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GRAIN SORGHUM IMPROVEMENT



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GRAIN SORGHUM IMPROVEMENT.

A. B. CONNER AND R. E. KARPER

The use of improved seed in growing any crop is of the greatest importance from the standpoint of acre value, as it costs no more to grow a crop from good than from poor seed. In fact, it costs less per bushel of grain produced. Much ordinary grain sorghum seed is sold as improved seed. It seems wise, therefore, for each and every farmer to familiarize himself with the ordinary methods of seed selection. By so doing, the farmer is assured of a good grade of planting seed, whereas, seed purchased in the market may or may not be of high quality.

The selecting of improved strains of seed is no difficult matter, and especially is this true in grain sorghums. The process requires no special skill, but it does require some slight amount of additional time and labor. This, however, will amount to only four or five days each year for the ordinary operator, and may be spent very profitably by any farmer in studying and improving the quality of his planting seed.

According to work done by the writers with grain sorghums, cross-fertilization may take place in the open field to the extent of six per cent. This amount of crossing under ordinary field conditions, together with the mechanical mixture which takes place at threshers and otherwise, has been so great that a field of uniformly pure grain sorghum is seldom seen. New varieties of grain sorghums are springing up in ever increasing numbers, few of which have proved their ability to compete successfully with the ordinary varieties of kafir, milo and feterita. A farmer can, therefore, spend his time much more profitably in selecting and purifying the variety he has by some systematic method than by growing or experimenting with new varieties which have not proved their worth.

FOUNDATION STOCK.

The foundation stock is the original selected seed heads used. This material should be secured from the standing stalk in the field for what it appears to be worth. If field material is not available, the heads may be taken from the bin or rick. In picking these plants or heads, it is desirable to consider several factors which have to do with quality and productiveness of the individuals. The important factors to be considered are as follows:

Seed heads must be true to type and variety.

Plants should be vigorous and healthy.

Seed heads should be chosen from plants which have had equal growing conditions, so as to avoid overestimating the value of

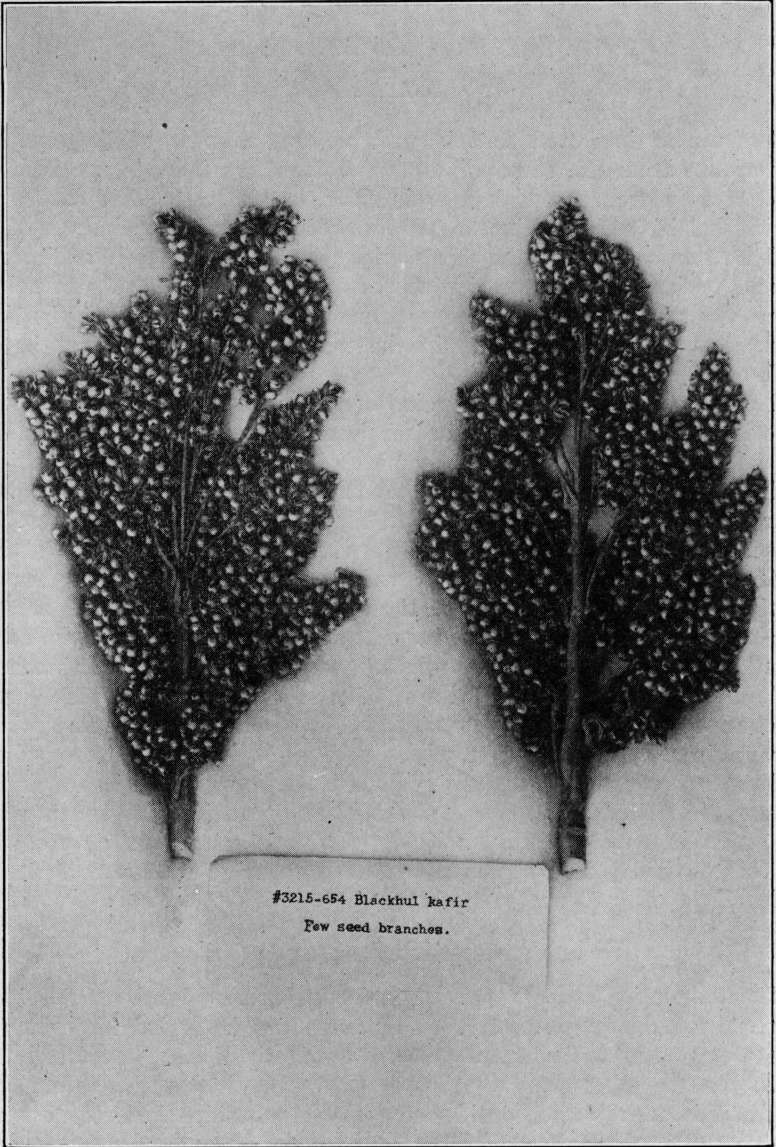


Figure 1.—Poor type of kafir head. This strain was developed by individual plant selection, and breeds true to type. Note the apparent low grain yield of this type. It was developed from the same Standard Blackhul kafir as the type on the opposite page.

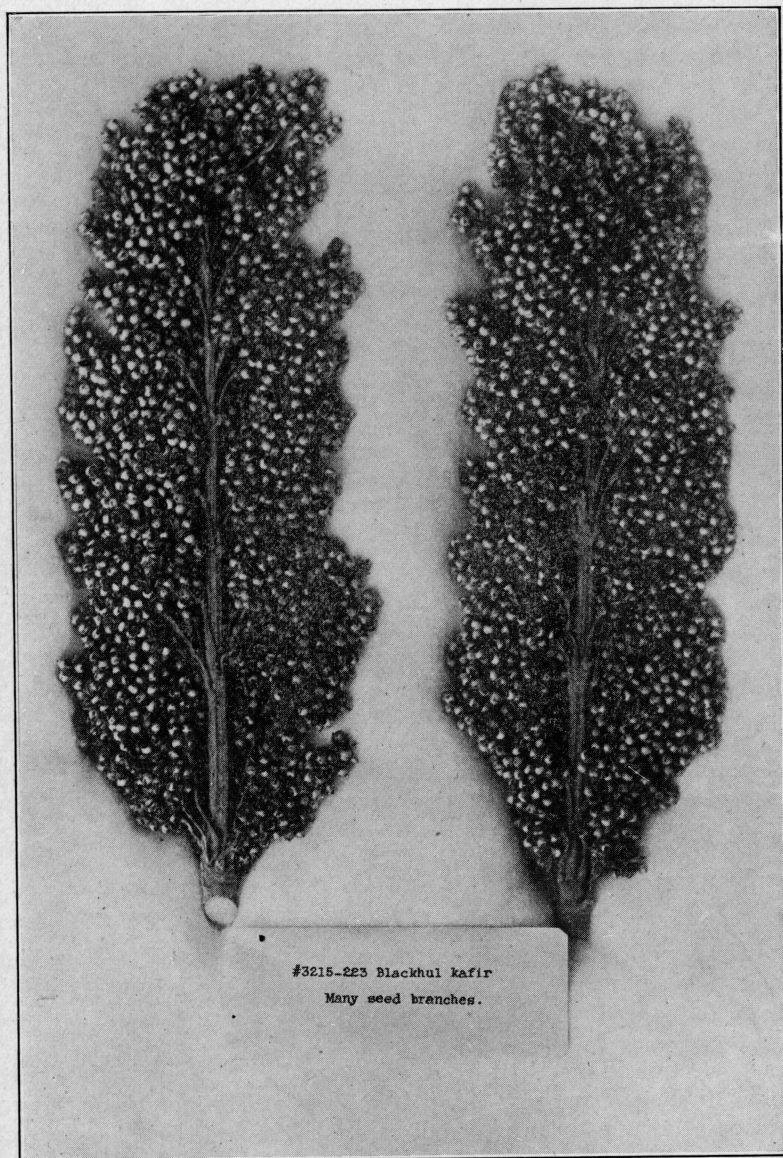


Figure 2.—Good type of kafir head. This strain was developed by individual plant selection, and breeds true to type. Note the apparent high grain yield of this type. It was developed from the same Standard Blackhul kafir as the type on the opposite page.

plants that have had unusual growing conditions due to stand or other factors.

Choose no plants growing near other varieties or off type, or hybrid plants with which crossing might have taken place.

Choose plants with good head exertion, i. e., heads that are fully free from the upper leaf sheath.

Choose plants that show earliness, if earliness is desirable.

Choose a large number of heads, not less than one hundred, and more if practicable.

There are a number of other visible characters such as size, shape, and structure of the head which have been considered to be indicative of high producing capacity, but as no positive information is available as to the relation of these characters to production it is not recommended that the farmer consider them in making selection of his foundation stock.

SEED SELECTION.

There are three general methods by means of which seed improvement by selection can be accomplished. These are as follows:

1. By mass selection.
2. By individual plant selection.
3. By hybridization.

The first two methods are the ones most commonly used with field crops. The subject matter in this paper will discuss only these two methods, both of which are practical and are perfectly satisfactory as means of improvement. The third method, hybridization, is not recommended to farmers as a practical means of quickly accomplishing improvement. Plant improvement can be accomplished by this means, but the process of combining certain desirable characters of parent plants in progeny is slow and requires the services of an expert who understands the behavior of hybrids and how to select stable and unstable forms with reference to certain characters.

Mass Selection

Mass selection is the most common method of seed improvement and is practiced more widely at the present time by farmers than any other system. This process does not accomplish rapid improvement, but it is a sure means of gradually securing improvement in quality and production.

Mass selection is practiced by threshing and mixing the seed selected as foundation stock and planting it in a select seed patch. This method gives opportunity to plant a small amount of selected seed each year in a seed patch and accomplishes improvement by the elimination of inferior, weak and diseased plants. If it is carefully followed from year to year, the obviously poor producers will be eliminated and the average yielding capacity of the variety increased. The general seed produced from the seed patch may be used for planting the general crop, whereas, the select seed from the seed patch is used again to

plant a select seed patch. If followed from year to year, this method gradually improves the quality, purity and productiveness of the strain.

Mass selection may also be practiced by actually testing the performance of the several selected heads and then mixing the seed of the best, and will result in rapid improvement in quality and productiveness.

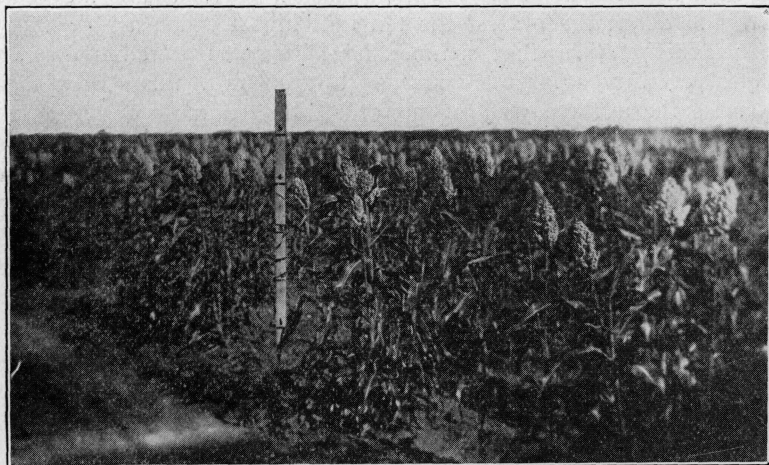


Figure 3.—A field of feterita showing uniformity of type due to selection. This is a high yielding strain.



Figure 4.—A field of feterita showing great lack of uniformity in type and probable low yielding capacity.

This method, however, involves more time and labor than the first mentioned. It requires the planting of individual heads selected as foundation stock, in individual plant rows as outlined in the performance test on page 10. At the end of the season, when the crop is harvested and the highest yielding individual heads determined, the re-

serve seed of, say, the ten best out of the 100 heads, are threshed and mixed for planting a seed patch. This seed patch including only the ten best producers out of the 100 heads tested will have an average yielding power much above the average of the original 100 heads selected. Although this system involves somewhat more time and labor than the ordinary mass selection process, it does enable the farmer actually to determine by test the ten individuals which are capable of high production. In that manner he is enabled to eliminate with absolute certainty a large number of inferior individuals and, therefore, raise the average yielding power of the strain by a considerable amount. It is important to rogue the seed patch carefully, removing any plants which appear to be off type or inferior.

Individual Plant Selection

The individual plant method of selection is based on the fact that a field of grain is composed of a population of many different races or strains, differing in one or more characters. The population or field yields at the rate of the average of all of the races contained and, therefore, any process which separates races from the population is conducive to securing these particular races separately for qualities such as high productiveness.

This method of plant improvement is the most rapid known to plant breeders at the present time. To determine the relative productiveness of the different individual plants or representative races so secured, it is necessary to conduct what is known as a head-to-row test or a performance test in which the several individual plants participate.

THE PERFORMANCE TEST.

The performance test involves the planting of parts of each selected individual head in separate rows in such a manner that the several contestant heads will be grown under equal conditions of moisture and plant food. Certain factors must be considered in the selection of the land and the planting and growing of the test. The following is a detailed statement of directions for operation:

Select a uniform piece of land, approximately 4 x 20 rods in size. Exercise care to select a level piece of land that is uniform in fertility and that has had similar previous cropping and treatment.

Plow and cultivate this land uniformly throughout the season and, if fertilizer is applied, the application should be made uniformly throughout, distributing it the long way of the area.

Number the selected heads from one to 100 or more and fasten the numbers to the head secured as foundation stock, so as to identify the good heads after the performance test has been made.

Mark off the rows three feet apart, running them the short way of the area. Remark the long way of the area so as to secure cross marks three feet each way.

Plant the first row, every tenth row throughout the block, and the last row to general seed of the variety from which the individual heads were selected. These rows at intervals across the block will serve to determine and account for any soil variation in the block.

Plant single rows four rods long from each of the selected heads, in numerical order, putting aside the reserve head with its number attached, in a tin vessel where it can be protected from moth, weevils and mice. Sprinkle liberally with moth balls.

Space the plantings in all rows eighteen inches apart, that is, plant hills on the cross marks and between each cross mark, using three or four seeds to the hill. If care is used to separate the seed in the hill, thinning may be done with ease after the seeds have germinated.

When the plants are well up, thin to one plant to the hill by hand, using a sharp pointed knife or hoe to uproot the small plants.

The field should receive clean cultivation.

Harvest the heads from each row separately and weigh them, recording the number of pounds as the yields of the respective head numbers. Record also the yield of the first, last, and each tenth row throughout the test planted from general seed.

When this performance test is completed and the record yield of each head secured, the reserve seed from the best yielding head or heads can be planted separately in isolated patches the next year for increase seed. The performance test has enabled the discarding of all but the best strain or strains, which represent high producing races and need only be increased in quantity. If more than one strain is retained, care should be exercised to keep them well separated so as not to allow crossing, as the best will be contaminated by the inferior ones.

SUMMARY OF PROCEDURE.

A very brief summary of procedure as outlined in this paper is as follows:

A. Selection of Foundation Stock.

The selection of foundation stock is necessary regardless of whether the grower intends to proceed by mass selection, as outlined in B following, or by individual plant selection, as outlined in C.

B. Mass Selection Use of Foundation Stock.

(1) By mixing foundation stock heads and planting in general seed patch the first year as select seed.

(2) By testing separately the foundation stock heads and mixing seed of only the best yielders for planting select seed patch the succeeding year.

C. Individual Plant Selection Use of Foundation Stock.

By testing separately foundation stock heads, and retaining the best one or two separately as pure strains, as outlined under "Performance Test" in the body of this paper.

D. Combination Use of Mass Selection and Individual Plant Selection.

First year: Plant performance test and save reserve seed.

Second year:

(a) Plant reserve from heaviest yielding head in performance test in isolated patch.

(b) Thresh the heads from the three or four rows from performance test and use seed for planting ten or fifteen acres in general crop.

Third year:

(a) Plant the reserve seed increase secured second year under (a) in an isolated seed patch. This seed should plant two or three acres.

(b) Plant the whole general crop from the increase seed obtained second year under (b).

Fourth year:

(a) Plant the entire general crop from the reserve seed patch planted third year under (a).

(b) Discard seed grown from general crop third year.

This process allows the farmer within four years' time to secure a strain of grain sorghum known to be a high producer, and at the same time have available during the intervening years selected seed superior from the beginning to the common field run seed.