THE CORRELATION BETWEEN THE LENGTH OF PARENT HEAD AND YIELD OF PROGENY, IN SUCCESSIVE GENERATIONS OF BLUE-STEM WHEAT (Minn. 169)

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It has long been a custom among cereal breeders and others to select seed wheat from the largest, finest looking heads. Such a custom may have had its foundation in the successful results attained by these earlier wheat growers, many of whom were more successful than those who give less attention to the art of selection.

All the present paper intends to give is the results of a line of experiments dealing with one narrow phase of selection, namely, the correlation between length of mother-head in wheat and yield of progeny.

Without going into great detail concerning the manner of planting, the original plants from which mother-heads were selected in 1912 were produced under as nearly identical conditions as possible. This was done in order that differences of length of central spike in the various plants might be due to hereditary differences in the plants, if possible, and not to accidental causes. At the close of the

season of 1912, selections of mother-heads for planting in 1913 were taken, all coming from the central stocks of the several mother plants.

Head rows were planted in 1913 and alternate order of long and short heads was preserved. At the close of 1913 the head rows thus planted were harvested and threshed separately and weights taken of the several yields. In the several years following 1913 similar plantings of head rows were continued with seed taken directly from the head rows of the year before, this latter seed being selected in bulk, that is, without making any continuous selection along the original line of long spikes versus short spikes.

Obviously the question involved here might be that of whether the original selection of mother-heads on a basis of length could give rise to strains which, being preserved, could be depended upon to effect yield in the generations following. Another way of stating the question might be whether or not yields of wheat may be modified in any way by making selections on a basis of length of head within a pure line.

The head row plantings started as has been described in 1912 were fairly successful, except that they were destroyed by rust in the year 1914. The experiment was not destroyed by seed accident, however, sufficient seed having been retained for replanting in 1915. The results for each year were calculated by the method of computing the correlation between the length of original mother-heads in centimeters and the yields of the progeny expressed in grams. The correlations thus calculated will be put down for the several years as follows:

(These computations were made by Professor W. E. Lattin, of the Department of Mathematics, South Dakota State College.)

1913 :r=0.17 + or − 0.04
1915 :r=0.02 + or − 0.04
1916 :r=0.03 + or − 0.06
1917 :r=0.03 + or − 0.06
1918 :r=0.07 + or − 0.59

It will be observed from the several numerical correlations as put down above that the selection of longer mother-heads gave a slightly higher yield in comparison with the shorter mother-heads for the first year after selection, namely, 1913. It is evident, however, that even this slight increase due to the selection of longer heads did not persist in the succeeding years. It seems logical to conclude that, at least for the conditions of this experiment, it is impossible to depend upon any mere method of selecting the longest mother-spikes for securing increased yields of wheat.

Attention is called to the very early work of Hallett in England. Hallett believed that various spikes not only had different powers for yields but insisted further that the several kernels within a given head varied from one another in yielding power. He did not discuss "pure lines" from a technical standpoint but he evidently believed that it would be possible to make improvements in any direction by selection within a "pure line." Hallett may be said to be the originator of head row methods of breeding. The importance of "pure lines" was emphasized by Johannsen and the use of "pure lines" has been the basis of all wheat breeding for many years.

The results of the present experiment are in no wise out of accord with many scientific conclusions. There may be several possible explanations outside of actual heredity. The increased yield resulting from the longer spikes in the first generation may be one of the several "fluctuations" observed by Johannsen. For instance, it is possible that the kernels of the longer heads were larger or heavier than those from the smaller heads, which in the present instance may be called the result of mere chance. It is generally accepted that large, heavy kernels yield a better crop, other things equal, than correspondingly small, light ones. Various researches might be cited along that line but they need not be discussed further until further statistical results are available.

REFERENCES

The following may be classified as among the number that are of interest to students of wheat, with reference to improvement by selection; also with some bearing upon the present subject:

"The Small Grains"—Carleton. M. M. Co. Chapters on: Cereal Improvement—Selection, p. 179; Hybridization, p. 207.

"Principles of Breeding"—Dean E. Davenport, University of Illinois. Ginn & Co. Correlation, p. 453.

"Breeding Cereals"—Professor C. A. Zavits, Ontario Agr. College, Guelph. American Breeders' Assoc. Vol. 1, p. 118. With Oats: "The selection of each of the following years was from the product of the selected seed of the previous years ..... In the crop of 1905 it was found that large, plump seed produced 65.5 bushels, and the light seed 44.7 bushels."

"Some Correlated Characters in Wheat"—Dr. T. L. Lyon, University of Nebraska. American Breeders' Assoc. Vol. 1, p. 29. Discussion of Relation of Size of Head to Yield, and Tillering, p. 37: "It is quite evident from these tables that the number of heads on a plant is more important in determining its productiveness than is the size of the heads, and that, although the kernels are larger on plants having large heads, they are not necessarily so on plants producing the greatest weight of grain." This statement apparently relates to given plants, rather than to relation between plants and their progeny.

"Methods for Testing the Seed Value of Light and Heavy Kernels in Cereals"—E. G. Montgomery, Proc. Am. Society of Agronomy, Vol. 2, p. 59-69.

"Variations in the Plants from the Same Head of Wheat"—Ewart. Journal of Agriculture, Victoria, March, 1916. "The germination is most rapid in the grains of the 16th row from the top and ..... the average rate of germination decreased toward the base and apex of the head."

"Does the Value of a Wheat Grain Depend on Its Position in the Ear?" Richardson and Green, Journal of Agri-

culture, Victoria, March 1916. "The weight of the individual grains may be described as following the shape of the ear, the grains increasing in weight from either extremity to the middle of the ear." .... "4. The results justify the practice often recommended of rejecting the upper and lower portions of the ears and grading the remainder, when applying mass selection to wheat for an improvement in yield."

"Relation of Size of Seed and Sprout Value to the Yield of Small Grain Crops." T. A. Kiesselbach and C. A. Helm. Nebraska Experiment Station, Bulletin 11. "When space-planted to permit maximum development a higher individual plant yield is obtained from large than from small seeds. When planted in equal weights at the rate of optimism for the large seed, all three grades—large, small and unselected—yield equally. As an average for all investigations, large and small seed yielded alike, and the unselected seed yielded one per cent more than the large. This also seems to be a matter of rate planting. The shortage in yield of plants from small seeds is overcome by planting a greater number of seeds."

"Wheat Experiments"—C. G. Williams, Ohio Experiment Station, Bulletin 298, Section, "The Relation of Weight of Kernel to Yield," p. 463. "As a result of both of these tests it seems to be apparent that heavy kernels may be expected to give larger yields of wheat than light kernels, if the differences in weight of kernels are large enough; certainly is this true in pure lines, and possibly in a mixed population. However, in the use of ordinary varieties screened and separated by wind blast, no important differences are likely to be secured."