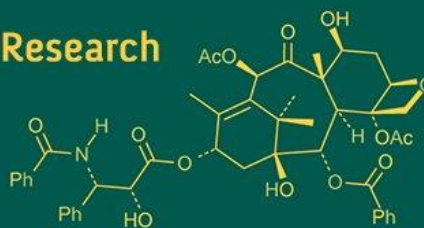


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Response of chrysanthemum cv. Bidhan Shweta to *Vrikshayurveda* based Herbal *Kunapajala* and biostimulants

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Abstract

The present investigation was conducted at the Model Floriculture Centre, Govind Ballabh Pant University of Agriculture and Technology, Pantnagar, during 2024-25 and 2025-26. The study aimed to evaluate the response of *Vrikshayurveda* based Herbal *Kunapajala* and biostimulants for sustainable chrysanthemum cultivation. The experiment was laid out in a Randomised Block Design with thirteen treatments and three replications. The treatments were assessed for their effects on vegetative growth and flowering. The application of *Ghanjeevamrit* + Herbal *Kunapajala* Pure Nettle @100 mL/L significantly enhanced vegetative and flowering parameters. During both the years, the maximum plant height (47.27 and 48.38 cm), plant spread (32.09 and 33.67 cm), leaf area (), earliness in flower bud initiation (49.78 and 48.45 days) and flower opening (61.67 and 60.78 days) were recorded under the treatment T₁₀ (*Ghanjeevamrit* + Herbal *Kunapajala* Pure Nettle @100 mL/L). These findings demonstrate the potential of Herbal *Kunapajala* as an eco-friendly and sustainable nutrient management approach for improving vegetative growth and flowering attributes of chrysanthemum.

Keywords: Herbal *Kunapajala*, biostimulants, height, plant spread, flowering

Introduction

Chrysanthemum (*Chrysanthemum morifolium* Ramat.) is one of the most important ornamental flowering crops belonging to the family Asteraceae. It is popularly known as the 'Queen of the East' due to its origin in East Asia and its immense cultural and economic significance. Owing to its remarkable diversity in flower colour, size, shape and growth habit, chrysanthemum occupies a prominent position in the global floriculture industry as both a cut flower and loose flower crop. Besides its ornamental value, chrysanthemum possesses medicinal, nutraceutical and industrial importance because its flowers contain abundant flavonoids, phenolic acids, terpenoids and other bioactive compounds exhibiting antioxidant, antimicrobial, anti-inflammatory and anticancer activities (Hadizadeh *et al.*, 2022) [6]. Modern intensive floriculture largely depends on chemical fertilisers to achieve higher productivity. However, prolonged and indiscriminate use of synthetic fertilisers has resulted in the deterioration of soil health, a reduction in beneficial microbial populations, nutrient imbalances, and environmental pollution. These concerns have accelerated the search for sustainable nutrient management strategies capable of maintaining crop productivity while improving soil fertility and ecosystem health. Integrated use of organic nutrient sources, microbial inoculants and plant biostimulants has emerged as a promising approach for sustainable ornamental crop production (Du Jardin, 2015) [5]. Plant biostimulants are defined as substances or microorganisms that enhance plant nutrition efficiency, improve tolerance to abiotic stress and promote crop quality irrespective of their nutrient content. Unlike conventional fertilisers, biostimulants stimulate physiological and biochemical processes such as nutrient uptake, root growth, photosynthesis, enzyme activity and antioxidant metabolism, thereby improving plant growth and flowering. Humic substances, seaweed extracts, microbial inoculants and protein hydrolysates are among the major categories of biostimulants widely adopted in horticultural crops (Du Jardin, 2015) [5]. Among indigenous organic formulations, *Kunapajala*, described in the ancient Indian treatise

Vrikshayurveda by Surapala, has attracted renewed scientific attention as an eco-friendly liquid organic fertiliser. Traditionally prepared through fermentation of animal or plant materials along with organic additives, *Kunapajala* is rich in macro- and micronutrients, beneficial microorganisms, amino acids, organic acids and naturally occurring plant growth regulators. Recent investigations have demonstrated that *Kunapajala* enhances soil microbial diversity, nutrient availability, chlorophyll synthesis, root development, and overall plant growth, while improving soil health (Biswas and Das, 2025) [2].

A modified form of this traditional formulation, Herbal *Kunapajala*, utilises nutrient-rich botanical materials instead of animal products, making it more acceptable, economical and environmentally sustainable. Fermentation of grasses such as nettle (*Urtica dioica*) and other nutrient-rich plant biomass produces a liquid formulation enriched with beneficial microbes, micronutrients, vitamins and bioactive metabolites that stimulate plant metabolism and reproductive development (Naik, 2022) [7]. Similarly, *Ghanjeevamrit*, a concentrated solid form of *Jeevamrit*, serves as an efficient source of beneficial microorganisms and organic nutrients (Vaz *et al.*, 2025) [11]. Although the beneficial effects of organic formulations and biostimulants have been demonstrated in several horticultural crops, systematic information regarding the combined application of *Vrikshayurveda*-based Herbal *Kunapajala* and biostimulants in chrysanthemum cv. Bidhan Shweta remains limited. Therefore, the present investigation was undertaken to evaluate the influence of Herbal *Kunapajala* and selected biostimulants on vegetative growth and flowering of chrysanthemum.

Materials and Methods

The field experiment was conducted at the Model Floriculture Centre (MFC), Govind Ballabh Pant University of Agriculture and Technology, Pantnagar, District Udham Singh Nagar, Uttarakhand, during the winter seasons of 2024-25 and 2025-26. Pantnagar is situated in the Tarai region of Uttarakhand, and the experimental soil belongs to the Mollisol order. The experimental material consisted of chrysanthemum (*Chrysanthemum morifolium* Ramat.) cv. Bidhan Shweta, a commercially important spray-type cultivar. The experiment was laid out in a Randomised Block Design (RBD) with 13 treatments and three replications. The treatments comprised different combinations of recommended fertiliser dose (RDF), humic acid, seaweed extract, *Ghanjeevamrit*, *Jeevamrit* and Herbal *Kunapajala*. The treatment details were as follows: T₀: 100% RDF (Control), T₁: 75% RDF + Humic acid @3 mL/L, T₂: 50% RDF + Humic acid @3 mL/L, T₃: 75% RDF + Seaweed extract @5 mL/L, T₄: 50% RDF + Seaweed extract @5 mL/L, T₅: *Ghanjeevamrit* + *Jeevamrit* @50 mL/L, T₆: *Ghanjeevamrit* + *Jeevamrit* @100 mL/L, T₇: *Ghanjeevamrit* + Herbal *Kunapajala* GBLW @50 mL/L, T₈: *Ghanjeevamrit* + Herbal *Kunapajala* GBLW @100 mL/L, T₉: *Ghanjeevamrit* + Herbal *Kunapajala* Pure Nettle @50 mL/L, T₁₀: *Ghanjeevamrit* + Herbal *Kunapajala* Pure Nettle @100 mL/L, T₁₁: *Ghanjeevamrit* + Herbal *Kunapajala* GBLW + Pure Nettle @50 mL/L and T₁₂: *Ghanjeevamrit* + Herbal *Kunapajala* GBLW + Pure Nettle @100 mL/L. Well-rooted terminal cuttings of chrysanthemum were transplanted at a spacing of 30 × 30 cm. Farmyard manure was incorporated during land

preparation, and recommended agronomic practices were followed throughout the crop growth period. Organic liquid formulations and biostimulants were applied as per the treatment schedule at appropriate crop growth stages. Irrigation, weeding, hoeing, and other intercultural operations were carried out uniformly for all the treatments as recommended. Observations on vegetative growth parameters, namely plant height, leaf area and plant spread, were recorded at the appropriate stages of crop growth. Flowering observations, including days taken for first bud initiation and days taken for first flower opening, were also recorded during the investigation. Data on all the parameters were recorded from randomly selected representative plants in each treatment and replication following standard procedures. The experimental data were statistically analysed in accordance with the Randomised Block Design (RBD) and the significance of treatment effects was tested at the 5% probability level.

Results

Vegetative parameters

Plant height (cm)

During the year 2024-25, plant height at full bloom differed significantly among the treatments. The highest plant height (47.27 cm) was recorded in T₁₀ (*Ghanjeevamrit* + Herbal *Kunapajala* Pure Nettle @100 mL/L), which was statistically at par with T₉ (45.57 cm) and T₁₂ (43.61 cm), but significantly superior to the remaining treatments. The lowest plant height (34.04 cm) was observed under T₀ (100% RDF; Control). A similar trend was observed during the second year of experimentation. The maximum plant height at full bloom (48.38 cm) was recorded under T₁₀, which remained statistically comparable with T₉ (46.24 cm) and T₁₂ (44.62 cm), while significantly outperforming the other treatments. The minimum plant height (35.13 cm) was recorded in T₀ (Control). The pooled analysis over two years confirmed significant differences among the treatments with respect to plant height at full bloom. The highest plant height (47.82 cm) was recorded in T₁₀ (*Ghanjeevamrit* + Herbal *Kunapajala* Pure Nettle @100 mL/L), followed by T₉ (45.90 cm), T₁₂ (44.12 cm), T₁₁ (42.85 cm) and T₆ (41.88 cm). The lowest plant height (34.60 cm) was observed in the control (T₀).

Plant spread (cm)

Plant spread was significantly influenced by the different treatments during the first year of experimentation. The maximum plant spread (32.09 cm) was recorded under T₁₀ (*Ghanjeevamrit* + Herbal *Kunapajala* Pure Nettle @100 mL/L), which was statistically at par with T₉ (29.39 cm) and T₁₂ (28.41 cm), but significantly superior to the remaining treatments. The minimum plant spread (20.48 cm) was observed under T₀ (100% RDF; Control). During the year 2025-26, the maximum plant spread (33.67 cm) was recorded in T₁₀, which was statistically at par with T₉ (30.42 cm) and T₁₂ (29.25 cm). The lowest plant spread (21.83 cm) was recorded under T₀ (Control). The pooled analysis revealed significant differences among the treatments. The maximum pooled plant spread (32.88 cm) was recorded in T₁₀. The minimum pooled plant spread (21.16 cm) was recorded in T₀ (Control). The pooled results further confirmed the consistency of treatment effects over both the years.

Leaf area (cm²)

The application of different organic formulations and biostimulants exerted a significant influence on leaf area. In the year 2024-25, among all the treatments, T₁₀ (*Ghanjeevamrit* + Herbal *Kunapajala* Pure Nettle @100 mL/L) produced the largest leaf area (31.56 cm²), indicating a pronounced improvement in leaf development. Treatments T₉ (29.88 cm²) and T₁₂ (27.95 cm²) also produced comparatively larger leaves and were statistically at par with T₁₀. The smallest leaf area (12.24 cm²) was observed in the control (T₀). A comparable trend was evident during the second year, wherein T₁₀ maintained its superiority by recording the maximum leaf area (33.46 cm²). It was closely followed by T₉ (31.78 cm²) and T₁₂ (30.42 cm²), whereas T₀ produced the minimum leaf area (14.00 cm²). The consistent increase in leaf area under organic treatments reflects their positive influence on leaf expansion and photosynthetic surface development. The pooled mean further confirmed the consistent response of chrysanthemum to the applied treatments. T₁₀ recorded the maximum leaf area (32.50 cm²), followed by T₉ (30.83 cm²) and T₁₂ (29.18 cm²), whereas the control (T₀) recorded the lowest value (13.12 cm²).

Flowering parameters

Days taken for first bud appearance

The data presented in Table 2 revealed significant variation among the treatments with respect to days taken for first bud appearance during the first year of investigation. The earliest bud appearance was recorded under T₁₀ (*Ghanjeevamrit* + Herbal *Kunapajala* Pure Nettle @100 mL/L), requiring only 49.78 days, which was statistically at par with T₉ (50.22 days) and significantly earlier than the remaining treatments. In contrast, the control (T₀) recorded the maximum number of days (57.11 days) for first bud appearance, indicating delayed floral initiation under conventional nutrient management. A similar trend was observed during the second year of experimentation. The minimum number of days for first bud appearance (48.45 days) was recorded in T₁₀, followed by T₉ (49.67 days) and T₁₂ (50.22 days), whereas the maximum number of days (56.11 days) was observed under the control (T₀). The remaining treatments exhibited intermediate responses with respect to floral bud initiation. The pooled analysis confirmed the consistent influence of different treatments on the earliness of bud appearance. The earliest first bud appearance was observed under T₁₀, requiring only 49.11 days, followed by T₉ (49.94 days) and T₁₂ (50.94 days). Conversely, the control (T₀) required the maximum number of days (56.61 days) for bud appearance.

Days taken for first flower opening

During the year 2024-25, the treatments exerted a significant influence on the number of days taken for first flower opening. The earliest flower opening was recorded under T₁₀ (*Ghanjeevamrit* + Herbal *Kunapajala* Pure Nettle @100 mL/L), which required 61.67 days, and was statistically at par with T₉ (62.78 days) and T₁₂ (63.22 days). In contrast, treatment T₀ (Control) required the maximum number of days (68.56 days) for first flower opening, indicating delayed flowering. The results obtained during the second year followed a trend similar to that of the first year. The minimum number of days for first flower opening

(60.78 days) was recorded under T₁₀, followed by T₉ (61.44 days) and T₁₂ (62.55 days). In contrast, the treatment T₀ (Control) recorded the maximum days for first flower opening (67.89 days), while the remaining treatments showed intermediate values. The pooled mean data revealed significant differences among the treatments with respect to days taken for first flower opening. The minimum number of days required for first flower opening (61.22 days) was recorded under T₁₀ (*Ghanjeevamrit* + Herbal *Kunapajala* Pure Nettle @100 mL/L), followed by T₉ (62.11 days) and T₁₂ (62.90 days), whereas the maximum number of days (68.22 days) was recorded under the control treatment (T₀). The pooled results clearly demonstrated that the integrated application of *Ghanjeevamrit* + Herbal *Kunapajala* Pure Nettle @100 mL/L effectively promoted earlier flowering in chrysanthemum.

Discussion

Vegetative parameters

The enhanced vegetative growth observed under *Ghanjeevamrit* and Herbal *Kunapajala* may be attributed to the synergistic action of beneficial microorganisms and bioactive compounds present in the organic formulations. Fermented organic inputs harbour diverse microbial populations, including nitrogen-fixing bacteria and phosphate-solubilising microorganisms, which improve nutrient mineralisation, availability and uptake, thereby promoting vigorous plant growth (Chakraborty *et al.*, 2019) [3]. These beneficial microbes also stimulate physiological processes such as cell division and cell elongation, resulting in greater meristematic activity, increased biomass production and improved canopy development. Similar beneficial effects of *Kunapajala* on vegetative growth have also been documented in ashwagandha and gladiolus by Ankad *et al.* (2017) [1] and Tamrakar *et al.* (2018) [9], respectively.

Flowering parameters

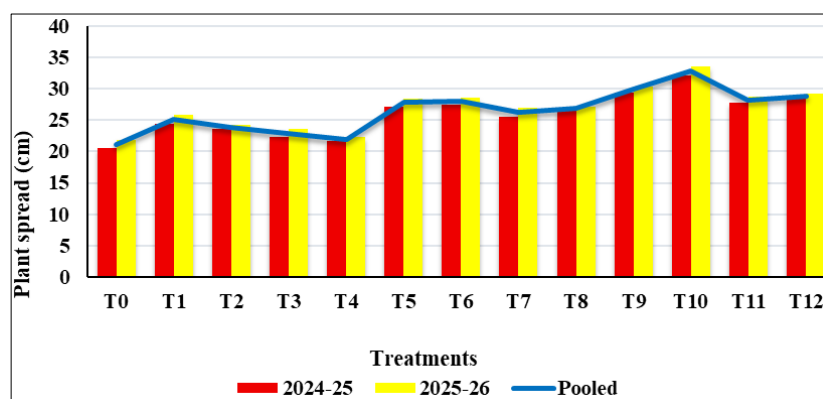
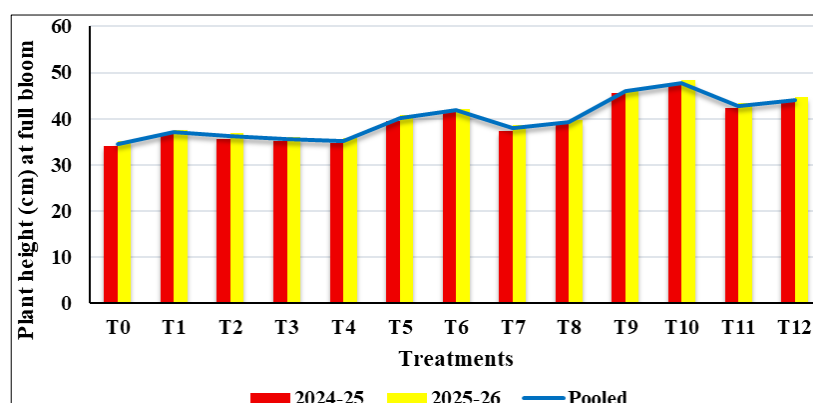
The earliness in flowering observed with *Ghanjeevamrit* + Herbal *Kunapajala* may be attributed to the combined effect of readily available nutrients, beneficial microorganisms and naturally occurring plant growth regulators produced during the fermentation process. These fermented bio-formulations enhance microbial activity in the rhizosphere, resulting in greater mineralisation and improved availability of nitrogen, phosphorus and micronutrients during the critical reproductive stage. Enhanced nutrient uptake increases photosynthetic efficiency and carbohydrate accumulation, allowing plants to attain physiological maturity earlier and initiate flowering sooner (Chaupoo and Kumar, 2020) [4]. Furthermore, microbial metabolites such as auxins, gibberellins and cytokinins synthesised during fermentation stimulate floral differentiation, accelerate flower bud initiation and promote the transition from vegetative to reproductive growth. The presence of humic substances, amino acids, vitamins and organic acids in Herbal *Kunapajala* further improves nutrient absorption, enzyme activity and assimilate translocation towards developing floral buds, thereby reducing the number of days required for flowering. Similar observations have been reported by Trivedi *et al.* (2016) [10] in rose and Pansuriya and Kumari (2024) [8] in chrysanthemum.

Table 1: Effect of Herbal *Kunapajala* and biostimulants on vegetative parameters of chrysanthemum cv. Bidhan Shweta

Treatments	Plant height (cm) at full bloom			Plant spread (cm)			Leaf area (cm ²)		
	2024-25	2025-26	Pooled mean	2024-25	2025-26	Pooled mean	2024-25	2025-26	Pooled mean
T ₀	34.04	35.13	34.60	20.48	21.83	21.16	12.24	14.00	13.12
T ₁	36.78	37.44	37.11	24.41	25.89	25.15	18.91	20.15	19.54
T ₂	35.63	36.85	36.24	23.55	24.21	23.88	17.46	18.72	18.09
T ₃	35.14	36.07	35.61	22.30	23.55	22.93	15.84	17.08	16.46
T ₄	34.72	35.73	35.23	21.69	22.31	22.00	14.33	15.62	14.98
T ₅	39.54	40.80	40.17	27.11	28.51	27.82	23.42	25.64	24.53
T ₆	41.70	42.07	41.88	27.41	28.63	28.02	24.85	27.21	26.03
T ₇	37.35	38.58	37.96	25.57	26.93	26.25	20.63	22.83	21.73
T ₈	38.83	39.67	39.25	26.66	27.13	26.90	21.98	24.26	23.12
T ₉	45.57	46.24	45.90	29.39	30.42	29.91	29.88	31.78	30.83
T ₁₀	47.27	48.38	47.82	32.09	33.67	32.88	31.56	33.46	32.50
T ₁₁	42.33	43.37	42.85	27.73	28.73	28.23	26.42	28.95	27.68
T ₁₂	43.61	44.62	44.12	28.41	29.25	28.83	27.95	30.42	29.18
S.E.m±	0.49	0.57	0.43	0.55	0.47	0.34	0.67	0.49	0.45
C.D. at 5%	1.44	1.69	1.26	1.62	1.38	1.01	1.97	1.45	1.32

Table 2: Effect of Herbal *Kunapajala* and biostimulants on the number of days taken for the first bud appearance and first flower opening in chrysanthemum cv. Bidhan Shweta

Treatments	Days taken for first bud appearance			Days taken for first flower opening		
	2024-25	2025-26	Pooled mean	2024-25	2025-26	Pooled mean
T ₀	57.11	56.11	56.61	68.56	67.89	68.22
T ₁	55.44	54.33	54.89	67.44	66.22	66.83
T ₂	55.89	54.78	55.33	67.89	66.67	67.28
T ₃	56.33	55.44	55.89	68.11	67.33	67.72
T ₄	56.78	55.90	56.33	68.22	67.67	67.95
T ₅	53.67	52.89	53.28	65.78	64.89	65.33
T ₆	53.11	52.33	52.72	65.34	64.22	64.78
T ₇	54.89	53.67	54.28	66.67	65.89	66.28
T ₈	54.22	53.11	53.67	66.11	65.33	65.72
T ₉	50.22	49.67	49.94	62.78	61.44	62.11
T ₁₀	49.78	48.45	49.11	61.67	60.78	61.22
T ₁₁	52.44	51.55	52.00	64.56	63.11	63.83
T ₁₂	51.66	50.22	50.94	63.22	62.55	62.90
S.E.m±	0.61	0.57	0.44	0.58	0.51	0.35
C.D. at 5%	1.80	1.68	1.30	1.71	1.49	1.02



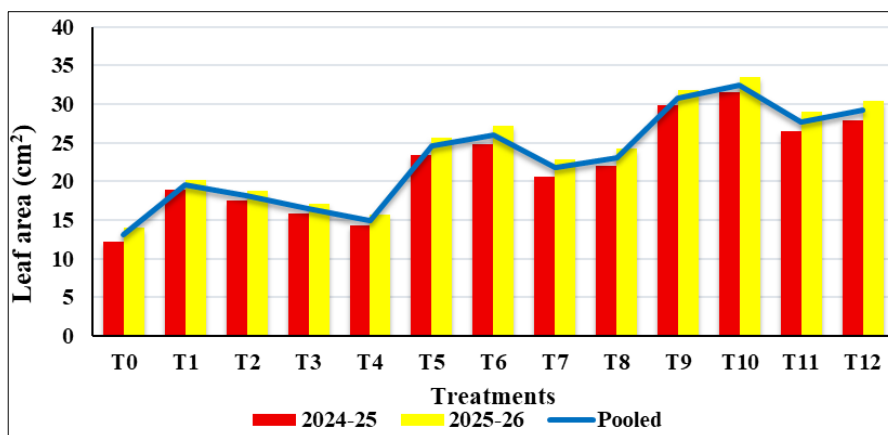


Fig 1: Effect of Herbal *Kunapajala* and biostimulants on vegetative parameters of chrysanthemum cv. Bidhan Shweta

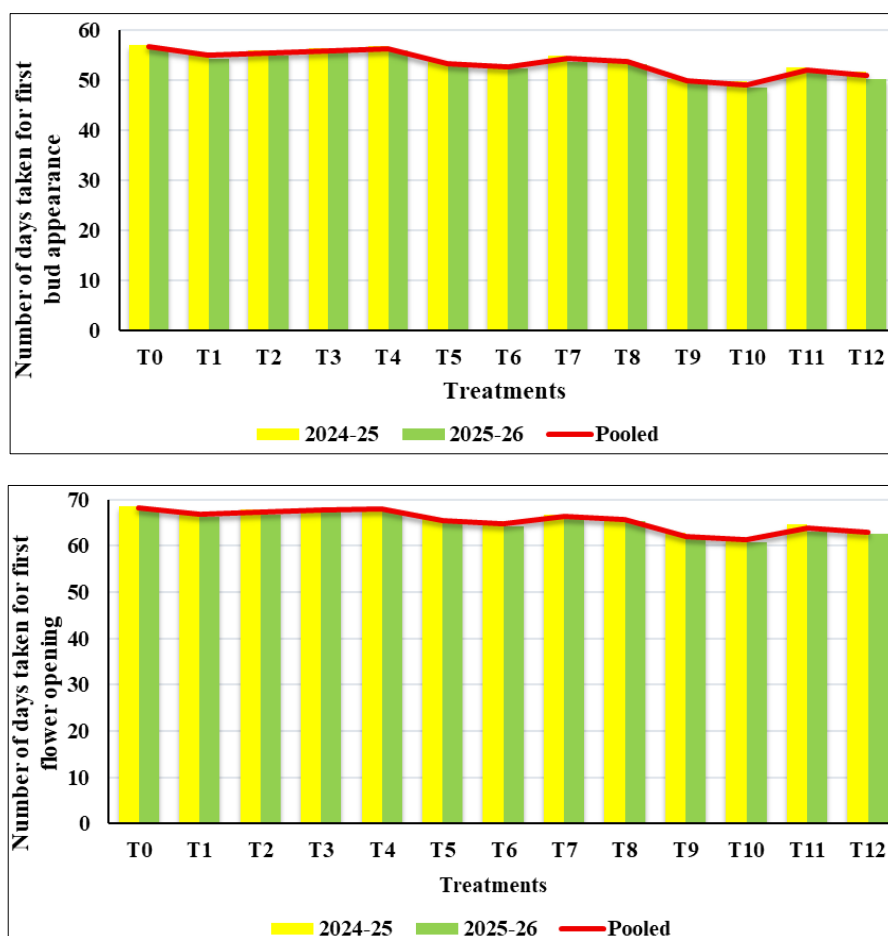


Fig. 2: Effect of Herbal *Kunapajala* and biostimulants on flowering parameters of chrysanthemum cv. Bidhan Shweta

Conclusion

The results revealed that the application of *Ghanjeevamrit* + Herbal *Kunapajala* Pure Nettle @ 100 mL/L (T₁₀) significantly enhanced the vegetative growth and flowering performance of chrysanthemum cv. Bidhan Shweta. Conversely, the lowest values for most growth and flowering parameters were recorded under the control treatment (100% RDF), indicating the superiority of Herbal *Kunapajala* based treatments in improving crop performance.

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