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EFFECT OF PINCHING ON THE GROWTH AND YIELD OF CHILI (*Capsicum annuum*)

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A B S T R A C T

Pinching is known to invigorate the growth of multiple shoots, promote the growth of lateral, and increase fruit formation. An experiment was conducted in the field of the Gokuleshwor Agriculture and Animal Science College, Baitadi, Nepal to examine the effect of pinching on the growth and yield of the chili (Capsicum annuum). The experiment utilized the 'NS-1701 variety and was carried out in a Randomized Complete Block Design (RCBD) with five replications and four treatments; pinching at 20, 30, and 40 days after transplanting (DAT), and no pinching as control. Results revealed significant effects of pinching on various parameters, including plant height, leaf number, number of branches, number of fruits, and fruit yield. The maximum plant height was observed in the control group without pinching. The maximum number of branches, the highest leaf number, the number of fruits, and the yield were achieved when pinching was performed at 30 DAT compared to other treatments and control. Based on the observed result, it can be concluded that pinching the chili plants at 30 DAT was the most effective approach for achieving optimal growth and yield.

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1. Introduction

Chili (*Capsicum annuum*) is a highly valued and widely cultivated spice crop known for its heat, flavor, and vibrant colors. They play an essential role in various cuisines, adding richness and depth to dishes such as vegetables, pickles, salads, and appetizers (Kumara et al., 2016). Chili belongs to the *Capsicum* genus, which is indigenous to southern North America and northern South America. This genus comprises a diverse range of species, estimated to be between 25 and 200. Among these species, there are five commonly cultivated ones: *Capsicum annuum* L., *Capsicum frutescens* L., *Capsicum chinense* Jacq., *Capsicum baccatum* L., and *Capsicum pubescens* L. (Roy, 2016).

In Nepal, chili cultivation is a significant agricultural activity, throughout the year. The primary chili season spans from October to April, accounting for approximately 70% of the country's total production (Ashrafuzzaman et al., 2011). However, despite its importance, Nepal faces challenges in meeting the demand for chili peppers, resulting in substantial imports from neighboring India. About 80% of dry chilies and 24% of green chilies are sourced from India, indicating the low domestic production and no self-sufficiency in this spice crop. Several factors affect the limited chili production in Nepal. Farmers encounter constraints such as a lack of necessary inputs, insufficient knowledge about appropriate farming practices, and limited technology development and transfer. Additionally, farmers in rural and hilly areas often lack awareness of effective pest and disease management techniques, further impeding chili cultivation.

To address these challenges and enhance chili production, it is crucial to explore innovative techniques and practices that can improve yields and farmers' livelihoods. One such technique is pinching, which involves removing the apical buds and some leaves, allowing side branches to develop (Rajput et al., 2020). Pinching offers several benefits, including disease control, promotion of lateral bud growth, and increased fruit formation (Jyothi et al., 2018). By stimulating the growth of multiple terminal shoots that bear flowers, pinching has the potential to enhance chili yield (George, 2004).

Despite the potential advantages of pinching, there is limited information available regarding the optimal timing and application of this technique in chili cultivation. Therefore, this study aims to determine the appropriate timing for pinching in chili production, with the goal of increasing growth and yield.

2. Materials and methods

2.1. Plant materials

The experiment was carried out from March 2021 to August 2021 at the Gokuleshwor Agriculture and Animal Science area in Baitadi, Nepal. The field's coordinates are 29.6880° N latitude and 80.5494° E longitude at an elevation of 850 m above mean sea level. This region falls within the subtropical and temperate climate zone, with average summer and winter temperatures of 21.1°C and 7.7°C, respectively. The experimental design was laid out in a Randomized Complete Block Design (RCBD) with four treatments (Table 1) and each treatment was replicated by five times. Each individual plot was of 1.8 × 1.8 m dimensions.

Table 1. Different treatments used in the experiment

Treatment	Treatment detail
T1	Pinching at 20 DAT
T2	Pinching at 30 DAT
T3	Pinching at 40 DAT
T4	No Pinching

The main field was plowed multiple times, and farmyard manure (FYM) was applied and incorporated into the soil during the final plowing. The recommended basal dose of fertilizer, including urea, single super phosphate, and muriate of potash, was applied. NS1701 seeds were sown in seedling trays and about a month after sowing, they were planted with between-row and within-row spacing of 45 x 30 cm in well-prepared soil on 24th April, 2021.

The remaining half dose of nitrogen was applied as a top dressing four weeks after transplanting. Regular cultural operations and plant protection measures were carried out as per requirement.

2.2. Methods

Five plants were randomly selected, excluding the border plants, and tagged accordingly to record observations on various growth and yield parameters. Observations were made on the plants on the 30th, 40th, 50th, 60th, 70th, 80th and 90th days after planting (DAT). The height of the plant was measured from the base to the tip of the apical bud. The number of leaves per plant was determined by counting fresh fully developed leaves. The number of branches, number of fruits, and total yield of chili were measured on tagged plants.

2.3. Statistical analysis

The collected data were compiled and entered into Microsoft Excel for analysis. GenSTAT C software (15th Edition) was used for the Analysis of variance. In this study groupings were established based on LSD (Least Significant Differences).

3. Results and discussion

3.1. Effect of pinching on plant height

Pinching did not significantly affect plant height at 30, 40, 60, and 70 DAT but it did have a significant impact on plant height at 50 DAT (Table 2). The control group (no pinching) showed the highest plant height, which was statistically similar to the plants subjected to pinching at 30 DAT.

On the other hand, the lowest plant height was observed in the group where pinching occurred at 40 DAT, and this was statistically similar to the plants in the pinching at 20 DAT and pinching at 30 DAT treatments. The reduced height of the pinched plants can be attributed to the removal of the apical portion during pinching, while the control plants showed greater height due to the absence of pinching. Nain et al. (2017) also reported similar results, noting that plants without pinching exhibited maximum height, possibly due to the limited distribution of nutrients towards lateral branches. This promotes continuous vegetative development, photosynthesis, and the production of auxin hormones, which aid in cell elongation. Consistent findings have been reported by Sahu and Biswal (2020) and Rajput et al. (2020). Meena et al. (2015) found that repeated pinching leads to the development of multiple side branches, resulting in reduced plant height.

Table 2. Effect of pinching on plant height (cm) of chili var. NS-1701.

Treatments/Days After Transplanting (DAT)	30 DAT	40 DAT	50 DAT	60 DAT	70 DAT
Pinching at 20 DAT	15.34^{ab}	26.00^{b}	37.20^{b}	54.84^{b}	59.40^{b}
Pinching at 30 DAT	14.00^{b}	26.48^{b}	37.08^{b}	58.64^{b}	64.14^{ab}
Pinching at 40 DAT	17.08^{a}	28.63^{ab}	38.31^{b}	54.64^{b}	59.14^{b}
No pinching	17.28^{a}	31.68^{a}	48.04^{a}	63.18^{a}	70.10^{a}
LSD	2.93	4.91	8.11	7.66	8.60
CV (%)	13.4	12.6	14.6	9.6	9.9

LSD= Least Significant Differences, NS= non-significant, *significant at 5% level

3.2. Effect of pinching on the number of leaves per plant

The effects of pinching on the number of leaves were not statistically significant at 30, 40, 50, 60, and 70 DAT (Table 3). At 70 DAT, the highest number of leaves per plant was observed in the group where pinching occurred at 30 DAT, but this was statistically similar to the plants subjected to pinching at 40 DAT and the control group (no pinching). The lowest number of leaves per plant was recorded in the group where pinching occurred at 20 DAT.

Similar findings were reported by Kattel et al. (2023) in okra plants, where pinching at different stages did not significantly affect the number of leaves. Their study compared at no pinching, first node pinching,

second node pinching, third node pinching after transplanting and found no significant differences in leaf number among the treatments. Likewise, Kumar et al. (2018) found no significant effect of nipping on leaf number in field bean.

Table 3. Effect of pinching on the number of leaves of chili var. NS-1701

Treatment/ Days After Transplanting (DAT)	30 DAT	40 DAT	50 DAT	60 DAT	70 DAT
Pinching at 20 DAT	47.68^{b}	93.72^{a}	104.6^{a}	105.8^{a}	115.3^{b}
Pinching at 30 DAT	60.22^{a}	101.40^{a}	119.2^{a}	129.1^{a}	139.8^{a}
Pinching at 40 DAT	52.76^{ab}	93.04^{a}	106.6^{a}	122.8^{a}	129.6^{ab}
No pinching	51.48^{ab}	90.96^{a}	101.0^{a}	114.8^{a}	133.1^{ab}
LSD	11.07	18.11	21.61	24.03	21.15
CV (%)	15.1	13.9	14.5	14.8	11.9

LSD= Least Significant Differences, NS= non-significant, *significant at 5% level

3.3. Effect of the pinching on the number of branches per plant

Pinching significantly impacted the number of branches at 40, 50, and 60 DAT, but not at 30 and 70 DAT (Table 4). The highest number of branches per plant was observed in the group where pinching occurred at 30 DAT, which was statistically partial similar to the group subjected to pinching at 20 DAT. On the other hand, the lowest number of branches was recorded in the control group without any pinching.

The increase in the number of branches per plant can be attributed to the removal of terminal buds during pinching, which reduces the concentration of auxin and limits vertical plant growth (Ali et al., 2021). Similarly, Maharnor et al. (2011) found that pinching at 30 DAT resulted in the maximum number of primary branches per plant, increased plant spread, and larger stem diameter.

Table 4. Effect of pinching on the number of branches of chili var. NS-1701

Treatments/Days After Transplanting (DAT)	30 DAT	40 DAT	50 DAT	60 DAT	70 DAT
Pinching at 20 DAT	6.56^{a}	7.52^{a}	8.38^{ab}	10.08^{ab}	11.64^{ab}
Pinching at 30 DAT	6.42^{a}	7.80^{a}	9.94^{a}	11.60^{a}	12.90^{a}
Pinching at 40 DAT	5.96^{a}	6.72^{ab}	8.05^{b}	9.11^{b}	10.46^{b}
No Pinching	5.48^{a}	6.22^{b}	7.36^{b}	8.63^{b}	9.94^{b}
LSD	1.258	1.059	1.612	1.606	2.245
CV (%)	15.0	10.9	13.9	11.8	14.5

LSD= Least Significant Differences, NS= non-significant, *significant at 5% level

3.4. Effect of pinching on the number of fruits per plant

Table 5 shows that the highest number of fruits per plant was observed in the pinching occurred at 30 DAT. The lowest number of fruits per plant was recorded in the group where pinching occurred at 40 DAT, which was statistically similar to the groups subjected to pinching at 20 DAT and the control group without any pinching.

The greater fruit production observed in the group subjected to pinching at 30 DAT could be attributed to the accumulation of additional synthetic compounds that were later utilized for the production of more flowers, resulting in a higher number of fruits. These findings align with a study by Eve et al. (2016) on butternuts, which reported similar outcomes. Tswanya et al. (2017) also found that pinching at around 30 DAT significantly increased the number of fruits in eggplant plants. Similarly, Mardhiana et al. (2016)conducted a study on cucumber plants and found that pruning significantly increased fruit yield, especially at the right time, by about 30 DAT. The development of lateral branches induced by pinching can be attributed to the increased number of fruits, with more sites for flower formation and subsequent fruit sets being provided, thereby supporting the findings of this study.

Table 5. Effect of pinching on the number of fruits of chili var. NS-1701

Treatments/Days After Transplanting (DAT)	50 DAT	60 DAT	70 DAT	80 DAT	90 DAT
Pinching at 20 DAT	1.24^{b}	15.68^{b}	23.72^{a}	35.40^{a}	30.50^{a}
Pinching at 30 DAT	2.48^{a}	21.02^{a}	29.09^{a}	41.23^{a}	34.62^{a}
Pinching at 40 DAT	1.90^{a}	17.83^{ab}	26.03^{a}	33.70^{a}	29.68^{a}
No pinching	1.20^{b}	10.95^{c}	17.20^{b}	31.56^{a}	31.76^{a}
LSD	0.640	4.417	6.068	10.76	5.877
CV (%)	27.2	19.6	18.3	22.0	13.5

LSD= Least Significant Differences, NS= non-significant, *significant at 5% level

3.5. Effect of pinching on yield

Pinching has significant variations in yield across the different treatments. The highest yield was observed when pinching was performed at 30 DAT, followed by pinching at 40 DAT, which was statistically similar to pinching at 20 DAT. The treatment without pinching resulted in the lowest yield. The average gross yield achieved was 25.12 tons per hectare.

The increased yield in the pinched treatments can be attributed to the stimulation of branching stems, flowers, and fruits as a result of the pinching technique. These findings align with previous research by Rajbeer & Kumar (2009), who reported similar outcomes. Singh and Kaur (2018) conducted a study on bell pepper plants and found that pinching at the appropriate stage significantly enhanced yield. They explained that pinching induced lateral branching, leading to an increased number of flowering sites and subsequent fruit production, resulting in an overall higher yield. Tswanya et al. (2016) investigated tomato plants and reported that pinching around 30 DAT led to increased lateral branching, flowering, and fruit production. Similarly, Sarkar et al. (2007) studied sweet pepper plants and found that pinching at the appropriate time significantly increased the number of branches and fruit yield, providing further support for the results observed in this study.

Table 6. Effect of pinching on yield of chili var. NS-1701

Treatment	Yield (ton per hectare)
1	23.81^{b}
2	33.06^{a}
3	24.58^{b}
4	19.05^{c}
LSD	3.819
CV (%)	11

LSD= Least Significant Differences, NS= non-significant, *significant at 5% level

4. Conclusion

The results of the study imply that pinching can significantly affect the growth and yield of chili plants. Pinching at 30 days after transplanting (DAT) was found to be the most effective technique, leading to increased plant height, maximum leaves and branches, as well as improved fruit output and yield. These results offer valuable insights for chili farmers, highlighting the potential benefits of incorporating pinching techniques into their cultivation practices. Further research can expand on these findings by exploring additional factors and parameters related to pinching's effects on chili cultivation.

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Compliance with Ethical Standards

Conflict of Interest

Authors have no conflict of interest to declare.

Authors' Contributions

Sabina Aryal and Pooja Thapa prepared the research proposal, field work, data collection, analysis, interpretation, and manuscript preparation. All other authors supported in data collection and editing. Sabina Aryal finalized the manuscript. All authors collectively reviewed and approved the final manuscript for submission.

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Data availability

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