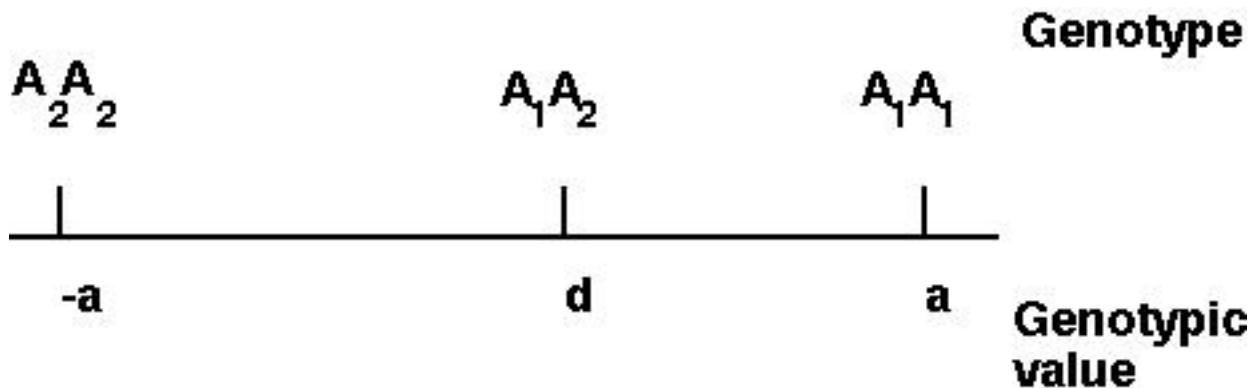


Values and means in
a single locus

Values and means in a single locus

- Genetic values
- Population mean
- Average allele effect
- Average allele substitution effect
- Breeding value



Phenotype

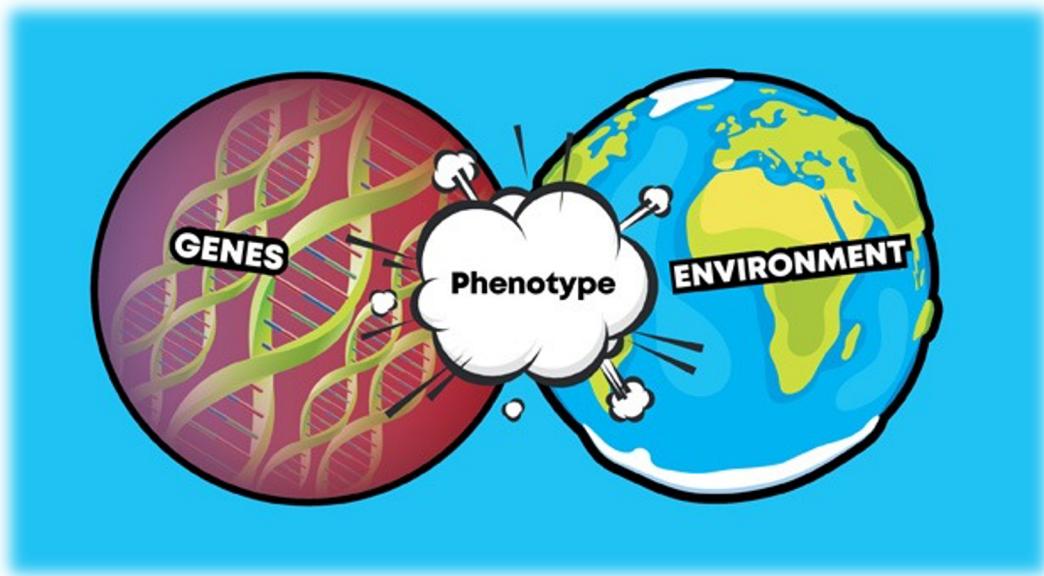
$$P = G + E$$

Where

P is the phenotypic value

G is the genotypic value

E is the environmental deviation



The mean environmental deviation in the population as a whole is taken to be zero

$$P = G$$

Phenotype

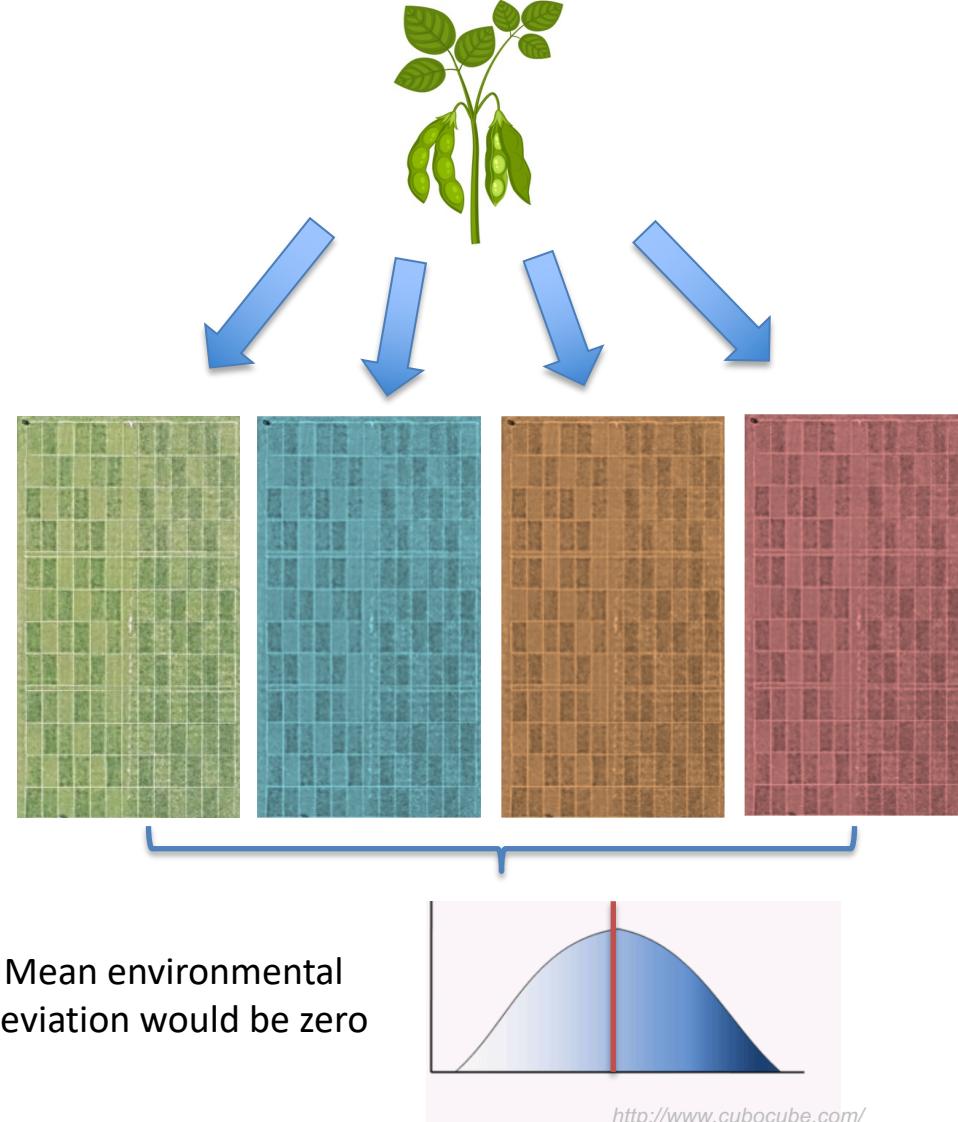
$$P = G + E$$

Where

P is the phenotypic value

G is the genotypic value

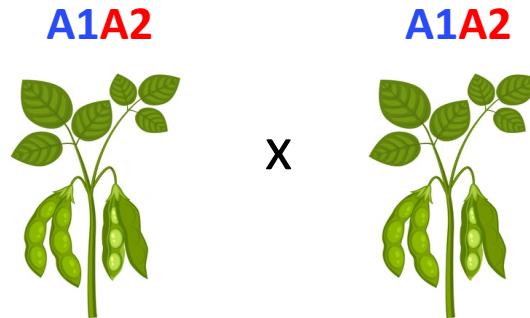
E is the environmental deviation



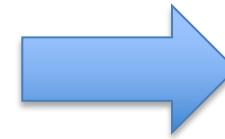
The mean environmental deviation in the population as a whole is taken to be zero

$$P = G$$

Genotype

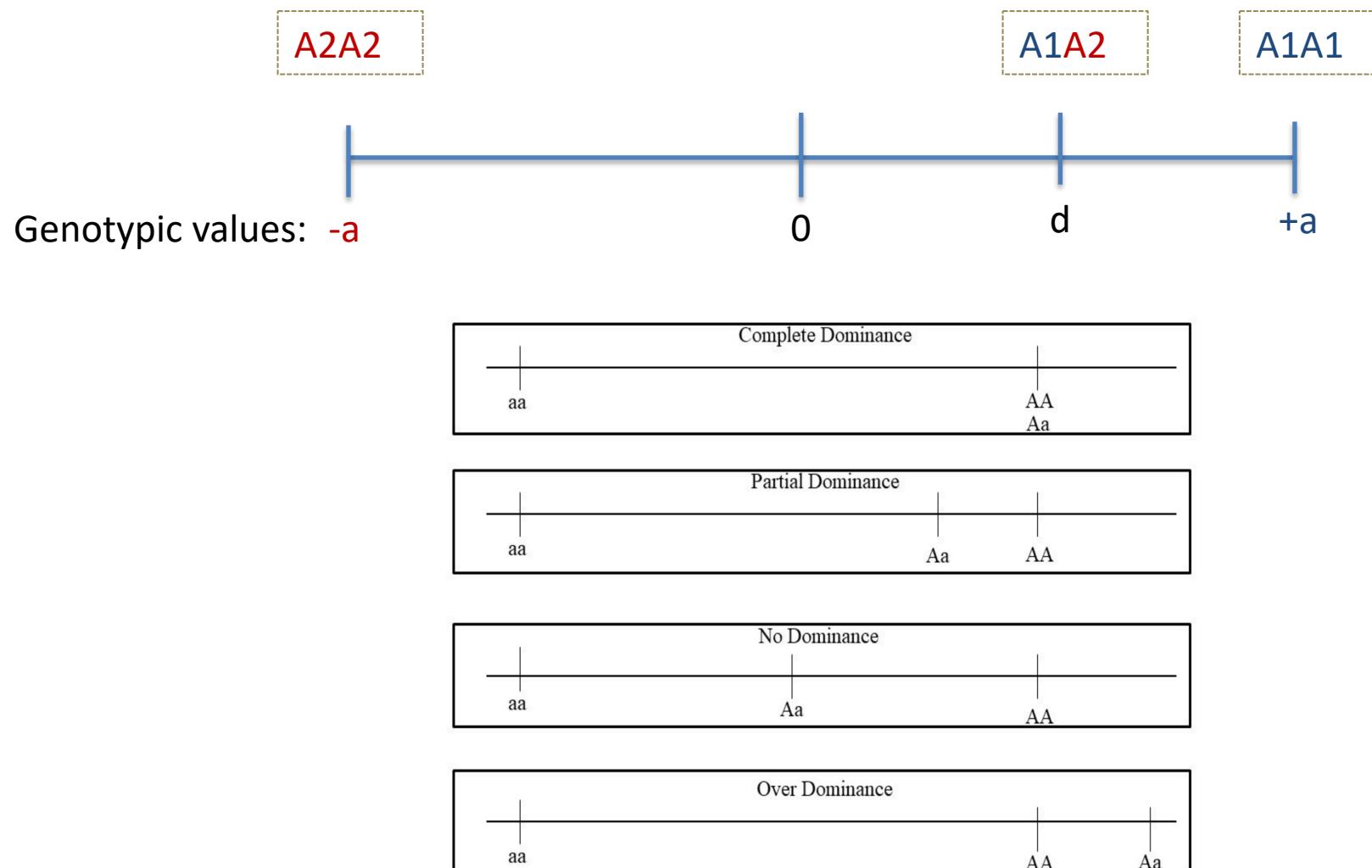


		Female gametes	
		A1	A2
Male gametes	A1	(A1A1) p^2	(A1A2) pq
	A2	(A1A2) pq	(A2A2) q^2



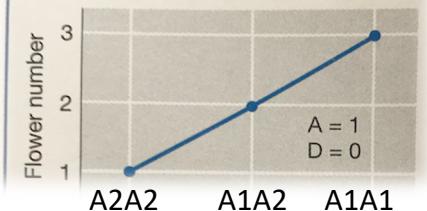
	A1A1	A1A2	A2A2
HW-Freq	p^2	$2pq$	q^2

Genotype



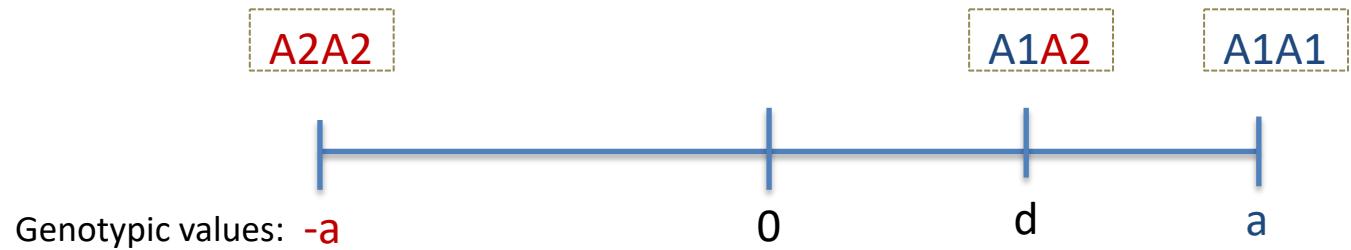
The difference between additive and dominant gene action

(a) Additive gene action



Griffiths et al 2012

Population mean



Genotype	Freq	Value	Freq × Value
A1A1	p^2	a	p^2a
A1A2	$2pq$	d	$2pqd$
A2A2	q^2	$-a$	$-q^2a$
Sum	1		$a(p-q)+2pqd$

$$u = \frac{1}{n} \sum_{i=1}^n X_i$$

$$u = \sum_{i=1}^k f_i X_i$$

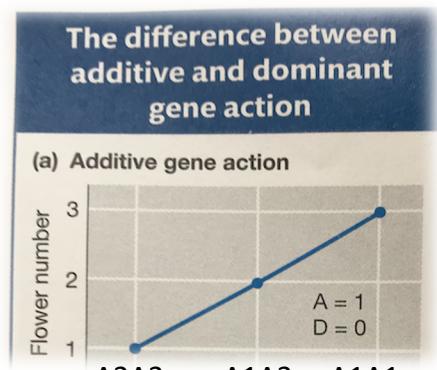
$$E[u] = a(p - q) + 2pqd$$

$$E[u] = a(p - q)$$

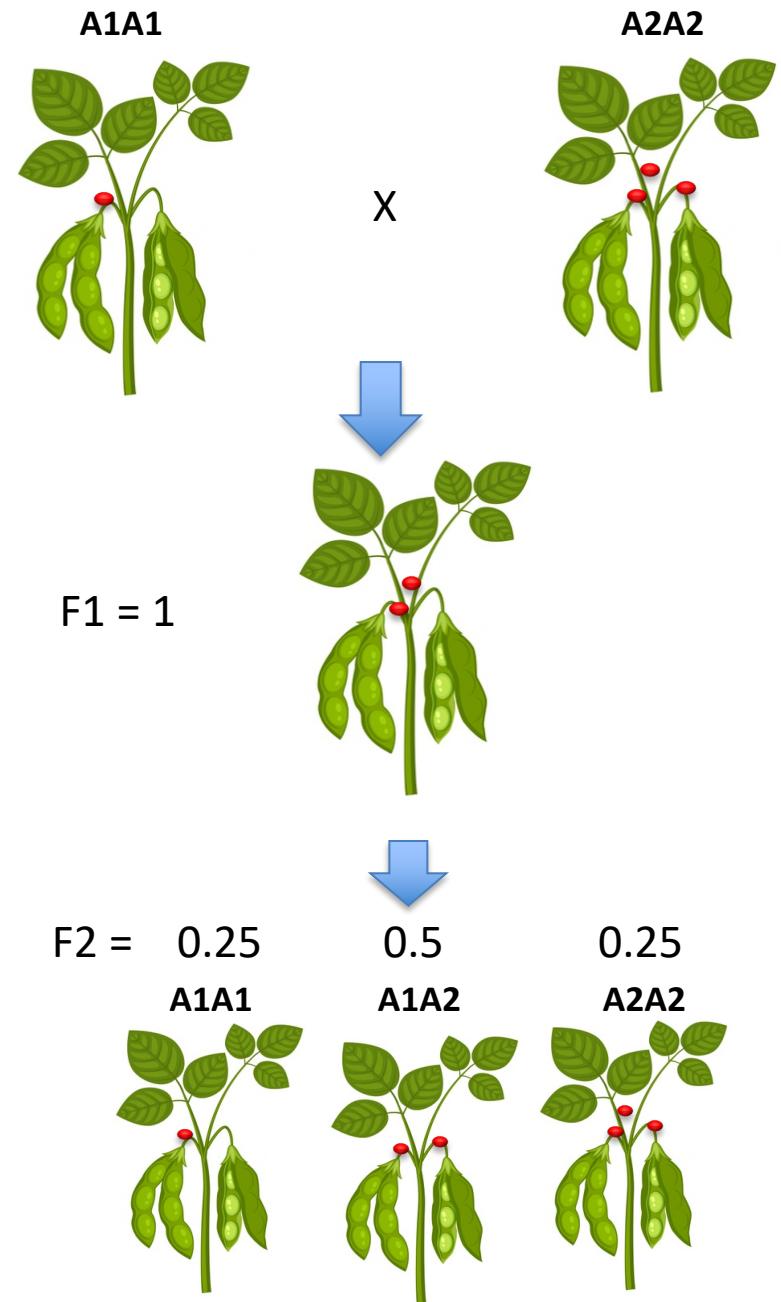
Population mean

$$u = \sum_{i=1}^k f_i X_i$$

Genotype	Freq	Value	Freq × Value
A1A1	p^2	a	p^2a
A1A2	$2pq$	d	$2pqd$
A2A2	q^2	-a	$-q^2a$
Sum	1		$a(p-q)+2pqd$



Griffiths et al 2012

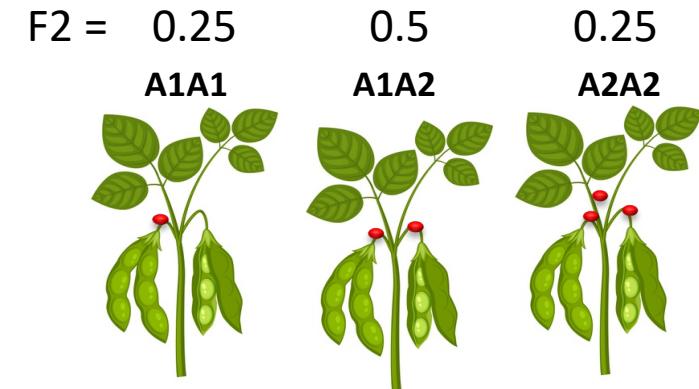
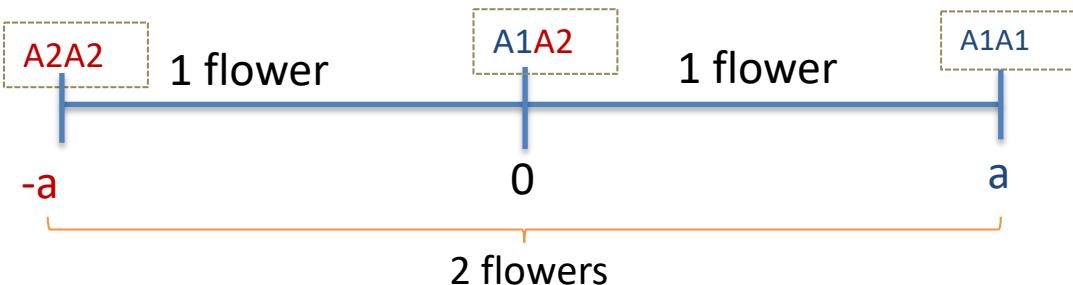


Population mean

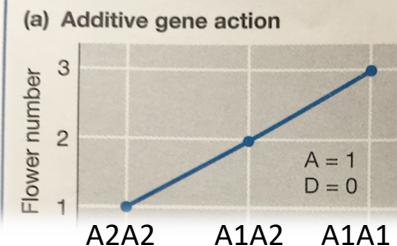
Genotype	Freq	Value	Freq × Value
A1A1	p^2	a	p^2a
A1A2	$2pq$	d	$2pqd$
A2A2	q^2	-a	$-q^2a$
Sum	1		$a(p-q)+2pqd$

$$p = \sqrt{0.25} = 0.5$$

$$q = 1 - p = 0.5$$



The difference between additive and dominant gene action



Griffiths et al 2012

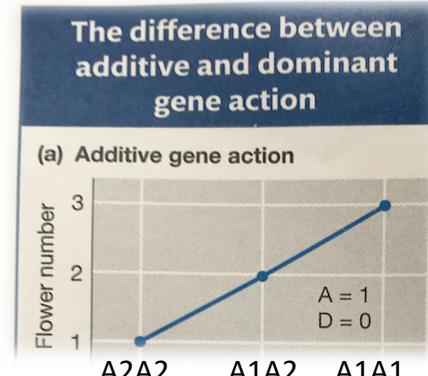
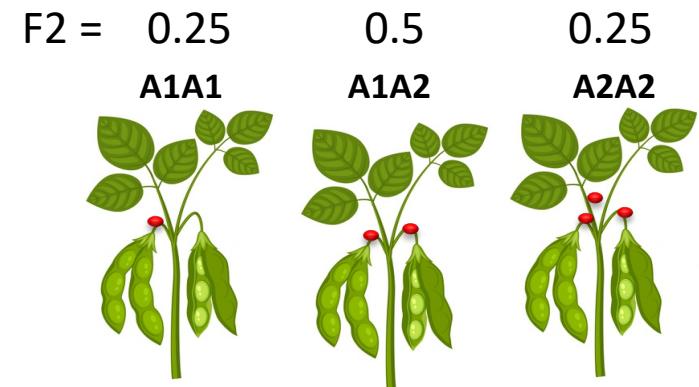
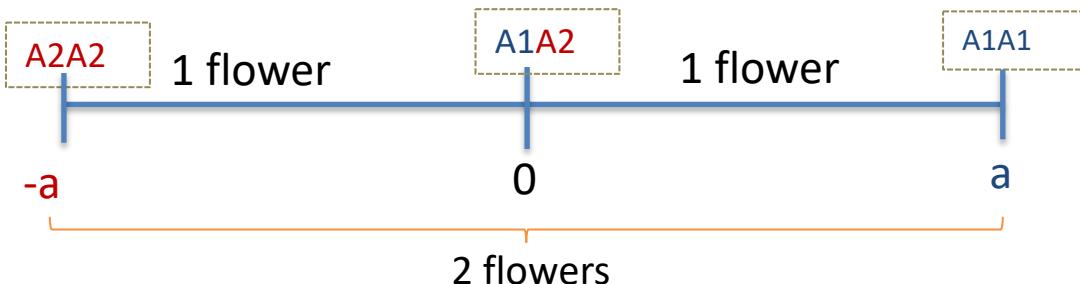
Population mean

Genotype	Freq	Value	Freq × Value
A1A1	0.5^2	1	$0.25*1$
A1A2	$2*0.5*0.5$	0	$2*0.5*0.5*0$
A2A2	0.5^2	-1	$-0.25*-1$
Sum	1		$1(0.5-0.5)+2*0.5*0.5*0$

$$a(p-q) + 2pqd = 0$$

$$p = \sqrt{0.25} = 0.5$$

$$q = 1 - p = 0.5$$

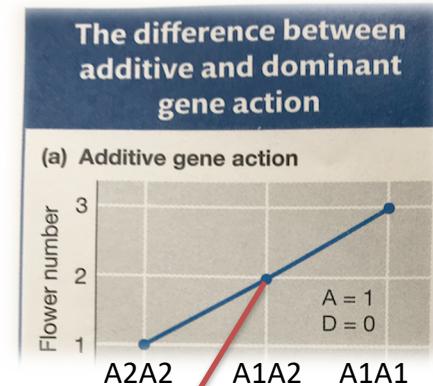
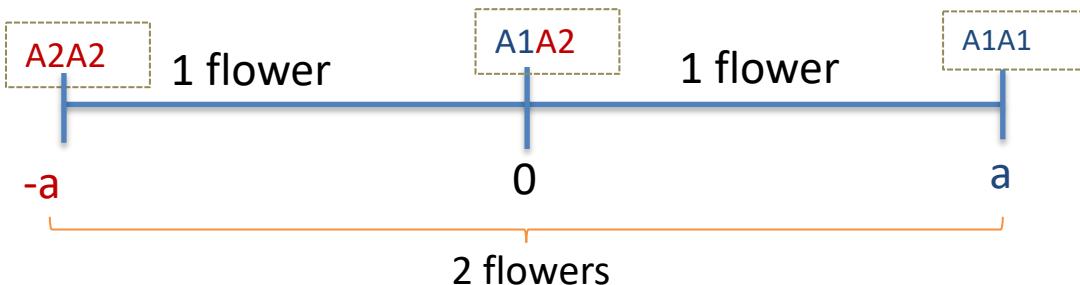


Griffiths et al 2012

Population mean

Genotype	Freq	Value	Freq × Value
A1A1	0.5 ²	1	0.25*1
A1A2	2*0.5*0.5	0	2*0.5*0.5*0
A2A2	0.5 ²	-1	-0.25*1
Sum	1		1(0.5-0.5)+2*0.5*0.5*0

$$a(p-q) + 2pqd = 0$$



This value of mean is measured from the mid-homozygote point, which is 2 flowers

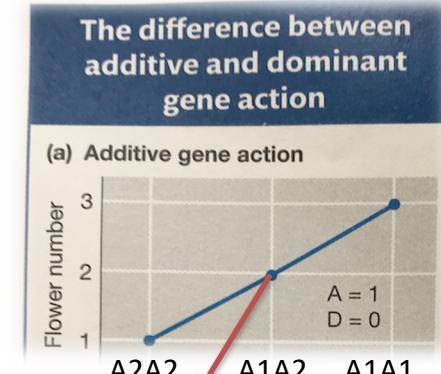
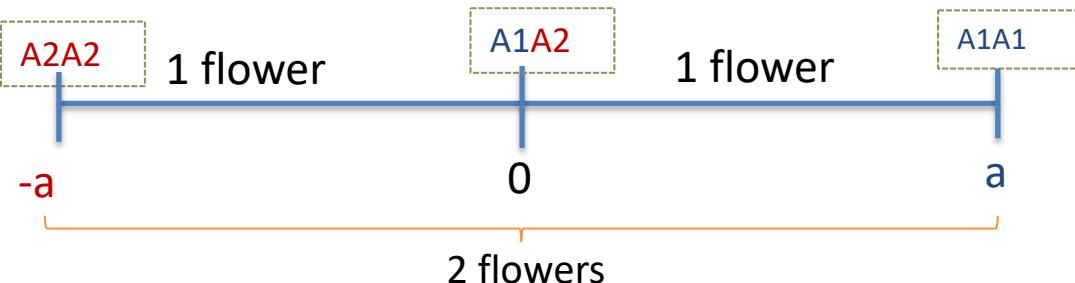
Population mean

Genotype	Freq	Value	Freq × Value
A1A1	0.9 ²	1	0.81*1
A1A2	2*0.9*0.1	0	2*0.09*0
A2A2	0.1 ²	-1	-0.01*1
Sum	1		1(0.8)+2*0.09*0

$$a(p-q) + 2pqd = 0.8$$

$$p = 0.9$$

$$q = 0.1$$



Griffiths et al 2012

$$2 + 0.8 = 2.8 \text{ flowers}$$

Population mean

Genotype	Freq	Value	Freq × Value
A1A1	p^2	a	p^2a
A1A2	$2pq$	d	$2pqd$
A2A2	q^2	-a	$-q^2a$
Sum	1		$a(p-q)+2pqd$

$$E[u] = a(p - q) + 2pqd$$

Single locus

The population mean resulting from joint effects of several loci is the sum of the contributions of each of separate loci

$$E[u] = \sum a(p - q) + 2 \sum dpq$$

Several loci

Average allele effect

Deviation from the population mean of individuals which received an allele (A_1 or A_2) from one parent when the other allele come at random from the population

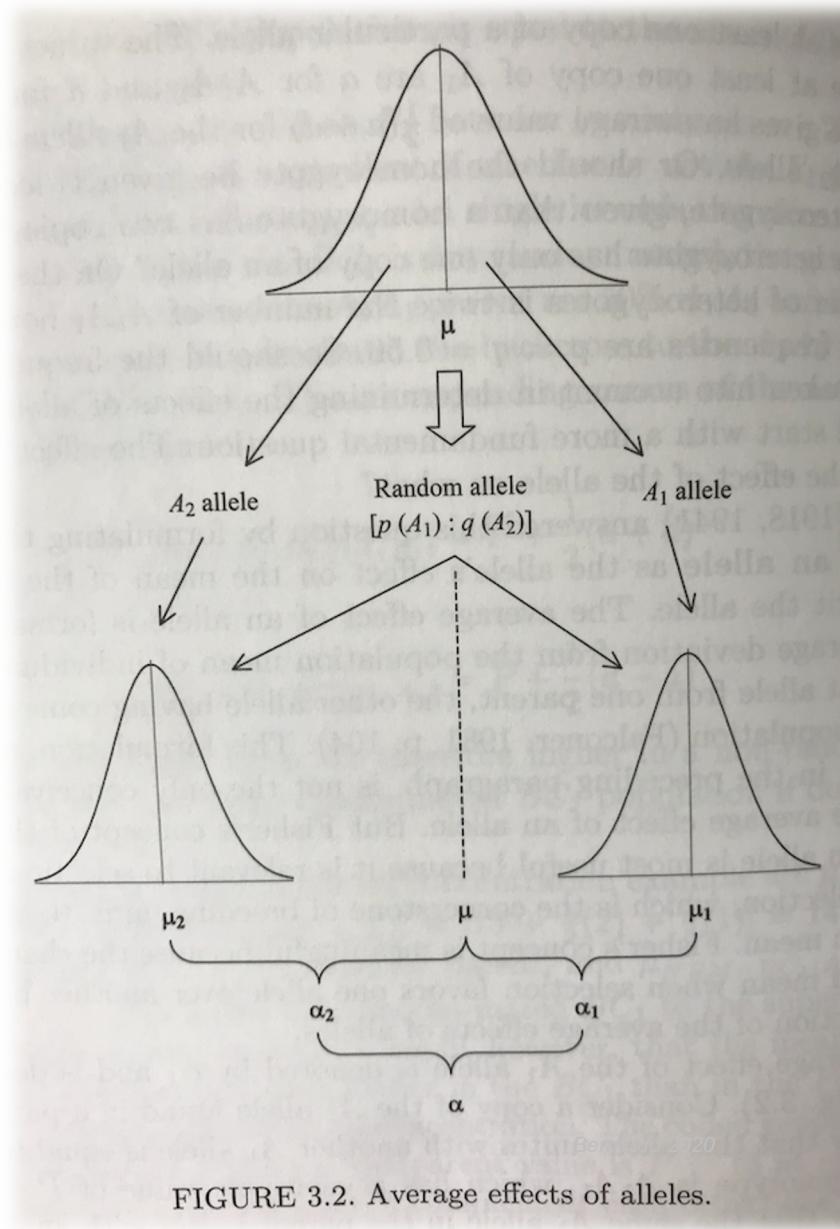


FIGURE 3.2. Average effects of alleles.

Average allele effect

Table 7.2

Type of gamete	Values and frequencies of genotypes produced	Mean value of genotypes produced	Population mean to be deducted	Average effect of gene
	A_1A_1 a	A_1A_2 d	A_2A_2 $-a$	$a(p-q)+2pqd$
A_1	p	q	$pa + qd$	$-[a(p-q) + 2dpq]$
A_2		p	$-qa + pd$	$q[a+d(q-p)]$
				$-[a(p-q) + 2dpq]$
				$-p[a+d(q-p)]$

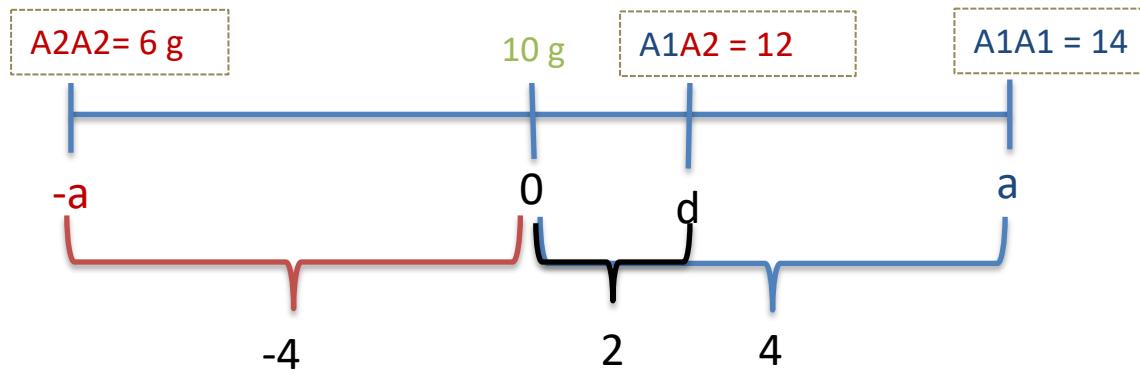
Falconer & Mackay 1996

Average effects of the alleles: $\alpha_1 = q[a + d(q - p)]$ $\alpha_2 = -p[a + d(q - p)]$

Average effects of gene substitution: $\alpha = \alpha_1 - \alpha_2 = a + d(q - p)$

Average effects of gene substitution:

$$\begin{aligned}\alpha &= \alpha_1 - \alpha_2 \\ &= a + d(q - p)\end{aligned}$$



$$\alpha = a + d(q - p)$$

Populations	p	q
Pop 1	0.9	0.1
Pop 2	0.6	0.4

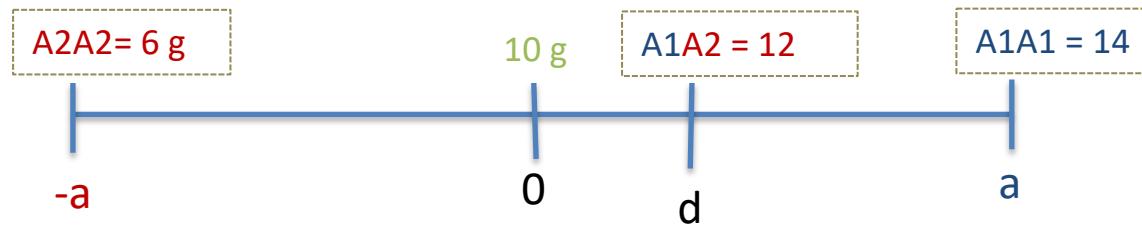
$$\alpha = 4 + 2(0.1 - 0.9) = 2.4$$

$$\alpha = 4 + 2(0.4 - 0.6) = 3.6$$

Table 7.2

Type of gamete	Values and frequencies of genotypes produced	Mean value of genotypes produced	Population mean to be deducted	Average effect of gene
	A_1A_1 a	A_1A_2 d	A_2A_2 $-a$	
A_1	p	q	$pa + qd$	$-[a(p-q) + 2dpq]$
A_2		p	$-qa + pd$	$q[a+d(q-p)]$ $-[a(p-q) + 2dpq] - p[a+d(q-p)]$

Falconer & Mackay 1996



Populations	p	q
Pop 1	0.9	0.1

$$\alpha = a + d(q - p)$$

$$\alpha = 4 + 2(0.1 - 0.9) = 2.4$$

$$\alpha_1 = q[a + d(q - p)] = q\alpha$$

$$\alpha_1 = 0.1 * 2.4 = 0.24$$

$$\alpha_2 = -p[a + d(q - p)] = -p\alpha$$

$$\alpha_2 = -0.9 * 2.4 = -2.16$$

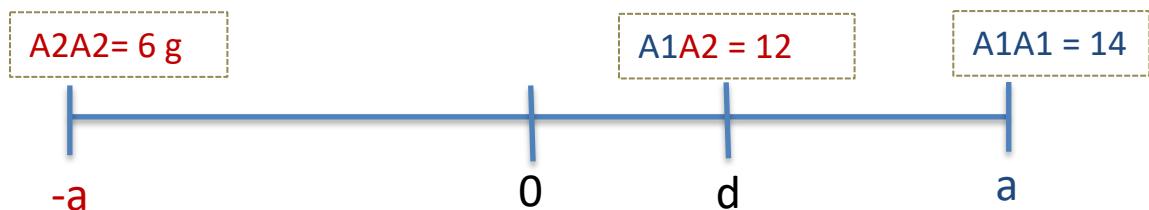
$$\alpha = \alpha_1 - \alpha_2 = 0.24 - (-2.16) = 2.4$$

Average effects of gene substitution:

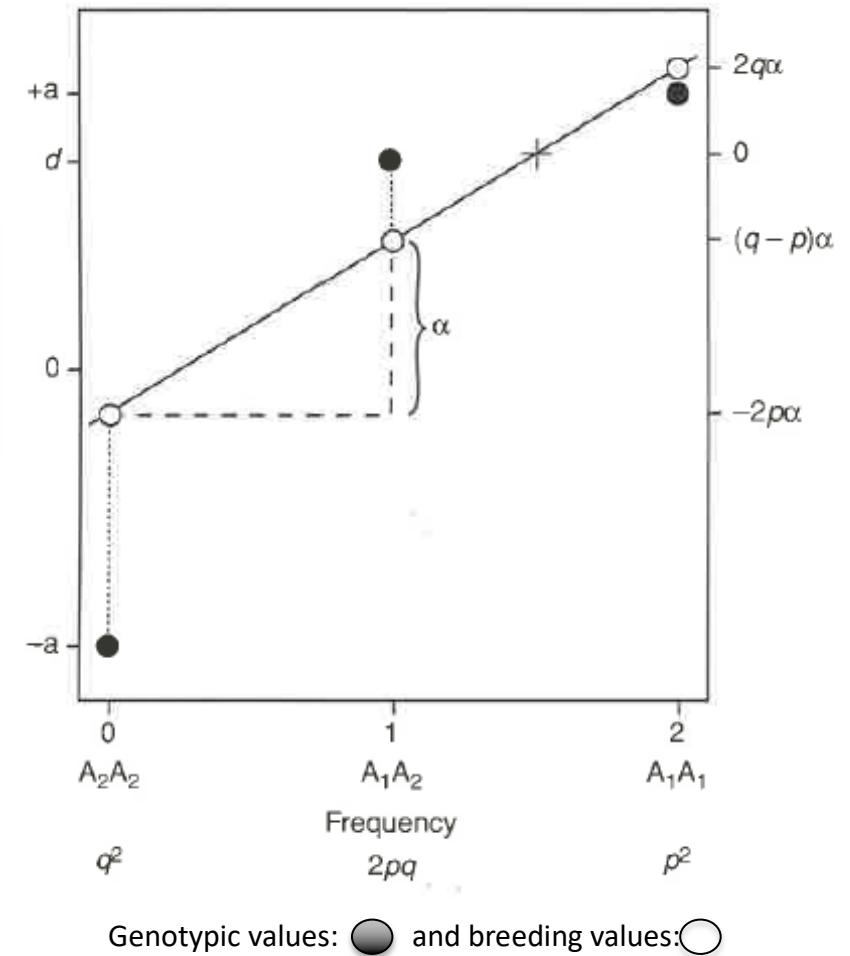
$$\alpha = a + d(q - p)$$

One half of the difference between the two homozygous

Deviation due to dominance



Breeding value	
$2\alpha_1 = 2q\alpha$	gniboei
$\alpha_1 + \alpha_2 = (q - p)\alpha$	ntent
$2\alpha_2 = -2p\alpha$	ad



Values and means in a single locus



Average effects of alleles:

