Maize drought phenotyping for modelling application

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Introduction

Much research has been devoted to the evaluation and selection of drought-tolerant cereals, which can bring enormous benefits to individuals, communities and countries in arid climates. Crop models can be useful tools for breeders, geneticists and physiologists to improve phenotyping methods and protocols. However, field data are necessary to validate these crop models. The objective of this research in "Whole plant physiology modeling of drought tolerance in cereals" project, is to provide growth and development data for maize crops under water deficit vs. no stress conditions, for model application, in edaphic and climatic conditions of Piauí State – Brazil.

Materials and Methods

Two experiments were carried (2005 wet season and 2006 dry season) out in Teresina, PI, Brazil (05° 05'S, 42° 48'W; 74.4m altitude). Teresina has a tropical climate with mean annual air temperature and humidity of 27.9°C and 69.2% respectively, and annual rainfall of 1299mm, concentrated from February to April (Bastos & Andrade Júnior., 2000). Soil is a sandy Acrisol (*Argissolo Vermelho-Amarelo*, Brazilian Classification System). Focus is made only on 2006 trial.

Four corn genotypes (two varieties: BR106, SINT-TS and two lines: PE01, PE02) were evaluated under two water regimes: water stress and supply during reproductive phase. Experimental design consisted in randomized blocks, with three repetitions. The planting dates were 09/20/06 (stress) and 09/26/06 (no stress), and plants were spaced on 0.8m x 0.25 m. At planting and about 30 days after planting (DAP), fertilization was applied. Irrigation was supplied by sprinkler spaced from 12mX12m, with 1.100 $L.h^{-1}$. A capacitance probe, Diviner 2000, was used for soil moisture monitoring. Leaf area index, plant phenology and corn biomass per organ type and yield were measured at 4 dates along the experiment to run SARRAH maize model (see Heinemann et al. 2007).

Results and Discussion

Irrigation depth was 412.4mm and rainfall, 124.3mm under no-stress conditions. Under water stress 309.1 mm were applied, with 127.9mm of rain. Time to reach male flowering, female flowering and physiological maturity (Table 1) is in agreement with Cardoso et al. (2006). Corn phenology under water deficit and no-stress was quite similar. This fact can be explained by the fact that water stress began 5 days before male flowering (about 45 DAP) and finished after the female flowering (about 60DAP). Therefore, there was no time for water stress to influence corn phenology.

Table 1. Corn phenology under water deficit and no-stress. Teresina, Brazil, 2006.

Genotypes	Male Flowering 50%		Female Flowering 50%		Physio Maturity 50%	
	No stress	Stress	No stress	Stress	No stress	Stress
PE 01	53.0	54.0	55.7	55.3	101.0	99.7
PE 02	54.7	55.0	58.0	61.3	101.7	100.7
BR 106	51.3	52.3	55.7	60.0	98.7	96.7
SINT TS	45.7	44.3	48.7	51.3	98.3	95.3
Medium	**51.2**	**51.4**	**54.5**	**57.0**	**99.9**	**98.1**

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LAI of corn submitted to water stress (0.3 to 3.5) and no stress (0.44 to 3.6) were similar for a given genotype (Figure 1). Water stress was only in the reproductive phase, in which leaf area is almost defined. Therefore, there was no time for water stress to affect the leaf area index. However, field observations showed that the leaf area index of the corn submitted to water deficit was quite reduced after reproductive phase, due to fast foliar senescence. This reduction can not observed in the Figure 1, since that the leaf area measurement between the flowering phase and the maturity phase was not quantified.

The BR 106 and SINT TS genotypes showed better foliar development than PE 01 and PE 02, because the last ones are lines no adapted to climatic conditions local.

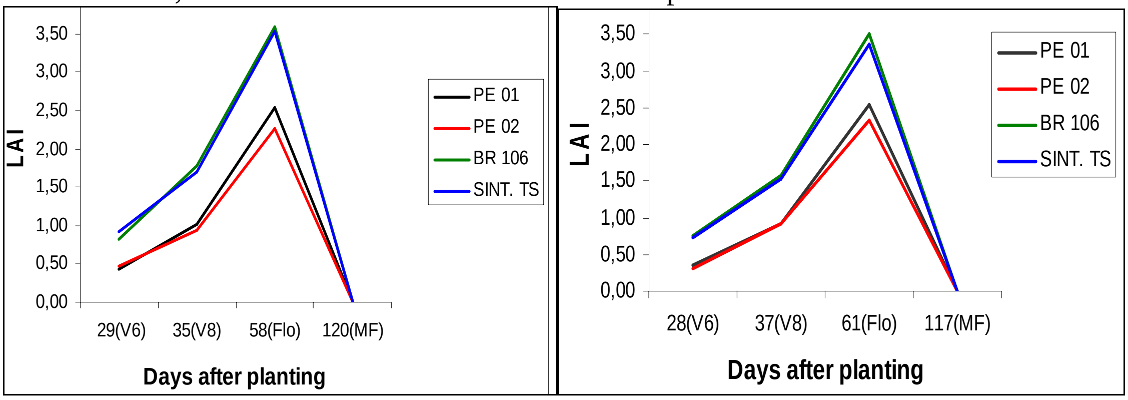

Figure 1. Leaf area index (LAI) of corn under water stress and no-stress

Grain yield showed a significance difference between corns submitted to water stress (average of 1631.8 kg.ha^{-1}) and no stress regime (average of 3532.3 kg.ha^{-1}) (Table 2). Grain yield of corn under water stress was reduced of 53.8%, i.e. more than those observed for Tollenaar & Lee, 2002; Banziger et al., 1999). BR106 (5378 kg.ha^{-1}) and SINT TS (4689 kg.ha^{-1}) varieties showed higher grain yield than PE01 and PE02 lines, as shown for LAI (Figure 1). Therefore, we can conclude that the BR 106 and SINT TS were more tolerant the drought.

Table 2. Grain yield (kg.ha^{-1}) of corn submitted to water deficit and no stress.

Genotypes	No stress	Stress
PE 01	2.486	860
PE 02	1.576	243
BR 106	5.378	1.831
SINT TS	4.689	3.593
Medium	**3.532**	**1.632**

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