Centro de Investigaciones Agropecuarias (CIAP)

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"OXIDATIVE STRESS and ANTIOXIDANT DEFENCES as a tools for identification of tolerant genotypes to abiotic stress"

Dra Celina Luna

IFRGV

CIAP

Plant Breeding:
Forage Group: Biderbost E., Grunberg K., Griffa S., Ribotta A., Lopez Colomba E., Carloni E.

Plant Physiology:
Drought and Heat stress Group: Grumberg, B.,Tomassino,E., Sagadin,M.

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General topics:

Why oxidative stress in a breeding program?

- **What is oxidative stress phenomenon?**
- **Antioxidant defenses**
- **Oxidative stress in a Breeding Program**

Environmental abiotic/biotic stress impair plant growth and productivity worldwide

Selection of environmental stress tolerant plants is a promising approach

How to select tolerant genotypes ?

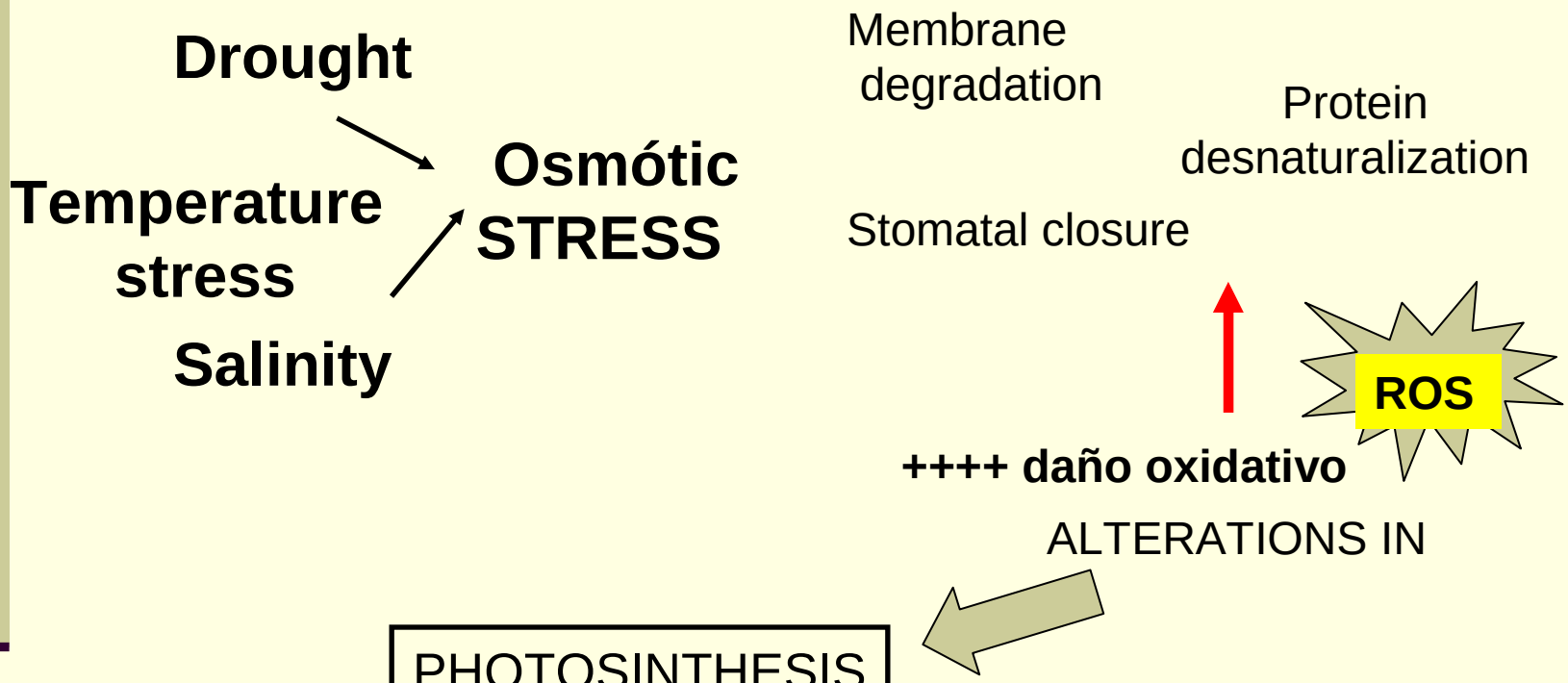
Interaction between
Plant Physiologists and Plant Breeders

Selection criteria related to abiotic/biotic stress tolerance

Agronomic, Physiological, Biochemical or Molecular markers

Understand the most important mechanisms related to abiotic stress tolerance

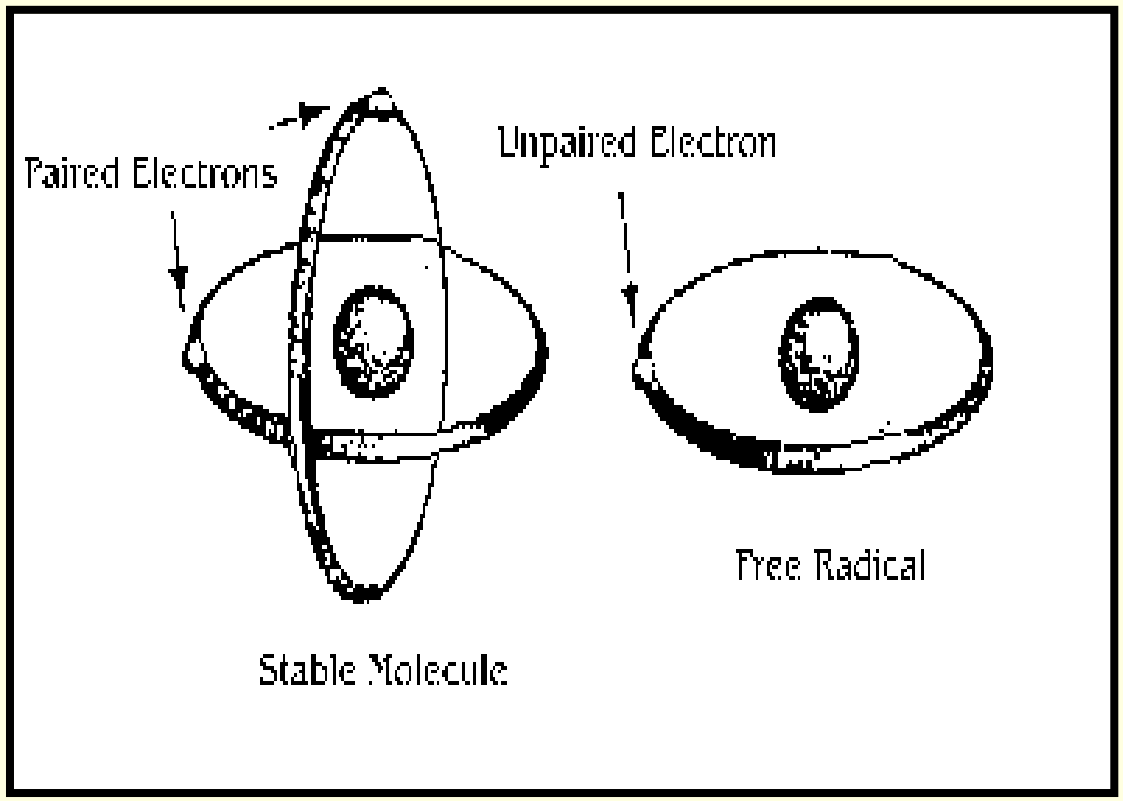
Key mechanisms related to abiotic stress tolerance:



M. Ashraf, M.R. Foolad / Environmental and Experimental Botany 59 (2007) 206–216

Reactive Oxygen Species (ROS)

Free radicals with atoms or molecules with an unpaired electron



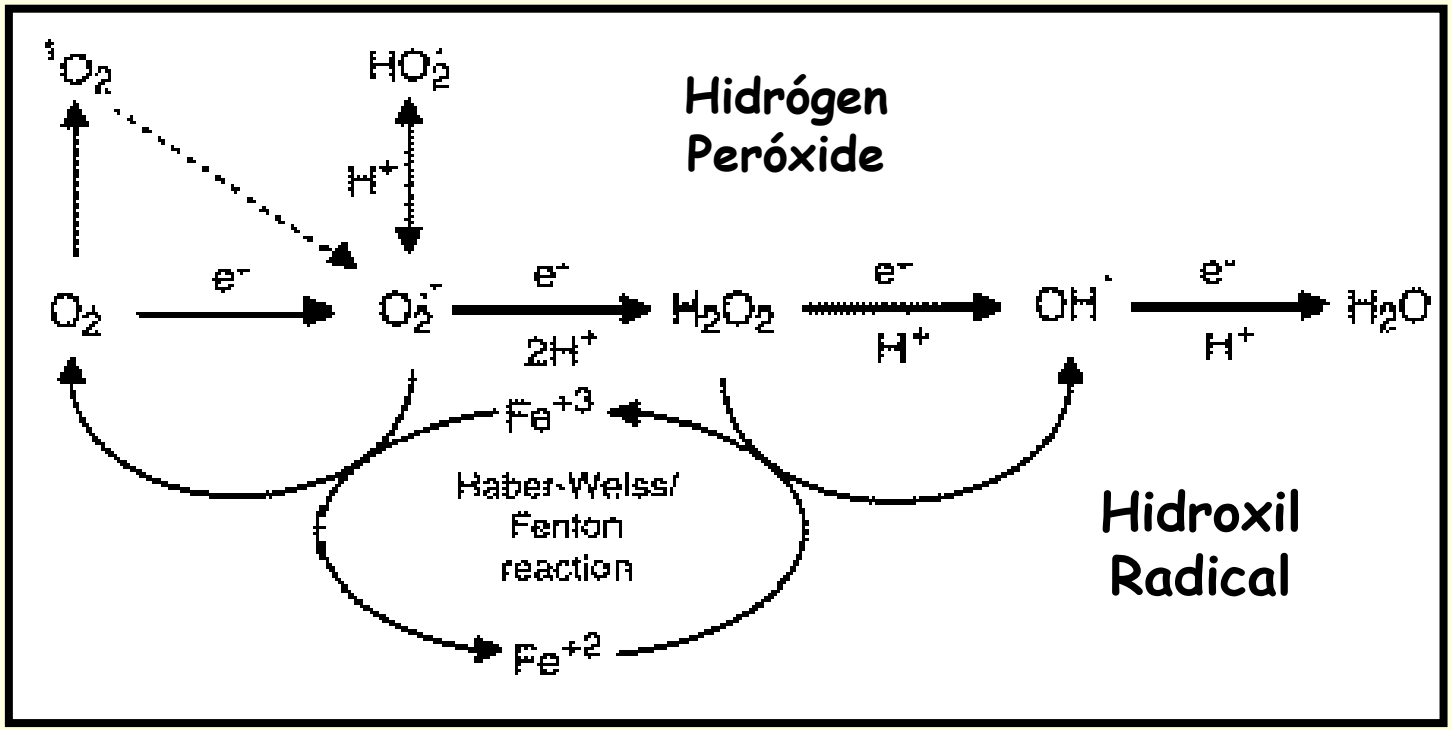
ROS : They are very reactive

They are able to react with other cell molecules in the redox reactions

Although oxygen (O_2) is essential for life, its reduction by any means results in the production of ROS

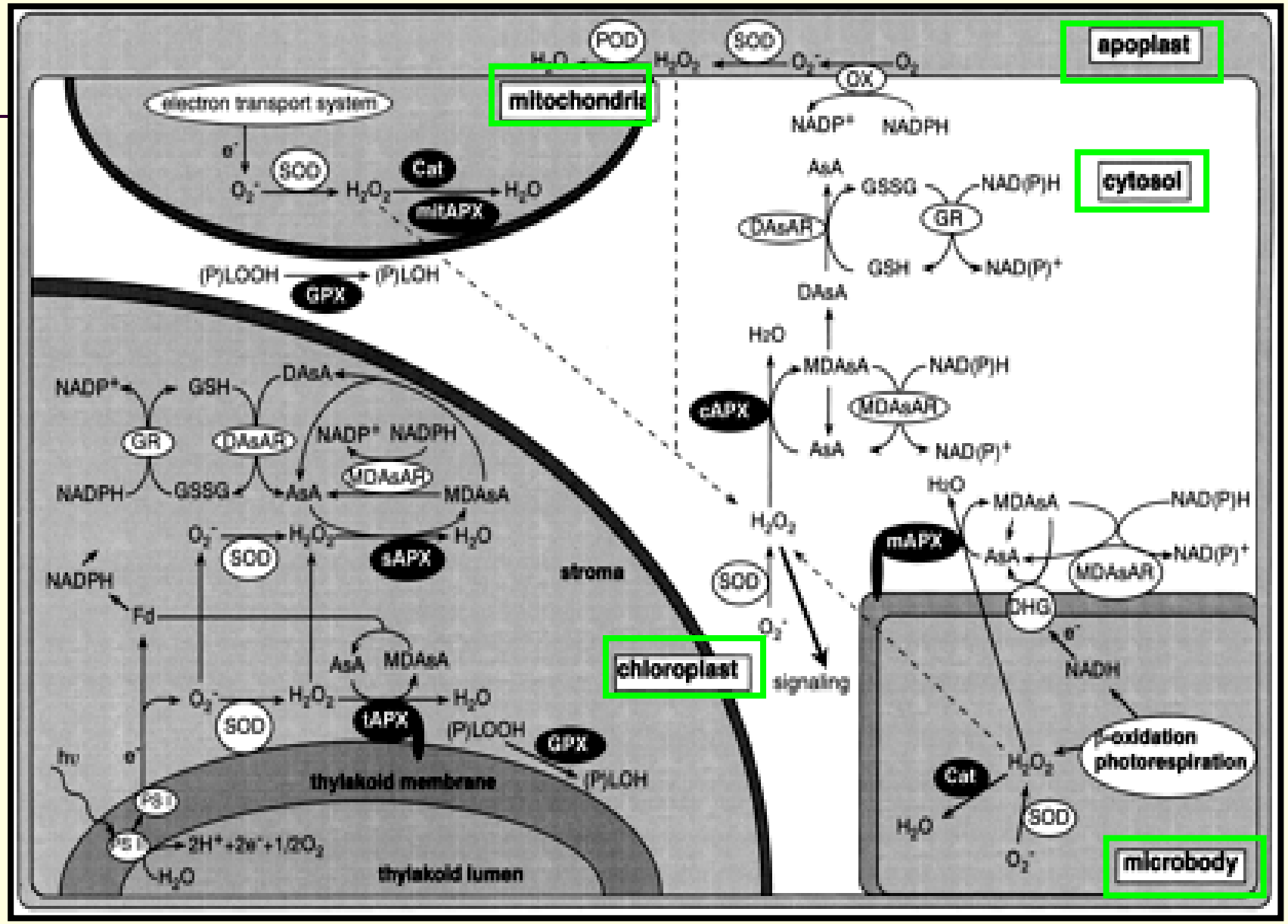
Singlet Oxígen

Superóxide Ion and Perhidroxil

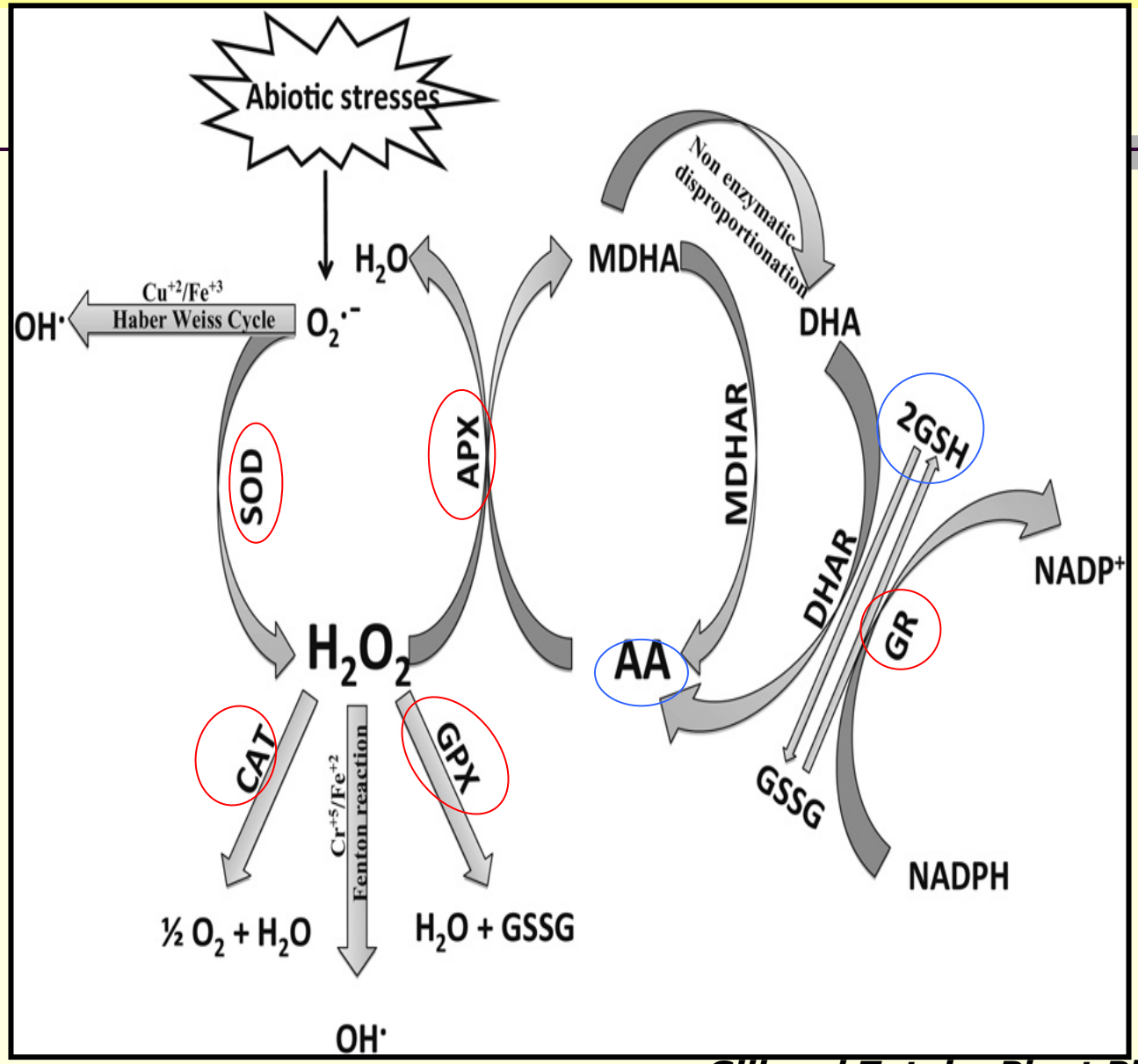


ROS are capable of unrestricted oxidation of ADN, Proteíns and Membrane lipids.

ROS generation in the cell



ANTIOXIDANT DEFENSES



Gill and Tuteja, Plant Physiology and Biochemistry, 2010

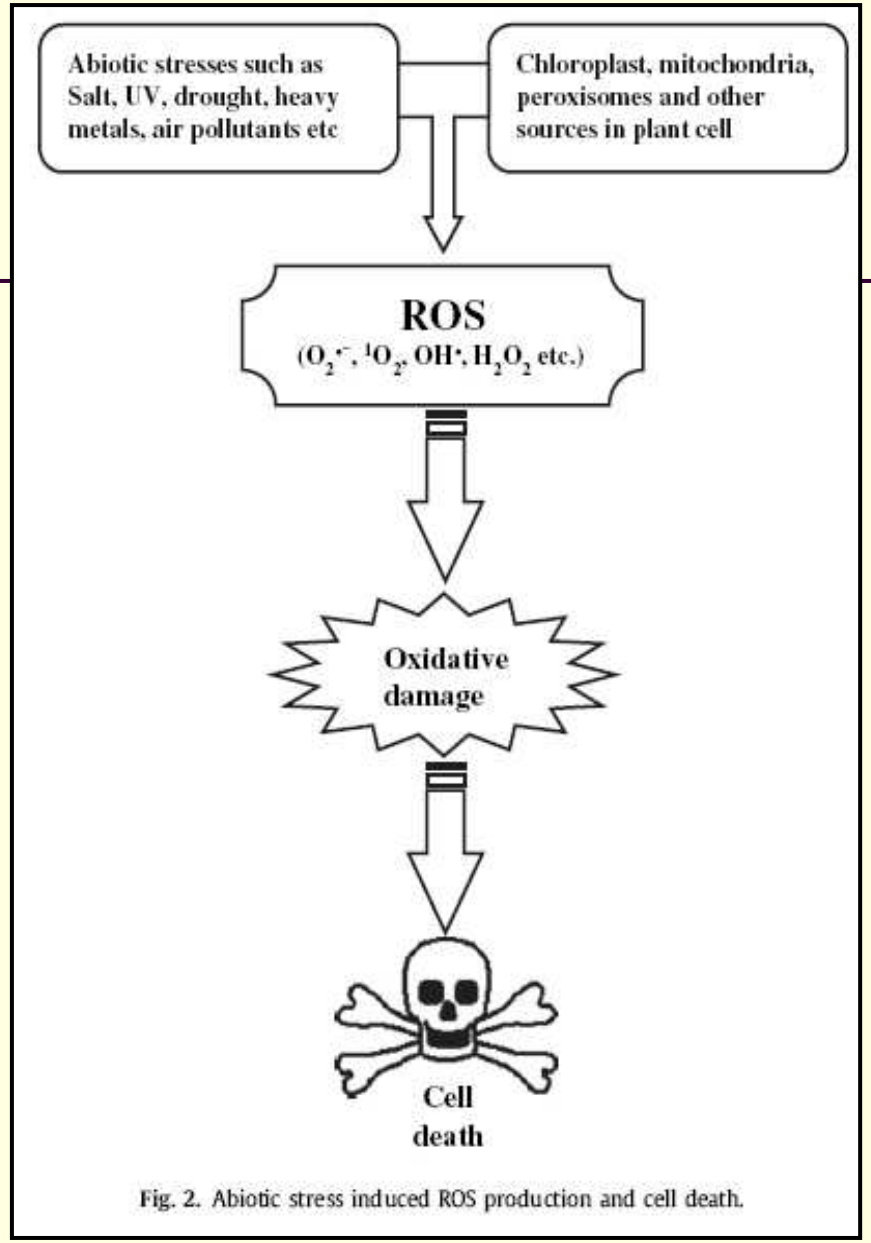


Fig. 2. Abiotic stress induced ROS production and cell death.

Gill and Tuteja, Plant Physiology and Biochemistry, 2010

Under normal conditions plants are continuosly producing ROS

Both biotic and abiotic stresses Increase ROS generation

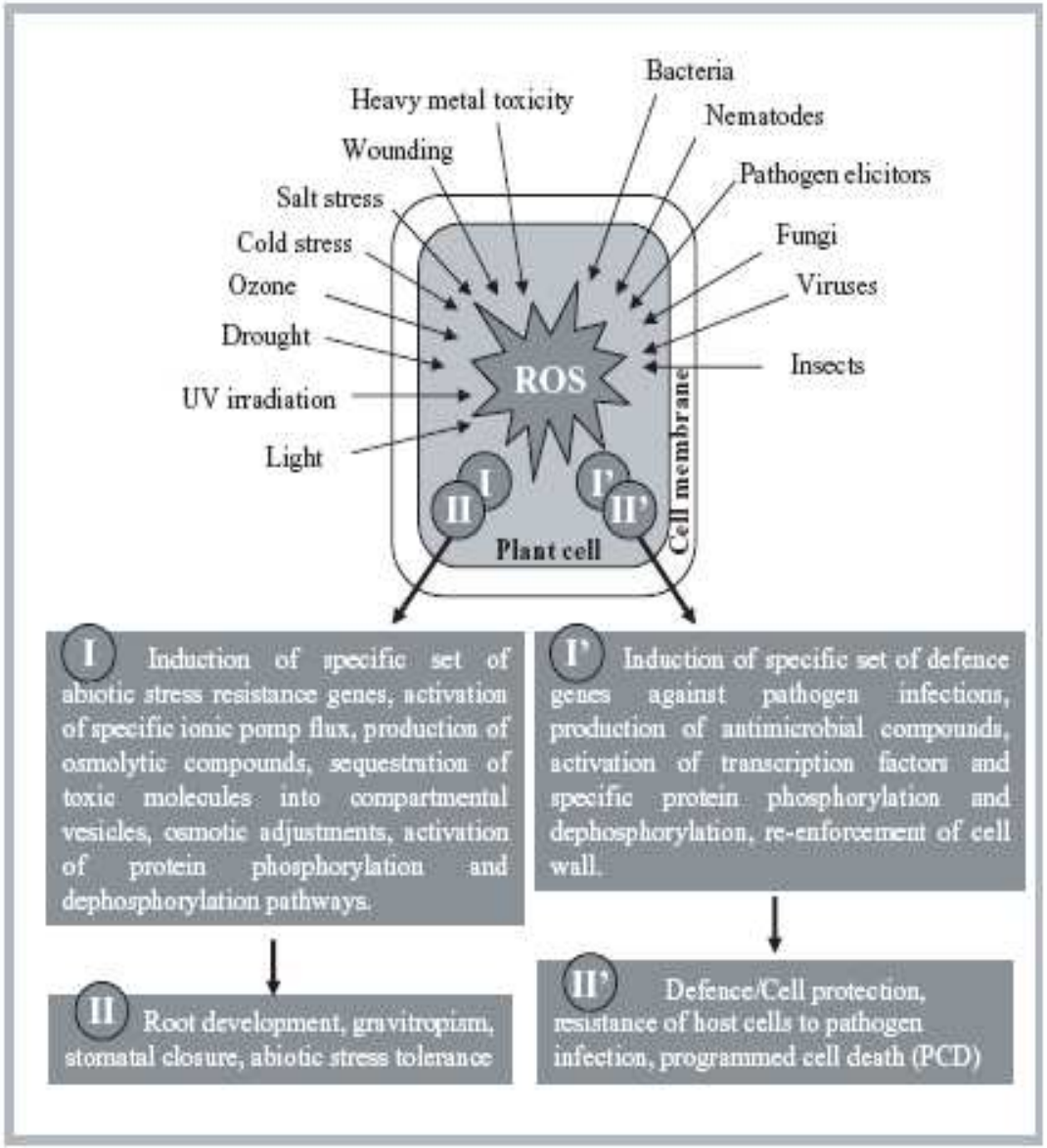


Figure 1. Involvement of ROS in cellular metabolic processes of plants response to both various environmental stresses. I and II indic the subsequent downstream events mediating by ROS in plant cells exposed to abiotic stresses, while I' and II' indicate the subsequ downstream events mediating by ROS in plants cells exposed to pathogens and pathogen-elicitors. The resistance of the plant cells to stress condition is dependent of the intensity and the speed of these downstream events.

ROS seem to have a dual effect that depend on their overall cellular amount

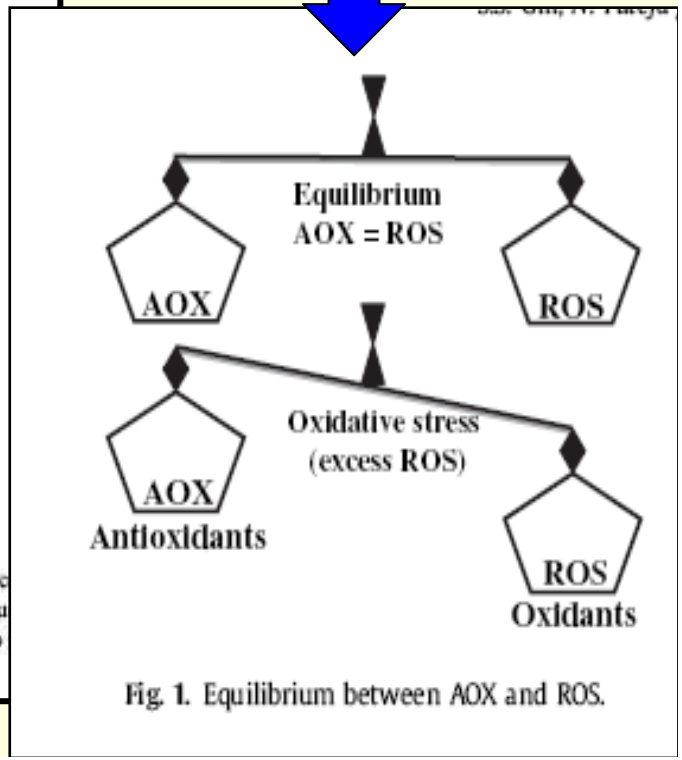
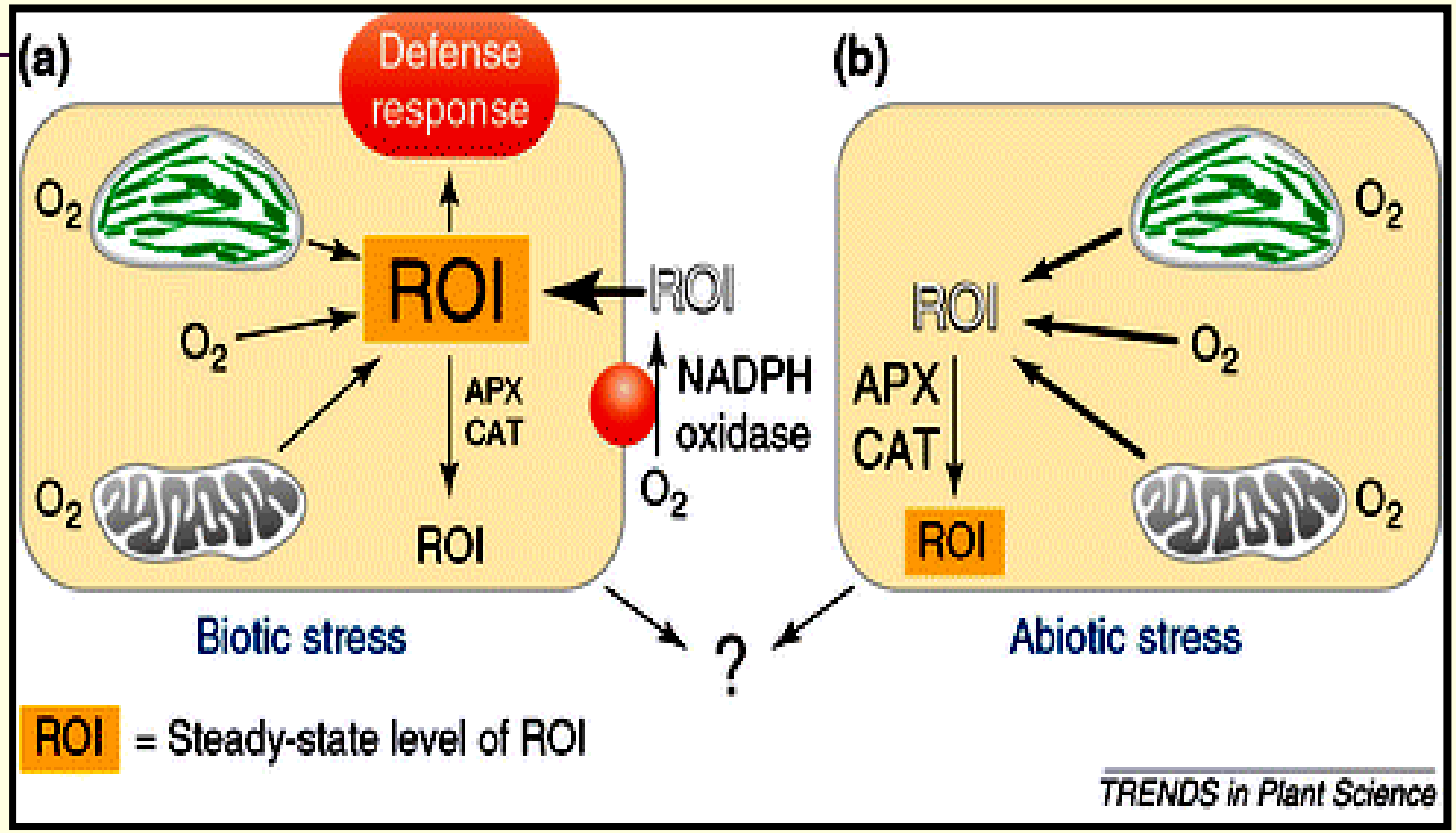


Fig. 1. Equilibrium between AOX and ROS.

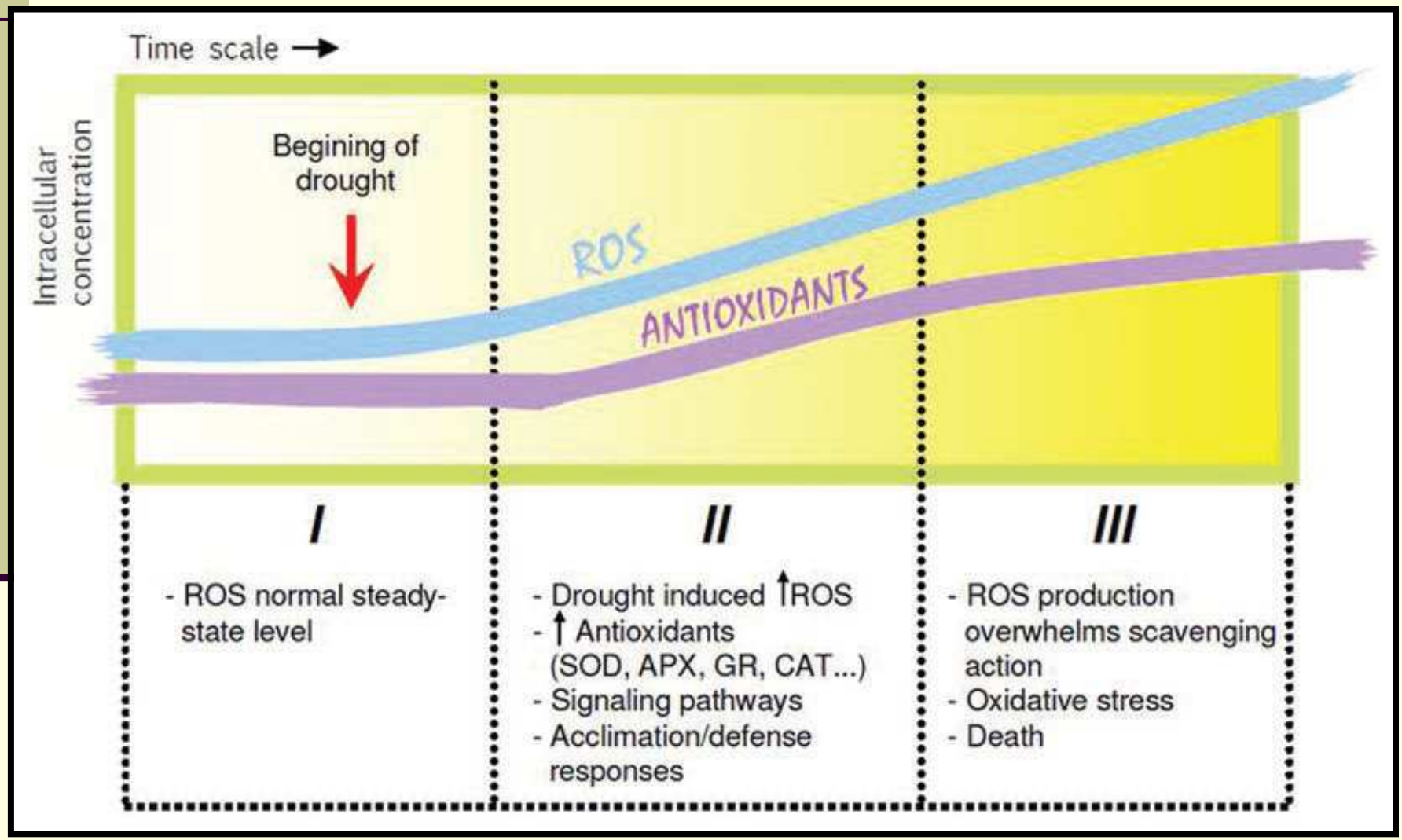
ROS IN BIOTIC AND ABIOTIC STRESS



DUAL EFFECT: LIKE SIGNALS OR OXIDATIVE DAMAGE

ABIOTIC STRESS

Drought stress response proposed model in three consecutive phases



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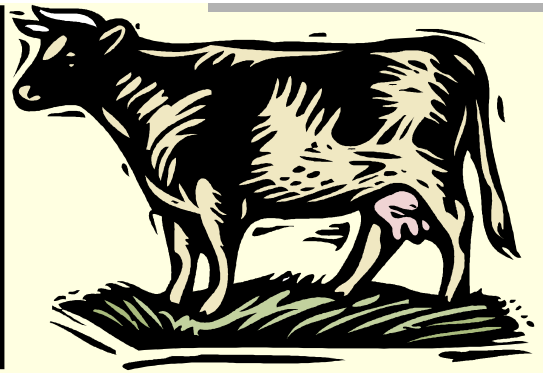


Breeding Programe

Forage: *Cenchrus ciliaris* L

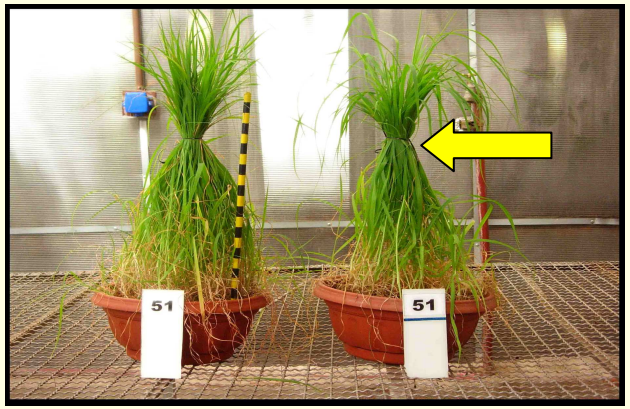
General Hipothesis: Genotypes showing better behaviour to oxidative stress under different abiotic stress, could be selected as more tolerant genotypes

Our Experimental system :

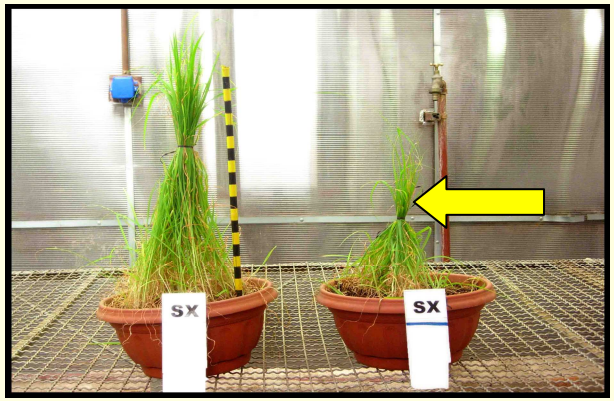
Growing genotypes in greenhouse

Abiotic stress under controled conditions

RECUPERATION in greenhouse



BILOELA



SEXUAL

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journal homepage: www.elsevier.de/flora

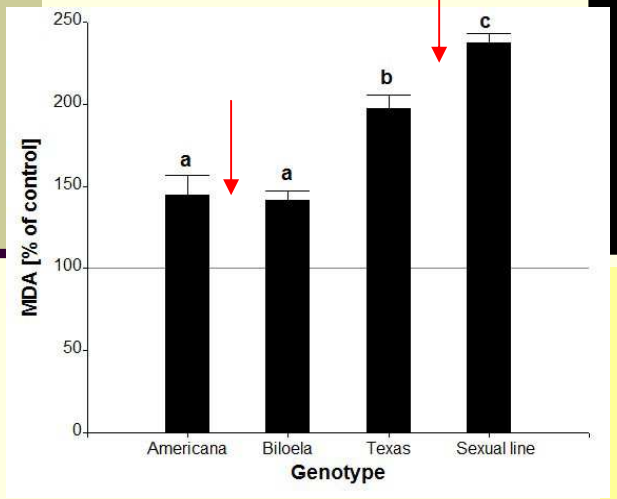
Oxidative damage and antioxidant defenses as potential indicators of salt-tolerant *Cenchrus ciliaris* L. genotypes

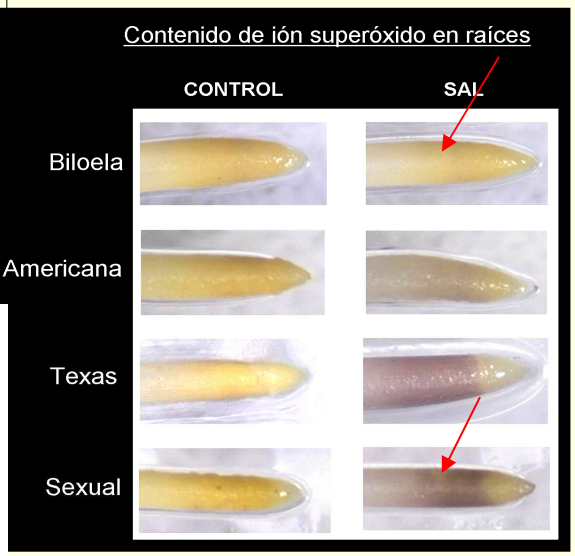
Sofia Lanza Castelli, Karina Grunberg, Nacira Muñoz, Sabrina Griffa, Eliana López Colomba, Andrea Ribotta, Elvio Biderbost, Celina Luna*

OXIDATIVE DAMAGE

as

MDA CONTENT





OXIDATIVE DAMAGE EVALUATED AS ION SUPEROXIDE CONTENT

Antioxidants defenses as selection criteria

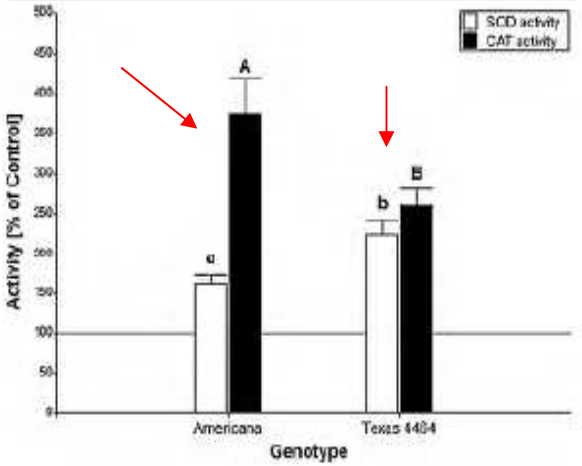


Fig. 2. Effect of NaCl on the activity of antioxidant enzymes, SOD and CAT, in leaves of the more tolerant genotype Americana and less tolerant genotype Texas 4464. Results are expressed as percentage of the control. Different letters indicate significant differences ($p < 0.05$).

Grass and Forage Science
The Journal of the British Grassland Society | The Official Journal of the European Grassland Federation

Research Note

Malondialdehyde content as a potential biochemical indicator of tolerant *Cenchrus ciliaris* L. genotypes under heat stress treatment

E. Tommasino, S. Griffa, K. Grunberg, A. Ribotta, E. López Colomba, E. Carloni, M. Quiroga and C. M. Luna

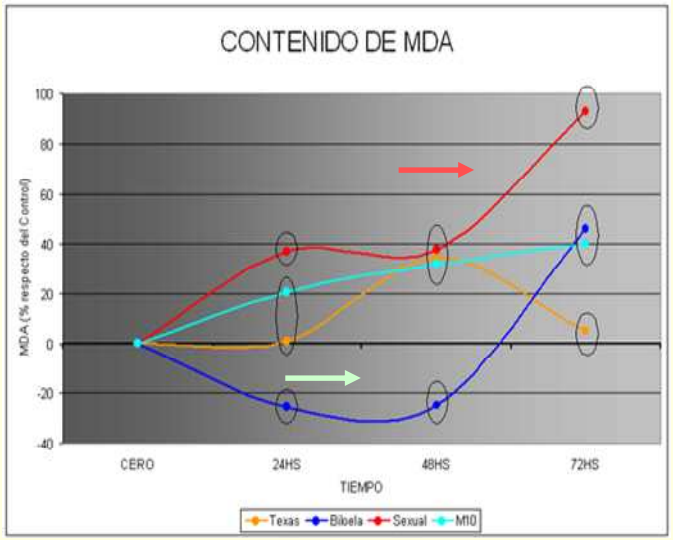


Figura 1: variación del contenido de MDA durante el EsT. Puntos dentro del mismo círculo no presentan diferencias significativas

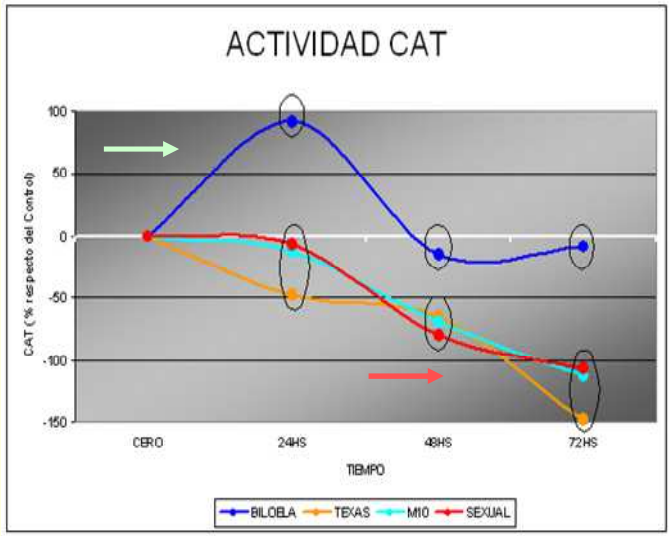


Figura 2: variación de la actividad CAT durante el EsT. Puntos dentro del mismo círculo no presentan diferencias significativas

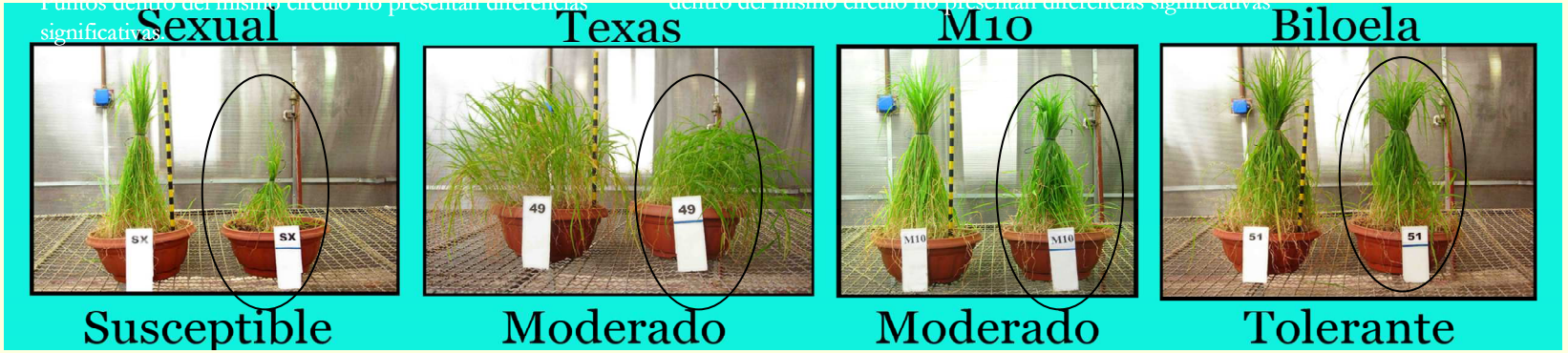
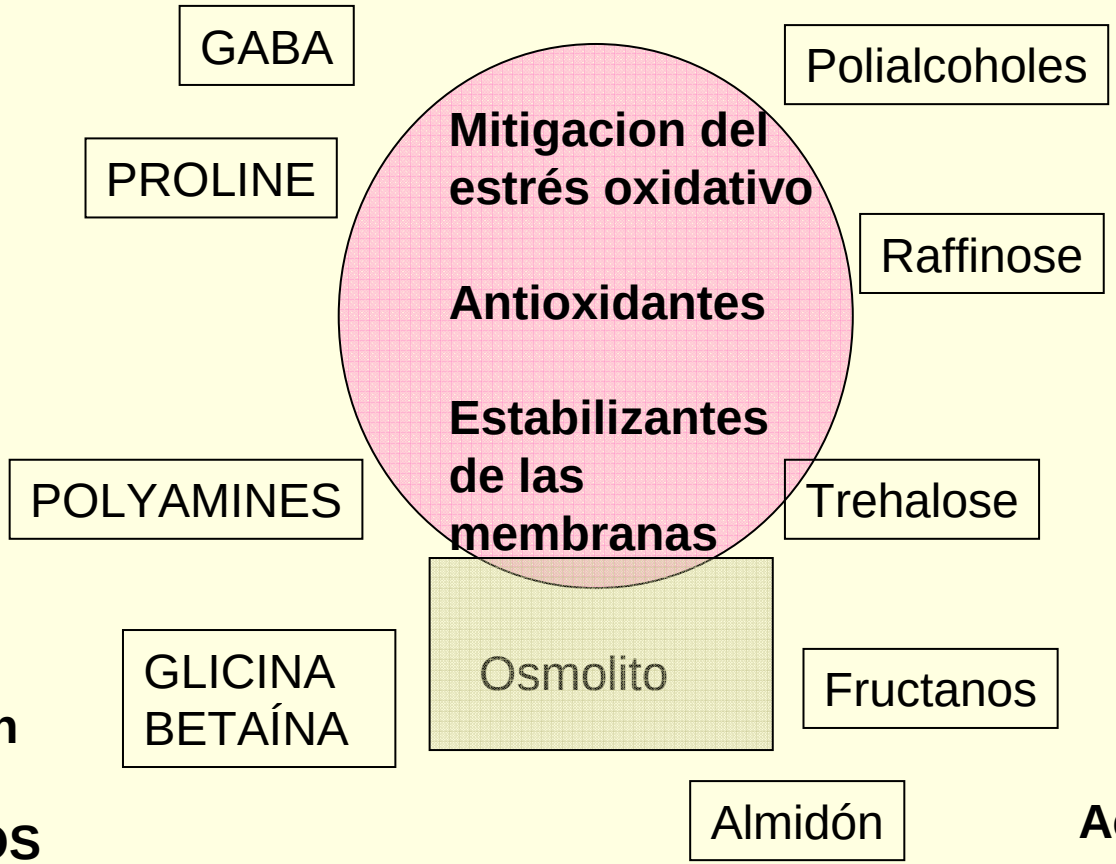


Figura 6: macetas control (izquierda) y macetas con EsT (derecha) al final del ensayo.

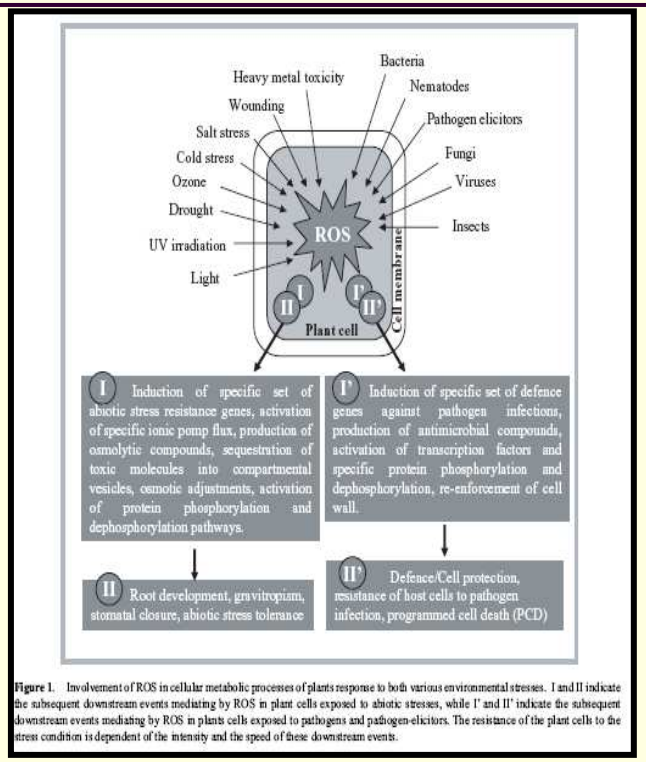
Drought, salt, and temperature stress-induced metabolic rearrangements and regulatory networks.

Julia Krasensky and Claudia Jonak. Journal of Experimental Botany, Page 1 of 16, doi:10.1093/jxb/err460 (2012).



SUMMARY POINTS

Why oxidative stress in a breeding program?



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IN GENERAL:

-Genotypes tolerant to oxidative stress were tolerant to other stress.

- Overexpression of enzymes for scavenging ROS INCREASE TOLERANCE

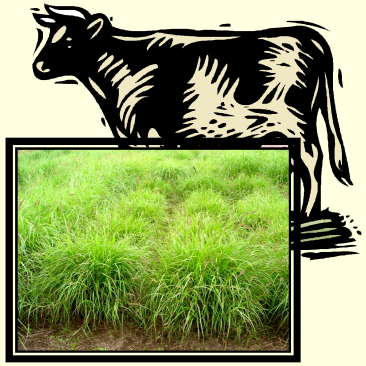
Biochemical Selection markers of abiotic stress tolerant genotypes

MDA
Permeability
Chlorophyll
ROS

\+ Proline
Glicyne Betaine

Rafinose
Trehalose
Polialcoholes

EMBRAPA-INTA



Plant Physiologists and Plant Breeders working together

Gracias!