

Trisomic analysis in barley

aa = mutant with unknown chromosome location

Procedure:

- Cross the mutant to 7 different primary trisomic stocks of barley
 - ✓ The genotype of non-critical trisomics for the gene of interest will be AA
 - ✓ The genotype of critical trisomic for the gene of interest will be AAA

Trisomic analysis in barley

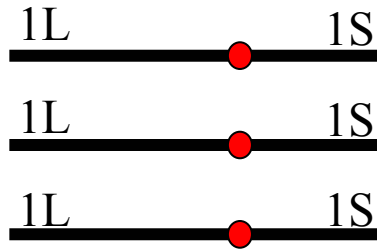
Procedure:

- Identify the trisomic progeny of the cross by root tip chromosome count
 - ✓ The genotype of trisomic F_1 for non-critical trisomics for the gene of interest will be Aa
 - ✓ The genotype of trisomic F_1 for critical trisomic for the gene of interest will be AAa

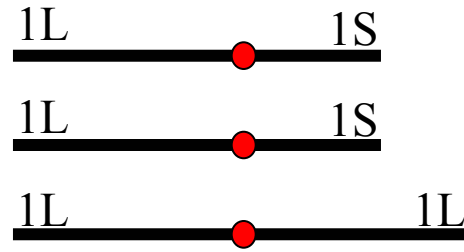
Trisomic analysis in barley

Procedure:

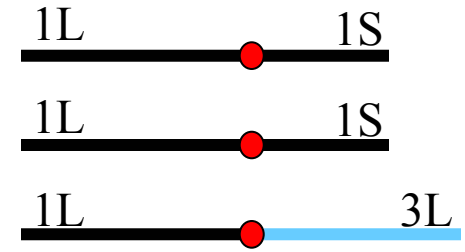
- With 33% transmission of $n+1$ gametes through the female, 0% transmission of $n+1$ gametes through the male, and no double reduction
 - ✓ The gene will segregate **3 dominant :1 recessive** phenotypes in F_2 if it is not located on the trisomic chromosome
 - ✓ The gene will segregate **25 dominant :2 recessive** phenotypes in F_2 if it is located on the trisomic chromosome



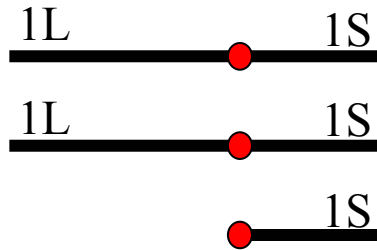
Primary trisomic



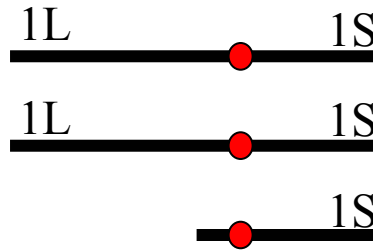
Secondary trisomic



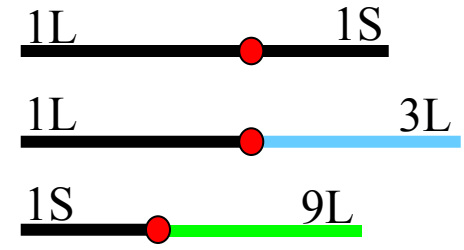
Tertiary trisomic



Telotrismatic



Acrotrismatic



Compensating trisomic

Transmission of the extra chromosome from trisomic plants

A $2n+1$ plant would be expected to produce n and $n+1$ gametes with equal frequency, but 50% $n+1$ gametes is rarely achieved.

Factors responsible for reduced transmission of $n+1$ gametes through the female include:

1. Elimination of the extra chromosome during meiosis due to lagging or misdivision of a univalent
2. Megaspore replacement
3. Reduced viability of $n+1$ spores or gametes relative to n gametes
4. Subnormal development of $2n+1$ zygotes
5. Poor and delayed germination of $2n+1$ seeds
6. Reduced vigor of $2n+1$ seedlings
7. The effect of genetic background (degree of tolerance of genetic imbalance)

Transmission of the extra chromosome from trisomic plants

Male transmission of the extra chromosome is usually extremely low relative to female transmission.

Factors responsible for reduced transmission of $n+1$ gametes through the male include:

1. All the factors that reduce transmission of the extra chromosome through the female probably affect male transmission in a like manner
2. The ability of $n+1$ pollen to compete with n pollen may be reduced since $n+1$ pollen may:
 - a. Mature later than n pollen
 - b. Produce slow growing pollen tubes
 - c. Produce defective pollen tubes
 - d. Fail to germinate
 - e. Fail to complete post-meiotic stages of microsporogenesis due to genetic imbalance of the nucleus

Genetic ratios expected from trisomic segregation

- ✓ Three genotypes are possibly in disomic individuals considering two alleles at a locus:
 - AA homozygous dominant
 - Aa heterozygous
 - aa homozygous recessive
- ✓ Four genotypes are possible in trisomic individuals considering two alleles at a locus:
 - AAA triplex
 - AAa duplex
 - Aaa simplex
 - aaa nulliplex
- ✓ Genetic ratios of factors located on trisomic chromosomes will be different from the ratios of genes on disomic chromosomes.
- ✓ Ratios will be further modified by low transmission of $n+1$ gametes through the pollen in addition to the trisomic condition.
- ✓ Genetic segregation ratios of trisomic individuals are a means of locating genes to chromosomes and establishing independence of linkage groups.

Genetic ratios expected from trisomic segregation

Trisomic segregation from a selfed duplex (AAa)

Assume:

1. No double reduction
2. 25% transmission of $n+1$ gametes through the female
3. 0% transmission of $n+1$ gametes through the male

		Pollen	
		2A	1a
25% n+1	1AA	2AAA	1AAa
	2Aa	4AAa	2Aaa
75% n	3 x 2A	12AA	6Aa
	3 x 1a	6Aa	3aa

2 AAA
 5 AAa
 2 Aaa
 12 AA
 12 Aa
 3 aa

33 A_ : 3 aa
 or
 11 A_ : 1 aa

The deletion stocks of common wheat

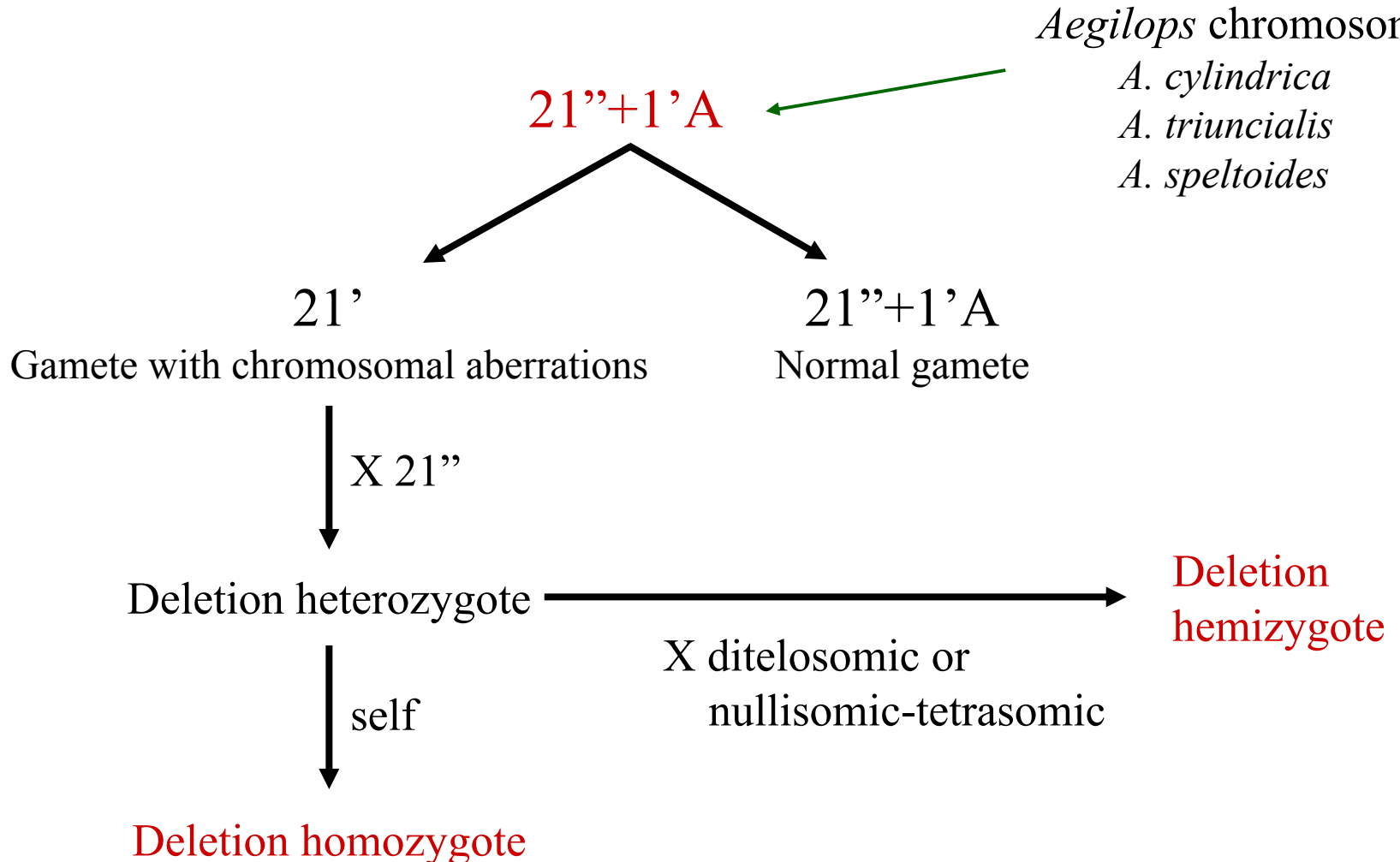
Endo & Gill

Aegilops chromosome

A. cylindrica

A. triuncialis

A. speltoides



The deletion stocks of common wheat

Endo & Gill

Chromosomal location of some genes:

- 2AS deletions were highly sterile, with many univalents forming during meiosis
→ Gene(s) controlling meiotic pairing must be located between 2AS-5 and 2AS-7
- 5AL deletions had speltoid spikes
→ The speltoid suppressing gene, *Q*, is located close to the 5AL-7 breakpoint
- Some 5BL deletions were highly male sterile
→ The pairing homoeologous suppressor gene, *Ph1*, is located between 5BL-11 & 1
- 6BS deletions showed severe pistilloidy
→ Gene(s) controlling the transformation of stamens into pistil-like organs reside on 6BS
- Deletions on 4AL, 7AS and 7DS showed absence of waxy protein
→ Granule Bound Starch Synthesis (GBSS) genes are located between 4AL-6 & 14, 7AS-12 & 1, and 7DS-2 & 3

The deletion stocks of common wheat

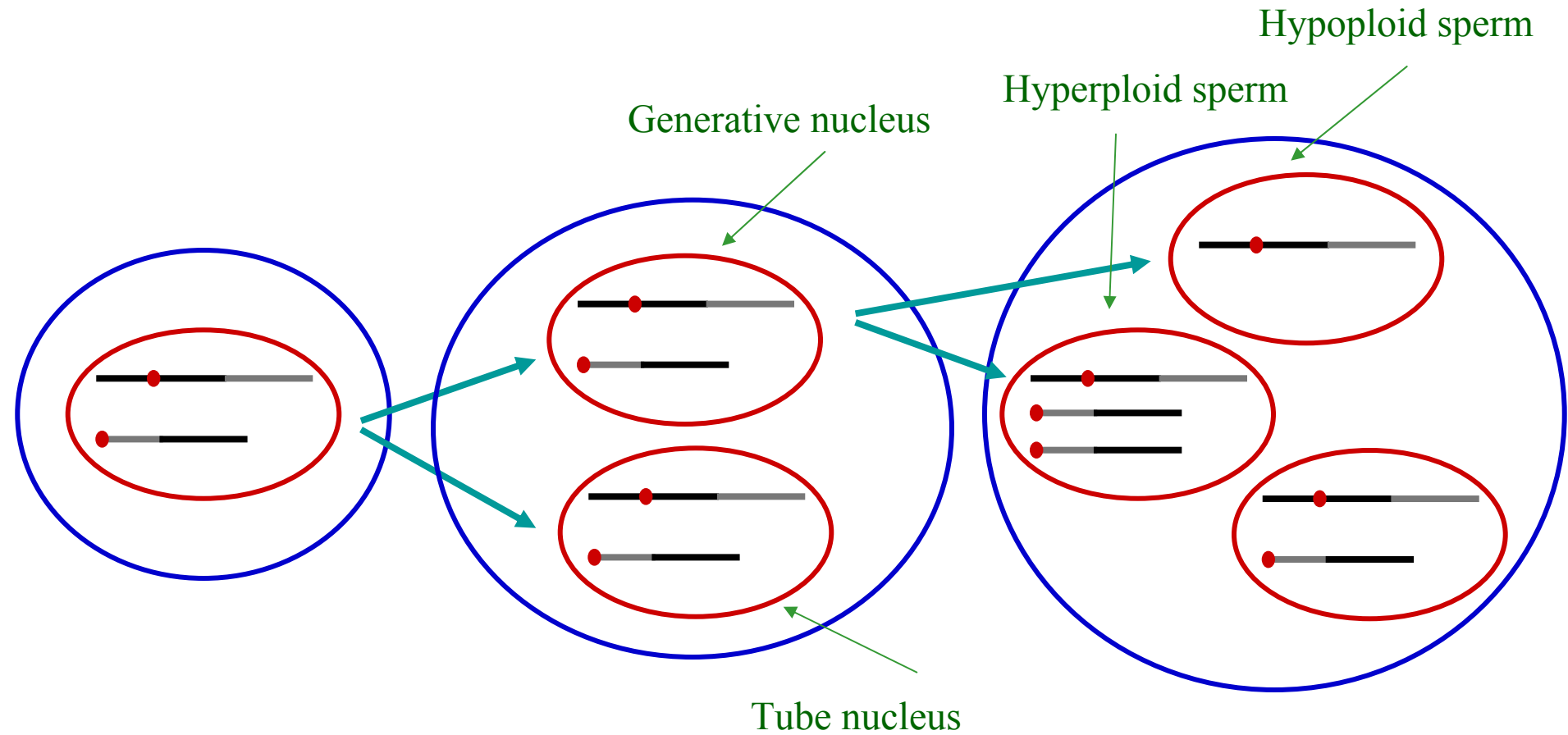
Endo & Gill

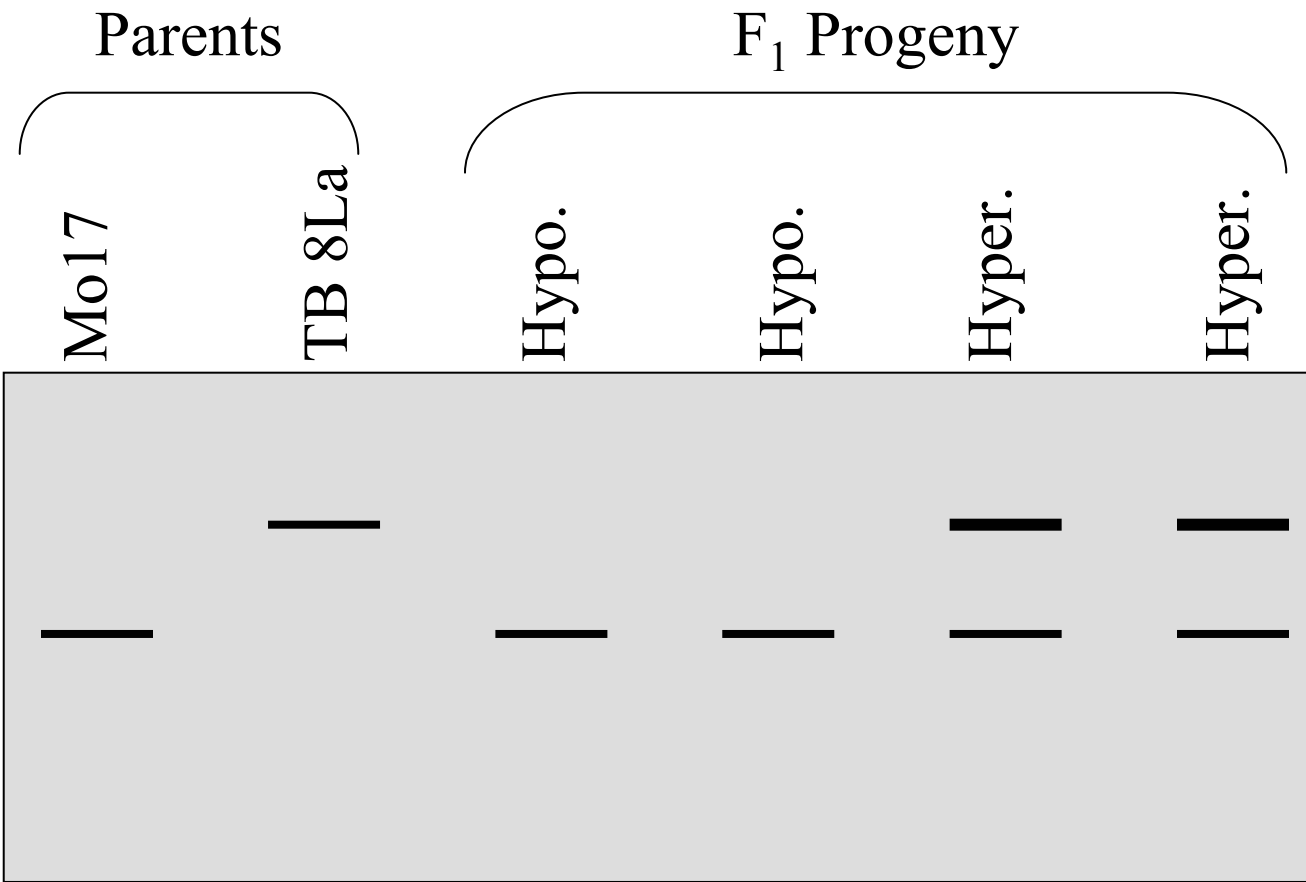
Distribution of deletions:

1. Distribution of deletions among A, B and D genomes corresponded well to their relative size
2. Among homoeologous groups, among chromosomes, and among chromosome arms, the chromosome size and breakage frequency are not correlated positively
3. Most of the hot spots of breakpoints seemed to occur at the junctures of heterochromatic and euchromatic regions
4. Deletion stocks are valuable not only in locating genes and sequences to chromosome regions but in relating the physical map to the genetic linkage maps

Mapping of RFLP loci in maize using B-A translocations

Weber & Helentjaris





Mapping of RFLP loci in maize using B-A translocations

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1. Identification of the short and long arms of each chromosome on the RFLP map
 2. Identification of the chromosomal regions which contain the centromeres on the RFLP map
 3. Greater correlation of this RFLP map with the cytological and conventional genetic maps
- B-A translocation mapping requires polymorphism
 - However, no analysis as to the relationship between the physical and genetic linkage maps were performed