Soybean Punnett squares

How might we predict traits in soybeans?

Flower color
Flower color in soybeans varies from white to purple.

Clark (purple) Bay (purple) Clark-*w4* (near white) 222-A-3 (near white)

E30-D-1 (light purple) kw4 (near white) T321 (dilute purple) T369 (pale)
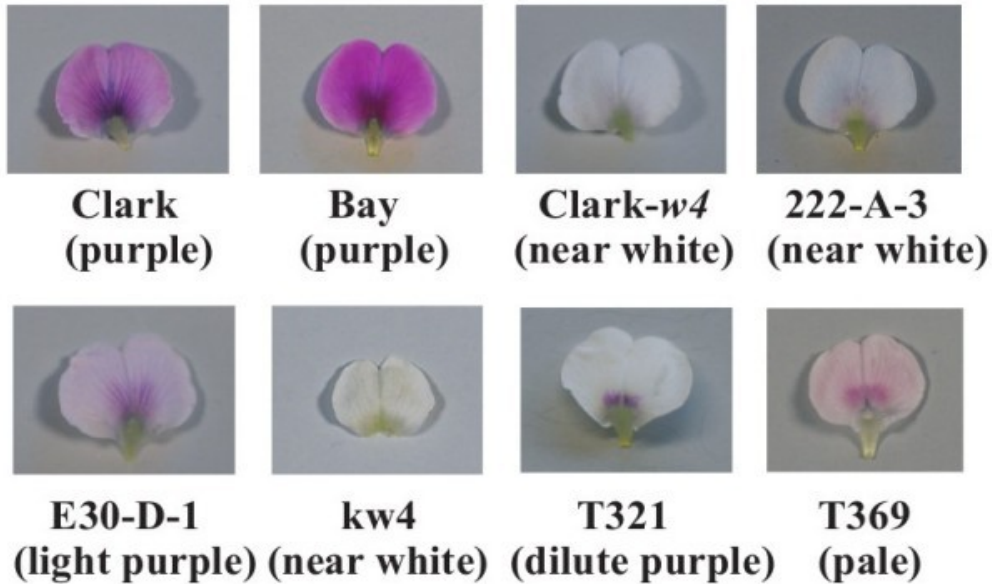
To simplify for our purposes, W (purple) is dominant over w (white).

1. The parents (P1 generation) of the initial cross are purple (WW) and white (ww). Cross WW with ww.

	W̄	W̄
W		
W		

2. Cross two of the F1 offspring.

a. What is the phenotype ratio of the offspring?

b. What color are the flowers?

c. What is the genotype ratio?

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3. Cross two of the F2 offspring to determine how we might breed soybeans with purple flowers most of the time.

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a. Which genotypes produce purple flowers in the highest proportion?

Note: Flower color does not have an impact on yield.

Pubescence

Pubescence describes the hairs on the outside of soybean pods. These hairs have different phenotypes depending on the genotype. T- results in tawny pubescence while tt results in gray pubescence.

4. Cross TT with Tt.

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a. What is the color of the pubescence in the offspring?

b. What is the ratio of the genotypes?

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Extension
Hilum color
The color of the hilum is an important genetic marker used in soybean breeding. Many food grade bean importers do not want a colored hilum as it has an impact on the tofu that is a primary product made from those soybeans. You have worked with flower color and pubescence. The genes that control hilum color may also have an impact on these two traits.

In most of the varieties used for crossing by soybean breeders, hilum color is determined by four genes, namely, `l/ii`, `R/r`, `T/t`, and W^1/w^1 (Bhatt and Torrie, 1968; Bernard and Weiss,1973). These four gene pairs interact to produce the six hilum color phenotypes shown in Table 1.

Table l
Hilum, pubescence, and flower color phenotypes of the 16 genotypes arising from the four gene pairs `l/ii`, `R/r`, `T/t`, and W^1/w^1

Genotype	Phenotype			
	Hilum color		Pubescence color	Flower color
	With $i^i i^i$	With `I`		
`R- T- `W^1-	Black	Grey	Tawny	Purple
`R- T- `$w^1 w^1$	Black	Grey	Tawny	White
`R- tt `W^1-	Imperfect black	Grey	Grey	Purple
`R- tt `$w^1 w^1$	Buff	Yellow	Grey	White
`rr T- `W^1-	Brown	Yellow	Tawny	Purple
`rr T- `$w^1 w^1$	Brown	Yellow	Tawny	White
`rr tt `W^1-	Buff	Yellow	Grey	Purple
`rr tt `$w^1 w^1$	Buff	Yellow	Grey	White

5. If a breeder is tasked with producing a soybean that has a yellow hilum and purple flowers, which genotype(s) might she choose to cross from Table 1? (Keep in mind that the genotype column is the genotype contained in either the ovary or pollen. The offspring will have 8 alleles.)

Resources

https://lib.dr.iastate.edu/cgi/viewcontent.cgi?article=1131&context=soybeangenetics

https://www.farmprogress.com/soybeans/flower-color-doesnt-affect-yield

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