Strategies to decrease management inputs and improve quality of *Tripsacum* for fodder production and ecosystem services

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Introduction

Species and biotypes of the genus Tripsacum include: eastern gamagrass (*T. dactyloides*) in North and Central America; Guatemala grass (*T. fasciculatum* syn. *T. andersonii*) in Latin America and the West Indies; and wide-leaf gamagrass (*T. latifolium*) throughout Mesoamerica. Of these, Guatemala grass has become widely popular throughout the tropics as a fodder plant and for its benefits related to environmental and ecosystem services.

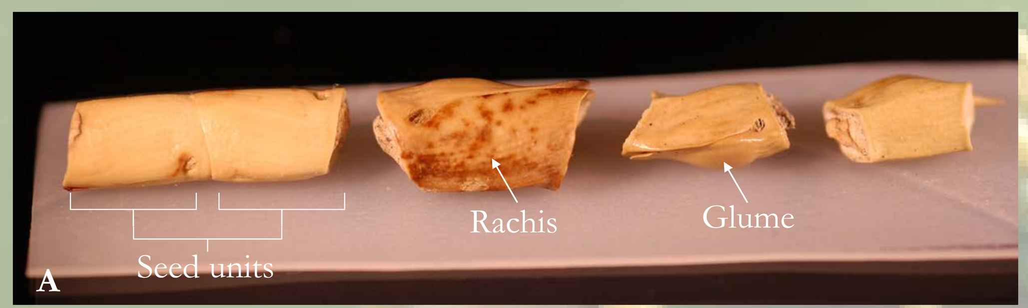

Image A. (l-r) Two joined *Tripsacum* seed units, ventral rachis, dorsal glume, entire seed

Guatemala grass is a hearty, long-lived perennial warm-season bunchgrass. Mature plants are somewhat shallow rooted, with short rhizomes, and produce robust foliage with leaf blades 10cm wide and 120cm long. The species has been utilized for forage (for cut-and-carry and green feed during dry conditions), environmental management (as contour strips for soil erosion) and for wildlife (as both forage for megafauna and as refuge for pollinators) throughout Uganda, Kenya, and Tanzania, and is often recommended as an alternative to Napiergrass (*Cenchrus purpureus*) because of its increased tolerance to drought. The major impediment to more widespread use of Guatemala grass extends from its tri-hybrid genetic origin, which causes plants to develop mostly sterile seed. There are no known commercial suppliers of seed in the Americas or Asia.

Image B. Crown and root structure of mature Tripsacum plant.

Image C. Arrangement and structure of seed in mature raceme.

Objectives

This shortfall in seed production necessitates vegetative production of all stands. Rapid establishment and growth of vegetative propagules is of key importance to reduce competition from non-desirable weed species. Recent research in Tripsacum has shown that nitrogen use efficiency (NUE) is maximized through early season fertility, which may also increase the days to maturity, extending the quality lifespan of a stand. Also, very-early season, late season, and very-late season applications of triazine-class herbicides (atrazine) have been shown to increase seasonal yields as well as decrease overall herbicide use. Selecting individuals for desirable forage characteristics (disease resistance, cold hardiness, late maturity digestibility) can begin to improve utilization for animal production.

Acknowledgments

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Genetic Resources and Breeding

It is believed that the genome of *T. andersonii* is of rather ancient origin, sharing both triploid *Tripsacum* (2n = 3x = 54) and haploid *Zea* (n = 10) genomes. This product is likely the result of a hybridization event between a *Tripsacum* (2n = 36) (most likely *T. latifolium*) and either domesticated maize (*Z. mays* L. ssp. *mays*) or annual teosinte (*Z. mays* L. ssp. *mexicana* (Schrad.))

Results

Figure 1. In vitro dry matter digestibility (IVDMD) of *Tripsacum sp.* in southeastern United States when harvested in 30d intervals. All plots were harvested to 15cm stubble height and fertilized with 56 kg ha-1 of N following each harvest. LSD = 0.8184

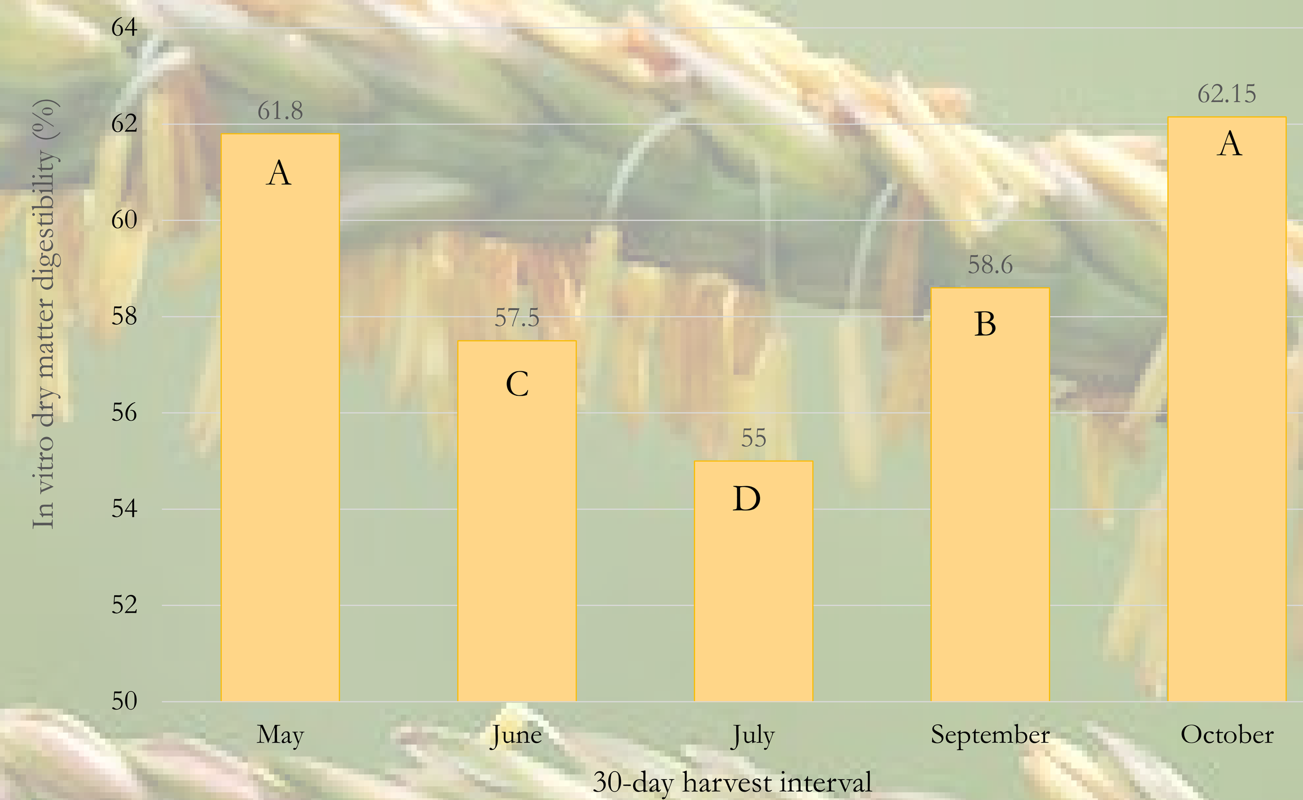

Figure 2. In vitro dry matter digestibility (IVDMD) of *Tripsacum* clones in southeastern United States when harvested in 30d intervals. All plots consisted of five fully mature clones, planted in rows at 0.61m intervals and 1.2m row spacing. Each plot was replicated three times. LSD = 1.48

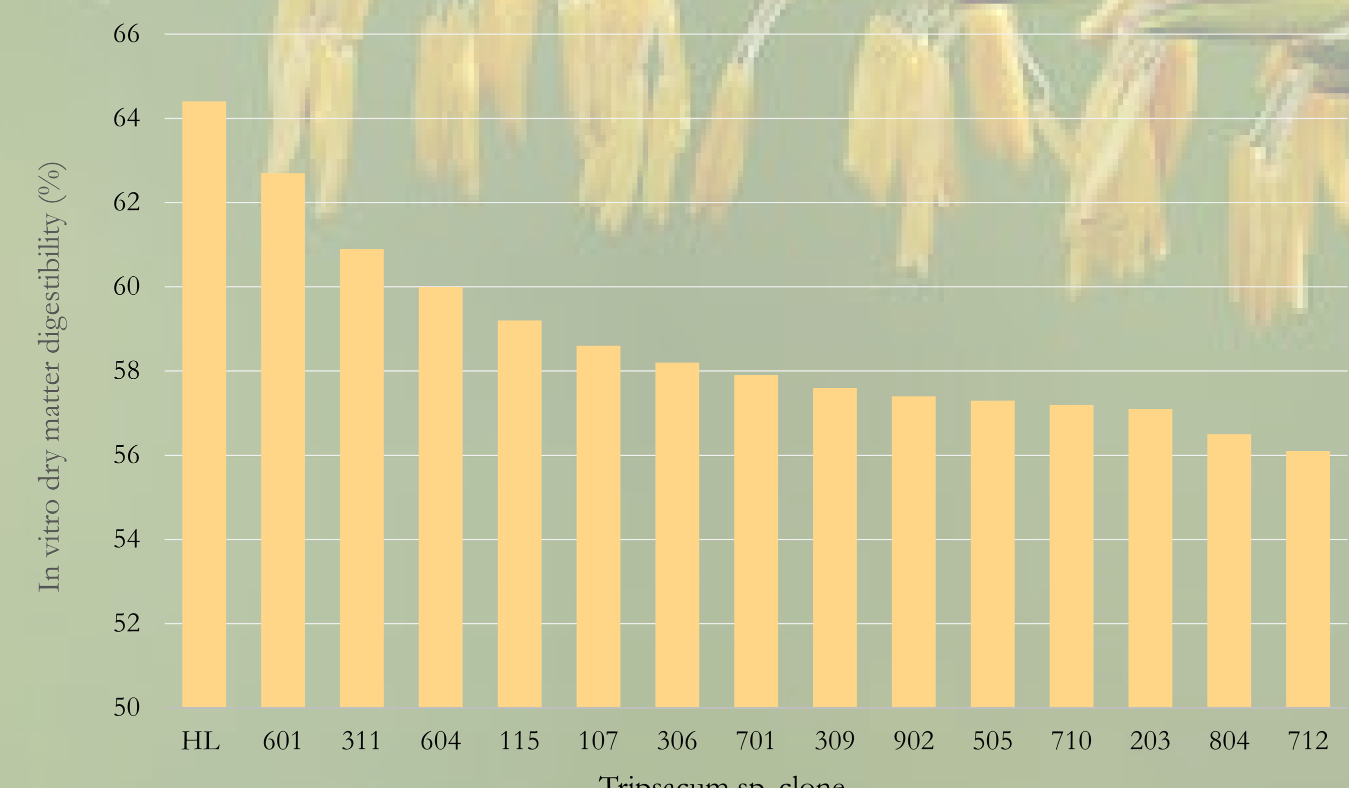

Image D. Structural detail of vegetative propagule of *Tripsacum sp.* commonly referred to as a proaxes. The proaxes is a thick, scaly, rhizome-like structure which is commonly used for vegetative propagation, especially in *Tripsacum* species that do not reliably produce viable seed, such as *T. andersonii*. Vegetative establishment is often achieved by planting a) stem cuttings with 3-5 nodes, b) rooted culms, or c) rhizomes at 1,000 – 2,000 kg ha^{-1} in row spacing of at least 1m.

Experimental Design and Methods

Elite Germplasm Evaluation

- 14 total individuals selected as elite
- Arranged as a randomized complete block
- Three replications
- Each plot = 5 proaxes in single row
- 0.61m between plants
- 1.2m between rows
- 1.5m between replications

Discussion

- Disease resistance - Southern corn rust (*Puccinia polysora*)
    - Significant accession effect (P<0.0001) LSD = 0.92
    - Local selections among the most severely infested
- Cold hardiness
    - Not significant (P=0.7264) LSD = 2.16
- Late maturity
    - No significant differences, but valuable for germplasm improvement
- Digestibility
    - Significant (P<0.0001) Range from 50% – 76%
    - Similar to data from tropical Mexico

Guatemala grass is established almost entirely through vegetative propagation, either through rooted tillers, rhizomes, or stem cuttings containing multiple nodes. This characteristic makes improvement breeding difficult, but not impossible. The collection, evaluation, and identification of elite germplasm will be key to further improvement of the species.

Further evaluation goals

- Fertilizer use efficiency
- Quality improvement via incorporation of forage legumes in polyculture
- Post-harvest recovery and regrowth initiation