Commentary
Volume 7:8, 2022

Advances in Recycling & Waste Management

ISSN: 2475-7675

Open Access

Humic Acids Cause Changes in the Metabolic Profile of Rice Leaves

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Introduction

The use of humic substances as a biostimulant in agriculture has emerged as one of the promising methods for promoting sustainable production. Different molecular, biochemical, and physiological processes are activated, resulting in better nutrient utilisation and resistance to abiotic stress. Understanding the plant changes induced by humic substances is critical for developing novel and tailored biostimulation technologies. The final target of the response chain is cell metabolites, and the metabolomic approach can be useful in revealing plant response pathways. The purpose of this study was to assess a global metabolic change in rice leaves caused by humic acids (HA) used in a hydroponics system [1].

Description

The agricultural application of humic substances is gaining popularity. The majority of commercial humic products are derived from geochemical sediments such as coals and peats. They can, however, be isolated from renewable sources of stabilised organic matter, such as compost and vermicompost, giving the farmer greater autonomy. When in aqueous suspension, HS are better represented as complex mixtures of thousands of different small molecules that take on a supramolecular organisation. When key functional groups are present in very low doses, they may induce positive physiological responses in plants. The increasing success of HS biostimulation has been based on two main factors: Their well-documented effects on ion uptake, nutrient utilisation efficiency, and plant resistance to abiotic stress [2].

Direct application of HS to crops allows for crop productivity to be maintained while using significantly less inorganic fertiliser.HS can also be used to protect plants from abiotic stress as a beneficial agent, inducing downstream effects on hormonal signalling pathways and plant development. Understanding how plants perceive and respond to HS applications is critical for designing and developing biostimulation technology. The effect of HS on plant growth, for example, is affected by the source, dose, content of bioactive molecules, and mode of application. Furthermore, changes in metabolism can aid in determining the impact of HS on plants [3].

Cell metabolites are the primary targets of physiological action, but metabolomic studies in plants treated with HS are limited. A previous metabolomic survey revealed that humic acids (HA) altered global metabolic distribution, resulting in a significant decrease in amino acid concentration. However, target analysis has already revealed an increase in some specific amino acid synthesis in plants treated with HS. Furthermore, HA increased the levels of 40 compounds, including metabolites associated with stress response and cellular growth (adenine and adenosine derivatives, ribose, ribonic acid, and citric acid).

Furthermore, the use of HS from compost improved the total extraction yield of steam distillation of basil leaves. Simultaneously, it had no effect on the composition of essential oils, a valuable bioactive secondary metabolite of aromatic plants. A similar effect was seen in maize roots treated with HA, which caused no changes in cell metabolite composition while only modifying their amount in root tissues. Mapping global metabolic changes can aid in understanding of plant-HA interactions. However, because soil is a multiphase and multicomponent system, a comprehensive understanding of the humic-plant interaction mechanism of applied biostimulants on rhizosphere environments may be hampered.

Indeed, the use of HA in hydroponic systems caused a significant change in the metabolic fingerprint of leaf extracts, as demonstrated by 1H NMR. Humic products' ability to promote growth has been linked to their influence on a variety of molecular, biochemical, and physiological processes. Because the final target is cell metabolites, the growth acceleration resulted in a decrease in cell metabolites overall when compared to control plants. In comparison to the control, 30 compounds were found in significantly higher levels in plants treated with HA. They are a candidate for expressing the effect of HA on plant metabolism because it is easier to track a metabolite at a higher concentration. The discussion will centre on the function of these compounds in plants [4,5].

Conclusion

The direct application of HA derived from recycled biomasses to plants can be included as an innovative technology to improve the sustainability of agricultural production systems by preserving soil fertility and reducing the negative environmental impact of current farming practises. HA-biostimulants alter rice plant metabolism to promote growth by activating and enhancing physiological events for improved plant development, resulting in lower cell metabolite concentration. Fewer compounds, however, were found in high concentrations, particularly those associated with defence potentiation and are candidates for metabolic markers of HA bioactivity. Based on the variable composition of composted biomasses, a comprehensive understanding of structural activity relationships using advanced metabolomic approaches is an essential requirement.

Acknowledgement

None.

Conflict of Interest

There are no conflicts of interest by author.

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Received: 02 August, 2022, Manuscript No. arwm-22-83747; **Editor Assigned:** 04 August, 2022, PreQC No. P-83747; **Reviewed:** 16 August, 2022, QC No. Q-83747; **Revised:** 21 August, 2022, Manuscript No. R-83747; **Published:** 28 August, 2022, DOI: 10.37421/2475-7675.2022.7.243

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How to cite this article: Hao, Tianwei. “Humic Acids Cause Changes in the Metabolic Profile of Rice Leaves." Adv Recycling Waste Manag 7 (2022): 243.