Effectiveness of Visual Selection Upon Yield in Oat Crosses

K. J. Frey

EVERY plant breeder uses selection indices in one form or another. Statistical selection indices show the relative weight that should be assigned in a selection program to each character according to its economic value and heritability (2, 6, 9). Another type of selection index universally used by plant breeders represents a “mental picture” of the desirable attributes that a variety should possess. The statistical selection index is advantageous because it is somewhat mechanical, whereas visual selection is best limited to use by experienced plant breeders who have formulated specific ideal types. In practice plant breeders follow either a combination of the two procedures or only the visual method in variety selection work.

This paper compares the yields of lines from visual selection in hybrid oat populations with the grain production of random selections when selection is practiced in different generations and based upon varying sample sizes.

LITERATURE REVIEW

After 3 generations of mass selection for large head and seed size and well-filled heads in bulk barley populations, Atkins (1) found that the selected strains yielded only 1 bushel per acre more than the unslected bulk population. This yield advantage was associated with increased height and later maturity. In soybeans, Weber (11) selected groups of desirable plants from hybrid populations spaced at intervals of 1, 4, and 8 inches in rows 40 inches apart. The mean yields, heights, and lodging scores of the 3 groups were approximately equal when corrected for maturity.

The effectiveness of visual selection for improving combining ability for yield in corn is controversial. Sprague and Miller (10) found no evidence that visual selection improved yield, whereas Wellhausen and Wortmann (12) and Osler et al. (8), working in Mexico, obtained significant improvement in combining ability for yield and ear and plant appearance by using this technique. In the latter study the mean increases of the yields of S, over those of S, lines were 4.4, 6.8, and 9.0 bushels per acre when the original source materials were derived from crosses of local x local, local x introduced, and introduced x introduced inbred strains, respectively. The Mexico studies indicate that the level of adaptability of the germplasm in the original population may influence the effectiveness of visual selection.

MATERIALS AND METHODS

In 1954, three hundred F₂ seeds from each of 2 oat crosses (C40 and C45) were planted at 1-foot intervals in rows 3 feet apart on a highly productive Clarion-Webster soil type on the agronomy farm at Ames, Iowa. The F₂ planting of each cross was divided into 3 sections, each with approximately 100 plants; and shortly before harvest time, good selections were tagged in one section, random selections in the second, and poor ones in the third. No single criterion or plant character was used in classifying the F₂ plants. The good selections were vigorous, had many large panicles and, in general, were phenotypically desirable in all aspects. The random ones were chosen by drawing random numbers. The poor plants selected normally would have been discarded. The number of selections in each category of the 2 crosses is given in Table 1.

When ripe, the F₂ plants were harvested individually and threshed and the seed from each plant was sown in 1955 to increase the quantity of seed for use in subsequent tests. In 1956 the 75 selected strains, plus 6 check varieties, were planted in a 9 x 9 triple lattice design with 3 replications. Plot size was 4 rows, 8 feet long with a 1-foot spacing between rows. The 2 center rows were harvested for yield. Date of heading was recorded when 50% of the heads in a plot were completely emerged. Plant height was the number of inches from the ground surface to the panicle tips, and bushel weights were taken on the bulked grain from the 3 replications. The 1956 season was extremely dry and unfavorable for oat production; top yields were only 45 bushels per acre. The test was repeated in 1957, a year that was favorable for high oat yields.

The second part of the study compared the effect of progeny sizes upon the efficiency of visual selection. In the winter of 1955–56 approximately 100 F₂ plants from each of 27 F₂ derived lines from C45 (4 good, 14 random, 9 poor) and 20 from C40 (8 good, 6 random, 6 poor) were grown in the greenhouse. Twenty-five of the 100 plants of an F₂ derived line were harvested individually and the seed from the other 75 plants was bulked. In 1956, seed from each greenhouse single-plant selection was planted in a 2-foot row, all 25 selections from an F₂ derived line being grown contiguous. Perpendicular and adjacent to the head rows, a single row was sown with 25 spaced seeds representing the same F₂ derived line from which the head rows were derived. The source of seed for the spaced plants was the bulked seed lot from the greenhouse grown material; thus, both head rows and spaced plants were in the F₂ generation.

Six progenies were derived from each F₂ derived line, represented by 3 plant rows and 3 spaced plants. From each F₂ derived line in group I, 3 good plants and 3 good rows were retained; from each F₂ derived line in group II 1 random and 2 desirable plants and rows were saved; and from each F₂ derived line in group III the poorest and 2 good plants and rows were retained. This procedure allowed a comparison of the effectiveness of visual selection when the sample size differed; i.e., a single plant vs. a row containing approximately 40 plants. In each family in group II the random row and plant selections were made first and then good rows and selections were made. In two cases the random and good selection were the same row or plant and the data collected on one entry were used in both categories. Because the quantity of seed from a single plant was insufficient for yield testing, the seed from each single plant and row selection was planted for seed increase in 1957.

The yielding abilities of lines within F₂ families were compared in 1958 with each cross in a separate split-plot experiment where

1Journal Paper No. J-4094 of the Iowa Agricultural and Home Economics Experiment Station, Ames, Project No. 1176. In cooperation with the Crops Research Division, ARS, USDA. Received for publication Apr. 20, 1961.

2Professor of Farm Crops, Agronomy Department.