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Effect of Pusa hydrogel and plant growth regulators on water use efficiency in strawberry (*Fragaria × ananassa* Duch.) cv. Chandler

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Abstract

Introduction: Hydrogels are water-absorbing polymers capable of retaining and gradually releasing large quantities of water, making them particularly useful in drought-prone and sandy soils. Pusa Hydrogel, developed by ICAR-IARI, helps conserve soil moisture, reduce nutrient leaching, and improve crop performance under water-limited conditions. Its integration with plant growth regulators (PGRs) may further enhance growth, yield, and water use efficiency in strawberry cultivation.

Aim and Objectives: The study aimed to evaluate the effects of Pusa Hydrogel on vegetative growth, flowering, fruiting, yield, fruit quality, water use efficiency, and economic returns of strawberry cv. Chandler.

Methods: A field experiment was conducted during 2021-22 and 2022-23 at the Central Research Farm, Department of Horticulture, Shri Durga Ji Post Graduate College, Azamgarh, Uttar Pradesh. The experiment was laid out in a Randomized Block Design with 27 treatment combinations involving Pusa Hydrogel, Cycocel, Triacantanol, their combinations, and a control, replicated three times.

Results: Significant differences in water use efficiency (WUE) were observed among treatments. The highest WUE was recorded in T₂₀ (Triacantanol 170 ppm + Pusa Hydrogel 60 g), with values of 0.496, 0.503, and 0.500 t ha⁻¹ cm⁻¹ during 2021-22, 2022-23, and pooled analysis, respectively. T₁₂ (Triacantanol 120 ppm + Pusa Hydrogel 60 g) ranked second. The lowest WUE was observed in T₄ (Cycocel 1200 ppm). Enhanced moisture retention and efficient water utilization contributed to superior performance under hydrogel-based treatments.

Conclusion: The combined application of Triacantanol (170 ppm) and Pusa Hydrogel (60 g plant⁻¹) significantly improved water use efficiency, growth, yield, fruit quality, and profitability in strawberry cv. Chandler and is recommended for commercial cultivation under Eastern Uttar Pradesh conditions.

Keywords: Strawberry, pusa hydrogel, triacantanol, water use efficiency, plant growth regulators, chandler

1. Introduction

One promising approach involves the application of Pusa Hydrogel, a superabsorbent polymer innovated by the Indian Agricultural Research Institute (IARI). This biodegradable hydrogel can retain up to 300 times its weight in water, providing a sustained moisture supply to the root zone, even under limited irrigation conditions. By improving the soil's water-holding capacity and minimizing evaporation losses, Pusa Hydrogel helps alleviate moisture stress and enhances overall plant performance.

Likewise, the application of Plant Growth Regulators (PGRs) such as gibberellic acid, cycocel (chlormequat chloride), and triacantanol plays a significant role in regulating plant physiological functions. These regulators influence flowering, fruit formation, cell elongation, and nutrient uptake, thereby leading to higher yields and better fruit quality.

Although both Pusa Hydrogel and PGRs have shown individual efficacy in strawberry cultivation, there is a lack of comprehensive studies examining their combined effects. Exploring the synergistic interaction between these two inputs offers a novel opportunity to optimize strawberry production through improved plant vigor, higher yield potential, and superior fruit quality. This study is therefore timely and relevant, as it addresses two major constraints - water scarcity and low productivity - faced by strawberry growers. The anticipated outcomes aim to guide sustainable and resource-efficient cultivation practices, leading to better economic returns for farmers and contributing to environmentally sound horticultural development. Furthermore, the findings have broader implications for advancing climate-resilient and eco-friendly fruit production systems in India and beyond.

Materials and Methods

The present investigation titled “Effect of Pusa Hydrogel and Plant Growth Regulators on Growth, Yield and Quality Parameters of Strawberry (*Fragaria × ananassa* Duch.) cv. Chandler” was conducted during 2021-22 and 2022-23 at the Research Field of the Department of Horticulture, Shri Durga Ji Post Graduate College, Chandeshwar, Azamgarh, Uttar Pradesh. The study aimed to evaluate the impact of

hydrogel and plant growth regulators on strawberry cultivation under Eastern U.P.'s agro-climatic conditions.

Observations to be recorded

Water use efficiency

Treatment detail

Notation	Treatment Details
T ₀	Control
T ₁	Pusa Hydrogel - 30 g
T ₂	Pusa Hydrogel - 60 g
T ₃	Cycocel (600 ppm)
T ₄	Cycocel (1200 ppm)
T ₅	Triacantanol (120 ppm)
T ₆	Triacantanol (170 ppm)
T ₇	Cycocel (600 ppm) + Pusa Hydrogel 30 g
T ₈	Cycocel (600 ppm) + Pusa Hydrogel 60 g
T ₉	Cycocel (1200 ppm) + Pusa Hydrogel 30 g
T ₁₀	Cycocel (1200 ppm) + Pusa Hydrogel 60 g
T ₁₁	Triacantanol (120 ppm) + Pusa Hydrogel 30 g
T ₁₂	Triacantanol (120 ppm) + Pusa Hydrogel 60 g
T ₁₃	Triacantanol (120 ppm) + Cycocel (600 ppm)
T ₁₄	Triacantanol (120 ppm) + Cycocel (600 ppm) + Pusa Hydrogel 30 g
T ₁₅	Triacantanol (120 ppm) + Cycocel (600 ppm) + Pusa Hydrogel 60 g
T ₁₆	Triacantanol (120 ppm) + Cycocel (1200 ppm)
T ₁₇	Triacantanol (120 ppm) + Cycocel (1200 ppm) + Pusa Hydrogel 30 g
T ₁₈	Triacantanol (120 ppm) + Cycocel (1200 ppm) + Pusa Hydrogel 60 g
T ₁₉	Triacantanol (170 ppm) + Pusa Hydrogel 30 g
T ₂₀	Triacantanol (170 ppm) + Pusa Hydrogel 60 g
T ₂₁	Triacantanol (170 ppm) + Cycocel (600 ppm)
T ₂₂	Triacantanol (170 ppm) + Cycocel (600 ppm) + Pusa Hydrogel 30 g
T ₂₃	Triacantanol (170 ppm) + Cycocel (600 ppm) + Pusa Hydrogel 60 g
T ₂₄	Triacantanol (170 ppm) + Cycocel (1200 ppm)
T ₂₅	Triacantanol (170 ppm) + Cycocel (1200 ppm) + Pusa Hydrogel 30 g
T ₂₆	Triacantanol (170 ppm) + Cycocel (1200 ppm) + Pusa Hydrogel 60 g

Calculation of water use efficiency

Water use efficiency (WUE) was calculated as the ratio of fruit yield to the total quantity of water applied, using the formula:

$$WUE \text{ (t ha}^{-1} \text{ cm}^{-1}\text{)} = \text{Fruit yield (t ha}^{-1}\text{)} \div \text{Total water applied (cm)}$$

Results and discussion

The results of the studies on the “Effect of Pusa Hydrogel and Plant Growth Regulators on Vegetative Growth, Fruit Yield and Quality of Strawberry (*Fragaria × ananassa* Duch.) cv. Chandler” are briefly described hereunder.

Two field experiments were carried out during 2021-22 and 2022-23 at the Research Field, Department of Horticulture, Shri Durga Ji Post Graduate College, Chandeshwar, Azamgarh (U.P.). This study was undertaken to examine the influence of Pusa Hydrogel and plant growth regulators on water use efficiency of strawberry (*Fragaria × ananassa*

Duch.) cv. Chandler. The experimental details are given below.

Effect of pusa hydrogel and plant growth regulators on water use efficiency

The effect of different treatments (Pusa Hydrogel, Cycocel, and Triacantanol) was assessed in terms of water use efficiency, calculated as the ratio of yield obtained in a particular treatment to the total depth of water applied. As shown in Table 1, significant differences among treatments were observed in the first year, second year, and pooled data. The maximum water use efficiency - 0.496, 0.503, and 0.500 t ha⁻¹ cm⁻¹ in 2021-22, 2022-23, and pooled data, respectively - was recorded in T₂₀ (Triacantanol 170 ppm + Pusa Hydrogel 60 g), followed by T₁₂ (Triacantanol 120 ppm + Pusa Hydrogel 60 g) with values of 0.448, 0.493, and 0.470 t ha⁻¹ cm⁻¹, respectively, which was statistically at par with T₂₀. The minimum water use efficiency - 0.269, 0.239, and 0.254 t ha⁻¹ cm⁻¹, respectively - was recorded in T₄ (Cycocel 1200 ppm).

Table 1: Effect of Pusa Hydrogel and Plant Growth Regulators on Water Use Efficiency ($\text{t ha}^{-1} \text{ cm}^{-1}$) of Strawberry (*Fragaria × ananassa* Duch.) cv. Chandler

Treatment	2021-2022	2022-2023	Pooled
T ₀	0.355	0.288	0.321
T ₁	0.337	0.286	0.312
T ₂	0.336	0.279	0.308
T ₃	0.430	0.305	0.367
T ₄	0.269	0.239	0.254
T ₅	0.358	0.290	0.324
T ₆	0.365	0.275	0.320
T ₇	0.346	0.281	0.314
T ₈	0.354	0.287	0.321
T ₉	0.442	0.278	0.360
T ₁₀	0.351	0.268	0.310
T ₁₁	0.368	0.284	0.326
T ₁₂	0.448	0.493	0.470
T ₁₃	0.340	0.289	0.314
T ₁₄	0.423	0.296	0.359
T ₁₅	0.371	0.312	0.342
T ₁₆	0.290	0.286	0.288
T ₁₇	0.431	0.299	0.365
T ₁₈	0.343	0.266	0.305
T ₁₉	0.372	0.317	0.344
T ₂₀	0.496	0.503	0.500
T ₂₁	0.435	0.277	0.356
T ₂₂	0.377	0.310	0.344
T ₂₃	0.337	0.261	0.299
T ₂₄	0.355	0.255	0.305
T ₂₅	0.435	0.321	0.378
T ₂₆	0.303	0.266	0.285
F Test	S	S	S
C.D.@ 5%	0.039	0.061	0.742
S.Ed	0.021	0.45	0.56

Conclusion

The present investigation clearly demonstrated that the application of Pusa Hydrogel and Plant Growth Regulators significantly influenced the growth, flowering, fruiting, yield, quality, and economics of strawberry cv. Chandler. Among all treatment combinations, T₂₀ (Triacantanol 170 ppm + Pusa Hydrogel 60 g) proved to be the most effective, producing the maximum water use efficiency in strawberry. The synergistic effect of Triacantanol and Pusa Hydrogel enhanced moisture availability, nutrient uptake, and physiological activities, resulting in improved crop performance. Therefore, the combined application of Triacantanol at 170 ppm and Pusa Hydrogel at 60 g per plant is recommended for commercial cultivation of strawberry cv. Chandler to achieve higher productivity, better fruit quality, and maximum profitability under the agro-climatic conditions of Eastern Uttar Pradesh.

Competing interests

Authors have declared that no competing interests exist.

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