

Bio-Based Augmented Fertilizer for Drought Resilience

Abstract

This paper presents the formulation and proposed application of a bio-based augmented fertilizer designed to enhance water retention and improve crop resilience under drought conditions. Leveraging naturally occurring mucilage, polysaccharides, and hydrophilic fibers found in select plants- specifically *Opuntia ficus-indica* (Nopales), *Aloe vera*, *Salvia hispanica* (Chia), and others- this fertilizer functions as both a soil moisture stabilizer and nutritional enhancer.

Introduction

Global agriculture is increasingly vulnerable to water scarcity, necessitating new strategies for drought resilience. Traditional fertilizers focus on nutrient supply but often ignore water dynamics. Mucilaginous plants like *Opuntia* survive dehydration by using internal gels. These biocompounds offer both nutrient delivery and hydration, ideal for drought-adapted fertilizers.

Objectives

- Evaluate mucilage-rich plants as organic water-retention enhancers.
- Formulate an augmented fertilizer combining hydrophilic biocompounds with nutrients.
- Explore use in arid and drought-prone regions.

Materials and Methods

Eight plants were selected for their mucilage content and compatibility. Nopales, Aloe, Chia, Flaxseed, Okra, Seaweed, Banana Peel, and Psyllium were processed to extract gels and combined with organic compost and rock dust. Simulated soil beds were used to test moisture retention and nutrient

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release.

Results and Discussion

Nopales-based blends retained 25-45% more moisture. Aloe and psyllium improved capillary water flow. Chia and seaweed enhanced hydration. Aloe and banana improved micronutrient absorption. Soil structure improved due to increased microbial activity from fermented blends.

Practical Applications

- Dryland farming: root soak or soil mix.
- Urban gardening: use in containers.
- Seed coating: natural hydrogel wrap.
- Land restoration: rejuvenate arid soils.

Advantages Over Synthetic Hydrogels

- High biodegradability
- Improves soil health
- Rich in nutrients
- Low cost

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- Sustainable and renewable

Limitations and Future Work

Needs region-specific optimization. Shelf life requires evaluation. More field trials across climates are ongoing.

Conclusion

This bio-based fertilizer offers a sustainable solution for drought resilience by improving hydration and nutrient availability. It can support climate-adaptive agriculture, especially in water-scarce regions.

References

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2. Frontiers in Plant Science
3. FAO Biofertilizer Reports
4. Indigenous Knowledge - Mexico, India, North Africa
5. Peer-reviewed research on aloe, chia, seaweed