Performance of Napier grass (*Cenchrus purpureus* L.) genotypes grown under limited soil moisture

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INTRODUCTION

Scarcity of feed and forage resources, in areas where annual precipitation is erratic and low particularly in dry seasons, is one of the main limiting factors for increased livestock productivity. Thus, securing forage biomass yield throughout the year is one of the strategies that can be employed for sustainable livestock production in drought prone areas. Napier grass (*Cenchrus purpureus Schumach* L.) is an important perennial forage in tropical countries. It is considered as a short-term drought tolerant forage, which is a useful trait in areas with low soil moisture during the dry season. In order to exploit the potential of this grass species for drought stress tolerance a field drought stress experiment was conducted using a panel of Napier grass genotypes to identify genotypes with higher biomass productivity under moisture stress conditions.

METHODOLOGY

- **Eighty four Napier grass accessions were planted using a P-rep design in four blocks in Bishoftu, Ethiopia.**
- **After establishment two blocks were treated with moderate stress (20% soil moisture) and the rest blocks were treated with severe stress (10% soil moisture) during the dry season (Fig. 1).**
- **Agro-morphological data were collected after every 8 weeks of re-growth.**

Fig. 1. Napier grass growing under moderate water stress (MWS, left) and severe water stress (SWS, right) conditions

RESULTS

Table 1. Summary ANOVA and coefficient of variation for morphological and agronomic traits of four dry season harvests

Sources of variation	Traits (P-Level)				
	LW	LL	Fv/Fm	TDW	WUE
Genotypes	<.001	<.001	<.001	<.001	<.001
Treatments (MWS/SWS)	0.04	0.03	0.04	0.05	0.05
Harvest	<.001	<.001	<.001	<.001	<.001
Genotype X Treatment	NS	<.001	NS	<.001	<.001
Genotype X Harvest	<.001	<.001	<.001	<.001	<.001
Treatment X Harvest	<.001	<.001	<.001	<.001	NS
Genotype X Treatment X Harvest	NS	<.001	NS	<.001	<.001
CV %	9.4	6.1	2.6	17.8	13.4

PH = plant height; LW = Leaf width; LL = Leaf length; FvFm= Photosynthetic efficiency; TDW = Total dry weight; WUE =Water use efficiency; Values indicate probability level ; NS= Non-significant difference

Table 2. Top 10 Napier grass genotypes in terms of stability analysis across six harvests for moderate water stress (MWS) and severe water stress (SWS) conditions

Genotype	MWS				Genotype	SWS			
	TDW mean (t/ha)	rY	rASV	YSI		TDW mean (t/ha)	rY	rASV	YSI
16819	2.79	1	78	79	16819	2.54	1	79	80
16803	2.65	2	3	5	CNPGL 93 -37-5	2.42	2	80	82
16839	2.55	3	84	87	CNPGL 92-66-3	2.39	3	33	36
BAGCE 30	2.5	4	83	87	16839	2.29	4	84	88
16811	2.46	5	77	82	BAGCE 100	2.27	5	58	63
16795	2.43	6	79	85	BAGCE 30	2.22	6	82	88
CNPGL 92-66-3	2.36	7	45	52	16791	2.21	7	32	39
CNPGL 93-42	2.36	8	82	90	16795	2.2	8	77	85
BAGCE 93	2.29	9	81	90	16802	2.19	9	39	48
14982	2.25	10	50	60	BAGCE 93	2.15	10	83	93

Rank based on dry biomass yield (rY), rank based on AMMI stability variance (rASV), Yield stability index (YSI), total dry weight (TDW), Moderate water stress (MWS) and Severe water stress (SWS).

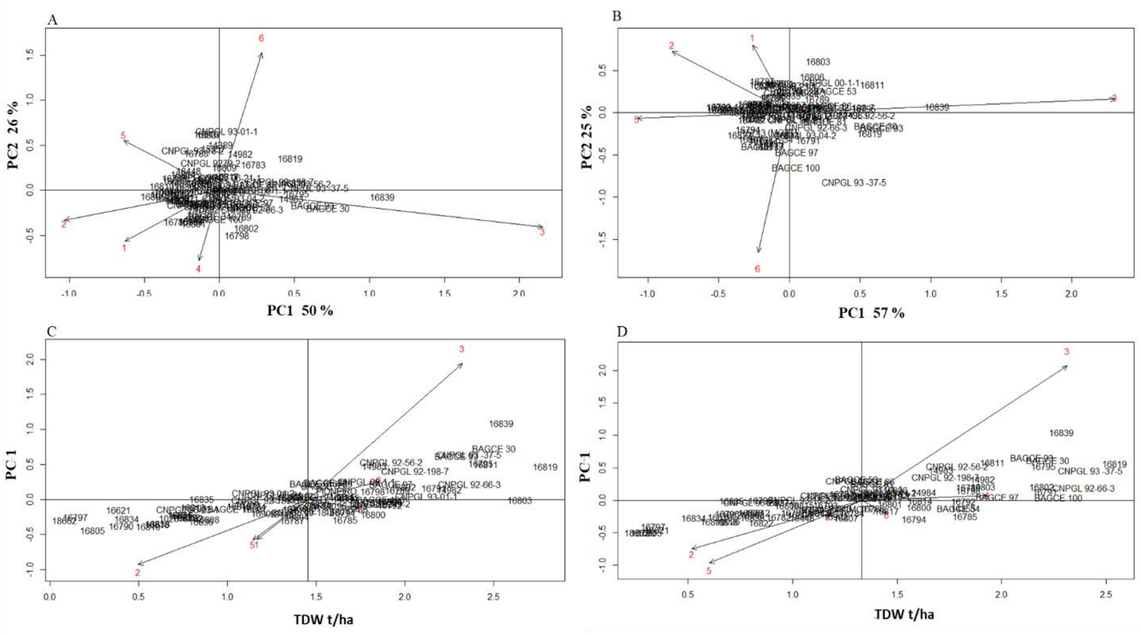

Fig. 2. Biplots of an Additive Main effects and Multiplicative Interaction (AMMI) analysis of Principal component 1 (PC1) and Principal component 2 (PC2) upper lane A) Moderate water stress B) Severe water stress and biplot dry weight (TDW) vs PC1 lower lane C) moderate moisture stress and; D) severe moisture stress conditions for 84 Napier grass genotypes and 6 harvests (numbered in red) in the dry season.

MAJOR FINDINGS

- Significant genotype, treatment (MWS/SWS), and harvest effects observed for the traits LW, LL, Fv/Fm, TDW and WUE (Table 1).
- Performance of genotypes was highly affected by harvest signifying differential response of genotypes to different harvests.
- AMMI biplot showed variability for both genotype and harvest variables, genotypes close to the axis have more general stability (Figure 2).
- Yield stability index identifies top ranking genotypes based on stable production of biomass across harvests in both MWS and SWS conditions (Table 2).
- Generally, similar genotypes were identified that are stable and productive in both MWS and SWS conditions that suggests that these genotypes have enhanced water use efficiency under soil moisture stress conditions.

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