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Diana Sagolsem
College of Horticulture, (Central
Agricultural University, Imphal),
Bermiok, Sikkim, India

Sunil Kumar Chongtham
College of Horticulture, (Central
Agricultural University, Imphal),
Bermiok, Sikkim, India

Y Rupert Anand
College of Horticulture, (Central
Agricultural University, Imphal),
Bermiok, Sikkim, India

Thusharreddy Jaganathan
College of Horticulture, (Central
Agricultural University, Imphal),
Bermiok, Sikkim, India

Subhajit Panigrahi
College of Horticulture, (Central
Agricultural University, Imphal),
Bermiok, Sikkim, India

Naveen Sankhla
College of Horticulture, (Central
Agricultural University, Imphal),
Bermiok, Sikkim, India

Abhishek Kumar Nirala
College of Horticulture, (Central
Agricultural University, Imphal),
Bermiok, Sikkim, India

Corresponding Author:
Sunil Kumar Chongtham
College of Horticulture, (Central
Agricultural University, Imphal),
Bermiok, Sikkim, India

Thusharreddy Jaganathan
College of Horticulture, (Central
Agricultural University, Imphal),
Bermiok, Sikkim, India

Effect of organic bio-stimulants on growth of Chinese cabbage under greenhouse conditions of Sikkim

Diana Sagolsem, Sunil Kumar Chongtham, Y Rupert Anand, Thusharreddy Jaganathan, Subhajit Panigrahi, Naveen Sankhla and Abhishek Kumar Nirala

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Abstract

A pot culture experiment was conducted using different organic bio-stimulant sprays for the Chinese cabbage (*Brassica rapa* var. *pekinensis*) variety F₁ Yates in the Kharif Season of 2025 at the College of Horticulture under low-cost polyhouse condition. The seven treatments, namely T₁ (Control), T₂ (3% Seaweed extract), T₃ (5% Seaweed extract), T₄ (3% Humic Acid), T₅ (5% Humic Acid), T₆ (3% Panchagavya), and T₇ (5% Panchagavya), were laid out in CRD and replicated thrice. A basal dose of 0.72 kg/ pot Farm Yard Manure and 0.18 kg rock phosphate/ pot were given in all pots, and foliar spray of bio-stimulants was done on 30 and 45 days after transplanting (DAT). The results showed that foliar spray of 5% Panchagavya (T₇) markedly improved various growth attributes, i.e., plant height (44.67 cm), number of leaves per plant (30.67), leaf length (38.85 cm), and leaf width (20.73 cm). Similarly, the significantly highest values of total fresh plant weight (1111.67 g/plant) and crop productivity (20.21 g/day) were noted under foliar spray of 5% Panchagavya (T₇). The minimal growth attributes are recorded for the T₁ (control) in all parameters observed. In conclusion, foliar application of 5% Panchagavya could be followed to enhance the growth and productivity of Chinese cabbage.

Keywords: Bio-stimulant, Chinese cabbage, humic acid, panchagavya, sea weed extract

Introduction

Chinese cabbage is an underutilized vegetable crop in India as well as in the state of Sikkim. It is scientifically called *Brassica rapa* var. *pekinensis* belonging to Brassicaceae family with a chromosome number of 2n=20. It is a winter leafy vegetable which is originated from the North China and is widely cultivated all across the Asia. The crop is grown as an annual crop for leaves and biennial for the seed production. It has a short vegetation period, and is considered as the fastest growing one among all leafy vegetables. In good conditions, its head can be cut at ten weeks after transplanting (El-Afifi *et al.*, 2014) ^[1]. It grows well in loamy soil and sandy loam soils that are rich in organic matter and water. It contains around 5% of dry matter, 10 g/kg of dietary fiber, 2,520 mg/kg potassium, 1,050 mg/kg calcium, 190 mg/kg magnesium, 650 mg/kg sodium, and 450 mg/kg vitamin C of fresh matter (USDA, 2007) ^[2]. The usage of chemical nitrogen fertilizer application significantly improves the yield, but it also leads to the decline in the nutritional quality of the economic part, as well as, the increase in nitrate content and pollutes the environment (Rumsby, 2002) ^[3], which paves way for the usage of organic amendments for the crop cultivation. The state of Sikkim after becoming organic state in 2016 restricts the synthetic agrochemicals for crop cultivation (Kumar *et al.*, 2017) ^[4]. The farmers of the state are still following traditional farming practices and unaware of the scientific organic practices of vegetable farming. Bio-stimulants, which are new gen amendments for supplements of nutrients for the plants, are derived from living organisms such as plants, seaweeds, microbes, etc., and function similar to chemical fertilizers (Bhupenchandra *et al.*, 2020) ^[5]. Besides supplying plant nutrients, certain bio-stimulants such as seaweed extract and humic acid derivatives support plants during the unexpected abiotic stresses, which are an added advantage of their usage in crop cultivation (Bhupenchandra *et al.*, 2022) ^[6]. So, this study was undertaken

to identify the suitable biostimulant and its dose for enhancing growth and yield of Chinese cabbage under low-cost polyhouse condition in mid-hills of Sikkim.

Materials and Methods

A pot experiment was carried out at the Experimental farm of College of Horticulture, Bormiok (Central Agricultural University, Imphal) in the *Kharif* season of 2025 to study the impact of different bio-stimulants spray in growth and yield of Chinese cabbage under low-cost polyhouse conditions in mid-hills of Sikkim. The experimental farm was located at 88° 46.8' 92.7'' E, 27° 23.2' 36.3'' N and 867 m MSL altitude. The pot experiment was laid out in completely randomized design (CRD) with seven treatments viz., namely T₁ (Control – water spray), T₂ (3% Seaweed extract), T₃ (5% Seaweed extract), T₄ (3% Humic Acid), T₅ (5% Humic Acid), T₆ (3% Panchagavya), and T₇ (5% Panchagavya) and replicated thrice. Biostimulant and water sprays were done at 30 and 45 days after transplanting as per the treatment in all the pots. The soil used in the experiment was slightly acidic with 6.1 pH, and contained 190.3 kg/ha N, 3.5 kg/ha P₂O₅ and 161.1 kg/ha K₂O. The average maximum temperature during the study was °C in the month of and the minimum temperature was °C which was in the month of. A uniform dose of farm yard manure (0.72 kg/ pot) and rock phosphate (0.18 kg/pot) were supplied to all the pots, including the control as basal dose of organic manures. Chinese cabbage var. F₁ Yates was used as planting material in this study. Seeds were sown on 24th May 2025 in pro trays, and then 24th day-old seedlings were transplanted in pots on 16th June 2025 in

polybags. Various growth and yield parameters such as leaf length (cm), leaf width (cm), number of leaves per plant, plant height (cm), and fresh weight plant yield (g) were measured on the day of harvest (9th August 2025). The crop productivity (g/day) was estimated by dividing the fresh plant weight by the total crop duration. The total crop duration was 55 days during the investigation. All statistical analyses such as mean and Analysis of Variance were carried out using Microsoft Excel and OPSTAT of HAU, Hisar at 5% significance to draw a cogent inference.

Results and Discussion

Data presented in Table 1 indicated that the tallest plant was observed under T₇ (44.67 cm) which was at par with T₆ (43.67 cm) but was significantly taller than the rest of treatments. Significant enhancement in leaf length was found in the treatment T₆ (40.23 cm) which was on par with T₇ (38.85 cm) and T₅ (36.69 cm). The maximum value of leaf width was registered under T₆ (21.19 cm) which was at par with T₃ (21.18 cm), T₇ (20.73 cm), T₅ (20.50 cm) and T₂ (19.32 cm), and it showed a significant difference with T₄ (16.83 cm) and T₁ (12.56 cm). Number of leaves per plant was markedly improved due to the application of T₇ (30.67) which was significantly higher the rest of treatments, except T₆. Similarly, the significantly highest total fresh plant weight was recorded under T₇ (1111.67 g/ plant) which was 10.15 times higher than T₁ (99.67 g). Consequently, the maximum value of crop productivity was noted under T₇ (20.21 g/day) which was significantly superior among all treatments.

Table 1: Effect of Bio-stimulants spray on Growth and yield of Chinese cabbage under shade net house conditions of Sikkim

Treatment	LL (cm)	LW (cm)	NL (Nos.)	PH (cm)	FW (g)	CP (g/day)
T ₁ Control	28.25	12.56	14.00	29.67	99.67	1.81
T ₂ 3% Sea Weed Extract	34.34	19.32	20.33	36.00	403.67	7.34
T ₃ 5% Sea Weed Extract	34.90	21.18	27.00	37.53	438.33	7.97
T ₄ 3% Humic Acid	32.34	16.83	24.00	36.07	357.00	6.49
T ₅ 5% Humic Acid	36.69	20.50	21.67	36.33	535.33	9.73
T ₆ 3% Panchagavya	40.23	21.19	29.33	43.67	882.00	16.04
T ₇ 5% Panchagavya	38.85	20.73	30.67	44.67	1111.67	20.21
C.D.	4.723	2.082	3.62	4.938	76.651	1.393
SE(m)	1.542	0.68	1.182	1.612	25.028	0.455
SE(d)	2.181	0.961	1.671	2.28	35.395	0.643
C.V.	7.612	6.23	8.581	7.407	7.928	7.925

N.B: LL - Leaf length, LW - Leaf width, NL - Number of leaves, PH - Plant height, FW – Total fresh plant weight, CP - Crop productivity

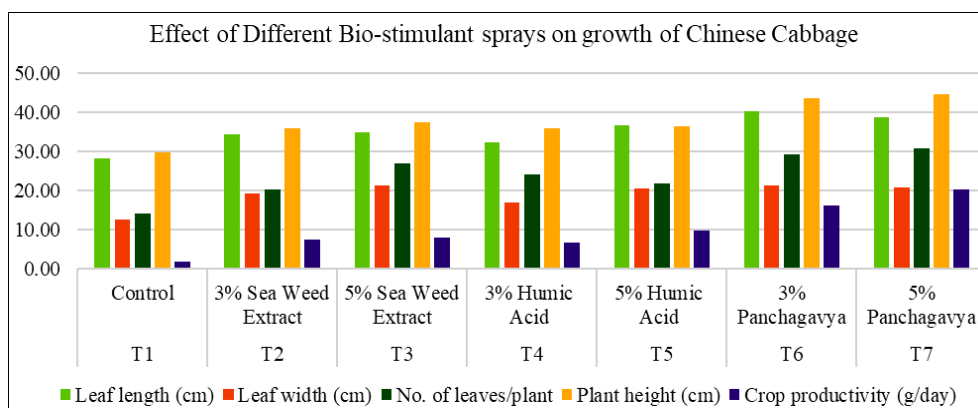


Fig 1: Graphical Representation of Plant growth and yield parameters recorded in Various Treatments

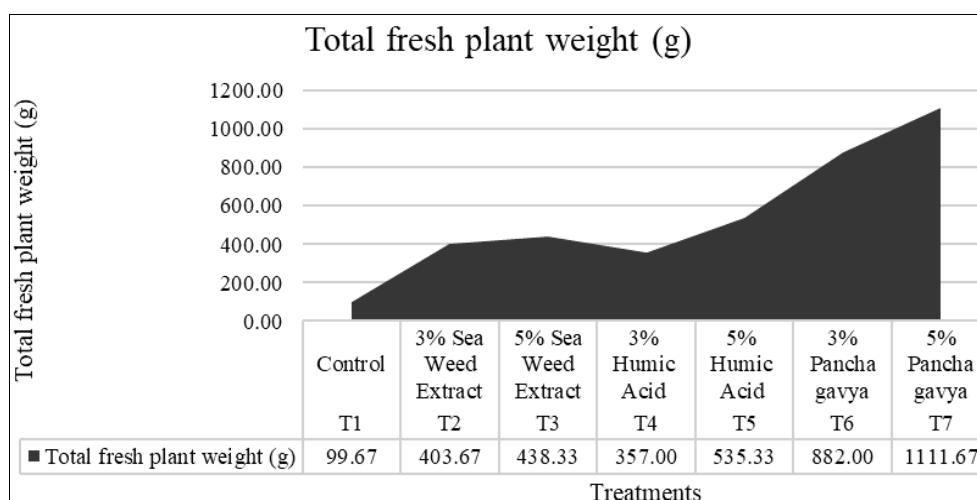


Fig 2: Graphical Representation of Total Fresh Weight recorded in Various Treatments

According to the results observed, the bio-stimulants were found to enhance the growth and yield of the Chinese cabbage with different mode of action and mechanisms. The humic acid may influence the membrane fluidity of the plant cells and the activity of the pyrophosphatase enzyme (H^+PPase), which in turn increase the uptake of macronutrients such as nitrogen, phosphorus and potassium and other secondary nutrients such as S, Ca, Mg, Mn, and Fe in crops (Bhupenchandra *et al.*, 2022)^[6], which will obviously increase the yield of crop. The seaweed extract contains several micro and macronutrients required by the plants, along with amino acids, vitamins, and phytohormones such as auxins, cytokinins & abscisic acid, which has the potential of changing the metabolism in cellular level and impacts plant growth and yield (Khan *et al.*, 2009)^[7]. Panchagavya which contains essential microorganisms along with some required plant nutrients that improves plant growth increases metabolic activities of the crop and also gives certain resistance to pest and diseases (Rakesh *et al.*, 2017)^[8].

In Broccoli, which is a crop of same family, Panchagavya 5% spray had been reported as best treatment by Chongtham *et al.* (2025)^[9] which supports the current finding. Panchagavya 3% along with 80% of RDF was found to be best treatment as per Chaudhari *et al.* (2024)^[10] in the beetroot cultivar which also highlights the role of Panchagavya spray in yield enhancement.

In Carrot cultivation under organic conditions, the treatment which found to give best quality characters is basal application of farm yard manure 20 t/ha and 3% Panchagavya spray at 45, 60 and 75 DAS (Das, 2020)^[11].

Conclusion

From this study, it is inferred that application of 5 percent Panchagavya foliar spray at 30 and 45 days after transplanting along with basal dose of 0.72 kg of farm yard manure/pot and 0.18 kg of rock phosphate/pot increased the growth and yield attributes of Chinese cabbage. Therefore, it can be recommended as an alternate source of nutrients for organic cultivation of Chinese cabbage under low cost poly-house conditions in the mid-hills of Sikkim.

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