# Carolina's Genetic Corn Ears

CAROLINA

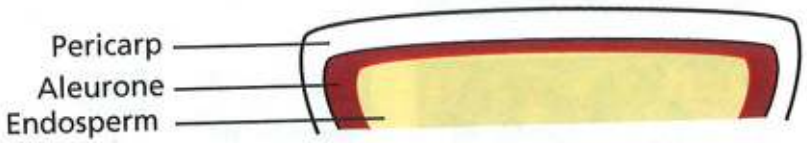
*World-Class Support for Science & Math*

# Carolina's Genetic Corn Ears

Our segregating corn ears demonstrate several patterns of Mendelian inheritance. Numerous contrasting phenotypes expressed in the grain are easy to recognize; even beginners can score them with confidence. The actual counts of seeds per ear closely approximate theoretical ratios. The various phenotypes involve seed color and endosperm characteristics.

## Color

The color of a corn grain is controlled by many genes that determine the phenotypes of three tissues: the pericarp, the aleurone (outer layer of the endosperm), and the endosperm proper. In our corn, the pericarp is always colorless. The aleurone may be colorless, purple, or red. The endosperm may be yellow or white.




**The layers of a corn kernel involved in producing colored phenotypes.**

If the aleurone is colorless, the kernel color will be that of the endosperm, either yellow or white. Normal corn endosperm color, yellow, occurs when the allele *Y* causes the production of carotenoid pigments in the endosperm. In the recessive condition (*y*/*y*), carotenoids are not produced and the endosperm is white. The *Y* alleles are masked by the presence of a colored aleurone.

For the aleurone to be colored, alleles *C* and *R* must be present. The homozygous recessive of either allele (*c*/*c* or *r*/*r*) disrupts anthocyanin production and results in a colorless aleurone. The dominant $C^I$ allele also inhibits anthocyanin production, giving a colorless aleurone. Genes *C* and *R* are located on separate chromosomes and segregate independently.

The allele *Pr* interacts with alleles *C* and *R* to produce a purple aleurone. The homozygous recessive condition (*pr/pr*) interacts with *C* and *R* to produce a red aleurone.

## Endosperm Characteristics

Normal corn endosperm is high in amylose starch. The gene *Su* in the homozygous recessive condition (*su/su*) produces endosperm that is high in sugar. As the corn dries, the sugary endosperm loses water and the seeds wrinkle.

The gene *Wx* in the homozygous recessive condition (*wx/wx*) causes the production of amylopectin starch in the endosperm and pollen. The endosperm of a *wx/wx* grain is opaque with a hard, waxy texture.

## $F_2$ Ears of Corn

Here are summaries of the crosses made to produce our $F_2$ ears of corn. The first line gives our product number for the ear (**boldfaced**), the alleles demonstrated, and the expected phenotype ratio. The next lines give the type of cross demonstrated (monohybrid, dihybrid, etc.) and the phenotype and genotype of the parental plants. The interacting alleles are shown in parentheses. Following that, only the alleles that segregate in the cross are shown.

**RN-176500** *R* Color Alleles 3:1

A monohybrid $F_2$ ear of a Purple with Yellow cross:

*R/R (Pr/Pr Y/Y) × r/r (Pr/Pr Y/Y)*

| | |
|---|---|
| P | *R/R × r/r* |
| $F_1$ | heterozygous Purple *R/r* |
| $F_1$ cross | *R/r × R/r* |
| $F_2$ | *R/R R/r r/r* phenotypes Purple, Yellow in a phenotype ratio of 3:1 |

Corn Mount RN-176810 is a visual display of this cross.

**RN-176502** *R* Color Alleles 1:1

A monohybrid test cross for Purple × Yellow:
*R/R (Pr/Pr Y/Y) × r/r (Pr/Pr Y/Y)*

$F_1$ heterozygous Purple, *R/r*
(from the RN-176500 Purple with Yellow cross)

The testcross reveals the presence of the recessive allele *r* in the $F_1$.

Testcross *R/r × r/r*

$F_2$ (offspring of the test cross) genotype *R/r* and *r/r*
phenotypes Purple, Yellow in a 1:1 ratio

Corn Mount RN-176812 is a visual display of this cross.

**RN-176520** *C* Color Alleles 3:1 (interaction of *C* and *pr*)

A monohybrid $F_2$ ear of a Red with White cross:
*C/C (pr/pr y/y) c/c (pr/pr y/y)*

P *C/C × c/c*

$F_1$ heterozygous Red *C/c*

$F_1$ cross *C/c × C/c*

$F_2$ *C/C* *C/c* *c/c* phenotypes Red, White in a 3:1 ratio

**RN-176522** *C* Color Alleles 1:1 (interaction of *C* and *pr*)

A monohybrid testcross for Red × White:
*C/C (pr/pr y/y) × c/c (pr/pr y/y)*

$F_1$ heterozygous Red *C/c*
(from the RN-17-6520 Red with White cross)

The testcross reveals the presence of the recessive allele *c* in the $F_2$.

Testcross *C/c × c/c*

$F_2$ (offspring of the test cross) genotype *C/c* and *c/c*
phenotypes Red, White in a 1:1 ratio

**RN-176540** *Su* Endosperm Alleles 3:1

A monohybrid $F_2$ ear of a Starchy with Sweet cross:
*Su/Su (r/r Y/Y) × su/su (r/r Y/Y)*

P Su/Su × su/su

$F_1$ heterozygous Starchy *Su/su*

$F_1$ cross *Su/su × Su/su*

$F_2$ *Su/Su Su/su su/su* phenotypes Starchy, Sweet in a 3:1 ratio

**RN-176550** *Wx* Endosperm Alleles 3:1

A monohybrid $F_2$ ear of a Starchy with Waxy cross:
*Wx/Wx (r/r Y/Y) × wx/wx (r/r Y/Y)*

P *Wx/Wx × wx/wx*

$F_1$ heterozygous Starchy *Wx/wx*

$F_1$ cross *Wx/wx × Wx/wx*

$F_2$ *Wx/Wx Wx/wx wx/wx* phenotypes Starchy, Waxy in a 3:1 ratio

RN-177020 Iodine Solution is used to score the phenotypes. Abrade the pericarp (seed coat) of the kernels to expose the endosperm, then rub the iodine solution on the exposed endosperm. Starchy kernels will stain dark blue-black, and waxy kernels will stain red. Pollen from the $F_1$ can also be stained to show the presence of the *Wx and wx* alleles in a 1:1 ratio.

**RN-176600** *R* Color and *Su* Endosperm Alleles 9:3:3:1

A dihybrid $F_2$ ear of a Purple Starchy with Yellow Sweet cross:
*R/R Su/Su (Pr/Pr Y/Y) × r/r su/su (Pr/Pr Y/Y)*

P *R/R Su/Su × r/r su/su*

$F_1$ *R/r Su/su*

$F_1$ cross *R/r Su/su × R/r Su/su*

$F_2$ phenotypes Purple Starchy, Purple Sweet, Yellow Starchy, Yellow Sweet in a 9:3:3:1 ratio

Corn Mount RN-176900 is a visual display of this cross.

**RN-176602** *R* Color and *Su* Endosperm Alleles 1:1:1:1

A dihybrid test cross for Purple Yellow with Starchy Sweet:
*R/R Su/Su (Pr/Pr Y/Y) × r/r su/su (Pr/Pr Y/Y)*

$F_1$ *R/r Su/su* (from the RN-17-6600 Purple Starchy with Yellow Sweet cross)

The testcross reveals the presence of the recessive alleles in the $F_1$.

Testcross *R/r Su/su × r/r su/su*

$F_2$ (offspring of the test cross) phenotypes Purple Starchy, Purple Sweet, Yellow Starchy, Yellow Sweet in a 1:1:1:1 ratio

Corn Mount RN-176902 is a visual display of this cross.

## Discontinued Genetic Corn Ears

We no longer produce the following crosses; however, we provide this information for customers who may still have ears of these stocks.

**RN-176542** *Su* Endosperm Alleles 1:1

A monohybrid testcross for Starchy × Sweet: *Su/Su (r/r Y/Y) × su/su (r/r Y/Y)*

$F_1$ heterozygous Starchy *Su/su* (from the RN-17-6540 Starchy with Sweet cross)

The testcross reveals the presence of the recessive allele *su* in the $F_1$.

Testcross *Su/su × su/su*

$F_2$ (offspring of the testcross) genotype *Su/su* and *su/su* phenotypes Starchy, Sweet in a 1:1 ratio

**RN-176560** $C^I$ Color Inhibitor Alleles 3:1 (dominant epistasis)

A monohybrid $F_2$ ear of a Yellow with Purple cross: $C^I/C^I$ *(Pr/Pr Y/Y) × C/C (Pr/Pr Y/Y)*

P $C^I/C^I \times C/C$

$F_1$ heterozygous Yellow $C^I/C$

$F_1$ cross $C^I/C \times C^I/C$

$F_2$ $C^I/C^I$ $C^I/C$ $C/C$ phenotypes Yellow, Purple in a 3:1 ratio

**RN-176620** *C*$^{I}$ Color Inhibitor and *Su* Alleles 9:3:3:1 (dominant epistasis)

A dihybrid $F_2$ ear of a Yellow Starchy with Purple Sweet cross: *C*$^{I}$/*C*$^{I}$ *Su/Su* (*Pr/Pr Y/Y*) × *C/C su/su* (*Pr/Pr Y/Y*)

P *C*$^{I}$/*C*$^{I}$ *Su/Su* × *C/C su/su*

$F_1$ *C*$^{I}$/*C Su/su*

$F_1$ cross *C*$^{I}$/*C Su/su* × *C*$^{I}$/*C Su/su*

$F_2$ phenotypes Yellow Starchy, Yellow Sweet, Purple Starchy, Purple Sweet in a 9:3:3:1 ratio

**RN-176660** *Y* and *R* Alleles 12:3:1

A dihybrid $F_2$ ear of Purple with Yellow cross: *R/R y/y* (*Pr/Pr*) × *r/r Y/Y* (*Pr/Pr*). Only *r/r* kernels show the color of the endosperm, which segregates in a 3:1 ratio of Yellow to White.

P *R/R y/y* × *r/r Y/Y*

$F_1$ heterozygous Purple *R/r Y/y*

$F_1$ cross *R/r Y/y* × *R/r Y/y*

$F_2$ phenotypes Purple, Yellow, White in a 12:3:1 ratio

**RN-176670** *Pr* and *R* Alleles 9:3:4 (interaction of *Pr* and *R* alleles)

A dihybrid $F_2$ ear of a Purple with White cross: *Pr/Pr R/R* (*y/y*) × *pr/pr r/r* (*y/y*). Only *r/r* kernels show the color of the endosperm.

P *Pr/Pr R/R* × *pr/pr r/r*

$F_1$ heterozygous Purple *Pr/pr R/r*

$F_1$ cross *Pr/pr R/r* × *Pr/pr R/r*

$F_2$ phenotypes Purple, Red, White in a 9:3:4 ratio

**RN-176680** *C*$^{I}$ and *Y* Alleles 9:3:4 (dominant epistasis)

A dihybrid $F_2$ ear of a Yellow with Purple cross: *C*$^{I}$/*C*$^{I}$ *Y/Y (Pr/Pr)* × *C/C y/y* (*Pr/Pr*). The homozygous *C/C* masks the color of the endosperm, which segregates in a 3:1 ratio of Yellow to White.

P *C*$^{I}$/*C*$^{I}$*Y/Y* × *C/C y/y*

$F_1$ *C*$^{I}$/*C Y/y*

$F_1$ cross *C*$^{I}$/*C Y/y* × *C*$^{I}$/*C Y/y*

$F_2$ phenotypes Yellow, White, Purple in a 9:3:4 ratio

**RN-176690** *C* and *R* Color Alleles 9:7 (interaction of *C*, *R*, and *pr*: double recessive epistasis)

A dihybrid $F_2$ ear of a Red with White cross: *C/C r/r* (*pr/pr y/y*) × *c/c R/R* (*pr/pr y/y*). Shows independent segregation of two aleurone color genes. The homozygous recessive of either gene (*c/c* or *r/r*) gives the White phenotype.

P *C/C r/r* × *c/c R/R*

$F_1$ *C/c R/r*

$F_1$ cross *C/c R/r* × *C/c R/r*

$F_2$ phenotypes Red, White in a 9:7 ratio

**RN-176700** $C^I$ and *R* Color Alleles 13:3 (dominant epistasis + recessive epistasis)

A dihybrid F2 ear of a Yellow with Purple cross:
$C^I/C^I$ *R/R* (*Pr/Pr Y/Y*) × *C/C r/r* (*Pr/Pr Y/Y*).
Shows the segregation of two aleurone color genes with both dominant and recessive epistasis.

P $C^I/C^I$ *R/R* × *C/C r/r*

$F_1$ *CI/C R/r*

$F_1$ cross *CI/C R/r* × *CI/C R/r*

$F_2$ phenotypes Yellow, Purple in a 13:3 ratio

**RN-176720** *C*, *Pr*, and *Y* Alleles 9:3:3:1 (trihybrid)

A trihybrid $F_2$ ear of a Purple with White cross: *C/C Pr/Pr Y/Y* × *c/c pr/pr y/y*. Three separate 3:1 ratios can be counted: purple-red aleurone, colored-colorless aleurone, and yellow-white endosperm.

P *C/C Pr/Pr Y/Y* × *c/c pr/pr y/y*

$F_1$ *C/c Pr/pr Y/y*

$F_1$ cross *C/c Pr/pr Y/y* × *C/c Pr/pr Y/y*

$F_2$ phenotypes Purple, Red, Yellow, White in a 9:3:3:1 ratio

**Carolina Biological Supply Company**
2700 York Road, Burlington, North Carolina 27215
Phone: 800.334.5551 • Fax: 800.222.7112
Technical Support: 800.227.1150 • www.carolina.com
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