Cross-Breeding in Wheat, *Triticum aestivum*. I. Frequency of the Pollen-Restoring Character in Hybrid Wheats Having *Aegilops ovata* Cytoplasm

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INTERACTIONS of cytoplasm and chromogenes in the inheritance of characters continue to be of interest to taxonomists, geneticists, and plant breeders. The modification of plant characters by exchanging the cytoplasm of one species, subspecies, or variety for that of another has been reported in numerous cases. Outstanding examples of cytoplasmic influence on plant characters are found in the Gramineae, and probably more reports will be forthcoming.

Distribution of pollen-restoring chromogenes is of primary interest in economically important crops that have shown cytoplasmically influenced sterility. This is especially true where the substituted cytoplasm does not interact with the chromogenes to produce adverse side effects and where cross pollination results in hybrid vigor.

In effecting practicably useful mass natural cross pollination in wheat, pollen sterility and restoration induced by cytoplasmic-genomic interactions appear necessary. Application of these genetic interactions could lead to improved breeding methods or to hybrid seed production which could prove valuable in the future improvement and production of wheat.

The initial phase of investigating hybrid seed production in wheat has centered around the cytoplasm of *Aegilops ovata*. The present paper deals with the fertility action of a number of hexaploid wheats in hybrid combination with a cytoplasmic male-sterile hexaploid wheat having *Ae. ovata* cytoplasm.

The first report of cytoplasmically influenced sterility in the Hordeae tribe was made by Kihara (6) in substituting the nucleus of hexaploid wheat into the cytoplasm of *Aegilops caudata*. In the backcrosses into *Aegilops caudata* cytoplasm, Kihara obtained some wheat-like types having one *Ae. caudata* chromosome and 70% pollen fertility. He associated partial pollen fertility with the *Ae. caudata* chromosome. Kihara made no mention of late-maturity accompanying the male-sterile interaction of *Ae. caudata* cytoplasm and wheat chromogenes.

Fukasawa (2) substituted *Triticum durum* genomes into an *Aegiloticum* which had *Aegilops ovata* cytoplasm and obtained male-sterile plants. When Fukasawa used *Ae. ovata* as the female in crosses to *Triticum durum* cytoplasm, pollen infertility, chlorosis, and late maturity resulted. The cytoplasmic male-sterile interaction in many of the tetraploid wheats in hybrid combination with a cytoplasmic male-sterile hexaploid wheat has centered around the cytoplasm of *A. caudata*.

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**MATERIALS AND METHODS**

The cytoplasmic male-sterile hexaploid wheat, male-sterile Nr 26, used in the present study was a vigorous type obtained from H. Fukasawa of Japan. Its pedigree was *Aegilops ovata* (Ae. ovata) -- *Triticum durum* (T. durum) -- *Aegilops ovata* -- *Triticum durum* -- *Agrilton compactum* (A. compactum) -- *Triticum aestivum*, variety Norin 26.

A considerable number of winter and spring wheats were obtained for use as pollen parents in crosses to the male-sterile Nr 26. Male-sterile and pollen parents were grown in 6-inch clay pots in the greenhouse, and the male-sterile plants were hand pollinated with each variety. A total of 124 different hybrids were produced.

The hybrids and some winter wheat pollen parents were grown in the greenhouse in June 1959, and the first spring wheat hybrids and winter wheat backcrossing were completed by following October. Also, some of the winter wheat hybrids were planted in the field in the fall of 1959 and wintered. The winter wheat hybrids were backcrossed and the F1's from greenhouse hybrids used in the fall were started in the vernalization chamber in November and transferred to the greenhouse in January, and the F1's from backcrosses and F2's determined during the spring of 1960.

Fertility of the F1, BC1, and F2's was determined from pollen stained with iodine, of anthers, and of seed set.

**EXPERIMENTAL RESULTS**

Most of the hybrids were completely male-sterile (Tables 1 and 2). Sterility (S) was characterized by having extruded stigmas, shriveled anthers, and aborted pollen (Figure 1).

Two spring wheat hybrids (Table 1) showed fertility (SF). The later spikes on these plants were male-sterile, but the first one or two spikes that emerged had 10 to 25% seed set. These slightly fertile spikes were determined fertile and sterile segments, with the fertile part of the spike nearly always fertile. Pollen fertility of the earlier section of spikes was 25 to 50% stainable. Cytological data on C.I. 8454 (Table 1) indicates this fertile condition is heritable.

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