

Title: Integrative roles of hydrogen sulfide and melatonin in oxidative homeostasis and sustainable plant growth

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Abstract: Abiotic stresses like salinity, high or low temperature, heavy metals, ultraviolet radiation, etc. are all on the rise in the current era of changing climate, which significantly hampers the growth and developmental processes of plants. Abiotic stresses can alter the cellular homeostasis by increasing the production of oxidative stress markers, reducing photosynthetic and respiration efficacy and modulating the expression of various transcripts. Overall, these abiotic factors influence numerous aspects of plant life and can lead to malfunctioning of various defense mechanisms. Therefore, there is an urgent need for strategies that can ameliorate the negative impact of unfavourable factors without harming the environment. Although plants are equipped with various adaptive processes to resist the undesirable effects induced by abiotic factors, these mechanisms are insufficient to shield the plants from stress-induced responses. Recently, the supplementation of diverse plant growth regulators, especially hydrogen sulfide (H₂S) and melatonin (MEL), has emerged as a potential strategy in imparting abiotic stress tolerance to the crop plants. Therefore, the present review provides an updated overview of the role of underlying mechanisms of H₂S and MEL biosynthesis and their potential role in mitigating the impact of unfavourable environmental conditions, individually and synergistically. Furthermore, the review proposes new research directions to the researchers to use these signaling molecules as a promising tool for sustainable agriculture practices.

Keywords: Hydrogen sulfide; Melatonin; Abiotic stress; Signaling molecule; Sustainable agriculture

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