MASS selection for the improvement of corn undoubtedly dates back to the time when this crop was first domesticated, and selection within open-pollinated varieties was a common practice prior to the concept of hybrid corn. The development of many better-adapted regional strains can be attributed to successful selection by farmers and plant breeders. However, late in the first quarter of this century the widespread belief that a plateau had been reached and that selection for yield in adapted varieties was no longer effective became prevalent among the breeders. About that same time the spectacular results obtained with inbreeding and hybridization in corn were announced and the entire corn breeding effort was soon turned in that direction. Although it was several years before hybrid corn actually replaced open-pollinated varieties on the majority of farms, little was done after 1925 to evaluate mass selection for yield. Yet the thought that mass selection for yield was ineffective prevailed.

Recently recent work at the North Carolina and the Nebraska Experiment Stations has indicated that relatively large amounts of additive genetic variance for yield exist in open-pollinated varieties of corn. Selection among single plants or among progenies, therefore, should be effective in improving the yield in all of the varieties investigated. These results suggested that the effectiveness of intra-variety selection should be thoroughly re-examined. A mass-selection program was initiated at the Nebraska Station in 1955 with the object of improving yield in an adapted variety. At the same time, a decision was made to study the effect of recurrent thermal neutron irradiation of the seed of the same open-pollinated variety together with mass selection as a possible procedure in corn improvement. The purpose of this paper is to report the results of this research.

LITERATURE REVIEW

As pointed out by Sprague (23) critical information on the effectiveness of mass selection is almost completely lacking in the literature, but there is considerable indirect evidence to indicate that mass selection may have been reasonably effective in modifying yield of grain. A modification of mass selection called ear-to-row or ear-row breeding was initiated by Hopkins (3) at the Illinois Experiment Station in 1896 and was used experimentally for 25 years at many agricultural experiment stations. Smith and Brunson (22) studied the effect of ear-to-row breeding on yield and used as their control a mass-selected composite from the original foundation stock. Each year they selected enough "good seed ears" from "standing corn" to plant an isolated field of several acres of the control the following year. After 10 years of selection and testing, they concluded that mass selection (picking seed ears from standing stalks in the field) is just as effective in improving yield as ear-to-row breeding and that "by continuous mass selection the yield of a well-adapted variety of corn can be maintained and perhaps somewhat increased." The linear regression coefficients calculated suggested an increase by either method of about 3.4 bushels per year; however, it is impossible to separate genetic trends from environmental trends in the data. The station strain of Reid Yellow Dent, also included in the experiment for comparison, showed an average annual increase of 3.3 bushels per acre. Although the authors do not indicate how the Reid Yellow Dent strain was maintained, they imply that it remained constant genetically. If so, little genetic progress in yielding ability or productivity is indicated by these data.

At the Nebraska Station, Montgomery (14) reported a gain of 9 bushels per acre from the first few years (1903-1907) of ear-to-row breeding, but for data for the years 1911 to 1917 reported by Kiesselbach (8, 9) indicated no difference between the original Hogue's Yellow Dent and the ear-to-row selection. Williams and Welton (24) of the Ohio Station found that 18 of 20 selected strains yielded more than the parent stock. Increases ranged from 1 1/2 bushels to 11 bushels per acre. However, most breeders (2, 6, 8, 9, 13, 16, 17, 22) found ear-to-row selection ineffective in increasing yield, and in 1922 Rice (16) summarized the various published investigations and concluded: "It seems probable that the yield of an entirely unselected or standard corn can be improved by a few years of intelligent ear-to-row selection. However, in view of the expense, the uncertainty with which larger yields have been obtained, and the small increases secured during a series of years in the most favorable cases, so far there appears to be little to recommend ear-to-row breeding as a practical method of corn improvement."

Although selection for yield seems to have been ineffective in most instances, selection for chemical characters, grain protein and oil (3, 20, 25), and for morphological characters, plant height, ear height, and number of internodes (21) has been quite effective. Since it was known beyond doubt that considerable genetic variance existed in open-pollinated varieties of corn, mass selection and ear-to-row breeding seemed theoretically sound, based on the breeders' limited knowledge. Why then did the early corn breeders have so little apparent success in improving yield? A possible explanation was provided by Hull (4, 5) who suggested that the genetic variance in such populations is largely nonadditive, in most instances, selection for chemical characters, grain protein and oil from the syn-2 to a more advanced generation were reported. But selection becomes ineffective when the equilibrium point has been reached.

The studies on inbreeding and hybridization led to such striking results that other methods of corn improvement were abandoned when Jones (7) suggested the use of the double cross for commercial production in 1918. Lonnquist's (10) more recent work with recurrent selection, however, indicates that progress by selection and ear-to-row selection. Williams and Welton (24) of the Ohio Station found that 18 of 20 selected strains yielded more than the parent stock. Increases ranged from 1 1/2 bushels to 11 bushels per acre. However, most breeders (2, 6, 8, 9, 13, 16, 17, 22) found ear-to-row selection ineffective in increasing yield, and in 1922 Rice (16) summarized the various published investigations and concluded: "It seems probable that the yield of an entirely unselected or standard corn can be improved by a few years of intelligent ear-to-row selection. However, in view of the expense, the uncertainty with which larger yields have been obtained, and the small increases secured during a series of years in the most favorable cases, so far there appears to be little to recommend ear-to-row breeding as a practical method of corn improvement."

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