1. Control mechanisms of cytoplasmic male sterility.

Variations in the degree of pollen sterility for the cytoplasmic sterile type in maize are quite common. Jones has reported that cytoplasmicly controlled male sterile lines originally isolated in Texas by Rogers and Mangelsdorf are far more stable in maintaining nearly complete sterility in crosses than are sterile lines from three other sources. These other sources include the selection of Jenkins, a South American isolate of Brieger, and a line selected from Plant Introduction material at the Connecticut Station.

The question arises as to whether or not these various cytosterile lines represent an identical basic plasmagene control. It is presumably possible that varying concentrations of the same cytoplasmic inclusion result in variations of good pollen produced. However, a second possibility exists. These lines may represent related but distinctly different forms of the plasmagene for cytosterility. Jones has noted (Conn. A.E.S. Bul. 550) that "the Brazilian type of Dr. Brieger produces much pollen under Connecticut conditions. No completely sterile progenies have so far been obtained. Indeed, when crossed with C142, a long inbred and very uniform line of California Rice Pop, it produced from 20 to 50% pollen on all plants. This same pollinator, C142, on KysT4 (Texas Sterile) inbred produced no more than 1% pollen on two plants". Although limited in plant numbers involved, the results suggest a potency difference of the plasmagene.

More extensive tests were carried out in 1951. The inbreds Wis.W9, Minn.A71, and Ky21 were utilized as sources of pollen restorat ion. The first two inbreds are considered to be weak restorers while the latter inbred is a strong restorer. Pollen samples from se veral plants from individual rows of the three restorer type inbreds we re mixed. These three pollen mixtures were used at random on three sterile inbreds -- two USDA steriles, Ind.P8^{S5} and the Wf9^{S5} and the third a Texas sterile, I205^{t4}. Table I illustrates the kind of pollen production obtained from progeny of each of the nine original single crosses.

These data indicate that a disproportion in plasmagene concentration could well account for the variations between the F_1 pollen productions of (Ind.P8^{S5} x Wis.W9) and (Ind.Wf9^{S5} x Wis.W9) as well as the other comparative crosses involving Ind.P8^{S5} and Ind.Wf9^{S5}. Hnwever, the picture while not entirely critical in the case of restorer crosses with the I205^{t4} sterilizer, points to a distinct change in plasmagene action (and perhaps potential). It is seen that Wis.W9, MinnA71, and Ky21 restore normal pollen production to Ind.P8^{S5} and Ind.Wf9^{S5} in rather proportional amounts. However, two of these restorers, Wis.W9 and Minn.A71, show no restoration potency in combination with I205^{t4} while Ky21 returns I205^{t4} to practically normal pollen production. In fact, the amount of good pollen produced by the cross (I205^{t4} x Ky21) is greater than that shown by the cross (Ind.Wf9^{S5} x Ky21). Logically, some element beyond simple concentration effect is indicated. This fact may well be of great practical importance in evaluating commercial crossing fields of cytoplasmicly [sic] male sterile inbreds and single crosses. Certainly, knowledge of the source of the plasmagene and its response in varying hybrid combinations will aid immensely in determining which inbreds or selections

with inbreds facilitate the practical application of this form of pollen sterility as a by pass to the detasseling process.

One other limited experiment was conducted last summer: Since pollen production of some restored single crosses such as (Ind.P8^{S5} x Ky21), (I205^{t4} x Ky21), and (C106^{t4} x Ky21) is restored to normal, > 95% or 95% good pollen, it is highly probably that some of these functional pollen grains no longer carry the dominant allele of the restoration gene. It has been shown by Jones that restored plants when selfed will segregate in a 3:1 ratio in F_2 progenies; hence, the sterilizing element, or at least a precursor of the element, is still present in restored plants. Crosses of restored plants onto a normal fertile inbred were made in this way:

$$C106_m \times (C106^{t4} \times Ky21)_h$$

Progeny of several such crosses were examined for evidences of cytoplasmic sterility. If the dominant restorer conditioned all pollen to function independently of the presence of the sterilizing plasmagene and independently of the dominant allele for restoration, certain pollen grains should carry the sterilizing effect over into the progenies observed. Table 2 presents the results from these and clearly indicates that the sterilizing plasmagene transmitted with any great frequency -- if at all -- through stored pollen grains. Fluctuations shown in Table 2 are greater than that which might be expected in any comparable sample from normally fertile material. The cause for a few plants with reduced amounts of normal pollen would likely be environmental upsets, however, these plants have been selfed and their progenies will be examined further.

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CYTOPLASMIC STERILITY

Test for Uni - or Multi Particle Control

Source of Sterility ♀		Source of Restoration ♂ Wis. W9	Minn. A71	Ky21
Ind. P8^{S5} USDA	% Good Pollen	49.1% *	34.4%	94.5%
	Range	5 - 75	1 - 90	90 - >95
	No. Plants	29	25	32
Ind. Wf9^{S5} USDA	% Good Pollen	6.6%	11.8%	82.6%
	Range	< 1 - 20	< 1 - 90	10 - 95
	No. Plants	27	28	27
Iowa I205^{t4} Texas	% Good Pollen	0%	0%	91.3%
	Range	0 - 0	0 - 0	50 - >95
	No. Plants	21	26	31

* Drawings indicate type of Pollen Produced - Iodine test.

Table 2.

Test Crosses: $C106_{m}$ x $(C106^{t4}$ x $Ky21)_{h}$

Summation

*Amount Good Pollen	> or 95%	90%	80%	60%
Cross I	40	1	1	0
Cross II	14	1	0	1
Cross III	26	2	0	0
Cross IV	26	3	0	0
Totals	106	7	1	1

*Iodine Test.

Grand Total = 115