SUNSHINE AGRICULTURE
e-Newsletter

ISSN (E): 2583 – 0821

Sun. Agri.:e- Newsletter, (2025) 5(5), 7-8

Article ID: 383

Use of Acetic Acid to Improve Crop Productivity Under Drought Conditions

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Open Access

Available online at
http://sunshineagriculture.vitalbiotech.org/

Article History
Received: 03. 05.2025
Revised: 08. 05.2025
Accepted: 13. 05.2025

INTRODUCTION

Farming in the arid and semi-arid regions of India is a major challenge, particularly when rainfall is erratic and insufficient. Farmers dependent on rainfed agriculture often suffer due to moisture stress, which adversely affects crop growth, development, and yield. Moisture deficiency leads to cell shrinkage in plants, leaf wilting, reduced photosynthesis, and disruption of essential physiological processes. As a result, flowering, pod formation, and grain filling are negatively impacted, causing a significant drop in yield. This is especially true for kharif-season pulses such as mungbean, moth bean, and cluster bean, where water scarcity leads to considerable yield loss and economic hardship for farmers. In such situations, it becomes essential to adopt scientific strategies to cope with moisture stress.

Bioregulators: Their Role in Enhancing Moisture Stress Tolerance

Bioregulators, also known as plant growth regulators, are compounds that, even when used in small quantities, influence various physiological and biochemical functions in plants. These can be natural or synthetic and are intended to help plants perform better even under adverse environmental conditions. During moisture stress, the activity of antioxidant enzymes in plants decreases, leaf drop intensifies, and cellular damage occurs. Bioregulators help counter these effects by maintaining hormonal balance, promoting root development, and enhancing water retention through leaves. In recent years, researchers have focused on several bioregulators like salicylic acid, jasmonic acid, and acetic acid. Among these, acetic acid has emerged as a cost-effective, simple, and promising solution.

Acetic Acid: Effectiveness in Enhancing Moisture Stress Tolerance

Acetic acid is an organic acid naturally found in vinegar. Though commonly used in kitchens, research has demonstrated that acetic acid can also be an effective bioregulator in improving drought tolerance in plants. Scientific studies have shown that when acetic acid is applied to crops during moisture stress conditions:

- Root length and spread improve, allowing better access to deep soil moisture.
- Photosynthetic activity increases, ensuring sustained energy production in the plant.
- Relative water content in leaves remains stable, keeping them green and physiologically active.
- Antioxidant enzymes such as proline, catalase, and SOD (superoxide dismutase) are activated, reducing cellular damage.
- Additionally, the use of acetic acid has been found to enhance flowering, increase pod number, and ultimately improve grain size and weight.

Use of Acetic Acid: Recommended Dosage and Application Time (For Mungbean, Moth Bean, and Cluster Bean)

Applying acetic acid at the right dosage and time under drought conditions improves a crop's ability to tolerate moisture stress and helps sustain yield. In pulses like mungbean, moth bean, and cluster bean, acetic acid should be applied through seed priming and foliar spray during the flowering stage.

- Based on research findings, the recommended dose of acetic acid is 25 mM for moth bean and cluster bean, while for mungbean, a concentration of 25 to 50 mM has been found effective.
- For seed priming, seeds should be soaked in acetic acid solution approximately 6 hours before sowing. This enhances germination and supports better early-stage growth.
- For foliar spray, acetic acid should be sprayed on leaves during the flowering stage (around 30–40 days after sowing). This activates key biochemical processes and helps minimize the damage caused by water stress.
- Using both seed priming and foliar spray ensures that plants develop early resistance to drought and maintain productivity even under adverse conditions.
- The main goal of seed priming is to prepare the plant from the beginning to withstand moisture stress.
- Foliar spray ensures a quick response by the plant, activating internal biochemical processes.

Precautions While Using Acetic Acid

- Always dilute glacial acetic acid (99%) properly with water before use.
- Do not exceed the recommended dosage, as higher concentrations can harm the plants.
- Spray during early morning or late evening to avoid damage from strong sunlight.
- Always wear protective gloves and a face mask while handling the solution.

CONCLUSION

Drought is a major constraint that affects both farmer effort and income. To face this challenge, it is essential to adopt scientific and low-cost technologies. Acetic acid is a safe, inexpensive, and effective bioregulator that can be used to improve the productivity of drought-sensitive crops like mungbean, moth bean, and cluster bean. Experimental results have clearly shown that when applied in the right dose and at the right time, acetic acid positively influences plant growth, enhances drought tolerance, and improves yield. Therefore, farmers are encouraged to adopt this technique under the guidance of agricultural scientists to achieve better yields and improve income in drought-prone areas.