# Comparing the water-use efficiency of 'bloom' and 'bloomless' Sorghum genotypes

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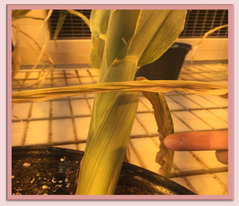
## Background

- Sorghum (*Sorghum bicolor L.* Moench) is an important crop grown for both fodder and food, especially in Africa and Asia.
- The bloomless (bm) type, which visually exhibits an absence of white, fluffy epicuticular wax on the leaf sheath, is known to be highly digestible compared to bloom (Bm) type.
- The bloomless trait has been associated with low stress tolerance, but this conclusion is based on a narrow pool of bloomless alleles. The purpose of this study was to determine if the Bm type confers a water use advantage over the bm mutants.

Bloom

Bloomless



Sparse Bloom

## Methodology

- Greenhouse experiments were conducted at College Station, TX, in 2015 using $BC_2F6$ bloom and bloomless near isogenic lines (NILs) derived from ethylmethanesulfonate (EMS) mutagenized Tx623, a heavily bloom inbred line.
- A second set of F4 was derived from a cross of Stg4 (bloom) X M1789 (EMS-induced bloomless).
- Two types of treatments were applied, well watered (WW) and water deficit (WD). In each treatment, a complete randomized block design was used in with four replications per treatment (pots) and two plants per pot for each of the bloom and bloomless lines.
- Intrinsic measurements were taken for gas exchange, stomatal conductance (C), canopy temperature, vapor pressure deficit (VPD) and humidity.
- Whole plant water use was determined by change in weight per pot every 2 d from emergence to heading, when non grain total biomass is expected to plateau.
- Integrated WUE was determined as the ratio of total dry biomass to whole plant evapotranspiration for each genotype in each treatment.
- The means were computed separately for F4 bloomless and F4 bloom, and separately for bloom NILs and bloomless NILs.

## Objectives

1. To compare the whole plant water use and transpiration efficiency of sorghum.
2. Determine the relative water use among Sorghum genotypes using spectral reflectance data and electromagnetic sensor.

## Results

- Results show that under the well watered (WW) treatment, the F4 Bm type had significantly higher WUE than F4 bm, but not different under WD conditions.
- There was no significant difference between the Bloom NILs and their bloomless counterparts under both conditions.
- These results suggest that the bloomless sorghum types can have equal potential to accumulate high biomass comparable to their bloom wild type counterparts under water stress.

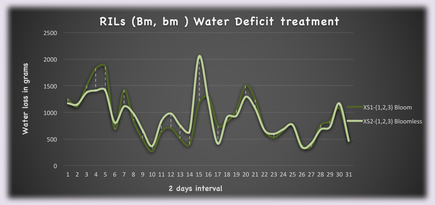



**Fig1.** The mean water loss between Bloom and bloomless F4 segregants from the Stg4 X M1789.

Data points are the differences between water loss in the water deficit treatment.

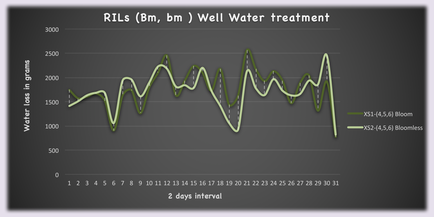
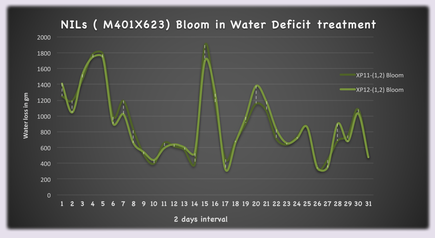



**Fig2.** The mean water loss between Bloom and bloomless F4 sergeants from the Stg4 X M1789.

Data points are the differences between water loss in the well watered treatment.



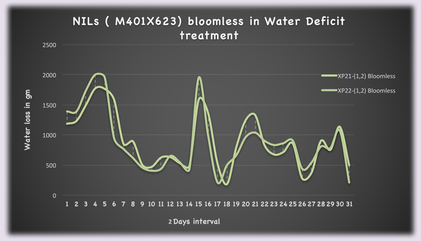
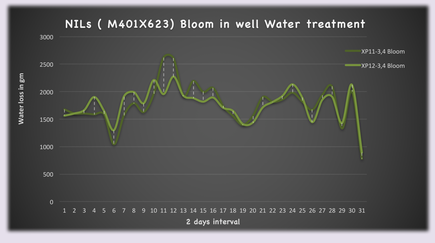




**Fig 3 and 4.** The mean water loss between the Bloom and bloomless BC2-F5 from M401 X 623 in water deficit treatment. XP11 and XP12 are the derivatives with Bloom phenotypes, while XP21 and XP22 are bloomless phenotypes



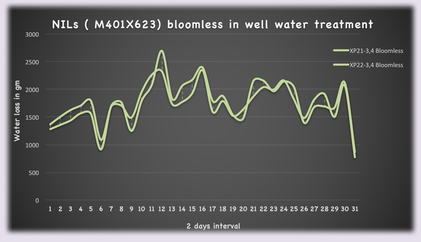




**Fig 5. and 6.** The mean water loss between the Bloom and bloomless BC2-F5 from M401 X 623 in well water treatment. XP11 and XP12 are the derivatives with Bloom phenotypes, while XP21 and XP22 are bloomless phenotypes

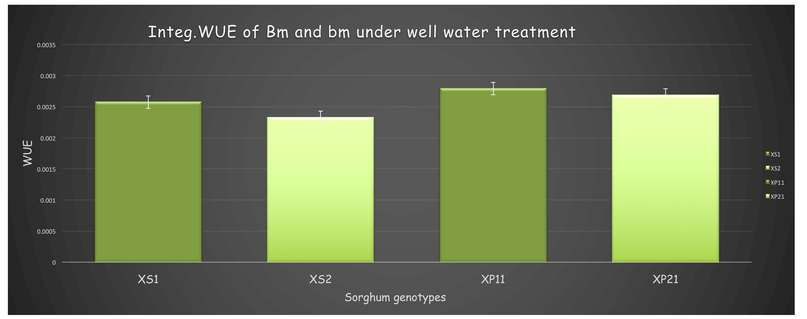



**Fig7. The mean water loss between Bloom (XS1) and bloomless (XS2) F4 segregants from the Stg4 X M1789 and BC2-F5 XP11 and XP21 from M401 X 623. Data points are the differences between water loss in the Well Watered treatment.**

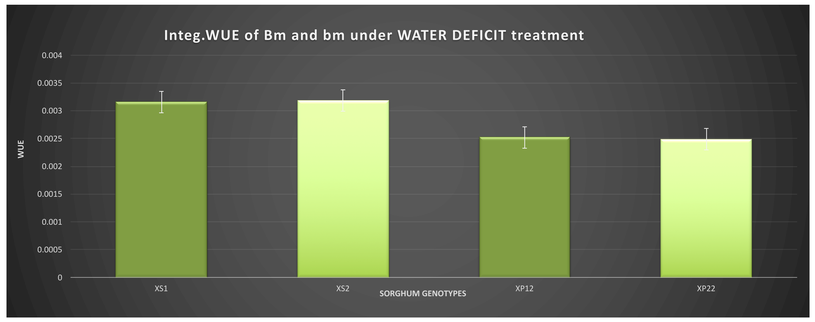
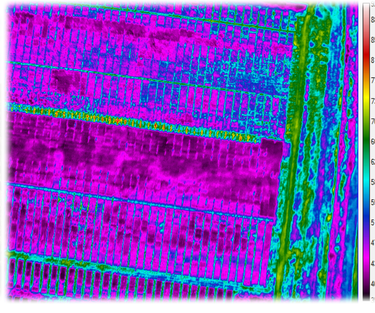
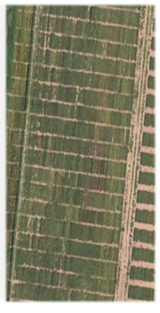



**Fig8. The mean water loss between Bloom (XS1) and bloomless (XS2) F4 segregants from the Stg4 X M1789 and BC2-F5 XP11 and XP21 from M401 X 623. Data points are the differences between water loss in the Water deficit treatment.**

## Research progress

- Field data from two different environment collected.
- Using hyper spectral reflectance information to remotely determine relative water use and productivity.
- Electromagnetic sensor EM38 to measure relative soil moisture.
- In order to get best results the EMI measurements and hyperspectral information will be combined.





**References**
Hamissou, Mijitaba, and Dale E. Weibel. 2004. The effects of epicuticular wax cover on the rate of water loss of Sorghum bicolor (L.) Moench. Asian Journal of *Plant Sciences*. 3 : 742-746

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