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Original Paper

Effect of Organic and Inorganic Manure on Growth And Yield of Okra in Ramdhuni, Sunsari

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***Abstract*— Farmers consider chemical fertilizer to be the only reliable source of plant nutrients, but its use decreases the physical, chemical, and biological properties of soil. Therefore, a field experiment was conducted at Jibika College of Agricultural Sciences, Ramdhuni, Sunsari, Nepal, from March 2023 to July 2023 to assess the effectiveness of different organic and inorganic manures on the growth and yield of okra. The experiment was carried out in an RCBD design with seven treatments (poultry manure, goat manure, FYM, vermicompost, pig manure, the recommended dose of fertilizers, and the control), which were replicated three times. The Arka Anamika variety of okra was used as a test crop. After analyzing the organic manure, the rate of manure application was fixed based on the nitrogen content. Data were collected on growth parameters such as days to first germination, days to first flowering, plant height, plant diameter, and number of leaves per plant. Similarly, yield parameters, including fruit length, fruit diameter, fruit weight, and yield, were measured. Analysis of variance was performed on the data via R-studio, and significant means were compared via Duncan's multiple range test. After analyzing the data, we found that most of the growth parameters, such as plant height, stem diameter, number of leaves, largest leaf length, and breadth, were prominent in poultry manure. Similarly, growth parameters for fruit weight and yield were significantly greater in poultry manure, but fruit length was greater with chemical fertilizer application. Based on the findings of the experiments, it was concluded that, compared with other types of fertilizers, poultry manure is the most appropriate fertilizer source for the optimum performance of okra, which is recommended for farmers.**

Keywords : Growth, Nutrient, Okra, Organic manure, Yield

I. Introduction

Okra (Abelmoschus esculentus) is an herbaceous, hairy annual plant belonging to the Malvaceae family and is also called a lady's finger because of its edible, green, tender, and delicious pods. It is an affordable source of carbohydrates, protein, minerals, vitamins, dietary fiber, and other phytonutrients with physiological benefits [1]. The plant is cultivated in tropical, subtropical, and temperate regions of the world. During the 12th century B.C., ancient Egyptians cultivated okra, which originated near Ethiopia. The chromosome number of okra varies greatly, with the number of diploids ranging from 2n = 66 to 144 [2].

According to [3], the total area is 2159 ha, with 24241 mt production, and the yield is 11.23 mt/ha in Province 1. Similarly, the area is 711 ha with 7942 mt production, and the yield is 11.17 mt/ha in the Sunsari district.

Manure contains nutrients that are released more slowly and retained in the soil for a longer period, ensuring longer-lasting impacts and increased root development [4]. The frequent application of FYM, which contains significant amounts of magnesium, may have aided in the production of chlorophyll and accelerated photosynthesis [5]. Combined application of organic and inorganic fertilizers reduces the farmer's cost of production and increases the production of okra [6].

A. Objectives

- To evaluate okra's growth performance after applying different organic and inorganic manures.
- To assess the yield and yield attributing traits of parameters treated with various organic and inorganic manures.

II. Materials And Methodology

An investigation was conducted at Jibika College of Agricultural Sciences, Ramdhuni-06, Sunsari, Nepal, from March 2023 to July 2023 to assess the effectiveness of different organic and inorganic manures on the growth and yield of okra. The experiment was conducted in a randomized complete block design, which consisted of 7 treatment combinations: vermicompost @10.63 kg/plot (T1), control (T2), FYM @12.66 kg/plot (T3), poultry @8.50 kg/plot (T4), chemical fertilizer @0.5:0.68:0.08 NPK gm/plot (T5), pig manure @ 11.90 kg/plot (T6), and goat manure @9.72 kg/plot (T7). Each treatment was replicated 3 times. The experimental block consisted of 21 plots, each accommodating 5 rows, with 6 seeds in each row constituting 30 plants spaced 45×45 cm

apart. The Arka Anamika variety was selected for investigation. The organic manure in each plot was incorporated into the soil 7 days prior to sowing, a full dose of phosphorus and potassium, along with ½ N, was applied to the T5 plot as a basal dose, and the remaining half of the nitrogen was applied 35 days after sowing. A fertilizer and soil test was performed, and the quantities of manure required for the experiment were calculated on the basis of the soil nutrient content and the nutrient content of the manure.

TABLE I. SOIL PROPERTIES OF THE EXPERIMENTAL FIELD BEFORE SOWING OKRA AT RAMDHUNI, SUNSARI, NEPAL.

Nutrients	Value
Nitrogen	0.05
Phosphorus	58.4
Potassium	143.0
pH	5.0
Organic Matter	1.06
Bulk density	1.41 g/cm
Texture of soil	Silty loam

TABLE II. NUTRIENT STATUS OF VARIOUS ORGANIC MANURES

Elements	Amount present (%)				
	FYM	Vermi compost	Poultry	Pig	Goat
Nitrogen	1.74	2.0	2.5	1.6	1.6
Phosphorus	2.03	3.3	2.4	4.5	2.05
Potassium	1.7	4.5	2.06	1.5	4.2
Carbon	15	14.7	13.4	14.5	15.8
Moisture	81	75	75	57.1	28
pH	7.7	8.8	7.0	7.3	9.1

Two okra seeds were sown per hole, and the seedlings were thinned to one plant per stand at two weeks after sowing. The intercultural operations and plant protection measures were followed as per the recommendation of the crop. The observations were measured on five randomly selected and tagged plants in each plot, and their mean value was calculated. Microsoft Excel was used for data manipulation. R-Studio was used for the analysis of different data collected during the experiment. The significance of the difference in the treatment effect was tested through the 'F' test at the 5% level of significance, and the critical difference (CD) was calculated wherever the results were found to be significant.

III. RESULTS AND DISCUSSION

A. Plant Height

The effects of various organic and inorganic manure treatments on the plant height of okra at different growth stages are presented in Table 8. At 20 DAS, pig manure resulted in a significantly taller (6.44 cm) height, which was similar to that of poultry (6.06 cm). The plant heights obtained from chemical fertilizer (5.63 cm) and goats (5.63) were similar. Similarly, the plant heights obtained from the vermi-compost (4.69 cm) and FYM (4.93 cm) treatments were similar to that of the control (4.68 cm), which was lower than those of poultry and pigs, respectively. At 35 DAS, poultry manure resulted in a significantly taller (15.53 cm) plant height than the other treatments did. The plant height obtained from NPK (13.30 cm) was similar to that obtained from pig manure (12.78 cm). The shortest plant height was obtained from the control (7.88 cm), similar to the FYM (8.24 cm). At 50 DAS, poultry manure had the tallest height (33.68 cm). Similarly, the plant height obtained from vermicompost (20.48 cm) was similar to that of FYM (20.25 cm). The shortest plant (16.67 cm) height was obtained from the control treatment.

TABLE III. EFFECTS OF DIFFERENT SOURCES OF MANURE ON THE PLANT HEIGHT OF OKRA AT RAMDHUNI, SUNSARI, NEPAL

Treatments	Plant height				
	20DAS	35DAS	50DAS	65DAS	80DAS
Vermicompost	4.69^{b}	9.22^{d}	20.48^{cd}	47.27^{cd}	81.11^{b}
Control	4.68^{b}	7.88^{e}	16.67^{d}	41.46^{d}	88.26^{b}
FYM	4.93^{b}	8.24^{de}	20.25^{cd}	46.23^{cd}	86.58^{b}
Poultry	6.06^{a}	15.53^{a}	33.68^{a}	76.80^{a}	123.69^{a}
Chemical fertilizer	5.63^{ab}	13.30^{b}	28.37^{ab}	66.42^{ab}	123.09^{a}
Pig	6.44^{a}	12.78^{b}	25.15^{bc}	58.88^{bc}	101.41^{ab}
Goat	5.63^{ab}	11.14^{c}	24.48^{bc}	57.21^{bc}	99.57^{ab}
Sem(±)	0.12	0.41	0.68	1.69	2.91
LSD(=0.05)	1.03*	1.03**	5.54***	13.81**	23.73**
CV (%)	10.71	5.20	12.91	13.78	13.27
Grand mean	5.43	11.20	24.15	56.32	100.53

Note: SEM(±), standard error of the mean; CV, coefficient of variation; LSD, least significant difference; means in the column with the same letter (s) in superscript indicate no significant difference between treatments at the 5% level of significance, '*' indicates significance at the 10% level of significance;'**' indicates significance at the 5% level of significance, '***' indicates significance at the 1% level of significance.

At 65 DAS, poultry manure produced significantly taller plants (76.80 cm) than the other treatments did. Similarly, pig manure produced a height of 58.88 cm, which was similar to that of goats (57.21 cm). Vermicompost produced a height of 47.27 cm, which was similar to that of the FYM (46.23 cm). The shortest plant (41.26 cm) height was obtained from the control treatment.

At 80 DAS, poultry manure produced significantly taller plants (123.69 cm) than those in the other treatments, which was similar to the results of the chemical fertilizer. The shortest plant height was obtained from vermicompost (81.11 cm), which was similar to that of FYM and the control.

Field experiments conducted by [7, 8, 9]also revealed that okra grown on poultry manure performed better in terms of the height of the plant than other sources of organic manure did, which supports our findings. Our findings were further supported by

B. Stem Diameter

The effects of various treatments on diameter varied significantly (<0.05) at 20, 35, 50, 65, and 80 DAS. At 20 DAS, poultry manure (3.33 mm) had a significantly greater diameter, which was similar to that in the pig manure treatment (3.29 mm).

TABLE IV. EFFECTS OF DIFFERENT SOURCES OF MANURE ON THE DIAMETER OF OKRA STEMS AT RAMDHUNI, SUNSARI, NEPAL

Treatments	Diameter(cm)				
	20DAS	35DAS	50DAS	65DAS	80DAS
Vermicompost	2.77^{abc}	5.18^{bcd}	7.68^{ab}	18.70^{d}	27.26^{ab}
Control	2.44^{bc}	3.63^{d}	6.78^{b}	17.59^{d}	25.50^{b}
FYM	2.22^{c}	4.23^{cd}	10.24^{ab}	18.34^{d}	25.07^{b}
Poultry	3.33^{a}	7.43^{a}	12.06^{a}	27.06^{a}	32.06^{a}
Chemical fertilizer	3.04^{ab}	6.50^{ab}	9.10^{ab}	24.42^{ab}	31.52^{ab}
Pig	3.29^{a}	5.75^{bc}	9.56^{ab}	20.52^{cd}	29.82^{ab}
Goat	2.86^{ab}	5.36^{bc}	10.07^{ab}	23.11^{bc}	29.08^{ab}
SEM (±)	0.07	0.18	0.52	0.46	0.81
LSD(=0.05)	0.57**	1.49**	4.19***	3.68***	6.53*
CV (%)	11.24	15.44	25.18	9.68	12.83
Grand mean	2.85	5.44	9.35	21.39	28.61

Note: SEM(±), standard error of the mean; CV, coefficient of variation; LSD, least significant difference; NS, non-significant; means in the column with the same letter (s) in superscript indicate no significant difference between treatments at the 5% level of significance, '*' Significant at the 10% level of significance: ** indicates significance at the 10% level; *** indicates significance at the 1% level of significance.

Similarly, the diameter obtained from the chemical fertilizer treatment (3.04 mm) was similar to that of the goat manure treatment (2.86 mm). Similarly, the diameter obtained from the FYM treatment (2.22 mm) was the lowest, which was different from that of the vermicompost and control treatments. At 35 DAS, the diameter obtained from poultry manure was greater (7.43 mm) than that of the other treatments. Similarly, the diameter obtained from pig manure (5.75 mm) was similar to that of goat manure (5.36 mm). The smallest diameter was obtained from the control (3.63 mm), which was separated from the FYM. At 50 DAS, the greatest diameter was obtained from poultry manure (12.06 mm) compared with all the other treatments. The diameters obtained from vermicompost, FYM, chemical fertilizer, and goat manure were similar. Similarly, the smallest diameter was obtained from the control (6.78 mm).

TABLE V. EFFECTS OF DIFFERENT SOURCES OF ORGANIC MANURE ON THE NUMBER OF LEAVES OF OKRA AT RAMDHUNI, SUNSARI, NEPAL

Treatments	Number of leaves				
	20DAS	35DAS	50DAS	65DAS	80DAS
Vermicompost	2.13^{b}	8.26^{bcd}	12.86^{bc}	31.53^{b}	36.40^{bc}
Control	1.93^{b}	5.46^{d}	10.00^{c}	29.20^{b}	35.33^{bc}
FYM	2.13^{b}	6.60^{cd}	12.67^{bc}	29.20^{b}	31.06^{c}
Poultry	2.86^{a}	12.80^{a}	22.46^{a}	57.80^{a}	63.73^{ab}
Chemical fertilizer	2.80^{a}	10.67^{ab}	16.67^{b}	56.26^{a}	68.67^{a}
Pig	2.80^{a}	8.93^{bc}	15.13^{bc}	45.67^{ab}	45.46^{abc}
Goat	2.60^{a}	8.26^{bcd}	14.80^{bc}	41.67^{ab}	44.26^{abc}
SEM±	0.06	0.35	0.60	2.31	3.52
LSD(=0.05)	0.41**	2.85**	4.92**	18.80*	28.63*
CV (%)	9.44	18.43	18.50	25.48	34.66
Grand mean	2.46	8.71	14.94	41.47	46.41

Note: SEM (±), standard error of the mean; cv, coefficient of variation; LSD, least significant difference; NS, not significant; means in the column with the same letter (s) in superscript indicate no significant difference between treatments at the 5% level of significance, '*' significant at the 10% level of significance;'**' significant at the 5% level of significance

At 65 DAS, the diameter obtained from poultry manure (27.06 mm) was the greatest. Similarly, the lowest diameter was obtained from the control (17.59 mm), which was separate from the vermicompost and FYM. At 80 DAS, poultry manure had the greatest diameter (32.06 mm). Similarly, the diameter obtained from chemical fertilizer was similar to that from the plots where the manures applied were pigs, goats, and vermicompost. The smallest diameter was obtained from the control, which was similar to that of the FYM. A greater stem diameter was obtained from poultry manure, which was similar to the findings [10].

C. Number of Leaves

The effects of various treatments on the number of leaves produced per plant varied significantly (<0.05) at 20, 35, 50, 65, and 80 DAS. At 20 DAS, the greatest number of leaves (2.86) was produced from poultry, followed by chemical fertilizer, pig manure, and goat manure, and the lowest (1.93) number of leaves was produced from the control, which was similar to the results of vermicompost and FYM.

TABLE VI. EFFECTS OF DIFFERENT MANURES ON THE NUMBER OF BRANCHES OF OKRA AT RAMDHUNI, SUNSARI, NEPAL

Treatments	Number of branches			
	35DAS	50DAS	65DAS	80DAS
Vermicompost	3.20	3.40^{bc}	2.06^{bc}	2.26
Control	3.13	3.20^{c}	1.73^{c}	1.93
FYM	4.60	4.40^{abc}	2.20^{abc}	5.46
Poultry	3.53	5.93^{a}	3.60^{a}	3.73
Chemical Fertilizer	4.13	4.53^{abc}	3.33^{ab}	3.06
Pig	3..60	4.33^{abc}	3.07^{abc}	3.13
Goat	4.00	5.00^{ab}	2.67^{bc}	2.93
SEM(±)	0.42	0.18	0.16	0.45
LSD(=0.05)	ns	1.48*	1.33*	ns
CV (%)	51.73	18.92	28.04	65.07
Grand mean	3.74	4.4	2.66	3.21

Note: SEM(±), standard error of the mean; CV, coefficient of variation; LSD, least significant difference; ns, not significant; means in a column with the same letter (s) in superscript indicate no significant difference between treatments at the 5% level of significance, * significant at the 10% level of significance

At 35 DAS, poultry manure produced significantly more leaves than the other treatments did. The control treatment produced the lowest number of leaves per plant; similarly, at 50 DAS, the highest number (22.46) of leaves was produced from poultry, followed by chemical fertilizer, and the lowest number of leaves was produced from the control.

TABLE VII. EFFECTS OF DIFFERENT ORGANIC MANURES ON THE NUMBER OF DAYS TO FIRST GERMINATION AND FIRST FLOWERING OF OKRA AT RAMDHUNI, SUNSARI, NEPAL

Treatments	Days to the first germination	Days to first flowering
Vermicompost	5.67^{ab}	43.33
Control	6.00^{a}	46.00
FYM	5.33^{ab}	45.67
Poultry	5.00^{b}	42.33
Chemical fertilizer	5.33^{ab}	42.33
Pig	5.33^{ab}	42.33
Goat	5.33^{ab}	45.00
SEM (±)	0.09	0.48
LSD(=0.05)	0.80*	ns
CV (%)	8.36	5.11
Grand mean	5.43	43.85

Note: SEM(±), standard error of the mean; CV, coefficient of variation; LSD, least significant difference; ns, non-significant; means in a column with the same letter (s) in superscript indicate no significant difference between treatments at the 0.05 level of significance, *Significant at the 10% level of significance

At 80 DAS, the highest number of leaves was produced from chemical fertilizer (68.67), followed by poultry, and the lowest number of leaves was produced from FYM, which was similar to that produced from vermicompost and the control. The leaf number increased as the age and height of the okra plants increased. The application of organic fertilizer increases the number of leaves per plant, highlighting its importance during crop plant vegetative development [11]. A study carried out by [12] reported that chemical fertilizer and vermicompost have no effect on leaf number but application of chemical fertilizer increases the leaf length as compared to vermicompost.

D. Number of Branches

The results revealed that the effects of different manures on the number of branches were insignificant at 35 DAS and 80 DAS. At 50 DAS, the number of branches was greater in poultry manure (5.93), followed by chemical fertilizer, FYM, and pig manure. The lowest number of branches was found in the control. Similarly, at 65 DAS, poultry manure had the greatest number of branches, followed by chemical fertilizer. The lowest number of branches was found in the control (1.73). The application of poultry manure increases the number of branches per plant compared to other organic manures. This was similar to the findings of [13, 14].

E. Days To First Germination and Flowering

There were significant differences between the different treatments. First, germination was observed in vermicompost, which was similar to FYM, chemical fertilizer, pig manure, and goat manure, followed by poultry manure. Compared with the other treatments, germination was late in the control. Similarly, there was no difference in the number of days to first flowering.

F. Yield parameters

Fruit length was greater in the chemical fertilizer treatment than in the other treatments, followed by poultry and goat manure. The fruit length was lower in the control group than in the vermicompost, FYM, and pig manure groups, and our findings are supported by previous findings [15].

TABLE VIII. EFFECTS OF DIFFERENT ORGANIC MANURES ON FRUIT LENGTH, FRUIT WEIGHT, FRUIT DIAMETER, AND FRUIT YIELD OF OKRA AT RAMDHUNI, SUNSARI, NEPAL

Treatments	Length(cm)	Weight(g)	Diameter	Yield(kg/ha)
Vermicompost	13.32[b]	19.51[a]	16.08	34.43[b]
Control	12.45[b]	15.52[b]	14.73	14.78[c]
FYM	12.87[b]	16.49[b]	15.58	25.88[bc]
Poultry	13.71[ab]	19.94[a]	16.00	67.88[a]
NPK	15.61[a]	19.82[a]	15.04	26.42[bc]
Pig	12.43[b]	16.67[b]	14.88	29.74[bc]
Goat	14.08[ab]	17.92[ab]	15.71	34.18[b]
SEM (±)	0.25	0.35	0.24	2.17
LSD(=0.05)	2.03*	2.83*	ns	17.66***
CV (%)	8.45	8.82	6.95	29.79

Note: SEM(±), standard error of the mean; CV, coefficient of variation; LSD, least significant difference; ns, non-significant; means in a column with the same letter (s) in superscript indicate no significant difference between treatments at the 0.05 level of significance, *Significant at the 10% level of significance, ***Significant at the 1% level of significance

The fruit weight was greater in poultry (19.94 g), which was statistically similar to the results for NPK (19.82 g) and vermicompost (19.51 g). The fruit weight was lower in the control, which was similar to the results obtained with FYM and pig manure. The significant differences in fruit weight between the manured plots and the control might be due to differences in soil fertility.

The fruit yield was significantly greater than that of the other treatments in poultry (67.88 kg/ha), followed by vermicompost and goat manure, which was in line with [16]. The yield obtained from pig manure was similar to that obtained from NPK and FYM. The lowest yield was obtained from the control. Similar findings were also presented by [17].

IV. CONCLUSION

Most of the growth parameters were better than those of the other treatments in terms of poultry manure application. The yield parameters were better than those of the other treatments in terms of poultry manure incorporation. These findings demonstrated the synergistic effects of organic and inorganic manure on okra yield and soil improvement. Local farmers noticed that okra, which is often grown without fertilizers, would benefit from fertilizer application. Poultry manure is a useful source of organic fertilizer for promoting healthy vegetative growth in okra. Based on the current analysis and all of the parameter results, there was a noteworthy variation in yield between the treated and control plots. Poultry manure could be less expensive than inorganic fertilizer in easily available areas.

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