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Bulletin No. 59 - Wheat-Grasses of Wyoming

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SLENDER WHEAT GRASS.

Harvest in progress; uncut portion in the background on the left: Experiment Farm, Laramie, 1903.
Wyoming
Agricultural Experiment Station.

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The Wheat-Grasses of Wyoming.

SUMMARY.

1. This bulletin is one of a series on the value of different groups of grasses to the farmers in this State, and treats of one of the most important and valuable groups.

2. Ranchmen are making some mistakes in irrigation and management of their pastures and meadows, to which attention is called, with suggested remedies. Over irrigation of meadows seems general.

3. The conclusion is reached that the solution of the range and forage problem will take much time and investigation to solve. The experimental trials here reported will be helpful in so far as they are applicable to the individual conditions of the ranchmen who would make use of them.

4. General observations as well as the few analyses which have been made indicate that the Wheat-grasses are the most nutritious hay and pasture grasses we have. Stock given a generous supply of such hay are often turned off fat enough for the butcher without having been fed grain.

5. The results presented in this bulletin have been obtained through observation and several years of experimental investigation by the Station Botanist and the Assistant in Agrostology.

6. Our experimental work has been greatly aided and extended by co-operation with the Division of Agrostology of the U. S. Department of Agriculture. Professor Scribner, the former chief of that bureau, and Professor Spillman, the pres-
ent head, have extended both financial aid and assisted us by furnishing seeds of native and foreign species. Reports of the work have been furnished the Department.

7. Eleven species of Wheat-grasses are mentioned in this bulletin, eight of which have been given trial. They are divided into two groups of equal importance, those with rootstalks forming sod and those forming bunches.

8. The different species of Wheat-grass are suitable to special conditions of soil and moisture, and for different purposes. Those which grow in strongest alkali soils are Western Wheat-grass, Bench-land Wheat-grass and Slender Wheat-grass. Those which stand drought best are Western Wheat-grass and Bunch Wheat-grass. Those best for hay are Slender Wheat-grass and Western Wheat-grass.

9. The Wheat-grasses respond readily to cultivation, it being easy to establish good stands with the ordinary amount of spring rains. The sod-forming species are helped by harrowing.

10. Too much water used in irrigation will drown out any of this class of grasses.

11. Only the seed of Slender Wheat-grass can be obtained from seedsmen, but it is possible to collect the seeds of other valuable kinds in our own State.

12. Some species like Slender Wheat-grass are valuable when planted alone for hay, but the results indicate that the seed would be also valuable in mixtures of grasses for meadows. Some of the species are valuable for planting in pastures to thicken the sod and make an increased amount of forage.
The Wheat-Grasses of Wyoming.

PART I.

AVEN NELSON.

INTRODUCTION.

Undoubtedly the greatest industry in the State of Wyoming is the stock industry. That being true, the greatest industrial problem is the forage problem. These facts have been commented upon in previous bulletins, but they need to be emphasized and re-emphasized until we fully realize that the maintenance of our stock interests, to say nothing of their expansion, requires that the forage question shall have the most careful consideration. Vast as are the droves, herds and flocks of Wyoming, it seems very certain that the number of animals might readily be doubled if intelligent attention were given to the available methods and means for increasing the forage. By forage we mean not only the hay and the summer pasture, but all forms of feed that complement these throughout the year.

Many of the largest cattle ranches have so far depended wholly upon the natural resources. Vast stretches of range, open or enclosed, private or the public domain, have served to bring about in large part the results so far attained. Of late years no prudent and intelligent owner, whether individual or corporate, has been foolhardy enough to face our winters without some reserve supplies. Hence it is true that thousands upon thousands of tons of hay are put up every year, but the supply so far barely serves to bring our present amount of stock through from one season to the next. Expansion of the
industry requires at least a proportionate increase in the amount of forage. The per cent. of profit, as well, might be materially raised on the stock now handled by being prepared to bring it through the winter in better condition. It is poor economy to winter stock in such manner that in April you have merely a shambling bag of bones only partly clothed in hair. Not only does it require a larger amount of feed, relatively, to recover the loss of flesh sustained than it would have required to retain it, but the increased length of time before the animal is ready for market uses up yet other forage that might otherwise go to supply food for additional animals. Then, too, it is not merely a question of the loss of the forage, but even more serious is the ultimate loss on the animal when it is finally marketed. Once stunted it never wholly recovers either its size or its appearance.

It is not asserted that all the ranchmen of Wyoming are improvident. In fact a majority are enterprising and progressive. But the majority are relatively small holders. It is the large "outfits," controlling vast areas, that are still depending, in large measure, upon the natural resources. Very few of these go farther in their efforts to aid nature than to supply water to the soil, and even this is often not judiciously done. Cultivated crops often find no place at all. Native crops are not properly discriminated, nor is it recognized that these severally need different treatments to secure satisfactory results.

On the other hand, the smaller ranchmen and farmers are doing much to supply their needs by the introduction of the standard cultivated crops. Alfalfa, easily first of these, is supplemented by Brome-grasses, Timothy, Clover, etc. As knowledge of these becomes more widely diffused they grow in favor and are introduced into larger and larger areas. When the holders of the larger tracts of land shall do as much relatively for the increase in quantity and improvement in quality as have the smaller holders, we shall see a very noticeable difference in the forage supplies.
SOLUTION OF THE FORAGE QUESTION.

Like many other economic problems, the forage problem cannot be fully solved even for the immediate present, much less for all time. Too many factors enter into the question to make it possible to give specific directions. Differences in soil, moisture, temperature and length of season determine what may be grown. From among the kinds that may be grown one must select to meet the needs of the stock to be supplied, and whether for pasture or hay. Evidently success must be worked out by each individual in a measure. The experiences of others under like conditions are the safe starting points, and upon the lines thus marked out adaptations must be made to meet the individual needs and conditions. Experience in the field or upon the experimental grounds gives facts upon which to base judgments and serves to indicate the lines along which success may hopefully be sought.

One of the purposes of the Experiment Station is to assist in the solution of the economic problems that confront the agriculturist, and the several departments of this station desire to contribute something to the solution of the forage problem. To this end some bulletins have already been issued,* and the one presented now may be considered as one of this series.

IMPORTANT GRASS GROUPS.

Among the many grasses adapted to this soil and climate there are a few groups that stand out as especially worthy of attention. These groups are meritorious for several reasons, among which we note the following: Each of these groups includes several species; the species are generally widely distributed, of frequent occurrence and fairly abundant; many of the species produce forage of great nutritive value; some of them are double purpose grasses in that they have value both as pasture and as hay grasses. Among the groups to which the

*See the following numbers: 16, Grasses and Forage Plants; 22, in part, Grasses and Forage Plants; 42, Some Native Forage Plants for Alkali Soils; 43, Alfalfa as a Hay Crop; 46, The Brome-grasses of Wyoming.
above characters belong may be named the Brome-grasses, the Wheat-grasses, the Spear-grasses, the Manna-grasses, the Reed and the Hair-grasses and others. These great groups it is the purpose of the Botanical Department to study with a view to their utilization in improving or augmenting the forage of the State. The first to receive attention was the Brome-grasses, which have been discussed in Bulletin No. 46, copies of which are still available.

THE NAME.

Wheat-grass is the common name in general use for the several species of grasses that are correctly designated by the scientific name *Agropyron*. There are several kinds or species of these, each of which, of course, is designated by a common name as well as a Latin name, the purpose of which is to distinguish a particular kind from the others. Sometimes one hears a few of these grasses called "blue-stems," but since this name has been applied to other grasses also, it seems best to use the name Wheat-grasses only.

VALUE OF WHEAT-GRASSES.

Among the grasses of the Rocky Mountains, in the estimation of the writer, they easily stand first. Like Wheat, with which the name suggests comparison, they represent that item in our forage supplies which is staple, universally used and of permanent value. There is scarcely any locality in the State in which one or more of the species do not occur, and fortunately the more valuable of the species occur on the vast plains (See Plate IV), along the streams and in the open hill country—just where they are the most readily available both as pasture and for hay. Like Wheat, they are rather coarse-stemmed and bulky, but like Wheat, they have a large head of nutritious grain-like seeds. These are the grasses that supply the bench-land and upland hay, that is so eagerly sought, and
Fig. 1. BENCH LAND WHEAT GRASS.
Showing its tolerance of alkali, the ground being somewhat incrusted with salt.

Fig. 2. SLENDER WHEAT GRASS.
The second year from seed; Experiment Farm, Laramie, 1903.
The Wheat-Grasses of Wyoming

which is usually pronounced superior to Timothy. Again, these are the grasses that "cure" the most readily on the ground, and which supply, therefore, a large share of the winter pasture. They are sufficiently rigid, so that they are not matted down by the first snows that come, hence may often be secured by stock when other grasses cannot be found. Being perennial, the pasture or meadow should improve with age, if given a fair chance. Experiment has shown that they are readily grown and that they respond to every cultural advantage given them.

THE SOURCES OF INFORMATION.

The facts upon which the statements in the bulletin rest have been obtained from four sources: (1) Close study, extending over many years, of the various species as they occur native throughout the state. (2) Careful and complete field trials upon the Experiment Farm of this Station. (3) Actual field results obtained by ranchmen in the State who have given them trial. (4) Experience and experiment as reported from other States. The information from all of the sources coincides so closely and seems to indicate so conclusively the high value of the Wheat-grasses that we feel justified in recommending them to the ranchmen as not only worthy of trial, but worthy of introduction at once into many of the meadows of the State.

TWO TYPES OF WHEAT-GRASSES.

If we consider the habit of growth of these grasses we shall soon see that they separate readily into two types, which we may designate, (1) the Sod-forming Wheat-grasses, and (2) the Bunch Wheat-grasses. The first of these are perpetuated from year to year by the underground stems (rootstocks) which spread horizontally through the soil. From these rootstocks spring at short intervals both stems and roots,
so that there is a constant widening of the area occupied by the original plant, and at the same time a rapid increase in the number of plants. In this way the plants of a stand, that may at first have been very thin, occupy new ground and increase in number till a close sod has been formed. The second class do not produce the rootstocks, but produce instead a dense tuft of fibrous roots and an increasing number of stems from the base. In fact the process is just the same as that by which a grain of wheat gives rise not to a single stalk, but to a stool bearing several or many stems. Since the Bunch Wheat-grasses live from year to year, this stool often becomes a tuft of great size, from six inches to a foot in diameter. The grasses considered in the bulletin may be classified as follows:

**BUNCH WHEAT-GRASSES.**

**SOD-FORMING WHEAT-GRASSES.**
1. Western Wheat-grass.
4. Western Couch-grass.

If we study the conditions under which the grasses of these two groups occur in nature—the character of the soil, the amount of water, the exposure and lay of the land—it should suggest to us the conditions and the treatment that they need as forage plants upon the ranch. If it is found that some never occur upon alkili ground, and that others often occur in such situations, it should teach us to select for a given soil accordingly. If some are found in dry situations and others in moist, that again suggests the choice that should be made for the particular condition we wish to meet. If the Wheat-grasses as a whole are dry-land grasses and never occur in bogs, that fact should tell something to the thoughtful in regard to methods of irrigation. Now, it is just because we have not learned to distinguish even the most important of our grasses, and because we do not discriminate in our treatment of them, that we often secure such meager results. The grass
that loves flood conditions is irrigated once during the season and the one that thrives best in rather dry ground is inundated from spring till harvest. That such practices may become less frequent is one reason at least for publishing the known facts in regard to important crop plants, such as the Wheat-grasses herein treated.

For every plant there is an optimum condition of soil, moisture and temperature. To the extent that it finds itself under conditions less favorable than the best, in any one of these respects, to that extent it fails to reach perfection. Very rarely do plants find themselves under optimum conditions in nature. The crop plants have reached their present condition and value because man has sought for them the nearest approach possible to optimum conditions in the points mentioned, besides protecting them against overcrowding and possible enemies. What has proven worth doing in the case of the recognized crop plants may prove worth while if applied to promising native sorts, not yet recognized and domesticated. The grasses, for instance, that supply forage of appreciable value under the hard conditions that nature often imposes would yield vastly more under the improved conditions that man may provide. Good treatment pays immensely, whether given to plants or animals. But good treatment does not consist in providing new conditions, but in improving those to which the plant has already become accustomed. You would not transfer plants from the cold temperate to the tropical zone, nor from the mountain heights to coastal plains. So in choosing among the Wheat-grasses, one or more for field trial, in order to choose intelligently, it is well that we should know just the conditions under which they occur in nature. These facts this bulletin endeavors to give.

**THE PLAINS GRASSES.**

The Wheat-grasses of the open plains are in a large measure the sod-forming species. These are, of course, the
most suitable for meadow grasses. Sparse they frequently seem upon the arid open plains, yet under the influence of a moderate amount of additional water, the often extensive underground system of rootstocks gives rise to so many new plants that a relatively dense crop is the result. Thousands of acres of such meadows have been formed in Wyoming and thousands more may be if water for irrigating the bench and plains lands, not yet utilized, can be secured. As an example of such native meadows, see Plate IV, representing most satisfactory results even with but slight irrigation. Many such meadows occur in basin-like depressions and in open valleys which, in favorable seasons, yield crops without irrigation that often are profitably harvested.

THE HILL SPECIES.

In the hills and mountains and in broken ground generally it is the Bunch Wheat-grasses that prevail. Naturally these are less suitable for meadow purposes, but for pasturage they serve quite as well. The fact that they naturally form in time large dense tufts or bunches does not altogether preclude their use as meadow grasses. If grown closely, as when sown for hay, the tendency to form tufts is less marked. This is peculiarly true of the most valuable of them all, viz., the Slender Wheat-grass. When found in swales and moist depressions this often grows so closely as to form a continuous uniform sod. Especially fine results have been secured from this species when sown on properly prepared ground for meadow purposes. This has proven true not only in the field tests at the Experiment Farm (See Plate I and Plate II, Fig. 2), but equally good results have been secured upon ranches in this and other States where it has been tried.

(For a full discussion of the natural habitat, relative abundance and merit of the several species, and characters by which they may be recognized, see the illustrated list in the pages following. See Plate V.)
TOLERANCE OF ALKALI.

The characteristic that most notably makes the Wheat-grasses of great importance in Western America is their tolerance of alkali. The great saline plains and alkaline basins would lose much of their value were it not for the vegetation that throughout the centuries has been adapting itself to the high salt-content of the semi-arid soils. In the Wheat-grass we find this tolerance more or less developed in most of them, but the following show this quality to such an extent that a stand and a crop may often be secured where other forage plants would be a total failure. Fortunately the species that endure the most alkali are the very ones that would be chosen for meadow grasses, because of their other characteristics as well. While it is difficult to say definitely which species is the most resistant, three of the more important ones may probably be named in the following order: (1) Western Wheat-grass, (2) Bench-land Wheat-grass, (3) Slender Wheat-grass. Now, it is not to be understood that these require alkali soil, but simply that they will attain excellent development in spite of it.

MANAGEMENT OF MEADOWS.

I. NATURE'S MEADOWS.—For many years to come the native meadows must be the basis for our forage. I think it would be a conservative estimate to say that 75 per cent. of the hay in this State comes from that source. Probably that proportion might be maintained even if the tonnage be greatly increased. In many of the meadows not even half the possible results are obtained. Sometimes from lack of water, sometimes from too much, often from overpasturing or from pasturing too late in the spring, and most frequently from continued cropping with no adequate return to the soil. Many of the crop failures or partial failures are to be attributed much less to a lack of water than to a lack of other plant food. We see this in the Wheat-grasses especially, for often a vigorous
growth of leaves takes place and then growth ceases, as if the soil strength was exhausted for the time. The failure to head-out would not be conclusive but for the fact that with the same amount of water the grass on the more fertile spots reaches complete maturity.

The Wheat-grasses are very susceptible to cultural advantages. Rarely do plants respond more promptly to water in proper season, to increase in soil fertility or to the cultivation of the same. While they grow in almost all soils, yet a loose soil, even the wagon-track ridges along the roadside, tends to a fuller development. This suggests some ways in which our native meadows may be improved. The harrow, or even the disc, if used freely in early spring, will tend to loosen the soil, break up the tufts and the rootstocks. By this process we shall secure a denser and more uniform stand and a more vigorous growth.

2. Fertilizers.—So far in the history of agriculture in Wyoming only the question of water has influenced our practice, since the temperature is outside our sphere of control, and the soil, as soil, has apparently met every claim made upon it. It is rich in all the elements of plant food, and we have gone on in our treatment of it as if it were inexhaustible. Meadow lands, of course, hold their own much better than lands planted to other crops, but it does not require much acumen to see that it is no more possible to go on taking something out of the soil, and putting nothing in, year after year, without reducing and finally exhausting its power of production, than it would be to manage your bank account in the same manner. There are two methods of managing your bank account, each successful in its day. One is to make your drafts upon it as small as possible and thus extend its life. The other is the business method of withdrawing liberally for such investments as give promise of ability to return the same with interest. We may apply this to our lands, growing upon them crops that make but slight
demand upon them or those that withdraw much, but enable
us to return more.

So far in this State the question of commercial fertilizers
has not concerned us, and in that we are fortunate, but in the
farming districts the day is not far distant when it will be of
vital importance. At the present time, however, an appeal to
do more than husband the resources that we have would fall
upon deaf ears. But there are two things that will appeal to
every one as reasonable. First, secure the maximum results
from the native crops, or the crops introduced, but on cultivated
soils renovate and restore by returning at intervals the whole
or part of a crop. It is well known that the Legumes, such as
the clovers, vetches and alfalfa, not only draw but slightly upon
the soil, but as a means of aerating, loosening up and restoring
soil fertility, they are marvelously efficient. Second, and here
is where it seems to me we have been and are most foolishly
negligent, we ought to utilize the corral and barn yard manures.
In most portions of the State one sees no appreciation of the
value that manures possess. Ranchmen act as if it were merely
an encumbrance to be rid of as best we may—at most of no value
except to fill up ditches, cover culverts and corduroy bridges
or fill up undesirable lake beds. In too many places one sea-
son’s layers accumulate upon its predecessor’s, to leach out and
bleach out in summer’s storm and sun. There are acres and
acres where train loads of the finest fertilizers in the world
could be taken up with scrapers from the natural corrals among
the sheltering groves on our stream banks. Here it is left,
where it can do no possible good, to be washed down our
streams into either ocean. No more profitable methods for im-
proving our meadows occurs to me now than the spreading out
upon them, just before the irrigation season opens, all the avail-
able manures. That is an operation that would yield more than
ordinary profits.

While on this phase of the subject, it may be permissible
to call attention to the value of feeding the crops upon the
meadow-lands themselves and not upon the roadways, in cor-
rals and wood-lots, where the waste and the droppings are not utilized.

3. IRRIGATION.—None of the Wheat-grasses are naturally bog grasses. Most of them do well with a relatively small amount of water. None of them will endure flooding. Meadows in which the water is turned on shoe-top deep in early spring and left on till harvest will in a season or two be devoid of Wheat-grasses. Sedges and rushes and often "Fox-tail" will replace them all. To many ranchmen, it seems to be a matter of indifference what is produced so long as something grows. No criterion except bulk is applied in estimating the value—not even weight, to say nothing of nutritive values. The Wheat-grasses will endure great drought, but they yield the best results when irrigated, much as you would the standard grains. Give the soil one to four thorough wettings during the season, according to the amount of the rainfall. Between times no water should be applied at all, except as nature supplies it, because by doing so low soil temperatures are maintained and a condition is established to which these grasses are not accustomed and to which they would not adapt themselves for generations.

4. MADE MEADOWS.—The Wheat-grasses are not difficult to grow. The seeds are large and, in properly matured seeds, the per cent. of germination high. In soils prepared as you would prepare them for wheat or oats a good stand may usually be secured. The first season, of course, the yield is light, since in these perennial species it requires one season for the root systems to become established and for the stools to thicken up. From the second year profitable crops should follow, on fair soils, with moderate amounts of water. (See Plate I and Plate II, Fig. 2.)

SEEDS.—With the exception of the Slender Wheat-grass, the seeds of the several species are not on the market. The fact
that the others are not on the market need not hinder any one from giving them a field trial. It is not at all difficult to find choice patches where enough can be mowed with a scythe or cut with a hand sickle to yield a bushel or two of seed. When dry, the seeds are readily flailed out and, if fairly well cleaned by the use of a fan-mill, may be sown with a seed drill. It is quite possible also to secure the seed in paying quantities by hand picking. With a large knife and a gunny-sack as a receptacle, the heads may be rapidly collected from the choicest spots, and, when dry, threshed and cleaned as before. After the first crop of a given species has been secured, it is then an easy matter to secure the seed in quantities adequate for any extension of the area that seems desirable.
WESTERN WHEAT GRASS.

An immense native meadow on the Arroyo Plata.

Water not being plentiful the Wheat grasses have not been irrigated out of evidence.
PLATE V.

1. Bunch Wheat Grass.
2. Bearded Wheat Grass.
4. Western Couch Grass.
5. Western Wheat Grass.

WHEAT GRASSES. Typical heads of important species.
The Wheat-Grasses of Wyoming.

PART II.

ELIAS NELSON.

WHEAT-GRASSES AT THE LARAMIE EXPERIMENT FARM.

As early as 1894 Wheat-grasses and other native grasses were planted on the farm. All of our work along this line has been prosecuted in co-operation with the U. S. Department of Agriculture, and nearly all the seeds used have been furnished us from the Office of Grass and Forage Plant Investigations.

From the seed sown in 1897 a stand was secured of Bearded Wheat-grass, Bunch Wheat-grass, Slender Wheat-grass, Western Wheat-grass and a European species (Agropyron acutum), all of which have persisted on the plats from year to year. The European Wheat-grass, though it has maintained itself and does well in this climate, we do not regard as of much agricultural value, for it is much coarser than our species.

In 1901 this Experiment Station again entered into co-operative work, and about sixty grasses were sown on plats 1x4 rods. Six of these were Wheat-grasses, natives of the arid West, and all came up and made a stand. The seed, which was furnished us by the Department, had been gathered by its field agents the preceding season from grasses in the wild state. The land used had been in alfalfa for a few years. It was plowed, harrowed and leveled in the spring, thus preparing a good seed bed and putting it in the best condition of tilth. The
seeds were sown by hand and covered by means of a smoothing harrow. A good germination was secured, for there was an abundance of rain in the spring. The minute seedlings were discernible on the plats three weeks after the time of planting, which was on May 8. The Wheat-grasses did well during the season, making leafy growths on the surface of the ground, but no heads appearing. The plats were irrigated July 10 and August 15, in order that the grasses might become well established. In 1902 and 1903 these grasses headed more or less evenly. The amount of growth which they have made on the farm has not been large, and represents what they will do in good soil without irrigation.

The different species, grown under similar conditions, have matured in order as follows, beginning with earliest: Slender Wheat-grass, Bunch Wheat-grass, Bench-land Wheat-grass, Bearded Wheat-grass, Western Wheat-grass. All the species produced some seed. The tufted species matured rather unevenly and shed the seed very soon. In the sod-forming grasses the seed-holding power was much better. Bunch Wheat-grass surpassed the other Wheat-grasses in the amount of early growth. As compared with the tufted species, the sod-forming ones maintained a more even growth throughout the season and suffered less from lack of moisture.

In the fall of 1902 Bunch Wheat-grass and Western Wheat-grass were sown on a piece of unbroken prairie land in the station pasture. The land was disc-harrowed and the seed sown broadcast, then a smoothing harrow run over the ground. This work was done on October 25. On June 17, the following spring, a careful examination was made of these range plats, and the presence of seedlings in considerable numbers of both species was readily discernible. As to what extent these seedlings have persisted, another season will tell. The experiment, however, showed that with such treatment of the soil as was employed, a reasonably good germination may be secured from
seeds sown on the range in the fall. Wheat-grasses planted in this way would without doubt become established in a season when the climatic conditions were at all favorable.

Our experiments with the Wheat-grasses have shown that they take kindly to cultivation, and that a stand may be secured when there is an average amount of rainfall during the spring months. Other Western Experiment Stations have tested these grasses and most of the species have been grown with success. They are as easy to cultivate as Bromus inermis, and with us made a good stand when under identical conditions Red top, Kentucky Blue-grass and other cultivated grasses failed to come up. The seeds of the Wheat-grasses are large and comparatively heavy, germinate readily and produce vigorous seedlings. Slender Wheat-grass is the only one of which seed is as yet on the market. The seed can be planted with a seed drill. An acre plat was sown in this way in 1902, a Havana seed drill being used. (See page 31.)

In the pages which follow each species is briefly described, its qualities noted and an account given of the behavior under cultivation of those which have been grown at the Wyoming Experiment Station.

I. Western Wheat-grass.

(\textit{Agropyron occidentale}.)

An erect and rigid grass, one to three feet high, having thick upright leaves and forming an open sod. The whole plant is usually of a bluish color, and hence it is commonly known as "blue stem."* It closely resembles the Couch-grass of the Eastern United States, and, like it, spreads by means of underground rootstalks. There is a variety (\textit{Agropyron occidentale molle}) which has hairy heads and is quite common in the State.

Western Wheat-grass is one of the commonest, as well as

*The name "blue stem" belongs properly to very different grasses (\textit{Andropogon} spp.) found at low altitudes in Wyoming, and common in Nebraska and other prairie states.
one of the most abundant of our native grasses. It grows in a great variety of soils and withstands drought extremely well. It occurs both on the open plains and on bottom lands and is especially abundant on bench-land in the hills. Of all our native Wheat-grasses this one is most frequently found on alkali land.

This Wheat-grass is highly esteemed by our stockmen both for pasture and for hay. As a pasture grass it is of considerable importance in this State on account of its drought-resisting qualities and great abundance. Some stockmen have succeeded in materially increasing the forage value of their grazing land by gathering and scattering seed of this grass over worn spots in pastures. As the sod is rather open and the leaves thick and rigid, it cannot be considered a first-class pasture grass.
As a hay, it is held in great repute, and large quantities are cut throughout the State. It does not yield as heavily as most cultivated grasses, but the nutritive value of the hay is universally believed to be unsurpassed. Analyses made by other stations show that it contains more nutriment, pound for pound, than the Kentucky Blue-grass or Timothy.

Though Western Wheat-grass will persist anywhere on the open range under the most adverse conditions, it will not make large growths unless there is a sufficient supply of moisture. The richness of the soil has also much to do with the yield. It does well under irrigation, but requires careful and intelligent treatment if the best results are to be obtained. Prairie land and uplands, when irrigated and made into hay meadows, will in most cases grow up almost exclusively to this grass. It is often the predominant grass in native meadows when first irrigated. Owing to the reprehensible practice of continuous flooding in vogue, this excellent grass has been killed out and has disappeared from most meadows and its place taken by rushes and “slough grasses.” Fine meadows of it, irrigated for many years and yet productive, may still be seen on gravelly soils or on sloping ground where there is naturally good drainage.

Ranchmen complain that it becomes sod-bound, that it often does not head, and that when cut every year the yield becomes less and less. Disc-harrowing may be employed to remedy this root-bound condition of the sod, and the application of manure would not fail to induce a more vigorous growth.

Western Wheat-grass is one of the most valuable of our native grasses and should be introduced into cultivation. It has been planted at several Experiment Stations and has been found to come readily from seed. It did well at the Idaho and the Iowa Stations, while at the South Dakota and the Wyoming Stations it made a good stand, but did not head well.
It was sown on the Experiment Farm at Laramie in 1901. It made a good stand and grew to the height of six to nine inches during that season. In 1902 it made a fair growth, but only a few heads appeared. It was 4-6 inches high May 8, and 6-8 inches high May 28. The stems which appeared were only 12 to 15 inches high. It was in bloom from August 4 to August 18, while the seeds were not ripe until about September 20. In 1903, as in the preceding season, it did not head out generally over the plat. It attained a height of 18 inches and was in bloom about two weeks earlier than in 1902.

It will be noted that it is a late grass, and of the Wheat-grasses which we have grown this is the last to reach maturity. The growth which it made on the farm was not large, and represents what it will do without irrigation. Had it been irrigated moderately at frequent intervals, it without doubt would have made a much better showing.

In the domestication of this grass a form in which the seeds and chaff are as blunt as can be found should be sought, as the sharp-pointed seeds have been known to be troublesome in feeding the hay to sheep. The seeds are nearly always short-awned or sharp-pointed, but forms in which they are tolerably blunt occur, and such should be secured for propagation. Some work along this line has already been started at this Station.


(*Agropyron dasystachyum subvillosum.*)

This grass is very similar to Western Wheat-grass. It has the same habit of growth and frequents similar situations. It differs from it in its finer stems, lesser growth, smaller heads and less sharply pointed seeds. (Plate V, Fig. 6.)

It is quite common on alkali flats and on benches in the hills and along streams, and frequently occurs in continuous
patches of larger and lesser size. Its finer stems and bluntish chaff and seeds would seem to make it more desirable than Western Wheat-grass, but it yields a much smaller amount of forage. (Plate II, Fig. 1.)

It has been tried at the Laramie Experiment Farm, where it was planted in 1901. The character of the growth made on the plats was very similar to that of Western Wheat-grass. It, however, headed out much better and reached maturity earlier in the season. In 1902 it was 3-5 inches high May 8, 6-10 inches high May 28 and 7-12 inches high June 11. It was headed June 24, in bloom July 8-18 and mature about August 11. The average height was 15 inches. The growth in 1903 was about the same, except that the height attained was 18 inches. Considerable aftermath was produced during September.

3. **Northern Wheat-grass.**

*(Agropyron dasystachyum.)*

Very similar to Western Wheat-grass in size and general appearance, but having narrower heads, which are always softly hairy. It is much larger in every way than Bench-land Wheat-grass and occurs in different soil. It is rare in this State, but common in sand hills and dunes in the Northwest Territory and in the region of Hudson's Bay.
4. **Western Couch-grass.**  

(*Agropyron pseudorepens*).

A native grass closely related to the Couch-grass known to Eastern farmers. It differs from that in being awnless, or nearly so, and in having less vigorous root-stalks. It grows one to three feet high, and has rather long leaves on both the stems and the sterile shoots. It forms more or less compact bunches, in which the root-stalks are not always evident.

This grass, though not abundant in the State, is not infrequent at lower altitudes. It appears to be a valuable hay grass, and since the leaves are softer and longer than those of Western Wheat-grass, it is considered a better grass for cultivation. (Plate V, Fig. 4.)
5. Bunch Wheat-grass.

(Agropyron spicatum.)

A densely tufted grass, one to two or even three feet high, with slender, wiry stems and an abundance of long and very narrow leaves. The widely spreading awns are a very characteristic feature of its heads.

Bunch Wheat-grass is a common and important pasture grass in hilly and broken country, occurring on steep slopes and rocky hills. Occasionally it is found in considerable abundance in loose soil on uplands, where it makes hay of the best quality, if cut early. It is an excellent grass for grazing, as it makes an early growth and thrives under extreme conditions of drought. Its large tufts of fine leaves cure well, and on that account it is one of the best grasses for winter pasture.

This native grass takes kindly to cultivation, and in the experience of several Western Experiment Stations it is not
difficult to secure a stand of it. Though of value chiefly as a pasture grass, it may be grown for hay in good soil and with irrigation. It will not yield as heavily as Slender Wheat-grass or Timothy, but the hay is much finer.

In Idaho and Washington occurs a variety (*Agropyron spicatum inerme*) which is awnless. This is the particular variety which should be introduced into cultivation. It has been grown on the Experiment Farm, where it was sown in the spring of 1901. The seed germinated well and a good stand was secured. During the season it made a leafy growth 6-10 inches high.

In 1902 it was 3-6 inches high May 8, 8-10 inches high May 28, 10-17 inches high June 11, 12-25 inches high June 24. The heads appeared about June 1, and from about July 1-8 it was in bloom. The seeds were ripe August 21. The average height attained was 20 inches and the radical leaves were 10-12 inches long. During the dry weather of September it cured on the ground. In October it freshened up and made some aftermath as a result of an abundance of moisture and the fine weather which prevailed.

In 1903 there was considerable rain in the spring and early summer, and the grass, therefore, made a larger early growth than in the preceding season, attaining an average height of 27 inches. It was 4-5 inches high April 20, 8 inches high May 21, 12-18 inches high June 11. The heads appeared in the middle of June and were in bloom from about July 10-15. The seeds were ripe about August 8. During September a little aftermath was produced.

For grazing purposes this is the most valuable of the Wheat-grasses. In 1903 it made a larger early growth than any of the species and withstood drought much better than Slender Wheat-grass.
6. **Vasey's Wheat-grass.**

*(Agropyron Vaseyi.)*

This has the same qualities as Bunch Wheat-grass and is like it in nearly all respects.

7. **Slender Wheat-grass.**

*(Agropyron tenerum.)*

A bunch grass, one and a half to three feet high, with slender stems and long, narrow heads. It grows naturally in sandy soils, and is one of the commonest grasses on river bottoms in Wyoming. It is often found spreading along ditches and in fallow fields and occasionally makes continuous growths on well drained meadow land. (Plate III, Fig. 1.)

Slender Wheat-grass is easy of cultivation, comes readily from seed, starts early and makes a rapid growth. It yields as heavily as Timothy, which it far surpasses in nutritive value. It is best suited to light, well drained soils and makes large growths under favorable conditions. It is quite tolerant of alkali, but is not so well adapted to alkali land as Western Wheat-grass.

This grass has during recent years been introduced into cultivation, especially in Minnesota and Manitoba. The seed is now on the market, but few seedsmen have it and the supply is soon exhausted.* The U. S. Department of Agriculture has distributed a large amount of seed for trial among ranchmen and farmers, and many favorable reports have been received. It has been grown at most of the Western Experiment Stations with marked success, and many experimenters regard it as a valuable hay grass for the West. (Plates I and II, Fig. 2.)

In the spring of 1901 two plats were sown on the Experiment Farm at Laramie and a good stand secured. It grew to

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*Northrop, King & Co., of Minneapolis, Minn., have had it in stock, and McKenziel Bros., of Brandon, Manitoba, supplied us with a quantity of seed in 1902.
be 15 to 24 inches high during the season, and a few isolated heads appeared.

During the dry season of 1902 it made a fair amount of early growth in the spring and attained an average height of 18 inches that season. It was 3-4 inches high May 8, and 5 inches high May 28. During the month of May it made a better showing than *Bromus inermis* grown under similar conditions. The heads appeared between June 24 and July 8. It was in bloom during the early part of July, and by the middle of August the seed were ripe. In September it dried up entirely, while in October some aftermath was produced.

In 1903 it was 2-3 inches high April 20, and 6-7 inches high May 21. Heads appeared early in July and by the middle of that month it was in bloom. The average height attained during the season was 22 inches. Seed was produced in abundance both in 1902 and 1903, but the ripening was rather uneven.
Besides the two small plats, 1x4 rods, of which an account has been given above, we have an acre of this grass sown in 1902. The amount of seed used for this acre was thirty-five pounds, and it was put in by means of a Havana seed drill. The land was in good condition of tilth and was quite fertile, as it had been in alfalfa until in 1901, when the plat was in grain. In spite of the dry weather which prevailed in the spring, a fairly good stand was secured and the grass became well established during the season. In 1903 it made a good showing, the bunches growing to a large size, headed well and stood three and a half feet high. It was headed by the middle of July and in bloom from July 22 to about August 1. One-half of the acre was allowed to stand until mature, when it was cut with a harvester for seed. The remaining half acre was cut for hay August 4. Though the stand was not thick and though it was irrigated but once in the season (on July 8), the half acre produced 2,065 pounds of hay, a yield of a little over two tons to the acre. (Plate I.)

The hay secured was not relished by the station horses accustomed to a hay ration of alfalfa. We believe, however, that stock would eat Slender Wheat-grass as readily as Timothy, for ordinarily it has a finer straw. For the best quality of hay it should be cut when in bloom.

Slender Wheat-grass will be found a valuable and profitable grass for cultivation in our State. It is a suitable grass for uplands under irrigation and may be freely used in all grass mixtures for permanent meadows. As the seed can now be procured, we recommend it to ranchmen and farmers. It will not fail to come up if sown early and if a seed bed is prepared, and it can be counted on to make a stand in a season of average rainfall.
8. MOUNTAIN WHEAT-GRASS.

(*Agropyron violaceum.*)

Very similar to Slender Wheat-grass, but having shorter and denser heads, which are usually short-awned and often purplish in color. It occurs chiefly in the mountains, where it largely replaces Slender Wheat-grass and forms a considerable portion of the forage in the parks and meadows. As a forage plant it differs little from Slender Wheat-grass, though the latter is undoubtedly better suited for cultivation.

9. BEARDED WHEAT-GRASS.

(*Agropyron caninum.*)

A bunch grass, two to four feet high, with bearded and somewhat one-sided heads. In habit of growth it resembles Slender Wheat-grass, but has a coarser straw and is not as abundant in the State. The heads are quite frequently purplish in color, and in some forms occurring at lower altitudes are in-

*A. Richardsoni is here treated as inseparable from A. caninum.*
clined to be nodding. It grows naturally on river bottoms, preferring a light, sandy soil. (Plate V, Fig. 2.)

This grass has been tried at several Western Experiment Stations and is readily grown from seed. A small plat was sown on the Experiment Farm in 1901 and a fairly good stand secured. In 1902 it made considerable growth in the spring, the leaves being 3-5 inches long May 8, and 6 inches long May 28. The heads did not appear until the second week in July. It was in bloom August 4 and by August 29 the seeds were ripe. The average height attained during the season was 15 inches. The growth in 1903 was very much the same.

This grass makes considerable leafy growth during the earlier part of the season, the radical leaves being broad and rather abundant. With us the heads appear late and the seeds are not ripe until late in August. It does not mature as early
as Slender Wheat-grass, and its coarser straw and bearded heads render it less desirable for hay. The seeds were found to ripen rather unevenly.

10. SCRIBNER'S WHEAT-GRASS.

(*Agropyron Scribneri.*)

A tufted species with rigid leaves and with bearded heads which break up at maturity. It is a rare species occurring above timber line in the mountains.

II. GMELIN'S WHEAT-GRASS.

(*Agropyron Gmelini.*)

A tufted grass with rather short, flat leaves, bearded heads and widely spreading awns. Infrequent; occurring in moist soil in the mountains, as also its variety *Pringlei.*