Scientific Inquiry and Review (SIR)
Volume 8 Issue 3, 2024
ISSN$_{(P)}$: 2521-2427, ISSN$_{(E)}$: 2521-2435
Homepage: https://journals.umt.edu.pk/index.php/SIR

Article QR

Title: **Impact of Various Organic Manures on the Germination, Development, and Growth of Okra (Abelmoschus esculentus L.)**

Author (s): Hussain Bukhsh Kaleri[1], Saba Ambreen Memon[1], Asif Ali Kaleri[2], Murad Ali Magsi[2], Danish Manzoor[2], Arsalan Achakzai[3], Alam Khan[4], Muhammad Nasir[5], Muhammad Wafa[6], Waheed Ali Khashkheli[2], and Faiz Ullah Niazi[7]

Affiliation (s):
[1]Department of Horticulture, SAU, Tandojam, Pakistan
[2]Department of Agronomy, SAU, Tandojam, Pakistan
[3]Directorate of Agriculture Research Fruit, Agriculture Research Institute, Quetta, Balochistan, Pakistan
[4]Directorate Agriculture Research Date Farm Turbat Kech, Balochistan, Pakistan.
[5]Horticulturist Khaity Technologies P.V.T Agriculture Research Institute Quetta, Pakistan
[6]Horticulturistat Directorate Agriculture Research Transfer Technology, Mastung, Balochistan, Pakistan
[7]Department of Horticulture, Balochistan Agriculture College Quetta, Pakistan

DOI: https://doi.org/10.32350/sir.83.06

History: Received: June, 26, 2024, Revised: 10 September, 2024, Accepted: September 10, 2024, Published: September 27, 2024

Citation: Kaleri HB, Memon SA, Kaleri AA, et al. Impact of various organic manures on the germination, development, and growth of Okra (Abelmoschus esculentus L.). *Sci Inq Rev.* 2024;8(3):119–134. https://doi.org/10.32350/sir.83.06

Conflict of Interest: Author(s) declared no conflict of interest

A publication of
The School of Science
University of Management and Technology, Lahore, Pakistan

Impact of Various Organic Manures on the Germination, Development, and Growth of Okra (Abelmoschus esculentus L.)

Hussain Bukhsh Kaleri[1*], Saba Ambreen Memon[1], Asif Ali Kaleri[2], Murad Ali Magsi[2], Danish Manzoor[2], Arsalan Achakzai[3], Alam Khan[4], Muhammad Nasir[5], Muhammad Wafa[6], Waheed Ali Khashkheli[2], and Faiz Ullah Niazi[7].

[1]Department of Horticulture, SAU, Tandojam, Pakistan
[2]Department of Agronomy, SAU, Tandojam, Pakistan
[3]Directorate of Agriculture Research Fruit, Agriculture Research Institute, Quetta, Balochistan, Pakistan
[4]Directorate Agriculture Research Date Farm Turbat Kech Balochistan, Pakistan.
[5]Horticulturist Khaity Technologies P.V.T Agriculture Research Institute Quetta, Pakistan
[6]Horticulturistat Directorate Agriculture Research Transfer Technology. Mastung, Balochistan, Pakistan
[7]Department of Horticulture Balochistan Agriculture College Quetta, Pakistan.

ABSTRACT

The Department of Horticulture at Sindh Agriculture University, Tandojam conducted the pots experiment during the 2018-19 growing season to evaluate the germination, growth, and development of okra using different organic manures. The study involved two varieties, namely Sabzpuri and Resham. Various plant characteristics, such as leaf count, germination index, fresh root biomass, root length, days until first flowers, and plant height were measured. The results showed significant differences across all metrics when comparing treatments with different organic manures. For okra plants grown with M1 (canal sediment + soil), the results were 39.16% with a germination index of 1.74, 6.98 leaves per plant, plant height of 25.05 cm, 58.16 days to flowering, 0.62 g fresh root biomass, 0.19 g dry root biomass, and root length of 22.67 cm. For okra plants grown with M2 (canal sediment + soil + sheep manure), the results were 75.0% with a germination index of 3.22, 9.83 leaves per plant, plant height of 28.83 cm, 41.83 days to flowering, 1.96 g fresh root biomass, 0.36 g dry root biomass, and root length of 32.24 cm. Okra plants grown with M3 (canal sediment+ soil+ fish meal) yielded 1.49 g of fresh root biomass, 0.27 g of dry root biomass, 16.05 leaves per plant, and attained a height of 30.83 cm. In comparison, okra plants grown with M4 (canal sediment+ soil+ bone meal) had a seed germination rate of 59.16%, yielded 12.77 leaves per plant,

[*]Corresponding Author: hussainbux432@gmail.com

attained a height of 30.39 cm, and began flowering in 52.83 days. To conclude, M2 (canal sediment + soil + sheep manure) resulted in the most robust growth of okra, outperforming the Resham variety in terms of growth and development.

Keywords: development, germination, growth, okra, organic manures, Resham, Sabzpuri

1. INTRODUCTION

Okra (*Abelmoschus esculentus* L.) is the most important vegetable crop in Pakistan, sown only once a year [1]. In both desert and green tropical climates, people cultivate fruits and vegetables throughout the crop year [2].The crop is also versatile in terms of usage, as it may be used in food and may also be incorporated in soups and rice dishes, among others. Additionally, the raw fruits are highly nutritious and rich in vitamins and minerals.Tropical regions typically cultivate okra, the most commonly grown vegetable crop, along with plant proteins during the spring and summer seasons [3]. Worldwide, this plant grows well in tropical, subtropical, and temperate climates [4]. Okra is economically important because its edible nature has the potential to improve food security [5].To find out the effects of different organic fertilizers, this study used the okra crop to see how it grows and sprouts [6].Organic fertilizers have only one source, that is, the breakdown or decomposition of plant and animal remains, as stated by [7].

A broad category of popular organic fertilizers arederived from plant and animal materials. These include compost or products of animal origin, such as manure. While, plant-derived products include green compost, non-industrially enriched organic compost, and organic mulches made from straw and legume leaves [8].The benefits of using animal-based fertilizers to improve garden soil stem from the incorporation of organic matter and a variety of animal-derived nutrients. Depending on various factors such as animal type, age, feed content, and fertilizer application method, these fertilizers efficiently supply the necessary plant nutrients [9]. It is also important to note that applying organic soil amendments not only leads to an increase in nutrient status but also has a knock-on effect on pest incidence [10]. Improving soil fertility through the application of essential fertilizers is one of the factors that can help to feed people around the world. Usually, farmers use both organic and inorganic fertilizers encompassing both physical and biological properties to maintain soil fertility and enhance its quality. As stated by [11], organic fertilizers are capable of improving crop yield, changing the soil pH, and affecting nutrient composition and availability [12].

There are apparent difficulties, such as fertility decline and soil erosion, that affect the ideal conditions in semi-tropical regions. This results in poor plant feeding and changes in the population of organisms living in the soil. However, challenges such as soil acidity, restricted access, nutrient imbalance, and high costs impede the application of fertilizers, making them prohibitively expensive for farmers with limited resources. This leads to a reduced number of fruits per plant, delayed bearing, and reduced yield [13]. The problem is that small-scale farmers and landowners with limited finances are not able to afford the massive amounts of organic fertilizers needed to sustain crop output. Furthermore, the majority of organic fertilizers release nutrients gradually over time. On the other hand, proper use of sufficient amounts of organic fertilizers can raise crop yields, improving agricultural food production and overall yield enhancement.

2. MATERIALS AND METHODS

The Department of Horticulture, Sindh Agriculture University, Tando Jam conducted pot experiments in the summer of 2019. Firstly, Subzpari and Resham okra seeds were sowed to assess the effects of different organic manures on okra plant germination, seedling growth, and overall plant development. Organic manures were created from sheep excrement, bone, and fish meal. A mixture of growing material was poured into earthen pots, leaving about 2.5 cm of room at the top. The study employed two major factors, that is, Factor A and Factor B.It used the completely randomized design (CRD) method, replicating each treatment three times. Two varieties, Subzpari and Resham, made up Factor A. Factor B included four types of organic manures: M1 (canal sediments plus soil at a 1:1 ratio), M2 (canal sediments plus soil plus sheep manure at a ratio of 1:1:0. 5), M3 (canal sediments plus soil plus fish meal at a ratio of 1:1:0. 03), and M4 (canal sediments plus soil plus bone meal at a ratio of 1). The following data were noted: days till first blooming, number of leaves per plant, plant height (cm), fresh root biomass (g), dried root biomass (g), percentage of seed germination, germination index (GI), and root length (cm).

3. RESULTS

The current study aimed to assess how well okra germinates, grows seedlings, and develops when grown with organic manures. Several parameters were observed and documented, including seed germination percentage, germination index, leaf count per plant, plant height in cm, time taken for flowering initiation, fresh root biomass in grams, dry root biomass in grams, and root length in cm.

3.1. Seed Germination (%)

Table 1 displays the outcomes concerning the germination percentage of okra seeds under various conditions involving organic fertilizers and different varieties (Sabzpuri and Resham). The analysis of variance (ANOVA)revealed no statistically significant impact ($p > 0.05$) on seed germination due to the application of organic fertilizers or the interaction between organic fertilizers and different varieties. Plants cultivated with M2(a combination of canal sediments, soil, and sheep manures) recorded the highest seed germination percentage of 75%, according to the data on the use of organic manures. Following closely behind, plants grown with M4(a mixture of canal sediments, soil, and bone meal) exhibited an average seed germination rate of 59.16%. Conversely, plants grown with M1(a mixture of canal sediments and soil) showed the lowest seed germination percentage of 39.16%. When considering the different varieties, Resham displayed the highest seed germination rate at 59.58%, while Sabzpuri exhibited a slightly lower rate of 51.66%. In the interactive data, plants grown using M2 exhibited the highest observed seed germination rate of 80%, particularly when using the Resham variety. Conversely, the lowest seed germination rate of 33.33% was recorded when M1was combined with the Sabzpuri variety.

Table 1. Seed Germination (%)

Treatments	Varieties		Mean
	Sabzpuri	Resham	
M_1 = Canal sediments + Soil	33.33	45.00	39.16 C
M_2 = Canal sediments + Soil + Sheep manures	70.00	80.00	75.00 A
M_3 = Canal sediments + Soil + Fish meal	45.00	53.33	49.16 BC
M_4 = Canal sediments + Soil + Bone meal	58.33	60.00	59.16 B
Mean	51.66 B	59.58 A	

Significance level	Treatments (T)	Varieties (V)	T×V
S.E.	6.0749	4.2956	8.5912

LSD (0.05)	13.029	9.2132	18.426
Probability	0.0000	0.0000	0.0896

3.2. Germination Index (GI)

Table 2 depicts the GI of two distinct types of okra, namely Sabzpuri and Resham, grown under various treatments using organic manures. According to the results of the analysis of variance (ANOVA), both organic and inorganic factors had a significant impact on manure GI and the interaction between organic manures and varieties ($p > 0.05$). In terms of organic manures, the highest GIvalues of 3.22 and 3.17 were recorded for plants grown with both M2 (canal sediments + soil + sheep manures) and M4 (canal sediments + soil + bone meal), respectively. Following closely behind, plants grown with M3 (canal sediments+ soil+ fish meal) exhibited the mean GIvalue of 2.65. Conversely, cultivated plants with M1 (canal sediments + soil) exhibited the lowest GIvalueof 1.74. In terms of varieties, Resham displayed the highest GIvalue of 3.26, while Sabzpuri exhibited a lower GI value of 2.14. In the interactive data, the Resham variety yielded the maximum GIof 4.13, when grown with M2 (canal sediments + soil+ sheep manures). Conversely, combining M1 (canal sediments + soil) with the Sabzpuri variety resulted in the minimum GIof 1.32. The LSD test revealed that there were no statistically significant differences in the GIvalues of various organic manures and between the varieties ($p > 0.05$).

Table 2. GI of Okra as Influenced by Different Natural Manures and Varieties

Treatments		Varieties		Mean
		Sabzpuri	Resham	
M_1 = Canal sediments + Soil		1.32	2.16	1.74 C
M_2 = Canal sediments + Soil + Sheep manures		2.32	4.13	3.22 A
M_3 = Canal sediments + Soil + Fish meal		2.30	3.01	2.65 B
M_4 = Canal sediments + Soil + Bone meal		2.61	3.73	3.17 A
Mean		2.14	3.26	
Significance level	Treatments (T)	Varieties (V)		T×V
S.E.	0.2130	0.1506		0.3012
LSD (0.05)	0.4569	0.3230		0.6461
Probability	0.0003	0.0866		0.8528

3.3. Number of Leaves per Plant

Table 3 depicts the number of leaves per plant among the two varieties of okra as influenced by the use of different organic manures. The analysis of variance (ANOVA) revealed a significant change in the number of leaves per plant and the interaction between organic manures and varieties (p> 0.05). The study found that plants grown with M3 (canal sediments + soil + fish meal) had the highest number of leaves per plant, that is, 16.05. Following closely behind, plants grown with M5 (canal sediments+ soil+ bone meal) exhibited an average of 12.77 leaves per plant. On the other hand, plants cultivated with M1 (canal sediments + soil) showed the lowest number of leaves per plant, with an average of 6.98. Regarding varieties, Sabzpuri displayed the most leaves per plant with an average of 12.10, while Resham bore a slightly lower number of leaves per plant, averaging 10.72. Considering the interactive data, plants grown with M3 (canal sediments+ soil+ fish meal) showed the highest number of leaves per plant, that is, 16.77. Conversely, the combination of M1 (canal sediments + soil) and the Resham variety yielded the lowest number of leaves per plant, that is, 6.22. It's important to highlight that the LSD test indicated that the differences in the number of leaves per plant between the various organic manures and varieties were statistically significant (p> 0.05).

Table 3. Number of Leavesper Plantof Okra as Influenced by Different Organic Manures and Varieties

Treatments		Varieties		Mean
		Sabzpuri	Resham	
M_1 = Canal sediments + Soil		7.77	6.22	6.98 D
M_2 = Canal sediments + Soil + Sheep manures		10.44	9.22	9.83 C
M_3 = Canal sediments + Soil + Fish meal		16.77	15.33	16.05 A
M_4 = Canal sediments + Soil + Bone meal		13.44	12.11	12.77 B
Mean		12.10 A	10.72 B	
Significance level	Treatments (T)	Varieties (V)		T×V
S.E.	0.1022	0.0722		0.1445
LSD (0.05)	0.2191	0.1550		0.3099
Probability	0.0000	0.0000		0.4112

3.4. Plant Height

Table 4 depicts the plant height (cm) of the two varieties of okra, namely Sabzpuri and Resham, as influenced by different treatments involving organic manures. The analysis of variance (ANOVA) indicated that neither organic manures nor their interaction with the two varieties significantly influenced plant height (cm) (p> 0.05). The highest plant heights, ranging from 30.83 to 28.83 cm, were recorded for plants grown with M3 (canal sediments + soil + fish meal), M4 (canal sediments + soil + bone meal), and

M2 (canal sediments + soil). In contrast, plants grown with M1 (canal sediments + soil) had the lowest average plant height of 25.05 cm. In terms of varieties, Sabzpuri had the highest plant height, averaging 32.47 cm. Whereas, Resham had a lower plant height, averaging 25.08 cm. Interactive data revealed that plants grown with M3 (canal sediments+ soil + fish meal) and the Sabzpuri variety achieved the highest plant height of 34.67 cm. Conversely, the combination of M1 (canal sediments + soil) with the Resham variety yielded the lowest plant height of 20.22 cm. Notably, the LSD test revealed that there was no statistically significant variation in plant height (cm) between the different organic manures and cultivars ($p > 0.05$).

Table 4. Plant Height (cm) of Okra as Influenced byDifferent Organic Manures and Varieties

Treatments		Varieties		Mean
		Sabzpuri	Resham	
M_1 = Canal sediments + Soil		29.88	20.22	25.05 B
M_2 = Canal sediments + Soil + Sheep manures		33.45	24.21	28.83 A
M_3 = Canal sediments, + Soil + Fish meal		34.67	27.00	30.83 A
M_4 = Canal sediments + Soil + Bone meal		31.89	28.89	30.39 A
Mean		32.47 A	25.08 B	
Significance level	Treatments (T)	Varieties (V)	T×V	
S.E.	1.5068	1.0655	2.1309	
LSD (0.05)	3.2318	2.2852	4.5704	
Probability	0.0072	0.0000	0.1533	

3.5. Days to Initiate the First Flower

Different treatments involving organic manures and the two varieties, namely Sabzpuri and Resham, influenced the time it takes for the first flower to appear on okra plants, as shown in Table 5. The analysis of variance (ANOVA) indicated that both organic manures and the interaction between organic manures and the two varieties significantly influenced the days required to initiate the first flower ($p > 0.05$). It was found that plants grown with M1 (canal sediments + soil) required the highest number of days to initiate the first flower, that is, 58.16 days. Following closely behind, plants grown with M4 (canal sediments+ soil+ bone meal) took an average of 52.83 days to initiate the first flower. Conversely, plants cultivated with M2 (canal sediments+ soil + sheep manures) took the longest number of days, that is, 41.83 days to initiate the first flower. Regarding varieties, Resham took a maximum of 51.33 days to initiate the first flower, while Sabzpuri took a shorter time, with an average of 48.75 days. In terms of interactive data, plants grown with M1 (canal sediments + soil) took the highest number of days to initiate the first flower, that is, 59.33 days when the Resham variety was used. Conversely, using M2 (canal sediments+ soil + sheep manures) in combination with Sabzpuri resulted in the shortest time to initiate the first flower, that is, 40.33 days. It's important to note that the LSD test indicated that the differences in the time taken between different first flowering or starter cultivars, as well as organic manures, were statistically significant ($p > 0.05$).

Table 5. Days to Initiate the First Flowerof Okra as Influenced byDifferent Organic Manures and Varieties

Treatments		Varieties		Mean
		Sabzpuri	Resham	
M_1 = Canal sediments + Soil		57.00b	59.33 a	58.16 A
M_2 = Canal sediments + Soil + Sheep manures		40.33 h	43.33 g	41.83 D
M_3 = Canal sediments + Soil + Fish meal		46.33 f	48.33 e	47.33 C
M_4 = Canal sediments + Soil + Bone meal		51.33 d	54.33 c	52.83 B
Mean		48.75 A	51.33A	
Significance level	Treatments (T)	Varieties (V)	T×V	
S.E.	0.1179	0.0833	0.1667	
LSD (0.05)	0.2528	0.1787	0.3575	
Probability	0.0000	0.0000	0.0014	

3.6. Fresh Root Biomass

Table 6 shows the fresh root biomass (in grams) of the two varieties of okra, namely Sabzpuri and Resham, as influenced by various treatments involving organic manures. The analysis of variance (ANOVA) indicated a significant influence of both organic manures and the interaction between organic manures and varieties ($p > 0.05$) on fresh root biomass. It was found that plants grown with M2 (canal sediments + soil + sheep manures) exhibited the highest fresh root biomass of 1.96 g. whereas,for plants grown with M4 (canal sediments + soil + bone meal) and M3 (canal sediments + soil + fish meal), the mean biomass of fresh roots was 1.55 g and 1.49 g, respectively. In contrast, plants cultivated with M1 (soil + canal sediments) exhibited the lowest fresh root biomass of 0.62 g. Among the varieties, Sabzpuri had the highest average fresh root biomass of1.68 g, while Resham had a lower average of 1.12 g. In terms of interactive data, the Sabzpuri variety, when grown with M2 (canal sediments + soil+ sheep manures), yielded the highest fresh root biomass of 0.25 g. Conversely, the combination of M1 (canal sediments + soil) and the Resham variety yielded the lowest fresh root biomass of 0.48 g. It's important to emphasize that the LSD test indicated that the differences in fresh root biomass between the various organic manures and varieties were statistically significant ($p > 0.05$).

Table 6. Fresh Root Biomass of Okra as Influenced by Different Organic Manures and Varieties

Treatments		Varieties		Mean
		Sabzpuri	Resham	
M_1 = Canal sediments + Soil		0.77	0.48	0.62 C
M_2 = Canal sediments + Soil + Sheep manures		0.25	1.67	1.96 A
M_3 = Canal sediments + Soil + Fish meal		1.71	0.27	1.49 B
M_4 = Canal sediments + Soil + Bone meal		2.02	1.08	1.55 B
Mean		1.68 A	1.12 B	
Significance level	Treatments (T)	Varieties (V)	T×V	
S.E.	0.1253	0.0886	0.1772	
LSD (0.05)	0.2688	0.1900	0.3801	
Probability	0.0000	0.0000	0.1079	

3.7. Dry Root Biomass

Table 7 shows thatneither organic manures nor the interaction between organic manures and varieties significantly influenced the dry root biomass (in grams) of the two varieties of okra, namely Sabzpuri and Resham. The data on organic manures revealed that plants grown with M2 (canal sediments + soil + sheep manures) had the highest dry root biomass, measuring 0.36 g. Following closely behind, plants grown with M4 (canal sediments + soil + bone meal) exhibited an average dry root biomass of 0.28 g. Conversely, plants cultivated with M1 (canal sediments + soil) reported the lowest dry root biomass of 0.19 g. In terms of varieties, Sabzpuri had the highest dry root biomass, with an average of 0.36 g, while Resham had a lower dry root biomass, averaging 0.19 g. In terms of interactive data, plants grown with M2 (canal sediments + soil + sheep manures) exhibited the highest dry root biomass, measuring 0.44 g. Conversely, the combination of M1 (canal sediments + soil) and the Resham variety yielded the lowest dry root biomass, measuring 0.06 g. It's important to note that the LSD test indicated that the differences between dry root biomass, various organic manures, and varieties were statistically significant ($p > 0.05$).

Table 7. Dry Root Biomass of Okraas Influenced by DifferentOrganic Manures andVarieties

Treatments		Varieties		Mean
		Sabzpuri	Resham	
M_1 = Canal sediments + Soil		0.31	0.06	0.19
M_2 = Canal sediments + Soil + Sheep manures		0.44	0.29	0.36
M_3 = Canal sediments + Soil + Fish meal		0.39	0.15	0.27
M_4 = Canal sediments + Soil + Bone meal		0.31	0.25	0.28
Mean		0.36 A	0.19 B	
Significance level	Treatments (T)	Varieties (V)	T×V	
S.E.	0.0924	0.0654	0.1307	
LSD (0.05)	0.1982	0.1402	0.2803	
Probability	0.3318	0.0171	0.7332	

3.8. Root Length

Table 8 presents the findings regarding the root length of okra, while taking into account different treatments involving organic manures and the two varieties, namely Sabzpuri and Resham. Appendix VIII contains the statistical analysis of these results. The analysis of variance (ANOVA) indicated a significant influence of both organic manures and the interaction between organic manures and varieties ($p > 0.05$) on root length (measured in cm). The maximum root length of 32.24 cm was recorded for plants grown with M2 (canal sediments + soil + sheep manures). Following closely behind, plants grown with M4 (canal sediments + soil + bone meal) and M3 (canal sediments + soil + fish meal) exhibited an average root length of 28.00 cm and 27.67 cm, respectively. Conversely, plants cultivated with M1 (canal sediments + soil) exhibited the lowest root length, measuring 22.67 cm. In terms of varieties, Sabzpuri had the longest root length, with an average of 31.20 cm, while Resham had a shorter root length, averaging 24.09 cm. In terms of interactive data, plants grown with M2 (canal sediments + soil + sheep manures) exhibited the highest root length, measuring 37.46 cm. On the other hand, the interaction between M1 (canal sediments + soil) and the Resham variety yielded the smallestroot length of 19.67 cm. The result of the LSD test shows that there were significant differences in root length of the various organic manures and varieties at $p <$ 0. 05.

Table 8. Root Length (cm) of Okra asInfluenced by DifferentOrganic Manures andVarieties

Treatments		Varieties		Mean
		Sabzpuri	Resham	
M_1 = Canal sediments + Soil		25.67 c	19.67 d	22.67 C
M_2 = Canal sediments + Soil + Sheep manures		37.46 a	27.02 bc	32.24 A
M_3 = Canal sediments, + Soil + Fish meal		30.66 b	24.67 c	27.67 B
M_4 = Canal sediments, + Soil + Bone meal		31.00 b	25.00 c	28.00 B
Mean		31.20 A	24.09 B	
Significance level	Treatments (T)	Varieties (V)		T×V
S.E.	1.4354	1.0150		2.0300
LSD (0.05)	3.0787	2.1769		4.3539
Probability	0.0000	0.0000		0.0106

4. DISCUSSION

Several studies have shown that organic manures enhance germination, seedling growth, and general plant growth. Moreover, they can improve plant yields, as evidenced by [14]. The application of Organic Manure in this study, especially poultry manure, enhanced the growth and yield of okra [15]. The study utilized a variety of animal waste sources and yielded significant insights into okra growth and yield. The results revealed that germination, seedling development, and plant growth were affected ($p<0.05$) by both types of organic manures and the varieties of okra. Among all the potting media tested in the study, the M2 media(canal sediments + soil + sheep manure)yieldedthe best results. These included seed germination percentage, germination index (GI), number of leaves per plant, plant height (in cm), days to first flowering, fresh root biomass (in g), and root length (cm) [16]. Research on the effects of cow, sheep, and chicken manure on okra yield and growth supports these findings.

In a similar study, [17] also noted that out of all the manure types; M3 organic manure yielded the best results across all the parameters. They collected data on plant height, number of leaves per plant, pod length, and fresh pod weight. The results revealed that okra underperformed in terms of growth and yield in control treatments, indicating the beneficial effects of organic manures on plant health and productivity. In their work on the impact of manures on the growth and productivity of okra, [11] established that the results obtained from the application of organic manure M3 were the most desirable across all parameters. The analyzed variables were the maximal stem diameter (2.4 cm) and the number of leaves per plant (50.6), on average. Additionally, there were 29 plants with an average leaf area of 4 cm^2, 5 plants with 7branches, and 21 plants with 21 branches. An average of 7 internodes, 88.3 g of fresh and 11.5 g of dry root biomass, 33.9 pods with an average diameter of 1.8 cm, and a yield of 369.0 g per plant and 3.3 kg per plot were observed.

However, the use of organic manure M1 led to the lowest recorded values across all the parameters [18]. Conducted a study that examined 11 different treatments using different organic fertilizers. Out of these treatments, the one that used 20 tons per hectare of FYM (farmyard manure) was the most productive. Ityielded 10.39 tons per hectare, with the benefit-cost ratio of 56. This treatment also led to low fiber content in okra fruits as compared to the control treatment [19,20]. Conducted a study and found that fertilized plots exhibited higher pod productivity, more pod components, but lower pod fiber content. The research also found that poultry compost was a better source of fertilizer for okra production than cattle manure. These findings confirmed that the application of organic manures, including FYM and poultry compost, has a positive effect on the growth, yield, and quality of okra fruits.

4.1. Conclusion

The findings of the current research indicate that okra, a blend of M2 (canal sediments + soil + sheep manure), demonstrated the highest levels of germination, seedling development, and overall growth. Furthermore, when comparing the two varieties, Sabzpuri demonstrated significantly superior growth compared to the Resham variety. These results emphasize the importance of organic manures, such as sheep manure (M2), and variety selection (Sabzpuri), in achieving optimal okra plant growth and development.

CONFLICT OF INTEREST

The authors of the manuscript have no financial or non-financial conflict of interest in the subject matter or materials discussed in this manuscript.

DATA AVALIABILITY STATEMENT

The data associated with this study will be provided by the corresponding author upon request.

FUNDING DETAILS

No funding has been received for this research.

REFERENCES

1. Alam M, Hayat K, Ullah I, et al. Improving okra (Abelmoschus esculentus L.) growth and yield by mitigating drought through exogenous application of salicylic acid. *Fres Environ Bulle*. 2020;29(1):529–535.
2. Scheel beek PF, Moss C, Kastner T, et al. United Kingdom's fruit and vegetable supply is increasingly dependent on imports from climate-vulnerable producing countries. *Nat Food*. 2020;1(11):705–712.https://doi.org/10.1038/s43016-020-00179-4
3. Eke KA, Essiens BA, Ogbu JU. Determination of optimum planting time of okra in the derived savannah. Paper presented at: The 42nd Conference of ASN; October 17–23, 2008; Abakaliki, Nigeria.
4. Kroschel J, Mujica N, Okonya J, Alyokhin A. Insect pests affecting potatoes in tropical, subtropical, and temperate regions. In: Campos H, Ortiz O, eds. *The Potato Crop: Its Agricultural, Nutritional and Social Contribution to Human Kind*. Springer; 2020:251–306.
5. Dantas TL, Alonso Buriti FC, Florentino ER. Okra (Abelmoschus esculentus L.) as a potential functional food source of mucilage and bioactive compounds with technological applications and health benefits. *Plants*. 2021;10(8):e1683.https://doi.org/10.3390/plants10081683
6. Muhammad M, Kutawa AB, Adamu M. Influence of NPK fertilizer and poultry manure on the growth of okra (Abelmoschus esculentus L. Moench) in Northern Sudan Savanna region of Nigeria. *Int J Hortic Agric Food Sci*. 2020;4:196–204.https://doi.org/10.22161/ijhaf.4.6.1
7. Filipovic A, Percin A, Hadziabulic A, Mandic A. Transformation of organic matter and impact on the ecosystem. In: Jhariya MK, Meena RS, Banerjee A, Kumar S, Raj A, eds. *Agroforestry for Carbon and Ecosystem Management*. Academic Press; 2024:311–329. https://doi.org/10.1016/B978-0-323-95393-1.00018-X
8. Chatzistathis T, Kavvadias V, Sotiropoulos T, Papadakis IE. Organic fertilization and tree orchards. *Agriculture*. 2021;11(8):e692.https://doi.org/10.3390/agriculture11080692

9. Sekaran U, Lai L, Ussiri DA, Kumar S, Clay S. Role of integrated crop-livestock systems in improving agriculture production and addressing food security–a review. *J Agricul Food Res*. 2021;5:e100190.https://doi.org/10.1016/j.jafr.2021.100190

10. Goud BR, Raghavendra M, Prasad PS, et al. Sustainable management and restoration of the fertility of damaged soils. In:Jatav HS, Rajput VD, eds. *Ecosystem Services: Types, Management and Services*. Nova Science Publishers; 2022:113–132.

11. Usharani KV, Roopashree KM, Naik D. Role of soil physical, chemical and biological properties for soil health improvement and sustainable agriculture. *JPharmcognPhytochem*. 2019;8(5):1256–1267.

12. Itelima JU, Bang WJ, Onyimba IA, Sila MD, Egbere OJ. Bio-fertilizers as key player in enhancing soil fertility and crop productivity: a review.*Direct Res J Agricul Food Sci*. 2018;6(3):73–83.

13. Kurlus R, Rutkowski K, Łysiak GP. Improving of cherry fruit quality and bearing regularity by chemical thinning with fertilizer. *Agronomy*. 2020;10(9):e1281. https://doi.org/10.3390/agronomy10091281

14. Agbede TM, Adekiya AO. Effect of wood ash, poultry manure and NPK fertilizer on soil and leaf nutrient composition, growth and yield of okra (Abelmoschus esculentus. *Emir J Food Agric*. 2012;24(4):314–321.

15. Nweke IA, Ijearu SI, Igili DN. Effect of different sources of animal manure on the growth and yield of okra (Abelmoschus esculentus L. Moench) in Ustoxic Dystropept at Enugu South Eastern, Nigeria. *J SciTechnol Res*. 2013;2(3):135–137.

16. Tiamiyu RA, Ahmed HG, Muhammad AS. Effect of sources of organic manure on growth and yields of okra (Abelmoschus esculentus L.) in Sokoto, Nigeria. *Nig J Basic Appl Sci*. 2012;20(3):213–236.

17. Shahriazzaman MC, Mazed HE, Pulok MA, Mehraj H, Uddin AF. Response of organic manures on growth and yield of okra (Abelmoschus esculentus L.). *J Sci Techniol Environ*. 2014;1(2):60–67.

18. Premsekhar M, Rajashree V. Influence of organic manures on growth, yield and quality of okra. *Am-Eurasian J SustainAgricul*. 2009;3(1):6–8.

19. Ofosu-Anim J, Blay ET, Frempong ME. Effects of organic manure on okra (Abelmoschus esculentus (L.) Moench) production. *J ApplHorticul*. 2006;8(2):155–158.

20. Davis TW. Grower's guide: a review for sustainable production of okra (Abelmoschus Esculentus) in West Africa and other regions. *Int J Res Appl Sci Eng Technol*. 2022;10(10):128–138.https://doi.org/10.22214/ijraset.2022.46950