Pleiotropic Phenotypes of clf1

Failure to produce purple aleurone due to absence of aleurone layer (Cone 1989), not involved in anthocyanin pathway. Message is cell autonomous.

Failure to produce normal scutellum and shoot primordia, but allows poor minimal root growth.

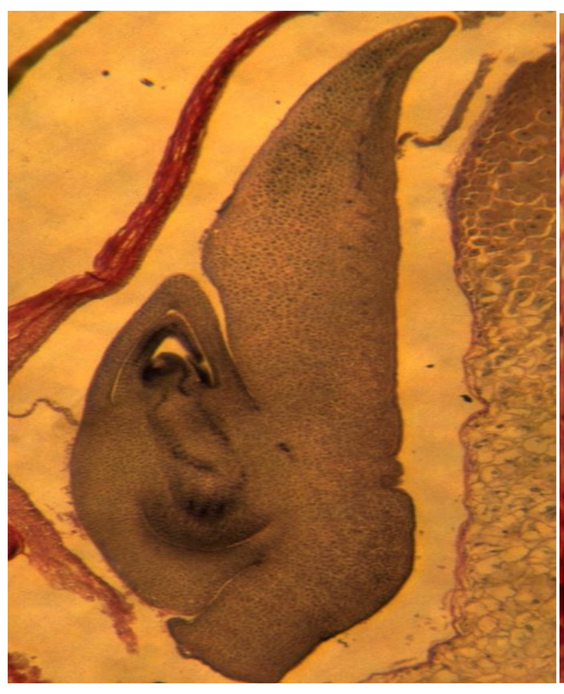
Failure to produce hard vitreous starch; message is non-cell autonomous.

Failure to produce normal leaf tissue in chimeral loss sectors, but instead show a morphological indentation of top leaf surface and a concordant protrusion of bottom leaf surface of the same sector.

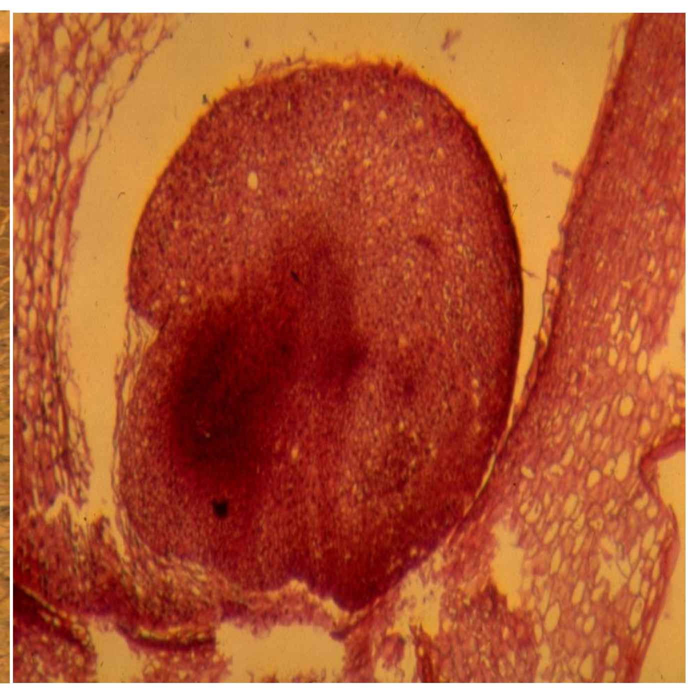
Large sectors are seen to be white indicating failure to produce chlorophyll.

Clf/clf*-N792, Selfed colored ACR ear segregating for <u>colorless, floury, defective,</u> mutant kernels

Selfed Clf/clf, C1/c1 purple A1R1Y1 ear segregating for colorless, floury and flinty kernels.



Stained kernel cross-section of a normal embryo, for comparison. (Embryo photos courtesy of W.F. Sheridan)

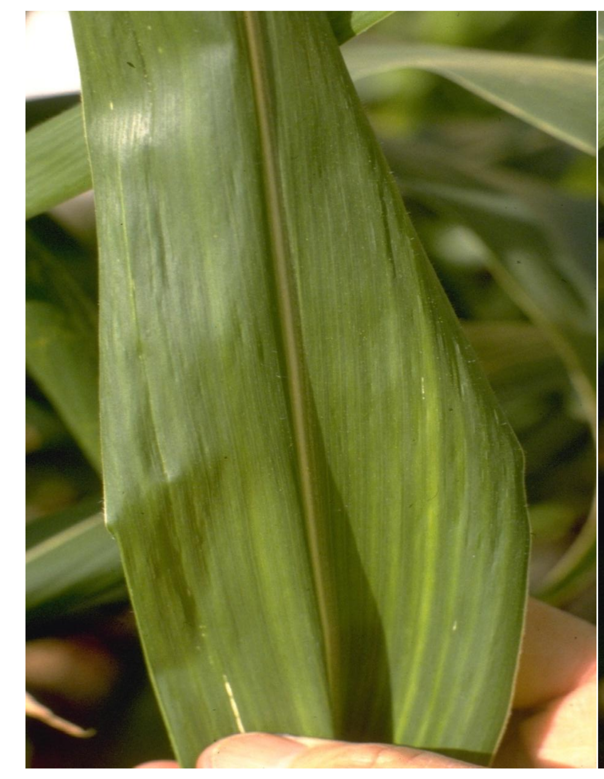


Stained section of a 16-day clf1-N971, defective colorless floury nonviable kernel showing a round embryo with root but no leaf primordia.

<u>Anthocyanin color and starch texture expression in chimeric loss of Clf in Clf clf clf kernels due to Ac-Ds induced chromosome breakage.</u>

Original Ac Ds-1S2 Clf/clf/clf mutant kernel with two large attached colorless areas and many smaller lace-like colorless sectors (repeated later losses of Clf). <u>Why no floury starch?</u>

Clf/*clf* x *Ac* Clf *Ds-1S4/clf* ear with full colored normal, colored colorless mosaic, collapsed *dek* kernels. The mosaic kernels have large patches of colorless tissue set off from smaller areas of colored cells that are often arranged in chains of dots and isolated islands of intensely colored tissue of one or more dots. The largest colorless areas have an interior of white floury tissue bordered by a yellowish flinty tissue between the floury and the colored areas. Non-autonomous expression.



Top leaf surface of Ac Ds-1S2 Clf/clf plant from original mosaic kernel. Showing small long narrow sectors of indented tissue. Largest one, lower left, is white indicating absence of chlorophyll (albino).

Underneath surface of same leaf section (left), showing sectors which are indented on the top, protrude on the undersurface conforming to and confirming the aberrant aleurone and leaf shoot morphology. The largest sectors is also white.

Phenotypic Analysis: Pleiotropy

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Phenotype is the message we get that tells us that there has been a change in a gene controlling some biological function. What we learn from the phenotype actually depends on our ability to recognize and properly interpret what we observe. In the simplest case, it is the presence or absence of a measurable product (anthocyanin) or structure (ligule). In actual fact there are many functions involved in production of a particular product or activity and these are all a part of a complicated choreography leading to a certain display. Maize is an exceptionally well suited organism for demonstrating this point. We have produced and have access to a unique large collection of several thousand mutants induced by EMS, by transposons, by radiation and of spontaneous unknown origin. All are currently kept in an extensive "Mutants Data Base" with high resolution photo images and pertinent information. A duplicate copy of most of these files with images and data is also kept at MaizeGDB. This presentation will use photo images of two mutant gene systems to demonstrate the intricate relationships involved in going to and from a gene and a recognizable phenotype.

(1) **clf1(dek1)**; EMS induced recessive mutant; **Ac Ds-1S2,4 Clf1** transposon analysis.
(2) **PgD;** EMS induced dominant chimera case.

In reviewing this material it is quite clear that there are many important genetically controlled activities that regulate expression of a phenotype without being in the biochemical pathway that leads to the observed phenotype.

33 series; 1982 M1 CORN FIELD; A632 x Mo17 EMS <u>5000 M1</u> plants; <u>recessive</u> mutation rate; <u>1 mutant per locus</u>, <u>per 1000</u> pollen grains

Pleiotropic Phenotypes of PgD

Dominant pale-pale green lethal mutant chimera mechanically supported by and nutritionally sustained through pollen shedding by healthy normal tissue: "light green lethal phenotype".

First outcross (using pollen from chimeric plant) to genetic stock gave dwarf pale green mutant plants that tended to fall over so that normal pollen was hard to get: "dwarf, lazy phenotype, root failure".

Cross of this pollen on W23 produced "healthy pale green" mutant plants that were almost normal in vigor while that on Mo 20w were weak & fragile like the first outcross, indicating strong complementary modifiers in the former.

Original PgD*-N2542/+ mutant chimeric plant showing broad pale-pale green sector covering 1/2 of the leaf blade, sheath and tassel. This sector is physically supported and nutritionally sustained by normal plant tissue. Note necrosis (arrow) in cross bands in pale green chimeral tissue only on older leaves.

Progeny from cross of PgD*-N2542/+ on normal, showing tiny weak dwarf plant at the base of a normal sib.

A vigorous pale green dwarf PgD*-N2542/+ mutant plant from outcross on a stock with a strong normality modifier.

Progeny from PgD*-N2542/+ mutant crossed on normal, showing a small pale green lazy dwarf plant.

A PgD*-N2542/+ mutant plant from a cross on normal, showing small pale green lazy dwarf phenotype. Supported so as to produce pollen.

Progeny from PgD*-N2542/+ mutant crossed on normal showing small pale green lazy dwarf plants. Under different field conditions.