



Enhancing Yield Potential of Hard Red Winter Wheat Via Use of Synthetic Backcrosses



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Introduction

- Genetic gain for grain yield in hard red winter wheat cultivars in US Great Plains has reached its peak in 1990s (Graybosch and Peterson, 2010). However, further improvement in genetic gain can be achieved with introduction of new sources of genetic variability
- Synthetic wheat (Figure 1) developed by crossing *Triticum durum* and *Aegilops tauschii* is believed to have the potential to increase genetic variability by introduction of new set of genes with wide range of tolerance to abiotic and biotic stresses
- Furthermore, synthetic derived lines (SDLs) developed by crossing synthetic lines and elite wheat cultivars such as 'TAM 111' and 'TAM 112' resulted in increased grain yield as a result of increased seed size (Figure 2) and weight (Cooper et al., 2012)
- However, the magnitude of genetic gain from such crosses remains unknown. Also, it is not evident if further increase in grain yield can be achieved by indirectly selecting for tillers plant⁻¹ and seeds head⁻¹.

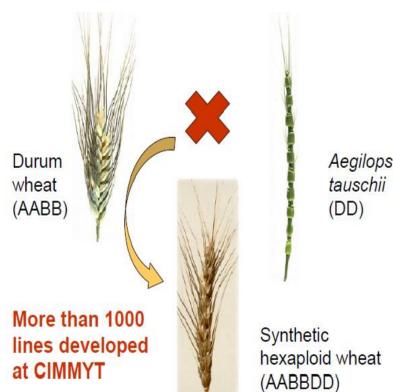


Figure 1. Synthetic wheat

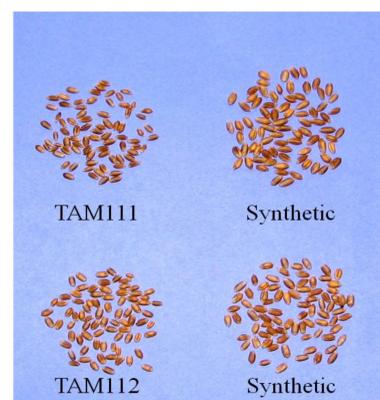


Figure 2. Seed size comparison

Objectives:

1. Predict gain in grain yield via indirect selection for tiller number and seeds per head
2. Characterize synthetic derived lines and conduct association mapping to identify unique alleles associated with drought tolerance
3. Determine allelic relation between greenbug resistance gene present in synthetic lines and Gb3 present in TAM 112

Materials and methods (Objective 1)

- 213 lines selected based on yield, tiller number and seeds head⁻¹ were and will be planted in multiple locations during 2011-12, 2012-13, 2013-14
- Agronomic traits associated with yield and its components will be determined
- Parent-offspring regression (Lush, 1940), Parent-offspring correlation (Frey and Horner, 1957), and realized heritability (Fehr, 1991) will be used to calculate heritability
- Expected response (R) to direct selection and correlated response for grain yield will be estimated to evaluate the effectiveness of indirect selection for grain yield (Falconer and Mackay, 1996)

CIMMYT E95Syn4152-4	CIMMYT E95Syn4152-46	CIMMYT E95Syn4152-78
CIMMYT E95Syn4152-5	CIMMYT E95Syn4152-50	CIMMYT E95Syn4152-84
CIMMYT E95Syn4152-6	CIMMYT E95Syn4152-51	CIMMYT E95Syn4152-89
CIMMYT E95Syn4152-7	CIMMYT E95Syn4152-54	CIMMYT E2Syn4153-3
CIMMYT E95Syn4152-8	CIMMYT E95Syn4152-55	CIMMYT E2Syn4153-12
CIMMYT E95Syn4152-16	CIMMYT E95Syn4152-56	CIMMYT E2Syn4153-24
CIMMYT E95Syn4152-23	CIMMYT E95Syn4152-61	CIMMYT E2Syn4153-31
CIMMYT E2Syn4153-26	CIMMYT E95Syn4152-63	
CIMMYT E95Syn4152-27	CIMMYT E95Syn4152-70	
CIMMYT E95Syn4152-37	CIMMYT E95Syn4152-72	
CIMMYT E95Syn4152-40	CIMMYT E95Syn4152-77	

Table 1. Synthetic parents present in pedigree of synthetic derived lines

Materials and methods (Objective 2)

- 3000 head-rows from 39 populations were grown at Bushland and McGregor, TX during 2011-12 season
- Based on yield and agronomic traits, 600 lines were selected from both locations. These lines will be grown at multiple locations during 2012-13 and 2013-14 seasons
- SDLs will be characterized for several agronomic traits and simultaneously screened for leaf and strip rust
- Phenotyping for drought and heat tolerance will be done based on spectral reflectance (Figure 3 and 4), canopy temperature depression, and other agronomic and physiological traits
- The SDLs will be screened for greenbug resistance in a controlled growth chamber
- Various molecular markers will be used to identify alleles associated with drought tolerance



Fig. Courtesy of Texas A&M AgriLife Research

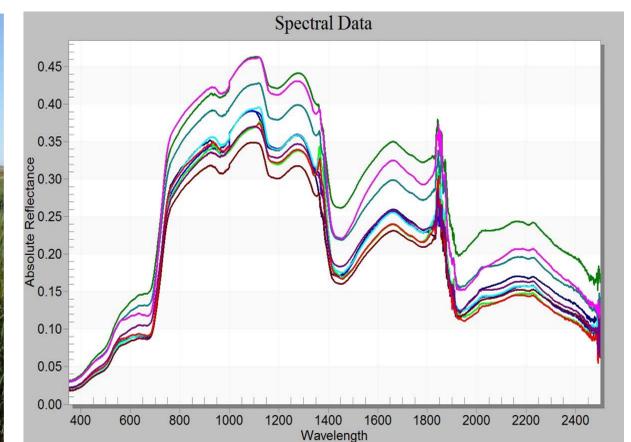


Fig. Courtesy of Texas A&M AgriLife Research

Figure 3. Measuring spectral reflectance using spectroradiometer

Figure 4. Spectral reflectance of different winter wheat cultivars grown under dryland conditions

Materials and methods (Objective 3)

- TAM 112 carries the greenbug resistant gene Gb3
- Synthetic parents E95Syn4152-16 and E95SYN4152-37 used for crossing are also resistant to greenbug; however, the source is unknown
- Screening for greenbug biotype E will done as described by Weng et al. (2005)
- Molecular markers tightly linked to Gb3 will be used for determining sources of greenbug resistance

Expected impact

- Identification of new synthetic derived HRW will ensure availability of new breeds of winter wheat with higher yield potential and better tolerance to biotic and abiotic stresses
- Identification and/or validation of sources of greenbug resistance in synthetic lines will facilitate their utilization in breeding for resistance to this destructive pest
- Identification of SNP markers associated with drought tolerance will facilitate their use in marker assisted breeding

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