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ORIGINAL RESEARCH ARTICLE

Effect of different organic manures on the growth and yield of Zucchini in Khotang, Nepal

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ABSTRACT

This experiment was conducted from February 2022 to May 2022 in ward no 1 of Diktel Rupakot Majuwagadi Municipality, Khotang district of Nepal to evaluate the efficacy of different organic manures in the growth and yield of zucchini in Khotang. We aimed to identify the most effective organic manure (goat manure, poultry manure, farm yard manure (FYM), vermicompost experiment, and control), and the research was carried out in a Randomized Complete Block Design (RCBD) with five treatments and four replications. The Cheongma variety of zucchini was used as a test crop. The recommended dose of manure (goat manure at 20 t/ha, poultry manure at 15 t/ha, FYM at 20 t/ha, vermicompost at 6 t/ha, and control) was applied to each treatment. There is no significant difference observed between treatments and vegetative parameters but a significant difference was found in yield. Furthermore, results showed that the highest yield was obtained from the field treated with poultry manure (1.84 kg), followed by FYM (1.40 kg) and 1.38 kg on vermicompost, respectively. The minimum yield was recorded at 1.09 kg from control, followed by goat manure (1.29 kg). The study by (Farhan, 2021; Eifediyi, 2010) found that the application of poultry manure and FYM significantly increased fruit yield and our research study also demonstrated the same findings.

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INTRODUCTION

Cucurbits are important vegetable crops in Nepal and are considered important in the local diet. Common cucurbits include pumpkin (*Cucurbita moschata*), cucumber (*Cucumis sativus*), bottle gourd (*Lagenaria siceraria*), sponge gourd (*Luffa acutangula*), and zucchini squash (*Cucurbita pepo*) (Mondal, 2020). Zucchini, also known as summer squash, produces a lot of biomasses and contains high nutrients (Pokluda, 2018). In horticulture, zucchini is considered an important crop globally, mostly consumed as a vegetable crop, and also has various health benefits and medicinal importance as it is rich in nutrients and bioactive compounds such as phenolics, flavonoids, vitamins, amino acids, carbohydrates, and minerals (Toscano, 2021; Shrestha, 2021). Furthermore, zucchini contains pectin which provides anti-bacterial, antioxidant, anti-inflammatory, diabetic, and insulin-regulating properties (Minzanova, 2018). Moreover, zucchini benefits in improving human health by helping inhibit hydrogen peroxide-induced damage and exhibiting anti-proliferative and pro-apoptotic action against tumor cells (Martínez-Valdivieso, 2017).

Zucchini can grow to massive sizes, but small and medium-sized zucchini are more flavorful. The bigger the zucchini, the harder, seedier, and less flavorful it becomes. In Nepal, this crop is relatively new but is increasingly gaining high economic importance (Gyawali, 2022). The total area, production, and productivity of

zucchini in Nepal are 1,528 ha, 23,906 mt, and 16 mt/ha, respectively (Shrestha, 2021). In Chitwan and the southern Terai region of Nepal, commercial cultivation of cucumber, watermelon, and zucchini squash began in the early 1980s (Dahal, 1992). Although the cultivation of zucchini began early, commercial production has not been practiced due to limited research, unaware of its nutritional importance and organic cultivation practices (Singh, 2017). With the ever-increasing use of chemical fertilizers and harsh climatic conditions, soil fertility is declining in developing countries. The only way to revive declining soil fertility is through the application of organic manures and fertilizers by reducing the use of chemical fertilizers (Agyarko, 2007). The rational use of organic manure not only increases soil fertility and productivity but also enhances sustainable farming practices.

Organic manure has been used since ancient times to provide nutrients to plants (Toscano, 2021). Organic fertilizer provides essential nutrients to the soil, which improves the soil's physical properties and supplies essential nutrients for plant growth and can be available in different forms, like farm manure, city waste, poultry manure, waste from industry, goat manure, rabbit manure, and many others (Larkin, 2020; Loss, 2019). Organic manures not only promote plant growth but also enable soil to hold more water and help improve drainage in clay soils, providing organic acids, which contribute to dissolving nutrients in the soil and making them available for plants (Shaji, 2021). According to the official Italian institution for the food and agriculture market, 1,167,360 ha of Italy's land is used for organic farming, which contributes to more than 25% of the organically grown goods in Europe (Maggio, 2013).

The use of bio-fertilizers is the principal factor in economic production that has been focused on global environmental problems, with the utilization of organic waste, vermicompost, and poultry manures as the most effective measures for the purpose (Kayesh, 2023). The properties include the structure of the soil, moisture holding capacity, diversity, the activity of soil organisms, aggregate stability, and the reduction of pollution from agriculture practices (Gurmu, 2019).

This experiment specializes in optimizing zucchini cultivation in Nepal via organic farming techniques and underscores the significance of organic manure in enhancing soil fertility, growth, and yield of zucchini, which not only helps in sustainable production but also complements the nutritional requirements of the plant. By the application of different organic manures such as goat manure, poultry manure, FYM, and vermicompost, this research contributes to the growth and massive yield of zucchini as compared to the control which ultimately helps to economic production of zucchini in Nepal.

MATERIALS AND METHODS

Study area

The experiment was conducted on the farmer's field of ward no 1 of Diktel Rupakot Majuwagadi Municipality which falls under the area of vegetable zone of Khotang district. The research site is at the elevation of 1530 masl. Geographically, Khotang is a hilly district of eastern Nepal. It lies on the coordinates of 260° 50" N to 270°28" N latitude and 860°58" E longitude. The total area of the district is 1,591 square kilometers.

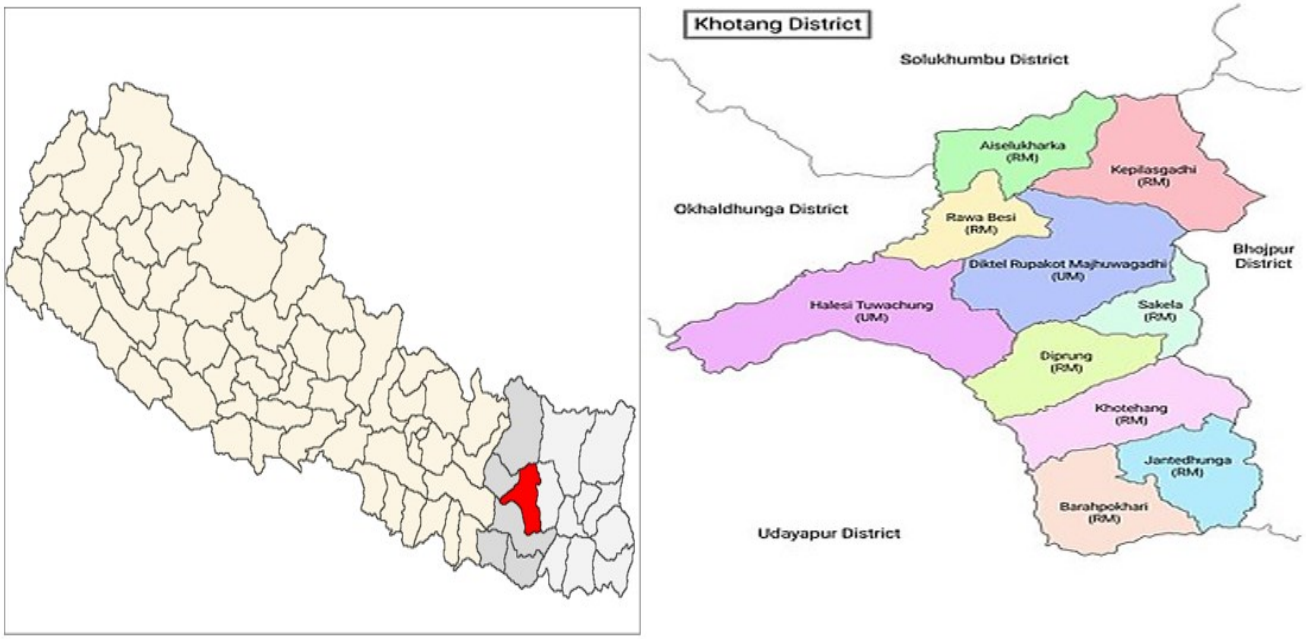

Figure 1. *Map of research site (Dhakal, 2014).*

Experimental design and treatment factors

The experiment was conducted in a Randomized Complete Block Design (RCBD) with 5 treatments including control and four replications. The total area allocated for the experiment field was 201.4m² (19×10.6). The spacing between replication was 1m, whereas it was 0.5m between treatments. Each replication contained 5 plots with an area of 7.2m² (3×2.4m) per plot. A total of 15 plants per plot were maintained at spacing 0.6 ×0.5m. The plots were raised to about 0.2m. The field was oriented in the North-South direction lengthwise.

The treatments consist of Goat manure, poultry manure, farm yard manure (FYM), vermicompost, and control.

T1: Goat manure; T2: Poultry manure; T3: Farmyard manure; T4: Vermicompost; T5: Control

Observation

Vegetative observation

The height of the plant was measured from the area of contact with the soil to the highest leaf in the plant at 30-day intervals from transplanting starting from 30 days after transplanting (DAT) and the number of leaves of each plant was calculated by calculating all its leaves very small 30 DAT.

Reproductive observation

Firstly, the number of flowers was calculated when 50% of the plant started blossoms and harvesting of fruits was started 48 days after transplanting and data was taken in 1-week intervals. In addition, the average number of fruits per plant was calculated by dividing the total number of fruits by the number of plants and the average weight of the fruit was calculated by measuring the total weight harvested and dividing it by the number of fruits. Additionally, the length of the fruit was measured by a measure of the base of the fruit and to the top. Lastly, the diameter of each fruit was measured and its average was calculated.

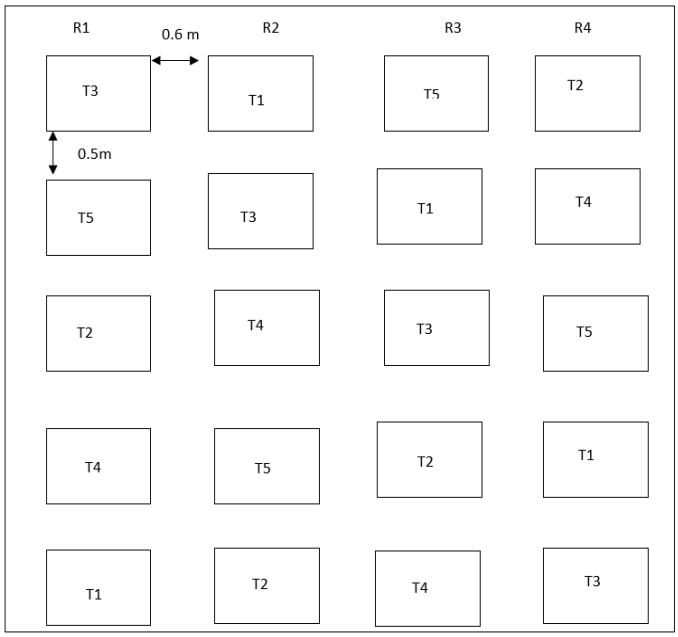

Figure 2. *Layout of field (FILHO, 2020).*

Statistical analysis

Data was entered in MS Excel (2007) and subjected to ANOVA with the help of GenStat (15th edition). Mean comparison among significant variables was carried out by the Fisher-LSD test at a 5% level of significance.

Nursery raising

The nursery area was plowed and leveled and a seedbed was prepared. The soil was treated with fungicides (*Trichoderma viridae*), and the seed was sown by line sowing method. The seeds were covered by sand to enhance proper germination. Light irrigation was done after sowing and the nursery area was covered by plastic to maintain proper temperature for faster seed germination. Optimum soil moisture was maintained in the nursery for proper growth. The seed was sown in the nursery on 10 Feb 2022.

RESULTS AND DISCUSSION

Effect of treatments on the number of leaves and plant height

Number of leaves

Analysis of the data revealed that the number of leaves was not significantly affected (P≤0.05) by the use of different organic manures (Table 2). However, farm yard manure produces the highest number of leaves (13.3) followed by goat manure (12.80) and control (12.72). The lowest leaves number was recorded in poultry and vermicompost treated plots i.e. 12.48 and 11.88 respectively.

Plant height

The mean plant height was not affected significantly (P≤0.05) by different treatments (Table 2). Zucchini plants grown using poultry manure attained the maximum plant height (31.91cm). The use of goat manure shows better performance after poultry (31.29) whereas FYM and control attained the lowest plant height (28.39 cm and 29.12 cm, respectively). The study shows that the maximum plant height recorded was in poultry manure followed by goat manure. The highest number of leaves recorded was shown on goat manure. Particularly, the number of flowers, fruit length, and yield were very low in the control treatments which is in line with an experiment carried out by (Souza, 2020). Although the result on vegetative parameters (plant height, no leaves) is not significantly affected by poultry manure but shows better performance than the control which is per the research done by (Rashwan, 2021).

Yield and yield attributing parameters

Fruit yield: There was a significant difference (p≤0.05) among different treatments in fruit yield per plant (Table 3). The highest fruit yield per plant was recorded from plots receiving poultry manure (1.84 kg) which was followed by FYM and vermicompost i.e., 1.40 kg and 1.38 kg, respectively. Whereas the lowest yield per plant was obtained from the control plot (1.09 kg) followed by goat manure (1.29 kg) which were statically at par with each other.

Table 1. Treatment details.

S. No.	Designation letters	Treatments	Dose	Nitrogen (%)
1	T1	Goat manure	20tons/ha	0.89
2	T2	Poultry manure	15 tons/ha	3.25
3	T3	Farmyard manure	20 tons/ha	0.91
4	T4	Vermicompost	6 tons/ha	1.25
5	T5	Control	---------	-----

The treatments presented above in the table are used for conducting the research and the percentage of nitrogen content from each dose is taken from the cited article (Sharma, 2022).

Table 2. Effect of different organic manure on the number of leaves and plant height at Khotang, Nepal in 2022.

Treatment	Number of leaves	Plant height (cm)
Poultry manure	12.48	31.91
Goat manure	12.80	31.29
Vermicompost	11.88	29.52
FYM	13.33	28.39
Control	12.72	29.12
Mean	12.64	30.05
Sed	1.49	1.88
CV (%)	16.60	8.90
F-Test	Ns	ns

Values are the mean of four replications; CV: Coefficient of variation; ns: non-significant at a 5% level of significance; Values with the same letters in a column are not significantly different at a 5% level of significance by Fisher-LSD.

Table 3. Effect of different organic manure on yield and yield attributing parameters at Khotang, Nepal in 2022.

Treatment	Number of flowers	Number of fruits	Fruit length (cm)	Fruit diameter (cm)	Yield per plant (kg)
Poultry manure	1.80	2.84	28.01	18.76	1.84[a]
FYM	1.63	1.92	24.36	15.33	1.40[ab]
Vermicompost	1.60	1.92	24.69	16.03	1.38[b]
Goat manure	1.90	2.59	25.36	15.83	1.29[b]
Control	1.45	2.25	22.28	15.59	1.09[b]
Mean	1.68	2.302	24.94	16.31	1.4
Sed	0.39	0.29	2.09	1.59	0.213
CV (%)	33.1	17.1	11.8	13.8	21.5
F-Test	Ns	ns	Ns	ns	*

Values are mean of four replications CV: Coefficient of variation; *: Significant at 5 % level of significance; Values with same letters in a column are not significantly different at 5% level of significance by Fisher-LSD.

Number of flowers: There was no significant difference ($p \leq 0.05$) among different treatments in several flowers per plant (Table 3). The highest number of flowers was observed in the plot receiving goat manure i.e. 1.90 which was followed by poultry manure and FYM i.e. 1.80 and 1.625, respectively. The lowest number of flowers was seen in the control plot which is 1.45 followed by vermicompost (1.60).

Number of fruits: There was no significant difference ($p \leq 0.05$) among different treatments in several fruits (Table 3). The use of poultry manure produces significantly a greater number of fruits (2.84) which was followed by goat manure (2.59) and control (2.25). The lowest number of fruits was recorded in FYM (1.917) followed by vermicompost (1.92).

Fruit length: There was no significant difference ($p \leq 0.05$) among different treatments in fruit length (Table 3). On analyzing the data, poultry manure had higher fruit length (28.01 cm), respectively followed by goat manure (25.36cm). Similarly, the minimum fruit length was shown on control (22.28 cm) followed by FYM (24.36cm).

Fruit diameter: There was no significant difference ($p \leq 0.05$) among different treatments in fruit diameter (Table 3). The highest diameter of the fruit was seen in poultry manure (18.76 cm) followed by vermicompost (16.03cm). While the treatments with FYM, control, and goat manure show the lowest performance in fruit diameter i.e., 15.33 cm, 15.59 cm, and 15.83 cm, respectively. Organic manures are natural products used by farmers to provide food for the plants. The observation was made to evaluate the impact of various organic manure on the growth and yield of zucchini. Significant difference was observed in yield over control among all treatments but non-significant difference was found in yield attributing parameters and vegetative parameters. A single field experiment may not be adequate for achieving proper recommendations. So, multiple experiments should be conducted in multiple locations with varying climatic conditions for extracting reasonable recommendations and conclusions. Poultry manure and farm yard manure were found best over the rest of the treatments by recording the maximum yield per plant. Although there was no significant difference in vegetative parameters, the maximum plant height was recorded in poultry manure, and the highest

number of leaves was recorded in farm yard manure. Also, there was no significant difference in yield attributing parameters, the maximum number of fruits, fruit length, and fruit diameter was highest in poultry manure, and a maximum number of flowers was found in goat manure. In the end, this study concludes that poultry manure and farm yard manure would be effective organic manures to obtain a better yield of zucchini. Analysis shows that the use of different organic manures does not have a significant effect on vegetative growth. However, it has a significant effect on yield. The highest yield of the zucchini was found in the poultry manure and farm yard manure. This result is by the findings of (Farhan, 2021) and (Eifediyi, 2010) in which poultry manure and FYM showed a significant increase in yield as compared to control. The experiment shows that poultry manure shows the best performance in yield, fruit diameter, fruit length, and number of fruits however, no significant difference was observed. In terms of several leaves, FYM shows the best performance having a maximum number of leaves among all treatments which supports the work done by (Kaur, 2021). The highest number of zucchini flowers was found in the plot where goat manure was used which is in line with the findings of (Mkhabela, 2020).

Conclusion

The comprehensive research on the Effect of Different Organic Manures on the Growth and Yield of Zucchini in Khotang, Nepal provided valuable insights. Adopting Randomized Complete Block Design (RCBD) with five treatments and four replications, a significant difference was observed in yield over control among all treatments. However, a non-significant difference was found in yield attributing and vegetative parameters. The highest yield was obtained from the field treated with poultry manure (1.84 kg), followed by FYM (1.40 kg), 1.38 kg on vermicompost, goat manure (1.29 kg), and (1.09) kg from control. Although there was no significant difference in vegetative parameters, the maximum plant height was recorded in poultry manure, and the highest number of leaves was recorded in farm yard manure. Also, there was no significant difference in yield attributing parameters, the maximum number of fruits, fruit length, and fruit diameter was highest in poultry manure, and a maximum number of flowers was found in goat manure. In the end, this study concludes that poultry manure and farm yard manure would be effective organic manures to obtain a better yield of zucchini.

DECLARATIONS

Author contribution statement

Conceptualization: A.S and R.B; Methodology: N.B.; Software and validation: R.B., N.A., and A.S.; Formal analysis and investigation: N.B.; Resources: A.K.; Data curation: N.B.; Writing—original draft preparation: R.B.; Writing—review and editing: N.B.; Visualization: A.S.; Supervision: R.C.; Project administration: N.A.; Funding acquisition: LB.C. All authors have read and agreed to the published version of the manuscript.

Conflicts of interest: The authors declare that there are no conflicts of interest regarding the publication of this manuscript.

Ethics approval: This study did not involve any animal or human participant and thus ethical approval was not applicable.

Consent for publication: All co-authors gave their consent to publish.

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Supplementary data: Available.

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