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IN BRIEF

Transposon Trouble: Macrotransposition and Chromosome Remodeling in Maize

Transposons were first recognized by their ability to generate chromosome breaks and now are implicated in many genome changes, including fluctuations in genome size, inversions, translocations, deletions, and duplications (reviewed in Feschotte and Pritham, 2007). At the single-gene level, transposons produce mutations, both on insertion and excision, and can capture and rearrange gene fragments. All this variation can spell trouble for the host genome but may also produce adaptive changes in gene coding sequence and regulation. Cut-and-paste transposons are particularly adept at producing rearrangements because their transposition mechanism produces double-stranded DNA breaks. Linked pairs of related transposons cause even more rearrangements through alternative transposition reactions where transposase reacts with the ends of two different transposons. Depending on the orientation of the elements, this can produce chromosome breakage, deletions, inversions, and other rearrangements. The ability of linked transposons to undergo macrotransposition, that is, mobilization of both transposons and the host sequences in between, has been proposed to contribute to breakdowns in synteny but is difficult to capture experimentally.

Huang and Dooner (pages 2019–2032) examined the results of alternative transposition reactions, starting with a maize line containing two linked transposons in direct orientation. The first transposon is a *Ds* element inserted in the *bronze* (*bz*) locus. This mutation is not stable, as the *Ds* element can be excised by transposase from the second element, an *Ac* 6.5 kb away. To identify rearrangements, the authors screened for *bz* mutants that had become stable. Genetic tests showed whether or not the transposons had moved, and a carefully designed set of PCR reactions, followed by DNA gel blots and sequencing, showed whether the region had been rearranged. Not surprisingly, the majority of the rearrangements isolated were imprecise transposon excisions or excisions coupled with deletions, all of which can generate a stable *bz* phenotype. More interestingly, a stable *bz* phenotype could be produced by macrotransposition of a fragment containing the two transposons and the host sequences in between. In this screen, several such events were isolated: these contained an excision of the macrotransposon, and several also had a reinsertion of the macrotransposon, usually at a closely linked site. The latter group showed a stable *bz* phenotype, as excision of the macrotransposon removes part of the *bz* locus, but they retained the transposon-mediated propensity for chromosome breakage (see figure). This novel mobilization of host genes by macrotransposition adds another mechanism to the toolkit by which transposons restructure the genome.

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Chromosome breakage causes formation of colorless sectors in the kernel. Rearrangements showing different chromosome breakage activity levels (**[A]** to **[C]**). Chromosome with excision of both transposons, showing no breakage activity **(D)**.

REFERENCES

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Huang, J.T., and Dooner, H.K. (2008). Macrotransposition and other complex chromosomal restructuring in maize by closely linked transposons in direct orientation. Plant Cell **20:** 2019–2032.

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