Albinism in Wheat

Winter and spring wheat seedlings with albino (white) tissue may occur in a random distribution among plants. Observations of albinism in winter wheat are generally made during early spring. Seedlings in the two- to four-leaf stage may be entirely white or have green lower leaves and white younger leaves, white stripes within or at the margins of leaves, or bands of white or light-green tissue across green leaves (Fig. 114-1). Purpling of leaf margins is sometimes associated with the white striping symptom. Seedlings with complete albinism seldom exceed two percent of the plant population. Albino plants die but albinism is not known to reduce wheat yield or quality.

Albinism in winter wheat occurs only intermittently. In years of high incidence, albinism becomes more prevalent in plantings made progressively later into the autumn. It occurs mostly during years with the coldest autumns and/or winters, in low areas or on certain slope aspects, varies in prevalence among wheat cultivars, and has no apparent relationship with previous land management including crop rotation and application of herbicides.

The cause of albinism in commercial wheat plantings has not been well characterized but is very common and well described for genetic recombination studies involving wheat and barley anther, callus, and immature-embryo cultures. Many mutations are known to confer temperature sensitivity on the expression of a phenotype. Mutants that die at certain temperatures but can be maintained in a viable and reproductive state at other temperatures are commonly used in genetics experiments.

The genetic basis for albinism has been studied intensively in barley and has resulted in current descriptions for 23 genes associated with albinism. All albinism genes exhibit monofactorial recessive inheritance and originated during spontaneous or induced mutations at well-characterized loci on barley chromosomes. Plants carrying these genes must be maintained in the heterozygous condition because the albino phenotype is expressed only in the homozygous condition. For instance, the barley plants homozygous for the temperature-sensitive albino gene “msm1-SCS” produce seedlings that are albino when grown at temperatures below 10°C, partially albino with stripes or bands at 16°C, and normally green and reproductive at temperatures above 18°C. Failure to produce chlorophyll at low temperature is confined to early seedling stages. In the field, double-cytoplasmic barley mutants carrying this “conditional lethal albino” gene survive the full season as green plants with normal reproduction during relatively warm years and appear as albino seedlings that fail to survive colder winters or warming temperatures during the spring. Barley seedlings with the homozygous albino phenotype exhibit color and survival characteristics that appear identical to field observations described earlier for wheat. Similar temperature-sensitive photosynthesis-gene switching mechanisms are known in rice, corn, and grasses.

Most mutations in enzymatic genes are recessive while most mutations in structural genes are dominant. Metabolism of tyrosine to 3,4-dihydroxyphenalanine is mediated by the tyrosinase enzyme which, when absent, results in complete albinism. Lack of enzymes to completely metabolize 3,4-dihydroxyphenalanine results in incomplete albinism. It is likely that a temperature-sensitive gene encoding for production of one or more enzymes in the photosynthetic pathway is responsible for albinism in wheat.
Selected References

Ahokas, H. 1997. Complementation of conditional lethals, albinos or chlorotics, or of shrunken endosperm or dwarf mutants as selectable markers in transgenic progenies of barley and other plant species. Barley Genet. Newslett. 27:45-47.

![Fig 230. Albinism of emerging and expanded leaves (courtesy R.W. Smiley)](image)

Reference to this chapter: