Blue Grama Types from West Texas and Eastern New Mexico[1]

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From the eastern edge of the Rolling Red Plains of Oklahoma and Texas westward across the High Plains, the Llano Estacado, the upper Pecos valley and lapping high up into the mountains of New Mexico is a broad expanse of natural grassland dominated to a large extent by blue grama. Southward from the New Mexico line into Texas, blue grama is found in islands at the upper elevations of the hills and mountains but seldom on the valley floors. Scattered throughout the area are several million acres of marginal and submarginal land that had been plowed up at one time and then abandoned. Attempts are being made to return this land to native grassland vegetation. Blue grama is the basic bread-and-butter grass for reseedings of this type.

Blue grama seed has always come from wild harvests, none of it being produced under cultivation. Sources of seed vary from year to year, depending entirely on the rainfall patterns of an erratic climate. It is important, therefore, to characterize the natural stands of blue grama in the region and obtain some idea of the relative agronomic value of the various sources.

Materials and Methods

The year 1946 proved to be an unusual year for blue grama development and collections were made by the author at 189 locations distributed fairly evenly over the region.

These collections were established in the breeding nurseries at the U. S. Southern Great Plains Field Station, Woodward, Oklahoma and maintained under observation until 1955 when the collection was plowed up. In 1950, a cytological survey of 108 of the collections was made by L. A. Snyder and reported elsewhere (Snyder and Harlan, 1953). The geographic pattern of chromosome numbers determined in this survey is reproduced in Figure 1 *(left)*.

Agronomic notes on flowering habits were taken on the full collection and reported here. Observations on growth and relative productivity of the 189 accessions led to the selection of nine source populations which were put into replicated yield tests (Kneebone and Heller, 1956). In addition, selected plants from the most promising sources with $2n = 20$ chromosomes were transplanted to an irrigated block at the Livestock Research Station, El Reno, for evaluation for seed production. A similar population of plants with $2n = 40$ chromosomes was established in the same way, as well as a block of collection no. 174 from the Capitan mountains of New Mexico.

In the fall of 1949 the Soil Conservation Service made a wild harvest on the site from which collection no. 34 was taken, a few miles north of Marfa, Texas. Since this material had given a good performance in spaced nurseries, sufficient seed was obtained to establish one 50 acre pasture on the Experimental Range Unit near Ft. Supply and a 2 acre block on the main station which has been used for a study of seed production practices. The results of these studies are largely available elsewhere (Kneebone, 1957; McIvain *et al.*, 1955) and will be summarized only briefly here together with some general observations on the collection as a whole.

Maturity and Flowering Habits

During the course of the collection in 1946 notes were taken on the maturity of the stand at each collection site. The maturity pattern is shown for the 189 collections in Figure 1 *(Right)*. It will be noted that on the whole, the ripest material was in northeast New Mexico and the higher elevations of the mountains of that state. The latest to mature was in the Davis mountains of Texas.

It was thought at the time that this was probably the result of rainfall patterns rather than due to inherent genetic factors. Notes taken on the same material in the breeding nurseries at Woodward in 1950 and 1951 showed clearly that this maturity pattern was inherent. As in many grasses, blue grama has an ill-defined blooming period. It was not possible to select a single date for blooming, but the flowering behavior of each accession was followed by taking notes on three separate dates as to the relative condition of the population on each of the three dates. The data for May 18, 1950, June 1, 1950, and June 12, 1950 were taken from 176 collections in the nursery at Woodward and then plotted on the maps shown in Figures 2 and 3. The flowering behavior of the accessions grown side by side at Woodward was very similar to the maturity pattern as noted in the field in 1946. Notes taken in 1951 were nearly identical to those of 1950.

Winter Hardiness at Woodward

Some plants in the collections from Sierra Blanca, Van Horn,

[1] *Contribution of Crops Research Division, Agricultural Research Service, U. S. Department of Agriculture.*

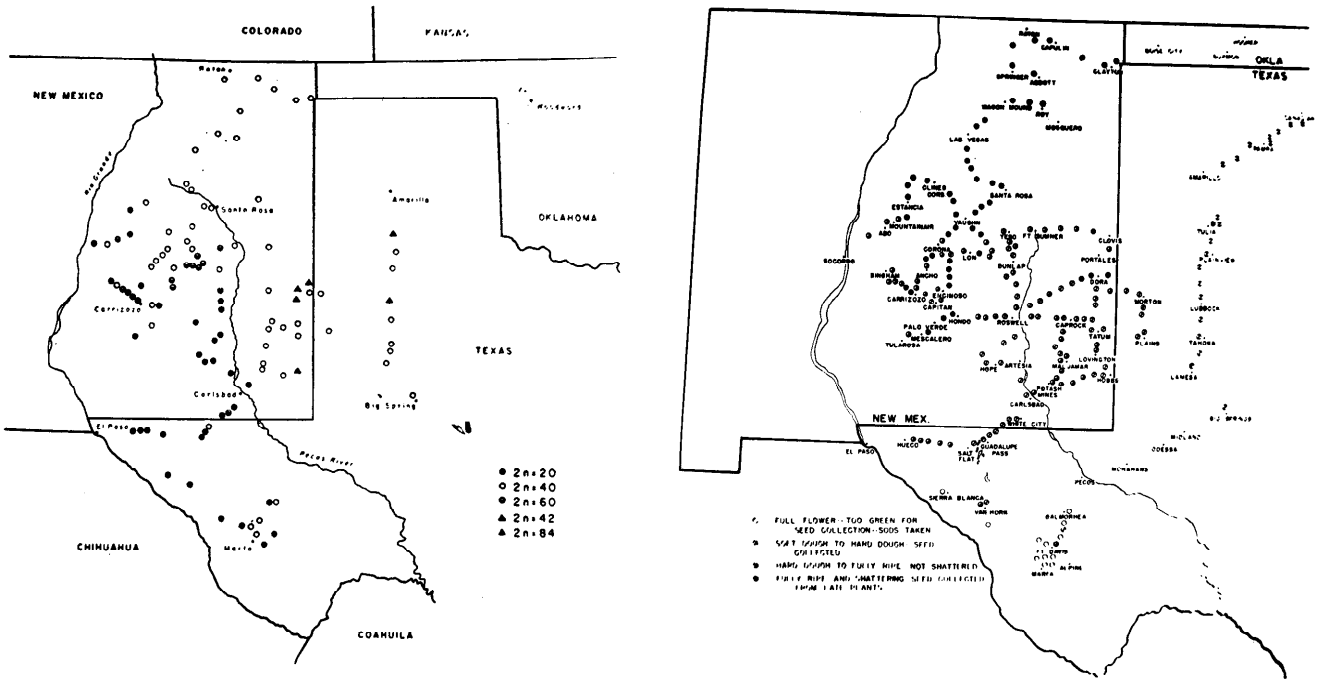

FIGURE 1. *Left:* Map of the area showing 108 localities from which cytological data were taken. *Right:* Maturity of the collections at the time of collection in October, 1946.

and near Marfa, Texas, showed considerable winter injury during the severe winter of 1950-51 and moderate injury in other years. Other accessions suffered no evident winter damage. Apparently there are many hardy plants in the Marfa population, since bulk seedings both at Ft. Supply and on the main station have survived well. No doubt the badly injured plants are replaced by fully hardy ones out of the same population where thick stands are obtained. Injury to these southernmost accessions, however, suggests that collections still further south should be used with caution, and that material from Van Horn, the Davis Mountain, etc. should not be used farther north than Oklahoma.

Distribution of Types

Because of space limitations, only 35 plants of each collection were established in the nursery. This sample was large enough, however, to show that very few of the collections were actual duplicates. Each population was in some way slightly different from every other population, yet certain broad agronomic types could be distinguished. Collections east and north of the Pecos River were rather similar for the most part and represented a broad, contiguous high plains type, highly variable, yet rather similar in growth habit and general aspect. The one exception to this generalization was collection 201 west of Roy, a site located deep in the Canadian River Canyon, and not truly of high plains origin.

Transpecos materials, by contrast, were remarkably diverse in appearance and performance. They included diploids ($2n = 20$), tetraploids ($2n = 40$), and hexaploids ($2n = 60$), Figure 1. Many were very tall, (36-40 inches in the nursery), leafy, robust, and apparently productive. Others appeared to be much less desirable. One (No. 174) had very long, weeping leaves, and was strikingly different from all other materials in the collection.

This last accession, under trial under the name of Capitan, came from a small meadow north of the town of Capitan, New Mexico. Since it appeared to be an agronomically desirable type, the site was revisited in 1949 and collections made at several points in the same meadow and at 0.5 mile intervals in all directions in order to determine its geographic range. When these collections were grown, it was found that none of them corresponded to the original collection except those taken within 100 yards of the original collection site. This strikingly different variety is apparently confined in its natural habitat to a meadow less than 20 acres in size.

Several of the other collections appeared to represent types with a distribution perhaps as limited. On the other hand, most of the material from the Davis Mountains appeared to be of a type, although diploids and tetraploids were represented and both contained considerable variability. Material from the hills between Hueco and Salt Flat was also distinctive and of the same general type; collections from the Guadalupe Mountains resembled each other more than they resembled other sources. Thus, the

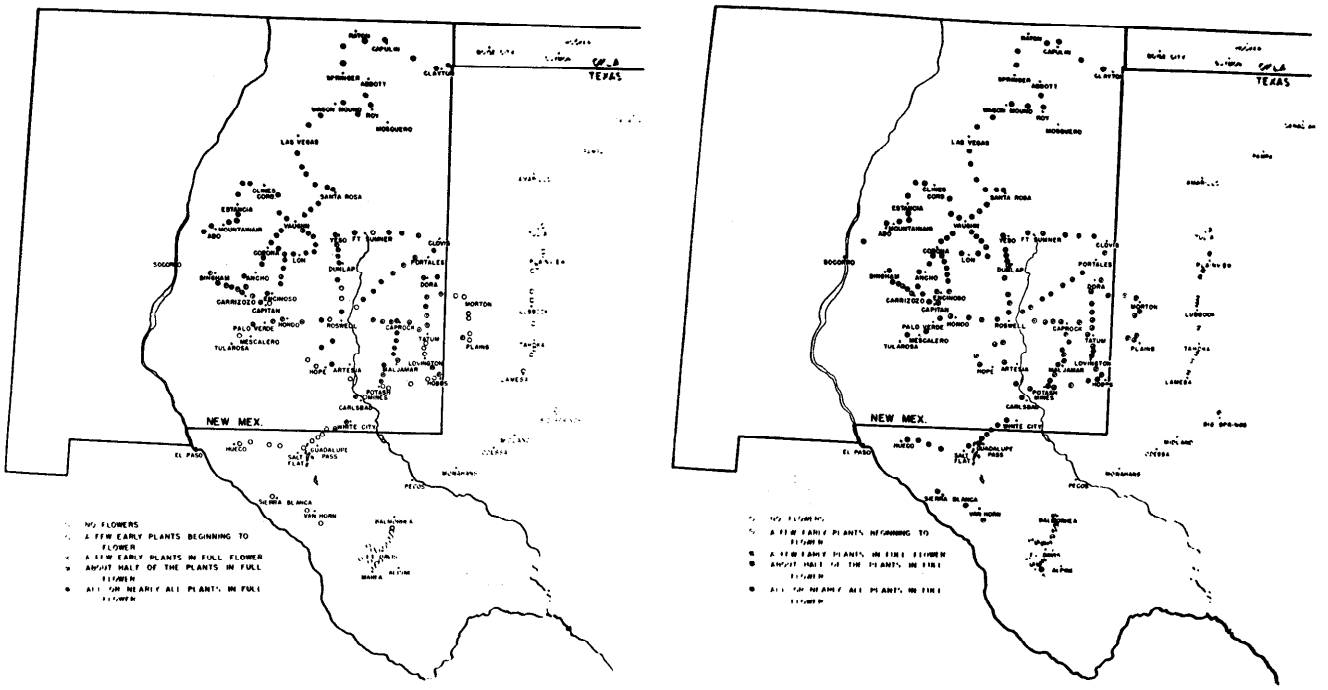

FIGURE 2. *Left:* Flowering notes taken in the nursery at Woodward on May 18, 1950, and plotted according to origin of each accession. *Right:* Flowering notes taken on June 1, 1950, plotted in the same manner.

transpecos material is rather finely divided into types and subtypes according to the physiographic features of the region, as well as into minute, distinctive colonies, as in the case of Capitan.

Forage Yield

Data from replicated clipping trials, Table 1, indicate a substantial difference in performance between the several sources tested (Kneebone and Heller, 1956). Some of the types like Van Horn, Capitan, and Ruidoso that stood out in the spaced nursery as strikingly vigorous and productive vegetative types made a relatively poor showing in replicated plots. Those that gave the best performance, Hueco, Pecos, Caprock, Dunlap, were relatively undistinguished in the spaced nursery, exhibiting more vigor and production than the average, but appearing in no way outstanding. The first two of the last group named are diploid, the other two tetraploid.

On the whole, the most southern sources were not the best adapted at Woodward, although perhaps all of the accessions might be considered satisfactory and generally superior to commercial sources from eastern Colorado and western Kansas. The best sources based upon performance at Woodward were those from intermediate latitudes and intermediate elevations of the general area sampled.

While W_3 was of Oklahoma origin, it could hardly serve as

Table 1. Yield in pounds air dry forage per acre in plots; average of three replications for a total of six clippings during the years 1951, 1952, and 1953.

Variety and Source	Yield lbs./acre	Av. protein— percent	Total protein yield lbs./acre
Hueco: Between Hueco and Salt Flat, Tex.	2654	8.36	222
W_3: Woodward and Noble Counties, Okla.	2290	7.93	182
Pecos: 3 locations 25-35 mi. N. Carlsbad, N. Mex.	2284	8.48	194
Caprock: Near Caprock, N. Mex.	2119	8.03	170
Dunlap: Near Dunlap, N. Mex.	2080	8.50	177
W_2: Selected late plants from collection	2066	7.78	161
W_1: Selected early plants from collection	2035	7.90	161
Roy: Canadian River Canyon West of Roy, N. Mex.	1990	8.21	163
Marfa-Davis: Selected plants Davis Mts., Tex.	1961	8.14	160
W_4: F_4 from Western N. Mex. x Okla. selections	1843	7.71	142
Van Horn: Near Van Horn, Texas	1817	8.13	148
Capitan: Near Capitan, N. Mex.	1719	7.67	132
Ruidoso: 3 locations Hondo-Ruidoso, N. Mex.	1666	7.99	133
L.S.D. .05	157	0.46	.....

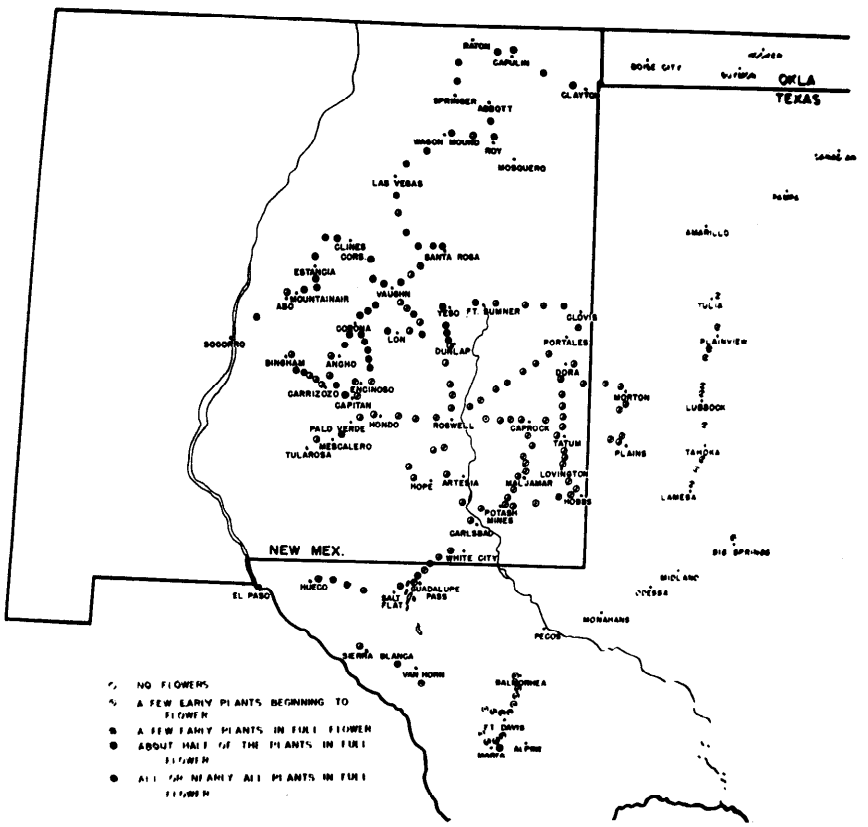

FIGURE 3. Flowering notes taken in the nursery at Woodward on June 12, 1950, and plotted according to origin of each accession. Compare with Figure 2.

an example of local commercial material, since it had been developed by selection and restricted breeding for several generations. A comparison with local check materials would be somewhat academic in any case, since blue grama seed is only rarely harvested in Oklahoma in commercial quantities. We may conclude from the limited plot studies that while almost any source of blue grama from the area sampled would be acceptable for northwest Oklahoma some sources are decidedly better than others. The best material for western Oklahoma would probably be from the hills east of Hueco and the mid-Pecos valley from Ft. Sumner southward to the Texas line.

The grazing trial at Ft. Supply comparing Marfa material with Texas panhandle material is inconclusive at the present time. A rather wide initial difference in stand was obtained which appears to confound the results of the first two or three years of the study (McIlvain, E. H., *et al.*, 1955).

Seed Production

A comprehensive study on seed production using the Marfa source was conducted by W. R. Kneebone and reported elsewhere (Kneebone, 1957; Harlan, Ahring, and Kneebone, 1956). A similar study has been started at El Reno using the Capitan variety. Results of these studies need not be repeated here, but it seems apparent that with suitable management and with irrigation water available, 300-450 lbs. of high quality seed can be produced per acre. Each variety and source appears to have its own specific requirements and it is difficult to generalize on specific recommendations. The Capitan variety, for instance, produces two seed crops at El Reno while Marfa produces only one at Woodward. The selected 2n = 20 population has made a consistently better seed set at El Reno than the selected 2n = 40 population, and the Capitan (2n = 20) has consistently performed better than either of them in both seed and forage production under irrigation.

Despite these variations in performance, we now probably have enough information on blue grama seed production under irrigation to produce seed of selected sources in artificial stands. It is hoped that the culture of selected types for seed production will eventually replace the present erratic wild harvests and provide the region with a steady, dependable supply of the blue grama of known and proven genetic origin.

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