Lecture title: Calculating the number of gametes produced from multi allele genotypes

Lecturer Affiliation: ***Rasha Jamal Al Dein,*** *BSc, MSc, PhD*

Lecturer, Department of Public Health

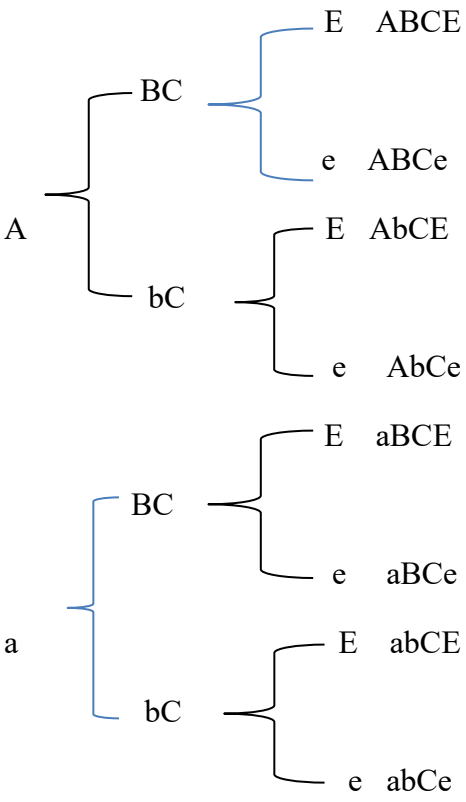
College of Veterinary Medicine, University of Mosul, Mosul, Iraq

https://orcid.org/0009-0008-6739-5461

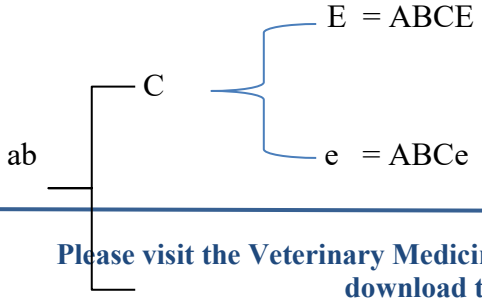
Solution2:

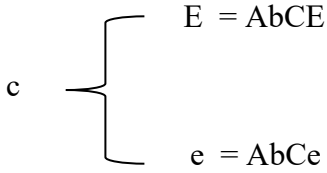
Gametes number produced by the genotype **AaBbCCEe** are $= 2^3 = 8$

Gametes structure:



aabbCcEe $= 2^2 = 4$





Pleiotropic effect of genes (Gene interaction)

The action of gene at cellular level is unitary i.e., one gene one action. But some genes produce a broad spectrum of phenotypic changes, so that a gene has multiple action. This is called **pleiotropic so** one gene is influencing two different characters.

LINKAGE AND CROSSING-OVER

During meiosis, a pair of synapsed chromosomes is made up of four chromatids, called a **tetrad**. The phenomenon of a **cross - over** occurs when homologous chromatids in the tetrad (one from each of the two parents) exchange segments of varying length during prophase. **The point of crossover** is known as a **chiasma** (pl. **chiasmata**). A tetrad typically has at least one chiasma along its length. Generally, the longer the chromosome, the greater the number of chiasmata. There are two theories on the physical nature of the process. The **classical theory** proposes that cross-over and formation of the chiasma occur first, followed by breakage and reunion with the reciprocal homologues. According to this theory, chiasma formation need not be accompanied by chromosome breakage. Alternatively, according to the **chiasmatype theory**, breakage occurs first, and the broken strands then reunite.

Linkage between loci is indicated when the recombinant phenotypes occur less frequently than the parental types. The frequency of crossing over (% recombination) between two loci is directly related to the physical distance between those two loci. Percent recombination in a test cross equals **map distance (1 map unit = 1 % recombination).**
Recombination frequency = #recombinants/total progeny x 100.

EXAMPLE :

P1 **Ab//Ab** x **aB//aB** parents genotype (AAbb x aaBB)

↓

F1 **Ab//aB** **x** ab//ab (test cross)

Gametes Ab, aB , AB, ab **x** ab (Parents + Recombinant)

F2: **Ab//ab** , **aB//ab** if parental was **90%** - parental combinations

AB//ab, **ab//ab** and **10%** - recombinant

10% recombinant indicates that loci **a** and **b** are 10 map units apart.

Gene Map **a b = number of recombinant progeny / total number x 100**
= 10/100 x 100 = 10 m. u.

Now if we suppose that the number of F2 was:

Ab// aB = 42 P

aB //ab = 38 P

AB//ab = 12 R

ab// ab = 8 R

12+8 / 42+ 38+ 12+ 8= 20/100 = 20% R = 20 m.u.

Three point test cross :

Parental types have the maximum phenotypic frequencies, double crossovers have the lowest phenotypic frequencies, and the single crossovers have phenotypic frequencies between these two classes. Suppose, ABC/abc are three linked genes located on two different chromosomes in F_1 of a cross between AABBCC and aabbcc parents.

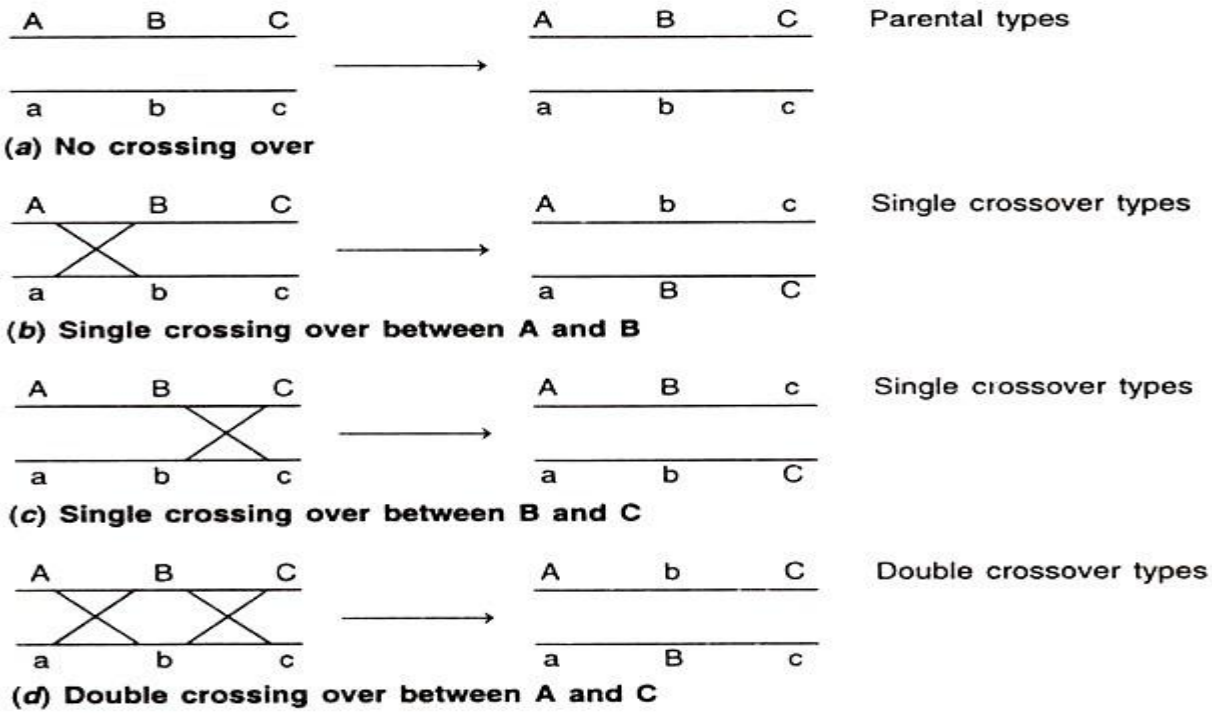


Fig. 9.3. Single and double crossing over between three linked genes.