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Review

Nitric oxide in marine photosynthetic organisms

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ABSTRACT

Nitric oxide is a versatile and powerful signaling molecule in plants. However, most of our understanding stems from studies on terrestrial plants and very little is known about marine autotrophs. This review summarizes current knowledge about the source of nitric oxide synthesis in marine photosynthetic organisms and its role in various physiological processes under normal and stress conditions. The interactions of nitric oxide with other stress signals and cross talk among secondary messengers are also highlighted.

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1. Introduction

Nitric oxide (NO) is a highly reactive gaseous molecule, initially described as a toxic compound and then recognized as a key signaling molecule in both animal and plant kingdoms [1]. In the last two decades, NO has gained significant importance in plant research because of its multifunctional roles in various fundamental physiological processes such as root and shoot development, flowering, plant maturation and senescence, stomata movement, plant–pathogen interactions and programmed cell death [2,3]. NO generation has also been reported in the case of abiotic (e.g. high temperature, drought etc.) and biotic (e.g. pathogen interaction) stress agents [4,5]. Though most of the findings regard terrestrial plants, very few studies are reported for marine photosynthetic organisms (MPOs), including microalgae, seaweeds, seagrasses and mangroves. This review aims to summarize the results reported so far about NO in MPOs in order to understand the main issues not yet solved, highlighting future directions of NO research in MPOs.

2. Source of NO

The source of NO production depends on the plant species, cell types, and environmental conditions of plant growth [6]. The main pathways of NO synthesis include either arginine or nitrite as substrate [7]. The arginine dependent pathway involves nitric oxide synthase (NOS) [8], whereas different enzymatic systems can generate NO from nitrite. An important source for NO is dependent on the activity of nitrate reductase (NR). Although the primary function of NR is to catalyze the reduction of nitrate to nitrite, it can

Abbreviations: NO, Nitric oxide; NOS, nitric oxide synthase; NR, nitrate reductase; Ni-NOR, nitrite-NO reductase; MPOs, marine photosynthetic organisms; PUAs, polyunsaturated fatty acids.

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