Morphological Variations at Different Stages of Growth in Normal, Cytoplasmic Male-Sterile, and Restored Versions of Zea mays L.¹

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Material sterility is associated with the formation of little or no pollen and shriveled anthers. Other morphological differences between normal and male-sterile maize plants are reduction of stalk length above the ear, individual internodes, and tassel culms in male-sterile plants (4). Shortening of internodes in the mature plant is not always sequential and certain internodes of the sterile version may be longer than those of the corresponding normal version. The restored version is erratic in its expression. Usually, the tassel culms are not shortened but the number of internodes above the ear is reduced. Jones (6) also noted a reduction in the tassel culm in male-sterile corn but not in restored versions. He believed that pollen reduction had something to do with the shortening of the internodes.

Some morphological differences associated with male sterility in other plants were described in a previous paper (4). Male sterility also has been found to reduce plant height significantly in male-sterile sweet corn plants and in sterile × restored hybrids (5). Since height to the top ear in these plants was not affected, shortening resulted from reduction of the stalk above the ear. Nonsignificant differences were obtained for length of time to 50% silking within lines. However, the interaction among the crosses was significant. Allard (1) observed complete correlation between male sterility in lima beans and a seedling abnormality which caused shorter plants, but the sterile plants eventually exceeded the normals because of longer vegetative growth. These two characters were thought to result from pleiotropy or linkage but more likely the former. An association in Oenothera crosses (8) existed between pollen breakdown, and leaf width and color. Corolla characters and sterility were related in an interspecific Nicotiana cross, but could not be distinguished between pleiotropic effects and linkage (10). Tsai (2) reported that male-sterile flue-cured tobacco grew slower, flowered later, and had fewer buds and suckers per plant than the fertiles. Males from crosses of Triticum durum and Aegilops ovata had considerably shorter culms than normals accentuating the differences. Heading time was also observed in male-sterile with Aegilops ovata cytoplasm (9).

These investigations have described the morphological differences associated with male sterility. However, when these effects first become evident has not been investigated. Thus, this study was initiated to determine when the morphological differences between normal and restored versions within several inbred lines of maize become evident during plant development.

MATERIALS AND METHODS

Developmental morphological studies were made on cytoplasmic male-sterile, and restored (in sterile cytoplasm) versions of 5 inbred maize lines (CI21, Mp313, Mp317, Mp444, and Mp466). The sterile versions in Texas cytoplasm had been backcrossed 8 to 12 generations. The sterile versions in Texas cytoplasm had been backcrossed 6 to 8 generations and selfed to homozygosity. Each line was grown as a group with each version grown as blocks from which 15 to 20 randomly-selected plants were selected at each stage of development.

The study of pre-anthesis morphological variations at a reference point. Meiosis (M) was taken as this point. Meiosis was occurring without destroying the plant. The external morphological characteristic was selected in the latter manner. The nodes on all young plants were counted from the scutellum and the fifth leaf punched since the lower leaves died in meiosis when an anther from the longer set of anthers in the middle of the tassel was in Metaphase I or II of meiosis was found, the node location and the internode measured. The tassels were excised, fixed in 3 percent acetic acid and examined for meiosis. The time in meiosis when an anther from the longer set of anthers in the middle of the tassel was in Metaphase I or II of meiosis was found, the node location and the internode measured. These two characters were thought to result from pleiotropy or linkage but more likely the former. An association in Oenothera crosses (8) existed between pollen breakdown, and leaf width and color. Corolla characters and sterility were related in an interspecific Nicotiana cross, but could not be distinguished between pleiotropic effects and linkage (10). Tsai (2) reported that male-sterile flue-cured tobacco grew slower, flowered later, and had fewer buds and suckers per plant than the fertiles. Males from crosses of Triticum durum and Aegilops ovata had considerably shorter culms than normals accentuating the differences. Heading time was also observed in male-sterile with Aegilops ovata cytoplasm (9).

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¹ Contribution from the Crops Research Division, ARS, USDA; and the Mississippi Agricultural Experiment Station, State College, Mississippi. Published as Journal Paper 1164 of the Mississippi Agr. Exp. Sta. Received July 23, 1964.
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