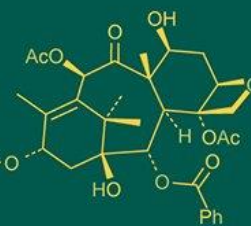
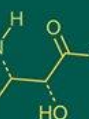
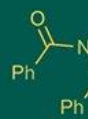


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Effect of seaweed extracts on growth, yield and fruit quality of Cape gooseberry (*Physalis peruviana* L.)

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Abstract

A field experiment entitled “Effect of Seaweed Extracts on Growth, Yield and Fruit Quality of Cape Gooseberry (*Physalis peruviana* L.)” was conducted during 2025-26 at the Horticulture Research Farm, SHUATS, Prayagraj, Uttar Pradesh, in a Randomized Block Design (RBD) with 10 treatments and 3 replications. The treatments were T₀ (Control), T₁ (100% recommended dose of fertilizers (RDF) + water spray), T₂ (4% *Kappaphycus* sap), T₃ (6% *Kappaphycus* sap), T₄ (4% *Sargassum* sap), T₅ (6% *Sargassum* sap), T₆ (100% RDF + 4% *Kappaphycus* sap), T₇ (100% RDF + 6% *Kappaphycus* sap), T₈ (100% RDF + 4% *Sargassum* sap), and T₉ (100% RDF + 6% *Sargassum* sap). Seaweed treatments significantly improved vegetative growth, flowering, fruiting, yield, fruit quality, and economic returns. Among all treatments, T₇ (100% RDF + 6% *Kappaphycus* sap) was the most effective, recording the highest growth, fruit weight (7.09 g), yield per plant (3.79 kg), total soluble solids (11.93 °Brix), benefit-cost ratio (1.98), and the lowest titratable acidity (0.80%). Therefore, the combined application of 100% RDF + 6% *Kappaphycus* sap is recommended for improving the growth, yield, fruit quality, and profitability of Cape gooseberry under the agro-climatic conditions of Prayagraj.

Keywords: Cape gooseberry, seaweed extract, *Kappaphycus Alvarezii*, *Sargassum*, yield, fruit quality

Introduction

Cape gooseberry (*Physalis peruviana* L.) is an important minor fruit crop belonging to the family Solanaceae and is native to Peru and Chile. It is widely appreciated for its attractive golden-yellow fruits, high pectin content, vitamins A and C, minerals, and antioxidant compounds, making it suitable for both fresh consumption and processing into jams, jellies, sauces, confectionery products, and other value-added products. The fruit is also recognized for its nutritional and medicinal properties. Despite its high economic and nutritional value, the productivity of Cape gooseberry remains comparatively low due to inadequate nutrient management and limited adoption of improved cultivation practices.

Seaweeds are macroscopic marine algae that have long been utilized as food for humans, fodder for livestock, and as a source of valuable industrial products such as agar and algininate. In recent years, seaweed extracts have gained considerable attention as eco-friendly alternatives to synthetic fertilizers because they are biodegradable, non-toxic, and environmentally safe (Begum *et al.*, 2018) [1]. Among the commercially important seaweeds, *Kappaphycus Alvarezii* and *Sargassum wightii* are widely used in agriculture owing to their rich composition of bioactive compounds.

Seaweed extracts are rich in macro- and micronutrients, amino acids, vitamins, carbohydrates, and naturally occurring plant growth regulators such as auxins, cytokinins, gibberellins, indole-3-acetic acid (IAA), kinetin, and zeatin (Layek *et al.*, 2016) [16]. These bioactive compounds enhance nutrient uptake, photosynthetic activity, chlorophyll synthesis, cell division, flowering, fruit development, and stress tolerance, ultimately improving crop growth, yield, and fruit quality. Auxins regulate cell elongation, differentiation, and protein synthesis, while cytokinins play a vital role in cell division, shoot development, fruit formation, and seed germination (Fatriana *et al.*, 2020) [3].

Considering the nutritional and economic importance of Cape gooseberry and the increasing demand for sustainable crop production, the use of seaweed-based biostimulants offers a promising strategy for improving plant growth, productivity, and fruit quality

while reducing dependence on chemical fertilizers. Therefore, the present investigation was undertaken to evaluate the effect of *Kappaphycus Alvarezii* and *Sargassum wightii* seaweed extracts on the growth, yield, and fruit quality of Cape gooseberry.

Materials and methodology

Experimental Site

The present investigation entitled "Effect of Seaweed Extracts on Growth, Yield and Fruit Quality of Cape Gooseberry (*Physalis peruviana* L.)" was conducted during the year 2025-26 at the Horticulture Research Farm, Department of Horticulture, Sam Higginbottom University of Agriculture, Technology and Sciences (SHUATS), Prayagraj, Uttar Pradesh, India. The experimental field is situated under subtropical climatic conditions characterized by hot summers and cool winters. The experiment was carried out from November 2025 to April 2026 to evaluate the effect of seaweed extracts on the growth, yield and fruit quality of Cape gooseberry.

Experimental Material and Treatment Details

Healthy and uniform seedlings of Cape gooseberry were transplanted in the experimental field. The experiment was laid out in a Randomized Block Design (RBD) comprising ten treatments and three replications. The treatments consisted of different concentrations of *Kappaphycus Alvarezii* sap and *Sargassum wightii* sap applied individually and in combination with the Recommended Dose of Fertilizers (RDF). Each treatment was randomly allocated within each replication to minimize experimental variation. The treatments included T₀ (Control), T₁ (100% RDF + water spray), T₂ (4% *Kappaphycus Alvarezii* sap), T₃ (6% *Kappaphycus Alvarezii* sap), T₄ (4% *Sargassum wightii* sap), T₅ (6% *Sargassum wightii* sap), T₆ (100% RDF + 4% *Kappaphycus Alvarezii* sap), T₇ (100% RDF + 6% *Kappaphycus Alvarezii* sap), T₈ (100% RDF + 4% *Sargassum wightii* sap), and T₉ (100% RDF + 6% *Sargassum wightii* sap).

Preparation and Application of Treatments

Commercial seaweed extracts of *Kappaphycus Alvarezii* and *Sargassum wightii* were diluted with water to prepare 4% and 6% solutions. The foliar sprays were applied according to the treatment schedule, while 100% Recommended Dose of Fertilizers (RDF) was applied as per the recommended package of practices. All treatments were applied uniformly to the respective experimental plots at the recommended growth stage. Standard cultural practices were followed throughout the crop season. Observations on growth, flowering, yield, fruit quality and economics were recorded

at appropriate stages of crop growth. The experimental data were subjected to Analysis of Variance (ANOVA) for a Randomized Block Design, and the significance of treatment differences was tested at the 5% level of significance.

Results and discussion

Plant height (cm)

At 90 DAT, significantly and T₇ (100% RDF + 6% *Kappaphycus* sap) produced the maximum plant height (71.97 cm), followed by T₈ (100% RDF + 4% *Sargassum* sap) with 69.42 cm and T₉ (100% RDF + 6% *Sargassum* sap) with 67.68 cm, whereas the minimum plant height (44.60 cm) was observed under the control (T₀). The superior performance of T₇ may be attributed to the growth-promoting substances, micronutrients, and bioactive compounds present in seaweed extract, which enhance nutrient uptake, cell division, and elongation.

Number of leaves (cm)

Seaweed treatments significantly increased the number of leaves per plant of Cape gooseberry at all growth stages. The highest number of leaves was recorded in T₇ (100% RDF + 6% *Kappaphycus* sap) with 103.00 leaves at 90 DAT, respectively, followed by T₈ and T₉. The lowest leaf count was observed in the control (T₀) with 54.00 leaves. The improvement in leaf production may be due to the growth-promoting substances, micronutrients and bioactive compounds present in seaweed extracts.

Plant spread (cm)

The maximum plant spread was recorded in T₇ (100% RDF + 6% *Kappaphycus* sap) with 103.33 cm at 90 DAT, respectively, followed by T₈ (100% RDF + 4% *Sargassum* sap) with 96.33 cm and T₉ (100% RDF + 6% *Sargassum* sap) with 88.33 cm. The minimum plant spread was observed in the control (T₀) with 54.00 cm. The increased plant spread under seaweed treatments may be attributed to growth-promoting substances and improved nutrient uptake.

Survival percentage (%)

The highest survival percentage (69.87%) was recorded in T₇ (100% RDF + 6% *Kappaphycus* sap), followed by T₈ (69.41%) and T₉ (67.36%). The lowest survival percentage (57.45%) was observed in T₁ (100% RDF + water), while the control (T₀) recorded 59.01% survival. The increased survival percentage under seaweed treatments may be attributed to the presence of growth-promoting substances, vitamins and micronutrients that enhance root development, nutrient uptake and stress tolerance.

Table 1: Effect of Seaweed Extracts on Growth Parameters of Cape Gooseberry

Treatment	Treatment Details	Survival (%)	Plant Height 90	Plant Spread 90	Number of Leaves 90	Days taken to flowering	Days taken to fruiting	Fruit polar diameter (cm)	Fruit radial diameter (cm)
T ₀	Control	57.45	44.6	54	54	64.87	101	2.07	1.55
T ₁	100% RDF (NPK) + Water	58.57	49.76	64	64	58.87	95.1	2.09	2.03
T ₂	4% K sap	59.01	50.33	74	74	55.87	92.83	2.09	1.99
T ₃	6% K sap	63.02	55.44	71	71	56.87	93.77	2.11	2.10
T ₄	4% S sap	62.13	58.63	67	67	62.87	98.83	2.23	2.35
T ₅	6% S sap	65.57	62.12	61	61	59.87	95.6	2.11	2.27
T ₆	100% RDF + 4% K sap	66.14	65.97	69	69	63.87	92.93	2.31	2.35
T ₇	100% RDF + 6% K sap	69.87	71.97	103	103	48.87	86.83	2.41	2.93

T ₈	100% RDF + 4% S sap	69.41	69.42	96.33	96.33	50.87	88.67	2.34	2.82
T ₉	100% RDF + 6% S sap	67.36	67.68	88.33	88.33	52.87	90.57	2.27	2.55
F - test		S	S	S	S	S	S	S	S
S.E.m.(±)		3.83	4.49	7.38	5.22	2.1	2.93	0.09	0.09
C.D. (P=0.05)		8.04	9.44	15.50	15.50	14.07	8.71	0.26	0.26
C.V. (%)		7.51	9.23	12.33	12.33	14.56	5.57	5.49	5.32

Flowering and Fruiting

Seaweed treatments significantly influenced both days to flowering and days to first fruiting in Cape gooseberry. The earliest flowering (48.87 days) and first fruiting (86.83 days) were recorded in T₇ (100% RDF + 6% *Kappaphycus* sap), followed by T₈ (100% RDF + 4% *Sargassum* sap) and T₉ (100% RDF + 6% *Sargassum* sap). In contrast, the control (T₀) recorded the maximum days to flowering (64.87 days) and first fruiting (101.00 days). The reduction in flowering and fruiting duration under seaweed treatments may be attributed to the presence of natural plant growth regulators, micronutrients, and bioactive compounds that enhance nutrient uptake, vegetative growth, and reproductive development. The combined application of RDF and seaweed sap proved more effective than individual treatments, indicating a synergistic effect in promoting early flowering and fruiting.

Fruit Physical Characters: Fruit weight, fruit polar diameter and fruit radial diameter were significantly

influenced by seaweed application. The maximum fruit weight (7.09 g), fruit polar diameter (2.41 cm) and fruit radial diameter (2.93 cm) were recorded under T₇. The enhanced fruit size may be due to improved nutrient uptake and better translocation of photosynthesis towards developing fruits.

Yield Attributes

Seaweed extracts significantly increased the number of fruits per plant and total yield. T₇ recorded the highest yield among all treatments, indicating the synergistic effect of RDF and *Kappaphycus* sap.

Fruit Quality

Fruit quality parameters were positively influenced by seaweed application. T₇ recorded the highest total soluble solids (TSS) and lowest titratable acidity (0.80%), indicating superior fruit quality. Improved quality may be attributed to enhanced carbohydrate accumulation and better physiological activity induced by seaweed bio stimulants.

Table 2: Effect of Seaweed extract on yield and fruit quality of Cape gooseberry

Treatment	Treatment details	Fruit weight (g)	Number of fruits/plant	Yield/Plant (kg)	TSS (°Brix)	Titratable acidity
T ₀	Control	4.57	63	1.56	7.32	1.20
T ₁	100% RDF (NPK) + water	4.76	73.67	1.89	7.57	1.16
T ₂	4% K sap	4.82	72.67	1.86	7.80	1.11
T ₃	6% K sap	4.85	82	2.14	8.27	1.07
T ₄	4% S sap	5.40	89.33	2.59	8.77	1.02
T ₅	6% S sap	5.03	76.33	2.05	9.10	0.98
T ₆	100% RDF + 4% K sap	6.05	86.33	2.80	9.57	0.93
T ₇	100% RDF + 6% K sap	7.09	98.33	3.79	11.93	0.80
T ₈	100% RDF + 4% S sap	6.39	94.33	3.24	10.57	0.84
T ₉	100% RDF + 6% S sap	6.05	91	2.97	9.69	0.89
F-test		S	S	S	S	S
S.E.m. (±)		0.03	2.45	0.35	0.333	0.051
C.D. (P=0.05)		0.08	7.27	1.05	0.987	0.152
C.V. (%)		0.81	5.11	8.21	6.08	5.44

Economics

The highest gross return (₹23,218 ha⁻¹), net return (₹11,491.5 ha⁻¹) and benefit-cost ratio (1.98) were recorded under T₇, making it the most economical treatment.

Conclusion

The present investigation demonstrated that seaweed extracts significantly improved growth, yield and fruit quality of Cape gooseberry. Among the treatments, T₇ (100% RDF + 6% *Kappaphycus* sap) proved superior by producing maximum vegetative growth, early flowering and fruiting, highest fruit weight, better fruit quality and maximum economic returns. Therefore, application of 100% RDF combined with 6% *Kappaphycus* sap is recommended

for commercial cultivation of Cape gooseberry under Prayagraj agro-climatic conditions.

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