High atmospheric drought exacerbates the negative effects of growth under moderate soil water content in Guinea grasses

Juan Andrés Cardoso, An Notenbaert, Solomon Mwendia and Michael Peters (e.mail: j.a.cardoso@cgiar.org)
Tropical Forages Program, International Center for Tropical Agriculture (CIAT HQ, Cali-Colombia; CIAT-Africa, Nairobi-Kenya)

Introduction

- There is a growing interest in Guinea grass (*Megathyrsus maximus*, formerly *Panicum maximum*) for its use as forage to feed livestock under a range of Sub-Saharan African (SSA) conditions.
- Traits related to a plant's water use influence the fitness of genotypes for specific rainfall and evaporative demand environments.
- Atmospheric vapor pressure deficit (VPD) has been widely recognized as the force driving transpiration in plants, thereby influencing their efficiency in water use.
- The objective of this work was to test differences in shoot biomass, leaf senescence and water use efficiency (WUE) of 126 accessions of Guinea grass under and two irrigation conditions and three levels of VPD.

Materials and methods

- 126 germplasm accessions of Guinea grass provided by the Genetic Resources Program of CIAT.
- Two irrigation levels (soil kept at 60 and 90% of field capacity, FC)
- Three VPD levels (1.5, 3.0 and 4.0 kPa), achieved by micro-humidifers.
- Traits measured after two weeks of treatment under greenhouse conditions:
  - ✓ Shoot biomass production
  - ✓ Leaf senescence
  - ✓ WUE (shoot biomass per amount of water transpired, g · ml)

Key results

- Overall, biomass production, leaf senescence and WUE were not affected in most genotypes when growing under moderate atmospheric and soil drought (3.0 kPa of VPD and 60% FC) when compared to plants growing under low atmospheric drought (1.5, kPa) and soil kept under 90% of FC (Figure 1).
- Under moderate soil water content (60% of FC) and high atmospheric drought (VPD of 4.0 kPa), at least a two-fold increase in leaf senescence was recorded compared to the others treatments (Figure 1B).
- Growth under high atmospheric drought (VPD of 4.0 kPa) resulted in reduced shoot biomass (Figure 1A) and reduced WUE (Figures 1C).

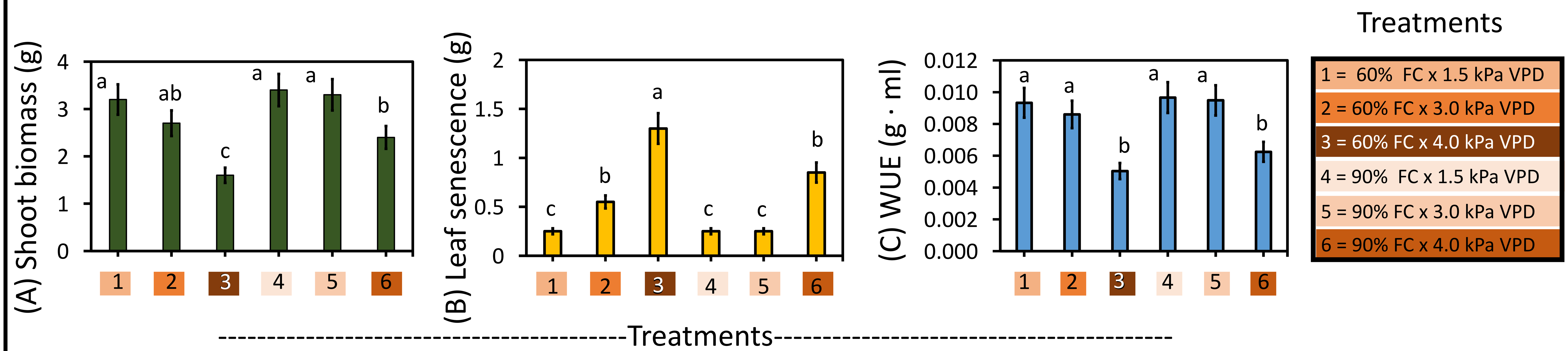
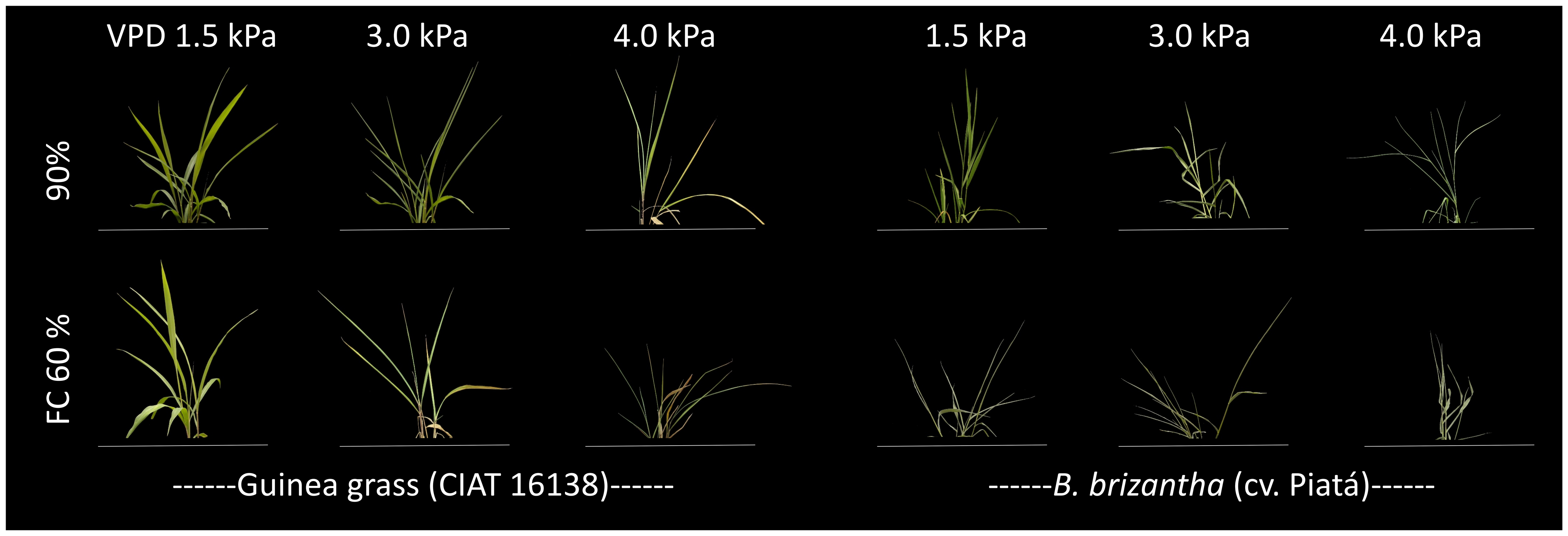


Figure 1. Mean values of shoot biomass (A), leaf senescence (B) and WUE (C) of 126 germplasm accessions of Guinea grass grown under a factorial arrangement of irrigation (60 and 90 % of FC) and VPD (1.5, 3.0 and 4.0 kPa) levels. Different letters above columns represent statistical differences at α = 0.05.

Figure 2.
A representative germplasm accession (CIAT 16138) showing the overall effects of growth under different conditions of soil water content (FC) and evaporative demand (VPD). For comparison, a cultivar of *Brachiaria brizantha* (cv. Piatá).
Note bigger plants of Guinea grass with not visual symptoms of stress (e.g., no wilting) under humid air (1.5 kPa) and moderately dry soil (60 % FC) compared to those of cv. Piatá. This suggests lesser stomatal control of water loss of Guinea grass under such conditions, which "red flag" their targeting to hot areas with low precipitations.



- Carbon starvation and hydraulic failure were likely the basis of reduced shoot biomass and WUE, and increased leaf senescence under high atmospheric drought and moderate soil water content.
- Further research is needed to test promising genotypes under field conditions.

- Our results suggest that the more productive Guinea grasses (i.e., those with yields similar to those of Napier grass; data not shown) could be suitable options for forage production, without big yield penalties, in tropical agro-ecosystems across SSA where short, frequent and mild droughts and low atmospheric evaporative demand conditions are common (i.e., a range of humid to sub-humid agroecosystems with annual precipitation above 900mm).

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