Identification of *Urochloa humidicola* hybrids with waterlogging tolerance and Biological Nitrification Inhibition (BNI) capability

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Introduction

Soil waterlogging (flooding of the soil) is a major limitation to pasture productivity due to the slow diffusion of gases in water that reduces plant growth, as O_2 availability in the root zone decreases (Cardoso et al., 2014).

Biological nitrification inhibition (BNI) is a process where roots exudate organic substances that inhibit the activity of soil nitrifiers - nitrification (Subbarao et al., 2007, 2009, Nunez et al., 2017).

Urochloa humidicola (*Uh*) is an important forage grass in humid lowland tropics that has been identified and characterized for having good waterlogging tolerance (Keller-Grein et al. 1996; Calisto et al. 2008; Cardoso et al., 2013) and high soil nitrification inhibitory potential (Subbarao et al, 2007; Gopalakrishnan et al., 2007).

Objective

To evaluate the variation in waterlogging tolerance and BNI of twenty seven hybrids of *Urochloa humidicola* developed by the *Urochloa* breeding program of CIAT. Two commercial cultivars of *Urochloa humidicola* (cvs. Tully and Llanero) were included for comparison purposes (checks).

Materials and Methods

Waterlogging tolerance test

Shoot growth (pixels) was measured in plants growing in a top Oxisol which was mixed with river sand in a proportion of 2:1 (w/w) and fertilized to avoid nutrient deficiencies. Plants were planted into PVC pipes of 80 cm high and 7.5 cm diameter in a factorial combination of two drainage conditions: drained (field capacity) and waterlogged.

The trial was established in a four-replicate randomized complete block, for 23 days under greenhouse conditions. Shoot growth was estimated as in Jiménez et al (2017).

Potential nitrification

Soil nitrification potential was measured to evaluate BNI capability from top soil samples taken in plots of $1m^2$ using a modified shaken slurry procedure (Hart et al., 1994, L. He et al. 2018) One g of soil (air-dried) was mixed with 10mL assay solution (30mM KH_2PO_4; 0.7mM K_2HPO_4 and 0.75mM ammonium sulfate, pH = 7.2) in a 50 mL covered flask. Then, incubated at 120 rpm at 25 °C. Potential nitrification rates were determined at 0h, 24h, until 96h intervals to calculate the slope of a linear regression of (NO_3^-)-N production versus time.

Results

Two hybrids were identified as promising based on similar biomass to that of commercial cultivars under drained and waterlogged soil conditions. These two genotypes showed ability to maintain positive growth under waterlogging conditions. This ability is most likely the outcome of a larger root (dry mass) than most of the other hybrids and the two checks tested (Figures 1 & 2).

Figure 1: Ranges of waterlogging tolerance among *Urochloa humidicola*. Note that Uh16-1351 and Uh16-1756 show greater green leaf area than checks.

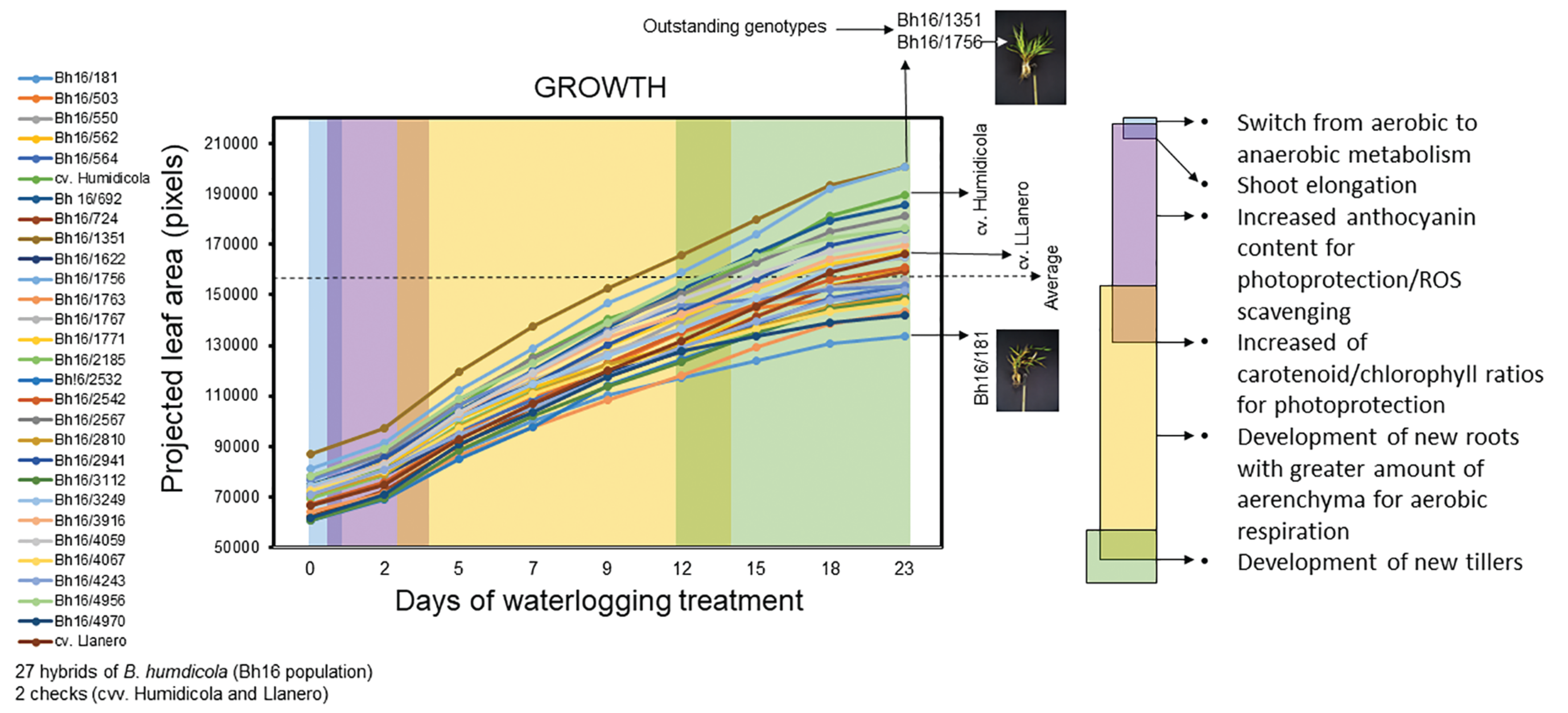

Figure 2: Time course of growth and acclimation processes of 27 *Urochloa humidicola* hybrids after 23 days of growth under drained or waterlogged soil conditions.

One promising hybrid for waterlogging (Uh16-1351) also showed highest BNI capacity among hybrids and similar to that shown by a commercial cultivar with high BNI (CIAT 679 cv. Tully, Figure 3).

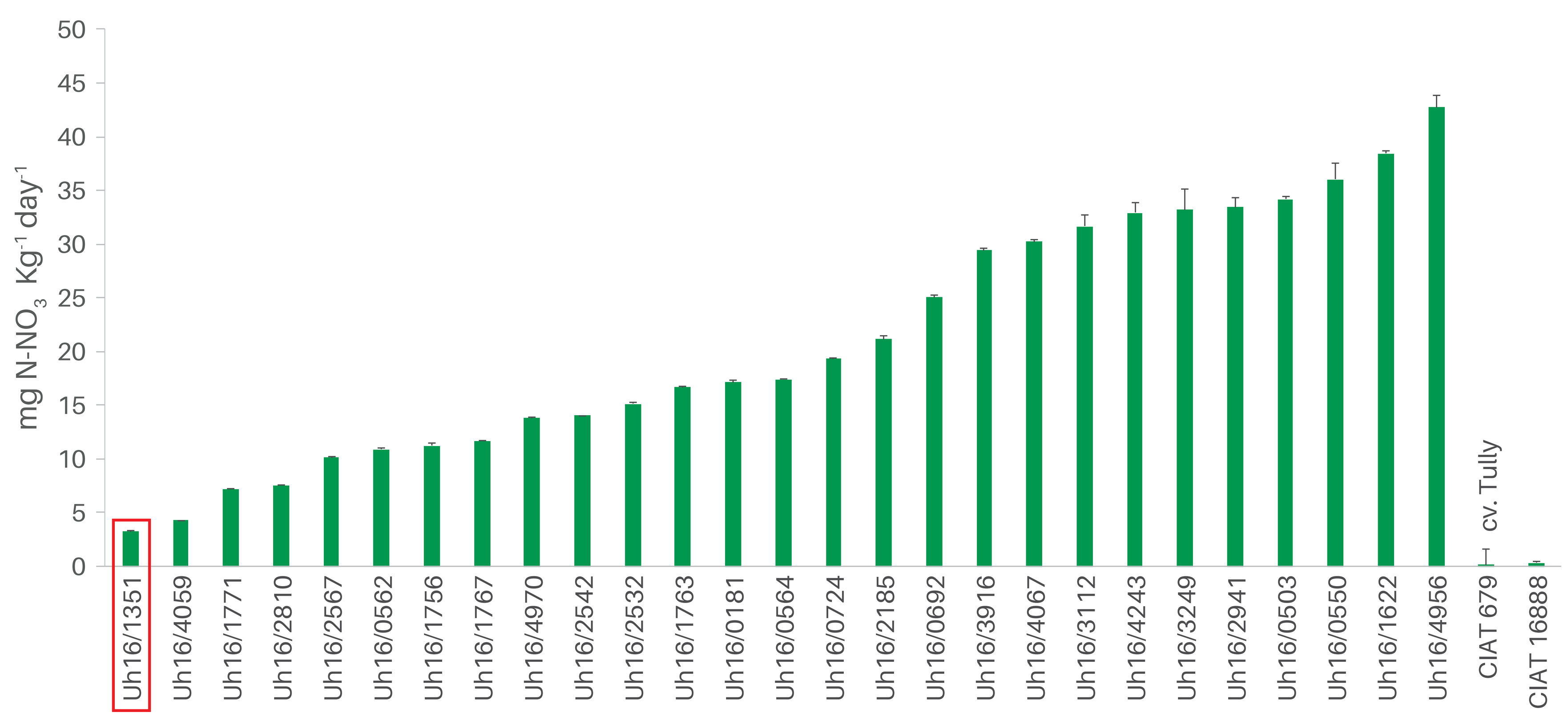

Figure 3: Potential nitrification from soil rhizospheric of 27 *Urochloa humidicola* hybrids. Low potential nitrification (expressed as mg N-NO3– Kg-1 day -1) represents high BNI capacity.

Conclusions

We identified one *Urochloa humidicola* hybrid (Uh16-1351) with both waterlogging tolerance and high BNI capacity. This promising hybrid needs to be further tested under field conditions.

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