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1. The production of new A-B translocations by crossing over with reciprocal A translocations.

The A-B translocations first produced by Roman have been very useful tools in genetic studies. In spite of their obvious usefulness, no new A-B translocations have been induced since Roman's initial series. This is probably due, in part, to the immense amount of work necessary to induce, isolate, and characterize such translocations. A theoretically possible alternative means of producing new A-B translocations is through crossing over between an A-B translocation and a reciprocal A translocation. We have results which seem to indicate that we have succeeded in producing several new A-B translocations in this way.

In one instance, TB-1b and T1-2c (carrying sr_1) were involved. TB-1b has its break point at 1S.05 and the break points of T1-2c are at 1S.77 and 2L.33. Plants carrying TB-1b were pollinated by homozygous T1-2c plants. It is important that the crosses be made with the A-B translocation plants as females. If they are used as males, non-disjunction will give F_1 plants that are hyperploid for the chromosomal segment translocated to the B centromere. Such hyperploid segments will pair together most of the time instead of pairing with the 1-2c translocation, and thus, the necessary crossover will not be possible. If the cross is made with the A-B translocation plants as female, there will only be one B^1 chromosome present and it will thus be forced to pair with the 1-2c translocation. The pairing expected in the F_1 is shown in Figure 1. A crossover anywhere in chromosome one in the region distal to the TB-1b break point and proximal to the break point of T1-2c will produce an A-B translocation that will consist of the short arm of chromosome one from S.05 to S.77 and the distal 2/3 of the long arm of chromosome two. Such a crossover followed by adjacent I segregation will produce a balanced gamete with the new "hybrid" TB-1S, 2L.

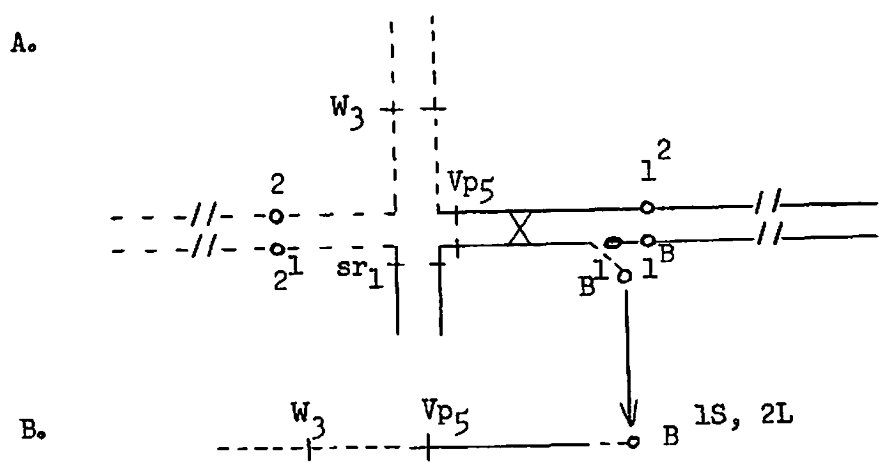

Figure 1. Expected chromosome pairing in plants heterozygous for TB-1b and T1-2c (A) and new A-B translocation produced by crossing over (B). (Gene loci discussed in the text are indicated. Positions are only approximate.)

To test for the production of such a new A-B translocation, the F_1 plants were used as pollen parents in crosses with plants carrying $\underline{w}_3$. This is a white endosperm albino-viviparous mutant located well out on the long arm of chromosome two. If the new A-B translocation was produced by crossing over, non-disjunction of the B centromere should result in the appearance of some $\underline{w}_3$ mutants on the test ears. If the deficient sperm fertilized the polar nuclei, and the hyperploid sperm fertilized the egg nucleus, white seeds will be produced with dormant embryos that give green seedlings. The reciprocal fertilization would give yellow seeds with albino-viviparous seedlings.

In tests made last summer, 8 ears were found that had white-dormant and/or yellow-albino-viviparous seeds. There were a total 51 white-dormant seeds with the number per ear ranging from 1 to 14. Approximately half of these have been planted in the greenhouse for our winter planting and these have all given green plants. There were a total of 16 yellow-albino-viviparous seeds found on these 8 ears with the number per ear ranging from 1 to 6. These figures probably do not represent the total number of deficient (hypoploid) embryos since $\underline{w}_3$ is not always viviparous. Thus, it is expected that some of the dormant yellow seed will give albino seedlings also. Theoretically, when the plants from white seeds (hyperploid plants) are selfed or sib pollinated, most of the F_2 offspring that are homozygous for the normal chromosome arrangement will also be homozygous for $\underline{w}_3$ which is carried on the normal chromosome. The remaining offspring will be heterozygotes or homozygotes for this complex rearrangement. Thus, most of the surviving plants with normal pollen will be homozygous for this new A-B translocation.

Another translocation T1-2_{4464} (1S.53, 2L.28) heterozygous with TB-1b was tested on $\underline{w}_3$ stocks with results similar to those for T1-2c. Translocation T1-2_{5376} (1L.77 and 2L.08) in combination with TB-1a (1L.20) when tested on $\underline{w}_3$ stocks also produced dormant-white seeds.

In order to determine if similar results could be obtained when a different A-B translocation and a different gene locus were involved, the combination of T2-3_{6270} (2S.46, 3L.60) and TB-3a (3L.10) was tested against the white endosperm albescent gene found near the end of the short arm of chromosome two. In these tests, a total of 21 dormant white seeds were found. Five of these were planted in the greenhouse and all gave green plants.

The four reciprocal A translocations used in these preliminary tests were chosen so that there would be a long distance between the A-B translocation break point and that of the reciprocal A translocation. This was done to provide the maximum possibility for crossing over. Because of the long distance involved, there is a considerable piece of the chromosome arm involved in the parent A-B translocation still present in the new "hybrid" translocation. Thus, when these "hybrid" A-B translocations are used to locate unplaced genes, a positive test will mean it is carried on one or the other of the two segments involved. However, if the parent A-B translocation used to produce the new "hybrid" A-B translocation does not uncover the gene, then it must be in the segment transferred to the B centromere by crossing over. Now that it appears that such "hybrid" A-B translocations are possible, reciprocal A translocations can be selected that will minimize the amount of the original chromosome arm incorporated in the new A-B translocation.

Not only would such hybrid A-B translocations be useful in placing new genes to chromosome arms not previously covered by A-B translocation, but they could be utilized to subdivide the regions of the present A-B translocations. If a new hybrid A-B translocation is tested with a gene that is uncovered by the original parent A-B translocation, the new A-B translocation will only uncover the gene if it is proximal to the break point of the reciprocal A translocation involved. For example, vp_5 is uncovered by TB-1b. Crossover studies have shown it to be very close to the break point of T1-2c. If it is proximal to this break point, then the "hybrid" A-B translocation produced by crossing over with this translocation will still have attached to the B centromere the segment of chromosome one which carries the vp_5 locus. Thus, vp_5 should be uncovered by the new "hybrid" translocation. However, if vp_5 is proximal to the break point of 1-2c, the vp_5 locus will be carried in the 2^1 chromosome and it will not be uncovered by the new translocation.

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2. Additional data on the genetics of TB-9b.

In last year's News Letter I reported upon the segregation in plants hyperploid for TB-9b (i.e., $9\ 9^B B^9 B^9$). Hyperploid plants with the genetic and cytological constitutions shown in Figure 1 were pollinated by pollen from homozygous c sh_1 wx plants.

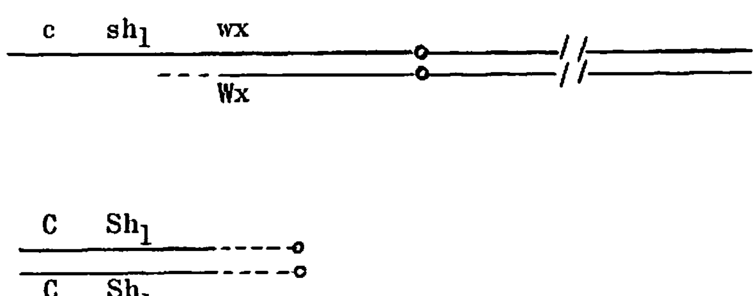

Figure 1. Genetic and cytological constitution of embryos of plants hyperploid for TB-9b.

Table 1 summarizes the testcross data and a suggested cytological configuration and genotype for each testcross phenotype observed.