

Maize drought phenotyping for modeling application

Project: Whole plant physiology modeling of drought tolerance in cereals

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Irrigation Researcher

Embrapa Mid-North

Teresina-Piauí-Brazil



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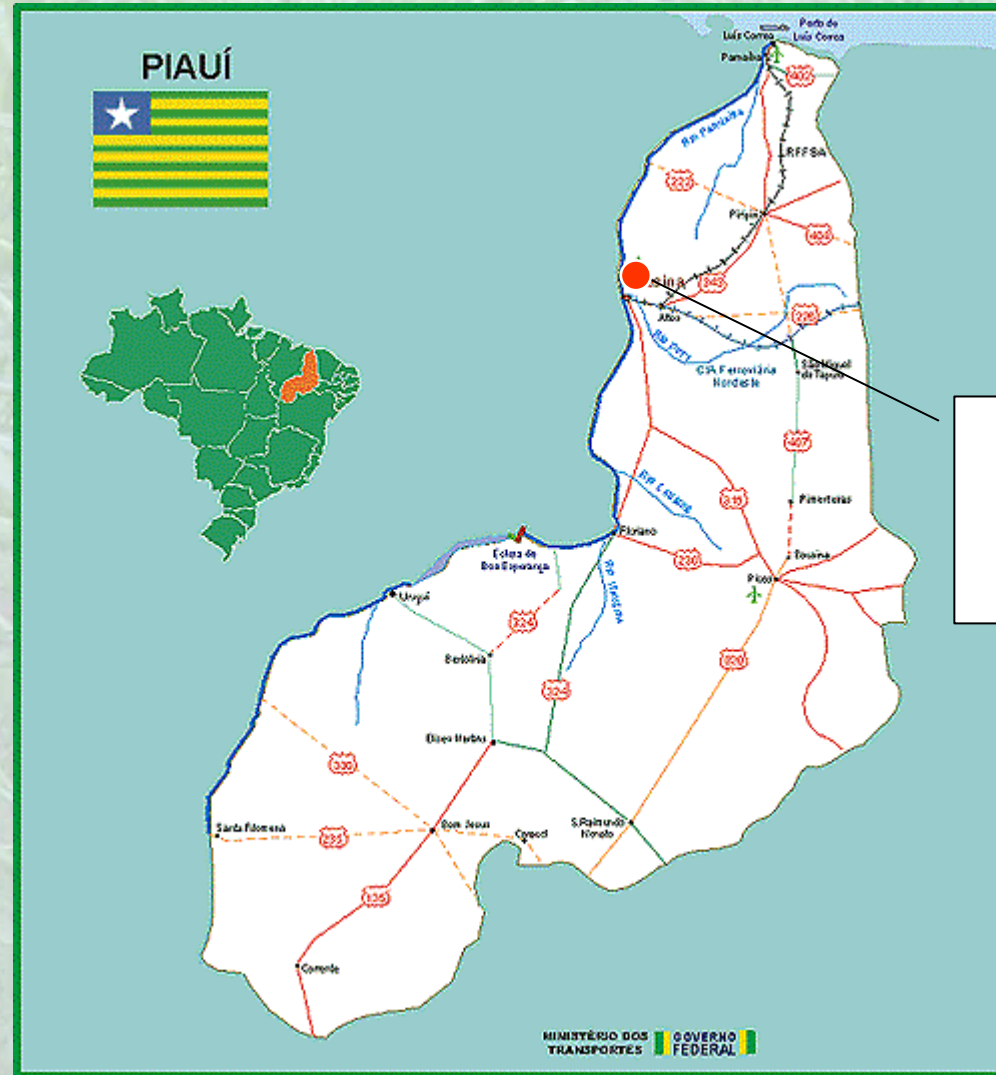
Objective

- The objective of this work is to provide growth and development data for maize crop under water deficit and no stress conditions, for model application, in soil and climate conditions of Teresina, Piauí State – Brazil



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Long: 05° 05' S
 Lat: 42° 48' W
 Alt: 74.4m

Reference: <http://www.ambientebrasil.com.br/images>



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Materials and Methods

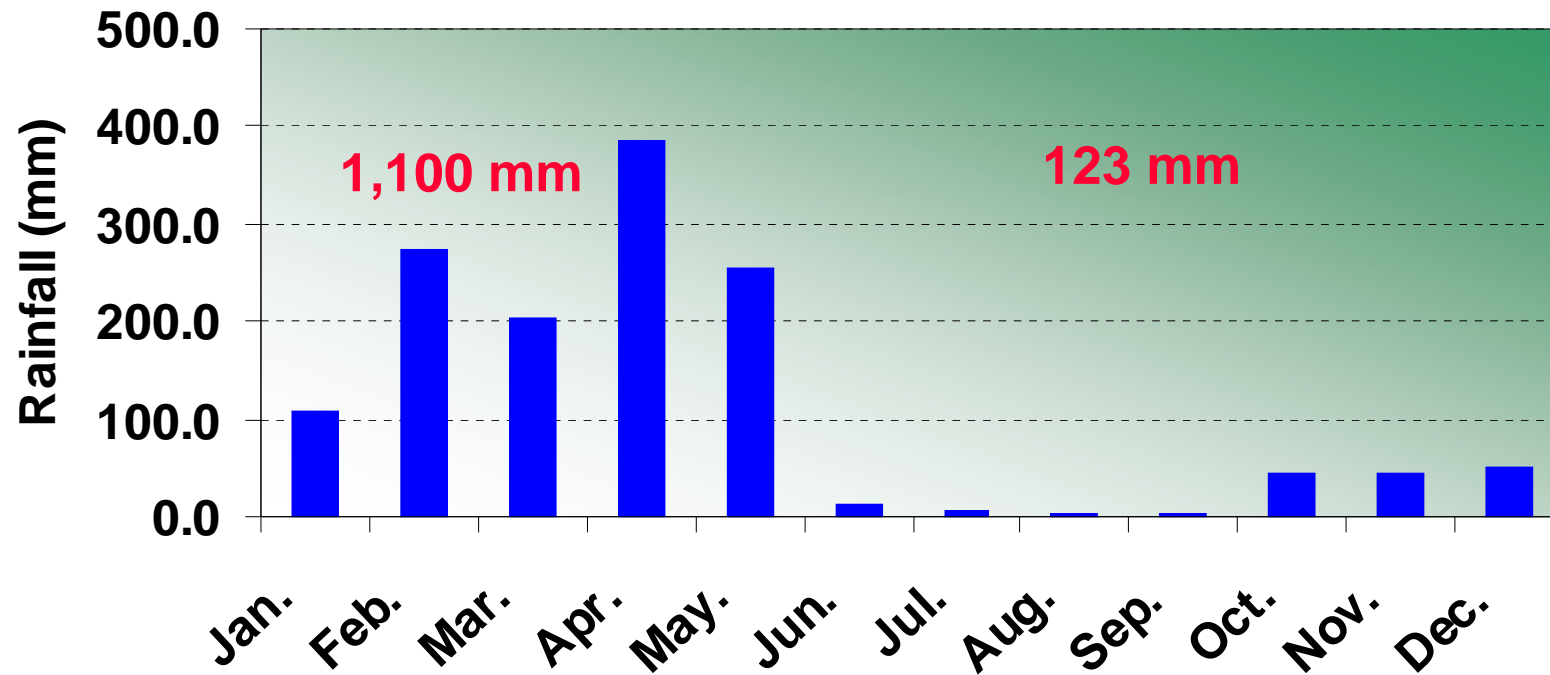
- Experimental area: Embrapa Mid-North
- Feb – Jun 2006 (wet season)
- Sep – Dec 2006 (dry season)



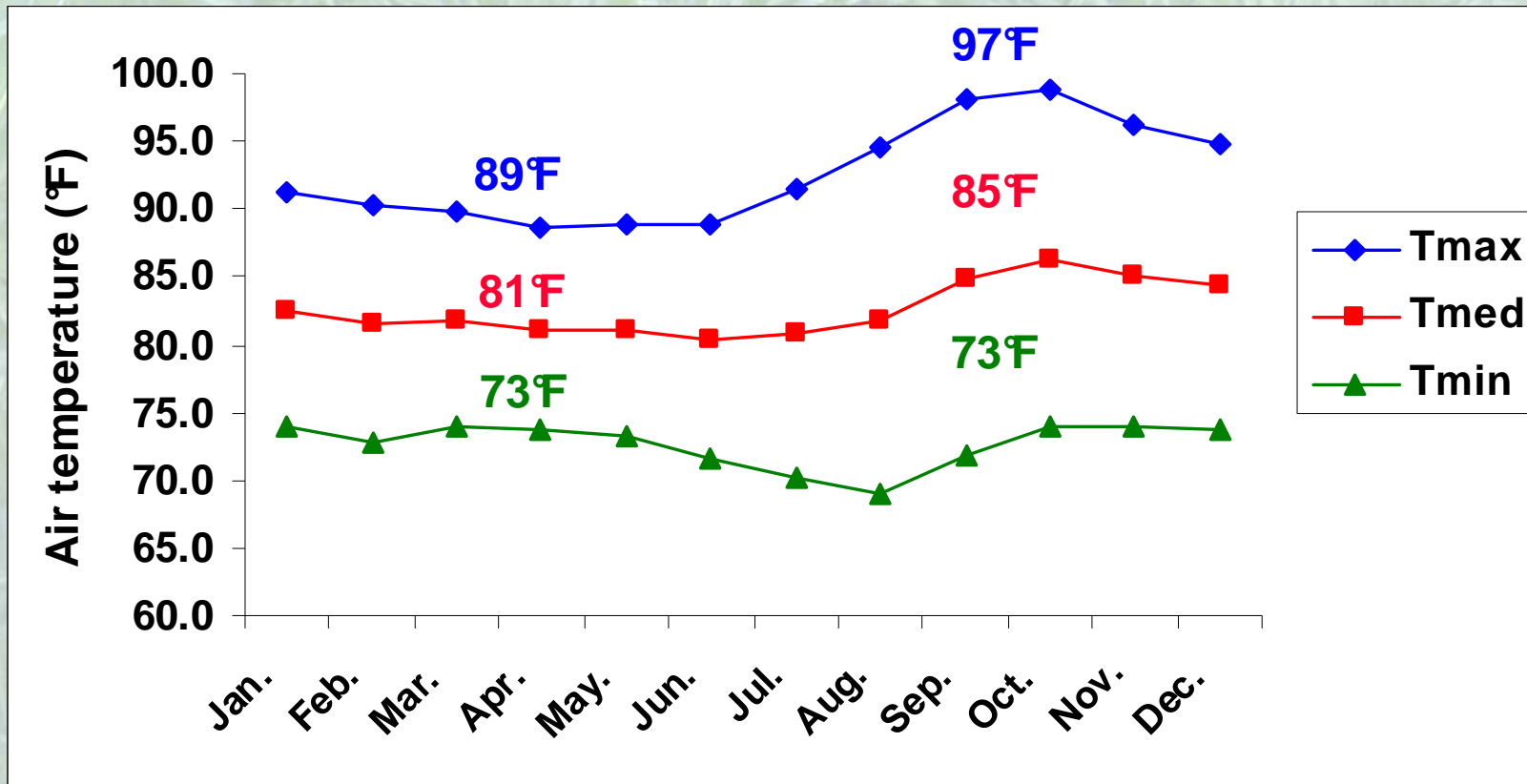
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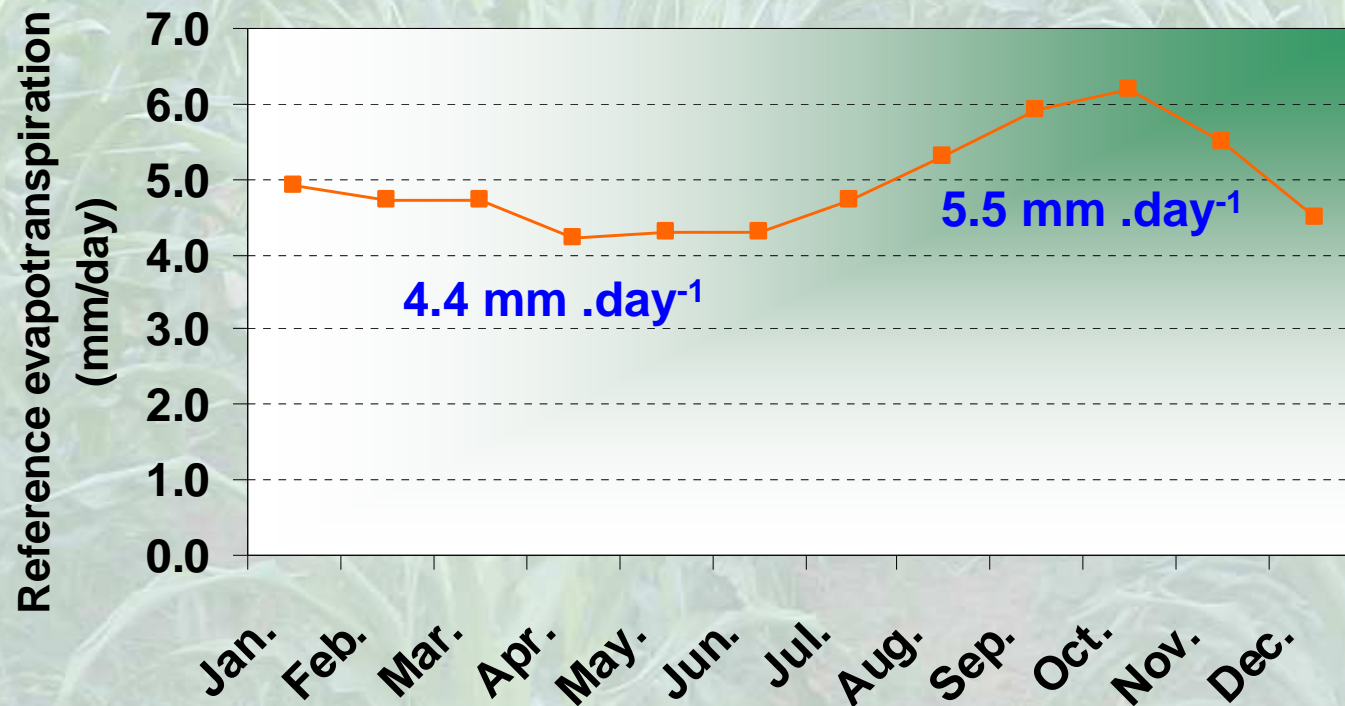
Rainfall



Air temperature



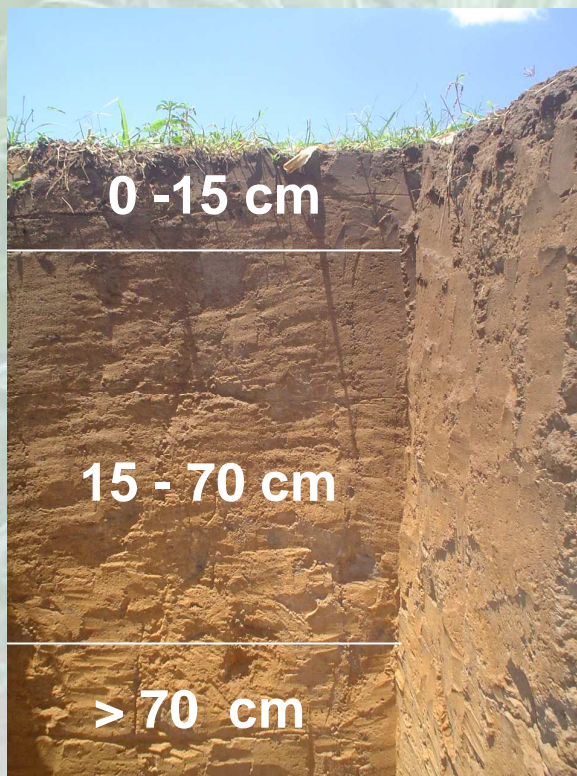
Reference evapotranspiration



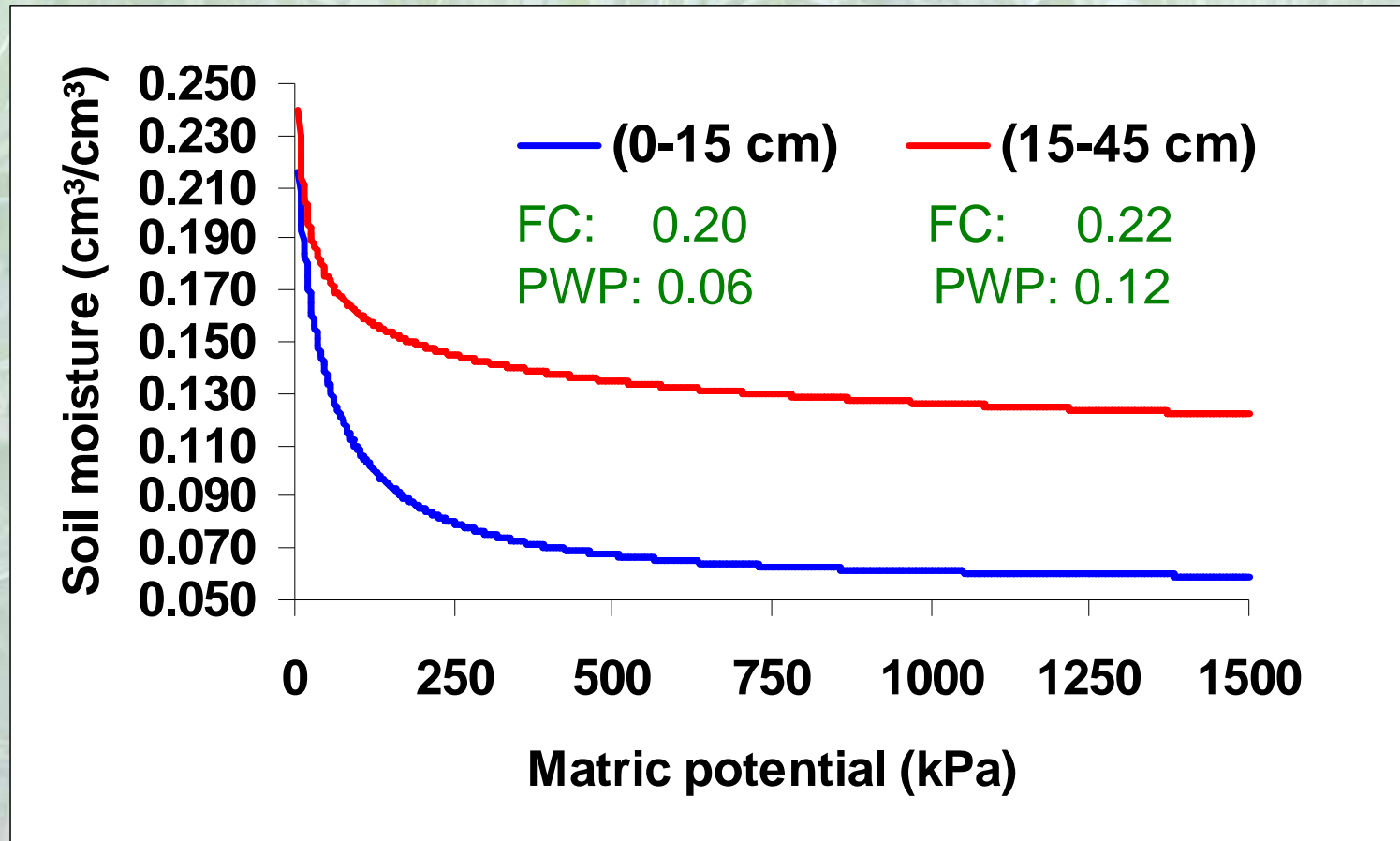
Soil: Arenic Hapludult Distrophic (*Argissolo Amarelo Distrófico*, Brazilian Classification Scheme)

Soil texture: 800 g.kg⁻¹ sand and 120 g kg⁻¹ clay (0 - 15 cm)

630 g.kg⁻¹ sand and 260 g kg⁻¹ clay (15 - 70 cm)



Soil-water retention curve



Experiment characteristics

- **Planting date:**
 - Wet season Feb 20, 2006
 - Dry season Sep 20, 2006
- **Four corn genotypes**
 - BR 106 and SINT-TS (Varieties)
 - PE 01 and PE 02 (Lines)



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➤ **Experimental design**
randomized blocks
three replications

➤ **Plant spacing:**
0.8 m x 0.25 m

➤ **Plots : 6 rows of 6m each**



➤ Wet Season

- Water supply by irrigation (if necessary)
- No water supply

➤ Dry season

- No water stress
- Water stress during reproductive phase



- **Irrigation: Conventional sprinkler system**
 - Lateral lines and sprinklers spacing: 12 x 12 m
 - Water flow rate: 1.1 m³.h⁻¹
 - Depth irrigation: no water stress → 412 mm
water stress → 309 mm



Soil moisture monitoring



Foto: Sebastião Nascimento



Foto: Eugênio Emérito

Access Tube

DIVINER 2000 – Sentek: Soil moisture was measured at every 10 cm depth (up to 1 m) of the soil profile

Plant parameters

- **Plant phenology**
 - Male flowering
 - Female flowering
 - Physiological maturity
- **Leaf area index (LAI)**
- **Crop biomass**
- **Yield**
- **Yield components ...**

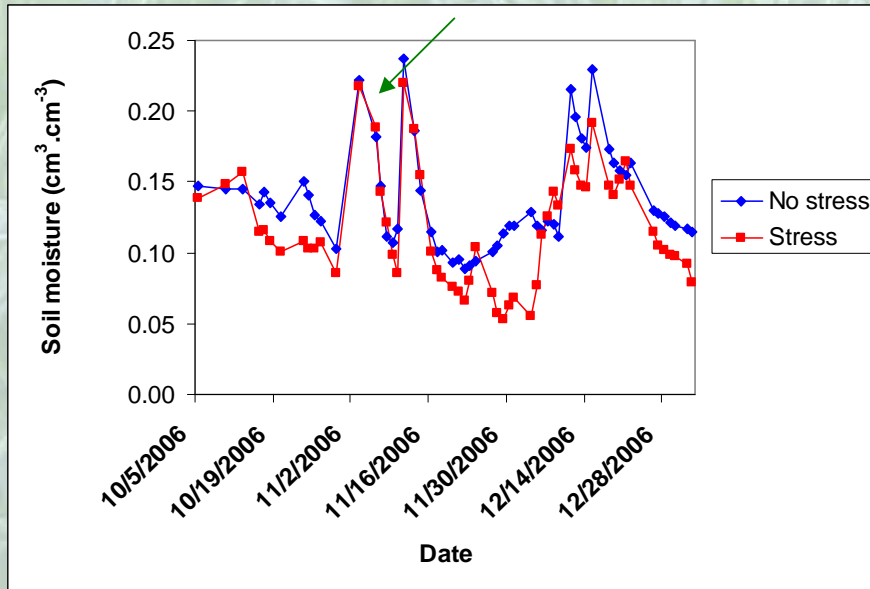
4 dates to run SARRAH
maize model

Results – Dry season

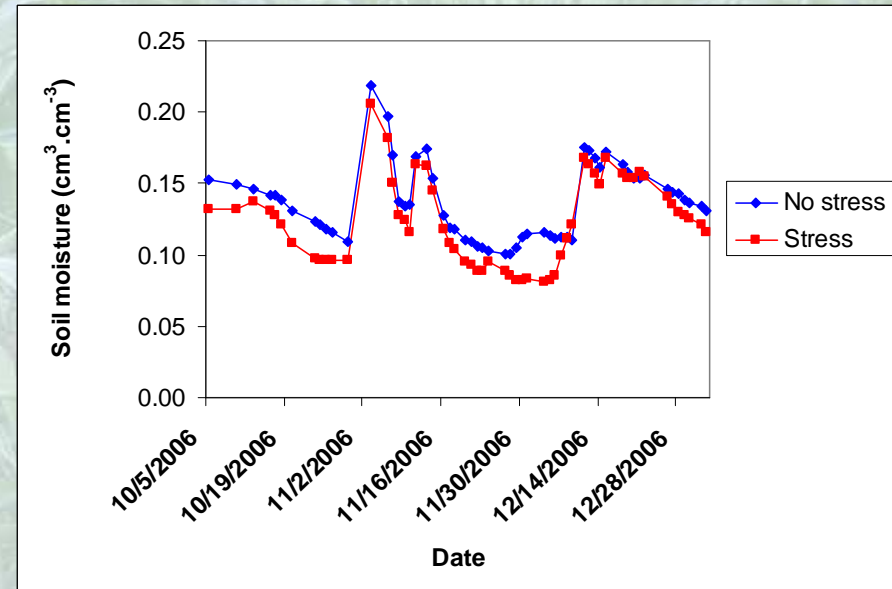
- Soil moisture
- Plant phenology
- Leaf Area Index (LAI)
- Yield

Soil moisture

Rainfall



Depth: 0 - 10 cm

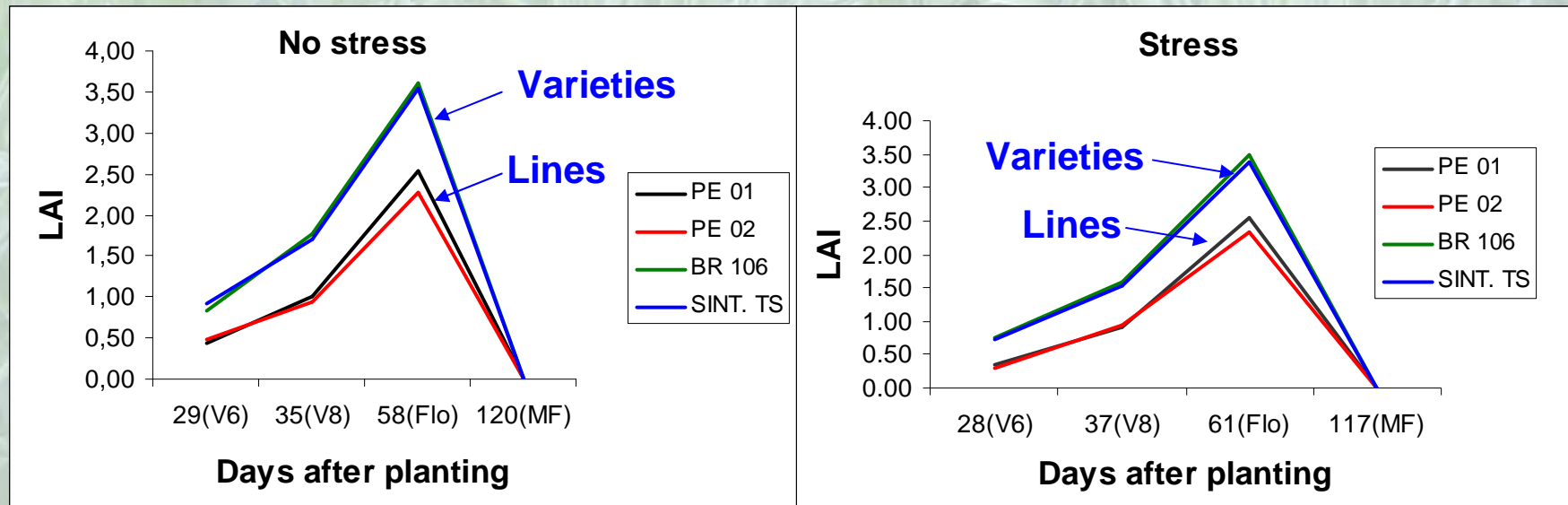


Depth: 10 - 20 cm

Plant phenology

- Amount of days to reach male and female flowering was similar in the plants under the two water regimes.
- Water stress started very close to the period of male flowering. Therefore, there was no time for water stress to influence corn phenology.

LEAF AREA INDEX



The varieties BR 106 and SINT. TS showed LAI higher than the lines for both water conditions.

GRAIN YIELD (kg.ha⁻¹) - Dry season.

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

- Corn yield under water stress was lower than under no water stress.
- BR 106 and SINT. TS varieties showed grain yield higher than the lines for both water regimes.

GRAIN YIELD (kg.ha⁻¹) under no water deficit

Genotypes	Wet season	Dry season
PE 01	3,013	2,486
PE 02	1,932	1,576
BR 106	6,375	5,378
SINT TS	6,294	4,689
Medium	4,404	3,532

Water stress



No stress



Final consideration

➤ The genotypes evaluated were submitted to two different stress: **WATER DEFICIT** and **HIGH TEMPERATURES**. In these conditions the genotypes selected can be used in breeding programs and therefore, bring benefits to individuals, communities and countries in arid climate. Crop models can help breeders, geneticists and physiologists to improve phenotyping methods and protocols.



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Setbacks and Recommendation

- Modeling and phenotyping experiments were carried out simultaneously
- Number of parameters:
 - Maize: 68**
 - Sorghum: 60**
 - Rice: 40**
- Few trainees and qualified workers
- To include in future projects fellowship for researchers with MSc and PhD degrees.

Team

Edson Alves Bastos	Irrigation
Milton José Cardoso	Maize crop
Reinaldo Lúcio Gomide	Irrigation
Aderson S. de Andrade Júnior	Irrigation
Francisco de Brito Melo	Soil Science
Cândido Athayde Sobrinho	Phytophatology
Paulo Henrique Soares da Silva	Entomology
Valdenir Queiroz Ribeiro	Exper. Statistic
Everaldo Moreira da Silva	Trainee
José Francisco de Carvalho	Trainee



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Thank you very much!

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