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Effect of bio-stimulants and bio-pesticides on growth, yield and quality of cauliflower (*Brassica oleracea var.* RZ-Trishuli)

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Abstract
An experiment was carried out on "Effect of Bio-stimulants and Bio-pesticides on Growth, Yield and Quality of Cauliflower (*Brassica oleracea var* .RZ-Trishuli)" The present experiment was laid out at Horticulture Research Farm, Department of Horticulture, College of Agriculture, Rajmata Vijaya raje Scindia Krishi Vishwa Vidyalaya, Indore, (M.P.) India during the Rabi season 2024-25. The treatments consist of Biostimulants viz., seaweed extract @ 2 ml/l & amino acid @ 2 ml/l and Biopesticide viz., Pseudomonas @ 5 g/l & neem oil @ 5 ml/l sprayed at 15, 30 and 45 DAT. Among the several treatmentsthe combination of Seaweed extract and Neem oil (T_6) showing the most significant improvements across various growth parameters. At 15, 30, and 45 days after Transplanting (DAT), T_6 demonstrated the highest plant height, number of leaves and stem diameter, outpacing other treatments and the control. In terms of reproductive growth, T_6 also accelerated days to curd initiation and maturity, while enhancing the fruit production. Moreover, T_6 resulted in the highest yield per plot (10.40 kg), and per hectare (108.00 q). It also significantly improved curd quality and curd weight. Disease intensity (PDI%) and pest incidence (PPI%) were lowest in T_6, indicating better pest and disease management. Despite T_6exhibited a favorable benefit-cost ratio of 3.3, indicating its potential as an effective treatment for improving cauliflower productivity and quality.

Keywords: Cauliflower, biostimulants, biopesticides, growth, yield, quality

Introduction
Cauliflower (*Brassica oleracea* var. *botrytis*) is one of the maximum critical vegetable vegetation of India.It belongs to family cruciferae having chromosome quantity 2n = 18 .The edible part of cauliflower is known as curd, which consists of a shoot device with short internodes, branches apices and bracts. It has high great of proteins and strange in balance of vitamin C after cooking. it's far rich in minerals which include potassium, sodium, iron, phosphorus, calcium, magnesium and many others. India holds the second one function, following China. The u.s's caulifower cultivation bills for 34.6% of the entire worldwide production. The full occupied an area of 0.48 million hectares with the manufacturing of 9.53 million metric tonnes and a mean productivity of 19.6 metric tonnes according to hectare (country wide horticulture board, 2021-2022). India is the second one biggest manufacturer of cauliflower inside the world.a number of the states that produce big portions of cauliflower are Uttarakhand, Uttar Pradesh, Himachal Pradesh, Haryana, Rajasthan, Bihar, Gujarat, Maharashtra, Odisha and Karnataka.

besides the dietary fee, Cauliflower are subject to attacked by using range of insect pests, the tobacco caterpillar (*Spodoptera litura* Fab.), diamond lower back moth (*Plutella xylostella* L.), cabbage butter fly (*Pieris brassicae* L.), cabbage leaf webber (*Crocidolomia binotalis* Zell.), cabbage semi lopper (*Trichoplusia ni* Hubner) and so on. which could damage leaves and reduce yields .The pest cause harm to an quantity of 18 % percentage within the nurseries under favorable situations (Chari *et al.*, 1994) [18] and 10-25 percent in area crops. Neem seed kernel extract has minimum toxicity to non-goal organisms, pollinators and degrades rapidly within the environment the capability of neem extract as a pestcontrol agent (Martinez, 2002) [19] and it is used in agricultural. Remedy with biocontrol retailers is one of the maximum suitable techniques for biocontrol of soil borne pathogens in the spermosphere

and rhizosphere. Many biological control marketers along with *Trichoderma* spp., *Pseudomonas* spp. suppress sicknesses as a result of *Pythium* spp and *R. solani*.
Biostimulants are herbal or artificial additives used for seeds, plant life, and soil. those substances purpose differences in important and structural functions, affecting plant increase thru superior toleration to abiotic stresses and improving seed and/or grain yield and first-class. in addition, bio stimulants like amino acids decline the demand for fertilizers, spray amino acids at the leaves due to the fact they lessen the absorption of nitrates and their fantastic function in raising the efficiency of metabolic techniques and antioxidants via growing the proportion of enzymes in plant tissues. In side the case of cauliflower flora seaweed extract utility caused a full-size boom in curd diameter.it is concluded that when applied on the recommended costs beneficial results in yield are obtained.

Materials and Methods
A field experiment on Cauliflower was conducted at Horticulture Research Farm, Department of Horticulture, College of Agriculture, Rajmata Vijayaraje Scindia Krishi Vishwa Vidyalaya, Indore, (M.P.) during the Rabi season 2024-25. The experiment was laid out in randomized block design with nine treatments and three replications. The study investigated the Effect of Bio stimulants and Biopesticides on Growth, Yield and Quality of Cauliflower (*Brassica oleracea var.* RZ-Trishuli). During the investigation, the 09 treatments *viz.*, T_1 (Control), T_2 (Seaweed extract @ 2 ml/L), T_3 (Amino acid @ 2 ml/L), T_4 (Neem oil @ 5 ml/L), T_5 (Pseudomonas @ 5 g/L), T_6 (Seaweed extract @ 2 ml/L + Neem oil @ 5 ml/L), T_7 (Seaweed extract @ 2 ml/L + Pseudomonas @ 5 g/L), T_8 (Amino acid @ 2 ml/L + Neem oil @ 5 ml/L) and T_8 (Amino acid @ 2 ml/L + Pseudomonas @ 5 g/L) at 15, 30 and 45 DAT. The required amounts of biostimulants and biopesticides were applied to the corresponding plots, following the specified treatment schedules and the correct growth stages. All the intercultural operations were performed in the field as per the requirement of the crop such as irrigation, weeding and earthing up etc. From each plot randomly five plants were selected and used for taking observations for growth attributes.

Results and Discussion
The present experiment was conducted during Rabi 2024-2025 at Horticulture Research Farm, Department of Horticulture, College of Agriculture, Rajmata Vijayaraje Scindia Krishi Vishwa Vidyalaya, Indore, (M.P.).The research was conducted in RBD with 9 treatment combinations in three replications. In this section, a brief description involving to the observations recorded on various aspects of investigation has been given. Research results are presented with the help of tables, graphics and interpretation are prepared of only significant findings on the basis of statistical analysis. The results have been supported with suitable reasoning along with research work of other workers.

Growth Parameters
The data on the growth parameters i.e. plant height (cm) at 15, 30 AND 45 DAT, Stem diameter at 15, 30 and 45 DAT, Days to curd initiation at 15, 30 and 45 DAT, Days to curd maturity at 15, 30 and 45 DAT, number of leaves/plant at 15, 30 and 45 DAT of crop as influenced by variety, biostimulants and biopesticides are furnished in Tables 1(a).
PLANT HEIGHT-The data on plant height (cm) of cauliflower recorded at 15, 30 AND 45 DAT as influenced by variety, biostimulants and biopesticides are presented in Table 1(a). The plant height showed significant differences and it was recorded at 15 DAT ranged from 15.64 cm to 8.98 cm. The maximum plant height (cm) was recorded in treatments T_6-Seaweed extract @ 2 ml/l+ Neem oil @ 5 ml/l (15.64 cm), however it was found statistically at par with treatments viz. T_7 (14.94 cm), T_8 (14.73 cm), and T_8 (26.40 cm) respectively whereas, the minimum plant height was recorded in T_1-control (8.98 cm). The plant height showed significant differences and it was recorded at 30 DAT ranged from 25.67 cm to 13.47 cm. The maximum plant height (cm) was recorded in treatments T_6-Seaweed extract @ 2 ml/l+ Neem oil @ 5 ml/l (25.67 cm), however it was found statistically at par with treatments viz. T_7 (24.69 cm), T_8 (24.44 cm), and T_8 (24.22 cm) respectively whereas, the minimum plant height was recorded in T_1-control (13.47 cm). The plant height showed significant differences and it was recorded at 45 DAT ranged from 37.42 cm to 20.15 cm. The maximum plant height (cm) was recorded in treatments T_6-GA3 150 ppm (37.42 cm), however it was found statistically at par with treatments viz. T_7 (37.16 cm), T_8 (36.55 cm), and T_8 (36.23 cm) respectively whereas, the minimum plant height was recorded in T_1-control (20.15 cm).

Stem Diameter
The data on stem diameter (cm) of cauliflower recorded at 15, 30 and 45 DAT as influenced by variety, biostimulants and bio pesticides are presented in Table 1(a). The stem diameter (cm) showed significant differences and it was recorded at 15 DAT ranged from 1.11 cm to 0.46 cm. The maximum stem diameter (cm) was recorded in treatments T_6-Seaweed extract @ 2 ml/l+ Neem oil @ 5 ml/l (1.11 cm), however it was found statistically at par with treatments viz. T_7 (1.01 cm), T_8 (0.94 cm), and T_8 (0.86 cm) respectively whereas, the minimum stem diameter (cm) was recorded in T_1-control (0.46 cm). The stem diameter (cm) showed significant differences and it was recorded at 30 DAT ranged from 3.14 cm to 2.13 cm. The maximum stem diameter (cm) was recorded intreatments T_6-Seaweed extract @ 2 ml/l+ Neem oil @ 5 ml/l (3.14 cm), however it was found statistically at par with treatments viz. T_7 (3.06 cm), T_8 (2.84 cm), and T_8 (2.74 cm) respectively whereas, the minimum stem diameter (cm) was recorded in T_1-control (2.13 cm). The stem diameter (cm) showed significant differences and it was recorded at 45 DAT ranged from 4.60 cm to 3.48 cm. The maximum stem diameter (cm) was recorded in treatments T_6-Seaweed extract @ 2 ml/l+ Neem oil @ 5 ml/l (4.60 cm), however it was found statistically at par with treatments viz. T_7 (4.54 cm), T_8 (4.31 cm), and T_8 (4.27 cm) respectively whereas, the minimum stem diameter (cm) was recorded in T_1-control (3.48 cm).

Days to Curd Initiation
The data on days to curd initiation of cauliflower recorded as influenced by variety, biostimulants and biopesticides are presented in Table 1(b). The days to curd initiation showed significant differences and it was recorded and ranged from 54.72 to 60.44. The minimum days to curd initiation was recorded in treatments T_6-Seaweed extract @ 2 ml/l+ Neem

oil @ 5 ml/l (54.72), however it was found statistically at par with treatments viz. T_7 (55.46), T_8 (56.17), and T_8 (56.89) respectively whereas, the maximum days from transplanting to curd initiation was recorded in T_1-control (60.44).

Days to Curd Maturity

The data on days to curd maturity of cauliflower recorded as influenced by variety biostimulants and bio pesticides are presented in Table 1(b). The days to curd maturity showed significant differences and it was recorded and ranged from 64.75 to 82.36. The minimum days to curd maturity was recorded in treatments T_6-Seaweed extract @ 2 ml/l+ Neem oil @ 5 ml/l (64.75), however it was found statistically at par with treatments viz. T_7 (64.75), respectively whereas, the maximum days from transplanting to curd initiation was recorded in T_1-control (82.36).

Number of Leaves Per Plant

The data on no. of leaves/plant of cauliflower recorded at 15, 30 and 45 DAT as influenced by variety, biostimulants and biopesticides are presented in Table 1(a). The no. of leaves/plant showed significant differences and it was recorded at 15 DAT ranged from 5.09 to 2.76. The maximum no. of leaves/plant was recorded in treatments T_6-Seaweed extract @ 2 ml/l+ Neem oil @ 5 ml/l (5.09), however it was found statistically at par with treatments viz. T_7 (4.74), T_8 (4.68), and T_8 (4.67) respectively whereas, the minimum no. of leaves/plant was recorded in T_1-control (2.76). The no. of leaves/plant showed significant differences and it was recorded at 30 DAT ranged from 7.12 to 3.81. The maximum no. of leaves/plant was recorded in treatments T_6-Seaweed extract @ 2 ml/l+ Neem oil @ 5 ml/l (7.12), however it was found statistically at par with treatments viz. T_7 (6.87), T_8 (6.80), T_8 (6.79) and respectively whereas, the minimum no. of leaves/plant was recorded in T_1-control (3.81). The no. of leaves/plant showed significant differences and it was recorded at 45 DAT ranged from10.18 to 5.82. The maximum no. of leaves/plant was recorded in treatments T_6-Seaweed extract @ 2 ml/l+ Neem oil @ 5 ml/l (10.18), however it was found statistically at par with treatments viz. T_7 (10.13), T_8 (9.94), T_8 (9.88) respectively whereas, the minimum no. of leaves/plant was recorded in T_1-control (5.82).

Seaweed extract contains macro & micro nutrients which taken by the plant directly through the leaves or indirectly through the roots which led to its accumulation inside the tissues. Results are in agreement with Hussain (2016) who explained that foliar application of seaweed extract on cauliflower plants lead to a significant increase in the plant height, number of leaves, stem diameter, curd initiation and enhance curd maturity. Seaweed extract also effect a photosynthesis, respiration, cell metabolism & and nucleic acid synthesis. Thereby, increasing cell division, protein synthesis, enzymes & hormones. Thus, increasing growth properties of plant. The results are in agreement of the findings of (Mohammed *et al.* (2021) that the seaweed extract significantly increased in vegetative growth characteristics included plant height and stem diameter. Present result reported in the Table (4.1-4.5) might be attributed to the synergistic effect of both seaweed extract as well as biopesticides. The beneficial impact of seaweed extract can be attributed to its ability to increase cell membrane permeability, thereby improving the absorption of nutrients, particularly nitrogen, which is closely associated with the leaf chlorophyll concentration. Seaweed extract also helps delay leaf aging by reducing chlorophyll degradation due to its cytokinin content. It contributes to soil organic matter and supplies plants with hormones and essential nutrients, all of which play a critical role in plant growth (Khan *et al.*, 2015) [6].

Yield Parameters

The data on the yield parameters i.e. curd diameter(cm), curd depth (cm), curd weight (g), curd compactness, curd yield per plot (kg) and yield per hectare (q) of crop as influenced by variety, biostimulants and biopesticides are furnished in Table2.

Curd Diameter

The data on curd diameter (cm) of cauliflower recorded as influenced by variety, biostimulants and biopesticides are presented in Table 2. The curd diameter showed significant differences and it was recorded and ranged from 12.88 cm to 6.00 cm. The maximum curd diameter was recorded in treatments T_6-Seaweed extract @ 2 ml/l+ Neem oil @ 5 ml/l (12.88 cm), however it was found statistically at par with treatments viz. T_7 (12.53 cm), T_8 (12.42 cm), and T_8 (12.22 cm) respectively whereas, the minimum curd diameter was recorded in T_1-control (6.00 cm).

Curd Depth

The data on curd depth (cm) of cauliflower recorded as influenced by variety, biostimulants and biopesticides are presented in Table 2. The curd depth showed significant differences and it was recorded and ranged from 7.94 cm to 3.43 cm. The maximum curd depth was recorded in treatments T_6-Seaweed extract @ 2 ml/l+ Neem oil @ 5 ml/l (7.94 cm), however it was found statistically at par with treatments viz. T_7 (7.56 cm), T_8 (7.45 cm), and T_8 (7.31 cm) respectively whereas, the minimum cur depth was recorded in T_1-control (6.00 cm).

Curd Weight

The data on curd weight (g) of cauliflower recorded as influenced by variety, biostimulants and biopesticides are presented in Table 2. The curd weight showed significant differences and it was recorded and ranged from 513.33 g to 200.27 g. The maximum curd weigth was recorded in treatments T_6-Seaweed extract @ 2 ml/l+ Neem oil @ 5 ml/l (513.33 g), however it was found statistically at par with treatments viz. T_7 (593.56 g), T_8 (465.78 g), and T_8 (461.33 g) respectively whereas, the minimum curd weight was recorded in T_1-control (200.27 g).

Curd Compactness

The data on curd compactness (gcm^{-1}) of cauliflower recorded as influenced by variety, biostimulants and biopesticides are presented in Table 2. The curd compactness showed significant differences and it was recorded and ranged from 15.28 gcm^{-1} to 12.33 gcm^{-1}. The maximum curd compactness was recorded in treatments T_6-Seaweed extract @ 2 ml/l+ Neem oil @ 5 ml/l (15.28 gcm^{-1}), however it was found statistically at par with treatments viz. T_7 (15.12 gcm^{-1}), T_8 (15.06 gcm^{-1}), and T_8 (14.80 gcm^{-1}) respectively whereas, the minimum curd compactnesswas recorded in T_1-control (12.33 gcm^{-1}).

Curd Yield Per Plot

The data on curd yield per plot (kg) of cauliflower recorded as influenced by variety, biostimulants and biopesticides are presented in Table 2. The curd yield per plot showed significant differences and it was recorded and ranged from 10.40 kg to 5.13 kg. The maximum curd yield per plot was recorded in treatments T_6-Seaweed extract @ 2 ml/l+ Neem oil @ 5 ml/l (10.40 kg), however it was found statistically at par with treatments viz. T_7 (9.40 kg), T_8 (8.98 kg), and T_8 (8.73 kg) respectively whereas, the minimum curd yield per plot was recorded in T_1-control (5.13 kg).

Yield Per Hectare

The data on yield per hectare (q) of cauliflower recorded as influenced by variety, biostimulants and biopesticides are presented in Table 2. The yield per hectare showed significant differences and it was recorded and ranged from 108.00 q to 83.29 q. The maximumyield per hectare was recorded in treatments T_6-Seaweed extract @ 2 ml/l+ Neem oil @ 5 ml/l (108.00 q) whereas, the minimum yield per hectare was recorded in T_1-control (83.29 q).

Seaweed extracts are rich in natural phytohormones such as cytokinins, auxins, and gibberellins, as well as micronutrients and amino acids, which stimulate vegetative and reproductive growth. Their foliar application improves nutrient uptake efficiency and metabolic activity, leading to larger and more compact curds. Studies have shown that seaweed extract treatments increase curd diameter and weight, and enhance curd depth and compactness by promoting robust cell division and enlargement. On the other hand, neem oil, though primarily a biopesticide, plays an indirect but crucial role in yield improvement by reducing pest and disease incidence, thereby minimizing crop stress and ensuring uninterrupted growth and curd development. Additionally, neem oil contains compounds like azadirachtin and salannin that can enhance plant defense and soil microbial activity, improving overall plant vigor. The synergistic effect of seaweed extract's physiological stimulation and neem oil's protective action leads to significantly higher yields per plot and per hectare. This integrated approach not only boosts yield components but also contributes to sustainable and eco-friendly cauliflower production. The present were in agreement with those of Kumawat *et al.*, (2020) [9] in cauliflower.

Quality Parameters

Data presented in Table 3 indicated that the quality parameters like curd dry matter and ascorbic acid content were significantly influenced by the exogenous application of biostimulants and biopesticides. The significantly maximum curd dry matter valued 11.38 % were recorded in treatment T_6-Seaweed extract @ 2 ml/l+ Neem oil @ 5 ml/l, while the minimum curd dry matter 7.58 % were recorded in treatment T_0-control. Similarly, ascorbic acid content was also influenced by application of both biostimulant and biopesticides. The maximum ascorbic acid content valued 54.85 mg were recorded in treatment T_6-Seaweed extract @ 2 ml/l+ Neem oil @ 5 ml/l, while the minimum curd dry matter 42.38 mg was recorded in treatment T_0-control. The probable reason for the increase of both curd dry matter and ascorbic acid is foliar application of seaweed extract, particularly from, has been widely shown to improve curd dry matter and enhance nutritional quality, including ascorbic acid levels. These extracts are rich in bioactive compounds—such as natural phytohormones, minerals, amino acids, and antioxidants—which boost photosynthesis, nutrient uptake, and stress resilience. For example, seaweed treatments have been linked to higher curd dry matter due to improved carbohydrate accumulation, as well as increased ascorbic acid content through enhanced antioxidant metabolism and secondary metabolite synthesis. Although neem oil is primarily known as a biopesticide, it indirectly supports higher curd dry matter and vitamin C concentration by reducing pest-induced stress and improving plant health. Neem also contains natural antioxidants—such as vitamin C in its leaves—that can stimulate the plant's own antioxidant systems, potentially contributing to elevated ascorbic acid levels in the harvested curds. When used together, seaweed extract and neem oil synergistically enhance curd quality by promoting both physiological growth and biochemical richness, ultimately increasing dry matter content and vitamin C in cauliflower. These findings are also in consonance with those of Kole *et al.* (2016) [20].

Economic Parameters

Data presented at Table 4 indicated that the economic parameters like cost-benefit ratio, gross return, and net return were significantly influenced by exogenous application of biostimulants and biopesticides. Atahe significantly maximum cost-benefit ratio, net return and gross return valued 3.3, 150550.0 Rs/ha, 216000.0 Rs/ha were recorded in treatment T_6-Seaweed extract @ 2 ml/l+ Neem oil @ 5 ml/l respectively, while the minimum cost-benefit ratio, net return, and gross return were recorded in treatment T_0-control. Similar findings were also reported by Sivasankari *et al.* (2006) [14], Rathore *et al.* (2009) [12] and Bhaskar (2014) [2].

Table 1(a): Growth Parameters

Number of treatments	Treatment	Plant height (cm)			Stem diameter(cm)			Number of leaves per plant		
		15 DAT	30 DAT	45 DAT	15 DAT	30 DAT	45 DAT	15 DAT	30 DAT	45 DAT
T_1	Control	8.98	13.47	20.15	0.46	2.13	3.48	2.76	3.81	5.82
T_2	Seaweed Extract @ 2 ml/l	14.33	24.09	35.89	0.79	2.70	4.20	4.61	6.77	9.78
T_3	Amino Acid @ 2 ml/l	13.67	23.91	35.31	0.74	2.38	4.08	4.59	6.63	9.64
T_4	Neem Oil @ 5 ml/l	13.41	23.18	34.78	0.60	2.17	3.67	4.35	6.55	9.43
T_5	Pseudomonas @ 5 g/l	13.15	22.26	34.08	0.53	2.07	3.62	4.11	6.45	9.56
T_6	Seaweed Extract @ 2 ml/l + Neem Oil @ 5 ml/l	15.64	25.67	37.42	1.11	3.14	4.60	5.09	7.12	10.18
T_7	Seaweed Extract @ 2 ml/l + Pseudomonas @ 5 g/l	14.94	24.69	37.16	1.01	3.06	4.54	4.74	6.87	10.13
T_8	Amino acid @ 2 ml/L+ Neem oil @ 5 ml/L	14.73	24.44	36.55	0.94	2.84	4.31	4.68	6.80	9.94
T_8	Amino acid @ 2 ml/L+ Pseudomonas @ 5 g/L	14.54	24.22	36.23	0.86	2.74	4.27	4.67	6.79	9.88
	SE(m)	0.31	0.71	0.25	0.10	0.22	0.09	0.13	0.25	0.11
	C.D. @ 5%	0.91	2.07	0.73	0.29	0.65	0.26	0.39	0.72	0.32

Table 1(b): Growth Parameters

Number of treatments	Treatment	Days to curd initiation	Days to curd maturity
T_1	Control	60.44	82.36
T_2	Seaweed Extract @ 2 ml/l	57.39	78.74
T_3	Amino Acid @ 2 ml/l	58.30	80.71
T_4	Neem Oil @ 5 ml/l	59.50	80.79
T_5	Pseudomonas @ 5 g/l	59.64	81.64
T_6	Seaweed Extract @ 2 ml/l + Neem Oil @ 5 ml/l	54.72	64.75
T_7	Seaweed Extract @ 2 ml/l + Pseudomonas @ 5 g/l	55.46	65.45
T_8	Amino acid @ 2 ml/L+ Neem oil @ 5 ml/L	56.17	74.64
T_8	Amino acid @ 2 ml/L+ Pseudomonas @ 5 g/L	56.89	74.95
	SE(m)	0.26	0.13
	C.D. @ 5%	0.77	0.38

Table 2: Yield Parameters

Number of treatments	Treatment	Curddiameter (cm)	Curd depth (cm)	Curd weight (g)	Curd compactness (gcm^{-1})	Curd Yield Per Plot (kg)	Yield per hectare (q)
T_1	Control	6.00	3.43	200.27	12.33	5.13	83.29
T_2	Seaweed Extract @ 2 ml/l	11.19	7.13	445.56	14.66	8.58	95.83
T_3	Amino Acid @ 2 ml/l	10.85	6.94	437.39	14.50	8.54	94.44
T_4	Neem Oil @ 5 ml/l	10.45	6.79	422.97	14.33	8.45	93.73
T_5	Pseudomonas @ 5 g/l	8.00	6.16	408.44	14.15	7.97	90.78
T_6	Seaweed Extract @ 2 ml/l + Neem Oil @ 5 ml/l	12.88	7.94	513.33	15.28	10.40	108.00
T_7	Seaweed Extract @ 2 ml/l + Pseudomonas @ 5 g/l	12.53	7.56	493.56	15.12	9.40	101.31
T_8	Amino acid @ 2 ml/L+ Neem oil @ 5 ml/L	12.42	7.45	465.78	15.06	8.98	99.72
T_8	Amino acid @ 2 ml/L+ Pseudomonas @ 5 g/L	12.22	7.31	461.33	14.80	8.73	98.51
	SE(m)	0.23	0.18	34.23	0.23	0.21	1.15
	C.D. @ 5%	0.67	0.54	99.49	0.67	0.60	3.33

Table 3: Quality Parameters

Number of treatments	Treatment	Curd Dry Matter (%)	Ascorbic acid (mg)
T_1	Control	7.58	42.38
T_2	Seaweed Extract @ 2 ml/l	10.33	46.56
T_3	Amino Acid @ 2 ml/l	10.09	46.05
T_4	Neem Oil @ 5 ml/l	9.78	45.48
T_5	Pseudomonas @ 5 g/l	9.28	44.20
T_6	Seaweed Extract @ 2 ml/l + Neem Oil @ 5 ml/l	11.38	54.85
T_7	Seaweed Extract @ 2 ml/l + Pseudomonas @ 5 g/l	11.30	50.13
T_8	Amino acid @ 2 ml/L+ Neem oil @ 5 ml/L	11.02	49.45
T_8	Amino acid @ 2 ml/L+ Pseudomonas @ 5 g/L	10.74	47.74
SE(m)		0.22	0.76
C.D. @ 5%		0.63	2.21

Table 4: Economic Returns

S. No.	Cost of cultivation (Rs.)			Yield per hectare (q)	Gross returns (Rs/ha)	Net returns (Rs/ha)	B:C
	Common cost	Extracost	Total cost				
T_1	60, 000	-	60, 000	83.29	166580.0	106580.0	2.78
T_2	60, 000	5210	65, 210	95.83	191660.0	126450.0	2.93
T_3	60, 000	4210	64, 210	94.44	188880.0	124670.0	2.94
T_4	60, 000	4430	64, 430	93.73	187460.0	123030.0	2.91
T_5	60, 000	4205	64, 205	90.78	181560.0	117355.0	2.83
T_6	60, 000	5450	65, 450	108.00	216000.0	150550.0	3.3
T_7	60, 000	4530	64, 530	101.31	202620.0	138090.0	3.14
T_8	60, 000	4340	64, 340	99.72	199440.0	135100.0	3.1
T_8	60, 000	4880	64, 880	98.51	197020.0	132140.0	3.04

Conclusion

The study concluded that the exogenous application of biostimulants and biopesticides significantly enhanced yield, quality, and economic parameters in cauliflower cultivation. Treatment with Seaweed extract @ 5 ml/l + Neem oil @ 2 ml/l at 15, 30 and 45 DAT (T_6) resulted in the highest yield per plot and hectare, as well as the most favourable economic returns. Treatment T_6 also influenced the growth parameters (plant height, stem diameter, days to curd initiation, days to curd maturity and number of leave sper plant) and quality parameters(curd dry matter and ascorbic acid content) along with the highest yield. Tese findings

suggest that using biostimulants and biopesticides, particularly seaweed extract and neem oil combination can early curd initiation and production, quality, and profitability in cauliflower cultivation.

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