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Influence of fertilizers and seaweed extract on growth, yield and quality of tomato (*Solanum lycopersicum* L.) under Chhattisgarh plain conditions

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Abstract

A field experiment was conducted during the summer season of year 2024-25 at the Instructional farm Khudmudi, College of Horticulture and Research Station, Mahatma Gandhi University of Horticulture & Forestry, Durg (C.G.), to evaluate the "Influence of Fertilizers and Seaweed Extract on Growth, Yield and Quality of Tomato (*Solanum lycopersicum* L.) under Chhattisgarh Plain Conditions". The field experiment was laid out in Randomized Block Design with ten treatments and three replications. A field experiment was conducted to evaluate the effect of different treatments on growth, flowering, fruit quality and yield of tomato under Chhattisgarh plain conditions. Among the treatments, T₄ (100% RDF + 4% S SAP) recorded the superior performance for most of the growth, flowering, fruit and yield attributes. It recorded maximum plant height, number of branches, flowers and fruits per cluster, flower clusters per plant, fruit weight, fruit size, locules, pericarp thickness and total soluble solids. T₄ (100% RDF + 4% K-SAP) also resulted in early flowering and fruit harvesting with lower acidity. The highest fruit yield was recorded under T₄ (100% RDF + 4% S-SAP) (1.83 kg/plant, 27.10 kg/plot and 677.78 q/ha), followed by T₂ (100% RDF + 4% K-SAP) and T₈ (75% RDF + 4% S-SAP), whereas the control (T₀) (100% RDF + water spray) recorded the lowest values. Overall, T₄ (100% RDF + 4% S SAP) proved to be the most effective treatment for improving growth, fruit quality, yield and economic performance of tomato under Chhattisgarh plain conditions.

Keywords: Growth, fruit quality, fertilizers, seaweed extract, yield

Introduction

Tomato (*Solanum lycopersicum* L.) is one of the most important and widely cultivated vegetable crops in the world. It belongs to the family Solanaceae and is a diploid species having chromosome number $2n = 24$ (Peralta *et al.*, 2006) [10]. Tomato is cultivated extensively under tropical, subtropical and temperate climatic conditions for both fresh consumption and processing purposes. Due to its high nutritional value, wide adaptability and economic importance, tomato is considered a high-value vegetable crop worldwide (Ali *et al.*, 2019) [1]. It also serves as an important source of income and livelihood for rural and peri-urban farmers in many developing countries. Among vegetable crops, tomato ranks second after potato in terms of global importance and consumption (Csizinszky *et al.*, 2005) [7].

The use of seaweed extracts in vegetable crops has shown significant improvement in seed germination, vegetative growth, flowering and fruit yield due to the presence of natural plant growth regulators and micronutrients (Crouch and Van Staden, 1993) [6]. application of seaweed-based biostimulants also enhances chlorophyll content, photosynthetic activity and stress tolerance in horticultural crops, thereby improving overall crop performance (Calvo *et al.*, 2014) [4].

Seaweed-based biostimulants improve plant growth, yield and quality by enhancing physiological and biochemical processes in plants. They also increase tolerance against abiotic and biotic stresses and improve nutrient uptake efficiency (Shukla *et al.*, 2019 and Arioli *et al.*, 2015) [2, 12]. The application of seaweed extracts along with organic nutrient sources such as farmyard manure and vermicompost helps in improving the physical, chemical and biological properties of soil, thereby promoting sustainable crop growth (Aydin *et al.*, 2012) [3].

Commercial seaweed products are available in liquid, granular and powder forms and can be applied through foliar spray, soil drench or soil incorporation methods.

Materials and Methods

The Eastern Plateau, Hills, and Chhattisgarh Plains agroclimatic area, as well as a sub-humid climate zone, encompass the experimental site at Durg. About 90% of the region's 1486 mm of yearly rainfall falls between June and mid-September. May is the hottest month, and January is the coldest. In order to analyze crop performance, temperature, relative humidity, wind speed, evaporation, and rainfall were measured during the experiment period. The study was conducted to determine the effect of vegetative growth, yield, and economic parameter of tomato.

Result and Discussion

Plant Height

Among all the treatments 90 DAT, T₄ was recorded the maximum plant height showed in (103.82 cm), followed by T₂ (100.85 cm), whereas T₀ recorded the minimum (74.25 cm). Thus, T₄ resulted in about 31.3, 35.7 and 39.8% higher plant height than the control at 90 DAT. Similar findings were also reported by Khan *et al.* (2009) [8] who stated that seaweed extracts improve plant growth through their hormone-like activity and enhanced nutrient uptake.

Number of branches

90 DAT, the maximum number of branches was recorded in T₄ (9.28), followed by T₂ (8.88) and T₈ (8.56), whereas T₀ recorded the minimum number of branches (6.14). The current results are consistent with those of Elansary *et al.* (2016) [14], who found that applying seaweed extract topically greatly enhanced the number of branches and vegetative growth in horticultural crops.

Days to First Flowering and Days to 50% flowering

Days to first and 50% blooming were greatly impacted by

the treatments. The earliest first flowering (30.18 days) and 50% flowering (37.12 days) were reported by T₄ followed by T₂ and T₈. The control T₀ showed 50% blooming (45.38 days) and the latest first flowering (38.42 days). Improved nutrient uptake and increased physiological activity may be responsible for earlier flowering when seaweed is applied.

No. of Flower Per Cluster

The treatments also affected the quantity of blooms in each cluster. T₄ had the most flowers (6.98), followed by T₂ (6.82) and T₈ (6.64). T₀ had the lowest number (5.02). Therefore, compared to the control, T₄ produced almost 39.0% more flowers per cluster. greater vegetative development and greater nutrient usage could be the cause of the increased bloom yield. the current results are consistent with those of Hernández-Herrera *et al.* (2014) [15], who found that seaweed extracts improved tomato flowering and reproductive growth.

No. of Fruit Set Per Cluster

Treatments differed considerably in the quantity of fruit sets per cluster. T₄ had the highest fruit set (5.30), followed by T₂ (5.12) and T₈ (4.71), and T₀ (2.12) had the lowest. Compared to the control, T₄ fruit set was around 150.0% greater. Better plant growth, enhanced flowering, and effective nutrient utilization may be responsible for the increased fruit set. These results concur with those of Shukla *et al.* 2019) [12], Calvo *et al.* (2014) [4].

Number of Flower Clusters/Plant

Each treatment had a different amount of bloom clusters per plant. T₄ had the highest value (9.32), followed by T₂ (9.21) and T₈ (8.73). T₀ (6.11) had the lowest value. Perhaps as a result of improved vegetative growth and food availability, T₄ recorded 52.5% more flower clusters than the control. Calvo *et al.* (2014) [4], and Shukla *et al.* (2019) [12] all showed similar results.

Table 1: Effect of fertilizer and Seaweed Extract on Vegetative and Flowering Parameter of Tomato (*Solanum lycopersicum* L.) under Chhattisgarh Plain conditions

S. No.	Treatments	Plant height (cm)	No. of branches per plant	Days to first	Days to 50% Flowering	Number of Flower/Cluster	Number of Fruit Set/Cluster	Number of Flower Clusters/Plant
		90 DAT	90 DAT					
T ₀	100% RDF + Water spray	74.25	6.14	38.42	45.38	5.02	2.12	6.11
T ₁	100% RDF + 2% KSAP	80.42	6.86	36.74	43.62	5.36	2.90	7.28
T ₂	100% RDF + 4% KSAP	100.85	8.88	31.28	38.32	6.82	5.12	9.21
T ₃	100% RDF + 2% SSAP	92.56	7.96	33.62	40.68	6.14	4.05	8.54
T ₄	100% RDF + 4% SSAP	103.82	9.28	30.18	37.12	6.98	5.30	9.32
T ₅	75% RDF + 2% K-SAP	86.82	7.24	34.84	41.82	5.72	3.58	7.82
T ₆	75% RDF + 4% K-SAP	96.42	8.26	32.12	39.04	6.46	4.68	8.65
T ₇	75% RDF + 2% S-SAP	89.42	7.66	35.24	42.18	5.98	3.35	7.56
T ₈	75% RDF + 4% S-SAP	98.26	8.56	31.56	38.54	6.64	4.71	8.73
T ₉	50% RDF + 2% K-SAP	83.92	7.06	36.42	43.18	5.28	2.70	6.94
T ₁₀	50% RDF + 4% K-SAP	87.84	7.44	36.88	43.66	5.18	2.56	6.68
T ₁₁	50% RDF + 2% S-SAP	82.46	6.66	37.26	44.02	5.10	2.30	6.26
T ₁₂	50% RDF + 4% S-SAP	85.46	7.16	35.06	42.06	5.84	3.45	7.36
S.E.(m)±		2.21	0.25	0.64	0.72	0.16	0.13	0.29
C.D. (0.05)		6.44	0.73	1.88	2.12	0.47	0.38	0.84

Yield Parameters

Days to First Fruit Harvest

Days until first fruit harvest were considerably impacted by the treatments. T₀ recorded the largest harvest (84.48 days), whereas T₄ showed in Table 2. and Fig 2. recorded the

earliest harvest (63.18 days), followed by T₂ (65.34 days) and T₈ (68.26 days). T₄ superior growth, early flowering, and quicker fruit development may have contributed to its 25.2% harvest advance over the control. Khan *et al.* (2009) [8] reported similar results.

The average fruit weight (g)

Each treatment had a different average fruit weight. T₄ had the highest fruit weight (81.20 g), followed by T₂ (78.60 g) and T₈ (76.40 g). T₀ had the lowest fruit weight (45.80 g). T₄ fruit weight was 77.3% greater than the control's, perhaps as a result of improved fruit development and nutritional availability. Hernández-Herrera *et al.* (2014) [15] reported similar results.

Fruit diameter (Polar and Radial)

Fruit diameter differed significantly between treatments. T₄ had the largest radial diameter (7.05 cm) and polar diameter (7.70 cm), followed by T₂ (7.52 and 6.90 cm) and T₈ (7.40 and 6.78 cm), respectively. T₀ (100% RDF + water spray) had the lowest radial diameter (5.00 cm) and polar diameter (5.80 cm). Better fruit development and assimilate accumulation were indicated by T₄ 32.8% higher polar and 41.0% higher radial diameters compared to the control. All things considered, T₄ was the best treatment for growing bigger fruits.

Fruit Yield per Plant

fruit yield per plant varied among treatments. The maximum yield was recorded in T₄ (1.83 kg/plant), followed by T₂ (1.79 kg/plant) and T₈ (1.76 kg/plant), while the minimum was observed in T₀ (0.72 kg/plant). T₄ recorded 154.2% higher yield than the control, possibly due to increased fruit number, fruit weight and better plant growth. Similar findings were reported by Zodape *et al.* (2011) [13], who observed increased tomato yield with seaweed sap application due to improved fruit number and size.

Fruit Yield per Plot

A similar pattern was seen in fruit yield per plot. The highest yield was recorded in (27.10 kg/plot), followed by T₂ (26.51 kg/plot) and T₈ (26.07 kg/plot), while the lowest was observed in T₀ (10.66 kg/plot). T₄ reported by Alam *et al.* (2023) [16] with seaweed extract application in tomato.

Fruit Yield (q/ha)

There were significant differences in fruit output per hectare

across treatments. T₄ had the highest yield (677.78 q/ha), followed by T₂ (662.96 q/ha) and T₈ (651.85 q/ha). T₀ had the lowest yield (266.67 q/ha). T₄ yield was 154.2% greater than the control's, mostly as a result of improved fruit growth, weight, and quantity. Garcia-Sanchez *et al.* (2025) [17] obtained similar results.

Quality parameter

Acidity (%)

Fruit acidity shown in ranged from 0.24% T₄ to 0.55% T₀. T₄ had the lowest acidity, followed by T₂ (0.28%) and T₈ (0.31%). The reduced acidity with seaweed treatments can be a sign of better fruit quality and maturity. Alam *et al.* observed similar findings (2023) [16].

Number of Locules per Fruit

The number of locules per fruit was highest in T₄ (6.63), followed by T₂ (6.45) and T₈ (6.28), while the minimum was recorded in T₀ (4.23). The higher number of locules under T₄ indicates better fruit development, possibly due to improved nutrient uptake and the biostimulatory effects of seaweed extract. Similar findings were reported by García-Sánchez *et al.* (2025) [17].

Pericarp Thickness (mm)

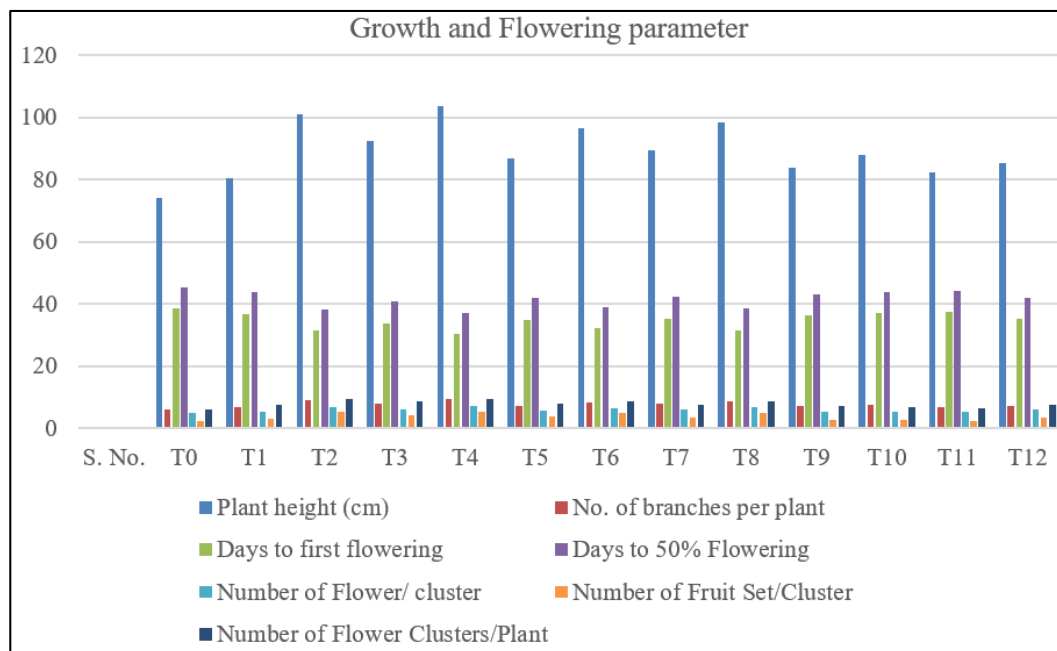
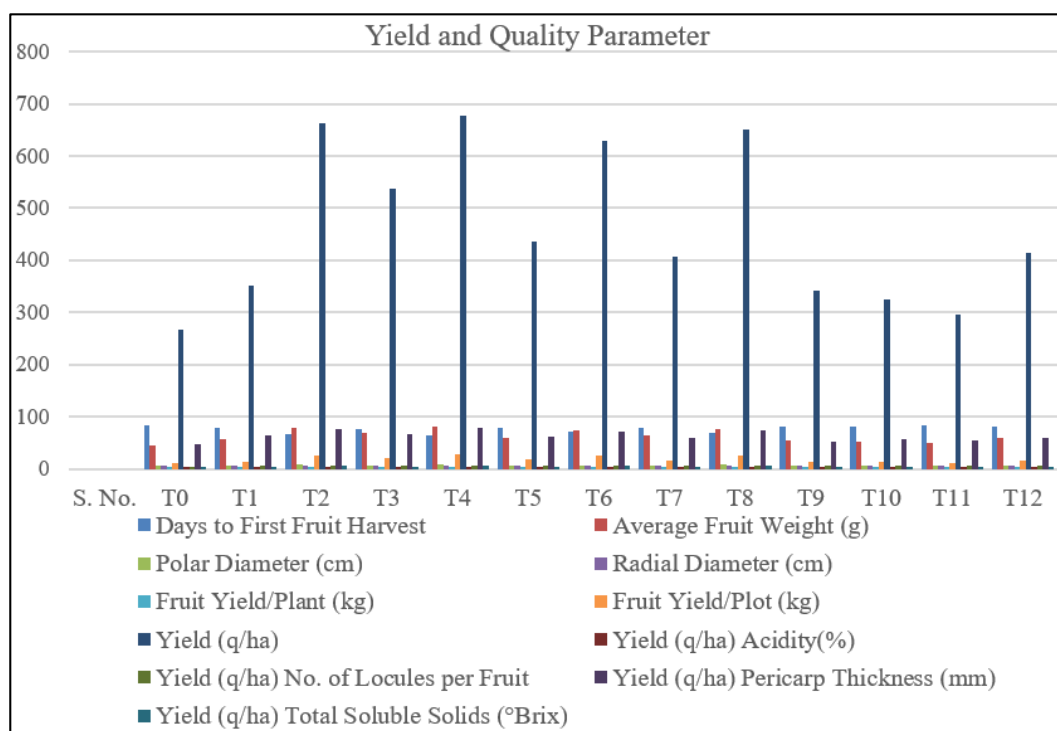
Pericarp thickness varied considerably among treatments. The maximum value was recorded in T₄ (79.20), followed by T₂ (76.80) and T₈ (74.30), while the minimum was observed in T₀ (46.87). The higher pericarp thickness under T₄ indicates improved fruit development and structural quality. Similar findings were reported by Alam *et al.* (2023) [16], who observed improved fruit quality with seaweed extract application.

Total Soluble Solids (°Brix)

TSS varied by treatment T₄. had the highest value (5.72°Brix), followed by T₂ (5.45°Brix) and T₈ (5.32°Brix), and T₀ (3.82°Brix). T₄ recorded 49.7% higher TSS than the control, indicating improved fruit quality and soluble sugar accumulation.

Table 2: Effect of fertilizer and Seaweed Extract on Yield and Quality Parameter of Tomato (*Solanum Lycopersicum* L.) under Chhattisgarh Plain conditions

S. No.	Treatments	Days to First Fruit Harvest	Average Fruit Weight (g)	Polar Diameter (cm)	Radial Diameter (cm)	Fruit Yield/Plant (kg)	Fruit Yield/Plot (kg)	Yield (q/ha)	Acidity (%)	No. of Locules per Fruit	Pericarp Thickness (mm)	Total Soluble Solids (°Brix)
T ₀	100% RDF + Water spray	84.48	45.80	5.80	5.00	0.72	10.66	266.67	0.55	4.23	46.87	3.82
T ₁	100% RDF + 2% K-SAP	79.62	56.40	6.30	5.55	0.95	14.07	351.85	0.53	5.97	62.87	4.05
T ₂	100% RDF + 4% K-SAP	65.34	78.60	7.52	6.90	1.79	26.51	662.96	0.28	6.45	76.80	5.45
T ₃	100% RDF + 2% S-SAP	76.28	68.50	6.95	6.25	1.45	21.47	537.04	0.50	5.60	66.20	4.82
T ₄	100% RDF + 4% S-SAP	63.18	81.20	7.70	7.05	1.83	27.10	677.78	0.24	6.63	79.20	5.72
T ₅	75% RDF + 2% K-SAP	77.54	60.40	6.48	5.82	1.18	17.48	437.04	0.49	5.87	62.20	4.42
T ₆	75% RDF + 4% K-SAP	70.42	74.20	7.28	6.62	1.70	25.18	629.63	0.34	6.12	71.50	5.18
T ₇	75% RDF + 2% S-SAP	78.36	63.60	6.65	5.98	1.10	16.29	407.41	0.46	6.03	59.20	4.30
T ₈	75% RDF + 4% S-SAP	68.26	76.40	7.40	6.78	1.76	26.07	651.85	0.31	6.28	74.30	5.32
T ₉	50% RDF + 2% K-SAP	80.84	54.80	6.18	5.45	0.92	13.63	340.74	0.44	5.80	52.20	4.15
T ₁₀	50% RDF + 4% K-SAP	81.56	52.60	6.08	5.36	0.88	13.03	325.93	0.43	5.30	56.53	4.00
T ₁₁	50% RDF + 2% S-SAP	83.14	49.80	5.92	5.20	0.80	11.85	296.30	0.45	5.23	53.50	3.90
T ₁₂	50% RDF + 4% S-SAP	79.94	58.70	6.42	5.76	1.12	16.59	414.81	0.42	5.53	58.87	4.25
S.E.(m)±		1.60	1.75	0.17	0.15	0.06	0.94	23.50	0.018	0.15	1.10	0.10
C.D. (0.05)		3.29	5.10	0.50	0.44	0.19	2.75	68.62	0.054	0.44	3.22	0.29

**Fig 1:** Growth and Flowering parameter**Fig 2:** Yield and Quality Parameter

Conclusion

Tomato growth, flowering, yield, and quality were greatly enhanced by foliar application of seaweed extracts with fertilizer. The most successful treatment was T₄ (100% RDF + 4% S-SAP), which was followed by T₂ (100% RDF + 4% K-SAP) and T₈ (75% RDF + 4% S-SAP). The lowest performance was recorded by the control (T₀). T₄ was therefore shown to be the most effective treatment for raising tomato yield and fruit quality.

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