Effect of water stress in *Megathyrsus maximus* during vegetative growth and early selection of promising genotypes

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INTRODUCTION

Megathyrsus maximus is a cultivated forage grass in tropical and subtropical regions of the world. In Argentina it is widely used in livestock systems due to its high production and forage quality. However, climatic restrictions, such as the scarcity of rainfall, cause yield losses in this species.

The aim of this work was to characterize *M. maximus* genotypes under water stress conditions in early stages of growth through the measurement of physiological, biochemical, and morpho-agronomic parameters.

MATERIALS AND METHODS

Eight *M. maximus* genotypes (Green Panic (GR), Gatton Panic (GA), Mutale (MU), Vencedor (VE), Penquero (PE), 55PE, 73MU and 16GR) were evaluated in two soil water contents (SWC). The assay was carried out in pots in a greenhouse under controlled conditions (Fig. 1). The SWC was determined via gravimetric method (100% SWC - maximum amount of water capable to be retained by the substrate (field capacity). The treatments were:

80% SWC - control treatment

20% SWC - water stress treatment (WS): the irrigation of pots was interrupted until 20% SWC was reached and kept for 25 days under this condition.

A completely randomized design was performed with four repetitions in a factorial arrangement (genotype * treatment).

Fig. 1 Pots in a greehouse with plants of *M. maximus* genotypes.

After 24 and 72 h of each treatment, samples of three plants per pot were collected to evaluate **physiological parameters** (relative water content and chlorophyll fluorescence parameters (Fv/Fm, DIo/RC, PI) and **biochemical parameters** (malondialdehyde content (MDA) and total reducing power by ferric reducing ability of plasma assay (FRAP). At the end of assay **morpho-agronomic parameters** were measured.

RESULTS

Significant differences for two-way interactions were observed for the evaluated parameters only after 72 h of exposure to stress. GA presented the highest value of relative water content (RWC) without differences with its control, followed by GR. On the other hand, PE, 16GR and 55PE registered the greatest difference with its control (>30%) (Fig. 2).

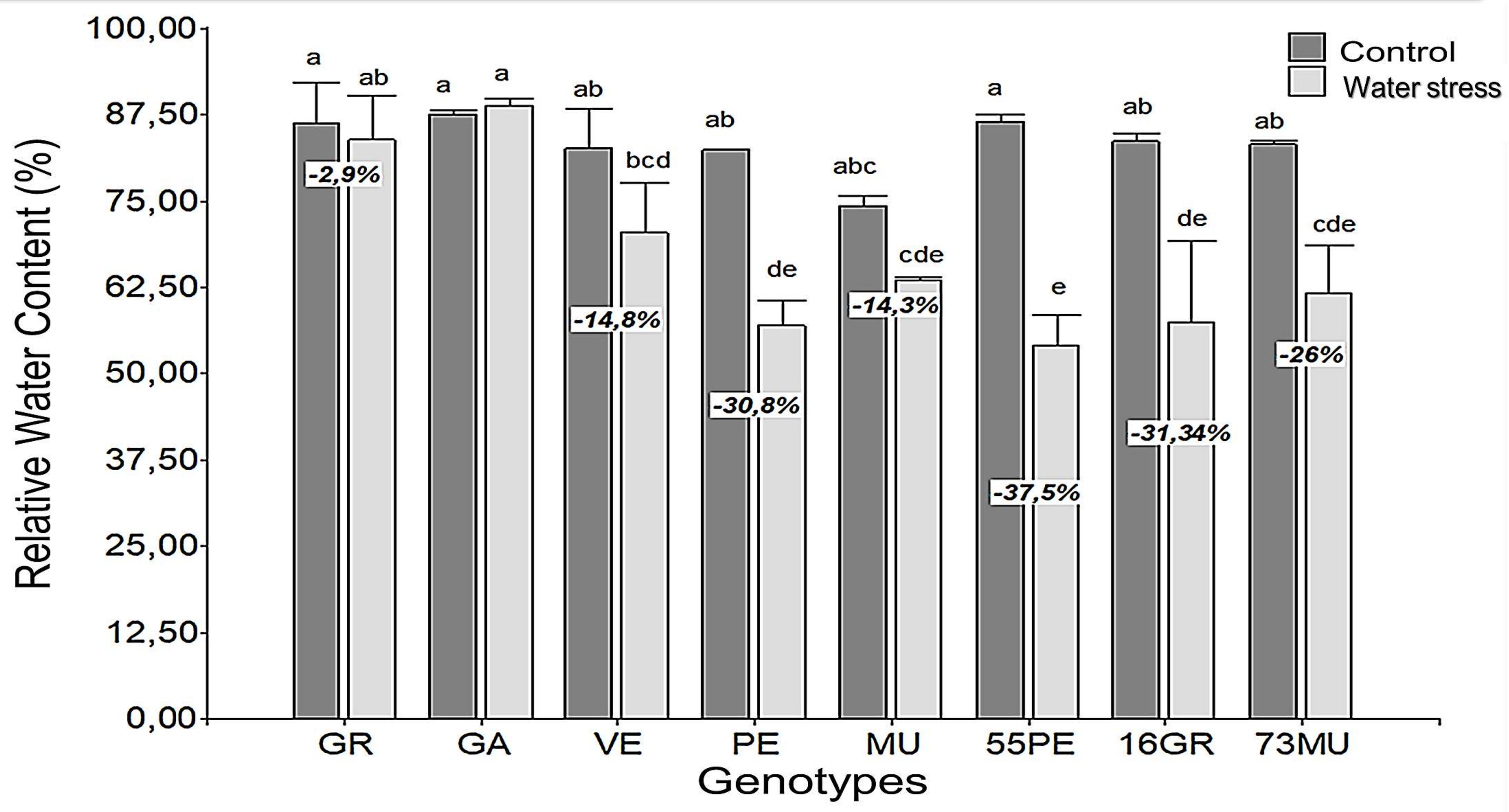

Fig. 2 Relative water content in *M. maximus* genotypes under two soil water content (80 and 20% SWC). Different letters denote significant differences between treatments for each genotype ($p \leq 0.05$). Error bars indicate standard error.

Regarding the maximum quantum efficiency of fluorescence (Fv/Fm), GR under WS conditions registered the highest value (0.78) without differences with its control, while VE and PE registered the lowest value (0.63 and 0.64, respectively); the same trend was observed for the performance index (PI). On the other hand, the light energy dissipation as latent heat (Dio/RC) was considerably increased in PE, MU and VE (Table 1). All genotypes under WS increased their malondialdehyde content (MDA), with the smallest differences compared with the respective control plants observed in 73MU (21%), GA (23%) and GR (34%). In contrast, PE, 16GR and VE differed by 208%, 149% and 131%, respectively. At the end of the assay, GR and GA registered the least reduction in aerial dry weight and height, while VE and MU were the most affected genotypes (Fig. 3, 4).

Table 1. Chlorophyll Fluorescence parameters measured on *M. maximus* genotypes in control and water stress treatment.

	Fv/Fm		DIo/RC		PI	
Genotypes	*Control*	WS	*Control*	WS	*Control*	WS
GR	0,78 ± 0,02 ab	0,78 ± 0,02 ab	0,42 ± 0,15 def	0,36 ± 0,15 ef	0,98 ± 0,24 bcde	1,46 ± 0,24 abc
GA	0,79 ± 0,02 ab	0,74± 0,03 abc	0,35 ± 0,15 ef	0,68 ± 0,17 bcdef	1,98 ± 0,24 a	0,75 ± 0,28 cdef
VE	0,81 ± 0,02 a	0,63± 0,03 d	0,33 ± 0,15 ef	0,87 ± 0,17 abcd	1,32 ± 0,24 abc	0,11 ± 0,28 f
PE	0,77 ± 0,02 ab	0,64± 0,02 d	0,42 ± 0,15 def	1,14 ± 0,15 a	1,44 ± 0,24 abc	0,41 ± 0,24 def
MU	0,77 ± 0,02 ab	0,67± 0,03 cd	0,43 ± 0,15 def	1,02 ± 0,17 abc	1,08 ± 0,24 bcd	0,32 ± 0,28 ef
55PE	0,82 ± 0,02 a	0,74± 0,03 bc	0,28 ± 0,15 f	0,57 ± 0,17 cdef	1,53 ± 0,24 ab	0,47 ± 0,28 def
16GR	0,81 ± 0,02 ab	0,68 ± 0,03 cd	0,77 ± 0,17 abcde	0,29 ± 0,15 f	0,31 ± 0,28 ef	0,76 ± 0,24 cdef
73MU	0,79 ± 0,02 ab	0,69 ± 0,02 cd	0,4 ± 0,15 ef	1,07 ± 0,15 ab	1,03 ± 0,24 bcef	0,36 ± 0,24 ef

Values represent the mean ± SE. Different letters indicate significant differences between treatments for each genotype ($p \leq 0.05$).

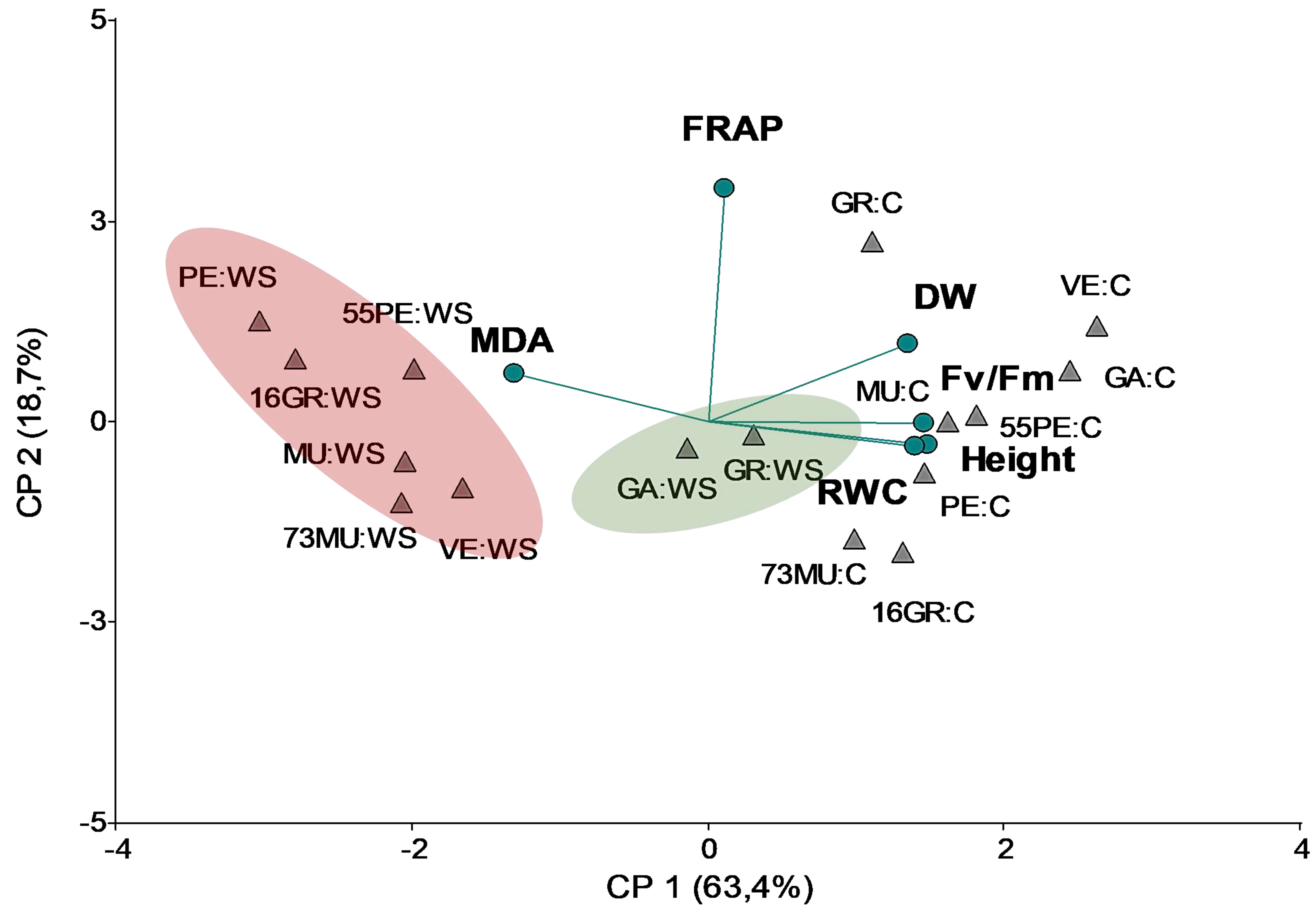

Fig. 3 Biplot showing the differences in physiological, biochemical and morpho-agronomic parameters between the different genotypes under two soil water content**.** Red circle corresponds to susceptible genotypes and green circle to tolerant genotypes under water stress.

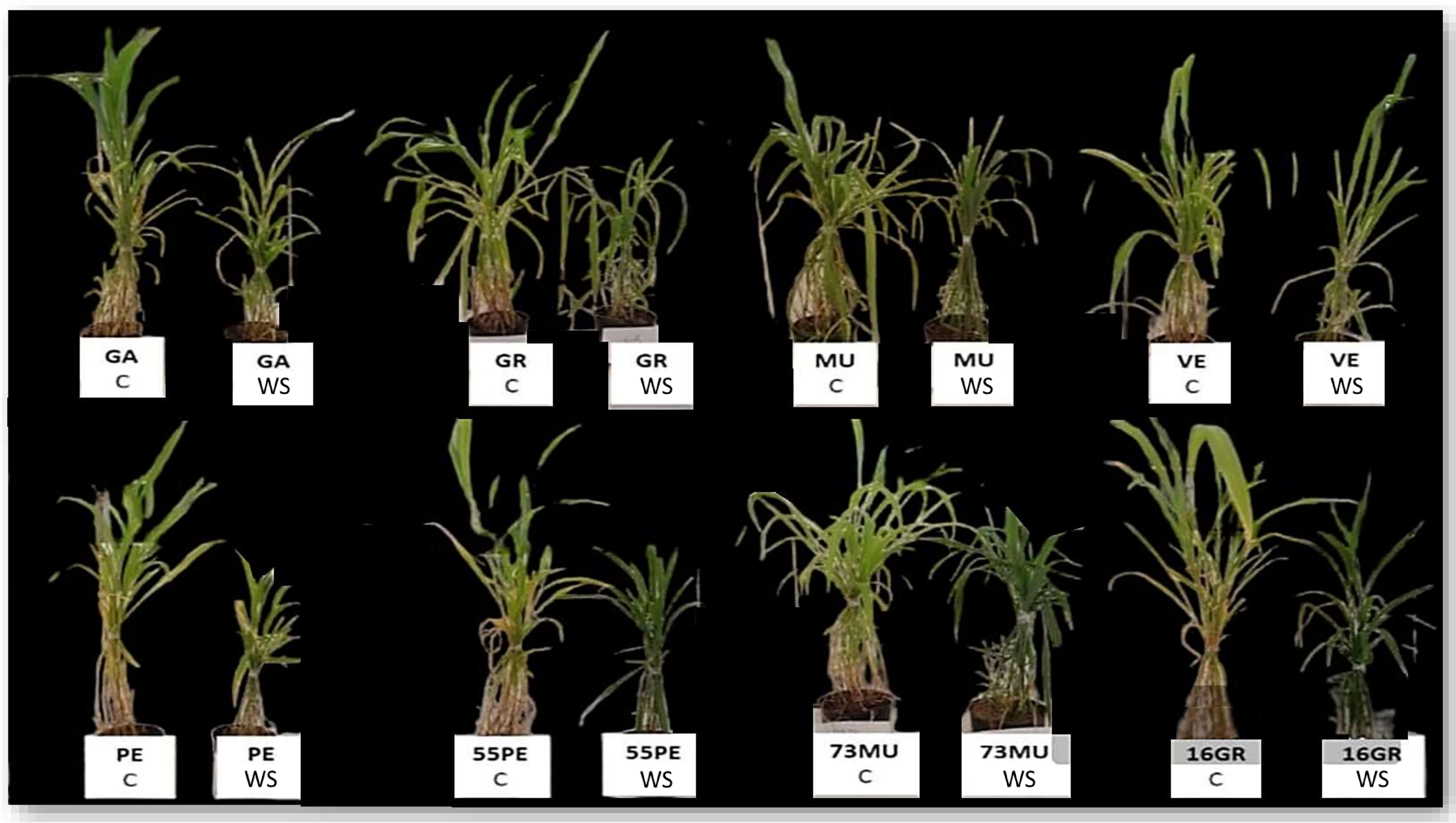

Fig. 4 Effect of water stress on morphological parameters (height) in the genotypes of *M. maximus* in control and water stress conditions

CONCLUSION

It was possible to identify promising genotypes for tolerance to water stress in *M. maximus* that could be used in breeding programs. GR and GA could be selected as stress tolerant genotypes, being VE and PE the most susceptible genotypes.