Bulletin No. 16 - Grasses and Forage Plants

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UNIVERSITY OF WYOMING.
Agricultural College Department.

WYOMING EXPERIMENT STATION,
LARAMIE, WYOMING.

BULLETIN NO. 16.
DECEMBER, 1893.

Grasses and Forage Plants.

BY THE HORTICULTURIST.

Bulletins will be sent free upon request. Address: Director Experiment Station, Laramie, Wyo.
WYOMING
Agricultural Experiment Station.

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The Horticulturist in Charge
Grasses and Forage Plants.

B. C. BUFFUM.

This bulletin is written to give a general report of such observations upon and experiments with grasses and forage plants as may be of value to the farmers and ranchmen of the state. As far as possible the use of technical terms and descriptions has been avoided, but the scientific names are used, as they give us the only means of distinguishing one species from another. For example, we have a half dozen different grasses which are called "blue stem," and it is only by using the botanical name that we can indicate which species is under consideration. Where known the common name in general use is also given.

Man is more dependent upon the grasses to furnish him the necessities of life than upon any other source, and writers who have spoken of them have never failed to dwell upon the importance of the grass family. The fact has often been mentioned that in Wyoming, with her high plateaus and broad grazing lands containing millions of acres which cannot be irrigated to produce ordinary crops, stock-growing must always be one of the most important industries. If, then, we can so improve our pastures and meadows that they will support twice the amount of stock that they do in their natural condition, the increased income and value to the state is apparent. The investigation of our grasses and forage plants began with the organization of the Experiment Station.

In the fall of 1891 the writer took three short excur-
sions for the purpose of collecting plants and seeds, and in 1892 an extensive trip was taken to study the native varieties and make a collection for the World's Fair. About one hundred and twenty species and varieties, including the sedges and some species of the Juncus family, were obtained and exhibited at the Fair, the collection being awarded a medal. Of many of the varieties small quantities of seed were secured, which will be used for future experiments.

The sedges (Carex) and rushes (Juncus) are often called "wire grass" or "slough grass," and even the clovers and other like plants which are cut for hay are commonly called grass, though nothing is a true grass which does not belong to the Gramineae, or grass family. A grass may easily be distinguished by the following points: The stem (culm) is round and divided into joints by solid or harder parts which are called nodes. The parts of the stem between the nodes are hollow, or sometimes filled with a soft pith as in Indian corn. The leaves are narrow, with the parallel veins running lengthwise of the blade, and with the lower part (sheath) wrapped around the stem and split on the side opposite the blade so it can be unwrapped. The leaves are in two rows on the stem. In the sedges the stems are three-cornered and the leaves in three rows on the stem with closed sheathes. The rushes (Juncus) have round, solid stems, not divided into joints and nodes.

Grasses have been divided into (1), cereals, comprising wheat, rye, barley, oats, corn and rice; (2), cane, as sorghum and sugar cane; (3), hay and pasture grasses; (4), ornamental grasses, and (5), weeds. Among those which may be classed as weeds we have a few introduced
species, as *Panicum capillare*, *Setaria viridis*, *Eragrostis major* and the native bur grass (*Cenchrus tribuloides*); also fox or squirrel tail grass (*Hordeum jubatum*). Fox tail, as it is commonly called, is not only a troublesome weed, where the soil is damp driving out valuable varieties, but when once introduced into pastures and meadows it spreads rapidly and is very injurious to stock. The long, rough awns make the mouths of horses and cattle sore, and in some places it is eaten in sufficient quantities by sheep to kill them. It always should be cut before the heads form and none allowed to go to seed if it can be prevented. Mr. Parker recommends planting red top in meadows which contain this *Hordeum*, for if kept wet enough it is claimed the red top will take its place.

The principal pasture grasses found on our ranges are the blue stems (*Agropyrum*), gramma grass (*Bouteloua oligostachya* and *B. racemosa*), buffalo grass (*Buchloa dactyloides*), June grass (*Koeleria cristata*), mountain rice (*Oryzopsis membranacea*), and in the northern part of the state red fescue (*Festuca rubra*).

On the Laramie plains *Carex stenophylla* forms considerable early feed, and at lower altitudes the black root (*Carex filifolia*) is abundant. In alkaline places salt grass (*Distichlis maratima*) and *Sporobolus airoides* are most common. The last named species is relished by stock and makes good pasture, though it is too light for hay. If meadows where the soil is alkaline are kept too wet this *Sporobolus* is apt to spread and run out the more valuable hay grasses. In the mountains and along the streams many other species supply a large amount of feed for range stock. In damp places, comparatively free from alkali, slough or water grass (*Beck-
manna eruciformis) is common. It is much relished by stock.

Sweet or salt sage, as it is called, is abundant in the Red Desert and other alkaline lands and forms a large amount of forage, especially for sheep, which will thrive upon it alone. When feeding upon it sheep require no salting, as the salts contained in it seem to supply the necessary amount. Several other shrubs, including sagebrush, grease-wood and deer-brush (Cercocarpus parvifolius), are freely browsed by stock in winter.

The principal native hay grasses are the blue stem, gramma grass and in some places red fescue, which are spoken of later. There are also several species of blue grass (Poa), the most important of which are several forms of Poa tenuifolia. Along the streams are found Muhlenbergia glomerata, a fine hay grass; Elymus Virginicus, producing a large amount of foliage, and switch grass (Panicum virgatum). Those which are considered of little value because they become hard and woody when mature are cord grass (Spartina cynosuroides), rye grass (Elymus Canadensis and E. condensatus), in swampy places reed grass (Phragmites communis), and in sandy land sand grass (Calamagrostis longifolia). Crow-foot or blue-joint (Andropogon provincialis) may be mentioned in this class, though it grows on higher ground and is sometimes cut for hay. Where better kinds may be had it is thought little of.

In the mountain meadows Bromus breviaristatus and Bromus Pumpellianus are common, and we consider them promising species for cultivation. In the Wind River and Big Horn mountains, at high altitudes, a native white clover (Trifolium eriocephalum) was found, and where
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abundant in meadows it is greatly esteemed for hay. Near Pacific Spring and in some of the meadows at high altitudes several species of *Juncus* and *Carex* are cut for hay and considered very nutritive.

In this dry climate our upland grasses at least have the peculiar property of curing naturally, retaining their high nutritive qualities. Some of them, also, instead of dropping their seeds as soon as ripe, retain them in the spikes until late in the winter or spring months, which increases their food value.

Grasses will certainly yield to cultivation and be improved as much by it as other plants. Careful experiments will be needed to determine the value of many of our native varieties.

EXPERIMENTS WITHOUT IRRIGATION.

In April, 1891, the Division of Botany of the United States Department of Agriculture established at Laramie a Co-operative Grass Station. All experiments upon this station were to be conducted without irrigation to discover if possible some variety or method of treatment which would improve our vast unirrigated grazing lands. Dr. George Vasey also suggested that we take up the study of the native grasses. The grass station consisted of ten acres of land on the east end of the University grounds, and was under the charge of Prof. McLaren, then Director. An outline of the first year's work is taken from his report* as follows:

Five acres of the land was plowed, treating each strip of about forty-five feet wide, running north and south, in

*This was a report to the Department, not published by the Station.
different ways and smoothing all with a clod-crusher to form a good seed-bed. Planting the seed in strips running east and west across these gave a means of determining which method of treatment of the soil was the most favorable. It is sufficient to state that the strips plowed three inches and six inches deep respectively gave better results than those which were plowed deeper, replowed, subsoiled, or subsoiled and replowed. The remaining five acres were left untreated, sowing the grasses on the native sod. The same grasses were sown as upon the plowed land. Those sown with the press drill all germinated but were killed by the June drought following, while the portion sown broadcast and harrowed in was a total failure.

On the plowed land twenty varieties of grasses and forage plants were sown with a press drill, which planted them about three inches deep and pressed the soil firmly upon the seed. All the varieties came up, and the Director's report upon their condition October 1, 1891, gives the following results, the numbers corresponding to the number of each plat:

1. *Poa memorialis* (northern blue grass); 2. *Panicum virgatum* (switch grass); 3. *Aira caespitosa* (northern hair grass), and 4. *Medicago sativa* (alfalfa), were all killed by the June drought.

5. *Trifolium incarnatum* (scarlet clover), and 6. *Dactylis glomerata* (orchard grass), were nearly all killed by the June drought.

7. *Hedysarum coronarium* (northern lupin); 8. *Anthyllis velueriana* (kidney vetch); 9. *Poterium sanguisorba* (burnet), and 10. *Trifolium hybridum* (Alsike clover) made a thin stand but were growing well.
11, *Sorghum vulgare* (Jerusalem corn), and 12, *Panicum miliaceum* (Indian millet), each made a good stand, grew eight inches high and were frosted August 21.

13, *Onobrychis sativa* (esparsette), made a fair stand and grew four inches high. 14, *Bromus inermis* (wild chess), made a fair stand and grew five inches high. 15, *Bromus Schraderi* (rescue grass), made a good stand, grew seven inches high and headed. 16, *Phalaris arundinacea* (reed canary grass), made a good stand and grew four inches high. 17, *Galega officinalis*, made an excellent stand, grew ten inches high and blossomed. 18, *Melilotus alba* (white sweet clover), made an excellent stand and grew nine inches high. 19, *Festuca elatior* (tall fescue), made an excellent stand, grew five inches high and remains evergreen. 20, *Lolium perenne* (English rye grass) grew six inches high and formed a matted sod producing good green pasture.

During the winter all of the above died except the white sweet clover, which came through with apparently no plants injured,* and scattering plants remained of *Bromus inermis* and *Lolium perenne*.

Nearly all the species were replanted in June, 1892, and in addition white clover (*Trifolium repens*) and California bur clover (*Medicago denticulata*). The seed was sown broadcast and raked in, but on account of the dry weather all failed to germinate.

The support of the general government has been withdrawn on account of the lack of funds, but the Experiment Station will carry on the work in a smaller way. No planting was done the past season, but an examination of the station in November revealed the fact that there are

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*See *Melilotus alba*, page 236.

—(18)
still alive, from the planting of 1891, scattered plants of *Lolium perenne* and *Bromus inermis*. A few plants of Indian millet, which must have grown from seed planted last season, succeeded in ripening their seed this year, though they made a growth of less than six inches.

It may be noted that the location of these grasses is upon high, exposed land with a sandy and naturally dry soil, and the fact that any of the varieties have withstood two winters and the drouth of the past summer is encouraging. In more favorable localities they may prove valuable for planting on unirrigated land.

The plowed land is again being covered with blue stem (*Agropyrum glaucum*) and *Oryzopsis membranacea*, having seeded themselves naturally, which indicates the superiority of the acclimated native species.

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**EXPERIMENTS UNDER IRRIGATION.**

Although much time is needed to determine the adaptation and value of grasses and forage plants, the experiments of the last three years carried on by the Station upon the several experiment farms in the state have indicated a few results, which, while as a rule not absolutely proven by thorough investigation, may be of interest and value. Proper irrigation is as necessary to produce good hay as other crops, and with no other crop is the wrong use of water more injurious and expensive. No experiments have yet been attempted with mixtures of grasses, though the advantage of planting several varieties together has been demonstrated in other
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states. The leguminous plants are given first, and after them the native and introduced grasses are taken up in alphabetical order. Only those are spoken of which are considered of most importance for hay.

ALFALFA.

Medicago sativa.

Where the conditions are favorable for its growth, alfalfa is pronounced without reserve the most valuable fodder plant for the arid region. It is a hardy perennial plant belonging to the same family as the clovers, and was known to the Greeks and Romans 2,300 years ago.* It spread over Europe, being known in northern Europe as Lucern and in Spain as Alfalfa. From Spain it was introduced into Mexico at the time of the Conquest, from there into South America and from Chile into California in 1854, where it is grown extensively, in some places being cut six and even eight times in a season. However the yield is about the same as in this state, where we obtain three crops in the season and a yield of from five to eight tons per acre. Above 6,000 feet altitude usually but two cuttings can be made, though the yield is much larger than that of ordinary hay crops.

Its points of advantage over other hay crops are, (1), its large yield per acre; (2), its hardiness, after getting started standing drouth well; (3), its high nutritive value, any kind of stock making flesh and fat upon it without other food, and (4), instead of impoverishing the soil, it enriches and leaves it in fine condition for any other crop, as do the clovers and other leguminous plants.

Alfalfa does well upon almost any land that will pro-

*The statements regarding the history of alfalfa are taken from Bulletin No. 8, of the Colorado Station, from which I have quoted freely.
duce other crops, providing it is not too wet or underlaid with a hard or impervious sub-soil. Generally it does not do well above 7,000 feet altitude, though in sheltered localities in Carbon county it is reported as thriving at this altitude, and produces two crops. On the Laramie Experiment Farm, situated at about 7,200 feet altitude, it made a good stand and lived through the winter, but the plants did not look thrifty, and made little growth. Dodder appeared in it the second year, and it was plowed up.

Irrigation seems to be necessary to make alfalfa reach its best development. It does not do well in the eastern states, where the rainfall is sufficient to produce other crops, and we cannot recommend it for general cultivation in this state where irrigation cannot be applied, though when once established it takes a great deal of drought to kill it. It requires considerable moisture to bring up the seed and keep the plants growing the first year. For hay, 20 or 25 pounds of seed to the acre is required, but if planted for the production of seed, half this amount is sufficient. Sowing oats with the seed is recommended as they shade and protect the young plants.

The general rule for harvesting all hay crops is to cut them at the time of blossoming or soon after. It is probable that the time to cut alfalfa to obtain the most nutritious hay is when it is budded and just before blossoming. This was determined by both chemical analysis and a feeding experiment on the Colorado Station in 1889.*

M. R. Johnston, superintendent of the Wheatland Experiment Farm, in speaking of alfalfa, writes: "On June 20, 1891 one acre on the experiment farm was planted to alfalfa, 24 pounds of seed being used. As the

*Bulletin No. 8, Colorado Experiment Station.
weather kept hot and dry the seed did not germinate and it was irrigated to bring the plants up. During the season of 1892 there was harvested from this acre 7 tons 1770 pounds, and in 1893 7 tons 1752 pounds.

"Our experience with alfalfa has demonstrated, I think, that we have a natural home for this plant. For the arid region I believe it is much superior to any other forage plant, being a much more profitable crop to grow on our high land than either the native blue stem or gramma grass. I do not dispute that the native grasses contain a larger per cent. of nutritious matter, but the superior cropping qualities of the alfalfa is greatly in its favor.

"The nature of alfalfa is the exact opposite of red top and timothy. The soil should have good under-drainage, as alfalfa will not do well where the soil is wet or heavy or where the underflow comes close to the surface. This has been the experience of many of the ranchmen on creek and river bottoms in this vicinity. On the Wyoming Development Company's land, where we have a large acreage of this crop, we have grown the first cutting successfully several times without irrigation, getting a fair yield. But water is the life of alfalfa, and to get good results it should have at least one irrigation to each crop. If the rainfall is short and the season is hot and dry, two irrigations for each crop is a great improvement. The plants have made a much quicker growth when irrigated as soon as possible after the crop is cut than when irrigated just before cutting."

J. D. Parker, of the Saratoga Farm, says, "Alfalfa is the coming hay crop in this valley for the reason that it yields more per acre than any other forage. It will pasture
more cattle per acre than the native grasses, and stock will fatten quicker upon alfalfa hay than upon any other."

In Fremont and Sheridan counties the farmers have found it advantageous to plant alfalfa and timothy together, though some complain that the two do not cure in the same time. It is claimed that the yield of hay is greatly increased and there is less danger of stock bloatting upon the pasture. If the hay is cured in the cock it is thought there will be little difficulty in curing the two together.

Hogs may be pastured upon alfalfa at any time, but care must be taken with other stock, as its tendency to bloat them when damp is well known. If the weather is dry, or after the alfalfa has been frosted in the fall, there is little danger of pasturing cattle or sheep upon it unless they are unusually hungry.

DODDER.—Alfalfa is sometimes affected by rust and insect pests, but as yet its greatest foe in this state is dodder, (Cuscuta), there being several species indigenous to this region. Dodder has been quite destructive on the Laramie, Saratoga and Sheridan Experiment Farms. It is a small annual parasitic plant with yellow or reddish-yellow twining stems, which wind themselves around the stems of alfalfa, clover or similar plants, near the ground, taking its nourishment from its host. It has small colorless scale-like leaves and produces clusters of ten or more flowers, each of which contains four small grayish seeds which are about half the size of alfalfa seed. These fall to the ground where they remain until the next season when they germinate. The young dodder plant cannot live long in the ground and unless it finds a host plant, soon dies. Where it is abundant the plants upon
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which it feeds assume an unhealthy appearance and finally die.

Dodder can be killed by cutting the hay before the dodder blossoms and burning it, or by plowing the crop under and cultivating the land for a year or two in corn, potatoes or other plants which have stems so large that dodder does not live upon them. Great care should be taken in purchasing alfalfa seed to get that which is pure. If our farmers would raise their own seed it could be kept free from dodder and other weeds and would also have the advantage of being acclimated.

ESPARSETTE OR SANFOIN.

Onobrychis sativa.

The seed of this plant do not germinate readily and it has been found difficult to obtain a good stand. On the Wheatland and Laramie Experiment Farms only about five per cent of the seed came up, and the crops were abandoned in both cases. It should be sown with a press drill, or else the ground should be rolled after sowing, to press the soil firmly around the seed. When once started, the plant stands drouth well. Mr. Dunn reports that it has been grown successfully in many parts of Crook county, and is a good forage plant. It merits further trial.

RED CLOVER.

Trifolium pratense.

This plant is being raised upon the experiment farms, and Thos. A. Dunn, superintendent of the Sundance Farm, reports it one of the most successful hay crops for that section of the state. Upon the Wheatland Farm it
is reported that 75 per cent of the plants winter-killed both in 1891 and 1892, however 1,200 pounds of good hay was harvested. Specimens were sent from Sheridan county which were over three feet long and it thrives in many parts of the state. It does not produce so much hay per acre as alfalfa, and experiments with it have indicated that it is not quite so nutritious, though it will probably do better on land with hard subsoils and is a valuable soiling plant, being easier to plow under than alfalfa.

WHITE SWEET CLOVER.  
*Melilotus alba.*

I only speak of this plant to warn our farmers not to introduce it. It is a biennial not producing flowers until the second year and the whole plant dying after ripening its seed. It has a strong sweet odor, produces coarse stems and an abundance of small white blossoms and is a good honey plant. We have never seen stock of any kind eat it, though it has been reported that when properly cured for hay they will do so. Where the conditions are at all favorable to its growth it produces a large amount of seed, spreads rapidly and its tenaciousness makes it a troublesome weed. The seed which was planted at Laramie in 1891 on unirrigated land produced an excellent stand and grew nine inches high the first summer. The plants came through the winter none the worse for wind and storm and their exposed position, and in 1892 grew three to four feet high, blossomed and ripened some seed. That planted in 1892 seemed to thrive equally well, excepting that it did not get quite so high the past summer before ripening its seed. Its apparent worthlessness is the great objection to its cultivation.
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BLUE STEM.

Agropyrum glaucum and A. violaceum.

These are sometimes called wheat grasses and were once put in the same genus. There are several distinct forms of both *A. glaucum* and *A. violaceum*. Of *A. glaucum* we have one form with dark green leaves, one with glaucus or grayish leaves, and one was found in Carbon county with doubled spikelets. This species is common on the plains and uplands, where it usually grows from a foot to fifteen inches high, though in favorable places and where irrigated it sometimes attains a height of two and even three feet. Where standing thick on the ground it often produces many fine long leaves and few stems. A bunch from Sheridan county contained leaves nearly fifteen inches in length. It produces root stalks under ground but they are not persistent or difficult to eradicate as they are in quack or couch grass, which belongs to the same genus and is a troublesome weed where introduced.

None of the couch grass has yet been found in this state.

*Agropyrum violaceum* resembles *A. glaucum* somewhat but is a taller species found on damper soils along the streams where it forms heavier crops of hay than the glaucus blue stem. A specimen from the Little Popo-Agie valley in Fremont county measured over four feet in length.

We have several other species of *Agropyrum*, among the most important of which are two forms of *A. divergens*, the value of which will be investigated upon the experiment farm.

It is a question whether the native grasses can be cut year after year without running out if they are not
allowed to ripen and reseed the ground, as they seem to deteriorate where the ranges are over stocked. It may be that harrowing every year to break up the root stalks will prevent it, though as yet this point does not seem to be well established. Speaking of these grasses J. D. Parker says: "The native grasses can be, and are, cut year after year without allowing the seed to drop off and reseed the land. The only cultivation which seems to be beneficial to them is plenty of water and a thorough harrowing of the sod with a heavy iron toothed harrow every spring just before the grass starts. Blue stem that yields one and one-half tons per acre is considered good."

M. R. Johnston, of Wheatland, writes: "Blue stem does much better on river bottoms than it does on our high lands, where to obtain profitable returns it requires a large amount of irrigation. I believe it has been the experience with all the older meadows in this section that blue stem runs out if cut year after year without allowing it to reseed. On large areas it yields from one-quarter to two and one-half tons per acre. I consider two and one-half tons a large yield. One and one-half tons is a good yield for gramma grass, which also requires an abundant supply of water.

ERGOT (*Claviceps purpurea*).—This is a fungus disease called "ergot of rye," because rye is more apt to be affected with it than other grasses. It often affects rye grasses and blue grasses and has been found in nearly all parts of the state upon our native blue stem. One ranch was visited near Laramie Peak upon which the hay was said to contain enough ergot to be injurious to stock. A few years ago the Swan Land and Cattle Company established a ranch upon the Little Medicine Bow river and
took out a large ditch to irrigate about one thousand acres of grass land, which was covered with blue stem. The second year horses which were pastured upon this land began to lose their hoofs, and in some instances the manes and tails came out, and the ranch was finally abandoned. In some cases the horse would not be affected for one or two months, and in other cases they would show signs in a few days. The symptoms are like those in ergot poisoning. Samples of the grass sent to the chemist of the Colorado Station were found to contain ergot, and we have examined a sample of hay from the same ranch which was saved by Prof. Knight and found it to be badly affected with ergot, though ergot poisoning does not usually show itself in so short a time. According to the special report of the Department of Agriculture upon the diseases of cattle, ergotism is more apt to affect cattle, generally appearing in the winter or spring.

Ergot affects the seeds of grasses, making them several times as large as the healthy seeds, and one or more of these elongated, hard, black, generally curved bodies can be easily seen protruding from the spikelets or heads. Warmth and moisture are necessary to the growth of ergot, and consequently it is more frequently found in irrigated meadows. Where it is known to exist in any quantity in the hay or pasture great care should be taken not to allow stock, especially brood mares and cattle, to have access to it. It is hoped that some method of eliminating it from our grasses may be discovered.

**RED TOP.**

*Agrostis vulgaris.*

This grass is recommended in both Carbon and Lara-
mie counties as valuable for planting in low lands where the soil is wet or marshy. It thrives well under irrigation and when supplied with enough water it will drive out other grasses. Mr. Parker recommends planting it to drive out injurious grasses, as squirrel-tail grass (Hordeum jubatum), and it would probably be found valuable to plant where Sporobolus airoides is driving out other grasses, to increase the yield. It is a rather light yielder and is not as nutritious as other cultivated grasses though it is relished by stock and makes valuable hay.

GRAMMA GRASS.

Bouteloua oligostachya.

This species is native and common to nearly all parts of the state. It is often called buffalo grass, but it is much larger than the true buffalo grass, growing eight to ten inches high upon the ranges and where irrigated attaining a height of from eighteen inches to two feet. It is easily recognized by its one-sided spikes, which are about one inch in length. Dr. Vasey says this species is not adapted for cultivation in the east, but here it forms our most nutritious hay. Like the blue stem, it is improved by a thorough harrowing in the spring before starting to grow.

AWNLESS BROME GRASS.

Bromus inermis

Two species of brome grass have been tried, the awnless variety being the most successful. This is one of the grasses which has been most successful without irrigation. On the Sundance Experiment Farm it is reported that it reached a height of forty inches, making excellent hay. M. R. Johnston, of the Wheatland Farm, writes: "In
1892 we planted one-half acre to English rye grass and one-fourth acre each to Schrader's brome and awnless brome grasses. The seed of all three varieties came up well and all made a splendid growth during the season. On Nov. 1 the roots of the plants were well protected by the growth from the tops. The growth of the English rye grass was very rank. Plants came through the winter all right, but the severe windstorms of March 27 and 28 killed 99 per cent of the Schrader's brome and rye grasses. The awnless brome grass came through all right, with very few plants injured, and this season it produced 3,600 pounds of hay per acre. It only takes a medium amount of irrigation and the quality of the hay is first class. Our farm team did fully as well when fed upon it as when fed upon either alfalfa or timothy.

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**RED FESCUE.**

*Festuca rubra.*

This is a native bunch grass found in the Wind River and Big Horn mountains and in the northern part of the state, where, upon the uplands, it forms a large amount of hay and pasture. It is a perennial, growing eighteen inches to two feet high and forming a large amount of foliage. It is a promising species for cultivation.

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**ENGLISH RYE GRASS.**

*Lolium perenne.*

A promising species for pasture lands which have some winter protection and can be irrigated. It does not cure as do our native grasses, but remains green until late in the fall. However, it produces an abundance of foliage, which makes it valuable for grazing. J. S. Gould states
that the first mention of "ray" or rye grass was by J. Worlidge in 1681, who says it was used to "improve any cold, sour clay weaping lands." "Its culture had just then commenced, and ever since it has maintained its high reputation."

Upon the Sundance, Wheatland and Laramie farms a large per cent of the plants winter killed, but in an exposed position on the Laramie plains specimens of it have lived three years without irrigation, though it has not produced seed.

TIMOTHY.

Phleum pratense.

This grass is a native of the eastern and southern states, but is now widely introduced and known by everyone. It is grown successfully in all parts of the state at the high as well as low altitudes. As it produces little bottom foliage timothy is not considered good for winter pasture, but it makes excellent hay and we recommend planting it in mixtures with other grasses, of which we have already spoken in connection with alfalfa. A native timothy (Phleum alpinum) grows at high altitudes in the mountains, and in some places is abundant enough to produce hay. It is too small to be of much agricultural value. J. D. Parker says that in the upper Platte valley next to alfalfa timothy is the best yielder and most valuable hay crop. Mr. Johnston, of Wheatland, reports as follows: "My experience with timothy the last two seasons has been that the cost of producing the crop leaves no profit. On our high land the results at harvest have not been satisfactory, as it produced only a fraction over one ton per acre. It is a greedy drinker, taking an unusual amount of water to keep the plants thriving."
JOHNSON GRASS.

*Sorghum Halapense.*

This is a large coarse grass which has been introduced into the southern states where in many places it is becoming a pest on account of its spreading rapidly by large root stalks which make it difficult to plow or kill out. It is being cultivated in many places, some reporting it of value, and others, as worthless. The conclusion drawn from our experiments with this grass is that where better grasses cannot be successfully grown it may be planted with profit. It is probably more valuable than some of the native grasses found on waste lands, as sand grass (*Calamagrostis longifolia*), broom sedge (*Andropogon scoparius*) and the like.

Mr. Johnston says: "As far as culture is concerned Johnson grass is well adapted to our soil and climate. It is very hardy, stands the drouth well and only requires an average amount of water to produce good results. On the Wheatland farm the yield was three tons per acre. As to its quality I was not favorably impressed. The stems grow very coarse and become hard and woody when fully matured." At Sundance the Johnson grass came up but was reported not a success.
NOTE.—In the future work of the Station upon the grasses, especially with our native varieties, we ask the co-operation of those farmers who are interested in their improvement. Where unknown species are found they may be sent to the Station Botanist for determination, and where, if possible, any questions regarding them will be answered. Send the whole plant, roots, stem and flowers or heads and always send more than one specimen, three to six or more where they can be obtained. Where they are more than a foot or fifteen inches long they may be folded. Put between sheets of common newspaper and cardboard and send by mail. Seeds of the native varieties will be gratefully accepted. Seeds of blue stem, gramma and switch grass already have a market value where they can be obtained in quantity. Thus it may be of advantage to those who correspond with us, and will assist us in the preparation of a bulletin giving the grasses found and their distribution in the state.
CATALOGUE.

Those species which without doubt are not native to the state, but which have been introduced, are printed in italics.

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**GRAMINEÆ.**

<table>
<thead>
<tr>
<th>Genus</th>
<th>Species</th>
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<tbody>
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<td>AGROPYRUM</td>
<td><em>A. caninum</em>, Roem. &amp; Schult.</td>
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<tr>
<td></td>
<td><em>A. divergens</em>, Nees.</td>
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<td><em>A. glaucum</em>, R. &amp; S.</td>
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<td></td>
<td><em>A. unilaterale</em>, V. &amp; S.</td>
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<td></td>
<td><em>A. violaceum</em>, Lange.</td>
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<tr>
<td>AGROSTIS</td>
<td><em>A. alba</em>, L.</td>
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<td></td>
<td><em>A. exarata</em>, Trin.</td>
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<td></td>
<td><em>A. scabra</em>, Willd.</td>
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<tr>
<td>ALOPECURUS</td>
<td><em>A. geniculatus</em>, var. aristulatus, Munro.</td>
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<tr>
<td>ANDROPOGON</td>
<td><em>A. provincialis</em>, Lam.</td>
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<td></td>
<td><em>A. scoparius</em>, Michx.</td>
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<tr>
<td>ARISTIDA</td>
<td><em>A. purpurea</em>, Nutt.</td>
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<tr>
<td>BECKMANNIA</td>
<td><em>B. erucæformis</em>, Host.</td>
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<tr>
<td>BOUTELOUÀ</td>
<td><em>B. oligostachya</em>, Torr.</td>
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<td></td>
<td><em>B. racemosa</em>, Lag.</td>
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<tr>
<td>BROMUS</td>
<td><em>B. breviaristatus</em>, Thurb.</td>
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<tr>
<td></td>
<td><em>B. ciliatus</em>, L.</td>
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<td></td>
<td><em>B. Hookerianus</em>, Thurb.</td>
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<tr>
<td></td>
<td><em>B. Pumpellianus</em>, Scrib.</td>
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<tr>
<td>BUCHLOE</td>
<td><em>B. dactyloides</em>, Engelm.</td>
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<tr>
<td>CALAMAGROSTIS</td>
<td><em>C. Canadensis</em>, Beavv.</td>
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<td></td>
<td><em>C. longifolia</em>, Hook.</td>
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<td></td>
<td><em>C. neglecta</em>, Ehr.</td>
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<tr>
<td>CATABROSA</td>
<td><em>C. aquatica</em>, P. B.</td>
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<tr>
<td>CENCHRUS</td>
<td><em>C. tribuloides</em>, L.</td>
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<tr>
<td>DACTYLIS</td>
<td><em>D. glomerata</em>, L.</td>
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<tr>
<td>DANThONIA</td>
<td><em>D. intermedia</em>, Vasey.</td>
</tr>
<tr>
<td>DESCHAMPSIA</td>
<td><em>D. cæspitosa</em>, P. B.</td>
</tr>
<tr>
<td>DISTICHLIS</td>
<td><em>D. maritima</em>, Raf.</td>
</tr>
</tbody>
</table>
EATONIA
E. obtusata, Gray.

ELYMUS
E. Canadensis, L.
E. condensatus, Presl.
E. Sitanion, Schult.
E. Virginicus, L.

ERAGROSTIS
E. major, Host.

FESTUCA
F. confinis, Vasey.
F. gracillima, Hook.
F. ovina, L.
F. ovina, var. brevifolia, Watson.
F. rubra, L.
F. tenella, Willd. (?)

GLYCERIA
G. arundinacea, Kunth.

HIEROCHLOA
H. borealis, R. & S.

HORDEUM
H. jubatum, L.
H. nodosum, L.

KÉLERIA
K. cristata, Pers.

LOLIIUM
L. perenne, L.

MELICA
M. bulbosa, Geyer.

MUHLENBERGIA
M. comata, Benth.
M. dumosa, Scrib.

M. glomerata, Trin.
M. gracilis, var. breviaristatus, Vasey.

MUNROA
M. squarrosa, Torr.

ORYZOPSIS
O. exigua, Thurb.
O. membranacea, (Pursh).

PANICUM
P. capillare, L.
P. Crus-galli, L.
P. miliaceum, L.
P. virgatum, L.

PHALARIS
P. arundinacea, L.
P. Canariensis, L.

PHLEUM
P. alpino, L.
P. pratense, L.

PHRAGMITES
P. communis, Trin.

POA
P. alpina, L.
P. andina, Nutt.
P. cæsia, var. stricta, Gray.
P. Californica, Vasey.
P. nemoralis, L.
P. Nevadensis, Vasey.
P. pratensis, L.
P. reflexa, V. & S.
P. serotina, Ehrh.
P. tenufolia, Nutt.
P. (Sp. ?)

SCHEDONNARDUS
S. Texanus, Steud.
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SETARIA
   S. viridis, Beauv.

SPARTRINA
   S. cynosuroides, Willd.
   S. juncea, Willd.

SPOROBOLUS
   S. airoides, Torr.
   S. asperifolius, Thurber.
   S. cryptandrus, Gray.
   S. cuspidatus, Scrib.

STIPA
   S. comata, Trin.
   S. spartea, Trin.
   S. viridula, Trin.

SORGHUM
   S. Halapense, L.
   S. vulgare, L.

TRISETUM
   T. subspicatum, P. B.

FORAGE PLANTS.

CHENOPODIACEÆ

ANTRIPLEX
   A. Patula, var. subspicata, Watson.

SARCObATUS
   S. vermiculatus, Torr.

CYPERACEÆ.

CAREX
   C. Sp. ? (Passes for alpina, Drej).
   C. athrostachya, Olney.
   C. aurea, Nutt.
   C. deflexa, var. media, Bailey.
   C. Douglassii, Boott.
   C. festiva, Dew.
   C. filifolia, Nutt.
   C. Geyeri, Boott.
   C. Liddoni, Boott.
   C. marcida, Boott.
   C. Nebraskensis, var. praevis, Bailey.
   C. Pennsylvanica, Lam.

   C. pratensis, Drej.
   C. Raynoldsi, Dew.
   C. rigida, var. Bigelovii, Tuckerm (?).
   C. stenophylla, Wahl.
   C. utriculata, Boott.
   C. utriculata, var. minor, Boott.

ELEOCHARIS
   E. ovata, R. Br.

ERIOPHORUM
   E. polystachyon, L.

SCIRPUS
   S. lacustris, L.
   S. atrovirens, Muhl.
Wyoming Experiment Station.

LEGUMINOSÆ.

MEDICAGO

*M. sativa*, L.

MELILLOTUS

*M. alba*, L.

TRIFOLIUM

*T. eriocephalum*, Nutt.

*T. pratense*, L.

*T. repens*, L.

JUNCACEÆ.

JUNCUS

J. Balticus, Deth.
J. longistylis, Torr.
J. nodosus, L.
J. nodosus, var. megacephalus, Torr.

LUZULA

L. spadicea, var. parviflora, Mey.

EQUISETACEÆ.

EQUISETUM

E. arvense, L.

E. variegatum, Schleich.