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Assessment of Different Fertilizer Treatments on Growth and Yield of African Marigold Variety Calcuttia Single Without Pinching Operation in Rampur, Chitwan

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Abstract: The research was conducted to assess the impact of various organic and inorganic fertilizers on the growth and yield of Marigold (*Tagetes erecta L.)* var. Calcuttia Single using a randomized complete block design with eight treatments including vermicompost, farmyard manure, poultry manure, charcoal, NPK fertilizer, and their combinations in triplicates. Measurements of vegetative and reproductive parameters were recorded at 35, 55 and 85 DAT. Results revealed that compared to the control, poultry manure and vermicompost, singly or combined with NPK, significantly enhanced both vegetative and reproductive traits. Poultry manure resulted in the tallest plants (126.21 cm), the highest number of branches (29.93), and the largest flowers (14.11 cm diameter), with the earliest flowering (51.33 days). Vermicompost showed effectiveness in plant height (117.37 cm), number of branches (28.80), plant spread (81.43 cm) and flower number (40.47). The control plot exhibited the least effectiveness in all parameters. These findings highlight the significant role of organic fertilizers in enhancing the growth and yield of Marigold (*Tagetes erecta* L.) var. Calcuttia Single.

1 Introduction

Marigold (*Tagetes spp*.) are bright orange colored and one of the widely popular commercial flowers among Nepali farmers and consumers. In Nepal, the floriculture sector including marigold contributes 0.05% of the total national GDP (Dangi et al 2019); they are locally known as "sayapatri". Their vibrant yellow and orange blossoms are an integral part of Nepali culture since they are easy to cultivate, fast-growing and drought-tolerant as well as being affordable and omnipresent flowers. There are mainly two common species of Marigold popular in Nepal; French marigold (*Tagetes patula* L.) and African marigold (*Tagetes erecta* L.) (Lalit et al 2020). They are originated from South and Central America, especially Mexico (Singh et al 2019) and belong to the Asteraceae family. Marigolds are often used in garlands, ceremonies, festivals and religious occussions. Both the leaves and flowers of marigold have antiseptic, anti-inflammatory and wound-healing properties.

Marigolds are major sources of bioactive compounds with antioxidant and antidiabetic effects (Parklak et al 2023). They are ingredients in many ointments, lotions and tinctures that are administered directly to the skin and have long been used as topical treatments for skin conditions (Melnyk et al 2022).

Floriculture is one of the emerging sector for the commercial production and sale of flowers in Nepal with a 24% annual growth rate in flower output. Marigold is currently cultivated for commercial purposes in 32 districts across the country, covering a total land area of 157 hectares (Mehta et al 2022). Despite the extensive research conducted on fertilizers and their influence on the growth and yield of plants, there is a noticeable gap in the literature when it comes to specifically assessing the impact of different fertilizer treatments on the growth and yield of Marigold var. Calcuttia Single without implementing pinching practices. Pinching is a common technique in horticulture involving the removal of terminal buds to stimulate lateral branching and enhance flower bud production. This research intends to bridge this gap by systematically evaluating the effects of various fertilizer treatments on the growth and yield of Marigold var. Calcuttia Single without pinching the terminal buds.

Both organic and inorganic fertilizers play a crucial role in enhancing the growth and yield of marigold plants. Organic fertilizers such as compost and manure are essential as they gradually release nutrients into the soil over some time (Nardi et al 2002). This slow release of nutrients ensures a consistent and steady development of the plants. On the other hand, inorganic fertilizers containing optimal levels of potassium, phosphate and nitrogen provide these vital nutrients in easily absorption forms (Marschner 2012). This immediate availability of nutrients enables the plants to fully mature and produce abundant flowers. The combination of slow nutrient supply from organic fertilizers and fast nutrient delivery from chemical fertilizers nourishes all stages of marigold growth and enhances yields. This study intends to explore the best fertilizer treatments and their combination for the maximum growth and yield of marigold plants without pinching operations.

2 Materials and Methods

2.1 Experimental Site

The experiment was conducted at the research field of Agriculture and Forestry University (AFU), Rampur, Chitwan, Nepal. The study site is located 228 meters above mean sea level at latitudes 27° 37´ N and 84° 25´ E. The soil acidity was slightly acidic while its texture was sandy loam. The experimental site is shown in **Fig 1**. The maximum and minimum temperature along with rainfall of the experimental site during the planting period are shown in **Fig 2**.

2.2 Experimental Design and Treatment

The experiment was conducted using French Marigold var. Calcuttia Single. A single-factorial randomised complete block design (RCBD) with three replications and eight treatments was applied. Three blocks, each comprising eight plots, have been developed out of the overall experimental plot. Five rows of plants, one for each plot, were present in the arrangement. Twenty-five plants were maintained per plot. Five plants were sampled in the middle of the plot. The plot-to-plot distance was 100 cm and the plot-to-block distance was 50 cm. Each plot has an area of 4 m^2. The seedlings were transplanted on August 5, maintaining a spacing of 40cm X 40 cm plant to plant and row to row, respectively. The treatments used in the experiment are shown in **Table 1.**

Table 2 shows the treatment details that were used in the experiment. T1 is the control plot. T2, T3, T4 and T6 are FYM, vermicompost, poultry and charcoal based fertilizer treatments respectively; they contain a given dose of N, P and K and are added at the rate of 10 tonnes/ha. T5 is purely NPK based treatment and was broadcasted in their plots in the ratio of 200:80:80 kg/ha. Plots having treatment T7 have 50% NPK and vermicompost added at the rate of 5 tonnes/ha. Similarly, plots having T8 have 50% NPK and poultry manure added at the rate of 5 tonnes/ ha.

2.3 Land preparation and intercultural operations

The experimental plot was deep ploughed once followed by one light ploughing and well levelling. The layout of the experimental plot was performed on July 29. After transplanting marigold seedlings, irrigation

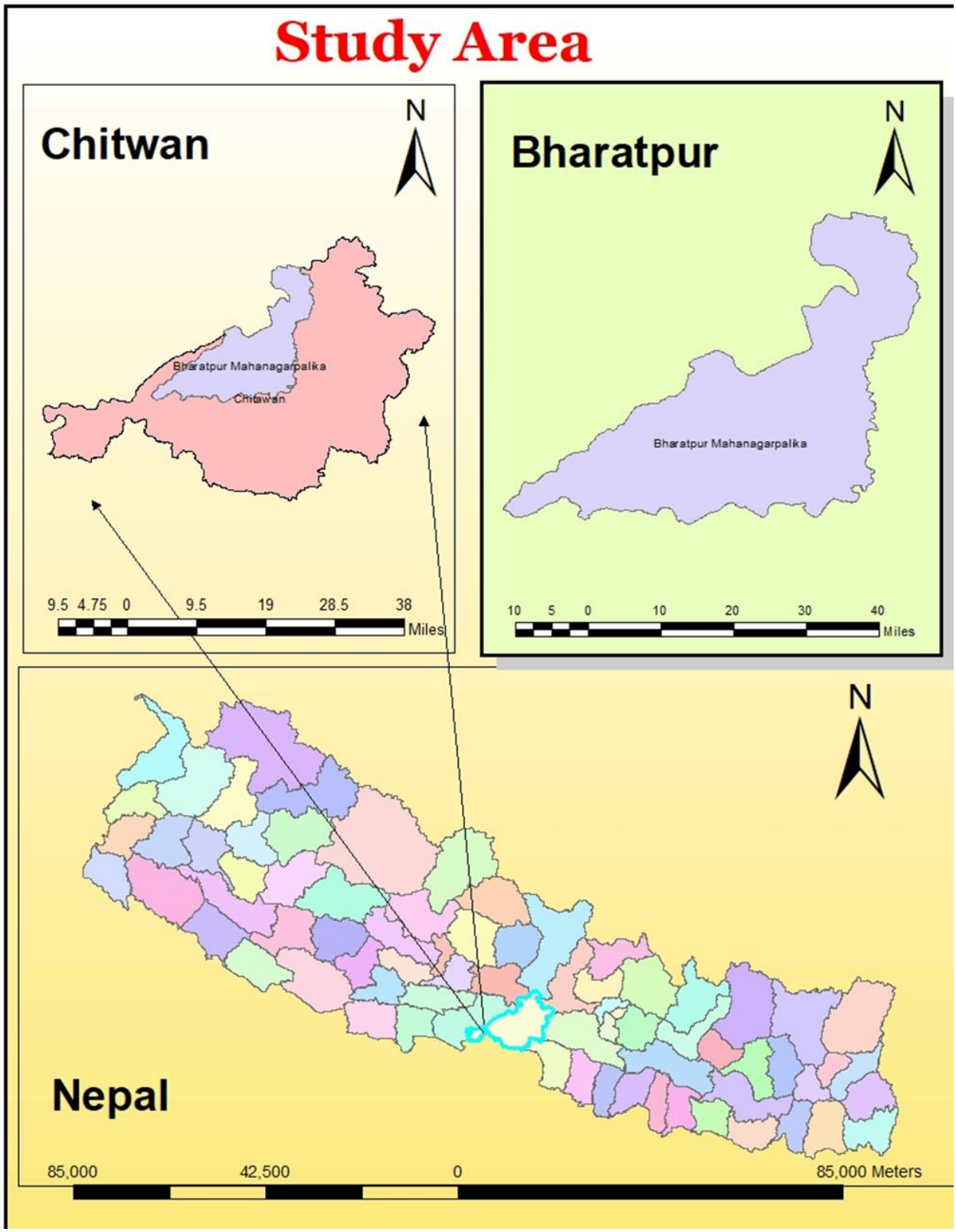

Fig 1. Map showing the experimental site

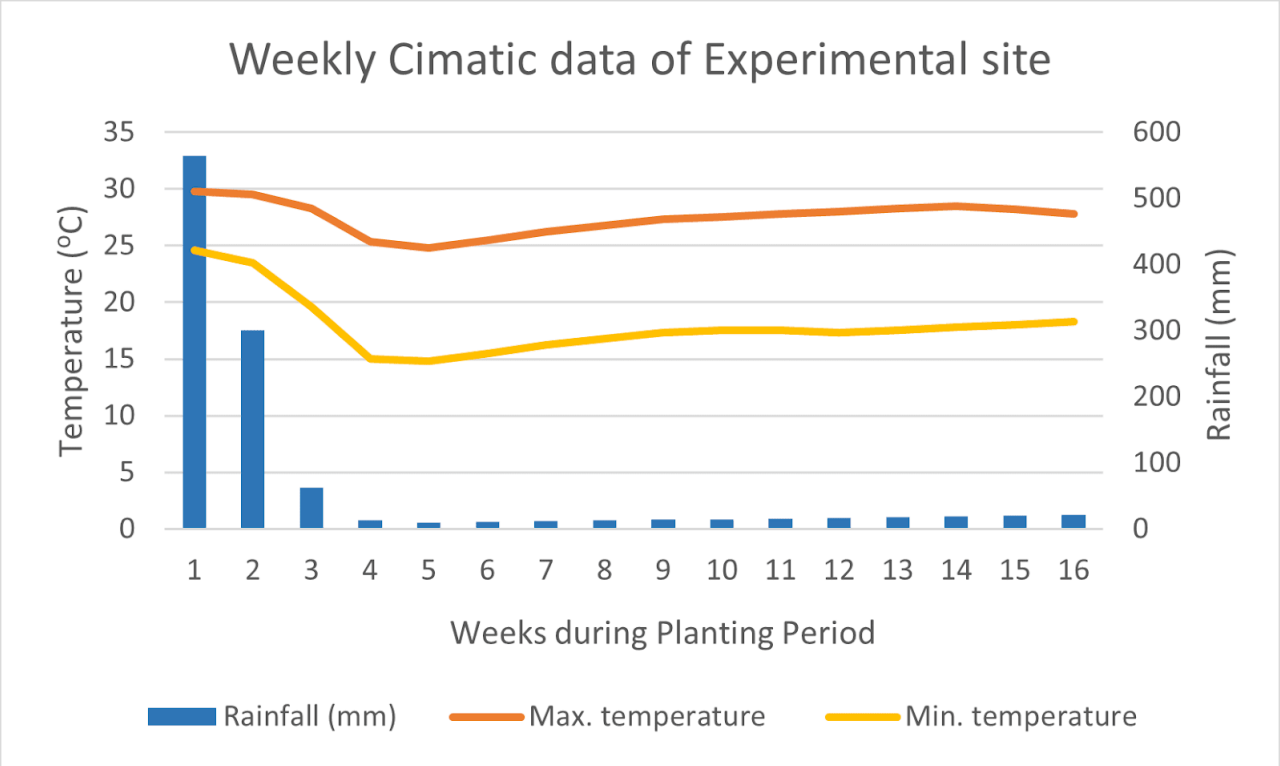

Fig 2. Weekly climatic data of experimental site during planting period

Table 1. Treatment details used in the experiment

Treatment Number	Treatment Name	Fertilizers doses(kg/plot)
T1	Controlled	0
T2	FYM	4
T3	Vermicompost	4
T4	Poultry	4
T5	NPK	80:32:32 (gm/plot)
T6	Charcoal	4
T7	50% NPK + Vermicompost	80:32:32 (gm/plot) 2
T8	50% NPK + Poultry	80:32:32 (gm/plot) 2

Table 2. Fertilizer doses in different fertilizer treatments

Treatment Number	Treatment Name	Fertilizers doses(gm/kg)		
		N	**P_2O_5**	**K_2O**
T1	Controlled	0	0	0
T2	FYM	10	6	12
T3	Vermicompost	30	10	15
T4	Poultry	30	25	15
T5	NPK	460 (in 1 kg urea)	460 (in 1 kg DAP)	600 (in 1 kg MOP)
T6	Charcoal	5.39	0.026	0.23
T7	50% NPK + Vermicompost	460 30	460 10	600 15
T8	50% NPK + Poultry	460 30	460 25	600 15

Fig 3. Leaf curiling symtoms of Tagetes erecta L.

was immediately supplied. Light irrigation was performed on alternate days for the next 15 days. Tagging and earthing up of Marigold plants were done at 6 DAT and 30 DAT respectively. Weeding of plots was carried out at the interval of 15 days. Leaf curling disease was seen in the Marigold plants 43 days after transplanting. The disease was controlled by spraying imidachloropid pesticide at a rate of 4g/15 liter. Yellow traps were used in the field after observing leaf curling symptoms (**Fig 3)** to control sap sucking insects such as whiteflies.

2.4 Data Collection and Analysis

Five plants at random were chosen from each experimental plot. Plant height (cm), number of branches, plant spread (cm), stem diameter (cm), days to first flower initiation, days to blooming, number of flowers per plant and flower diameter (cm) were among the growth and yield-related components that were observed. For basic calculations and data aggregation, Microsoft Excel was utilized. The Least Significance Difference (LSD) test was used to separate the means at the 5% level of significance to conduct a statistical analysis of the data using R-studio software.

3 Results and Discussion

3.1 Vegetative parameters

Various vegetative parameters including number of branches, plant height, diameter of stem and plant spread were measured at intervals of 35, 55 and 85 days after transplanting (DAT). We studied the effect of various inorganic and organic fertilizer treatments on influencing the overall growth of marigold plants.

3.1.1 Plant height

There was a significant effect of all fertilizer treatments on the plant height of marigold plants. At 35 DAT, the average plant height was 57.17 cm. The maximum height was found with poultry manure (62.57 cm) which is statistically similar to NPK + poultry (59.54 cm), FYM (58.66 cm), NPK (57.20 cm), NPK + vermicompost (56.93 cm) and vermicompost (56.90 cm). This was followed by charcoal (53.82 cm) which is the minimum plant height and statistically similar to that of the control (51.70 cm).

At 55 DAT, the average plant height was 81.72 cm. The maximum plant height was found with poultry manure (89.00 cm) which is statistically similar to NPK + poultry (85.46), NPK + vermicompost (83.16), and NPK (81.87). This was followed by vermicompost (80.49), FYM (78.67), charcoal (78.02) and control (77.06). The minimum plant height was found in the control (77.06 cm).

At 85 DAT (harvest), the average plant height was 112.06 cm. The maximum plant height was found with poultry manure (126.21 cm) which is statistically similar to vermicompost (117.37). This was followed by NPK + poultry (114.74) which is statistically similar to FYM (112.93), NPK (110.87) and NPK + vermicompost (110.58), followed by charcoal (102.96) which is statistically similar to control (100.80). The minimum plant height was found in the control (100.80 cm). The details are given in **Table 3.**

3.1.2 Number of branches

There was a significant effect of all fertilizer treatments on the number of branches of Marigold. At 35 DAT, the average number of branches was 18.15. The maximum branches were found in treating plants with poultry manure (21.27), which is statistically similar to NPK + poultry (19.67), NPK + vermicompost (19.07), NPK (18.67) and vermicompost (18.13). This was followed by FYM (17.47), charcoal (15.53) and control (15.47). The minimum number of branches was found on control (15.53).

At 55 DAT, the average number of branches was 24.93. The maximum number of branches was found on treating plants with poultry manure (29.00) which is statistically similar to NPK (26.47), FYM (25.73) and NPK + vermicompost (25.27). This was followed by vermicompost (24.13), NPK + Poultry (23.93) and charcoal (23.13). The minimum number of branches was found on control (21.80).

At 85 DAT (harvest), the average number of branches was 26.74. The maximum number of branches was found in treating plants with poultry manure (29.93). This was followed by vermicompost (28.80) which is statistically similar to NPK + poultry (27.80). This was further followed by NPK (26.53) which is statistically similar to NPK + vermicompost (26.47) and FYM (25.87), followed by charcoal (25.27). The minimum number of branches was found in control (23.27). The details are given in **Table 4.**

Table 3. Effects of different fertilizer treatments on plant height in different interval of time

Treatment	Plant height (cm)		
	35 DAT	**55 DAT**	**85 DAT (at harvest)**
T1: Controlled	51.70^{c}	77.06^{c}	100.80^{d}
T2: FYM	58.66^{ab}	78.67^{bc}	112.93^{bc}
T3: Vermicompost	56.90^{abc}	80.49^{bc}	117.37^{ab}
T4: Poultry	62.57^{a}	89.00^{a}	126.21^{a}
T5: NPK	57.20^{abc}	81.87^{abc}	110.87^{bcd}
T6: Charcoal	53.82^{bc}	78.02^{bc}	102.96^{cd}
T7: NPK+Vermicompost	56.93^{abc}	83.16^{abc}	110.58^{bcd}
T8: NPK+Poultry	59.54^{ab}	85.46^{ab}	114.74^{b}
SEM(±)	1.08	1.42	1.98
LSD(0.05)	5.63	7.35	10.28
CV(%)	5.69	5.20	5.30
F-test	**	*	**
Grand Mean	57.165	81.718	112.06

Means within the column followed by the same letter are not significantly different at the 5% level of significance by DMRT. ns: non-significant, *Significant at 5% ($p<0.05$), ** significant at 1% ($p<0.01$) and *** significant at 0.1% ($p< 0.001$) and SEM= Standard Error of Mean, LSD= Least Significant Difference and CV= Coefficient of Variation

Table 4. Effects of different fertilizer treatments on number of branches of marigold plant in different interval of time

Treatment	Number of Branches		
	35 DAT	**55 DAT**	**85 DAT (at harvest)**
T1: Controlled	15.47^{c}	21.80^{c}	23.27^{e}
T2: FYM	17.47^{bc}	25.73^{abc}	25.87^{cd}
T3: Vermicompost	18.13^{abc}	24.13^{bc}	28.80^{bc}
T4: Poultry	21.27^{a}	29.00^{a}	29.93^{a}
T5: NPK	18.67^{abc}	26.47^{ab}	26.53^{cd}
T6: Charcoal	15.53^{c}	23.13^{bc}	25.27^{d}
T7: NPK+Vermicompost	19.07^{abc}	25.27^{abc}	26.47^{cd}
T8: NPK+Poultry	19.67^{ab}	23.93^{bc}	27.80^{bc}
SEM(±)	0.65	0.71	0.35
LSD(0.05)	3.37	3.67	1.83
CV(%)	10.71	8.51	3.95
F-test	*	*	***
Grand Mean	18.15	24.93	26.74

Means within the column followed by the same letter are not significantly different at the 5 % level of significance by DMRT. ns: non-significant, *Significant at 5% ($p<0.05$), ** significant

at 1 % ($p<0.01$), and *** significant at 0.1 % ($p< 0.001$), and SEM= Standard Error of Mean, LSD= Least Significant Difference, and CV= Coefficient of Variation

Table 5. Effects of different fertilizer treatments on diameter of stem of marigold plant in different interval of time

Treatment	Diameter of Stem (cm)		
	35 DAT	55 DAT	85 DAT (at harvest)
T1: Controlled	2.30^{d}	2.75^{c}	3.22^{b}
T2: FYM	2.69^{abc}	3.39^{ab}	3.78^{ab}
T3: Vermicompost	2.68^{abc}	3.39^{ab}	3.64^{ab}
T4: Poultry	2.78^{a}	3.81^{a}	4.11^{a}
T5: NPK	2.54^{abcd}	3.39^{ab}	3.69^{ab}
T6: Charcoal	2.37^{cd}	3.00^{bc}	3.24^{b}
T7: NPK+Vermicompost	2.45^{bcd}	3.33^{ab}	3.70^{ab}
T8: NPK+Poultry	2.70^{ab}	3.55^{a}	3.70^{ab}
SEM(±)	0.06	0.09	0.10
LSD(0.05)	0.29	0.44	0.51
CV(%)	6.57	7.71	8.04
F-test	**	**	*
Grand Mean	2.56	3.33	3.63

Means within the column followed by the same letter are not significantly different at the 5 % level of significance by DMRT. ns: non-significant, *Significant at 5% ($p<0.05$), ** significant at 1 % ($p<0.01$), and *** significant at 0.1 % ($p< 0.001$), and SEM= Standard Error of Mean, LSD= Least Significant Difference and CV= Coefficient of Variation

3.1.3 Diameter of stem

There was a significant effect of different organic and inorganic fertilizer treatments on the diameter of the stem of Marigold (**Table 5)**. At 35 DAT, the average diameter of the stem was 2.56 cm. The maximum diameter of the stem was found in treating plants with poultry manure (2.78 cm) which is statistically similar to NPK + poultry (2.70 cm), FYM (2.69 cm), vermicompost (2.68 cm) and NPK (2.54 cm). This was followed by NPK + vermicompost (2.45 cm) and further followed by charcoal (2.37 cm) which is statistically similar to control (2.30 cm). The minimum diameter of the stem was found in the control (2.30 cm).

At 55 DAT, the average diameter of the stem was 3.33 cm. The maximum diameter of the stem was observed in treating plants with poultry manure (3.81 cm) which is not statistically different from NPK + poultry (3.55 cm), FYM (3.39 cm), vermicompost (3.39 cm), NPK (3.39 cm) and NPK + vermicompost (3.33 cm). It was followed by charcoal (3.00 cm) which is statistically similar to control (2.75 cm). The minimum diameter of the stem was found in the control (2.75 cm).

At 85 DAT, the average diameter of the stem was 3.63 cm. The maximum diameter of the stem was found in plants treated with poultry manure (4.11 cm), statistically similar to FYM (3.78), NPK + poultry (3.70), NPK + vermicompost (3.70 cm), NPK (3.69 cm) and vermicompost (3.64 cm), followed by charcoal (3.24 cm) which is statistically similar to control (3.22 cm).

3.1.4 Plant Spread

A significant effect was observed on plant spread of Marigold by using different organic and inorganic fertilizers (**Table 6)**. At 35 DAT, the average plant spread was 32.30 cm. The maximum plant spread was found in the application of poultry manure (36.77 cm), statistically similar to NPK + poultry (35.13 cm), FYM (33.88 cm), NPK + vermicompost (32.93 cm), vermicompost (32.34 cm) and NPK (32.16 cm). This was followed by charcoal (27.89 cm), statistically similar to control (27.32 cm), while the minimum plant spread was found in control (27.32 cm).

Table 6. Effects of different fertilizer treatments on plant spread of marigold plant in different interval of time

Treatment	35 DAT	55 DAT	85 DAT (at harvest)
T1: Controlled	27.32^{c}	35.27^{c}	63.61^{c}
T2: FYM	33.88^{a}	42.29^{abc}	79.66^{ab}
T3: Vermicompost	32.34^{ab}	42.39^{abc}	81.43^{ab}
T4: Poultry	36.77^{a}	47.29^{a}	85.37^{a}
T5: NPK	32.16^{ab}	42.79^{abc}	70.11^{abc}
T6: Charcoal	27.89^{bc}	37.02^{bc}	68.75^{bc}
T7: NPK+Vermicompost	32.93^{a}	39.79^{abc}	78.11^{abc}
T8: NPK+Poultry	35.13^{a}	45.32^{ab}	78.98^{ab}
SEM(±)	0.84	1.66	2.65
LSD(0.05)	4.38	8.63	13.78
CV(%)	7.83	12.00	10.51
F-test	**	*	*
Grand Mean	32.30	41.52	75.76

Means within the column followed by the same letter are not significantly different at the 5% level of significance by DMRT. ns: non-significant, *Significant at 5% ($p<0.05$), ** significant at 1% ($p<0.01$), and *** significant at 0.1 % ($p< 0.001$) and SEM= Standard Error of Mean, LSD= Least Significant Difference and CV= Coefficient of Variation

At 55 DAT, the average plant spread was 41.52 cm. The maximum plant spread was obtained in the application of poultry manure (47.29 cm) which is statistically similar to NPK + poultry (45.32 cm), NPK (42.79 cm), vermicompost (42.39 cm), FYM (42.29 cm) and NPK + vermicompost (39.79 cm). It was followed by charcoal (37.02 cm), statistically similar to control (35.27 cm). The minimum plant spread was found in the control (35.27 cm).

At 85 DAT, the average plant spread was 75.76 cm. The maximum plant spread was found in the application of poultry manure (85.37 cm) which is statistically similar to vermicompost (81.43 cm), FYM (79.66 cm), NPK + poultry (78.98 cm), NPK + vermicompost (78.11 cm) and NPK (70.11 cm), followed by charcoal (68.75 cm) and statistically similar to control (63.61 cm). The minimum plant spread was found in control (63.61 cm).

As a result, poultry manure, or vermicompost alone or in combination with NPK led to the maximum plant height while the control was the least effective. Similarly, poultry manure fertilizer treatment produced the most number of branches, largest stem diameter, and canopy size of marigold in all time intervals of 35, 55 and 85 days after transplanting. Poultry excreta and vermicompost offer a wide range of essential macronutrients e.g. nitrogen, phosphorus, potassium and micronutrients such as calcium, magnesium and sulphur that are necessary for the plant growth (Warman and AngLopez 2010). The regulated release of nutrients from organic amendments promotes the best possible growth for plants. Through microbial activity, manures and composts gradually mineralize bringing their availability into line with crop needs over time. This consistent nutrient supply is in contrast to chemical fertilizers which could be quickly lost through leaching or runoff (Gutser et al 2005). These organic inputs enhance the number of soil microorganisms and soil physical properties such as structure and texture which promotes healthy root development and nutrient absorption (Gore and Sreenivasa 2011). Beneficial microbes present in vermicompost and manures promote plant growth directly through increasing nutrient availability or hormone production. (Bin 1983, Adesodun et al 2005, Deryqe et al 2016) found that on incorporating poultry manure to soil increased soil organic and inorganic matters such as nitrogen and phosphorus which supports our experimental results; conversely, the control plants exhibited poor plant growth. Many research studies have illustrated that the absence of fertilizers results in reduced shoot dry mass and lower levels of substrate nutrients in various plant varieties (Shreckhise et al 2022). Additionally, the lack of fertilizers can negatively affects all

above mentioned vegetative parameters (Ashour et al 2023). Additionally, plants not treated with fertilizers often exhibit reduced net photosynthesis as well as lower concentrations of total soluble sugars, chlorophylls and soluble proteins in their leaves, leading to a decrease in crop yield. (Silva et al 2021). It has also been observed that control plants without fertilizers have limited nutrient uptake and may exhibit nitrogen leaching (Fernandes et al 2019). Therefore, it is important to provide appropriate fertilization to ensure optimal plant growth and development.

3.2 Reproductive Parameters

Various reproductive parameters including stem diameter, flower count, days for bud formation and days to first bloom were assessed during the harvesting phase, specifically at 85 days after transplanting (DAT). The impact of different organic and inorganic fertilizer treatments on these parameters was examined and found affecting the overall marigold plant yield as discussed bellow and illustrated in **Table 7**.

3.2.1 Flower diameter

The diameter of Marigold flowers was notably influenced by various organic and inorganic fertilizer treatments. The average diameter of the flower was 13.10 cm. The maximum diameter of the flower was found in poultry manure treatment (14.11 cm), statistically similar to NPK + poultry (13.79 cm), NPK + vermicompost (13.54 cm), vermicompost (13.53 cm) and FYM (13.69 cm), followed by NPK (12.74 cm) which is statistically similar to those of charcoal (11.86 cm) and control (11.50 cm) treatments. The minimum diameter of the flower was found in the control (11.50 cm). The details are given in **Table 7.**

3.2.2 Number of flowers

The number of flowers of Marigold was significantly influenced by various organic and inorganic fertilizer treatments, as shown in **Table 7**. The average number of flowers was 36.28. The maximum number of flowers was found in poultry manure treatment (45.13) which is statistically similar to vermicompost (40.47), NPK + poultry (38.53), NPK + vermicompost (36.67) and FYM (36.60). This was followed by NPK (32.60) and is statistically similar to charcoal (32.60). The minimum number of flowers was found in control (27.67).

3.2.3 Days for bud initiation

Variations in bud initiation periods of marigold flowers as a result of fertilizer treatments were listed in **Table 7**. The average number of days for bud initiation was 50.54 days. The least bud initiation days was found in treating plants by poultry manure (46.33) which is statistically similar to NPK + poultry (47.67) and FYM (49.33). This was followed by vermicompost (50.00), statistically similar to NPK + vermicompost (51.33) and NPK (52.67). The maximum days for bud initiation were found in control (53.67), statistically similar to charcoal (53.33).

3.2.4 Days for first flowering

There was a significant effect of fertilizer treatments on minimizing days for first flowering (**Table 7)**. The average days for the first flowering was 55.54 days. First flowering occurred in least period in poultry manure (51.33) which is statistically similar to NPK + poultry (52.67) and FYM (54.33), followed by vermicompost (55.00), NPK +vermicompost (56.33) and NPK (57.67) while the maximum days for first flowering was observed in control (58.67), statistically similar to charcoal (58.33).

Accordingly, the results demonstrated that poultry manure causes significant enhancement in multiple yield-attributing characteristics of marigold including flower diameter and number as well as the accelerated onset of bud initiation and flowering which is in accordance with the results of Himaja et al (2021). Organic manures as poultry manure and vermicompost were found more effective than NPK alone (Peyvast et al 2008). The flower diameter and number increased significantly whereas the number of days for bud initiation and first flowering were reduced significantly with the application of organic manures such as poultry manure, vermicompost alone or with the interaction with NPK which is similar to the the findings of Chander et al (2015). Studies with alternative commercial organic fertilizers have also shown that using organic fertilizers can result in comparable or superior growth, yields or quality when compared to conventionally grown crops (Altland et al 2000, Gaskell et al 2000, Russo 2005, Treadwell et al 2007). Conversely, the control plants exhibited the smallest flower sizes and quantities along with the longest flowering delays which are further supported by the results of studies conducted by Siracole et al (2017) and Sathappan (2018).

Table 7. Effects of different fertilizer treatments on yield attributing characters of marigold

Treatments	Diameter of flower (cm)	Number of flowers	Days for bud initiation	Days for first flowering
T1: Controlled	11.50^{c}	27.67^{c}	53.67^{a}	58.67^{a}
T2: FYM	13.69^{ab}	36.60^{abc}	49.33^{cde}	54.33^{cde}
T3: Vermicompost	13.53^{ab}	40.47^{ab}	50.00^{bcd}	55.00^{bcd}
T4: Poultry	14.11^{a}	45.13^{a}	46.33^{e}	51.33^{e}
T5: NPK	12.74^{bc}	32.60^{bc}	52.67^{ab}	57.67^{ab}
T6: Charcoal	11.86^{c}	32.60^{bc}	53.33^{a}	58.33^{a}
T7: NPK+Vermicompost	13.54^{ab}	36.67^{abc}	51.33^{abc}	56.33^{abc}
T8: NPK+Poultry	13.79^{ab}	38.53^{ab}	47.67^{de}	52.67^{de}
SEM(±)	0.23	1.64	0.58	0.58
LSD(0.05)	1.20	8.51	3.02	3.02
CV(%)	5.30	13.55	3.45	3.14
F-test	***	*	**	**
Grand Mean	13.10	36.28	50.54	55.54

Means within the column followed by the same letter are not significantly different at the 5 % level of significance by DMRT. ns: non-significant, *Significant at 5% ($p<0.05$), ** significant at 1% ($p<0.01$) and *** significant at 0.1 % ($p< 0.001$) and SEM= Standard Error of Mean, LSD= Least Significant Difference, and CV= Coefficient of Variation

4 Conclusion

This study demonstrated that adding organic fertilizers such as poultry manure and vermicompost, alone or with chemical NPK fertilizer, can greatly improve marigold plant growth, early flowering and flower yield compared to just NPK or no fertilizers. Poultry manure performed the best overall, producing the tallest plants (126.21 cm), with the most branches (29.93), the biggest flowers (14.11 cm) and the fastest flowering time (51.33 days). Organic fertilizers slowly release nutrients and improve soil characters, for better plant development at all stages, compared to the fast-acting chemical NPK alone. In conclusion, using organic fertilizers, *especially poultry manure and vermicompost, is a* promising approach to grow more marigold flowers. These organic methods can potentially meet the high demand for marigolds in Nepal and other countries.

5 Conflict of Interest

There is no known conflict of interest.

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