

tinguishing among cytoplasm. If it is true that variegation is more frequent in the WF9 S steriles, this would mean that the normal and sterile cytoplasm differ not only in their effects on pollen viability, but also in the cytoplasmic factors whose response to a WF9 nucleus produces the chlorophyll abnormality. Also, there is some indication of differences in the response of cytoplasm A - H. In short, it is suggested that the relative frequency with which cytoplasmically inherited plastid alterations occur in the presence of a WF9 genotype may be used as a criterion for characterizing different cytoplasm. This is only a speculation, and further investigation is needed to establish the validity of this approach.

Harry T. Stinson, Jr.

#### 4. The origin of cytoplasmic sterility in maize.

So far all of the many different sources of cytoplasmic male sterility or pollen abortion fall into two distinct groups which we have designated S and T. These two plasmatypes together with the usual cytoplasm, which may be called the M type, found in most of the cultivated maize varieties commonly grown throughout the world, form three distinct classes of cytoplasmic differences. Their classification is based on their interaction with fertility restoring genes. It is possible that these cytoplasm originated in the different species that are considered to have had a part in the development of cultivated maize. These are the primitive pod corn or pro-maize described by Mangelsdorf, *Tripsacum* (gama grass) and *Euchlaena* (teosinte). Mazoti has shown that chlorophyll genes that are aberrant in maize cytoplasm are normal in teosinte cytoplasm. This is evidence that teosinte cytoplasm is different from that of *Zea mays*.

If this conjecture should be borne out by more complete evidence it would show that cytoplasmic differences are permanent over very long periods of time and that they are more important in the origin and separation of species than is generally realized.

Donald F. Jones  
Harry T. Stinson, Jr.

#### 5. The performance of restored-sterile hybrids.

Many double crossed hybrids made on sterile seed parents with various non-restoring and restoring pollinators have been compared in yield, time of maturity, and stalk quality. The results are given in our annual corn report (Conn. A. E. S. Progress Report G1, 1960). Where natural restoring inbreds are used with either normal fertile or sterile inbreds as pollinator single crosses, the final double crosses are equal in performance in all characters measured. The actual ratio of fertile and sterile plants in percent is 56:44 where the pollinator is fertile  $\times$  restorer and 58:42 where the pollinator is sterile  $\times$  restorer. The excess of fertile plants in both cases is probably due to minor modifying factors.

Twelve different double crosses were made with restoring pollinators nearly alike in genotype but differing in plasmatype. One series is a normal fertile inbred  $\times$  a restored sterile inbred. The other series is the sterile version of the same inbred by the same restored sterile inbred. In both series the segregation of fertile and sterile plants is practically the same; 47:53 in the normal  $\times$  restored sterile, and 46:54 in the sterile  $\times$  restored sterile. In both series there is a slight excess of sterile plants. The excess of steriles in this series and an excess of fertiles in the other is probably due to residual gene differences in the different inbreds used for the sterile seed parents and restoring pollinators. For practical purposes the differences are not important since adequate pollen production is supplied in both series.

It is important to note that in all of these experiments where a heterozygous T restoring gene is acting in either T cytoplasm or in M cytoplasm there is no selective action determining the survival of either the dominant or recessive gamete as in the case with S restorers in S cytoplasm.

In another series of double crossed hybrids three types of pollen parent single crosses were compared, all crossed on the same sterile seed parents. One group was made with the original non-restoring inbreds with no restoration. In another group one inbred was sterile and the other a restored sterile version of the same inbred as used in the first group, giving approximately 50 percent of the plants shedding pollen. In the third group both of the inbreds had been converted to restored sterile versions. This group gave all plants shedding pollen normally. The restored sterile inbreds had been backcrossed four times and then selfed three times.

In all cases the three groups were closely alike in days to silking and in percent of moisture in the grain at harvest. However, in yield of grain and percent of plants erect at harvest the 50 percent restored version of the same hybrids were significantly lower. From this evidence it appears that four generations of backcrossing are not enough to change an inbred to pollen restoration without altering performance in other characters. Yield of grain was reduced less than erectness of stalk. This may be due to the source of the restoring gene which was Ky21. This inbred has good yielding ability but poor stalk quality. Evidently some of the linked genes determining stalk breakage have not been eliminated in the backcrossed plants.

In this experiment where the same hybrids were restored to 100 percent pollen fertility (both pollinator inbreds converted to pollen restoration) yield of grain was the same in one and above in two of the combinations. In these cases the other restored inbred evidently brought in additional genes for yielding ability. But in all three of these fully restored hybrids stalk quality was reduced.

Donald F. Jones

#### 6. Recurrent selection for pollen restoration and yield performance.

In three widely used inbreds a program of selection in test crosses is underway for pollen restoration and ability to yield with proper maturity and equal or better stalk quality. The procedure is to cross the T sterile version of the inbred by a good restorer source and then backcross on to the sterile inbred for enough generations to recover the inbred type and then self for several generations to obtain homozygosity for the necessary pollen restoring genes as shown by progenies that are all normal in pollen production. During this process selection is also made for the desired maturity, stalk quality, disease and insect resistance, and other agronomic characters.

As soon as the lines are reasonably well converted to type and appear to be suitable for use as pollinators they are then further selected by test crossing. In some cases selections are made while the lines are still segregating for pollen restoration. Selected individual plants in each progeny are self-pollinated and crossed on to a suitable sterile single cross seed parent. These 3-way test crosses are then grown and scored for pollen fertility, time of flowering, stalk quality, grain quality and yield. The selfed inbreds giving both good fertility and superior performance are then composited, either by intercrossing by hand pollination or by bulking and growing in an isolated plot. Further selections from these composites are again tested. The inbreds being selected in this way at the present time are C103, Hy and Kr.

Donald F. Jones