cocks after giving it an additional exposure to the sun for several hours. The experiments made at the Texas Station show that the percentages of fat and protein increase as the sorghum ripens, but when ripened it is not so digestible, so that the increase in fats and protein are more than off-set by the indigestibility of the forage.

Georgia experiments show that the highest percentages of fat and protein are found in the plant when cut during its inflorescence. Unquestionably the consensus of opinion with a large majority of farmers is that it makes the best forage when cut in bloom. The yield often runs as high as 12 to 15 tons from one sowing. As a food for milch cows it is

unexcelled on account of the large flow of rich milk, which it induces. Care should be taken at first in the feeding of the green forage to cattle unaccustomed to it. They should be restrained and not suffered to take a full feed, as it is very succulent and like clover, is apt to induce hoven.

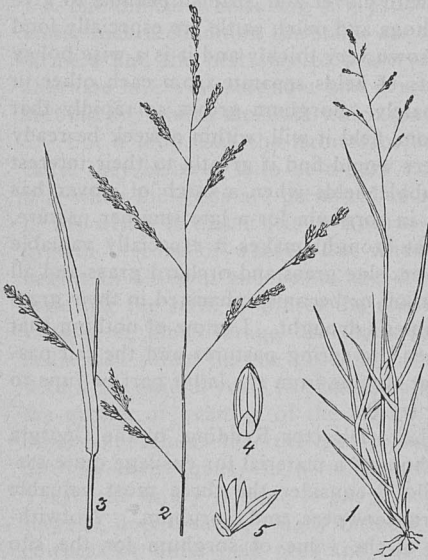
AS A PASTURE—As a pasture grass sorghum has been highly commended. The Arkansas Experiment Station issued a bulletin in August, 1896, in which it is stated that sorghum gave excellent results as a hog pasture used in connection with clover and Spanish peanuts to give a succession of fresh food. Sheep, hogs and milch cattle are especially fond of it. For a pasture it should be sown very thickly and it is a wise policy to sow two or three fields or parts of fields separate from each other in sorghum and pasture them alternately. Sorghum grows so rapidly that as soon as the stock is taken off one field it will, within a week be ready to pasture again. Tennessee farmers would find it greatly to their interest to break up portions of their stubble fields when a catch of clover has failed or been destroyed, and sow in sorghum for a late summer pasture. The capacity of this plant to resist drought makes it especially valuable for pastures at a season when clover, blue grass and orchard grass and all the best pasture grasses have fallen off or become exhausted in their grazing capacity by reason of the summer's drought. I know of nothing that will so well fill up the gap between the spring pastures and the fall pastures as sorghum sown upon wheat stubble from the latter part of June to the last of July. Farmers should try it.

SORGHUM FOR THE SILO—Director Redding, of the Georgia Experiment Station, regards sorghum as a material for ensilage quite satisfactory. He says: "For the silo I consider the three most valuable plants in order, are Indian corn, cowpeas and sorghum." Notwithstanding this favorable estimate of the value of sorghum for the silo many object to it on account of its tendency to become acid. It also lacks the nutritive quality of Indian corn and unless cut very early in its growth the stalk becomes so hard that it is not eaten with comfort by cattle. One advantage, however, of sorghum is that it will remain green in the fall for a much longer time than corn and so a larger quantity of it may be utilized for making ensilage. When it is grown in conjunction with cowpeas or soy beans it gives a much more nutritious ensilage than corn taken by itself.

With all the short-comings of sorghum it must be regarded as one of the most useful and widely cultivated plants that has ever been introduced into the United States. Among the small farmers it is highly prized for its syrup-making properties. Among stock-breeders it is valued because of the immense amount of forage which it supplies at a small cost. It has the capacity to resist dry weather better than almost any other crop. It may be used for more purposes than almost any other crop. It is very valuable as a pasturage for sheep, hogs, cattle, mules and horses. It makes good hay for winter feeding. The seed is said to be worth, for feeding purposes, about 90 per cent. as much as corn. The hay is better than corn-fodder and the stalk when properly cured may be reckoned among the best fattening foods grown.

JOHNSON GRASS—(*Andropogon sorghum halepense*.)—Meadows and Pasture.

Space for a description of Johnson grass is given in this bulletin mainly for the purpose of warning Tennessee farmers against it. While it makes excellent hay and furnishes a large amount of grazing it is at the same time one of the most troublesome weeds that can be introduced



Johnson Grass—*Andropogon Sorghum halepense*.

upon a farm. If one wishes to raise nothing but hay; if he has no regard for the rights of his neighbors; if he expects never again to grow tillage crops on his farm, then the wisdom of sowing Johnson grass may be commended. Otherwise it should be left severely alone for no time will completely eradicate it when once well set upon good land. It has a thick fleshy root stock that penetrates the soil in every direction and throws up a culm from every joint. If a single piece of root an inch long is left in the ground it will be the prolific mother of a numerous progeny of stalks and roots within a year. It is possessed of a strange and extraordinary vitality. A barrel of salt poured upon a bed of

it eight feet square did not destroy the roots. Within a month the salt disappeared, leaving a briny surface, but the invincible roots sent up an army of numerous stalks that waved their flags in victory over the bed that was intended to be their grave.

The only possible way to keep Johnson grass in subjection, so far as the writer knows, is to pasture it with hogs and never suffer the grass to go to seed. Frequent plowing of the land and bringing the roots to the surface so that the hogs may find them readily will assist in keeping it down. One of its greatest virtues is that hogs will thrive upon its succulent roots which they seem to prefer even to artichokes. They never tire in searching for them.

SOILS—Rich, well drained, calcareous soils and especially rich alluvial soils will grow this grass most luxuriantly, but it will thrive on a sandy dune, in a barren field, on a rocky ledge, wherever it can find a handful of dirt, and it will even flourish in the bottom of a gully. It knows not how to fail. In a southern climate it will grow on any spot and will resist the severest droughts, withstand the coldest weather of southern winters, and make a vigorous growth where but few other plants

will live. It is in a sense the most self-assertive of all the grasses and like the wild garlic will propagate itself equally as well from the roots as from the seeds.

With all its bad qualities it is probably the most prolific perennial hay grass in the United States. In the latitude of Tennessee, Northern Alabama and indeed throughout the South, it may be mowed three to four times a year and will yield at each mowing from two to three tons of excellent hay when grown on rich soil. The best time for cutting it to make hay is before the heads appear. After the seeds are formed the stalks grow hard, which makes the hay unfit for stock. Jno. B. McEwen, of Williamson county, a most observant farmer, speaks in rather extravagant terms of the quality of hay made from this grass and declares that it is the best hay he makes on his farm.

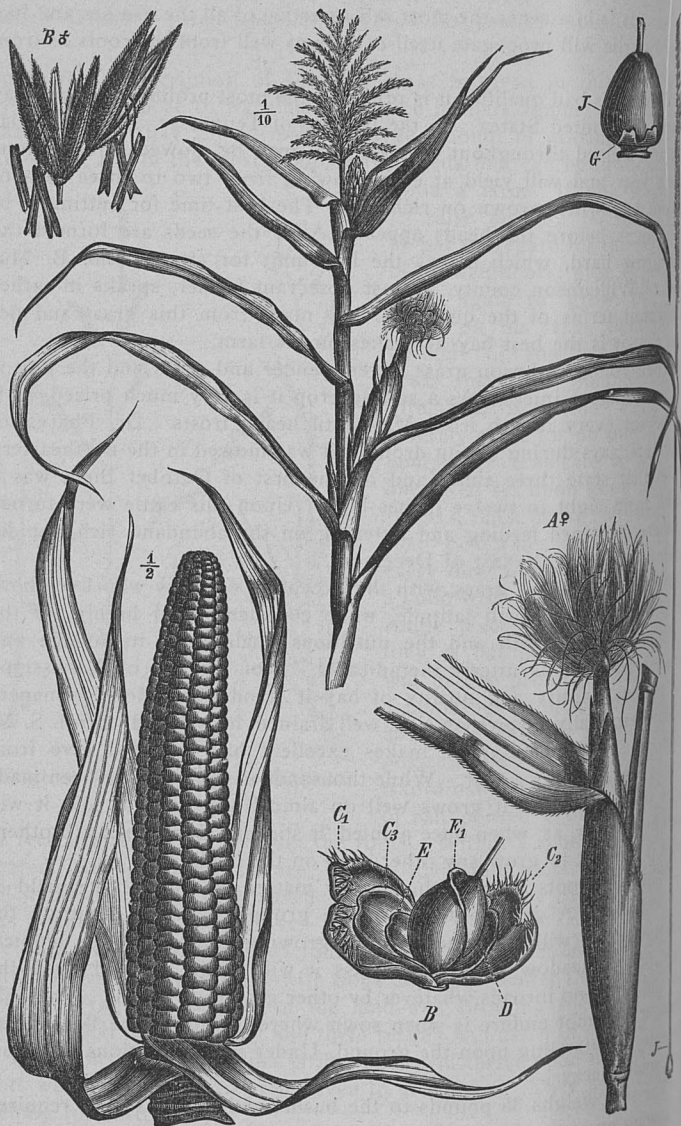
When young, Johnson grass is very tender and sweet and the pith is filled with sugary juices. As a soiling crop it is very much prized, as it may be cut every month from May until heavy frosts. Dr. Phares, of Mississippi, says during a long drought it was mowed in the northeastern part of that state three times and on the first of October there was a growth from eight to twelve inches high. Upon this cattle were turned and there remained feeding and fattening on the abundant, rich, rapidly growing foliage to the last of December.

All writers on this grass, with the exception of a few who live above the 37th degree of north latitude, while commending it highly for the fecundity of its growth and the nutritious qualities of its foliage and roots, speak of it as utterly ineradicable. Prof. Gulley, of Mississippi, says in the quantity and quality of hay it stands first for permanent meadow, especially if sown on rich, well drained, heavy land. Prof. S. M. Tracy, says: "Johnson grass makes excellent hay and will give from three to four cuttings a year. While thousands of dollars have been made by its cultivation and it grows well on almost any kind of soil, it will never be popular, as, when once planted 'it sticketh closer than a brother,' and it is difficult to grow any other crop on the land."

When the roots become thoroughly matted in the soil the yield of hay decreases. A good plowing of the ground so as to dislocate the masses of roots will start the grass to growing again in all its tropical vigor. As a meadow or pasture grass it will retain its hold upon the land and suffer no inroads whatever by other grasses or weeds. The only situation it cannot endure is when sown where it will be overflowed and the water left standing upon the ground. Under such conditions the roots will rapidly decay.

The seed weighs 35 pounds to the bushel and one bushel is required for sowing an acre. It may also be propagated by setting out pieces of the roots a foot apart.

The writer, however, wishes to emphasize and repeat his warning to the farmers of Tennessee: Never plant Johnson grass with the expectation of destroying it for it is a "stick-fast" and will survive the roughest treatment. Many excellent valley farms in the central basin of Middle Tennessee have had their value greatly decreased by the presence of this unconquerable grass.



Indian Corn—*Zea Mays*.

BOTANICAL DESCRIPTION OF INDIAN CORN—(*ZEa MAYS*, L.)—In the center above is a single stalk, reduced to 1-10th its natural size, showing the terminal male (the "tassel") and in the axil of the third leaf from the base is the female inflorescence enveloped in broad, leafy bracts. At the base of the figure on the right side this female inflorescence is shown more clearly; the hair-like tuft is formed by the projecting slender styles (the "silk.") To the left at the base of the figure is shown an "ear" of corn, the kernels being the matured ovaries from which the styles have disappeared. In the upper left-hand corner of the figure are two spikelets. The flowers of Indian corn are unisexual, the one male or staminate, the other female or pistillate; both are born upon the same plant, but each is in a separate inflorescence.

INDIAN CORN—(*Zea Mays.*)—(For Forage).

Taking it in all its manifold uses there is no other product of agriculture grown in America so important to man and to domestic animals as Indian corn. The grain is more extensively used in the United States than all other grains combined. The average annual crop does not fall short of two thousand million bushels. The oat crop which comes second rarely surpasses 800,000,000 bushels. The corn crop has always been a leading one with the farmers of Tennessee from pioneer days to the present. In fact, in 1840, Tennessee grew more Indian corn than any other state in the Union.

It is not the purpose of this bulletin, however, to try to teach Tennessee farmers how to raise corn or to go into an elaborate description of the great number of varieties produced in the United States. The chief object of this paper is to direct their attention to the value of Indian corn in the making of hay and forage. The "saving of fodder" was for nearly a century considered one of the indispensable tasks of the farmers of Tennessee, but no one in early times ever thought of sowing Indian corn and mowing it to supply the place of fodder. The dairymen of the north have, for many years, been using corn so sown as a soiling crop for their cows during the dry months of July and August after the first pastures have dried up and before the fall pastures have become green with the latter rains. A vast amount of forage in the form of fodder tops and stalks is saved in every part of the United States. Even in Europe corn forage is growing to be very popular, and the grain is now used by the inhabitants of many foreign states who knew nothing of it thirty years ago.

Mr. Mechi, who for a long time enjoyed the distinction of being one of the best farmers in England, placed a very high estimate upon corn fodder not only in the feeding of sheep and cattle, but for the production of milk and butter. He estimated that one ton of such fodder is equal to forty bushels of grain.

There is a class of small farmers and tenants in the State of Tennessee who do not own the land which they cultivate. These farmers must raise some kind of hay, or as they call it "roughness" with which to feed their work stock. This can be easily done by sowing, the first of May upon well prepared land, a few acres in corn at the rate of a bushel and a half to the acre. It should be covered with a harrow. The corn fodder will mature in about 90 days, that is to say, it will arrive at that stage when it should be cut, which will be about the time the tassels and silks are well developed. Cut at this stage, it will make from 40 to 50 tons of green forage on an acre of fertile land and from three to four tons of dry forage. It makes also an excellent soiling crop for milch cows.

There is some difficulty in curing corn-fodder properly, as it is extremely succulent. It must be cut in good weather and spread evenly on the land so as to receive as much sun as possible. It may then be put up in shocks like hay, after it has been sufficiently dry to escape the danger of fermentation. It may be managed very much in the same manner as sorghum. Corn fodder, green, is also an excellent material for ensilage, especially when grown with cowpeas, oats and soy beans.

There is a small variety of corn known as Dixie corn, the ears of which are not larger than the fingers. This corn usually yields from six to eight and even as high as fifteen ears to the stalk. The grains are very small and the corn matures quickly. If this corn should be sown upon rich land and cut at the time the grains are in the dough state, it would make a mass of forage highly nutritious and would serve the purpose of both grain and hay. The stalks are so small that they may be cut with a reaper or mower and put up in the same way as the corn shocks of ordinary corn when cut in the fall. The sowing and saving of this Dixie corn for forage deserve the consideration of Tennessee farmers. Stubble land could be employed for the growing of this crop.

CRAB GRASS—(*Panicum sanguinale*.)—(Hay and Pasture.)

This is a hardy annual grass, attractive because of its digitate form of inflorescence. It is indigenous to the soil and troublesome in the cultivation of other crops when clover or peas have not been used in the systems of rotation. In the early settlement of Tennessee it was far more abundant in the cultivated fields than at present. This grass comes up



Crab Grass—*Panicum sanguinale*.

2. Upper leaf and inflorescence. 3. Portion of one of the racemes. 5. Spikelet, front view. 6. Spikelet, side view.

spontaneously. It grows with the greatest luxuriance upon stubble fields and in corn-fields in low situations. It makes an excellent pasture from June until October in the latitude of Tennessee and even to a later date when heavy frosts do not occur. Its most intimate associate is green foxtail (*Setaria viridis*), which is totally worthless when it begins to seed. Crab grass is never sown. When cultivation ceases it takes possession of the land. It is justly regarded as an excellent pasture grass but it forms no sward. It sends out numerous stems, however, branching at the base. Crab grass serves a useful purpose in stock husbandry all over the south. It

comes on at a time when northern farmers are compelled to resort to soiling crops in order to supply green food to their milch cows. A dairy man from Ohio said to the writer upon seeing a field of crab grass growing to the height of three feet, that it was the most valuable summer grass for the dairy he had ever seen. It grows very rank after oats and, cut when in flower, often yields more forage than the oat crop that precedes it. Sometimes as much as two tons of crab grass hay to the acre have been cut within forty days after the oat crop has been re-

moved. The hay is sweet but light, and stock seem to prefer it to any other when cut early before the seeds harden. It will not shed rain very well and it should be cut during a dry spell. It cures rapidly and unless very rank it may be hauled in and stored away the next day after it is mowed. It may be stacked in the open fields but the stacks must be capped with herd's grass or timothy hay. The hay is sometimes gathered by pulling it up from between the corn rows. This is a tedious task but not more so than the pulling of fodder. Crab grass furnishes more hay for home use in the Gulf states than any other grass. It is usually cut in August or September, and even as late as October.

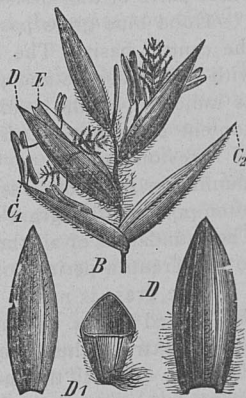
Mr. Sinclair says that the clean seed, when boiled in milk, makes a dish resembling sago. It has been used as a substitute for sago in Germany, and is really cultivated for that purpose in some districts.

BLUE GRASS—JUNE GRASS—(*Poa pratensis*.)—(Pasture Grass.)

This is a perennial grass and is well styled the king of all the pasture grasses. It is very choice, however, in the selection of soils and situation.



Kentucky Blue Grass—*Poa pratensis*.
2. Panicle. 3. Upper leaf. 4. Spikelet.
5. Empty glumes.



Spikelet of Blue Grass,
showing seed.

Wherever it plants itself the land advances rapidly in price and it becomes the breeder's ideal home. Blue grass indeed has no rival within the limits of its growth. All other grasses that make inroads upon its territory are regarded as intruders. Whoever has blue grass is possessed of the key to fortune. Stock breeders depending upon other grasses may do well. The stock breeder in the blue grass region can hardly fail to do well.

SOILS—The best blue grass soils in Tennessee and Kentucky are the calcareous loams of the Trenton formation. In Tennessee these soils prevail in the central basin. There are parts of East Tennessee, where the Trenton limestone abounds, that will also grow blue grass well.

Even upon some of the foot hills of the mountains, as well as in the valleys, thick blue grass sod is often met with. Among the limestone hog-back ridges in that region, and especially in Southwestern Virginia, are found some of the best blue grass pastures of the South. Blue grass may be successfully grown upon the more fertile lands of the highland rim, particularly in those localities where the St. Louis limestone abounds. A singular fact in connection with the heavy clay soils of Montgomery, Robertson and Stewart counties deserves mention. When the lands are first opened to cultivation, the soils seem adapted to the growth of blue grass. Tramping however, soon destroys it. After being in cultivation for a few years so as to destroy a large part of the original humus, it seems to reach a condition, a second time, favorable for the growth of blue grass. All old fields thrown out of cultivation in these counties soon show considerable areas covered with blue grass. In the digging of an ice house many years ago on the writer's farm, the red clay was thrown out and a mound made of it around the superstructure. Blue grass after a few years appeared and is now growing in vigor upon this clay. The presence of locust and walnut trees always induces a growth of blue grass on any soil clear of underbrush. West Tennessee has some blue grass lands in the tier of northern counties where limy concretions abound in the soils. It is also successfully grown in the yards in many other parts of that division of the state.

Good blue grass pastures, however, are rare in Tennessee outside of the central basin. The best soil for its growth is strongly impregnated with the carbonate and phosphate of lime, potash, alumina, ferric oxides as indicated by the reddish color of the soil, all associated with a large content of humus. Commingled with the soil are small angular pieces of limestone gravel to the extent of twelve or fifteen per cent. The alumina in such soils varies from 15 to 30 per cent., though the subsoil is often porous. Blue grass sown on such soils is benefited by being tramped. The foundation of all these soils is a soft calcareous limestone belonging to the Trenton period.

Blue grass is not so highly prized for pastures in England as it is in the United States. Doubtless its nutritious qualities are there impaired by the extreme humidity of the climate, notwithstanding Mr. Sole, of England, calls it "the most noble of all the grasses for agriculture." It produces nearly all its flowery stems at once and when the seed ripens and the stalks decay a wealth of blades spring up and falls over in great folds which furnishes an immense amount of grazing. Its aftermath is more valuable than its first growth. Blue grass is rarely injured by cold weather, by close grazing or by the tramping of stock. It bears a drought heroically. Though it may look brown and sere after a long dry summer, the first autumnal rains will start it afresh and in a few days its beautiful leaves will clothe the earth with a rich mantle of verdure.

Blue grass requires three or four years to become well established. It should be grazed but lightly during this period. After it has grown into a good thick sod close grazing will not hurt it. When eaten down to the ground in favorable weather it will reproduce itself in a few days.

The early spring growth, by its succulence, greatly increases the flow of milk but it does not add materially to its richness. As the summer advances the quality of the milk grows richer and its capacity for butter-making increases.

HOW AND WHEN TO SOW IT—If a wooded lot has been selected for seeding to blue grass, all leaves and trash and underbrush should be removed. The seed must come in contact with the soil. Sown on a bed of leaves the seed will germinate during moist weather but under such conditions the rootlets will soon wither and die. The timber trees should be thinned out if standing very thickly upon the land. At least one-half or two-thirds of the area should have unobstructed sunshine during a portion of the day. The tallest and best timber trees should be left and the bushy trees should be removed. Blue grass does better when subjected to the cool of the shade during a part of the day.

So many seasons have been recommended as the best time for sowing blue grass that it may be said each one, under favorable conditions, is a good one. One Kentucky farmer says: "Any time in the winter, when snow is on the ground, sow broadcast from three to four quarts of clean seed to the acre. With the spring the seeds germinate and the sprigs of grass are then very fine and delicate. No stock should be allowed for the first year, nor until the grass seeds in June for the first time, which will be in the second or third year. The best plan is to turn on your stock when the seeds ripen. Graze off your grass, then allow the fall growth, and graze all winter, taking care never to feed the grass too closely at any time."

Another authority says: "Follow nature and obey her dictates. The seeds ripen in June and are scattered by the winds and rains as soon as ripe and therefore, sow your seeds as soon as they can be gathered."

This plan might be a proper one in a colder or moister climate than that of Tennessee but here it would result in the grass being often killed by the droughts that come almost invariably in the latter part of summer. Many sow on winter snows, which is a very good method, but care should be observed to have the ground free from leaves before the snow falls.

There are others who sow in the latter part of February or first of March. This season does as well as any provided the grass gets sufficient hold to resist the withering effects of the summer's drought. The main point is to get the grass large enough to resist successfully the frosts of winter or the droughts of summer. It can endure frost better than heat and this fact justifies the statement that the most approved time of sowing is in the latter part of August or first of September. If sown at that time the autumnal rains will cause the seed to germinate quickly and the grass to grow rapidly. At this season there is comparatively little trash on the ground, the leaves having not yet fallen. The ground being prepared the seed is sown broadcast, at the rate of one bushel of seed in the chaff per acre. The sower should be followed with a harrow, or if the ground is very loose with a stiff brush and roller. This will give the seed a sufficient covering. Blue grass seeds will vegetate best when put at a depth of one-quarter of an inch. It may be supposed that, with no more

covering than will be given by a harrow or brush, a great many seeds will be left uncovered. This is true but in one pound of blue grass seed (clean seed) there are 3,888,000 seeds. By a computation every square inch of surface will contain from nine to ten seeds. With this amount on the surface, one scarcely need fear a stand, when if one or two take root there will be a close turf in a year upon good soils.

Dr. F. H. Gordon, of Smith county, who during his life paid more attention to the growing of blue grass than any one else in the State, adopted a plan of management that has been repeatedly tested, with uniform success. It was this:

He sowed, either in the autumn or spring months indiscriminately, as suited his convenience. He usually sowed with rye, wheat or barley if sown in an open field, but if in a woods lot, the blue grass was sown only with rye, or after a crop of millet. The soil was cleared of all trash and brush, and broken up as well as the nature of the land would permit. The grain was first sown, the land harrowed and if possible rolled. After this, the grass seed was sown over the ground and brushed lightly. Cattle, horses and sheep were then turned in, as many as could be secured. If there were not enough on his place he borrowed his neighbor's stock, and let them run on the land until it was well packed all over the surface. If sown after millet (and that is greatly recommended, as millet destroys more effectively than anything else, all weeds) the land should be harrowed about the first of September thoroughly, the seed sown and brushed in. After this the stock should be turned on the land. If it is desired to sow the grass in the spring, during the latter part of February or early in March, if not practicable sooner, the grain field should be harrowed, the ground having been well prepared in the fall. The seed is sown and stock turned on the wheat, rye or barley as the case may be. Oat land may be sown in the same way. The treading of the stock packs in the seeds and prevents the grass from drying up in summer or freezing out in winter. Dr. Gordon considered an open, loose porous surface, extremely unfavorable to the safety of the young grass. When packed as directed, the grass will quickly spring up and get a firm hold, and the loose condition of the subsoil will favor the transmission of the roots to a good depth.

Dr. Gordon would not permit the grass to seed at all. His great success in this branch of agriculture gives weight to his authority. Others, who have been successful in managing blue grass think no stock should go on it for two years, or at least until after the first seeding, which will take place in June of the second year. Some of the best blue grass lots in Middle Tennessee have been started by following either of the methods given above. The ground should not be well broken up. The surface should be as firmly packed as possible in order to secure a perfect stand and to form a perfect turf. When the surface is loose, the grass dries up in summer and freezes out in winter. With favorable weather, seed sown in the spring on a crop of oats will do as well as fall sowing. What is meant by favorable weather, is that no unusual dry weather supervenes. But the risk of meeting with unfavorable weather in spring sowing is great, and for this reason fall sowing is preferred. The sowing should take place as early in the fall as the weather will permit, or indeed in the

latter part of summer, if there is a proper degree of moisture in the soil. Some sow a limited amount of seed daily and over the same surface sprinkle shelled corn and then turn on their hogs. The hogs root in search of the corn and thus plant the seed, doing the work of plow and harrow. This, to say the least, is a slovenly way, and though possibly insuring a good stand, the ground is made so rough it can never make a beautiful pasture until worn down.

If the land is loose as some soils are, it will answer a very good purpose to simply scratch the surface well with a sharp toothed harrow, and this is especially to be commended where there is a large number of roots in the ground.

AFTER TREATMENT—A blue grass pasture must not be pastured to death. It will stand almost unlimited grazing, but there is a point beyond which grazing will cease to be profitable. That limit should never be passed. The better method is to have the field divided into lots and allow the stock to run on one lot until it is cropped down, and then the stock should be removed. No good purpose is served in letting stock run on a lot in which there is no grass. It will not only do the stock no good, but by constant tramping, the grass will be unable to throw up any foliage. Under such treatment the roots will frequently perish. Time should be given for the grass to recuperate by changing the stock from one pasture to another, and never permitting it to be overstocked. Grass that will keep ten oxen in growing order, will fatten five oxen quickly. Stock of all kinds are constant feeders and there should always be forage enough to enable them to get plenty to eat without the labor of hunting for it.

There is much variety of opinion as to the amount of stock that ought to be put on an acre. This arises from the difference in the capacity of the land to produce grass, the character of the season and the nature of the soil. Porous soils will stand much heavier grazing than compact soils. It is better to err on the safe side and it is wiser to put on too few than too many cattle. If stock are fattened quickly, they are more remunerative than when fattened slowly. Ordinarily two acres of good grass are sufficient for one three year old ox and what will fatten one ox of that age, will fatten ten head of sheep. Some think that blue grass should be allowed to go to seed once or twice or until the ground is well set or turfed over and then never again. It is a grass that propagates itself mainly by its creeping roots or rhizomes after the first sowing, and it is the disposition of all plants and animals to lose vitality in the process of reproduction. It lies dormant for a time after a full crop of seed. It is to be doubted if blue grass should ever be allowed to go to seed after the first time.

The grass sometimes becomes so dry that it will burn. Stock will, however, eat it, ravenously, in that condition. The grass having dried full of nourishing juices, it is equal to the best of hay, and stock will fatten upon it, unless the dried grass has been drenched with rain.

The fall growth of some lots should be kept untouched by stock so as to have a good winter pasture. The grass will grow high enough to fall over and protect the surface foliage. In this condition stock will



PASTURE ON UNIVERSITY OF TORONTO CAMPUS

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keep up their flesh when permitted to run on it during the winter months without other food. When snow falls, however, cattle will have to be fed, but horses, mules and sheep will paw off the snow, unless it is too deep and get at the grass. It is the first grass that puts forth its leaves in the spring. Good fat lambs can be sent into the market earlier than from any other grass. It makes milk rich in butter, and gives the latter a fine golden color without injuring its taste, or, like clover, imparting its peculiar flavor to it.

While blue grass is the most valuable of all grasses for those portions of Tennessee where the soils are adapted to its growth it is too true that many farmers living in those sections show a total indifference concerning its cultivation. A farm well set in blue grass will yield a return per acre of from \$10 to \$15 for grazing purposes alone. With such profits from its growth it would seem that every farmer in the state would hasten to sow it. Many do not because they are unacquainted with the best system for its management. In its nutritive elements it ranks very high. Recent tests show that while timothy contains $4\frac{1}{3}$ per cent. of albuminoids; orchard, $6\frac{1}{2}$ per cent., red top, $6\frac{2}{3}$ per cent., blue grass contains 8 per cent. These results vary with grasses grown on different soils, time of harvesting and methods adopted in curing.

A standard bushel of seed weighs 14 pounds.

It is the very best grass grown for lawns and yards. A good sod of it with proper care will last for centuries. It will withstand, under favorable conditions, all the vicissitudes of the weather, the heat of summer, the cold of winter, parching droughts and sweeping floods.

It forms the greatest attraction of a country home. It is the groundwork of all natural and artificial decorations. Without this grass the shade is not half so grateful nor the flowers half so beautiful. For the embellishment of yards it is the best of all grasses. Wherever blue grass flourishes homes are more inviting and beautiful; lands are more valuable and in greater demand; the people are more intelligent and cultivated, have a nobler bearing and a higher sense of honor, become more highly educated; domestic animals are better bred and of higher types, both for beauty of form and for profitable marketing. In blue grass regions there is more wealth, greater taste, more real contentment, a larger hospitality, more ease and luxury, better society and fewer paupers, less worry, less enervating labor, more charming surroundings and happier families.

Blue grass is nature's sweetest smile; it is God's benediction; it helps to support us in life; it cheers us on our way by its freshness and beauty and it covers our last resting place with its perennial mantle of green, at once the emblem of life, of resurrection and of immortality.

ENGLISH BLUE GRASS OR CANADA BLUE GRASS.

(*Poa compressa*.)—(Grazing and Hay.)



English or Canada Blue Grass—*Poa Compressa*.

3. Panicle. 4. Upper leaf. 5. Spikelet. 6. Empty glumes. 7. Floral glume seen from the side.

In many of its features this grass resembles the Kentucky blue grass, but it has a more creeping habit, narrower panicles and flattened stems. The leaves have a deep bluish tint and it deserves the name of blue grass more than the blue grass does.

This grass does not require for its growth such fertile soils of calcareous origin as the *Poa pratensis* or blue grass. It is more hardy. It will thrive upon dry, sandy, thin soils. It flowers later than blue grass proper but its blades appear very early. Stock are very fond of it and it is rich in nutritive matter but the amount of its foliage is not great. Gould says:

"Cows that feed upon it both in pasture and in hay, give more milk and keep in better condition than when fed on any other grass. Horses fed on this hay will do as well as when fed on timothy hay and oats combined. Sheep fatten astonishingly when fed upon it." This is high commendation but this commendation is more applicable to this grass when grown upon the soils and in the climate of New York than when grown in Tennessee. But little of it is ever seen in Tennessee, except among the mountains of East Tennessee. It is known in some sections as the "blue grass of the North." It is rarely sown in Tennessee. The price of the seed is quoted at \$14 per 100 pounds or \$2 per bushel. It is easily distinguished from blue grass by its compressed stems, its lower habit of growth, the want of fuzziness on its seed, its smaller panicles and by its intense bluish color. It deserves to be tried in Tennessee upon those soils where blue grass will not grow. Many farms in the more sandy regions of the state would probably increase their grazing capacity by the introduction of this grass, as it will withstand drought better than blue grass. It withstands cold as well. On good soils it will grow to the height of two feet and may be mowed for hay, of which it will make a yield of from one ton to one and a half tons per acre. The grass is said to lose less in drying than any other economic grass.

ROUGH MEADOW GRASS—(*Poa trivialis*.)—(Pastures.)

This grass is a perennial and is known in Lombardy as the queen of forage plants (*La regina dell'erbe*.) It is closely related to blue grass but it has no conspicuous rootstocks and has rough stems and sheaths:

hence its name. It is said to be an excellent grass on good, moist, loamy soils, but it is not adapted to sandy or dry soils. It multiplies itself greatly by seed and does not throw out rhizomes and thicken by means of its roots. It forms a good bottom grass in pastures.

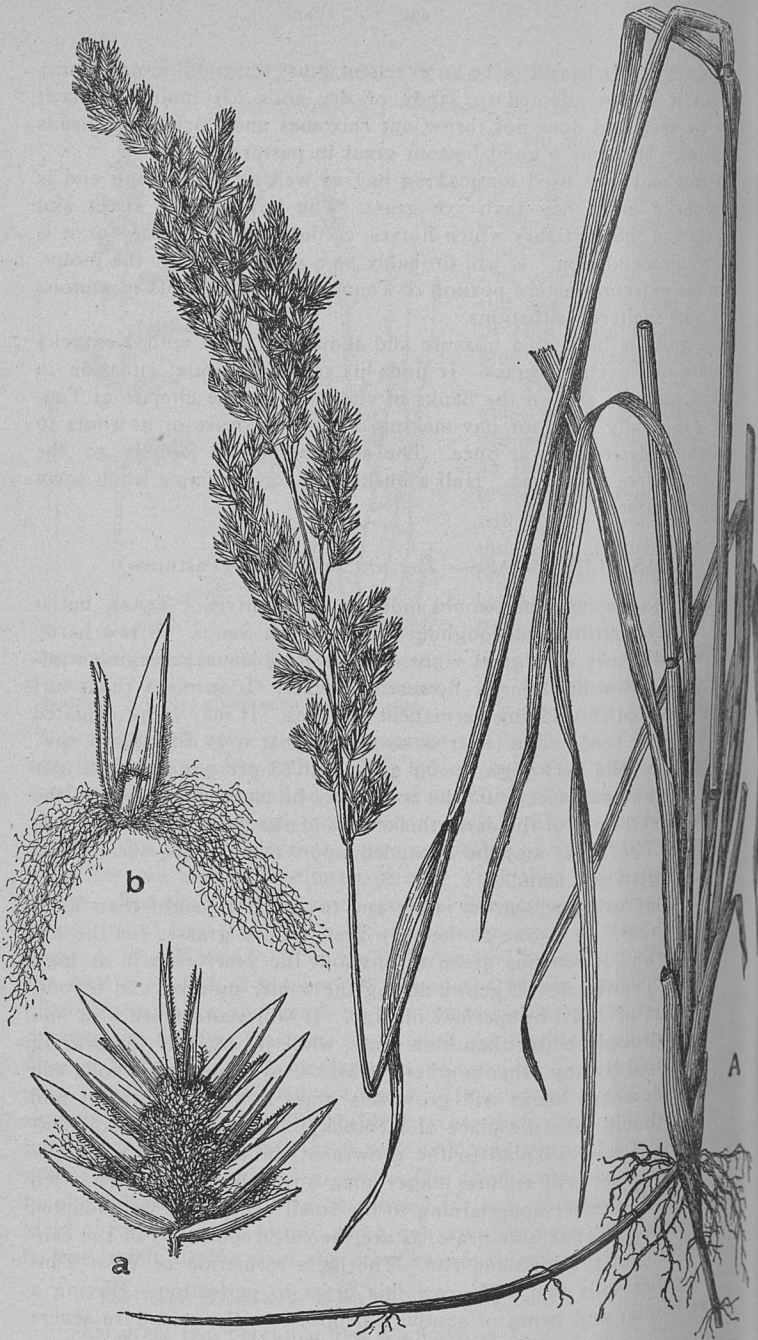
In England it is used for making hay as well as for grazing and is said to make more hay than rye grass. The hay is very sweet and nutritious and the partiality which horses, cattle and sheep show for it is a high recommendation. It will probably be a good grass for the mountains in the extreme eastern portion of Tennessee as it delights in a moist climate and sheltered situations.

This grass is best for a mixture and should be sown with Kentucky blue grass and orchard grass. It finds its most congenial situation in woodland pastures and on the banks of streams. In the climate of Tennessee it is totally unfit for hay-making, as the exposure of its roots to the sunshine destroys it at once. The seed weighs 15 pounds to the bushel and is free from fuzz. Half a bushel per acre is ample when sown with other grasses.

TEXAS BLUE GRASS—(*Poa arachnifera*.)—(Pastures.)

This grass, as its name would indicate, is a native of Texas, but it is now largely distributed throughout the Southern States. It is a hardy perennial and grows with great vigor. It has long leaves, creeping rootstocks and narrow but densely flowered panicles. It forms a thick turf and is well suited for making permanent pastures. It may be propagated by the roots or seed. The latter is so woolly that it is difficult to sow. The seed also sells very high, being quoted at \$3 per pound or \$42 per bushel. In rows two feet apart the roots may be planted one foot in the rows with a certainty of the early thickening of the grass by its creeping rootstocks. The roots may be depended upon much more surely than the seed for getting a stand.

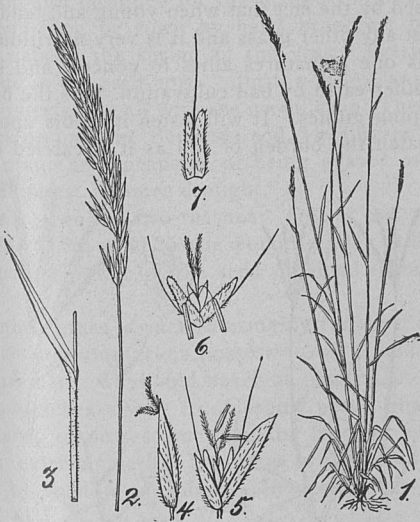
Texas blue grass will grow faster and to greater height than Kentucky blue grass. It is one of the very best pasture grasses for the extreme south and it remains green throughout the year, even in as high a latitude as Tennessee. It grows during the winter months, and blooms the latter part of April or the first of May. It will stand more heat and will resist a drought better than blue grass, while its capacity for grazing is not surpassed by any other southern grass. Any good fertile soils and especially calcareous loams will grow this grass in rank luxuriance and beauty. It should take the place of Kentucky blue grass in all soils except those especially adapted to the growth of the latter, but Kentucky blue grass well set will endure longer than any other grass. The rich soils of East Tennessee appertaining to the small valleys are well adapted to the growth of Texas blue grass, as are the calcareous soils of the central basin and of the highland rim. The loess formation of West Tennessee supplies soils that will grow this grass to perfection. Having a southern habitat and being of southern origin, it will not endure severe freezes.



Texas Blue Grass—Poa arachnifera.
a. Spikelet. *b.* Flowering glume.

SWEET VERNAL GRASS—(*Anthoxanthum odoratum*.)—(Pastures.)

This is a perennial pasture grass and is only valuable because it is one of the first to shoot up its green leaves in the spring and one of the last to disappear in cold weather. It is almost worthless when sown alone but



Sweet Vernal Grass—*Anthoxanthum odoratum*.

it imparts to the pastures, or to hay cut from such pastures, an agreeable fragrance. It scarcely deserves notice, as its foliage when green is bitter to the taste.

The seed weighs 10 pounds to the bushel. A few pounds of seed as a mixture sown on an acre will not be objectionable in a pasture.

YELLOW OAT GRASS—(*Trisetum flavescens*.)—(Pastures.)

This grass has recently been introduced from Europe where it is greatly prized as a mixture for permanent pastures. It may be grown on every variety of soil but it seems to prefer in this country mountain slopes having fairly good soils. It is a slender, loosely tufted perennial with fibrous roots, and grows to the height of about two feet.

In England its natural habitats are dry pastures, heaths, rocky places and chalk meadows. Sheep and cattle relish the early foliage. The highest yield recorded in this country was when grown on clayey loam like much of the valley land of East Tennessee and of the highland rim.

Prof. Beal thinks it promises little for this country.

Prof. F. Lamson-Scribner thinks it has some agricultural value. But for the misleading name of oat grass it might be passed over without mention.

BERMUDA GRASS—(*Cynodon Dactylon*.)—Pasture and Meadow.)

Bermuda grass is of little or no value when grown above the 37th degree of north latitude. It is the child of the sun and luxuriates in a tropical or semi-tropical climate. It cannot stand the rigorous winters of

the northern states. The value of this grass has rarely been appreciated. Because it is a most troublesome weed in tillage it has been decried as almost worthless by a large class of planters in the south, who want corn and cotton and not grass and stock. Though regarded as a nuisance its merits are disclosed by the fact that when young and tender it is preferred by stock to almost any other grass and it is very nutritious. It is a friend in disguise. It is one of nature's allies to conceal and heal the wounds inflicted upon mother earth by bad cultivation. It is the best of all natural agencies for stopping gullies. It will fasten its roots upon the bottom of the gullies and catch the burden of soil as it is carried down by a rain.



Bermuda Grass—*Cynodon dactylon*.

2. Inflorescence. 3. Spikelet. 4. Empty glumes.

As the bottom of gullies fill up the grass rises with it, building up, little by little, until the general surface is reached.

Bermuda grass is a perennial and the most valuable for a pasture grass of any grown in the cotton states. It will also grow on rich soils in all parts of Tennessee and especially in West Tennessee. Freezing weather endangers its vitality and therefore it will not do to rely upon in exposed situations, especially upon great elevations. It prefers sandy soils and fluvial deposits, but it is not so well suited to sandstone soils such as obtain on the Cumberland table-land. It will readily grow upon the moist rich soils of the central basin but winter freezes often leave great vacant places upon such soils. The clayey soils of East Tennessee in proper situations will grow it in vigor. It has the capacity to endure the greatest amount of summer heat, and droughts that will threaten the vitality of all other grasses will not arrest its growth.

HOW IT IS PROPAGATED—Bermuda grass does not mature seed in Tennessee and only to a limited extent in the Southern States. The best and surest means of propagating this grass is to cut pieces of the turf and scatter it along shallow furrows or sow it over the land well prepared by plowing and harrowing and cover or compress the roots into

the soil with a roller or drag brush. A stand can be secured also by cuttings of the grass if it is at once distributed over the land and covered.

A writer in the Southern Farm Magazine says: "Let the plants be gathered, root and branch, from some patch of ground thickly occupied by them. Let them be shaken free from earth and passed through the cutting-box as though designed for the manger of an animal. Let these giblets of an inch long be sown by hand broadcast before the harrow along with the oats in the spring of the year. Every joint will be as sure to germinate as the seed corn. But the little plants will be too tiny the first year to interfere at all with the cereal crop. The next year the old stubble will have become the Bermuda sod, yielding an almost incredible amount of pasturage and incapable of being grazed out by the severest treatment in the hottest summer drought."

Seed is rarely sown for two reasons. One is that the seed is expensive and sells for \$1.00 to \$1.25 per pound, and a still better reason is that the germinating power of the seed obtained from the West Indies is very low.

When Bermuda grass is once thoroughly rooted it spreads itself with amazing rapidity and soon takes possession of a field. It is extremely difficult to exterminate. It should never be planted on any land intended for tillage as it becomes a very troublesome pest. Shade will ultimately destroy it. A crop of peas sown upon the land for two or three years will do much to exterminate it. Exposure of the roots to winter freezes, which is done by shallow plowing, often destroys it in the latitude of Tennessee.

Rev. C. W. Howard, a well known writer on grasses, says he has found "no difficulty in destroying it upon the uplands of Georgia by close cultivation in cotton for two years. When not pastured broom grass or briars soon destroy it." He also thinks it very doubtful whether "there is one acre of land in the South thoroughly set with Bermuda grass that is not worth more than any other crop that can be grown on it."

Dr. C. W. Dabney says: "The Bermuda grass sod, not only in the cotton states, but in Virginia, has proved itself the most fruitful of all pasturage. There are well-known fields, not on superior soil and never fertilized, which are today fattening more than one head of cattle per acre. This will almost equal the blue grass in Kentucky. Some wheat farmers in Virginia have almost surrendered tillage for the sake of cattle rearing upon these Bermuda grass fields, because they have found live stock more profitable than wheat, and their present pursuit free from many vexations. The farmers upon the red-wheat lands of Virginia report that Bermuda grass can be entirely dispossessed by turning it under and keeping it constantly under the plow for two or three years. In this case they advise, after taking off the wheat crop in June, to plow the stubble under and sow the field in peas. In September the peas are turned under as a fallow crop and the field resown in wheat. After two or three summers of this double cropping, which should yield profitable returns in itself, Bermuda grass will be found to be extirpated by the shade of the pea vines while the enrichment of the soil still continues."

For the making of hay Bermuda is held in high esteem in all those



BOUQUET OF GRASSES FROM THE GRASS GARDEN,
TENNESSEE EXPERIMENT STATION.

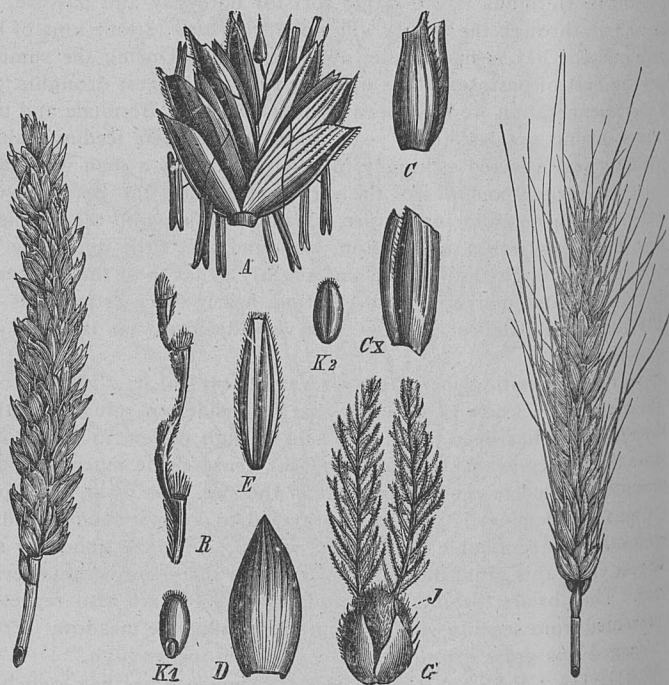
(U. S. Dept. Agric.)

sections of the South where it grows to a sufficient height for mowing. The grass must be cut early and often to make good hay. If left until the culms harden it is almost valueless for feeding purposes. Just as soon as it grows high enough it should be cut and cured much after the manner of timothy hay. Prof. S. M. Tracy, in an address delivered before an Agricultural and Horticultural Convention in Jackson, says of its hay-making qualities:

"With us, Bermuda is the staple sort for both hay and pasture. It grows well all through the South, will make from two to four tons of hay per acre and the hay is fine, tender and nutritious. During the summer it gives the best of pasture, and is uninjured by the longest droughts. At the Experiment Station we have been feeding with both Bermuda and timothy hays during the last three years, as a test of their feeding values. The timothy was selected especially for the purpose by a man who ships that hay very largely and was of the very best quality; the Bermuda was purchased from a neighboring farmer. Without going into the details of the trial, I may state that, ton for ton, we found very little difference between the two, though the balance was slightly in favor of the Bermuda. As the timothy cost, delivered at the Station, nearly twice as much as did the Bermuda, the balance of profit was very decidedly in favor of the home-grown hay."

Prof. Phares, writing in the early seventies says of it: "As a perennial pasture grass I know of no other that I consider so valuable as this. As hay this grass has been cured and held in high esteem in Mississippi for more than forty years. It does not bear dense shade but grows best where most exposed to the intense heat of the sun. To make good pasture it must be kept well trodden and grazed to keep it tender, and to suppress other objectionable grasses and weeds. To make good hay and the largest yield, this grass must be mowed from three to five times every summer. Thus briars, brome grass and other weeds are also repressed and prevented from seeding, multiplying and ruining the meadow. Properly managed this grass grows from ten to fifteen inches high."

BERMUDA GRASS AND SHEEP—Bermuda grass has long been recognized as one of the very best grazing grasses for cattle in the United States, but its capacity for carrying large flocks of sheep has not received the attention from the people of the South which the subject merits. No grass will bear tramping so well in all kinds of weather. The Southern States are the largest producers of cotton in the world; they should rival or surpass Australia in the production of wool. On the same plantations where cotton grows best, Bermuda grass finds its most congenial home. The cheapest wool should be produced on the same fields that produce the cheapest cotton. One acre of Bermuda grass well established on soils entirely adapted to its growth will carry ten sheep for eight months in the year, and in many parts of the South, ten months. Texas blue grass, sheep fescue, and in some places Kentucky blue grass, when properly cared for, will carry the flocks through the remaining months. When one considers the great profits that may be derived from the sale of early lambs in the northern markets, and the growing demand for first-class American wool and mutton, it is not too much to expect that within the



Botanical Description of Wheat—Triticum sativum.

On the left, a "head" or spike of beardless wheat. *A*, a single spikelet; the two uppermost florets are reduced to small sterile or empty glumes. *C*, empty glume seen from the side. *Cx*, the same seen from the back. *D*, flowering glume. *E*, palea. *K1*, grain seen in front. *K2*, the same seen from the back. *R*, a portion of the axis of the spike. *J*, the pistil. *G*, lodicules. On right, a "head" or spike of bearded wheat. Wheat, which belongs to the same family as the grasses here described, is occasionally cut in the spring or early summer for forage. It is frequently grazed a little, but must not be too much grazed.

next score of years sheep and wool, mutton and early lambs will be as well known products of southern agriculture as cotton is at the present time. The establishment of Bermuda grass pastures for the purpose of carrying sheep, supplemented by pastures of winter grasses, will work an industrial revolution in the South. This would bring about a realization of untold wealth. It is a prize well worth contending for to be the largest producers in the world of two of the most important fibres for clothing the population of the globe. They form the basis of the most numerous and most useful industrial establishments in the world, which give employment to a larger number of people than any other manufactories. A larger part of this cotton and wool should be manufactured where produced.

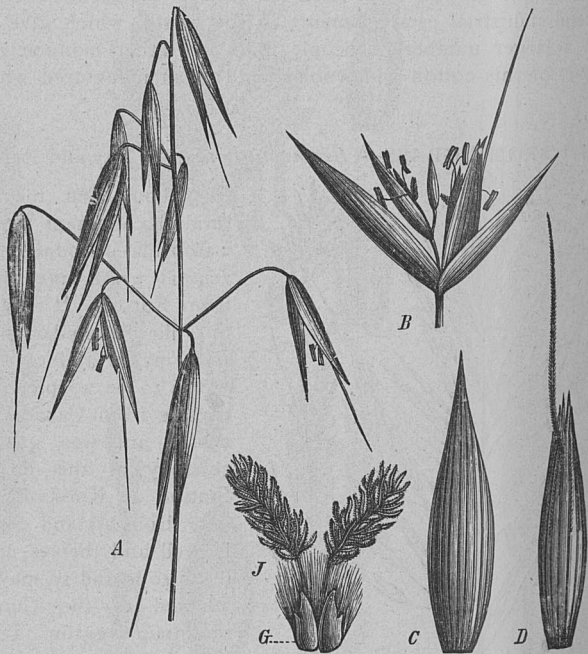
SMOOTH BROME GRASS—(*Bromus inermis*.)—(Hay and Pasturage.)



Smooth Brome Grass—*Bromus inermis*.
2. Panicle. 3. Upper leaf. 4. Spikelet. 5. Empty glumes. 6, 7. Floral glume.

About 1880, the Agricultural Experiment Station of California introduced this perennial grass into that state from Europe. It is stoloniferous like Bermuda grass and soon makes a thick turf. It seems to be adapted to every climate from Canada to Tennessee, and was grown successfully at the Experiment Station at Knoxville. It resists droughts and cold equally well and thrives upon dry, loose soils and so may be well adapted to the Cumberland mountain region. It grows, however, more vigorously upon good soils. It is difficult to exterminate, but not so much so as Bermuda or Johnson grass. It possibly may

supply a want on the gravelly soils of East Tennessee and of the siliceous soils of the highland rim. Its introduction, however, is attended with some risk. It remains green the greater part of the winter and is desirable as a winter pasture. It is said to be low in its nutritive elements. A bushel of seed weighs 14 pounds and sells for \$20 to \$22 per hundred pounds. As three bushels of seed are required for one acre, it is hardly probable that the grass will receive much attention from the farmers of Tennessee. It is one of those grasses of questionable value that may prove an enemy rather than a friend to the farmer. If in its habits it at all resembles its kindred grass, cheat, (*Bromus secalinus*) its introduction would be altogether injurious to the best interests of agriculture.



Botanical Description of Oats—Avena sativa.

A, a portion of the inflorescence which is a simple, open panicle. *B*, a spikelet, two-flowered, with a sterile rudiment terminating the rachilla. *C*, one of the broad, lanceolate empty glumes. *D*, a flowering glume; this bears an awn on the back just below the two-toothed apex. *J*, pistil; the ovary of which is very hairy. *G*, lodicules.

The oat is a most useful forage plant; but its culture and uses are well understood and require no discussion here.

RESCUE GRASS—AUSTRALIAN OATS—(*Bromus unioloides*.)—(Winter Grazing.)

This grass is a native of South America. It is an annual, but as it seeds freely the young plants succeed the old ones so quickly that it is practically a perennial. It supplies good grazing during the winter. It grows from one to three feet in height. It makes its best growth during cold weather and has come to be regarded as an excellent grazing grass for the winter months. It resembles chess or cheat in its habits of growth, and danger to agriculture may lurk in its introduction. It is



Rescue Grass—*Bromus unioloides*.

2. Panicle. 3. Upper leaf. 4. Spikelet. 5. Empty glumes. 6. Flowering glume.

not therefore recommended for cultivation to the farmers of Tennessee. The notice of this and the preceding grass is made as a warning rather than as a recommendation. Farmers will never regret the exercise of due caution in the introduction of new and but partially known grasses. They have herd's grass and blue grass and wheat, rye, barley and winter oats that will serve as winter pastures without taking the risk of introducing a strange grass with unknown qualities that may prove to be an enemy.

HAIRY FLOWERED PASPALUM—(*Paspalum ovatum* or *dilatatum*.—(Pastures.)

This is a perennial, said to be a native of Brazil, and is considered an excellent grass for late pastures, as it makes its principal growth in autumn. Dr. Gattinger, of Nashville, mentions it in his Tennessee Flora as being one of the grasses found in open ground and in grass plots. It

grows from two to four feet high and has long narrow leaves. It is greatly relished by stock and does not appear to have any troublesome qualities.

There are twelve species of this grass, according to Dr. Gattinger, found in the Southern States, seven of which are found in the State of Tennessee. He says: "The various species which represent this grass within the State of Tennessee rank, in my opinion, foremost by the number of individuals, nutritious qualities and tenacity of life, amongst the whole of the grazing herbage. They are perennials with thick, strong,



Hairy Flowered Paspalum—Paspalum ovatum.

2. Inflorescence. 3. Upper leaf. 4. Spikelet. 5. Spikelet laid open. 6. Floral glume.
7. Palea and lodicule.

running roots, often making a dense matting. Wherever they take hold other plants disappear. * * * Blue grass and paspalum are frequently commingled but the latter succeeds the former by four or five weeks and comes in full force after the former has perished away. They are vigorous growing succulent grasses with heavy culms, large and smooth seed grains with a smooth and thin epidermis. They must surely be very nutritious and their habit and cultivation ought to be studied."