Characterization of Backcross Progeny Resulting from *Sorghum halepense* x *S. bicolor* Hybridization

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Background

- Many cultivated species hybridize spontaneously with their wild and weedy relatives and produce fertile hybrids (e.g., Ellstrand et al. 2013)
- There is a likelihood for outcrossing between *Sorghum bicolor* (sorghum) and its wild relative *Sorghum halepense* (Johnsongrass) under field conditions (Arriola and Ellstrand 1996)
- Hybridization between *S. bicolor* and *S. halepense* presents a challenge to successful deployment of novel traits in crop sorghum
- Herbicide resistance is a trait of great interest to facilitate effective grass weed management in sorghum, including the management of johnsongrass, but the transfer of resistance from crop sorghum into johnsongrass would make such a trait obsolete
- It has been suggested that the sterile triploids could backcross with the *S. bicolor* parent to produce viable hybrids
- The genetic characteristics of progeny resulting from such backcrosses is not well understood

Objective

To characterize the genotype of backcross progeny (BC_1F_1) resulting from control crosses between a F_1 hybrid (triploid) and a *S. bicolor* parent

Materials and Methods

- A greenhouse experiment was conducted at the Weed Science Laboratory, Texas A&M University, College Station, TX between August 2015 and February 2016
- Controlled artificial crosses between *S. bicolor* and *S. halepense* produced a male-sterile triploid plant (F_1)
- The triploid was then backcrossed with three *S. bicolor* lines, TX-623, RTX-2783, and RTX-436 using the triploid hybrid as the female parent
- BC_1F_1 seed were harvested through multiple backcrossing events
- Preliminary characterization was carried out on approximately 100 progenies
- Seedlings were established in small pots for subsequent ploidy determination
- First, a flow-cytometry analysis was carried out using leaf tissue samples (Loureiro et al. 2007) (Fig. 1)
- Actual chromosome numbers were subsequently determined, following a proven chromosome spreading technique (Jewell et al. 1994) (Fig. 2)

Results and Discussion

- Crosses between *S. halepense* and *S. bicolor* are typically triploid or tetraploid
- Backcrosses between the F_1 triploid hybrid (female) and the *S. bicolor* parent (male) produced either euploids or aneuploids
- A backcross event between the triploid F_1 hybrid and *S. bicolor* genotype RTX-2783 produced a diploid (20 chromosome) individual (Fig. 3)

Results and Discussion

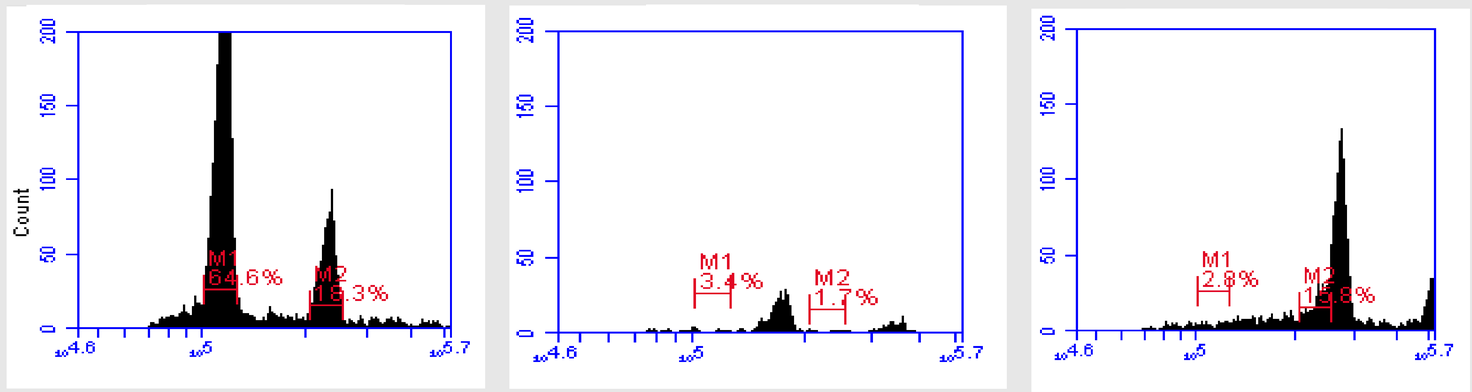

Fig. 1. Flow cytometric analysis confirmation of a) diploid, b) triploid, and c) tetraploid

Fig. 2. A 20-chromosome diploid, verified using the chromosome spreading technique

Fig. 3. Hybrid progeny (triploid F_1 X RTX-2783) with a 20 chromosome euploid

Fig.4. Hybrid progeny (triploid F_1 X RTX-623) with a 21 chromosome anueploid

Results and Discussion (cont…)

- A backcross event between the triploid F_1 hybrid and *S. bicolor* genotype RTX-623 produced an aneuploid (21 chromosome) individual (Fig. 4)
- The 20 chromosome euploid (Fig. 2) resembled *S. bicolor* in growth characteristics, with a short stature, "bushy" appearance and robust, compact panicle. The majority of flowers appeared to be fertile (Fig. 3.)
- The 21 chromosome aneuploid resembled *S. halepense* in growth characteristics, with slender, tall (approx. 1.5 m) stems and open panicles. The majority of flowers appeared to be male sterile.
- Results indicate that the BC_1F_1 progeny can be fertile and may persist in the environment

References

Arriola PE, and Ellstrand NC (1996). Crop-to-weed gene flow in the genus sorghum (poaceae): Spontaneous interspecific hybridization between johnsongrass, *Sorghum halepense*, and crop sorghum, *S. bicolor*. *American Journal of Botany* 83:1153–1159.

Ellstrand NC, Meirmans P, and Rong J (2013). Introgression of crop alleles into wild or weedy populations. *Annual Review of Ecology, Evolution, and Systematics* 44:325-345.

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Conclusions

- Confirmation of fertile BC_1F_1 progeny has implications for the escape of novel traits into *S. halepense*
- More studies are necessary to fully characterize the fitness of the BC_1F_1 progenies in the environment

Future Research

Further characterize the phenotype and genotype of the BC_1F_1 progenies

Acknowledgement

SORGHUM CHECKOFF