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Plant metabolites role in developing abiotic stress-resilience in plants: Evaluating the Effects of Melatonin and Myoinositol on photosynthetic efficiency of apple rootstocks under western Himalayan region.

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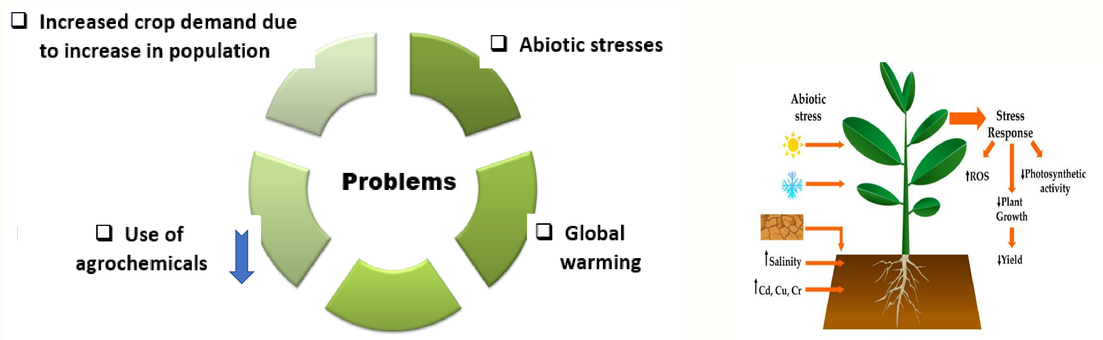
Introduction

- Global population growth challenges agricultural productivity, requiring innovative strategies to meet rising food demand while minimizing agrochemical impacts on health and ecosystems.
- Fruit production dynamics, influenced by various factors, highlight the dual objective of regulating plant growth and mitigating biotic and abiotic stresses for optimal productivity.[3]
- Plant metabolites, considered environmentally friendly, show promise in enhancing overall sustainability, with a distinction between primary and secondary metabolites.[2]
- Apple cultivation in regions like Himachal Pradesh faces drought susceptibility despite using resistant rootstocks. Ongoing experiments explore exogenous metabolites like Melatonin and Myo-inositol for solutions.
- The experiment aims to counteract abiotic stress, boosting productivity and improving fruit quality, showcasing plant metabolites as a transformative strategy for agricultural sustainability amid global demands.

Objectives

To standardize the exogenous level of melatonin and myo-inositol on apple rootstocks under drought stress

To study physiological responses associated with exogenous melatonin and myo-inositol in apple rootstocks under drought stress



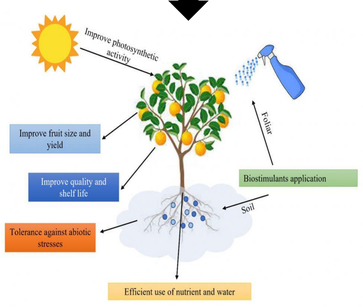
Plant metabolites as bio-stimulants

Plant Metabolites → **Bio-stimulant**

Plants have a large diversity of metabolites in order to carry out the complicated plant metabolic pathway in a coordinated manner under normal as well as stressful conditions.[4]

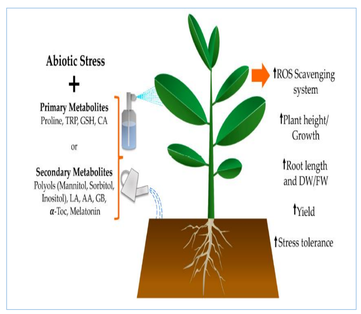
Ability to regulate plant metabolism and at the same time reduce the impact of abiotic and biotic stress.[1]

Primary metabolites	Secondary metabolites
Responsible the for main metabolic pathways growth and development that are critical for the survival of plants	Developing the ability of the plants to interact with the surrounding adverse environment. Serve as defense compounds against herbivores, microorganisms and adverse climatic conditions



1. Proline
2. Tryptophan (TRP)
3. Glutathione (GSH)
4. Citric Acid (CA)

1. Polyols
2. Mannitol
3. Sorbitol
4. Inositol
5. Lipoic Acid
6. Ascorbic Acid
7. Glycine Betaine
8. Alpha Tocopherol
9. Melatonin



Application of primary and secondary plant metabolites ameliorates the negative effects of abiotic stress

Apple rootstock

Apple varieties semi spur or spur is main grown in HDP on rootstock M9 and MM106 due to its dwarfing and winter hardy traits to increase production of qualitity fruits

Jeromine on M9 and MM106

Major problem is these rootstocks are drought susceptible thus reducing the production and productivity of quality fruits

Methodology

❖**Rootstocks selected:**

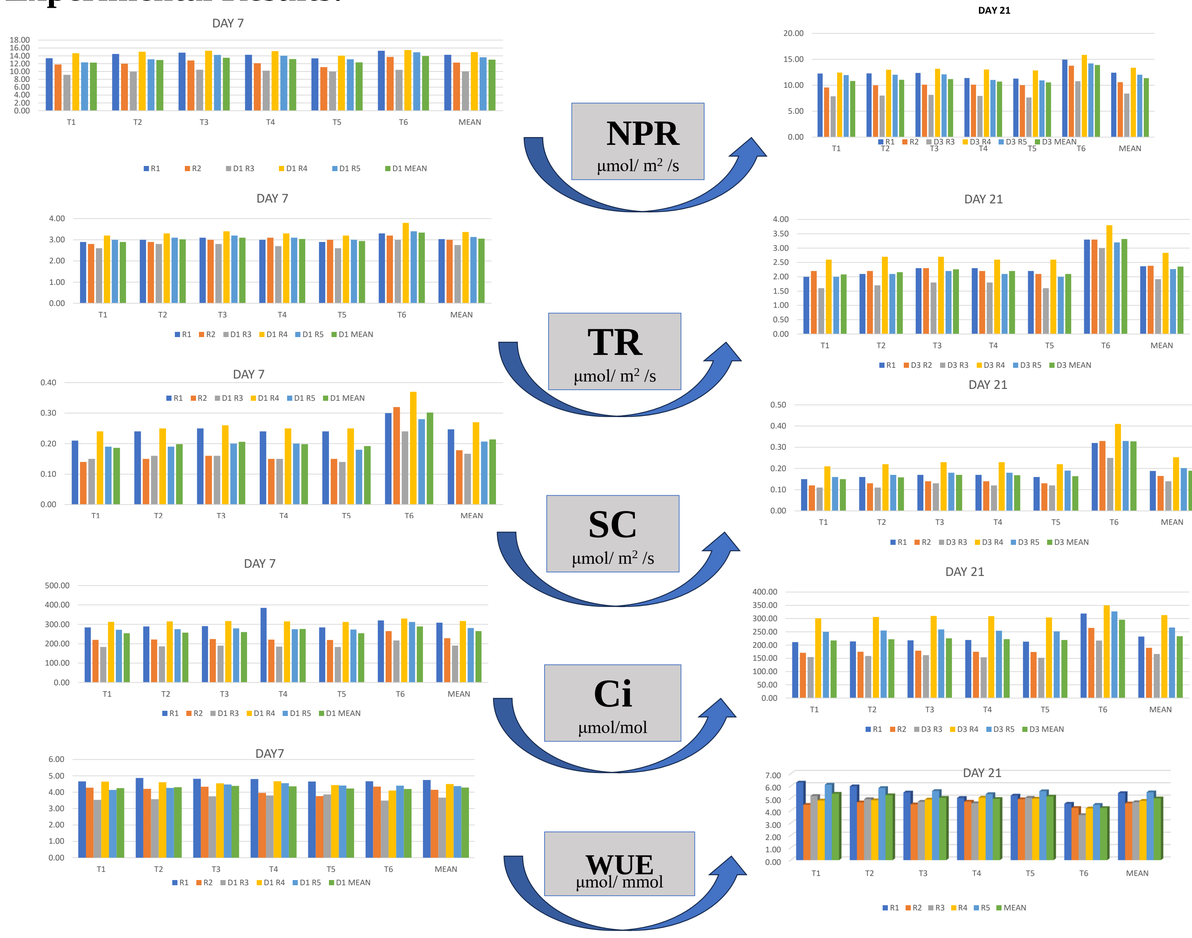
a. **MM111**
b. **MM106**
c. **M9**
d. **Bud118**
e. **M 116**

Water regimes

1) 40% FC
2) 100% FC

Treatment	Combinations
T1	Melatonin (100µM) + Myo-inositol (20µM)
T2	Melatonin (100µM) + Myo-inositol (50µM)
T3	Melatonin (100µM) + Myo-inositol (100µM)
T4	Melatonin (100µM) + Myo-inositol (150 µM)
T5	Melatonin (100µM) + Myo-inositol (200 µM)
T6	Control

Experimental Results:



Rootstocks under drought conditions with treatment

Rootstocks under drought conditions without treatment

Conclusions

✓ **Drought Stress Impact on Photosynthesis in Rootstocks**

Drought stress significantly inhibited photosynthesis in the rootstocks, posing a challenge to overall plant productivity.

✓ **Effective Mitigation through Foliar Spray**

The combination of melatonin and myo-inositol, particularly at 100 µM(M) + 100 µM(MI), demonstrated remarkable efficiency in mitigating the adverse effects of drought stress.

✓ **Mechanisms of Mitigation**

Melatonin and myo-inositol were found to improve photosynthesis by inhibiting stomatal closure, enhancing light energy absorption, and promoting electron transport in PSII.

✓ **Measurement Techniques**

The assessment of photosynthetic rate, transpiration rate, and internal carbon dioxide levels was conducted using Infrared Gas Analyzers (IRGA) for precise and detailed measurements.

Future Plans

➢ **Implications for Agricultural Practices**

The understanding of the underlying mechanisms provides valuable insights for optimizing agricultural practices, contributing to improved crop resilience and productivity.

➢ **Future Roles of metabolites in Plant Growth Optimization**

Bio-stimulants emerge as a promising and sustainable tool for enhancing plant growth and productivity, showcasing effectiveness in improving nutrient and water use efficiency, enhancing tolerance against various abiotic stresses such as salinity, water stress, cold, and high temperatures, and ultimately contributing to increased yield and quality in both agricultural and horticultural crops.

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