Genetic Variations for Spike Fertility and Associated Traits in US Southeastern Soft Wheat Germplasm

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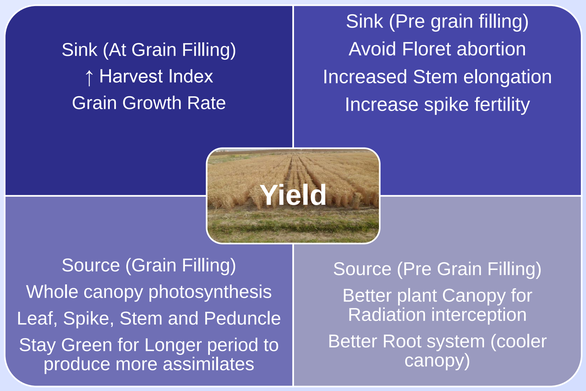
Introduction

- Wheat is prone to different biotic (diseases and pests) and abiotic (drought and heat) stresses around the world.
- Drought affects morphological, chemicals and physiological mechanism in wheat.
- The yield and harvest index are heavily reduced when drought stress is imposed during heading, flowering and soft dough stages (Bauder, 2001; Gupta et al., 2001).
- Drought can decrease wheat yield in early (decreasing tillering and biomass) and late (decrease spike infertility, spike reduction, shrunken grains, grain number and reduced harvest index) stages of crop growth.
- The global climate change will lead to an increasingly unpredictable rainfall events in the future.
- The wheat breeders must develop varieties that can withstand global climate change conditions.
- Genetic improvement is the most effective and sustainable method to achieve this goal.

Objectives

- Study genetic variations for spike fertility, grain number, yield, HI and associated traits in US soft wheat association panel under post-anthesis drought stress.
- Evaluate stay green trait and its association with assimilate partitioning and grain number improvement.
- Identify novel alleles and QTLs associated with spike fertility, stay green and associated traits through genome-wide association analyses



Materials & Methods

- Experimental design: Modified Augmented design with 3 repeated checks
- Drought imposed after Anthesis
- Sowing date: November, 24 2015
- Harvesting date: May 18, 2016
- **Spike Fertility**
  - ✓ Spike fertility is considered to be the major venue for increasing grain number under stress and non stress conditions
  - ✓ Ratio of spike dry chaff weight and number of grains.
- **Stay Green**
  - ✓ NDVI and SPAD were utilized to study whole plant and leaf level senescence in wheat genotypes.

Results

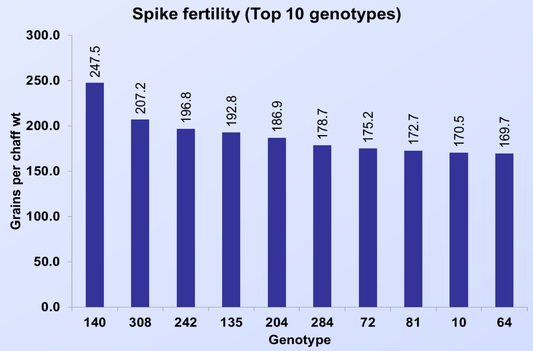


Fig 1. Spike Fertility of Top 10 genotypes

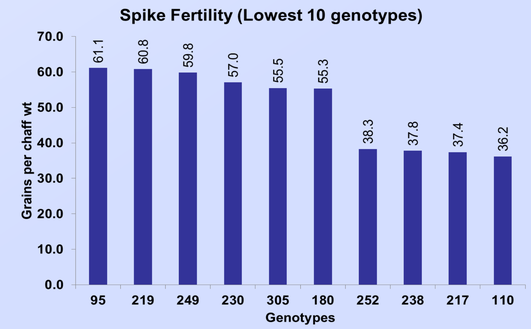


Fig 2. Spike Fertility of Lowest 10 genotypes

Significant variation recorded for spike fertility trait. Breeders can tap this resource by improving sink strength and increasing stay green trait for progressing yield under drought stress condition.

	Grain Yield kg/plot	Spike Fertility (grain g^{-1})	1000 KWT	No of Grains/spikes
Max	404	207	60	674
Min	10	36	13	152
Avg	143	111.67	27.02	404

Table 1. Variation (Min, Max and Avg.) among genotypes for grain yield, spike fertility, 1000 kernel weight and no of grains per selected spikes

NDVI and SPAD for Stay Green Measurement

NDVI is an indicator of greenness at whole plant level while SPAD calculate chlorophyll content at leaf level.. These indicator combines leaf area with chlorophyll content to produce greenness index. NDVI readings were collected with a Green Seeker handheld crop sensor (Trimble Navigation) while SPAD with Minolta, USA. NDVI measurements were taken five growth stages from heading to physiological maturity while SPAD were taken

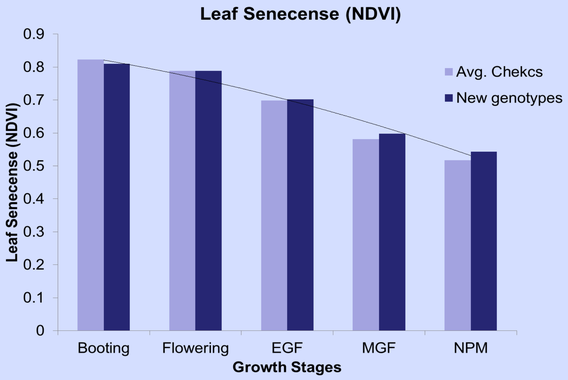


Fig 3. Leaf Senescence from booting to anthesis

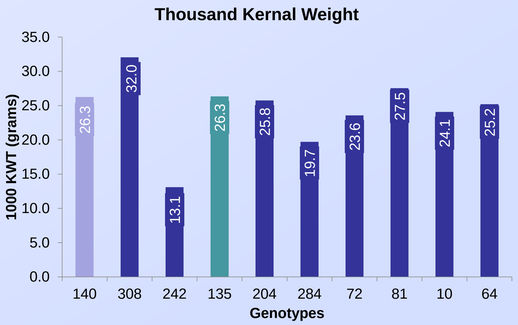


Fig 4. 1000 kwt of Top 10 genotypes

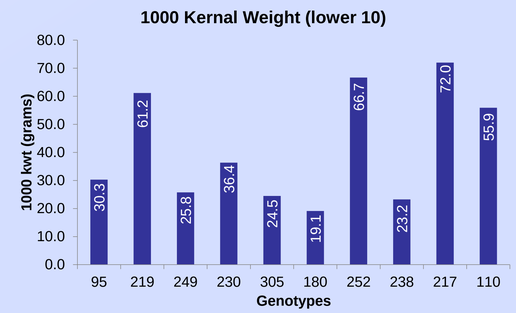


Fig 5. 1000 kwt of lowest 10 genotypes

Conclusion

- Significant genetic variability observed in spike fertility and stay green trait during first year of study under drought conditions.
- Next step to identify genes/loci involved with higher spike fertility and stay green traits in soft wheat
- Introgress those genes in different genetic background to develop high yielding wheat varieties

Bibliography

Wang W., Vinocur B., Altman. (2003) Plant response to drought, salinity and extreme temperatures towards genetic engineering for stress tolerance. Planta. 218, 1-14.

Bauder, J. 2001. Irrigating with limited water supplies. Montana State Univ. Comm. Ser. Montana Hall. Bozeman, MT 59717, USA

Gupta, N.K., S. Gupta and A. Kumar. 2001. Effect of water stress on physiological attributes and their relationship with growth and yield of wheat cultivars at different stages. J. Agron. Crop Sci. 186: 55-62.

Cossani and Reynold (2012). Plant Physiology 160.-1710-18