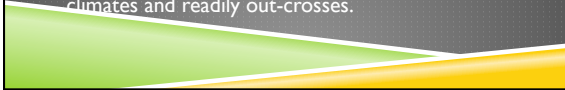


WINTER WHEAT BREEDING BASICS
Richard Little




WINTER WHEAT COMPARED TO OTHER SMALL GRAINS

- ▶ Like many other small grains, winter wheat is a self-pollinating plant. (Pollen drift from transgenic wheat is a minor concern compared to corn or alfalfa).
- ▶ Winter wheat breeding has extended the range of adaptation as far north as North Dakota and Canadian provinces. In contrast, winter barley's northern range is Nebraska, while winter oats and winter durum are limited to Kansas and south.
- ▶ Also, in contrast, rye is readily adapted to northern climates and readily out-crosses.



BREEDING CONCEPTS FOR WINTER WHEAT

- ▶ Adaptation traits of winter wheat
- ▶ Linked traits in winter wheat
- ▶ Crossing strategy
 - ▶ introducing variation
 - ▶ understanding linkages
 - ▶ maintaining favorable trait combinations



REGIONAL ADAPTATION FACTORS

- ▶ Daylength (affects heading date)
- ▶ Rainfall (affects disease spread, use of soil nitrogen, pre-harvest sprouting)
- ▶ Timing of hot season (wheat evolved in a cool climate)
- ▶ Altitude (affects transpiration rate)
- ▶ Wind pattern (determines presence of disease spores)
- ▶ Winter severity
- ▶ Management system specific to a region (demands specific traits, such as long coleoptile in dry areas and dual forage/ grain types for grazing systems)

REGIONAL ADAPTATION—NORTH TO SOUTH

A map of the central United States showing wheat adaptation lines. A vertical double-headed arrow indicates the gradient from north to south. The northern part of the map is labeled "Later Maturing and Winter-hardy Lines" and includes state abbreviations ND, SD, and MN. The southern part is labeled "Earlier Maturing Lines" and includes state abbreviations WY and NE. The map uses a color gradient from blue (north) to red (south).

REGIONAL ADAPTATION—WEST TO EAST

A map of the central United States showing wheat adaptation lines from west to east. A horizontal double-headed arrow indicates the gradient. The western part of the map is labeled "Long Coleoptile" and includes state abbreviations WY, SD, and NE. The eastern part is labeled "Fusarium Head Blight (Scab)" and "Preharvest Sprouting" and includes state abbreviations ND and MN. The map uses a color gradient from red (west) to blue (east).

**SUCCESSFUL CROSSING STRATEGY:
ELITE X ELITE CROSS**

- ▶ Elite lines are locally adapted for heading date, yield and agronomic traits.
- ▶ Elite lines for Nebraska must fall within a small range of heading date. Most lines from the Kansas breeding program are too early. Most lines from the North Dakota breeding program are too late for Nebraska.
- ▶ The goal is to recombine traits to obtain offspring that are better than both parents.

**CROSSING STRATEGY TO INTRODUCE
VARIATION**

- ▶ Cross elite x unadapted lines (x elite)
- ▶ Unadapted lines have a desired trait, such as disease resistance, that is not available in another elite line.
- ▶ When a cross is made to an unadapted, you will lose the favorable trait combinations in most offspring. You need to screen many offspring to find the 'needle in the haystack' with the right combination of desired traits. To increase the odds of obtaining good trait combinations, it is common practice to cross again with an elite line = three-way cross.

UNDERSTANDING LINKED TRAITS

- ▶ Tight linkage = hard to break
 - ✓ Long coleoptile is linked to tall plant height
- ▶ Moderately tight linkage = has been broken in some lines
 - ✓ Disease resistance obtained from rye chromosome arm is linked with poor bread quality, but has been broken in 'Nekota.'
- ▶ Loose linkage = broken more readily
 - ✓ Historically, winter-hardiness had been linked to tall plant height. Some Canadian lines for the Plains have broken this linkage, eg 'CDC Falcon'.

**FAVORED CROSSING STRATEGY
ELITE X PROMISING LINE**

- ▶ Promising lines are lines with desired new trait(s) that have been screened a few years to insure local adaptation and lack of unfavorable linkages.
- ▶ The promising line would be from either a three-way or single cross.
- ▶ This strategy requires access to a full-fledged breeding program, since it takes several years of screening before the promising line is identified.
