

ORIGINAL ARTICLE

Effect of Multiple Organic Manure on Growth of Lettuce (*Lactuca Sativa* L.) Under Low Hills of Uttarakhand

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ABSTRACT

From ancient times until the present, the effective utilization of organic fertilizer has been an important part of agriculture. Today, the use of organic fertilizer is considered an important strategy in the effort to preserve the global environment. In addition to the major nutrient elements, manure contains several trace elements required by the crop and a large amount of organic matter needed for soil improvement. The main objective of this research was to study the influence of different sources of organic manure on vegetative growth of lettuce. For this purpose, a field experiment was planned and executed during 2022-2023 at Horticulture Research Block of Department of Horticulture, School of Agriculture Sciences, Shri Guru Ram Rai University, Dehradun, Uttarakhand, India. The experiment was conducted in a randomized block design (RBD) replicated thrice with ten treatments involving nine organic fertilizers and a control treatment. The treatments were viz. T₁ (control), T₂ (FYM@20t/ha), T₃ (Vermicompost@5t/ha), T₄ (Jeevamrutha@100%), T₅ (Biostimulant @3%), T₆ (FYM @20t/ha + Vermicompost@5t/ha), T₇ (Vermicompost@5t/ha + Jeevamrutha@100%), T₈ (FYM@20t/ha + Biostimulant@3%), T₉ (FYM@10t/ha + Vermicompost@2.5t/ha + Jeevamrutha @50% + Biostimulant @1.5%) and T₁₀ (FYM @ 20t/ha + Vermicompost @ 5t/ha + Jeevamrutha @100% + Biostimulant @3%). Different growth parameters were recorded and statistically analyzed. The results revealed that treatment T₆ (FYM @20t/ha + VC @5t/ha) recorded maximum plant height (14.80cm), leaf width (15.12cm), fresh weight of plant (262.73g), dry weight of plant (31.76g), diameter of plant (15.36cm) and root length (5.63). On the other hand, significant differences were also noted on the fresh weight of leaf (6.42g), dry weight of leaf (1.93g) and root diameter (1.66cm).

KEYWORDS

• Organic manure • Randomized • Vermicompost • Jeevamrutha • FYM • Biostimulant

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INTRODUCTION

Lettuce is one of the most significant leafy vegetable which belongs to Asteraceae or Compositae family having chromosome number $2n = 18$. Lettuce originated in the Mediterranean region. It is known as a major salad crop, therefore is commonly found in salad mixture and sandwiches. The leaf of lettuce is known to be the most commonly used part of lettuce, but in countries like China and Egypt stems of lettuce are also eaten very commonly by cooking, pickling, drying or raw as it is (Bhatta, 2022). Lettuce is usually consumed as a salad or shredded in a salad mix of onion, tomato, cheese and basil. It is usually used as salad with tomato, carrot, cucumber or other salad vegetables (Ullah, 2017). Lettuce cultivated in ancient Egypt. Earlier, Europe and North America were the leading producers of lettuce; however, since the late 20th century, lettuce's production and consumption had spread throughout the world. In present, China is the leading producer of lettuce in the World, followed by the USA and India ranks 3rd in commercial production of lettuce, occupying 4% of the World's total production (Sawat, 2023). It is popular for its delicate, crispy, texture slightly bitter taste as fresh condition. It is mainly a cold loving crop that grows well in day temperature of 18 to 25°C and the night temperature of 10 to 15°C (Ullah, 2017). Colorful lettuce types have increased in recent years and darker lettuce types (romaine, green leaf and red leaf) were reported to be better sources for vitamin A, niacin, riboflavin, thiamine, Ca, Fe, K, Mn, Se and beta-carotene. (Lasco, 2020). It contains selenium, an antioxidant that has a medicinal property in prevention of certain type of cancers, colon and lungs. It contains many necessary amino acids for the formation of the proteins, alanine, and necessary for the construction of muscular and nervous tissues (Anilakumar, 2017).

Organic agriculture plays a significant role in promoting environmental sustainability by reducing chemical pollution, enhance soil health, biodiversity conservation etc. The growth of organic agriculture reflects increasing consumers demand for environmentally sustainable and healthy food options. The continuous use of chemical fertilizers and pesticides in the cultivation of horticulture crops have caused decreased soil fertility physical and chemical properties of soil. Therefore,

the application of plant nutrients through organic sources like FYM, vermicompost jeevamrutha and biostimulant becomes an alternate choice for maintaining sustainability production. Farmyard manure when applied to the soil it improves soil structure, enhances water retention, and provides a slow-release source of nutrients that benefit plant growth. Additionally, it encourages the growth of beneficial microorganisms in the soil, promoting a healthier and more balanced ecosystem (Indira, 2023). Vermicompost is an organic soil amendment produced from the decomposition of organic matter, such as, food wastes and animal manure, by earthworms and microorganisms which improve physical, chemical and biological properties of the soil (Paymaneh *et al.*, 2023). Application of jeevamrutha which is liquid organic manure is an excellent source of natural carbon and biomass that contain macro and micro nutrients required by crops. In compare to other forms of manures the product of organic liquid fertilizer is meant for the fermentation of process, which constitute efficient living soil microorganism that improves the plant growth, productivity and supply sufficient amount of nutrients (Kumar, 2021). Biostimulants are natural or synthetic substances that can be applied to seeds, plants, and the soil. These substances cause changes in vital and structural processes in order to influence plant growth through improved tolerance to abiotic stresses and increase seed and /or grain yield and quality (Vasconcelos, 2019).

MATERIALS AND METHOD

The field experiment was conducted at Horticulture Research Block, School of Agricultural Sciences, Shri Guru Ram Rai University, Pathri Bagh, Dehradun, Uttarakhand during the rabi season of 2022-23. The experiment was laid out in Randomized Block Design (RBD) and replicated thrice. Total ten treatments were tried namely T_1 (control), T_2 (FYM@20t/ha), T_3 (Vermicompost@5t/ha), T_4 (Jeevamrutha@100%), T_5 (Biostimulant @3%), T_6 (FYM @20t/ha + Vermicompost@5t/ha), T_7 (Vermicompost@5t/ha + Jeevamrutha@100%), T_8 (FYM@20t/ha + Biostimulant@3%), T_9 (FYM@10t/ha + Vermicompost@2.5t/ha + Jeevamrutha @50% + Biostimulant @1.5%) and T_{10} (FYM @ 20t/ha + Vermicompost @ 5t/ha + Jeevamrutha @100% + Biostimulant

@3%). The soil of the research field was clay loam. It was fairly rich in organic matter and had good water holding capacity. The lettuce cultivar chosen for research purpose was "Ice Berg Salista". Organic manures i.e., FYM, vermicompost jeevamrutha and biostimulant i.e seaweed extract were incorporated in experimental field as per the treatments at the time of final field preparation. The seed were sown directly in the field on 18/11/2022. All the cultural practices were done at regular intervals as per the requirement of crop during the course of research work. During the experimentation, from each replication, three plants were randomly selected and used for recording various observations on growth promoting parameters during the cropping period at 40DAS, 60DAS and at final harvest.

Table 1: Treatment Details

No. of Treatments	Combinations	Concentration
T ₁	Control	-
T ₂	FYM	20t/ha
T ₃	Vermicompost	5t/ha
T ₄	Jeevamrutha	100%
T ₅	Biostimulant	3%
T ₆	FYM + Vermicompost	20t/ha + 5t/ha
T ₇	Vermicompost + Jeevamrutha	5t/ha + 100%
T ₈	FYM + Biostimulant	20t/ha + 3%
T ₉	FYM + Vermicompost + Jeevamrutha + Biostimulant	10t/ha + 2.5t/ha + 50% + 1.5%
T ₁₀	FYM + Vermicompost+ Jeevamrutha + Biostimulant	20t/ha + 5t/ha + 100% + 3%

RESULT AND DISCUSSION

The various growth parameters viz. plant height (cm), number of leaves per plant, leaf length (cm), leaf width (cm), petiole length (cm), total fresh weight of leaves per plant (g) and total dry weight of leaves per plant (g) were significantly influenced by different doses of solid and liquid organic manures as compared to control during the course of investigation. The data presented in Table 1, 2 and 3 showed that the significant

improvement was noticed when applied different combinations of organic manures on lettuce economics as compared to control. The findings of the investigation were recorded and are thoroughly discussed below:

Plant height (cm)

The observation of plant height, recorded at 40, 60 DAS and at Final harvest was presented in Table 2 and Figure 1 revealed significant differences among the treatments. At 40 DAS the maximum plant height was recorded in treatment T₃ (7.14cm) and it was at par with T₅ (7.10cm) and T₆ (7.05cm). However, significant differences were observed in treatment T₉ (6.99cm), T₈ (6.97cm), T₇ (6.91cm), T₄ (6.90cm), T₂ (6.86cm) and T₁₀ (6.68cm). The minimum plant height (6.22cm) was recorded under the treatment T₁ (control). At 60 DAS the maximum plants height was obtained in treatments T₂ (9.63cm), which was at par with treatment T₁₀ (9.38cm) and T₉ (9.37cm). The significant difference was recorded with treatment T₆ (9.36cm), T₃ (9.36cm), T₄ (9.34cm), T₅ (9.24cm), T₇ (9.16cm) and T₈ (9.11cm). The minimum plant height treatment T₁ (9.000cm) was recorded under control condition. At final harvest, the plant height was maximum in T₆ (14.80cm) which was comparable with T₂ (14.43cm) and T₃ (14.30cm). However, significant difference was observed with treatment T₈ (14.26cm), T₇ (14.13cm), T₄ (14.06cm), T₁₀ (14.03cm), T₅ (13.66cm) and T₉ (13.30cm) while, minimum plant height was obtained in the treatment T₁ (12.86cm) under control condition. This variation might be due organics which increases the availability of all the nutrients to the plant. The results are in line with the findings of (Durak *et al.* 2017).

Number of leaves

The observation of number of leaves, recorded at 40, 60 DAS and at Final harvest was presented in Table 2 and Figure 2 revealed significant differences among the treatments. At 40 days after sowing, the highest no. of leaves of lettuce was recorded in treatment T₅ (16.20cm) and it was at par with T₉ (15.96), T₃ (15.06) and T₆ (15.06) however, significant differences were observed in treatments T₄ (14.73), T₈ (14.50), T₂ (14.16), T₁₀ (13.53) and T₇ (13.40). The minimum number of leaves (12.73) was recorded under the treatment T₁. In case of 60 days after sowing, the maximum number of leaves was obtained in treatments

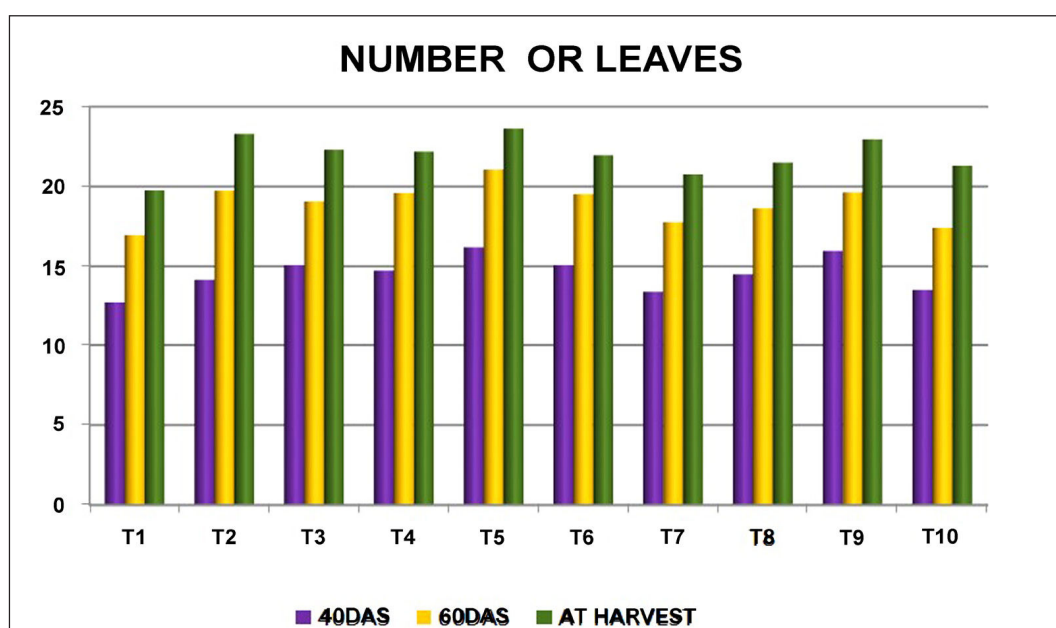
Table 2: Effect of organic manures on plant height, number of leaves, leaf width and leaf length of lettuce at different harvest interval

Treatment	Plant height (cm)			Number of leaves			Leaf width (cm)			Leaf length (cm)		
	40DAS	60DAS	At final harvest	40DAS	60DAS	At final harvest	40DAS	60DAS	At final harvest	40DAS	60DAS	At final harvest
T ₁	6.22	9.00	12.86	12.73	16.96	19.76	12.73	7.03	11.49	4.48	6.45	12.07
T ₂	6.87	9.63	14.43	14.16	19.73	23.30	14.16	7.60	12.76	4.65	6.83	12.86
T ₃	7.14	9.36	14.30	15.06	19.06	22.30	15.06	7.08	12.83	4.76	6.77	12.76
T ₄	6.90	9.34	14.06	14.73	19.60	22.20	14.73	7.39	13.22	5.03	7.37	13.63
T ₅	7.10	9.24	13.66	16.20	21.06	23.63	16.20	7.28	12.54	4.88	6.70	14.10
T ₆	7.05	9.36	14.80	15.06	19.53	21.96	15.06	7.77	15.12	4.88	7.54	13.73
T ₇	6.91	9.16	14.13	13.40	17.76	20.76	13.40	7.20	12.98	4.62	6.87	13.66
T ₈	6.97	9.11	14.26	14.50	18.63	21.50	14.50	7.19	12.80	4.92	6.98	13.29
T ₉	6.99	9.37	13.30	15.96	19.63	22.96	15.96	7.26	13.29	4.97	7.55	12.87
T ₁₀	6.68	9.38	14.03	13.53	17.40	21.30	13.53	7.49	13.58	4.58	7.16	13.06
CD _(5%)	0.31	NA	NA	NA	NA	NA	0.379	NA	1.566	NA	NA	NA
SE (m)	0.10	0.22	0.43	0.98	1.18	1.22	0.13	0.16	0.52	0.14	0.24	0.42
SE (d)	0.15	0.31	0.62	1.38	1.67	1.73	0.18	0.22	0.74	0.19	0.35	0.59
C.V. (%)	2.63	2.13	3.44	3.66	3.79	2.66	3.51	3.70	2.93	2.09	2.05	3.53



T₁ Control T₂ FYM (20t/ha) T₃ VC (5t/ha) T₄ Jeevamrutha (100%)
 T₅ Biostimulant (3%) T₆ FYM (20t/ha) + VC (5t/ha)
 T₇ VC (5t/ha) + Jeevamrutha (100%)
 T₈ FYM (20t/ha) + Biostimulant (3%)
 T₉ FYM (10t/ha) + VC (2.5 t/ha) + Jeevamrutha (50%) + Biostimulant (1.5%)
 T₁₀ FYM (20t/ha) + VC (5t/ha) + Jeevamrutha (100%) + Biostimulant (3%)

Figure 1: The effect of various organic manures treatment on plant height (cm) of lettuce at different harvest interval



T₁ Control T₂ FYM (20t/ha) T₃ VC (5t/ha) T₄ Jeevamrutha (100%)
 T₅ Biostimulant (3%) T₆ FYM (20t/ha) + VC (5t/ha)
 T₇ VC (5t/ha) + Jeevamrutha (100%)
 T₈ FYM (20t/ha) + Biostimulant (3%)
 T₉ FYM (10t/ha) + VC (2.5 t/ha) + Jeevamrutha (50%) + Biostimulant (1.5%)
 T₁₀ FYM (20t/ha) + VC (5t/ha) + Jeevamrutha (100%) + Biostimulant (3%)

Figure 2: The effect of various organic manures treatment on number of leaves of lettuce at different harvest interval

T₅ (21.06), which were at par with the treatments T₂ (19.73), T₉ (19.63) and T₄ (19.600). The significant difference was observed with treatment T₆ (19.53), T₃ (19.06), T₈ (18.63cm), T₇ (17.76) and T₁₀ (17.40). The minimum number of leaves (16.96) was recorded under the treatment T₁ (control). At final harvest, the number of leaves was maximum in T₅ (23.63) which was comparable with T₂ (23.30) and T₉ (22.96) however, significant difference was observed with treatment T₃ (22.30), T₄ (22.20), T₆ (21.96), T₈ (21.50), T₁₀ (21.30) and T₇ (20.76) while, minimum number of leaves was obtained in the treatment T₁ (19.76). This might due to inducing an enhancement of photosynthetic activity in the early phase of growth, thus supplying carbon skeletons useful for increasing the number of leaves and their efficiency and the findings were supported with (Carillo *et al.*, 2022).

Leaf width (cm)

The observation of leaf width, recorded at 40, 60 DAS and at Final harvest was presented in Table 2 and Figure 3 revealed significant

differences among the treatments. At 40 days after sowing, the highest value of leaf width of lettuce was recorded in treatment T₃ and T₄ (4.32cm) and the lowest value (3.58cm) of leaf width was recorded under control condition i.e treatment T₁. At 60 days after sowing, the maximum number of leaf width was obtained in treatments T₆ (7.77cm), which were at par with the treatments T₂ (7.60cm) and T₁₀ (7.49cm). The significant difference was observed with treatment T₄ (7.39cm), T₅ (7.28cm), T₉ (7.26cm), T₇ (7.20cm), T₈ (7.19cm) and T₃ (7.08cm). The minimum leaf width (7.03cm) was recorded under the treatment T₁. At final harvest, the leaf width was maximum in T₆ (15.12cm) which was comparable with T₁₀ (13.58cm), T₉ (13.29cm) and T₄ (13.22cm) however, significant difference was observed with treatment T₇ (12.98cm), T₃ (12.83cm), T₈ (12.80cm), T₂ (12.76cm) and T₅ (12.54cm) while, minimum leaf width was obtained in the treatment T₁ (11.49cm). The increasing activity of cytokinin hormone will enlarge the leaf width and similar findings were obtained by (Adiloglu *et al.* 2018).

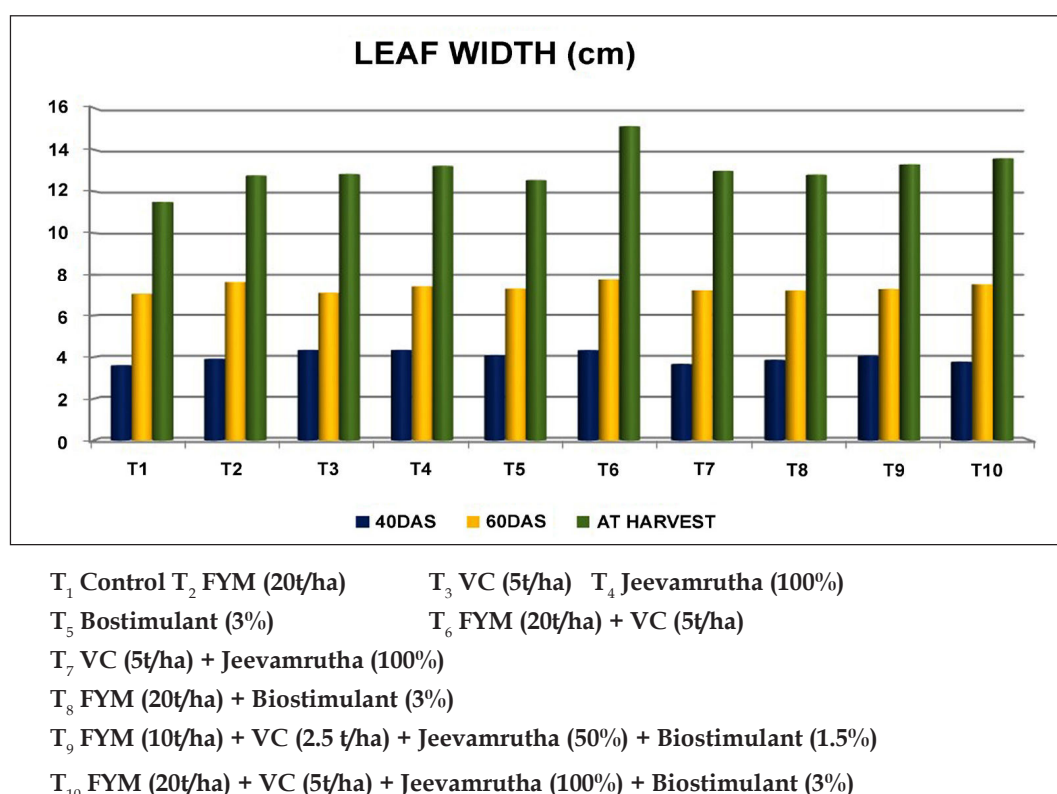


Figure 3: The effect of various organic manures treatment on leaf width (cm) of lettuce at different harvest interval

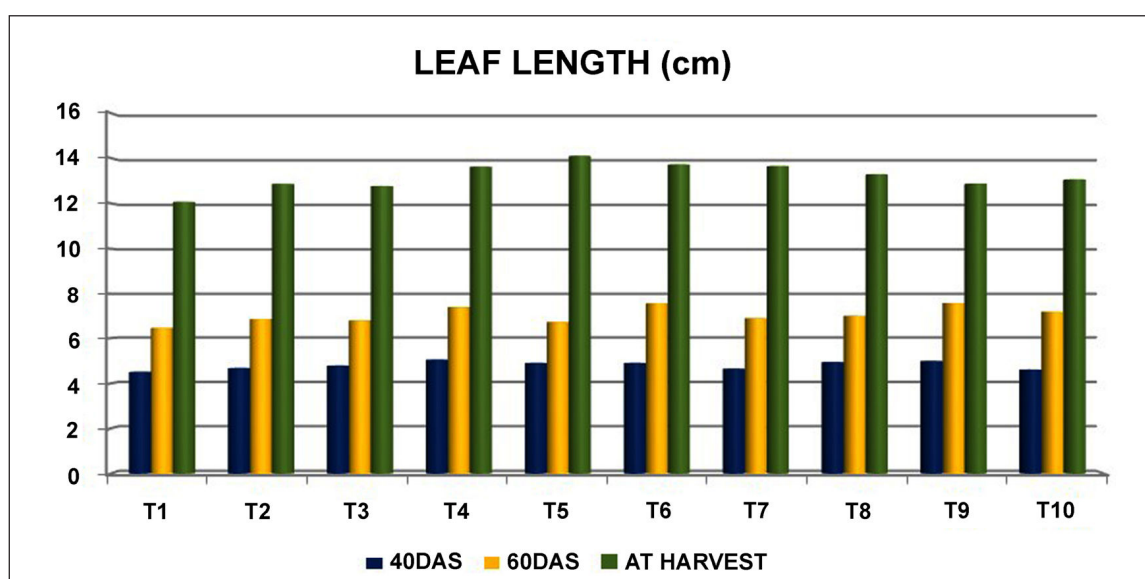
Leaf length (cm)

The observation of leaf length, recorded at 40, 60 DAS and at Final harvest was presented in Table 2 and Figure 4 revealed significant differences among the treatments. At 40 DAS, the highest value of leaf length of lettuce was recorded in treatment T₄ (4.88cm) and the lowest value (4.48cm) of leaf length was recorded under the treatment T₁ (control). At 60 DAS, the maximum number of leaf length was obtained in treatments T₉ (7.55cm), which were at par with the treatments T₆ (7.54cm), T₄ (7.37cm) and T₁₀ (7.16cm). The significant difference was observed with treatment T₈ (6.98cm), T₇ (6.87cm), T₂ (6.830cm), T₃ (6.77cm) and T₅ (6.70cm). The minimum leaf length (6.45cm) was recorded under the treatment T₁ (control). At final harvest, the maximum number of leaf length was obtained in treatments T₅ (14.10cm), which were at par with the treatments T₆ (13.73cm), T₇ (13.66cm), T₄ (13.63cm), T₈ (13.29cm) and T₁₀ (13.06cm). The significant difference was observed with treatment T₉ (12.87cm), T₂ (12.86cm) and T₃ (12.76cm). The minimum leaf length was recorded in the treatment T₁ (12.07cm) under control condition. Organic manures are good source of various macro and micro elements

which may have resulted in longer leaf length and also the application enhance leaf length by increasing auxin and hormone synthesis. Similar results were reported by (Ovali *et al.* 2024).

Petiole length (cm)

The observation of petiole length, recorded at 40, 60 DAS and at final harvest was presented in Table 3 and Figure 5 revealed significant differences among the treatments. At 40 DAS, the highest value of petiole length of lettuce was recorded in treatment T₃ (1.28cm) which were at par with the treatments T₄ (1.24cm), T₂ (1.19cm), T₇ (1.16cm) and T₉ (1.15cm). The significant difference was observed with treatment T₅ (1.14cm), T₆ (1.13cm), T₁₀ (1.12cm) and T₈ (1.11cm) and the lowest value of petiole length was recorded in the treatment T₁ (1.09cm) under control condition. At 60 DAS, the maximum number of petiole length was obtained in treatments T₃ (1.64cm), which were at par with the treatments T₄ (1.54cm), T₂ (1.49cm), T₉ (1.46cm) and T₈ (1.41cm). The significant difference was observed with treatment T₁₀ (1.38cm), T₅ (1.37cm), T₇ (1.35cm) and T₆ (1.32cm). The minimum petiole length (1.31cm) was recorded under the treatment T₁. At final harvest, the maximum number of

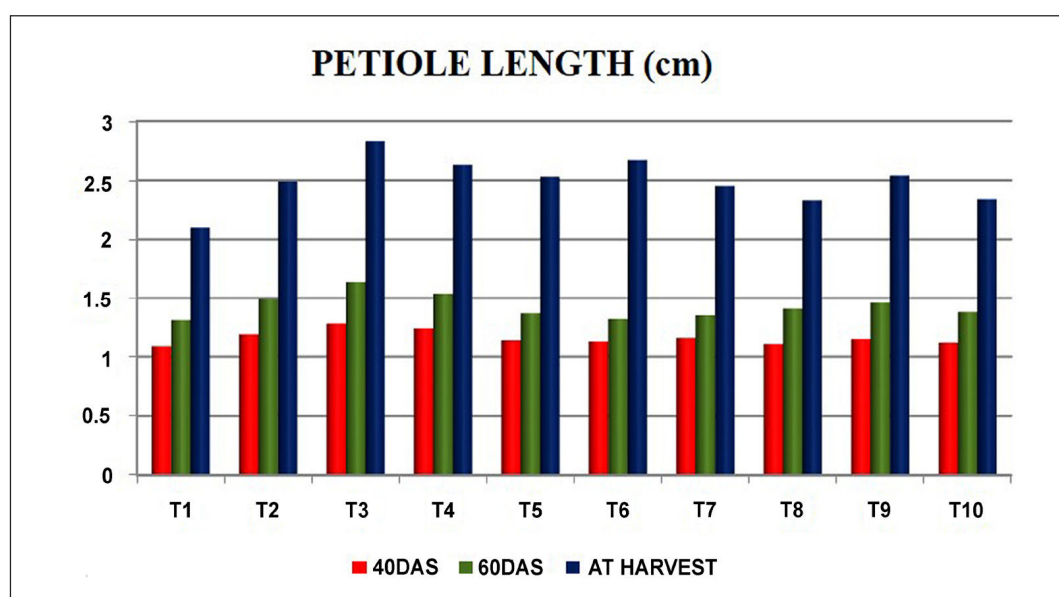


T₁ Control T₂ FYM (20t/ha) T₃ VC (5t/ha) T₄ Jeevamrutha (100%)
T₅ Bostimulant (3%) T₆ FYM (20t/ha) + VC (5t/ha)
T₇ VC (5t/ha) + Jeevamrutha (100%)
T₈ FYM (20t/ha) + Biostimulant (3%)
T₉ FYM (10t/ha) + VC (2.5 t/ha) + Jeevamrutha (50%) + Biostimulant (1.5%)
T₁₀ FYM (20t/ha) + VC (5t/ha) + Jeevamrutha (100%) + Biostimulant (3%)

Figure 4: The effect of various organic manures treatment on leaf length (cm) of lettuce at different harvest interval

Table 3: Effect of organic manures on petiole length, moisture percentage of leaf, fresh weight of leaf and dry weight of leaf of lettuce at different harvest interval

Treatment	Petiole length (cm)			Fresh weight of leaf (g)			Dry weight of leaf (g)		
	40DAS	60DAS	At final harvest	40DAS	60DAS	At final harvest	40DAS	60DAS	At final harvest
T ₁	1.09	1.31	2.10	1.14	3.13	4.77	0.83	1.23	1.43
T ₂	1.19	1.49	2.49	1.14	3.61	6.07	1.13	1.50	1.76
T ₃	1.28	1.64	2.83	1.18	3.32	4.97	1.03	1.40	1.56
T ₄	1.24	1.54	2.63	1.19	3.72	6.42	1.13	1.53	1.93
T ₅	1.14	1.37	2.53	1.24	3.27	5.36	0.86	1.30	1.63
T ₆	1.13	1.32	2.67	1.26	3.84	6.45	1.16	1.56	1.96
T ₇	1.16	1.35	2.45	1.26	3.31	6.08	1.10	1.36	1.80
T ₈	1.11	1.41	2.33	1.28	3.29	4.97	0.96	1.33	1.46
T ₉	1.15	1.46	2.54	1.29	3.58	6.02	1.16	1.46	1.73
T ₁₀	1.12	1.38	2.34	1.27	3.54	6.09	1.06	1.43	1.86
CD _(5%)	NA	0.19	NA	0.06	NA	NA	0.18	0.17	NA
SE (m)	0.05	0.07	0.15	0.02	0.22	0.59	0.06	0.06	0.16
SE (d)	0.07	0.09	0.22	0.03	0.32	0.83	0.08	0.08	0.22
C.V. (%)	4.11	7.94	1.69	2.86	1.24	7.83	3.75	6.96	5.96



T₁ Control T₂ FYM (20t/ha)

T₃ VC (5t/ha) T₄ Jeevamrutha (100%)

T₅ Biostimulant (3%)

T₆ FYM (20t/ha) + VC (5t/ha)

T₇ VC (5t/ha) + Jeevamrutha (100%)

T₈ FYM (20t/ha) + Biostimulant (3%)

T₉ FYM (10t/ha) + VC (2.5 t/ha) + Jeevamrutha (50%) + Biostimulant (1.5%)

T₁₀ FYM (20t/ha) + VC (5t/ha) + Jeevamrutha (100%) + Biostimulant (3%)

Figure 5: The effect of various organic manures treatment on petiole length (cm) of lettuce at different harvest interval

petiole length was obtained in treatments T₃ (2.83cm), which were at par with the treatments T₆ (2.67cm), T₄ (2.63cm), T₉ (2.54cm), T₅ (2.53cm) and T₂ (2.49cm). The significant difference was observed with treatment T₇ (2.45cm), T₁₀ (2.34cm) and T₈ (2.33cm). The minimum petiole length (2.10cm) was recorded under the treatment T₁.

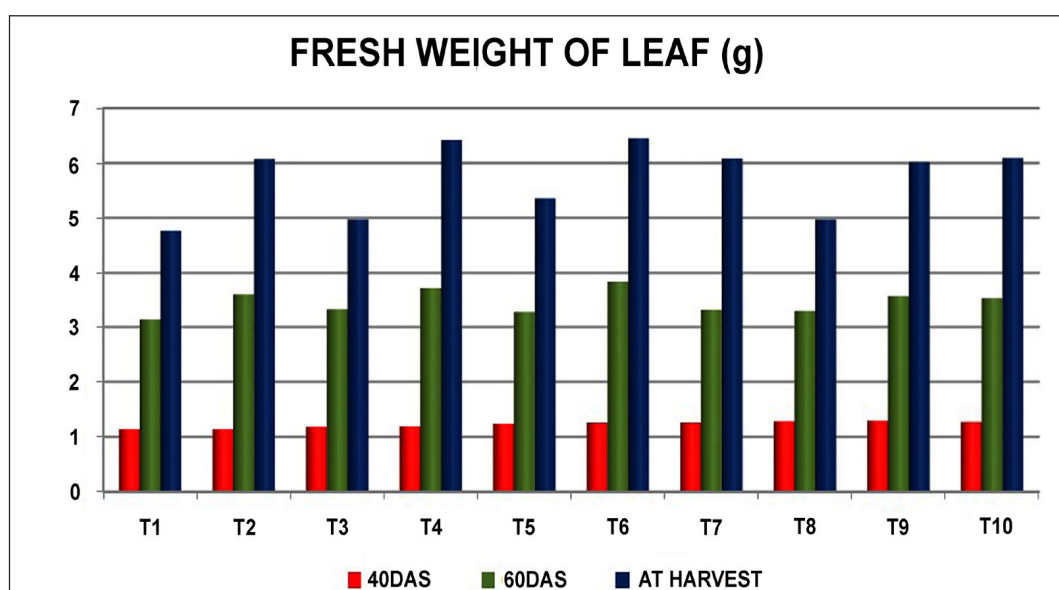
Fresh weight of leaf (g)

The observation of fresh weight of leaf, recorded at 40, 60 DAS and at final harvest was presented in Table 3 and Figure 6 revealed significant differences among the treatments. At 40DAS, the highest value of fresh weight of leaf of lettuce was recorded in treatment T₉ (1.29g) and the lowest value (1.14 g) of fresh weight of leaf was recorded under the treatment T₂ and T₁ (control). At 60 DAS, the maximum number of fresh weight of leaf was obtained in treatments T₆ (3.84g), which were at par with the treatments T₄ (3.72g), T₂ (3.61g), T₉ (3.58g) and T₁₀ (3.54g). The significant difference was observed with treatment T₃ (3.32g), T₇ (3.31g), T₈ (3.29g) and T₅ (3.27g). The minimum fresh weight of leaf was recorded in treatment T₁ (3.13g) under the control condition. At

final harvest, the maximum number of fresh weight of leaf was obtained in treatments T₆ (6.45g), which were at par with the treatments T₄ (6.42g), T₁₀ (6.09g), T₇ (6.08g), T₂ (6.07g) and T₉ (6.02g). The significant difference was observed with treatment T₅ (5.36g), T₃ (4.97g) and T₈ (4.97g). The minimum fresh weight of leaf was recorded in treatment T₁ (4.77g) under the control condition. There was a significant interaction between the organic compost dosages and the successive crop for fresh weight of leaf. This result is supported by (E. De Castro Paes *et al.* 2022).

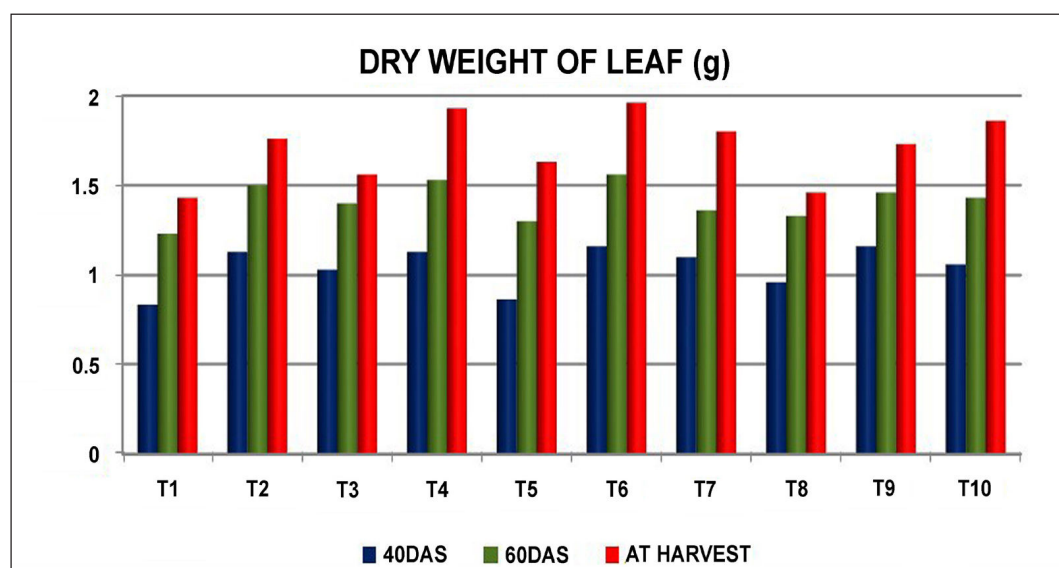
Dry weight of leaf (g)

The observation of fresh weight of leaf, recorded at 40, 60 DAS and at final harvest was presented in Table 3 and Figure 7 revealed significant differences among the treatments. At 40 days after sowing, the highest value of dry weight of leaf of lettuce was recorded in treatment T₉ (1.16g) and the lowest value (0.83g) of dry weight of leaf was recorded under the treatment T₁ (control). At 60 DAS, the maximum number of dry weight of leaf was obtained in treatments T₆ (1.56g), which were at par with the treatments T₄ (1.53g), T₂



T₁ Control T₂ FYM (20t/ha) T₃ VC (5t/ha) T₄ Jeevamrutha (100%)
 T₅ Biostimulant (3%) T₆ FYM (20t/ha) + VC (5t/ha)
 T₇ VC (5t/ha) + Jeevamrutha (100%)
 T₈ FYM (20t/ha) + Biostimulant (3%)
 T₉ FYM (10t/ha) + VC (2.5 t/ha) + Jeevamrutha (50%) + Biostimulant (1.5%)
 T₁₀ FYM (20t/ha) + VC (5t/ha) + Jeevamrutha (100%) + Biostimulant (3%)

Figure 6: The effect of various organic manures treatment on fresh weight of leaf (g) of lettuce at different harvest interval



T₁ Control T₂ FYM (20t/ha) T₃ VC (5t/ha) T₄ Jeevamrutha (100%)
 T₅ Biostimulant (3%) T₆ FYM (20t/ha) + VC (5t/ha)
 T₇ VC (5t/ha) + Jeevamrutha (100%)
 T₈ FYM (20t/ha) + Biostimulant (3%)
 T₉ FYM (10t/ha) + VC (2.5 t/ha) + Jeevamrutha (50%) + Biostimulant (1.5%)
 T₁₀ FYM (20t/ha) + VC (5t/ha) + Jeevamrutha (100%) + Biostimulant (3%)

Figure 7: The effect of various organic manures treatment on dry weight of leaf (g) of lettuce at different harvest interval

(1.50g), T₉ (1.46g) and T₁₀ (1.43g). The significant difference was observed with treatment T₃ (1.40g), T₇ (1.36g), T₈ (1.33g) and T₅ (1.30g). The minimum dry weight of leaf (1.23g) was recorded under the treatment T₁. At final harvest at par with the treatments T₄ (1.93g), T₁₀ (1.86g), T₇ (1.80g), T₂ (1.76g) and T₉ (1.73g). The significant difference was observed with treatment T₅ (1.63g), T₃ (1.56g) and T₈ (1.46g). The minimum dry weight of leaf was recorded in treatment T₁ (1.43g) under the control condition. The probable reasons for enhanced dry weight of leaf might be due to planting lettuce in clay soil may be ascribed to clay soils holds maximum moisture per unit volume and provides moisture for plant growth. Similar findings were obtained (E. De Castro Paes *et al.* 2022).

CONCLUSION

On the basis of present experimental research on "Effect of multiple organic manure on growth of lettuce (*Lactuca sativa* L.) under low hills of Uttarakhand" in cultivar Ice berg Salista, it can be concluded that among different organic manures treatments, the combination of (FYM @20 t/ha + Vermicompost @5t/ha) i.e. treatment T₆ was found to be most effective for increasing plant height, leaf width, fresh weight of leaf and dry weight of leaf.

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