When we will have a transgenic cane?

João Carlos Bespalhok F.

RIDESA/UFPR

Cana transgênica pode ser moída em 4 anos

Variedades geneticamente modificadas dependem de regulamentação e intensificação de testes

RENATO ANSELMI, DE CAMPINAS
FREE LANCE PARA O JORNALCANA

Canavial transgênico é questão de pouco tempo, assegura Sizuo Matsuoka

As variedades de cana transgênica deverão estar disponíveis, no Brasil, daqui a quatro a cinco anos, gerando diversos benefícios para as áreas agrícola e industrial no setor sucroalcooleiro e para o meio ambiente. As empresas CanaVialis e Alellyx Applied Genomics, sediadas em Campinas, SP - vinculadas à Votorantim Novos Negócios - pretendem lançar, por exemplo, em 2009, a nova versão da Co740, uma variedade importada da Índia que já foi bastante utilizada, na década de 70, principalmente no Norte do Paraná e Sul de São Paulo. Com resultados positivos nos testes de campo, a variedade deverá ressurgir com uma característica adicional, segundo Sizuo Matsuoka, diretor da CanaVialis: será resistente ao mosaico da cana, que a afastou das plantações no início dos anos 80.

As ações e medidas, que serão adotadas nos próximos meses e anos, terão importância vital para que a transgenia na cultura da cana possa realmente deslanchar. Em primeiro lugar, novos experimentos deverão surgir a partir da regulamentação das modificações estabelecidas pela legislação nessa área. Depois disso, a Comissão Técnica Nacional de Biossegurança - CTNBio poderá analisar e autorizar outros testes com plantas transgênicas. A própria CanaVialis está na fila. Pretende acompanhar o desenvolvimento de plantas, geneticamente modificadas, para que tenham maior teor de sacarose, maior resistência à seca ou não apresentem florescimento, dependendo de cada caso. "Até março ou abril de 2006, a avaliação, no campo, deverá ser iniciada", prevê Sizuo. Nesse período, a Alellyx - que cuida, entre outras ações, dos experimentos laboratoriais - continua realizando trabalhos para a obtenção da transformação celular.

Para o engenheiro agrônomo William Lee Burnquist, coordenador de tecnologia do Centro de Tecnologia Canavieira - CTC (ex-Copersucar), até 2010, o cronograma, nessa área, deve incluir, além da regulamentação, a realização de testes de plantas transgênicas em diferentes tipos de solo, que ainda não tiveram autorização da CTNBio. "É preciso verificar se os resultados serão os mesmos", ressalta ele que é um dos pesquisadores mais envolvidos no País com o Projeto Genoma Cana, programa, iniciado em 1999, que utiliza os recursos da biotecnologia no melhoramento genético da planta, realizado em conjunto com a Fundação de Amparo à Pesquisa do Estado de São Paulo - Fapesp, universidades e outras instituições.

Topics

- Transgenic sugarcane variety
- Transgenics in RIDESA

Transgenic sugarcane around the world

- USA
- Australia
- China
- India
- Argentina
- Colombia
- South Africa
- BRAZIL

Potencial

- Introduction of specific traits to elite varieties
  - Herbicide resistance
- Fix varieties and clones with some problem
  - Resistance to insects
  - Resistance to diseases
  - Resistance to drought stress

Technical difficulties

- Many clones
  - Backcross is not possible
  - Each variety must be transformed
    - Capacity of regeneration
    - More time
    - More expensive
    - “Yield lag”

Technical difficulties

Transgenic sugarcane

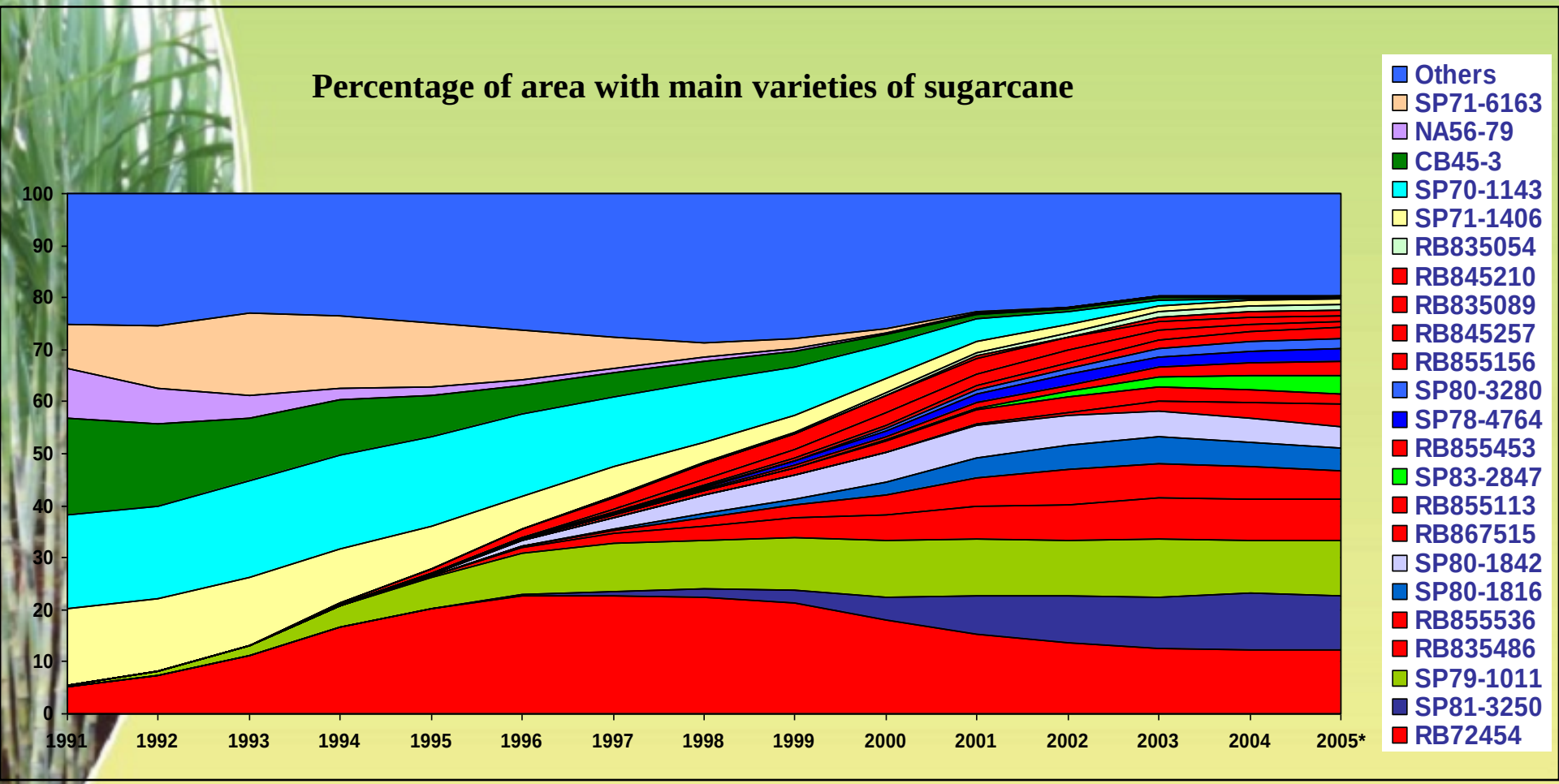
100 ton/ha

New clone

120 ton/ha

Yield lag – a transgenic clone produces less than a new clone

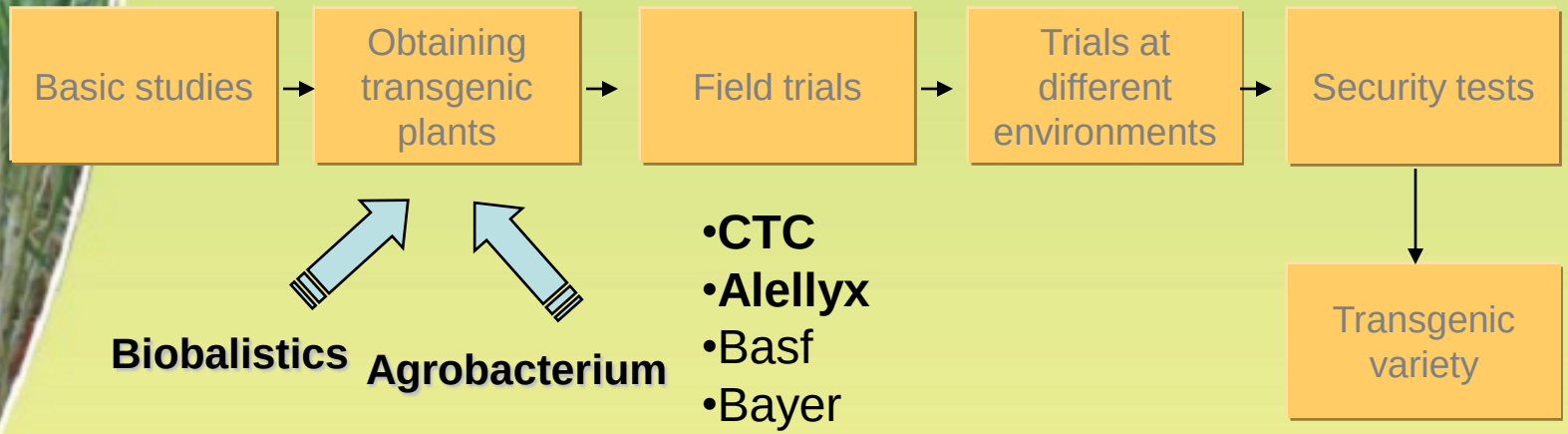
Varietal profile



Source: Datagro(from 1991 to 2005 – estimated)

Steps for a transgenic variety

-CTC
-Alellyx
-Esalq
-IAPAR
-Others



Field trials

- CTC (1997-2009) – 20 field trials
  - Herbicide, disease, insect, sucrose, drought, flowering
- Alellyx Applied Genomics (1999-2008) – 18 field trials
  - Herbicide, disease, sucrose, drought, insect+herbicide
- BASF (1999-2003) – 5 field trials
- BAYER (1997) – 1 field trial
  - Herbicide

Source: CTNBIO, 2009

Field trials

- Total of 44 field trials
  - Herbicide – 15 trials
  - Sucrose – 13 trials
  - Disease – 5 trials (Mosaic and Yellow leaf virus)
  - Insect + herbicide - 5 trials
  - Insect – 1 trial
  - Drought – 4 trial
  - Flowering – 1 trial

Consumer market

- Negative perception of consumers related to transgenic
- Transgenic sucrose
  - Difficulties to trade
- Transgenic ethanol
  - Better acceptance

Transgenic sugar beet

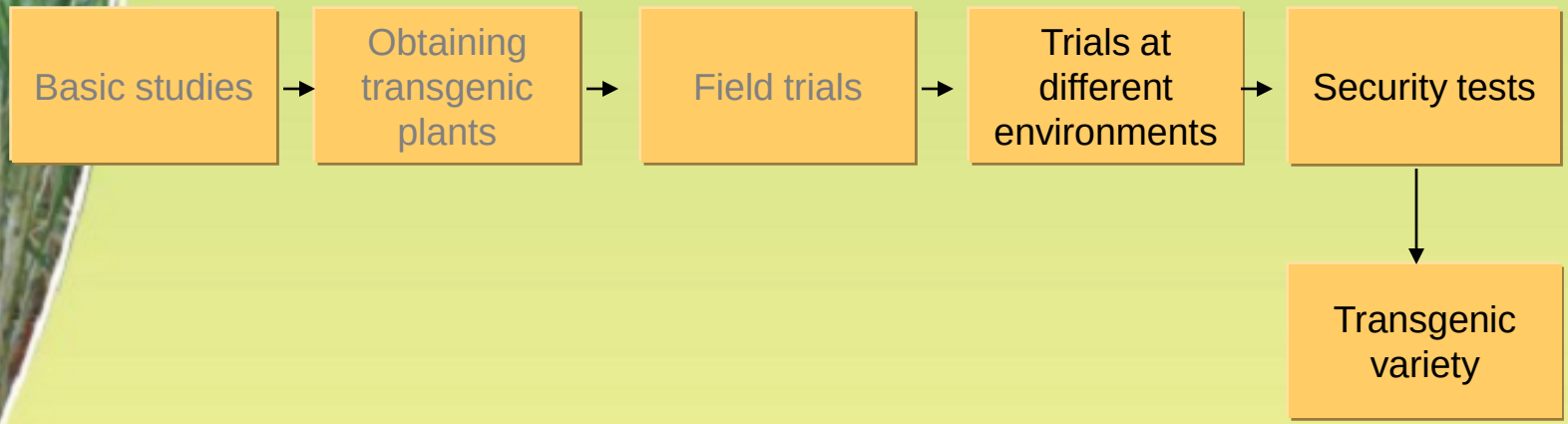
A new biotech crop, RR®sugar beet, was commercialized in two countries, the USA and Canada

In 2008, a new biotech crop, RR® herbicide tolerant sugar beet, was introduced for the first time globally in the USA plus a small hectarage in Canada. Notably, of the total US national hectarage of 437,246 hectares of sugar beet, a substantial 59% (the highest ever percent adoption for a launch) or 257,975 hectares were planted with RR® biotech sugar beet in 2008, the launch year; the percentage adoption in 2009 is expected to be close to 90%. The success of the RR® sugar beet launch has positive implications for sugar cane, (80% of global sugar production is from cane) for which several biotech traits are at an advanced stage of development in several countries.

Source: ISAAA, 2009

When we will have a transgenic sugarcane?

- Still a long way to go
- My guess: at least more 5 years



Transgenics in RIDESA

Transgenics in RIDESA

- Rede Interuniversitária para o Desenvolvimento Sucroalcooleiro
- History
  - Created in1990 with the end of IAA/Planalsucar
- 11 Federal Universities
- Breeding Program (PMGCA)
- RB Varieties


Brasil
UFPI
UFRPE
UFS
UFAL
UFMT
Bolivia
UFG
UFV
UFGD
UFSCAR
UFRRJ
Paraguai
UFPR
(Asunção)
Chile
© 2009 DMapas
© 2009 Europa Technologies
© 2009 MapLink/Tele Atlas
© 2009 LeadDog Consulting
©2009 Google
15°18'58.52" S 55°36'13.14" O elev 837 pés
Altitude do ponto de visão 2521.19 mi

RB Varieties

- More than 50% area
  - RB72454
  - RB867515
  - RB92579
  - RB966928

Transgenics in Ridesa

- Paternships
  - IAPAR
  - EMBRAPA

Transgenics in RIDESA

Physiologia Plantarum 130: 218–229. 2007

Evaluation of the stress-inducible production of proline in transgenic sugarcane (*Saccharum* spp.): osmotic adjustment, chlorophyll fluorescence and oxidative stress

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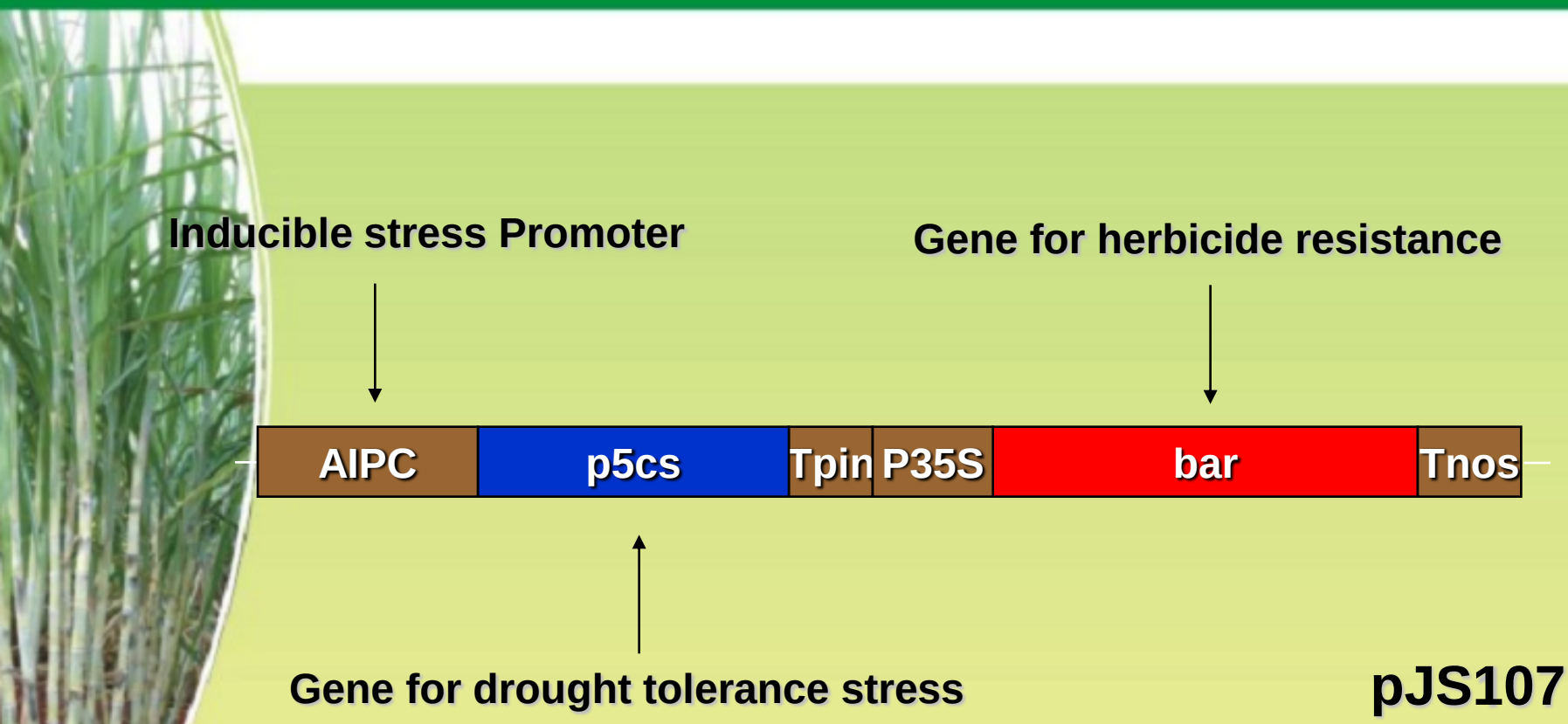
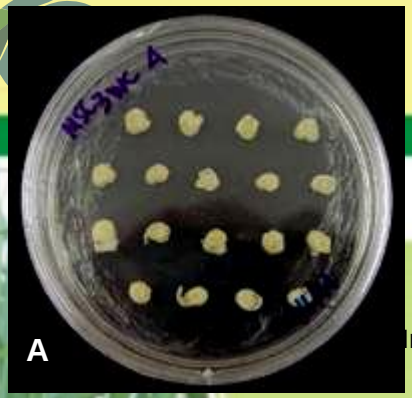
Drought resistance

- Paternship RIDESA/UFPR/IAPAR
  - Biotechnology lab IAPAR
  - Thesis – Hugo Molinari
- P5CS Gene
  - Proline biosinthesis
  - *Vigna angustifolia*

Construction used

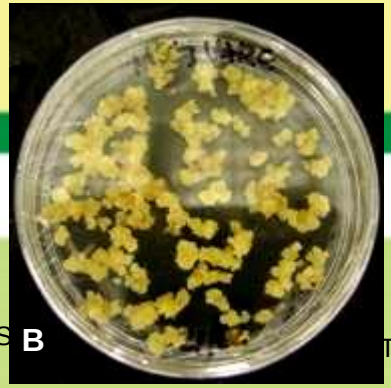


pJS107



Explant

Incubação escuro MS 2,4D



Somatic embryos

Tratamento osmótico

Particle bombardment apparatus

In vitro micropropagation

D

Regeneration

Selection of transformants

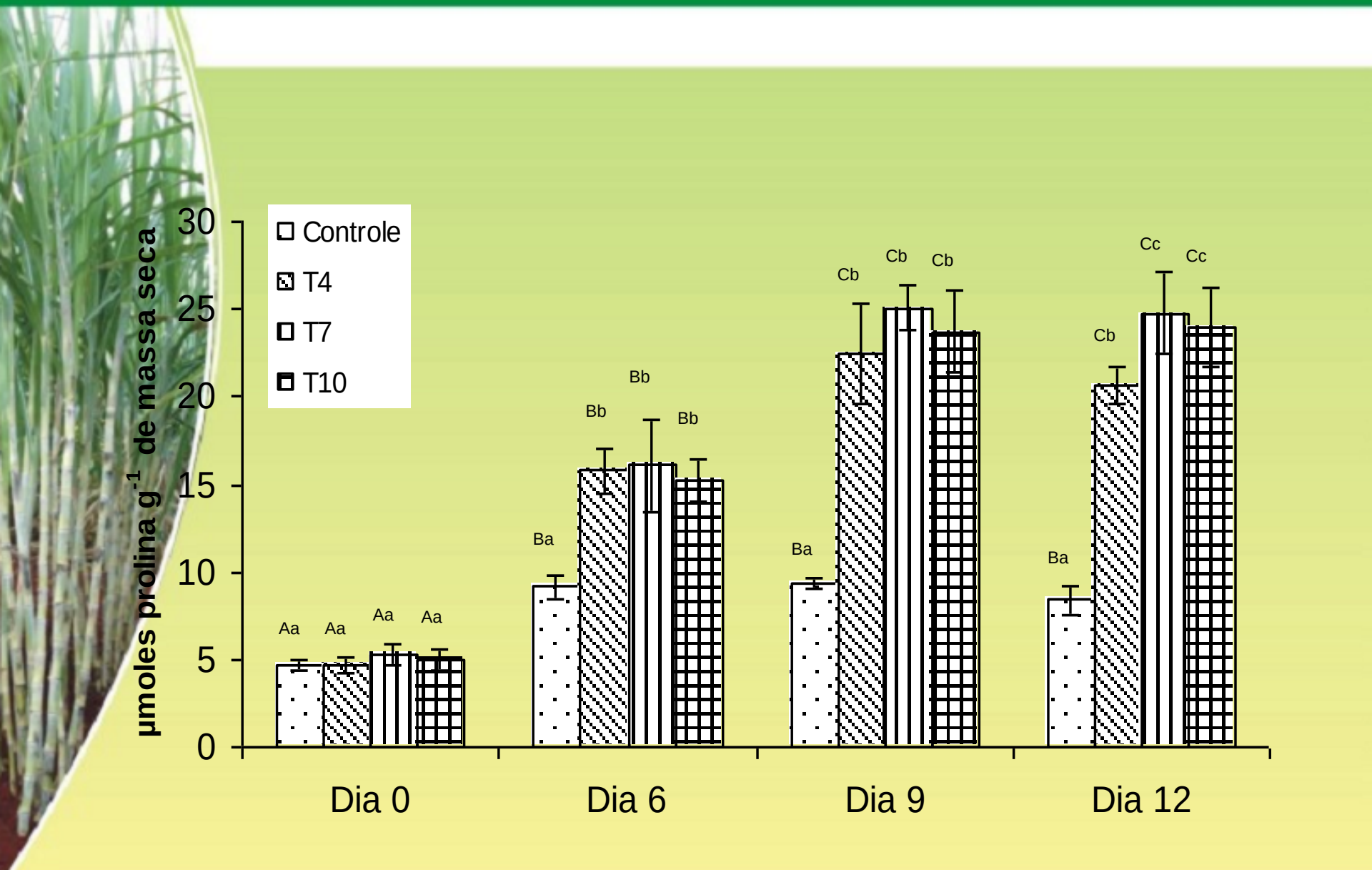
Acclimatization

Multiplication of events

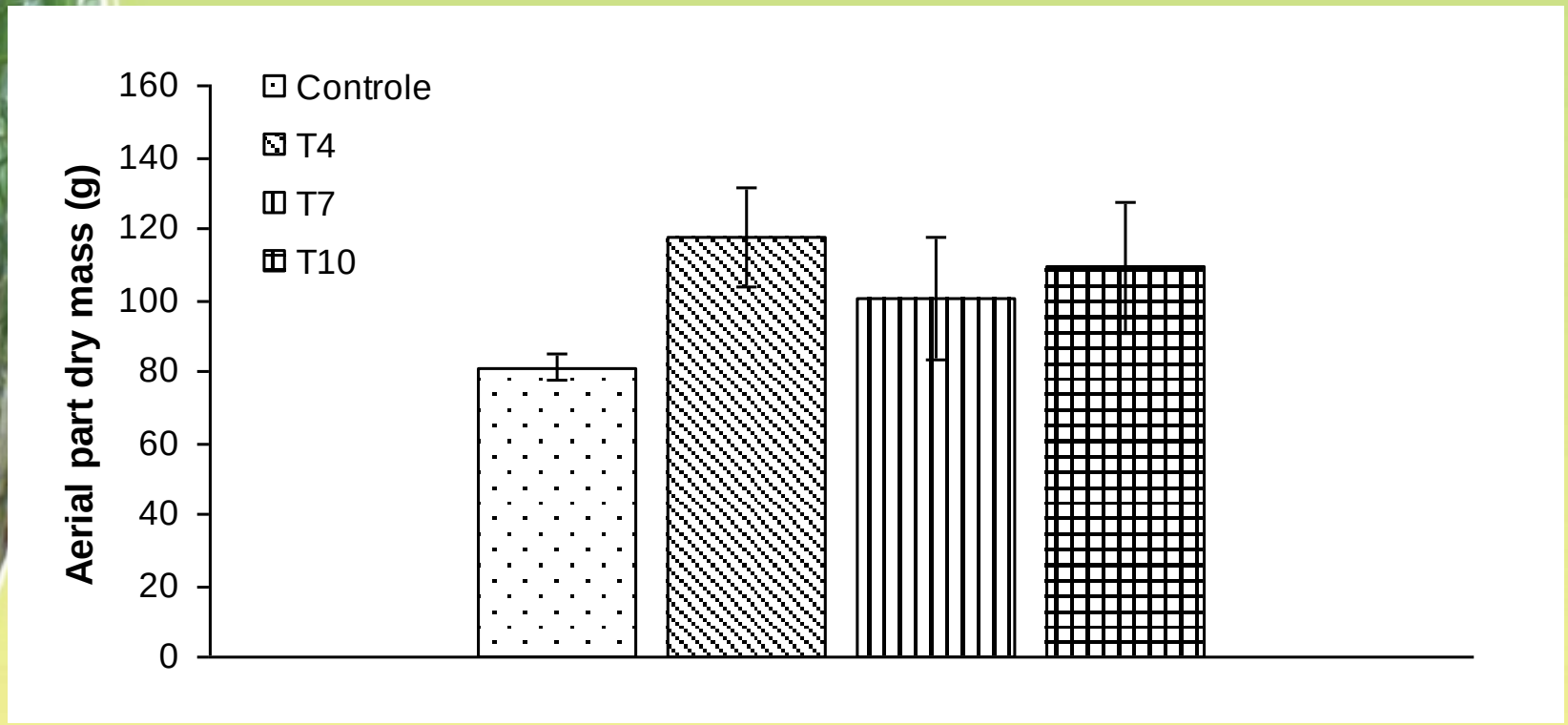
Results

- 17 events were obtained
- Drought resistance tests
  - Greenhouse
  - 3 events choosen – T4, T7 e T10
  - 12 days without irrigation

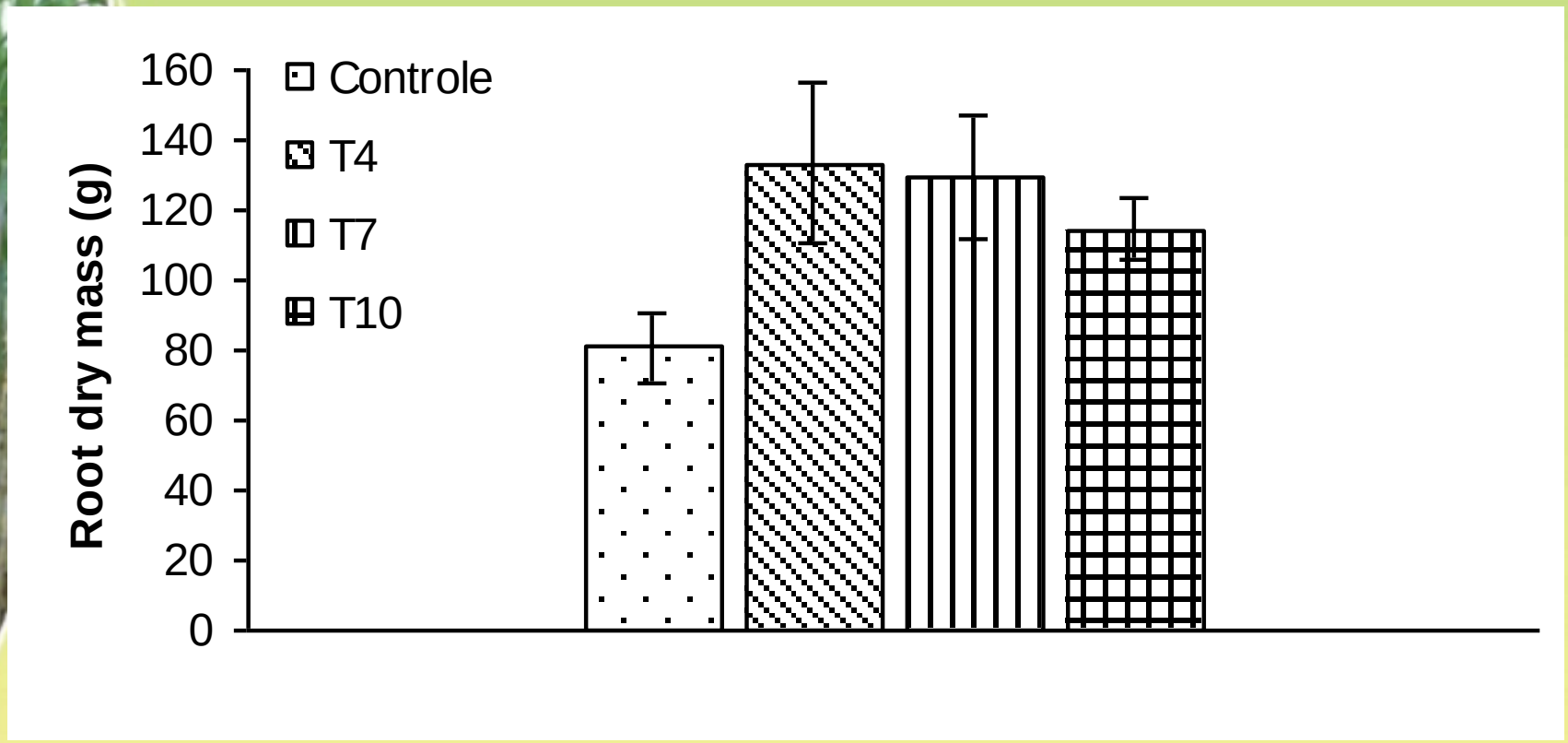
Proline concentration



Dry mass of aerial part after 12 days of stress



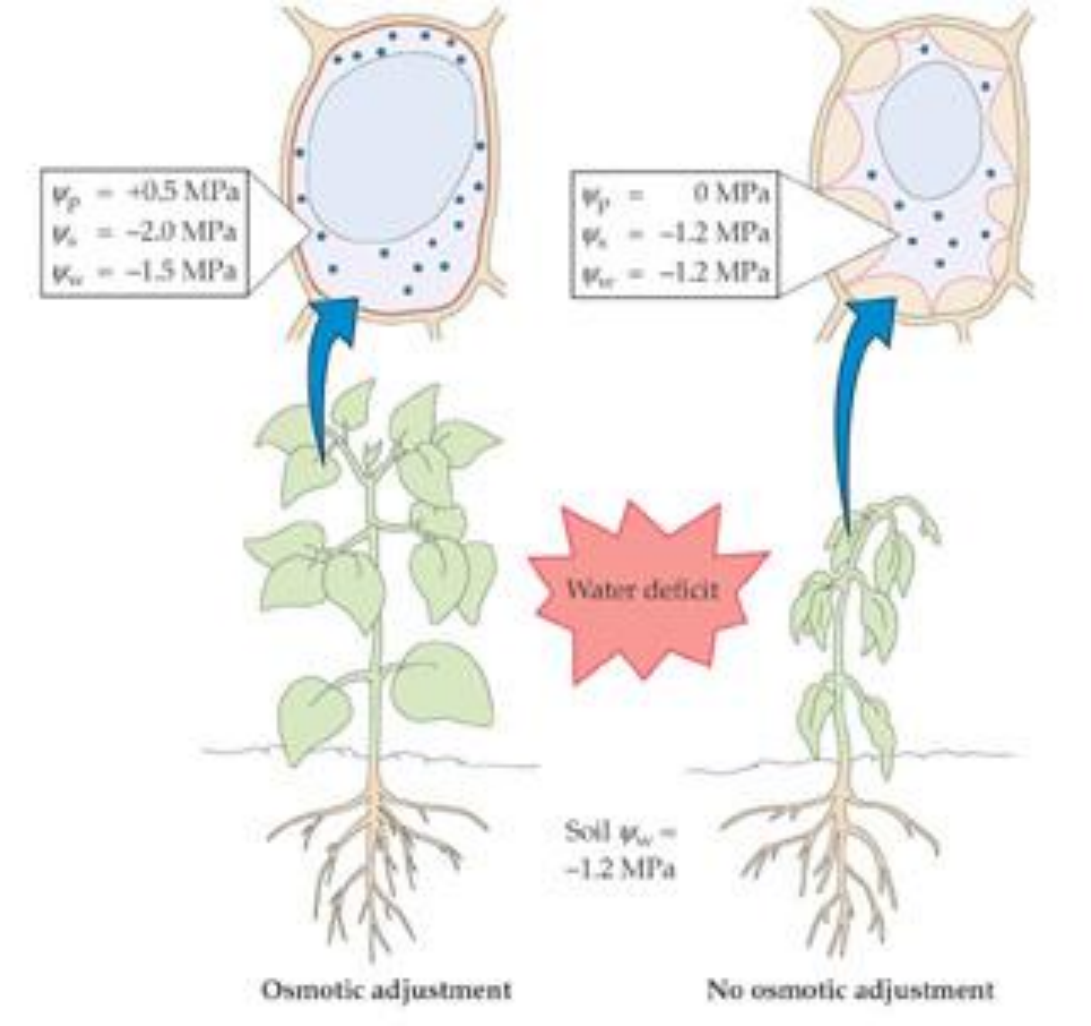
Dry mass of root system after 12 days of stress

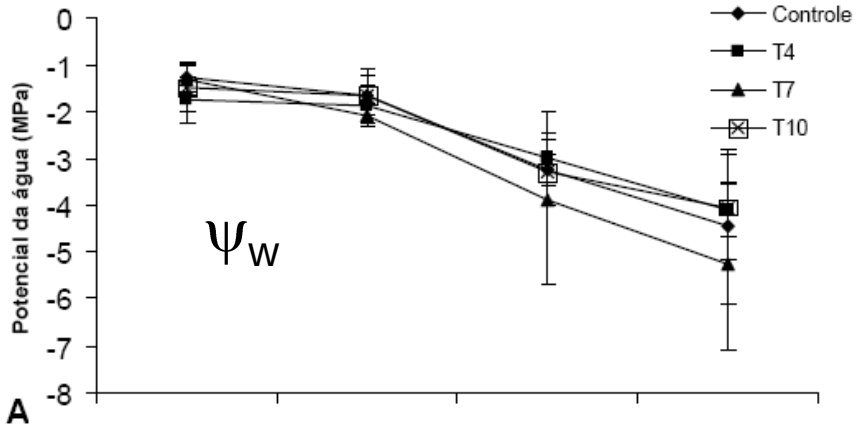


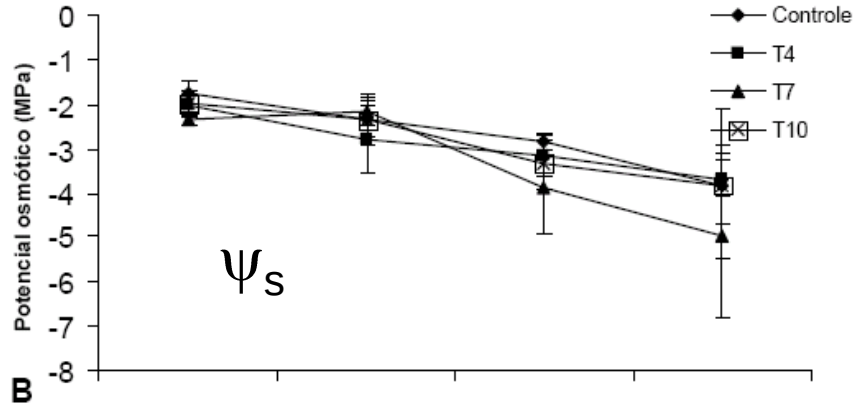
Why transgenic plants were more tolerant to drought stress?

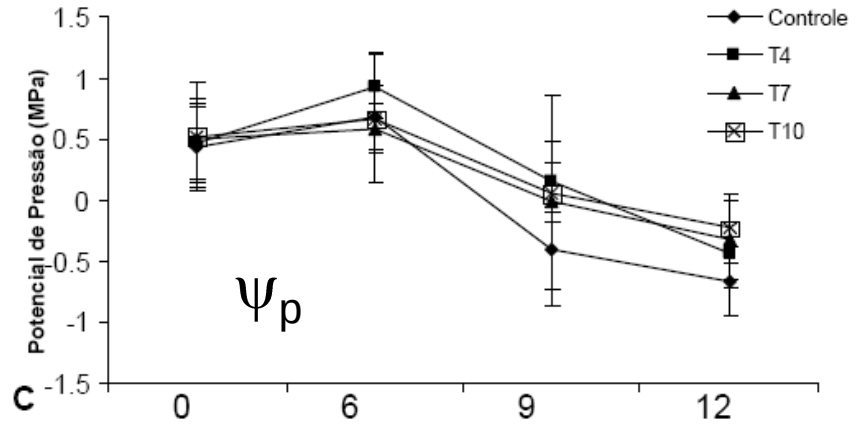
- Osmotic adjustment?
- Protection against oxidative stress?
  - MDA
- Protection of the photosynthetic apparatus?

Osmotic adjustment



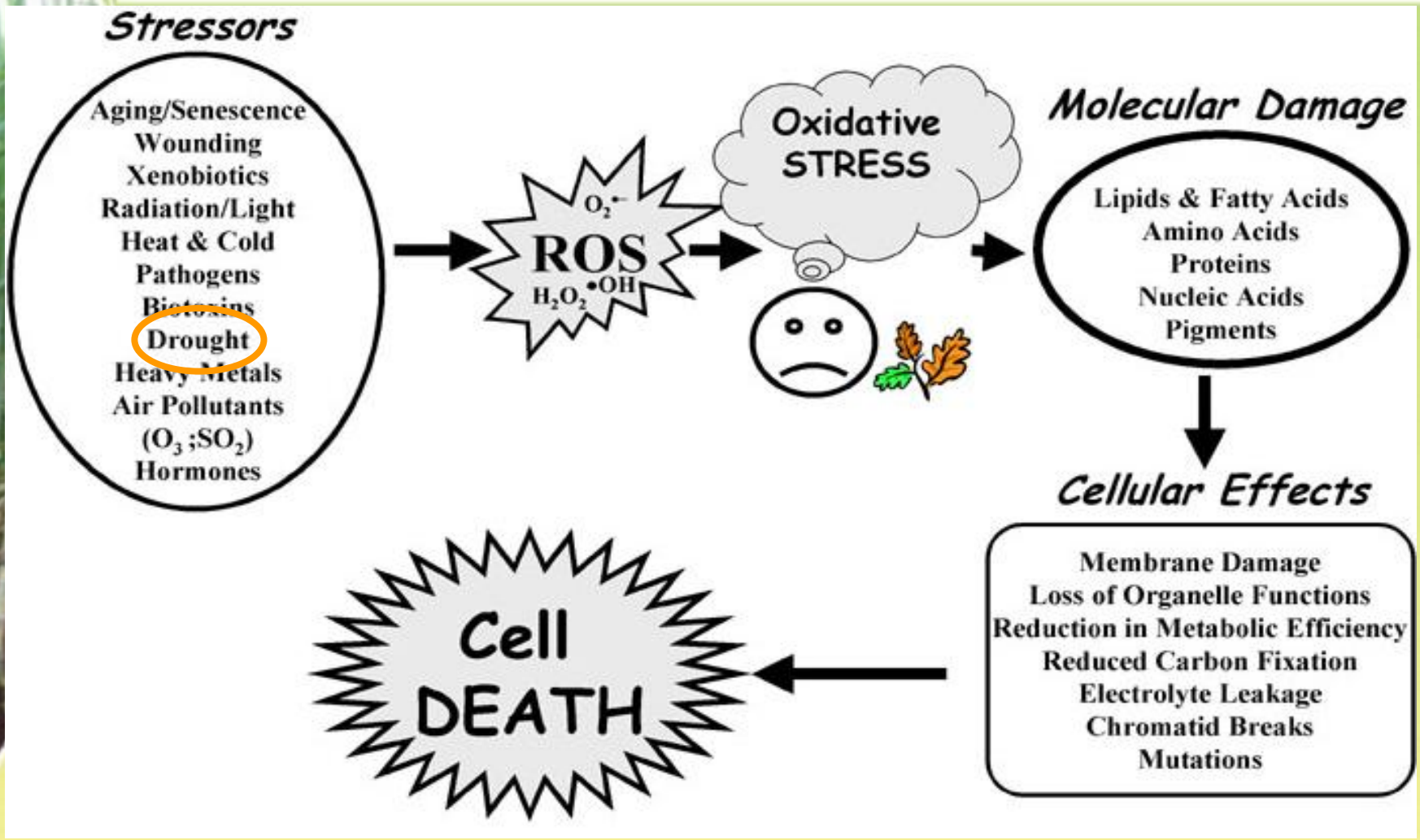




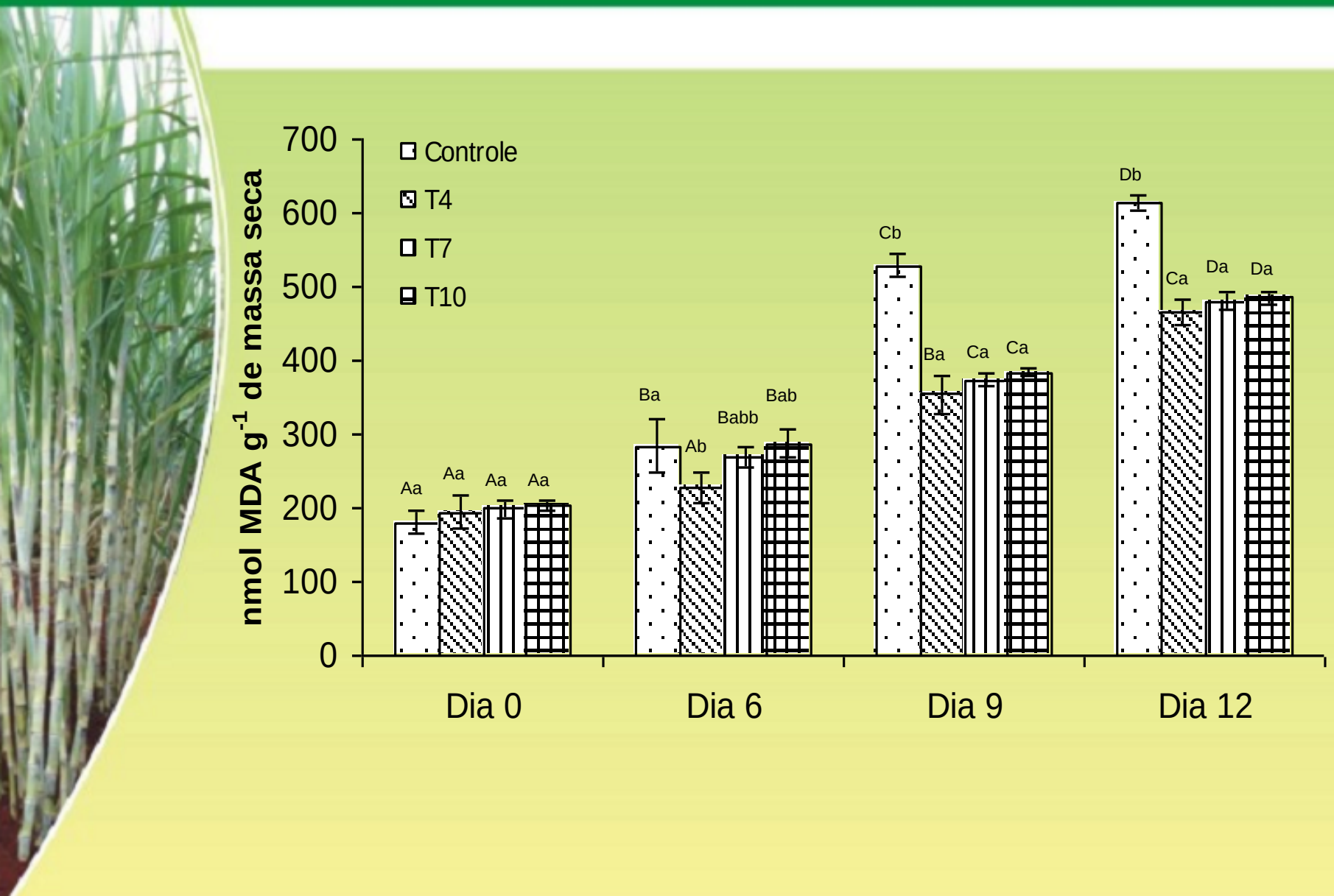


Water potential in leaves

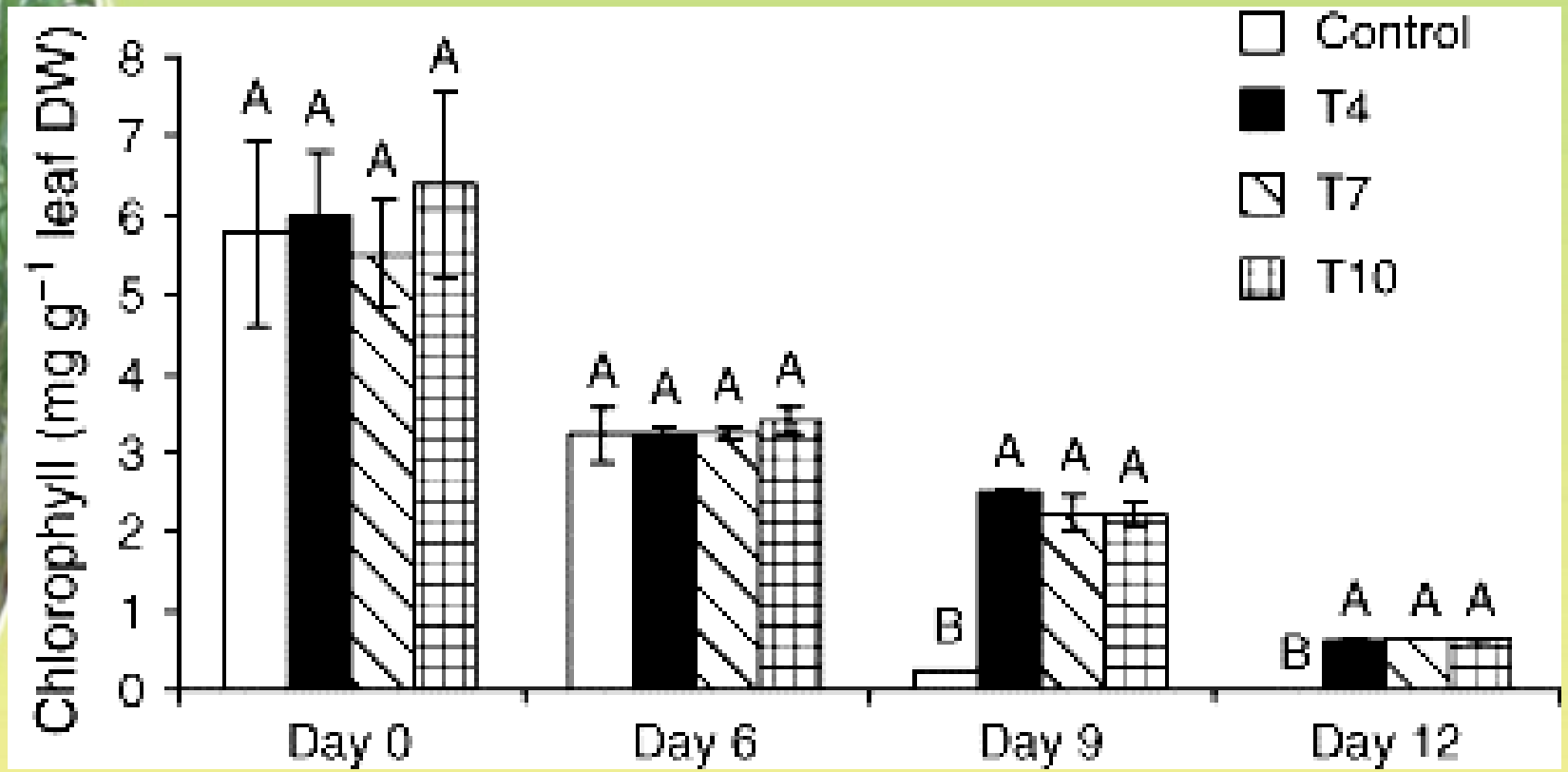
Protection against oxidative stress (ROS)



Lipid peroxidation (MDA level) on leaves



Total chlorophyll on leaf segments treated with paraquat (5 µM)



Conclusions

- Role of proline on protection of photosynthetic apparatus throught the capacity to act as scavenge of ROS

Next steps

- Field trial
- Transformation of others varieties with P5CS gene

People

IAPAR

- Celso Jamil Marur
- Jane Portela de Carvalho
- Luiz Gonzaga Esteves Vieira

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- Marília K. Freitas de Campos
- João Carlos Bespalhok F.

Embrapa

- **Hugo Bruno Correa Molinari**
- Luiz Filipe Protasio Pereira

Thank you