International Journal of Horticultural Science 2025, 31: 95-100.
https://doi.org/10.31421/ijhs/31/2025/15522

# Effect of nitrogen on growth and yield of chili (*Capsicum annuum* var. 'Marshal') in Chitwan, Nepal

**Thapa Tamang, A.[1], Bhattarai, R.[1], Pant, M.[1], Rimal, B. K.[1] & Rokaya, R. P.[2]**

[1]*Faculty of Agriculture, Agriculture and Forestry University, Rampur, Chitwan, Nepal*
[2]*Department of Horticulture, Agriculture and Forestry University, Rampur, Chitwan, Nepal*
*Author for correspondence: mukeshpant.ug2019@foa.edu.np*

***Summary:*** A field experiment was conducted from April to July 2024 in Rampur, Chitwan, to evaluate the performance of different levels of nitrogen on the growth and yield attributes of chili. The Marshal variety of chili was tested under five different nitrogen doses (0, 30, 60, 90, and 120 kg/ha). The treatments were arranged in a one-factorial Randomized Complete Block Design (RCBD) with four replications. Observations were for different growth and yield parameters, and data were analyzed using R-studio. The results revealed that all growth and yield characters of chili were significantly influenced by nitrogen levels. The plants treated with 120 kg/ha nitrogen produced the maximum height (45.6 cm), canopy (604.5 $cm^2$), primary branch (8.67), leaf number (9.78), fruit length (6.26 cm), and fruit weight per plot (111.04 g). The 90 kg/ha nitrogen ranked second, with plant height of 43.12 cm, canopy cover 570.70 $cm^2$, primary branch 7.30, leaf number 9.23, fruit length 5.87 cm, and fruit weight per plot 103.63 g. All parameters were significantly reduced in the control, where no nitrogen was applied. The highest yield was obtained in $T_5$ (3.07 t/ha) followed by $T_4$ (2.98 t/ha), $T_3$ (2.67 t/ha), and $T_2$ (2.32 t/ha). The findings of this study demonstrated that 120 kg/ha nitrogen level resulted in the highest values for all measured traits and was significantly greater than that of all other nitrogen levels. Therefore, it is concluded that nitrogen dose of 120 kg/ha is the most economical for achieving better growth and fruit yield in chili (variety 'Marshal').

Tamang, A. T., Bhattarai, R., Pant, M., Rimal, B. K., Rokaya, R. P. (2025): Effect of nitrogen on growth and yield of chili (*Capsicum annuum* var. 'Marshal') in Chitwan, Nepal. International Journal of Horticultural Science 2025, 31: 95-100. https://doi.org/10.31421/ijhs/31/2025/15522

***Key words:*** canopy cover, fruit length, fruit weight, HP5736

## Introduction

Chili (*Capsicum annuum* L.) is a well-known spice crop originating from Latin America, commonly used for its spicy fruits. Mexico is considered the primary center of diversity for the widely cultivated pepper *Capsicum annuum*, with Guatemala recognized as a secondary center (Bose, 1986). It belongs to the genus *Capsicum*, one of the most important genera of the family Solanaceae. In Nepal, chili is widely cultivated from subtropical to temperate agro- climatic conditions in all 77 districts. Chili holds the third position among spice crops, following cardamom and ginger in terms of production. Till date, there are all total 16 varieties which are listed at the National Seed Board for commercial purpose (SQCC, 2021), in which three are open pollinated varieties (OPV) including the first released variety, 'Jwala' in 1994. Approximately 11,349 ha agricultural land is under chili cultivation with annual production of 86,992 Mt (MoALD, 2022/23). Chili is a spice crop utilized for fresh consumption, ground into dried powder, and processed into products like pickles. In addition to its culinary uses, hot and spicy chili is also valued for its medicinal properties, including the treatment of neuropathic pain (Deka et al., 2016; Chung and Campbell, 2016).

The area under chili cultivation in Nepal is about 23,083 ha with production of 184,885 Mt and the yield is about 8.0 mt/ha (MoALD, 2022). But the potential yield of chili is more than 8 mt/ha. And, the farmers are unable to get the potential yield of chili. One of the reasons why the yield of chili farming is inferior using conventional methods is the incorrect amount of fertilizer used. The macro nutrients are vital for the healthy growth and development of chili. Nitrogen is the most crucial component for the healthy vegetative growth and yield of chilies among them. Farmers are not applying as much nitrogen as the government recommends. Farmers are using nitrogen inefficiently due to the lack of region- specific guidelines for the optimal use of nitrogen level. Low levels of nitrogen in the soil result in low quality, weight, and growth. Similarly, too much nitrogen has detrimental effects. Deficit amount of reactive N causes the low yield and low food production while the excess of it causes the inefficient use and adverse effects on the environment (Rütting et al., 2018). Subedi et al. (2023) conducted research to assess the effect of different level of nitrogen and charcoal on growth and yield traits of chili (*Capsicum annuum*) and found growth and yield of chili were increased due to the application of nitrogen at the rate of 100 kg/ha and the application of 2.5% charcoal has produced significant increment for plant height, fruit length and yield. Similarly, the application of 140 kg nitrogen per ha and 60 kg/ ha $P_2O_5$ produced the greatest yield and yield contributing characters of chili (Islam et al., 2018). The research conducted by Wahocho et al. (2016) on five chili varieties (Kunri, Nagina,Tota puri, Longi and Ghotki) to evaluate the impacts of different levels of nitrogen (0,50,150 & 250 kg/ha) on growth and productivity in pot trials revealed that among the five varieties Ghokti (or Ghokti) performed best and the higher doses of nitrogen showed better results for all investigated growth and yield parameters.

This study aims to evaluate the influence of varying nitrogen application levels on the growth and yield attributes of chili (*Capsicum annuum* var. 'Marshal') cultivated in Rampur, Chitwan. Specifically, it seeks to identify the optimal nitrogen dose for maximizing fruit yield while systematically assessing its effects on key vegetative parameters, including plant height, canopy coverage, number of primary branches, and leaf number. The research further investigates how nitrogen availability affects critical fruit traits such as length and weight, and explores the implications of both nitrogen deficiency and excess on the overall productivity and efficiency of chili cultivation.

## Materials and methods

### *Study area*

The experimental site was located on the central campus of Agriculture and Forestry University (AFU), Rampur, Chitwan. It is located 10 km west of Bharatpur, the district headquarters of Chitwan, in Bagmati Province (***Figure 1***). The geographical coordinates are 27.65 °N latitude and 84.35 °E longitude at an elevation of 189 msl.

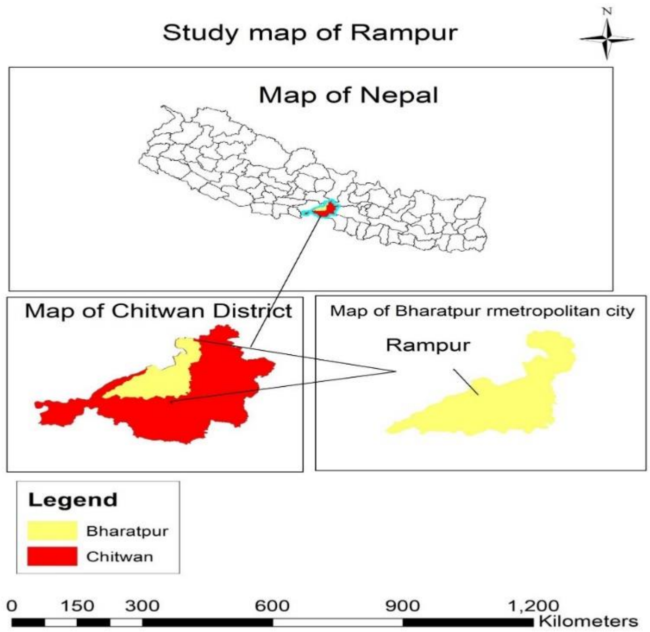


***Figure 1.*** Location map of experimental site in Rampur, Chitwan, Nepal.

### *Weather condition*

The data showed that the temperature decreased slightly toward the end of the experiment following the onset of precipitation. Initially, the relative humidity was low at the beginning of the research period and fluctuated significantly throughout. Precipitation was also low at the start of the experiment, but increased toward the end of the experiment. The average maximum temperature during the research period was 38.61 °C, while the average minimum temperature was 12.74 °C. The average relative humidity during the research period was 39.06%, and the average precipitation was 3.42 mm, as shown in ***Figure 2***.

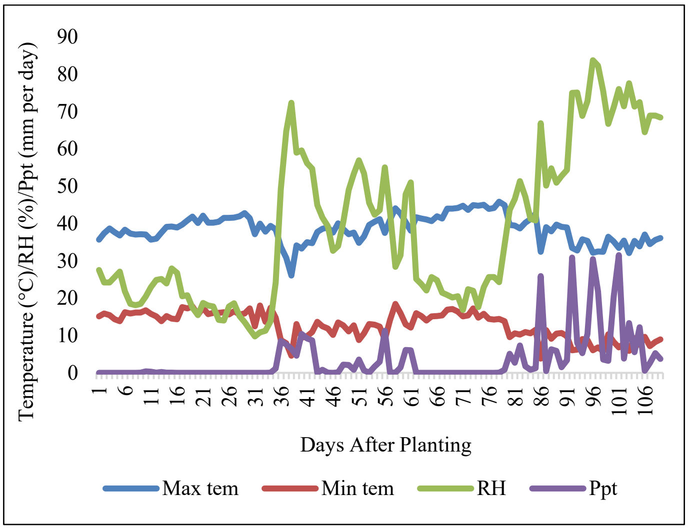


***Figure 2.*** Weather parameters recorded during the experimental period in Rampur, Chitwan.

### *Experimental details*

#### *Experimental materials*

The experimental materials used in this investigation was chili (*Capsicum annuum*) F1 Hybrid variety named Marshal (HP5736).

#### *Design of experiment*

The field experiment was conducted using a Randomized Complete Block Design (RCBD), incorporating five distinct treatments, each replicated four times (***Table 1***).

***Table 1.*** Detailed description of experimental design, agronomic practices, and plot layout for chili (*Capsicum annuum var. 'Marshal'*) cultivation in Rampur, Chitwan.

| | |
|---|---|
| Number to treatments | 5 |
| Number of replications | 4 |
| Total number of plots | 20 |
| Size of plot | 1.8×1.5 m |
| Plant to plant distance | 30 cm |
| Row to row distance | 60 cm |
| Distance between two plots | 30 cm |
| Distance between two blocks | 1 m |
| Design | RCBD |
| Crop | Chili (Marshal variety) |
| Research Duration | 1 April to 13 July, 2024 |

#### *Details of the layout*

Each plot was 1.8 × 1.5 m (2.7 m$^2$) in size, and the total number of plots in the experiment was 20. The net experimental area was 11.2 × 10 m (112 m²). The distance between the two replications was 1 m, while the distance between the two plots was 0.3 m. Each plot contained 12 transplanted chili plants, with row-to-row and plant-to-plant spacing maintained at 60 cm and 30 cm, respectively (***Figure 3)***.

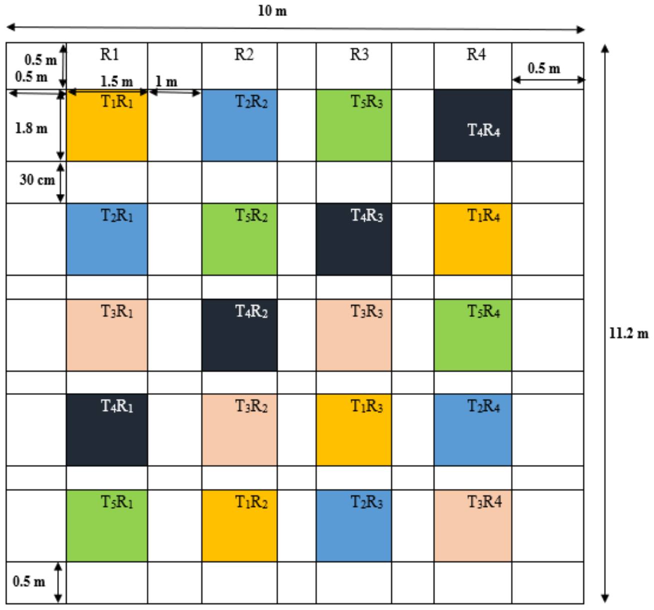

***Figure 3.*** Field layout of the experimental site in Rampur, Chitwan.

*Details of the treatments*

Five nitrogen treatments were evaluated in the study, corresponding to application rates of 0, 30, 60, 90, and 120 kg N/ha, designated as $T_1$ through $T_5$, respectively.

***Details of the cultural operations***

*Nursery raising and fertilizer application*

The nursery bed of 2.1 m×0.9 m×0.15 m was prepared inside the premises of the Department of Horticulture at AFU, Rampur, Chitwan on April 2, 2024. The nursery bed of above-mentioned dimensions was prepared and proper weeding and pulverizing was done. The bed was made weed and stones free and then seed sowing was done. The seed (F1 hybrid variety: Marshal HP5736) was sown by line sowing method; each line being 1 cm apart. The seed was sown in line by continuous method. Then, the seed was covered by the well decomposed vermi- compost followed by light irrigation. The seed bed was covered with rice straw and necessary plastic structure was made to protect it from extreme weather conditions like wind and raindrop beating action. The aftercare operations such as irrigation, weeding, intercultural and plant protection measures was undertaken till the seedlings was ready for transplanting.

*Field preparation and fertilizer application*

The experimental field was prepared through deep ploughing, followed by three cross harrowings and leveling conducted one week prior to transplanting. A detailed plot layout was finalized before the transplantation process. Fertilizers including urea, diammonium phosphate, and muriate of potash were applied. A full dose of phosphorus (P), potassium (K), farmyard manure (FYM), and half of the nitrogen (N) requirement were incorporated as a basal dose during chili seedling transplanting. The remaining nitrogen was administered in two equal split doses at 25 and 50 days after transplanting (DAT) (Krishi dairy, 2022).

*Transplanting of seedling*

Forty-five-day-old seedlings were transplanted in the experimental plot on 12$^{th}$ May, 2024. Transplanting was done in the evening hours. Light irrigation was done just after the transplant. Gap filling was carried out within one week following transplanting. The spacing between rows and plants was maintained at 60 cm and 30 cm, respectively.

*Cultural practices*

All intercultural practices, including weeding and hoeing, were uniformly executed as required throughout the crop growth period. Irrigation was provided at daily basis till the seedling were well established and weekly interval until the onset of monsoon.

*Harvesting*

Fruits were harvested from each plot (four selected plants) at green matured stage manually.

*Detail of the observation*

<u>Growth parameters</u>

The characters which were studied in the present investigation are given below. Four interior plants were selected in each plot to record most of the observation.

- **Plant height (cm):** The height of four plants in each plot was taken at 15 Days After Transplanting (DAT) for first time and every 20 days interval up to flowering. Plant height was recorded from the soil surface up to the apex of the main shoot's growing point.
- **Number of primary branches per plant:** The number of primary branches arising from the main shoot was counted at each harvest of sampled plants and average was calculated.
- **Canopy cover:** The diameter of the individual sample plant was measured in a cross wise direction. Then, it was multiplied to obtain the cross- sectional area of the plant and average was calculated.
- **Leaf number:** The total number of fully grown leaf in a sample plant was counted manually at 15 DAT.

<u>Yield and yield parameters</u>

- **Fruit length (cm):** Four matured green fruits per plot was taken randomly at each harvesting to measure fruit length. The length was measured from the base of fruit to the tip excluding the fruit stalk. Then the average fruit length in each treatment was computed.
- **Fruit weight (g) per plot:** Matured green marketable fruits were harvested at each harvesting from each plot (four sample plants). Total fruit weight from each plot were recorded by measuring the fruits harvested from four sample plants of each plot.
- **Total fruit yield per hectare:** Total fruit yield per hectare was calculated from the fruit weight of the sample plants of each plot. The fruit weight from each harvesting was summed and divided by four to get the yield from one plant. And then it was multiplied by the total number of plant population obtained by dividing the 10,000 m$^2$ area by the spacing (50×30 cm$^2$). Then, the obtained data was recorded as the fruit yield per hectare (t/ha).

## Results

### *Growth parameters*

The plant height showed significant differences for the different doses of nitrogen (***Table 2***). In all three dates, the plant height was significantly higher for 20 kg/ha of N. The highest height observed was 45.16 cm during 55 DAT for 120 kg/ha of N. 90 kg/ha of N showed significantly higher height for all the observations after 120 kg/ha compared to the remaining nitrogen doses. Low height was observed for plants with no application of N. The least height observed was 13.54 cm during 15 DAT.

***Table 2.*** Plant height (cm) as influenced by the different Nitrogen dose in Rampur, Chitwan, Nepal, 2024.

| | Plant height (cm) | | |
|---|---|---|---|
| Treatment | 15 DAT | 35 DAT | 55 DAT |
| $T_1$ | 13.54$^e$ | 22.64$^d$ | 31.34$^e$ |
| $T_2$ | 17.24$^d$ | 25.27$^c$ | 34.28$^d$ |
| $T_3$ | 18.82$^c$ | 26.62$^c$ | 39.92$^c$ |
| $T_4$ | 25.86$^b$ | 28.89$^b$ | 43.12$^b$ |
| $T_5$ | 30.16$^a$ | 32.07$^a$ | 45.16$^a$ |
| Sem (±) | 0.45 | 0.60 | 0.65 |
| LSD | 1.40 | 1.85 | 2.02 |
| CV% | 4.32 | 4.43 | 3.38 |
| F-Test | S | S | S |
| Grand mean | 21.12 | 27.10 | 38.76 |
| P value | 0.05 | 0.15 | 0.81 |

Note: DAT= Days After Transplanting; CV= Coefficient of Variation, LSD= Least Significant Difference, SEm= Standard Error of Mean. Mean followed by a common letter(s) within the column are not significantly different based on DMRT P= 0.001. S: Significant.

***Table 3***. Canopy cover as influenced by the different nitrogen doses in Rampur, Chitwan, Nepal, 2024.

| | Canopy cover (cm$^2$) | | |
|---|---|---|---|
| Treatment | 15 DAT | 35 DAT | 55 DAT |
| $T_1$ | 119.48$^e$ | 273.12$^d$ | 317.34$^d$ |
| $T_2$ | 123.87$^d$ | 299.52$^d$ | 331.01$^d$ |
| $T_3$ | 135.92$^c$ | 341.53$^c$ | 393.58$^c$ |
| $T_4$ | 156.17$^b$ | 393.39$^b$ | 570.70$^b$ |
| $T_5$ | 160.23$^a$ | 486.57$^a$ | 604.50$^a$ |
| SEm (±) | 0.94 | 11.27 | 4.73 |
| LSD | 2.92 | 34.75 | 14.58 |
| CV% | 1.36 | 6.28 | 2.13 |
| F-Test | S | S | S |
| Grand mean | 139.13 | 358.83 | 443.43 |
| P -value | 0.16 | 0.99 | 0.71 |

Note: DAT= Days After Transplanting; CV= Coefficient of Variation, LSD= Least Significant Difference, SEm= Standard Error of Mean. Mean followed by a common letter(s) within the column are not significantly different based on DMRT P= 0.001. S: Significant.

The effect of different levels of nitrogen dose on the canopy cover of the chili plant was recorded at 15 DAT, 35 DAT, and 55 DAT as shown in ***Table 3***. It was found that the increased dose of nitrogen leads to the increased canopy cover or area of the plant in contrast to the controlled treatment of 0 kg/ha. The greatest canopy cover was found to be for 120 kg/ha (604 cm$^2$) followed by 90 kg/ha (570 cm$^2$) at 55 DAT. The least canopy cover was observed for 0 kg/ha (119.48 cm$^2$) at 15 DAT. The canopy cover for 0 kg/ha (273.12 cm$^2$) was at par with the canopy cover for 30 kg/ha (299.52 cm$^2$) at 35 DAT. Similarly, the canopy cover for 0 kg/ha (317.34 cm$^2$) was at par with the canopy cover for 30 kg/ha (331.01 cm$^2$) at 55 DAT.

The mean number of primary branches of chili plant is shown in the ***Table 4***. The observation revealed that the mean number of primary branches has increased with increased in the level of nitrogen dose. The highest number of primary branches can be seen for 120 kg/ha at both 35 (3.61) and 55 DAT (8.27) followed by 90 kg/ha (7.30) at 55 DAT. Whereas the least number of primary branches was seen for the controlled treatment 0 kg/ha (1.7) at 35 DAT. The mean number of primary branches for 30 kg/ha (2.45) was found to be at par with that of 60 kg/ha (2.65) at 35 DAT.

***Table 4.*** Primary branch number as influenced by the different nitrogen doses in Rampur, Chitwan, Nepal, 2024.

| | Primary branch number/plant | |
|---|---|---|
| Treatment | 35 DAT | 55 DAT |
| $T_1$ | 1.78$^d$ | 4.17$^e$ |
| $T_2$ | 2.45$^c$ | 5.36$^d$ |
| $T_3$ | 2.65$^c$ | 6.24$^c$ |
| $T_4$ | 3.16$^b$ | 7.30$^b$ |
| $T_5$ | 3.61$^a$ | 8.27$^a$ |
| SEm (±) | 0.10 | 0.16 |
| LSD | 0.31 | 0.49 |
| CV% | 7.44 | 5.26 |
| F-Test | S | S |
| Grand mean | 2.73 | 6.11 |
| P -value | 0.82 | 0.53 |

Note: DAT= Days After Transplanting; CV= Coefficient of Variation, LSD= Least Significant Difference, SEm= Standard Error of Mean. Mean followed by a common letter(s) within the column are not significantly different based on DMRT P= 0.001. S: Significant.

The observation revealed that the mean leaf number increased as the dose of nitrogen is increased (***Table 5***). The highest leaf number is seen at 120 kg/ha (9.78) at 15 DAT which is statistically similar to 90 kg/ha (9.23) at 15 DAT. The mean leaf number for 90kg/ha (9.23) is also at par with that of 60 kg/ha (8.53) at 15 DAT. The table also revealed that the leaf number for 0 kg/ha (7.24) and 30 kg/ha (7.66) is also statistically similar to each other.

***Table 5.*** Leaf number as influenced by the different nitrogen doses in Rampur, Chitwan, Nepal, 2024.

| | Leaf Number per plant |
|---|---|
| Treatment | 15 DAT |
| $T_1$ | 7.24$^c$ |
| $T_2$ | 7.66$^c$ |
| $T_3$ | 8.53$^b$ |
| $T_4$ | 9.23$^{ab}$ |
| $T_5$ | 9.78$^a$ |
| SEm (±) | 0.26 |
| LSD | 0.82 |
| CV% | 6.33 |
| F-Test | S |
| Grand mean | 8.44 |
| P -value | 0.95 |

Note: DAT= Days After Transplanting, Ln= Leaf number, CV= Coefficient of Variation, LSD= Least Significant Difference, SEm= Standard Error of Mean. Mean followed by a common letter(s) within the column are not significantly different based on DMRT P= 0.001. S: Significant.

***Yield and yield parameters***

The effect of different nitrogen doses was observed on the fruit length of chili at 55 and 65 DAT (***Table 6***). The observation revealed that the highest value for fruit length was found both for 120 kg/ha at 55 (5.14 cm) and 65 (6.26 cm) DAT respectively. Whereas there was no significant difference between the fruit length for treatment 0 kg/ha (4.7 cm), 30 kg/ha (4.7 cm) and 60 kg/ha (4.75 cm) at 55 DAT. Similarly, there was no significant difference between 0 kg/ha (5.22 cm) and 30 kg/ha (5.44 cm) at 65 DAT and 30kg/ha was also statistically similar to 60 kg/ha (5.59 cm) at 65 DAT.

***Table 6.*** Fruit length as influenced by the different nitrogen doses in, Rampur, Chitwan, Nepal, 2024.

| | Fruit length (cm) | |
|---|---|---|
| Treatment | 55 DAT | 65 DAT |
| $T_1$ | 4.70$^c$ | 5.22$^d$ |
| $T_2$ | 4.70$^c$ | 5.44$^{cd}$ |
| $T_3$ | 4.75$^c$ | 5.59$^c$ |
| $T_4$ | 4.90$^b$ | 5.87$^b$ |
| $T_5$ | 5.14$^a$ | 6.26$^a$ |
| SEm (±) | 0.03 | 0.07 |
| LSD | 0.10 | 0.24 |
| CV% | 1.45 | 2.74 |
| F-Test | S | S |
| Grand mean | 4.84 | 5.67 |
| P -value | 0.78 | 0.92 |

Note: DAT= Days After Transplanting; CV= Coefficient of Variation, LSD= Least Significant Difference, SEm= Standard Error of Mean. Mean followed by a common letter(s) within the column are not significantly different based on DMRT P= 0.001. S: Significant

***Table 7.*** Fruit weight as influenced by the different nitrogen doses in Rampur, Chitwan, Nepal, 2024.

| | Fruit weight per plot (g) | |
|---|---|---|
| Treatment | 55 DAT | 65 DAT |
| $T_1$ | 53.02$^e$ | 81.01$^d$ |
| $T_2$ | 55.92$^d$ | 83.48$^d$ |
| $T_3$ | 65.30$^c$ | 95.33$^c$ |
| $T_4$ | 70.14$^b$ | 103.63$^b$ |
| $T_5$ | 76.08$^a$ | 111.04$^a$ |
| SEm (±) | 0.84 | 1.02 |
| LSD | 2.61 | 3.16 |
| CV% | 2.65 | 2.16 |
| F-Test | S | S |
| Grand mean | 64.09 | 94.90 |
| P -value | 0.53 | 0.48 |

Note: DAT= Days After Transplanting; CV= Coefficient of Variation, LSD= Least Significant Difference, SEm= Standard Error of Mean. Mean followed by a common letter(s) within the column are not significantly different based on DMRT P= 0.001. S: Significant.

All the marketable fruit from the sample plants were harvested and their weights were recorded as the fruit weight per plot. The highest fruit weight was observed for both 120 kg/ha at 65 DAT (111.04 g) and 55 DAT (76.08 g). The lowest value for fruit weight was found for 0 kg/ha (53.02 g) at 55 DAT. The mean fruit weight for 0 kg/ha (81.01 g) and 30 kg/ha (83.48 g) was found to be statistically similar to each other (***Table 7***).

The overall mean of the chili was found to be 2.64 t/ha (***Table 8***). The different levels of nitrogen dose have been found to have a significant effect on the fruit yield of the chili plant. The highest yield was obtained for 120 kg/ha (3.07 t/ha) followed by 90 kg/ha (2.89 t/ha). The lowest yield was observed for the controlled treatment with 0 kg/ha (2.24 t/ha) where no nitrogen was applied at all.

***Table 8.*** Yield as influenced by the different nitrogen doses in, Rampur, Chitwan, Nepal, 2024.

| Treatment | Yield (t/ha) |
|---|---|
| $T_1$ | 2.24$^e$ |
| $T_2$ | 2.32$^d$ |
| $T_3$ | 2.67$^c$ |
| $T_4$ | 2.89$^b$ |
| $T_5$ | 3.07$^a$ |
| SEm (±) | 0.01 |
| LSD | 0.04 |
| CV% | 1.22 |
| F-Test | S |
| Grand mean | 2.64 |
| P -value | 0.91 |

Note: DAT= Days After Transplanting; CV= Coefficient of Variation, LSD= Least Significant Difference, SEm= Standard Error of Mean. Mean followed by a common letter(s) within the column are not significantly different based on DMRT P= 0.001. S: Significant

## Discussion

The maximum plant height for higher doses of nitrogen treatments might be due to the better availability of nitrogen to the plants. This ultimately leads to better cell division and tissue formation which finally leads to better vegetative growth and as a result higher plant height. N increases the vegetative growth of the plant (Baloch, 2008). The plant height, including a few other morphological characteristics, are characteristics which are significantly affected by genetic differences across various plant varieties (Pradhan et al., 2011). These results are strongly supported by Singegol et al. (2007) which showed that application of 150 kg/ha nitrogen leads to better results with regards to growth parameters like plant height, canopy and branch numbers as well as yield attributes like fruit number and fruit weight. Similarly, Subedi et al. (2023) observed that applying nitrogen at 100 kg/ha enhanced the growth and yield of chili, while the use of 2.5% charcoal significantly improved plant height, fruit length, and overall yield. The higher doses of N lead to greater canopy cover because the plants were able to utilize more N nutrients for more vegetative growth and development. Ayodele et al. (2015) documented that the application of adequate amounts of nitrogen in plants significantly enhanced leaves and leaf area per plant in chili.

The maximum number of branches (9.42) was observed when the chili plants were fertilized with N dose of 250 kg/ha which was statistically similar to 9.06 when plants were fertilized with 150 kg/ha (Wahocho et al., 2016). Singegol et al. (2007) also found out that the application of N at 150 kg/ha leads to better results with growth parameters like the number of branches per plant. The greatest nitrogen dose (180 kg/ha) produced the most branches per plant (18.3), followed by nitrogen administered at 120 kg/ha (14.4), and the lowest (8.49) was observed in the control treatment (Khan et al., 2014).

The number of leaves is directly correlated with the number of branches. A higher number of branches means a higher number of leaves per plant. An adequate amount of N provided an ideal environment and balanced nutrition to plants which increased the number of leaves. The application of adequate N in chili plants leads to an increased number of leaves per plant (Ayodele et al. 2015). The plants applied with 180 kg N/ha produced a leaf number of 294 as compared to the control (Khan et al., 2014).

The enhanced vegetative growth in plants with higher N doses definitely leads to the development of a higher number of flowers and buds which means more developed fruits and increased fruit length. Wahocho et al. (2016) observed that the application of N at 250 kg/ha produced a fruit length of 3.12 cm and 150 kg N/ha produced a 3.02 cm fruit length. Maximum fruit length was observed which was 30% more as compared to the fruit length of control treatment when the plants were applied with 120 kg N/ha (Singh & Srivastava, 1988). Fruit from the greatest dose of nitrogen (180 kg/ha) had the longest mean fruit length (6.83 cm), followed by fruit from the second-highest dose (120 kg N/ha) (5.93 cm), and fruit from the control plots had the smallest mean fruit length (4.62 cm) (Khan et al. 2014).

The higher dose of N leads to the production of a greater number of flowers and buds which ultimately results greater number of fruits per plant and per plot. Singh & Srivastava (1988) concluded from their research that a higher rate of N (120 kg/ha) produced 245 % more number of fruits and 177% more fruit weight in comparison to the control.

The higher doses of N provide an ideal environment and balanced nutrition which means greater availability and utilization of N to enhance plant growth and development. This eventually results in longer fruits and more fruit per plant and increased yield. This point is strongly supported by the research conducted by Khan et al. (2014) who found that application of N at 180 kg/ha yielded 8.803 t/ha, followed by 7.813 t/ha where 120 kg N/ha was applied and a minimum of 5.296 t/ha was found in control.

## Conclusions

The research revealed that using urea as the source of nitrogen at the rate of 120 kg/ha in Marshal variety of chili in region of inner terai like Chitwan having similar climate and topography, can really lead to the increased yield as compared of the other dose of nitrogen used in this experiment. The use of higher doses of N level leads to the increased fruit qualities like fruit length and fruit weight per plot as compared to the other lower doses of nitrogen.

## Acknowledgements

We wish to express our deep gratitude to Dr. Pradeep Raj Rokaya, Department of Horticulture, Agriculture and Forestry University (AFU), Rampur, Chitwan for his regular guidance, valuable insights, encouragement and suggestions throughout the research period.

## References

**Ayodele, O. J., Alabi, E. O., Aluko, M. (2015):** Nitrogen fertilizer effects on growth, yield and chemical composition of hot pepper (Rodo). International Journal of Agriculture and Crop Sciences. 8(5): 666.

**Baloch, Q. B., Chachar, Q. I., Tareen, M. N. (2008):** Effect of foliar application of macro and micro nutrients on production of green chilies (*Capsicum annuum* L.). Journal of Agricultural Technology. 4. 177–184. https://doi.org/10.55706/jae

**Bose, T. K., Som, M. G., Kabir, J. (1986):** Vegetable crops. Calcutta: Naya Prakash, 334.

**Chung, M. K., Campbell, J. N. (2016):** Use of capsaicin to treat pain: mechanistic and therapeutic considerations. Pharmaceuticals. 9(4). 66. https://doi.org/10.3390/ph9040066

**Deka, S. D., Dadlani, M., Sharma, R. (2016):** Diversity study in *Capsicum* using numerical taxonomy.

**Islam, M. R., Sultana, T., Haque, M. A., Hossain, M. I., Sabrin, N., Islam, R. (2018):** Growth and yield of chili influenced by nitrogen and phosphorus. Journal of Agriculture and Veterinary Science. 11(5): 54-68. https://doi.org/10.9790/2380-1105025468

**Khan, A., Shah, S. N. M., Rab, A., Sajid, M., Ali, K., Ahmed, A., Faisal, S. (2014):** Influence of nitrogen and potassium levels on growth and yield of chillies (*Capsicum annuum* L.). International Journal of Farming and Allied Sciences. 3(3): 260-264.

**MoALD (2021/22):** Statistical Information in Nepalese Agriculture. Ministry of Agriculture and Livestock Development. Singhadurbar, Kathmandu, Nepal.

**MoALD (2024):** Krishi diary [Agriculture Diary 2081]. https://aitc.gov.np/uploads/documents/agriculture-diary-2081-file-2081-03-2pdf-6568-329-1719146649.pdf

**Pradhan, A. M., Nanadeshwar, B. C., Sarkar, K. K., Konar, A. (2011):** Estimation of genetic parameters and association of traits related to yield in potato (*Solanum tuberosum* L.). Journal of Crop and Weed. *7*(2): 229-231.

**Rütting, T., Aronsson, H., Delin, S. (2018):** Efficient use of nitrogen in agriculture. Nutrient cycling in agroecosystems. 110: 1-5.

**Singegol, H. Y., Patil, H. B., Patil, D. R. (2007):** Growth and yield of green chilli (*Capsium annuum* L.) cv. Pusa Jwala as influenced by nitrogen and phosphorus. The Asian Journal of Horticulture. 2(2):184-187.

**Singh, K., Srivastava, B. K. (1988):** Effect of various levels of nitrogen and phosphorus on growth and yield of chilli (*Capsicum annuum* L.). Indian Journal of Horticulture. 45(3-4): 319-324.

**SQCC (2021):** Notified and denotified varieties of different crops till 2021-07-15., Seed Quality Control Centre (SQCC), Ministry of Agriculture and Livestock Development, Nepal.

**Subedi, P., Bhattarai, P., Lamichhane, B., Khanal, A., Shrestha, J. (2023):** Effect of different levels of nitrogen and charcoal on growth and yield traits of chili (*Capsicum annuum* L.). Heliyon, 9(2): 1-8. e13353. https://doi.org/10.1016/j.heliyon.2023.e13353

**Wahocho, N.A., Zeshan Ahmed, S., Jogi, Q., Talpur, K.H., Leghari, S.J. (2016)**: Growth and productivity of chilli (*Capsicum annuum* L.) under various nitrogen levels. Science International. 28(2): 1321-1326.