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Variation Studies in Brome Grass

(A Preliminary Report)

By ALVIN KEYSER

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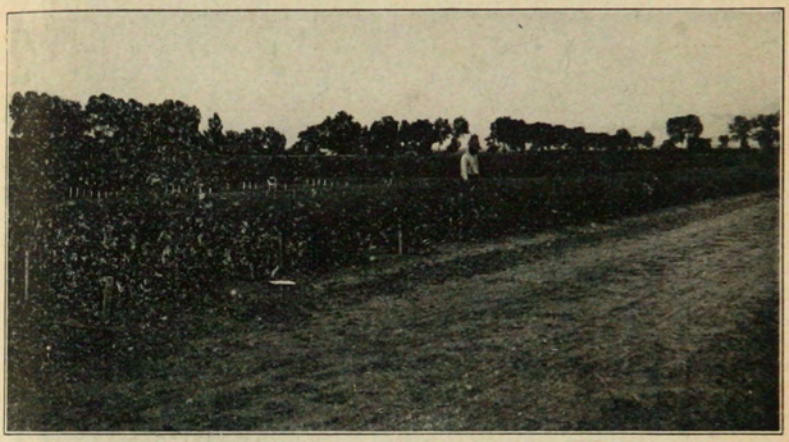

Plate No. 1.

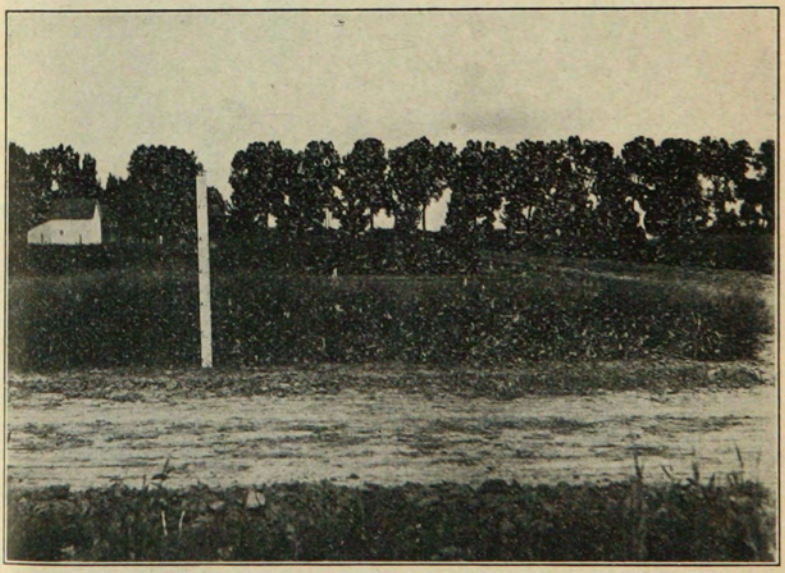

Plate No. 2.

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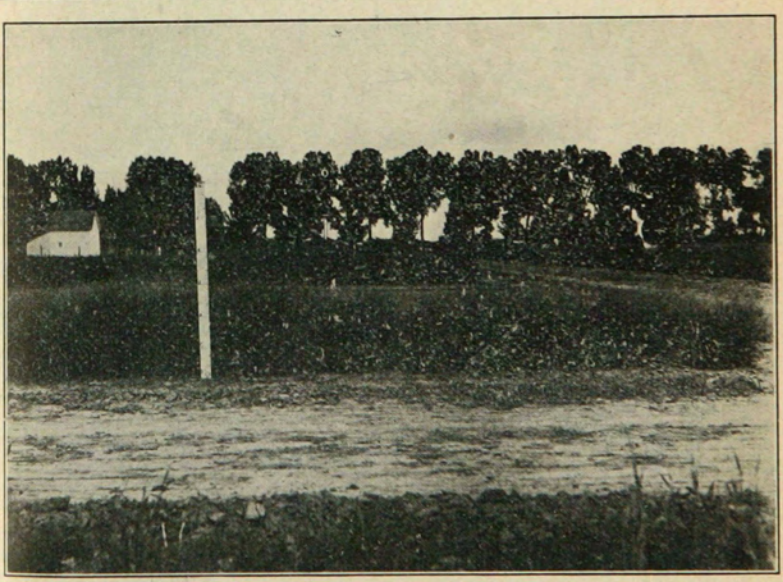

Plate No. 2.

this was not a simple problem because Colorado presents all possible conditions of altitude variation, between an altitude of approximately 3,500 feet and over 14,400 feet. These variations in altitude alone bring forth conditions varying from a temperate to an arctic climate. The climatic variations due to altitude are not the sole climatic variations to be met in a study of this kind. The rainfall varies from a minimum of less than ten inches to a maximum of over 30 inches in some localities. We have dry land agriculture and irrigated agriculture represented in practically every section under these various conditions of altitude and rainfall.

Plate No. 3.

Manifestly, no one grass or combination of grasses is best adapted for all of these conditions. It so happened that among the grasses giving considerable promise for pasture purposes, especially in the higher altitudes, both under the dry land and irrigated conditions, what is commonly known as the awnless brome grass (Bromus inermis) was one of the most promising. When the experiment had gone far enough to demonstrate the advisability of pushing this grass for certain sections, studies were commenced to see if there were different types or strains of Bromus inermis which might have peculiar advantages for specific definite conditions. With this idea in view, seed was obtained from a number of different sources and planted in our grass gardens upon the experimental grounds at Fort Collins. The particular line of studies here reported are the outgowth of a portion of the studies thus started.

It was early observed that we possessed a large number of

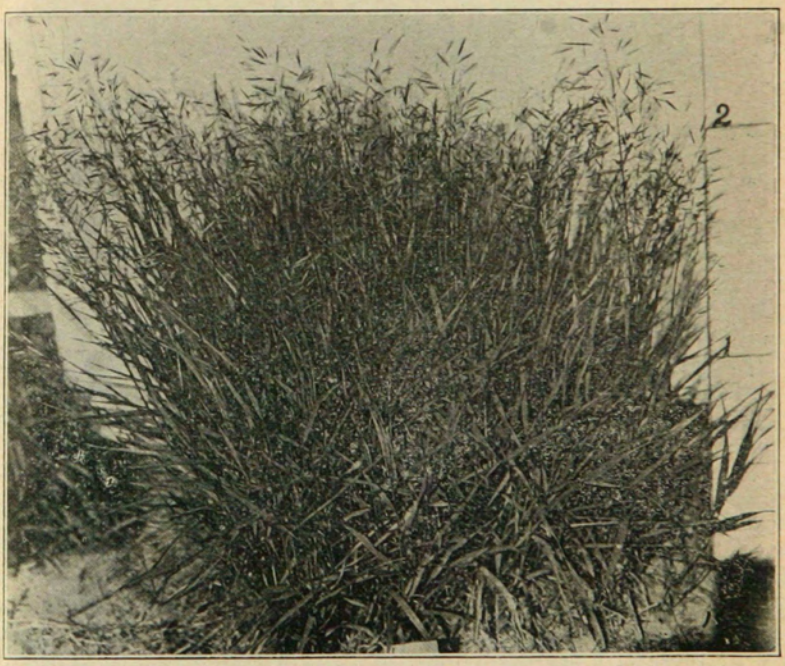

Plate No. 4.

strains and apparently different types in the plantings. These strains were then selected and seed from each strain was planted in rows three feet apart. The plantings in the rows themselves were made two feet apart. After the young plants had started they were thinned to one plant in the hill. This was done in order to have each hill rep-

resent not only an individual plant, but as far as possible, a distinct individual type or strain for future study. At the present time there remain under observation, 121 distinct strains or types which have survived the conditions of winter and the vicissitudes attendant upon their growth and development.

One of the next steps to be taken up in this work was to determine if these different strains appearing were *pure line* strains or whether they

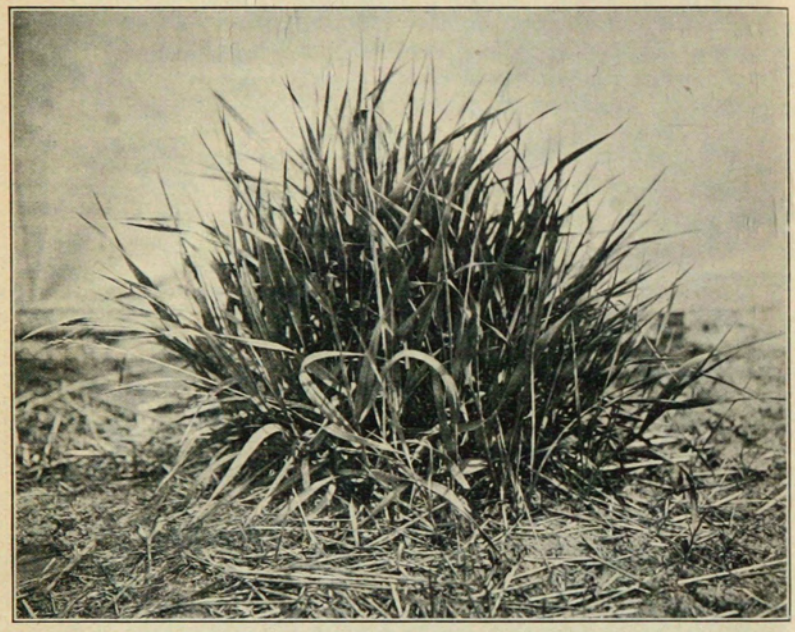

Plate No. 5.

would break up into mixed strains when the seed was planted for the next generation. Accordingly, three different plantings of each of these types have been made for progeny studies. This work is not yet ready for complete report, but has progressed far enough so that we can say that in the large majority of cases it has been found that each one of these strains was a pure line strain and bred true when the seed was planted, giving rise to a generation resembling the parent plant in habits of growth, color, size, root development and other observable physical characteristics.

In a few cases it was found that the progeny of an individual strain broke up into different forms. The supposition or the hypothesis upon which we are working is that these forms which show splitting are crosses. The evidence is very strong in favor of this fact,

altho it has not been carried far enough to permit of positive statements. If this splitting should continue to occur in succeeding generations, we would consider the evidence sufficiently conclusive to call such splitting strains crosses or hybrids. Up to this point of our investigation, however, these splitting strains have not been propagated by seed to determine this point, as other factors under observation have occupied the time at present available for this experiment. We have the seed of the splitting strains and when some other portions of

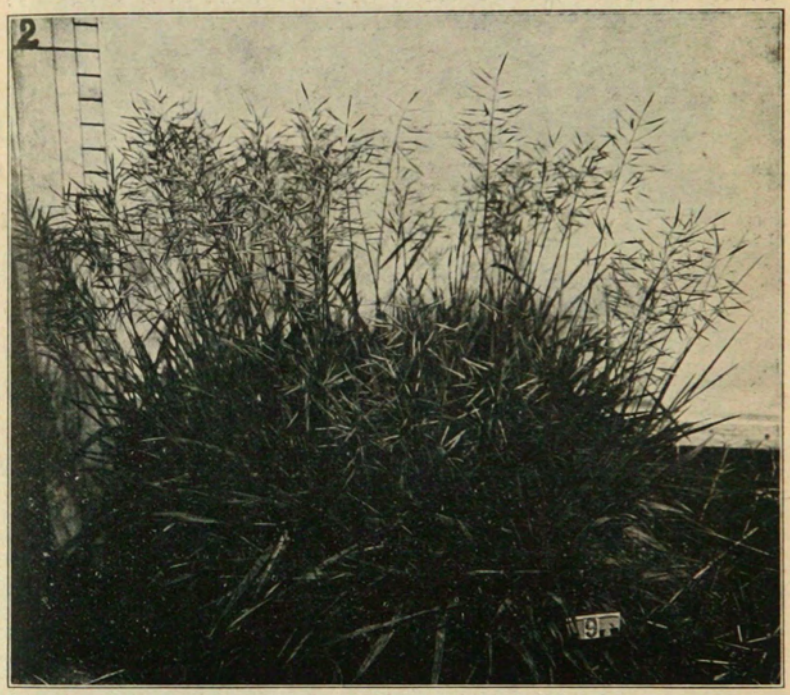

Plate No. 6.

the experiment are completed we expect to make plantings of these strains for genetic studies on these points. Until other work is completed we will not be able to do this because time and land are both occupied with other phases of the subject. Suffice it to say that three crops of seed from the parent strains have been planted in progeny rows and that the progeny, with the exception of the splitting strains above noted, have bred true, indicating pure types. This phase of the work has gone far enough so that we feel justified in saying that it

would be possible for us to successfully propagate by seed the most of the highly variable strains which occur in our work. From a practical standpoint this phase is extremely important, because if we work out a type of brome grass plant that is peculiarly adapted for pasture or

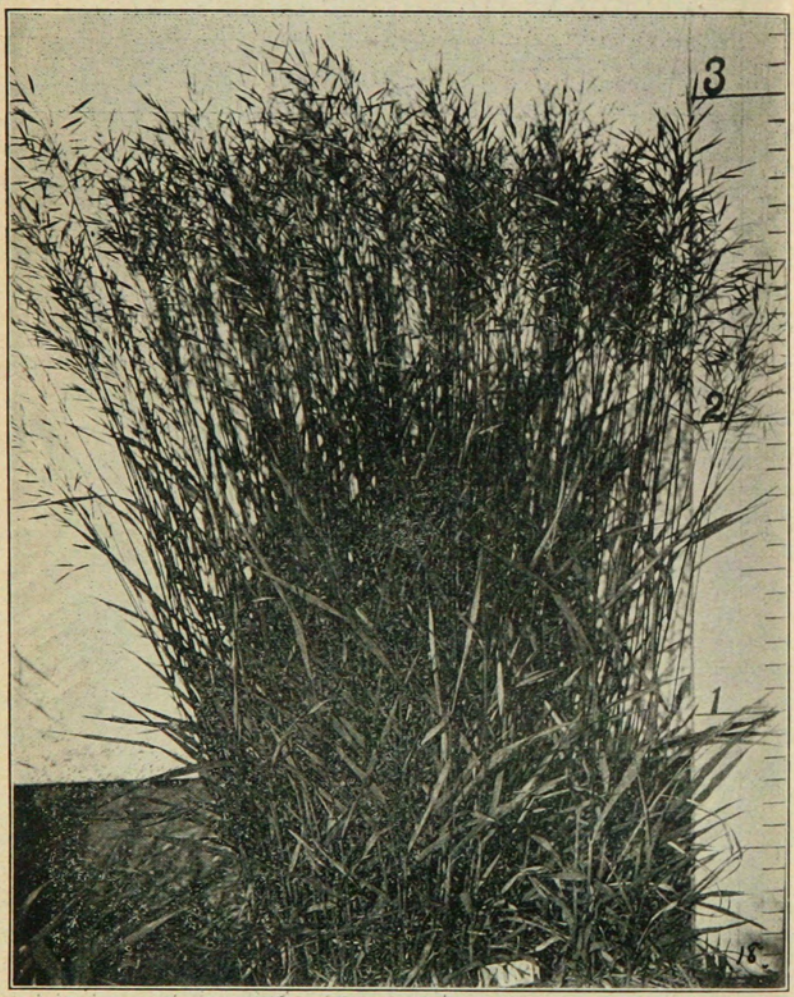

Plate No. 7.

hay purposes in any locality, it is absolutely essential that the characters which make it valuable must be susceptible of successful seed

propagation in order to be able to establish the type in any community to which it is adapted.

A few of these types which have proved themselves to be pure line types are being grown in small fields in some of our high altitude locations. They are thus being observed under actual farming conditions. This part of the work of necessity progresses slowly at first, until a strain proves itself in a locality and people commence to desire the seed in order to get the same desirable strain.

While these phases of the subject are being studied, studies upon the variations occurring in the different strains are being made. It may be interesting to call attention to some of these variations at the present time, altho the studies are not completed and will not be for some little time in the future. In the illustrations which follow, pictures are shown of some of these types, selected to illustrate variations which occur. These pictures illustrate differences to be noted both in the mature or seed stage of the crop and in the spring condition of the crop. A comparison will show that these differences are maintained thruout the growing period.

Plate No. 8

Plate No. 1 shows a general view of some of these strains taken at the time of greatest growth when the seed was about in the milk stage.

Plant No. 6 and plant No. 42 (Plates 3 and 4), illustrate one set of differences which occur. Plant No. 6 represents a type of varia-

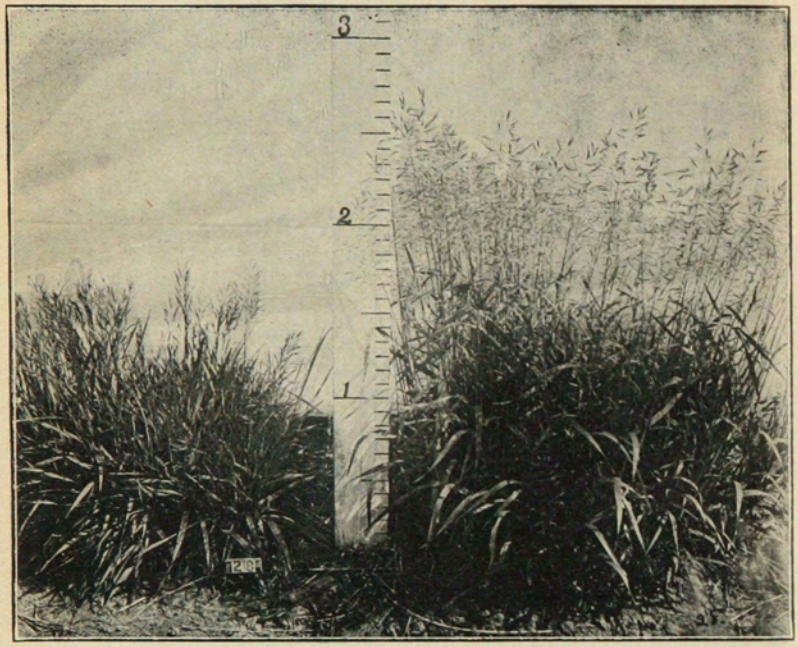

Plate No. 9.

tion having a very sparse number of stools or tillers. Plant No. 42 on the other hand, illustrates one very profusely stooled. These pictures were taken upon the same day at a time representing practically the same state of development. Altho plant No. 6 has an average height of 29 inches, the average height of the leaf mass is only 19 inches. The leaf mass is very sparse. The leaves present a medium broad appearance of natural length. The color is a very yellow green. In describing the plant this was described as sparingly leafy. Notes were taken upon the date of ripening, showing that these plants were both considered ripe July 7, 1912.

Plant No. 42 Plate No. 4), on the other hand, has a total height

somewhat less than plant No. 6. The leaf type is what we describe as very narrow. The leaves, altho short, are exceedingly abundant, so that a very felty tuft or sod is produced. The stools are exceedingly abundant and artificial means have to be resorted to to keep

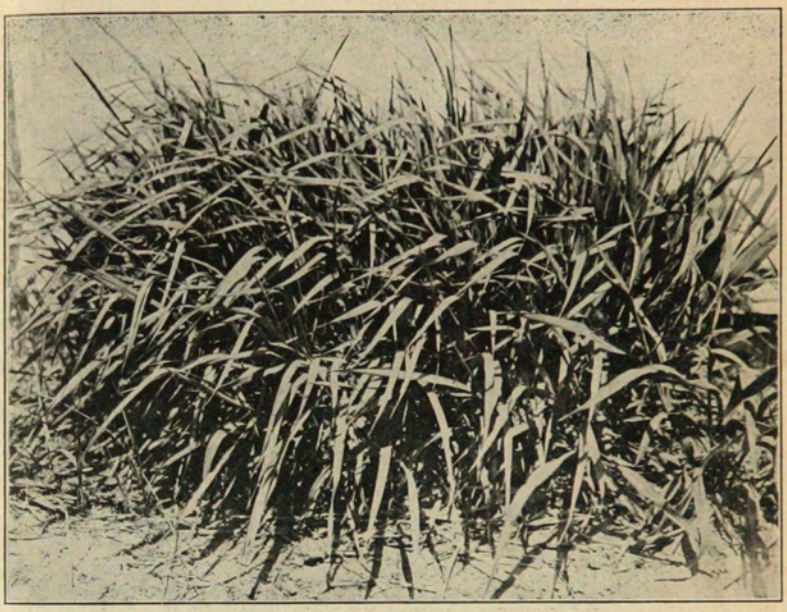

Plate No. 10.

the stools from tillering by the underground root stalks so abundantly as to mix this strain with the adjacent plants in the same rows and even with adjacent rows. The color is a very dark green. Altho this plant is shorter in height than plant No. 6, the leaf mass has an average height of 21 inches as compared with 19 inches in the case of plant No. 6.

Plant No. 6 (Plate No. 5) is also shown as it appeared in the spring of 1913.

Plant No. 40 (Plate No. 6) illustrates another type of variation which takes place. In this plant, the leaf mass is only 10 inches high, altho the leaves are exceedingly abundant. The seed heads are also short, attaining an average height of only 18 inches in 1912. This is a type of plant that we have designated as a purely pasture type. It does not make growth enough even under good irrigation condi-

tions to warrant mowing for meadow purposes. It is a type that will endure a great deal of grazing and tramping, as it makes a very heavy underground root development, springs up strong and quickly, yet never grows to a very great height.

Plant No. 43 (Plate No. 7) illustrates what we have designated as a good hay type. This plant stood in the same row and was grown under the same conditions as plant No. 40 and plant No. 42 described above. While No. 40 made a height growth of only 18 inches, No. 43 stood 35 inches, and the leaf mass which is the valuable part of the hay, made a height growth of 22 inches. This is a very desirable type

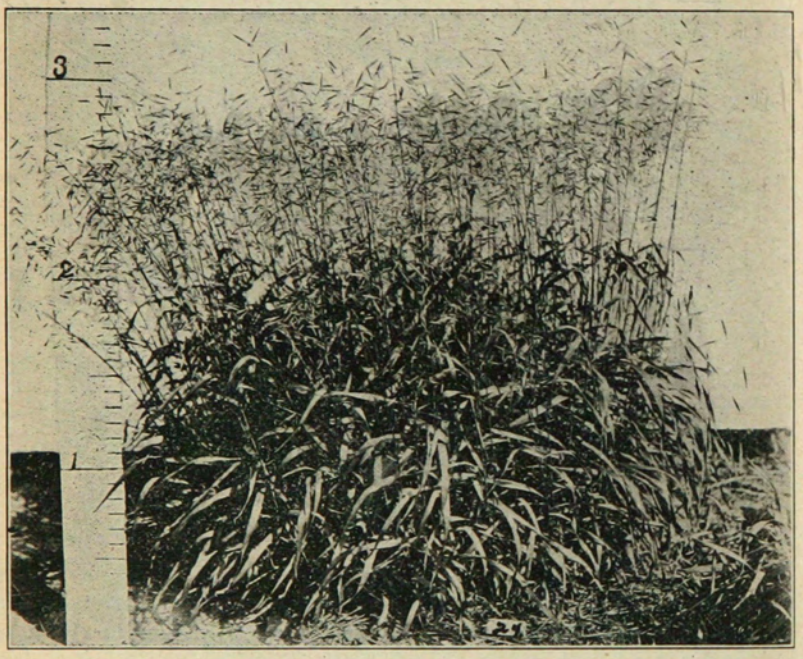

Plate No. 11.

of hay plant as the plant is not only of the very desirable leafy type, but also stools quite abundantly. It is also an exceedingly heavy seed producer so that this characteristic can be propagated.

Plant No. 67 (Plate No. 8) illustrates the same desirable hay characteristics. Plant No. 67 is a more vigorous stooler than plant No. 43, but is not quite as desirable in leaf characters. Plant No. 67

is a very bright yellow-green, while No. 43 is a very dark green, having a brownish tinge to the inflorescence.

Plate No. 9 illustrates plants Nos. 40 and 41, No. 41 being the plant on the right. These two plants grew in the same row and under

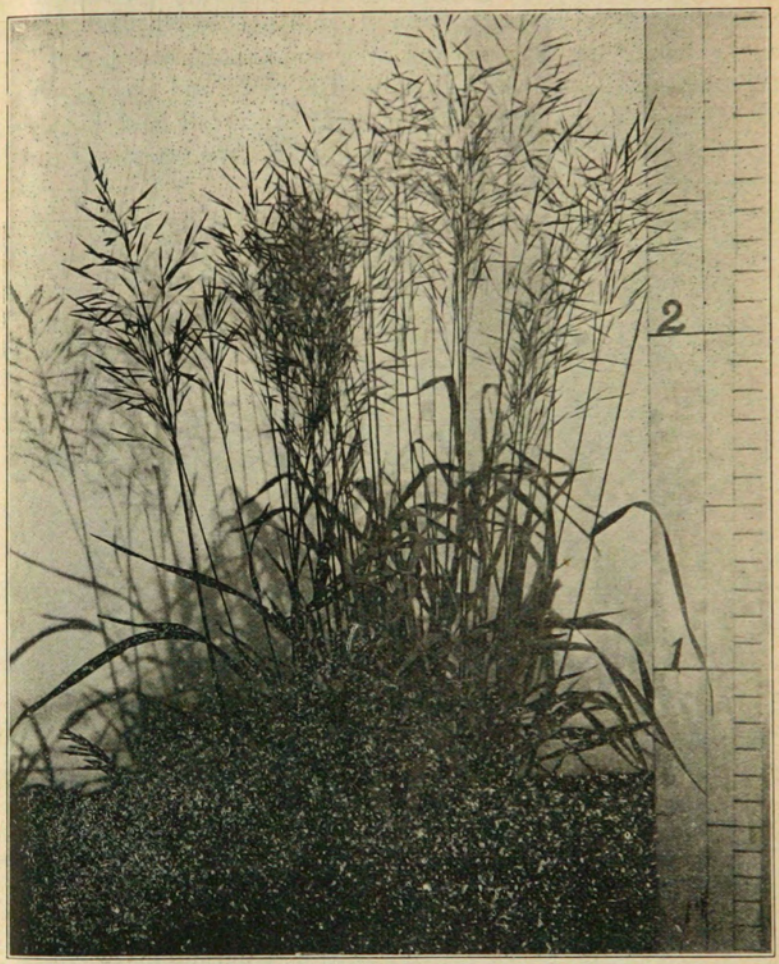

Plate No. 12.

the same conditions. Plant No. 40 attained a total height growth of 18 inches, No. 41, 29 inches in 1912. No. 41 is a very heavy stooler; No. 40 was rather sparse in this characteristic. No. 41 produced an abundant supply of seed. No. 40 produced seed heads very sparsely.

The progenies of these plants exhibited the same characteristic.

Plate No. 10 illustrates the appearance of plant No. 41 in the spring of 1913.

Plant No. 107 and Plant No. 18 (Plates Nos. 11 and 12) illustrate some other interesting variations. These two plants have made practically identical height growth. It so happened that both of these plants exhibited the same general color appearances and almost identically the same type of leaf growth. The shape and general appearance of the leaf is so much alike that they can scarcely be distinguished. The chief differences to be observed in these two plants are that of

Plate No. 13.

tillering. Plant No. 107 is an exceedingly abundant stooler. The stolons put out from the roots are so abundant and vigorous that it is necessary to prume them back several times during the summer in order to keep this plant separated from the individual plants each side of it in the rows and in adjacent rows. Plant No. 18 on the other hand, puts out almost no stools. The plant at the time this picture was taken was three years old and yet the stool was practically of identical size as shown by measurements and counts, that it was during the latter part of its first season of growth. Our present expe-

rience with this characteristic is such that for pasture purposes especially, a type of plant similar to No. 107 would be selected always, because it is very much hardier, and stands tramping very much better because of its stoloniferous habit. For hay making purposes, the question is still in doubt, because meadows are not subjected to some of the conditions which surround pastures, so that it is not yet wise to pass an opinion. We do know that a type of plant like No. 107 has a

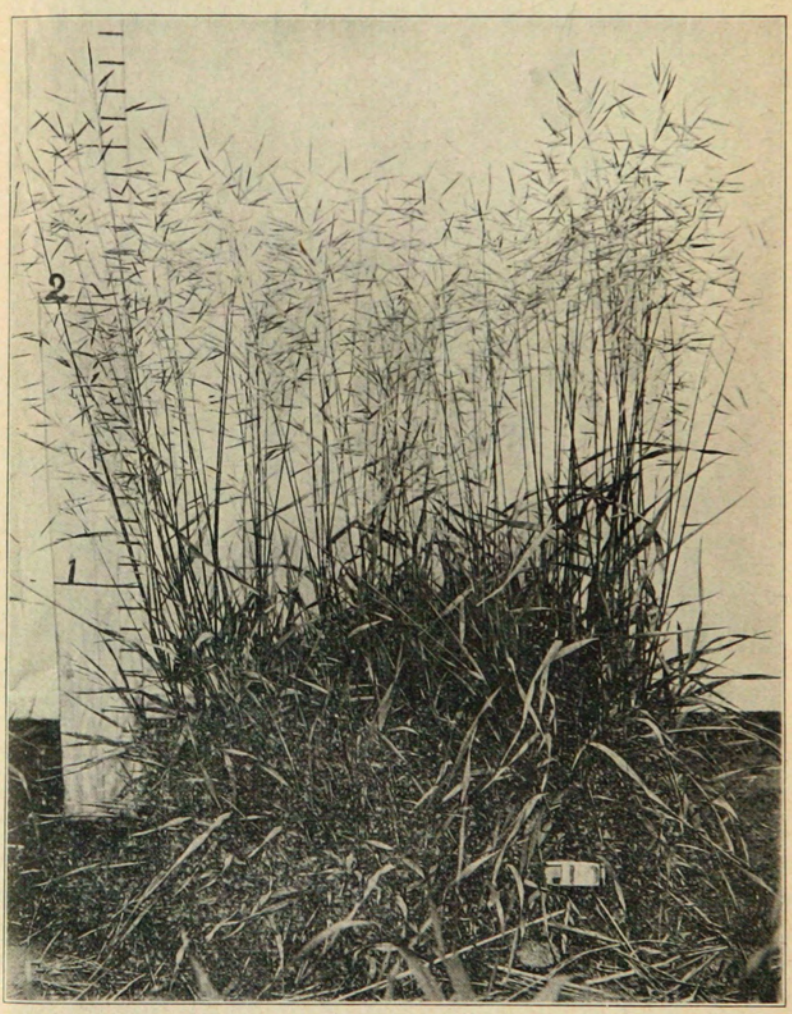

Plate No. 14.

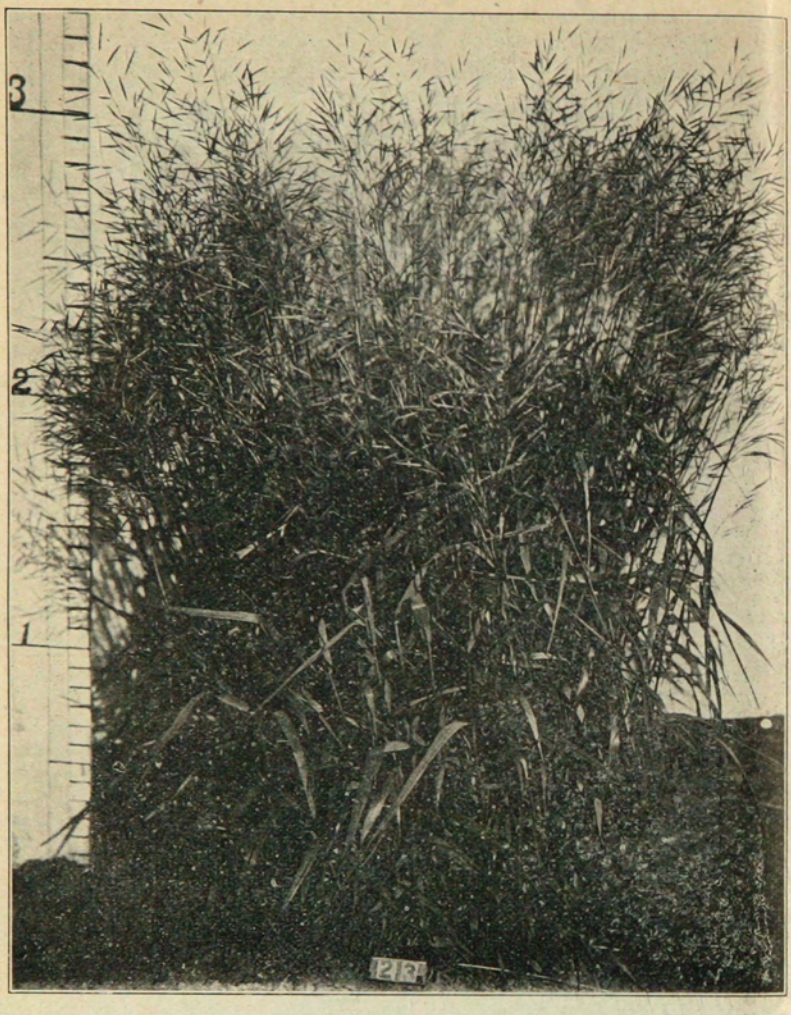

Plate No. 15.

tendency under meadow conditions, to a reduced length of leaf and stem growth because of the very great abundance of stolons put out and the tillers produced, while seemingly, there is a tendency of plants of the type of No. 18 to maintain under meadow conditions, a sufficiently high growth to permit continuous mowing for a longer period without some special treatment to increase development.

Plate No. 13 illustrates plants Nos. 116, 117 and 118, also three

distinct types of variation which occur. Plant No. 116 made an average height growth in 1912 of nearly three feet. The plant was evidently possessed of a very great amount of vigor because in spite of the very much larger number of tillers it made a higher stem growth, a heavier infloresence and a higher, denser leaf growth than either plant No. 117 or No. 118 growing in the same row and immediately adjacent in the order given.

Plant No. 78 (Plate No. 14) and Plant No. 105 (Plate No. 15) illustrate two contrasting growth habits. These two plants are practically equal in stooling habit in so far as the lateral extent of the stooling area is concerned. Each has covered in three years' time practically the same area of ground. It will be noticed that the leaf height in plant No. 78 is low, while the leaf height in plant No. 105 extends

Plate No. 16.

well up into the infloresence. Altho the ground covered by these two plants was almost identical there was over three times the amount of weight of foliage produced at the time of cutting in the case of plant No. 105, indicating a very much better habit of plant for hay making purposes in the case of No. 105. It is interesting to note that the progeny rows from these individuals exhibited exactly the same characteristics, showing that in these speecific instances, pure lines were attained. The variations in spring starting of these different strains are

nearly as striking as the variations in their later development.

Plate No. 16 shows early sprng development of plants No. 105 and 106, in the spring of 1913 Plant No. 105 on the left, started very much earlier and more vigorously than plant No. 106 on the right. These two plants exhibited a striking contrast not only in the shape of the growing mass produced but in the character of their foliage. Plant No. 105 is a broad leaved, vigorous grower, and starts very early in the spring, and continues growing late in the fall. Plant No. 106 starts slowly in the spring, has narrow, short leaves, and a very dark green color. By the first of June plant No. 105 had attained a height of 30 inches in 1913, and plant No. 106 a height of only 18 inches. Fom previous experience with this plant we would be warranted in concluding that it has practically reached as much development in the way of leaf growth as it will make during the season, while we can expect plant No. 105 to make a considerable further growth before it reaches seed maturity.

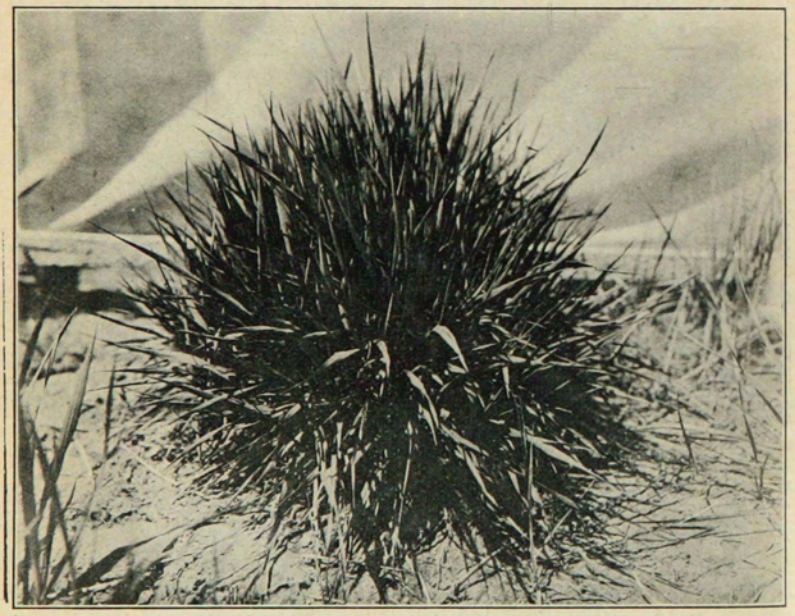

Plate No. 17.

Plant No. 24 (Plate No. 17) and Plant No. 25 (Plate No. 18) illustrate another set of contrasts Plant No. 24 in a very sparse stooler.

Plant No. 25 is an exceedingly abundant stooler. These two plants in the past have been practically identical in height growth Plant No. 24 is a very bright yellow green. Plant No. 25 is a very dark green or blue green. Plant No. 24 has very fine leaves and stems, while plant No. 25 is rather coarse. These two plants exhibited about the same characteristics in starting in the spring.

A further contrast is shown in Plate No. 19, between plant No. 24 shown on the left, and plant No. 63 shown on the right. While plant No. 24 is a sparse stooler, it is a vigorous grower, attaining a good height and continues vigorous. Plant No. 63 on the other hand, appears to be of very low vigor. It stools very sparsely, starts very late

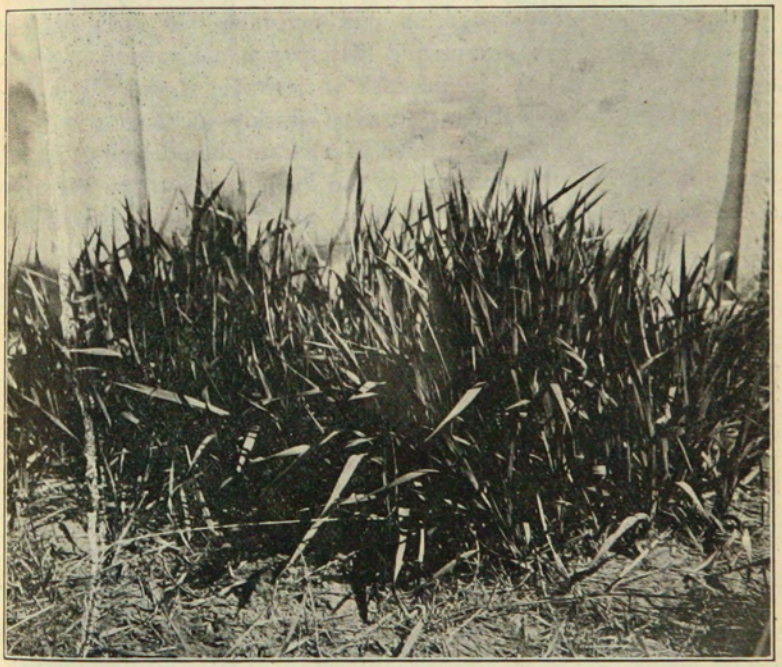

Plate No. 18.

in the spring. The progeny rows obtained by planting seed from plant No. 63 have this same slow, sickly development shown by the parent.

Notes are being taken and studies made to determine if any of these various physical characters as exhibited in these original plantings or their progeny are correlated with specific performances. While

correlation tables might be constructed from the data at hand, this will not be done until more data is accumulated. From a cursory eximination there would seem to be very little correlation between color and leaf habits and ability of the plants to perform. Preliminary counts and preliminary computations, however, seem to indicate that there may be a relation between the tillering habit and the development which actually takes place in the strains and their progeny, when these strains prove themselves to be pure lines.

Some studies have been made on propagating some of these strains vegetatively. While we have none of these vegetatively propagated strains in the nursery at the present time, we have had clonal varieties which were destroyed as soon as it was shown by experiment that this method of propagation was favorable for increased seed production of desirable strains and that true clonal varieties could be made by such a method. In the case of desirable strains this method of propagating may enable us to very quickly increase a desirable strain for seed increase. Of course, if a strain should happen to be a hybrid so that splitting occurred in the F_2 generation, the vegetative method of propagation would be of no use, but in the case of pure lines it can be utilized to get a larger seed producing capacity of some of the pure strains.

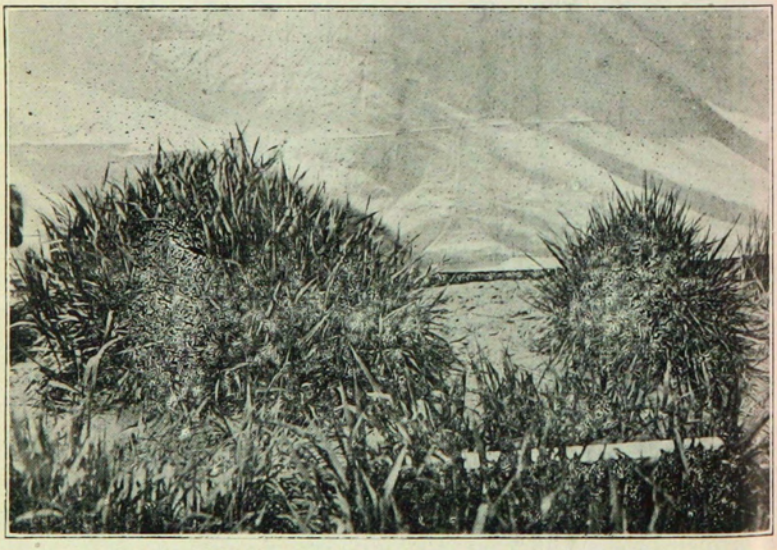

Plate No. 19.