

3. Cytoplasmic male sterility: Influence of environment on degree of sterility.

The fact that environment may affect the degree of pollen sterility in cytoplasmic male sterile maize has been noted by several workers (Josephson and Jenkins, 1948; Rhoades, 1931; Rogers, 1952; and Stringfield, 1953). In all of these cases, however, only one source of sterility has been observed at a time in the various environments, and in most of the cases the effect was not reproduced.

In the course of a routine survey of sterilizability of various inbred lines when crossed on A (USDA) and T (Texas) cytoplasmic male sterile inbreds, a pronounced and regular variation in sterility has been reproduced in two successive years by growing the material in three widely different locations. In any one complete season, the same single crosses (about 30 in 1951-2, and 50 in 1952-3) were grown (1) near Homestead, Florida, in the wintertime; (2) in a greenhouse at Des Moines, Iowa, in the wintertime; and (3) in the field at Johnston, Iowa (near Des Moines in the summertime).

It was found that: (1) certain crosses were entirely fertile and others were entirely sterile no matter where they were grown. (2) Crosses falling in the intermediate group (partially sterile) were most strikingly affected by changes in the environment. (3) Partial steriles in T cytoplasm shed: (a) the greatest amount of fertile pollen when grown in the greenhouse, (b) the least when grown out-of-doors at Johnston, and (c) slightly more pollen (but much less than in the greenhouse) when grown in Florida in the winter time. (4) Partial steriles in S cytoplasm shed the greatest amount of fertile pollen when grown in Florida in the wintertime and shed little, if any, more pollen in the greenhouse than when grown out-of-doors at Johnston. (5) When partial steriles grown in any one location were ranked (by cross) in order of increasing fertility, roughly the same ranking (on a different level of pollen fertility) could be made when these crosses were grown in either of the other two locations.

The conditions in the three locations which were responsible for differences in pollen fertility are not known. However, several possible causes may be ruled out. For example: (1) Day length would appear to have little effect on T Steriles, since Florida (10-12 hrs.) and Johnston (13-15 hrs.) gave nearly the same effect. (2) Light intensity would not seem to have a marked effect on S steriles, since greenhouse (weak light) and Johnston (summer sun) gave about the same results.

In a second experiment, several partially sterile crosses, both S and T, were grown in two fields near Johnston, located about a mile apart. One field was highly fertile, and well watered; the other field was sandy, low in nitrogen and potassium and the corn ran low on water and nitrogen before tasseling. Both fields tasseled at about the same date.

Both S and T crosses showed an increase in number of exerted anthers (although not usually an increase in amount of fertile pollen per anther) when grown on the low fertility field, as compared to the high fertility field. This resulted in a small increase in actual amount of fertile pollen

shed. The increase was not nearly so great as that induced by the greenhouse for T-steriles, nor that induced by Florida for S-steriles.

In this second experiment, one can rule out variable effects of temperature, light intensity, humidity and day-length, leaving for consideration such variables as nitrogen balance and internal water supply in the plants.