Balanced Tertiary Trisomics for Use in Hybrid Seed Production

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The successful commercial production of hybrid seed depends on a reliable and economical source of male sterile individuals to serve as the female parent of the hybrid. Balanced tertiary trisomics with genetic recessive male sterile genes as markers can provide a female parent for commercial production of hybrid seed in certain crops.

Balanced tertiary trisomics are tertiary trisomics set up in such a way that the dominant allele of a marker gene, closely linked with the interchange break-point, is carried on the extra chromosome; and the recessive allele is carried on the two normal chromosomes that constitute the diploid complement. The dominant marker allele may be carried on either the centromere or the interchanged segment of the extra chromosome.

The breeding behavior of balanced tertiary trisomics in barley is illustrated in Figure 1. Such trisomics will produce 3 types of functional female gametes and only 1 type of functional male gamete. A spore with the interchanged chromosome alone is deficient for a chromosome segment and will abort. An extra chromosome is rarely transmitted through the male because of slower development of microgametophytes containing an extra chromosome. Most of these undergo division of the generative nucleus much later than haploid microgametophytes; often as late as anthesis. Only three types of plants are expected in the self progeny of balanced tertiary trisomics: diploids recessive for the marker gene; primary trisomics recessive for the marker gene; and balanced tertiary trisomics dominant for the marker gene.

In barley, the two normal chromosomes disjoin preferentially; thus, few spores that abort or that result in primary trisomics are produced. Also, there is lowered transmission of the extra chromosome through the eggs. The typical progeny of a selfed balanced tertiary trisomic in barley consists of about 30% balanced tertiary trisomics and 70% diploids, with less than 1% primary trisomics.

When a genetic recessive male sterile gene is used as the marker, all functional pollen produced by the balanced tertiary trisomic carries the male sterile allele; and all diploid plants produced by selfing the balanced tertiary trisomic are male sterile. Chromosome segments on both sides of the break-point of the extra chromosome are not transmitted through the pollen and are not included in the diploid self progeny; thus, these segments are available for carrying informational genes that aid in the identification of diploids and balanced tertiary trisomics. These facets of the breeding behavior of balanced tertiary trisomics make available a number of possibilities for their use in the commercial production of hybrid seed.

Two types of seed production fields will probably be required when balanced tertiary trisomics are used in hybrid seed production by the trisomic, sufficient wind pollination, and it also assumes feasibility of the system. Such a system is illustrated in Figure 2. The trisomic would be marked, on either the interchanged segment, with a dominant marker character, such as red plant color. All balanced trisomics would be male fertile and dominant reciprocal diploids would be male sterile and recessive for the marker gene produced by the balanced tertiary trisomic. The male sterile allele and the green plant color in the self progeny of such a trisomic would be used in an isolation block. Diploid plants in the block recessive for the plant marker, and all seed set produced male sterile diploids in the next generation. Diploid plants would be harvested separately, and seed produced on them would be used to plant the isolation block.