Dear Prof. M. Feldman.

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A PRELIMINARY ANALYSIS ON CENTROMERE TRANSPOSABLE CONTROLLING ELEMENT IN WHEAT

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Transposable controlling elements were discovered by McClintock in maize more than 30 years ago, it turned out that they also existed in other organisms such as fruit fly and yeast. However, no report has been made about common wheat, except for soybean and A. majus in high plant. Based on the extensive observation of the genetic behaviour possessed double ditelosomics of Chinese Spring, this article focuses on a possible centromere transposable controlling element in wheat in comparison with that transposable element system formulated by McClintock. Even when maize lines are phenotypically devoid of a particular transposable element, but on several occasions the activated elements have appeared in the progeny of plants that had undergone "genomic stress" (McClintock, 1978). In this statement, the genomic stress was caused by chromosome breakage which resulted either from radiation or breakage-fusion-bridge cycle caused by rupture of dicentric chromosome during anaphase (McClintock, 1950; Peterson, 1953). The fusion and rebreakage of chromosome provides a possibility for recombinant fragment and unstable mutation associated with a specific transposable element. If the element is a DNA insertion sequence in substance, then the regulation of the insertion of the DNA sequence is dependent on the breakage-fusion-bridge cycle, which is supported by following observations. 1. Abnormal synapsis of prophase of meiosis. In conventional viewpoint, D.D. series which is produced simply by centromere misdivision are genotypically same as their origins so that they have no genetically difference from Chinese Spring. However, we found that at zygotene chromosome synapsis is characterized by homoeologous pairing through unpaired loop and overlap range (Fig. 1, 2), and especially univalents resulting from asynapsis or desynapsis were frequently found at zygotene or pachytene (Fig. 3), this aberration was mainly caused by chromatide premature individualization; chromosome chain formed by trivalent or multivalent ring by the linkage between short and long arms and two short arms terminal pairing with heterochromatin globules were also observed, all that implies the centromere misdivision which has activated the newly formed centromere so that they have the capability to self-transpose, cutting and fusion (Fig. 4, 5 and 6). 2. Features at metaphase 1. (1) A large number of terminal chiasma and open ring chromosome were observed (D.D. 5D). A typical inversion homozygote bivalent (IH) and a ring chromosome formed by a short arm chiasma bivalent from terminalizalion and long arm terminal pairing were also found. (Fig. 7, 8). Chiasma terminalization can be caused either by the fast movement of the chiasma to the top of a chromosome or by the direct terminal pairing instead of normal pairing. Prokker (1943) pointed out that the synapsis mutation of rye was that chiasma was formed not on the long arm as in the normal plant but on the short arm, probably the function of cell division was disodered, which may contribute to the rapid short arm pairing and thus the long arm can't realize pairing for the wrong time order. (2) At this time a great structural change of chromosome has been found in D.D. 5D (Fig. 9), that shows the formation of a small global dark-black heterochromatin body from the malfunctional chromosome. In addition, because the spindle fibers have not been formed, a C-blocked meiosis caused by metaphase arrest may be in process (Fig. 10). 3. Breakage-fusion-bridge cycle in D.D. series. Because of the fact that D.D. series originally have the dicentric

chromosome, they provide a varied feature at anaphase, in Fig. 13-1, D.D. 1A has a two-chromatin bridge formed by dicentric short and long arms, in D.D. 2B (Fig. 13-2) presents a single bridge with the other arm being a lagging semivalent; Fig. 13-3 provide a rebreakage of a chromosome bridge and the new telochromosome begin to form in D.D. 5B. It should be noted that in D.D. 5D the chromosome bridge is formed at anaphase 2. From the above, we can assume that break-fusion-bridge cycle and manipulation of centromere misdivision probably are the mechanism for the chromatin bridge resulted from the inversion or reverse tandem duplication, and this situation is basically same as maize double Ds in which a 2Kb-inversion sequence is present, it could produce U-shaped dicentrics and acentrics in sister-strand exchanges by pairing of inverted sequences. Concerning Di-3Bl, B-genome displays a collectively lagging phenomena, which implies that the movement of B-genome is influenced by the regulation of Di-3Bl. The lagging of chromosomes fragments definitely cause chromosome lossing or partial deletion, which is exactly the same as that of the loss of part Ds DNA being responsible for the altered chromosome breakage pattern. 4. A preliminary analysis for a possible transposable element in wheat. (i) In our experiment, phenotypical change was also found, such as the expression of spelta head among the successive progenies from those D.D. 5D. We assume that Chromosome 5D may be an allele of "Q" gene carried by 5A. and centromere misdivision of D.D. 5D may activate the allel so that it can be expressed, especially in the progenies of D.D. 5D spelta mutation, square head was expressed again indicating that these changes of ear pattern are neither chromosome deletion nor gene mutation (its frequency only 10^{-4}), but a chromosome aberration. (as Fig. 14). (2) Fig. 15 shows two monosomics at metaphase 1 in D.D. 5A. But no one individual of monosomic 5A had been obtained in D.D. 5A self-progenies since 5 years ago. The univalent (if any) formed by two telochromosomes again has a centromere misdivision and thus the stable heredity of D.D. maintained. The similar is in D.D. 5B and 7B. We can conclude that centromere misdivision is the major way for division in D.D. series, and chromosome behaviour is characterized by breakage-fusion-bridge cycle, which are similar to those characteristics of Ds5933 and Ds6233 in maize. Therefore, we can assume that: Centromere misdivision and given D.D. line mainly constitute a possible transposable element system in wheat, and in this system activator and dissociation element are supposed to be combined into one element, but a complicated one may be further developed.

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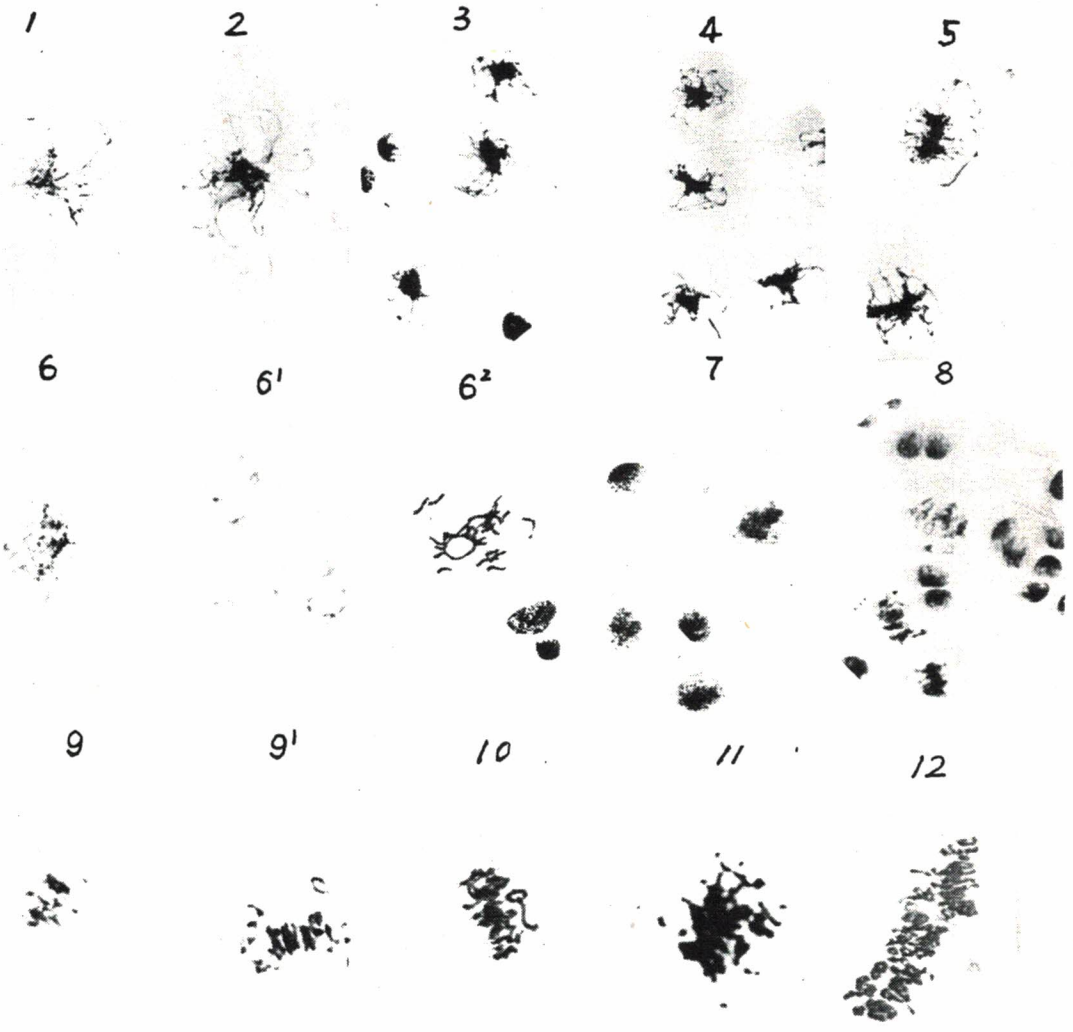
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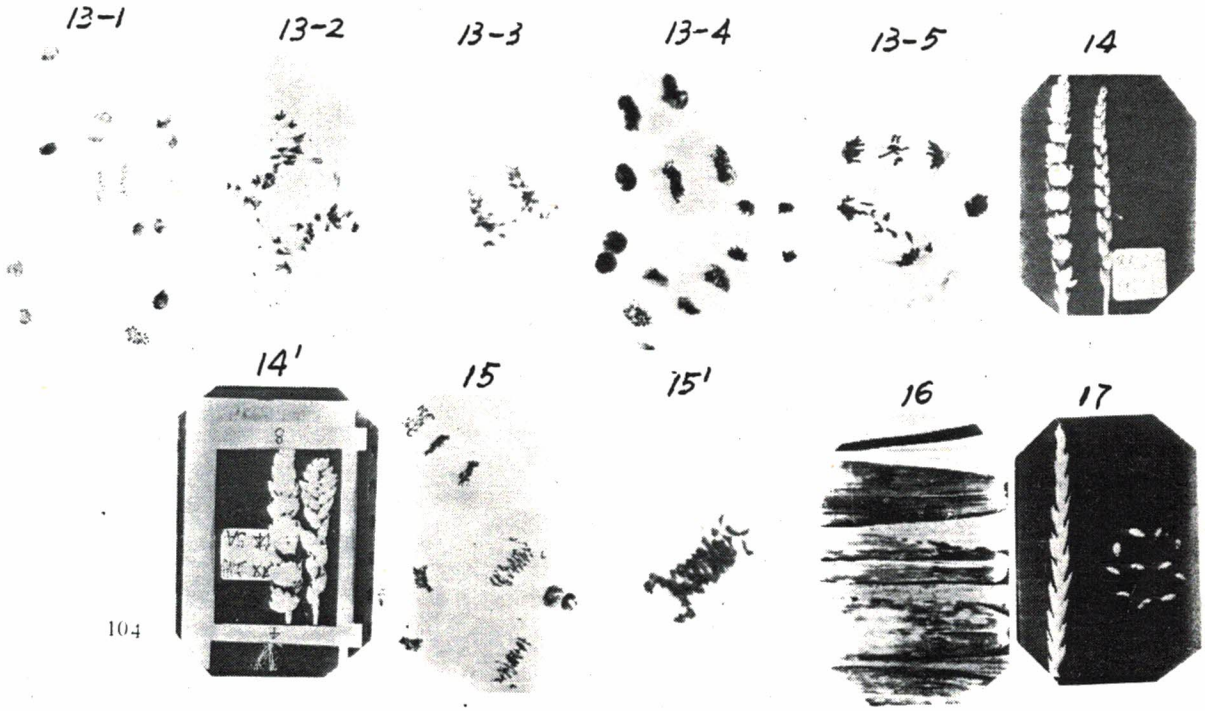
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