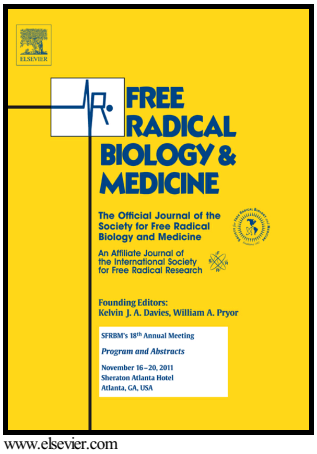
Friend or foe? Reactive oxygen species production, scavenging and signaling in plant response to environmental stresses

Weronika Czarnocka, Stanisław Karpiński



www.elsevier.com

PII: S0891-5849(18)30021-2
DOI: https://doi.org/10.1016/j.freeradbiomed.2018.01.011
Reference: FRB13586

To appear in: *Free Radical Biology and Medicine*

Received date: 10 October 2017
Revised date: 17 December 2017
Accepted date: 9 January 2018

Cite this article as: Weronika Czarnocka and Stanisław Karpiński, Friend or foe? Reactive oxygen species production, scavenging and signaling in plant response to environmental stresses, *Free Radical Biology and Medicine,* https://doi.org/10.1016/j.freeradbiomed.2018.01.011

Friend or foe? Reactive oxygen species production, scavenging and signaling in plant response to environmental stresses

Weronika Czarnocka [1,2], Stanisław Karpiński [1,3]

[1]Department of Plant Genetics, Breeding and Biotechnology, Faculty of Horticulture, Biotechnology and Landscape Architecture, Warsaw University of Life Sciences (SGGW), Nowoursynowska Street 159, 02-776 Warsaw, Poland
[2]Department of Botany, Faculty of Agriculture and Biology, Warsaw University of Life Sciences (SGGW), Nowoursynowska Street 159, 02-776 Warsaw, Poland
[3]The Plant Breeding and Acclimatization Institute (IHAR) - National Research Institute, Radzików, 05-870 Błonie, Poland

Corresponding author:
Stanisław Karpiński
Tel.: +48 22 593 2172 , e-mail: stanislaw_karpinski@sggw.pl

Highlights

- Biotic and abiotic stresses induce ROS production in different subcellular compartments
- In plant cells, different ROS have various degrees of reactivity toward molecules
- ROS scavengers keep ROS homeostasis and are involved in ROS-dependent signaling
- Within a cell, ROS cross talk with RNS, hormones, and Ca^{2+} ions
- ROS transduce SAA signal together with NPQ, hormones, Ca^{2+} and electrical waves

Abstract

In the natural environment, plants are exposed to a variety of biotic and abiotic stress conditions that trigger rapid changes in the production and scavenging of reactive oxygen species (ROS). The production and scavenging of ROS is compartmentalized, which means that, depending on stimuli type, they can be generated and eliminated in different cellular compartments such as the apoplast, plasma membrane, chloroplasts, mitochondria, peroxisomes, and endoplasmic reticulum. Although the accumulation of ROS is generally harmful to cells, ROS play an important role in signaling pathways that regulate acclimatory and defense responses in plants, such as systemic acquired acclimation (SAA) and systemic acquired resistance (SAR). However, high accumulations of ROS can also trigger redox homeostasis disturbance which can lead to cell death, and in consequence, to a limitation in biomass and yield production. Different ROS have various half-lifetimes and degrees of reactivity toward molecular components such as lipids, proteins, and nucleic acids. Thus, they play different roles in intra- and extra-cellular signaling. Despite their possible damaging effect, ROS should mainly be considered as signaling molecules that regulate local and systemic acclimatory and defense responses. Over the past two decades it has been proven that ROS together with non-photochemical quenching (NPQ), hormones, Ca^{2+} waves, and electrical signals are the main players in SAA and SAR, two physiological processes essential for plant survival and productivity in unfavorable conditions.