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Effect of organic sources of nutrients on growth and yield of okra (*Abelmoschus esculentus* L. Var. Pusa Makhamali). Under agro-climatic condition of Kanpur

Sandeep Devkota, Jitendra Kumar, Vinay Joseph Silas, Ram Nivas, Pujan Khanal and Mansun Dahal

Abstract
The study was conducted in field at Mandhana of Rama University during Feb, 2022 to July, 2022 to study the effect of organic source of nutrient on growth and yield of okra (*Abelmoschus esculentus* L. var. Pusa Makhamali). There were 8 treatments and 3 replications laid out in Randomized Block Design.. These were applied as basal application of fertilizer in this experiment. The treatments were T_1 (Cow Manure) T_2 (50% sheep manure + 50% cow manure) T_3(50% sheep manure + 50% poultry manure) T_4(sheep manure), T_5(50% poultry manure + 50% cow manure), T_6(poultry manure), T_7 (25% Sheep manure + 50% cow manure + 25% poultry manure) and T_8(control).
The maximum germination percentage was noted in T_7(72.59%) (25% sheep manure + 50% cow manure + 25% poultry manure) and minimum germination percentage was recorded in T_8(62.88%) (control) the length of shoot was observed maximum in T_2 (131.33 cm) (50% sheep manure + 50% cow manure) and minimum shoot length was found in T_8 (115.75 cm) 9control).
The number of branches per plant was observed maximum in T_7 (4.363) (25% sheep manure + 50% cow manure + 25% poultry manure) and minimum number of branches per plant was found in T_8 (1.493) (control). The number of leaves per plant was observed maximum in T_5(33.75) (50% poultry manure + 50% cow manure) and minimum number of branches per plant was found in T_8 (19.72) (control). Number of fruits per plant, fruit length, fruit diameter, number of seeds per plant fruit weight, total yield was reported maximum in T_7 (25% sheep manure + 50% cow manure + 25% poultry manure) treatment and minimum in T_8 (control). In quality of fruit, TSS was observed maximum in T_7(7.09ºbrix) (25% sheep manure + 50% cow manure + 25% poultry manure) and minimum was found in T_8 (5.26ºbrix) (control). The ascorbic acid was observed maximum in T_3 (12.45 mg⁄100g) (50% sheep manure + 50% poultry manure) and minimum was found in T_8 (10.15 mg⁄100g) (control).
So based on the result it could be concluded that the applications of the organic manures and their combinations (25% sheep manure + 50% cow manure + 25% poultry manure) Favourable for the growth, yield, yield attributing characters and quality parameters of okra cv. Pusa Makhamali.

Keywords: Okra, poultry manure, sheep manure, cow manure, yield

Introduction
Okra (*Abelmoschus esculentus*) is a popular summer vegetable which belongs to the Malvaceae family. (Maurya *et al.*, 2013) [8]. It was thought to have originated in Africa and expanded throughout the tropics, subtropics, and milder temperate regions.
India ranks first in the world with 5.44 million tonnes (70*%* of the total world production) of okra produced from over 0.35 million ha land (NHB 2021⁄022). It is quite popular in India because of its easy cultivation, dependable yield and adaptability to varying moisture conditions. The major producing states of okra are Uttar Pradesh, Bihar, West Bengal, Odisha, Assam, Andhra Pradesh and Karnataka. It is also important in other tropical areas including Asia central and South America.
Okra is cultivated in a variety of soil types and climates. It grows best in temperatures between 22 °C and 35 °C and is a warm-season crop. When the temperature falls below 12 °C, okra might freeze. As the subtropical humid climate of India has a hot climate so okra is ideal for the growth. Intense farming practises and the use of High Yielding Varieties (HYV) reduced the soil's nutritional content. In recent years there are many awareness works Helding regarding the eco-friendly organic products. Sustainable and eco-friendly agriculture minimizes the use of harmful energy intensive inputs through the use of organic Andbio-fertilizers.

Okra is a good source of vitamins, minerals, 33 calories and amino acids. Okra contains high-carbohydrate(7.5 g), (1.9 gm) protein, (23 mg) vitamin-A and (36 mcg) vitamin-c vegetable with a wide range of applications, including raw or cooked consumption, animal fodder, medical, and industrial uses (Farinde *et al.*, 2007; Kumar *et al.*, 2017) [7]. Okra is high in iodine as well as other essential vitamins and minerals. Polysaccharides, such as galacturonic and glucuronic acids, make up the mucilage in Okra fruit (Singh and Ram, 2018). In medical purposes, it can also be utilized as a plasma replacement and blood volume expander. The mucilage in okra binds cholesterol and bile acid, which contains poisons that the liver dumps into it (Gemede *et al.*, 2015) [6]. The International Journal of Chemical Studies is a peer-reviewed journal that published that in okra seeds protein and unsaturated fatty acids like linoleic acid are abundant. Okra is utilized as traditional medicine in a few countries as an anti-ulcerogenic, gastro protective, and diuretic medication. (Gurbuz, 2003). It is also a good source of minerals like calcium and potassium.

Organic agriculture is defined by the International Federation of Organic Agriculture Movements (IFOAM) as a production system that promotes the health of soils, ecosystems, and people too. Rather than using harmful inputs, it relies on biological processes, biodiversity, and cycles that are tailored to local conditions. Organic agriculture helps to bring together tradition, creativity, and science to encourage fair relationships, and improve everyone's quality of life.

The application of organic manure helps to ameliorate acidic condition of soils so as to improve crop production **(**Akande *et al.*, 2003) [11]. Poultry manure supplies more nutrient to plant in comparison to other manures (Garg and Bahl, 2008). Poultry manure is rich in organic matter which helps in improving the physical properties of soil (Ayeni, 2011) [3]. Poultry manure increases plant height (Aniefiok, 2013) [1]. The growth, number of pods and yield of okra increased with increasing amount of goat manure (Awodun, 2007) [2]. Various plant originated manures such as mustard oil cakes, sesame oil cakes, peanut cakes, castor cakes helps in growth of plants and increase in yield of the crops by reducing the incidence of phytonematodes (Frederick, 2015; Sumbul, 2015) [5].

Material and Method

There are eight treatments in my thesis. The treatments were T_1 (Cow Manure) T_2 (50% sheep manure + 50% cow manure) T_3(50% sheep manure + 50% poultry manure) T_4(sheep manure), T_5(50% poultry manure + 50% cow manure), T_6(poultry manure), T_7 (25% Sheep manure + 50% cow manure + 25% poultry manure) and T_8(control). Pusa makhmali variety of okra was selected. Three types of organic manure were used in the treatments (Cow, Sheep and Poultry manure). To get a new treatment, these manures are blended together. The trials were set up in a three-replication randomized block design (RBD). To protect the seeds against soil pathogens and pests, the seeds were treated with Apron star at a rate of 10kg per 3kg seeds prior to sowing.

Planting was done at a 50cm x 30cm spacing. At a depth of 2cm, four seeds of okra Pusa Makhamali were immediately seeded per hole. Three weeks after sowing, seedlings were trimmed to one plant per stand following germination. Soil samples ranging in depth from 0 to 10 cm were collected from 12 different locations around the study area, composited, air-dried, and sieved through a 5mm sieve, and their physical and chemical parameters were assessed prior to treatment application.

By distributing 20 kg of manure per plot, the experimental plot was intensively worked. The 3 x 2.5m plots were irrigated and left for one week before the seeds were planted. This was done to allow carbon dioxide to escape, keeping the seedlings from being burned or scorched. Spraying and weeding were among the cultural operations that were strictly adhered.

Data were systematically arranged on the basis of various observed parameters. MS-Excel was used for the data management and data analysis. Means were compared using Duncan's Multiple Range Test (DMRT) at 0.05 level of significance

Result and Discussion

The result and discussion of present work experiment entitled "study on effect of organic sources of nutrients on growth and yield of okra (*Abelmoschus esculentus* L. Var. Pusa Makhamali). Under agro- climatic condition of Kanpur" was conducted at Horticultural Field of Rama University, Kanpur, Indiaduring Feb to June 2022 to evaluate the effect of organic and their combnations on the yield and quality paameters of okra cv. pusa makhmali.

Effect of organic manures and their combinations on vegetative growth of okra

The length of shoot was observed at 30 DAT and found maximum in T_3 (34.56 cm) (50% sheep manure + 50% poultry manure) and minimum shoot length was found inT_8 (31.17 cm) (control), at 60 DAT, the length of shoot was observed maximum in T_5 (126.64 cm) (50% poultry manure + 50% cow manure) and minimum shoot length was found in T_8 (83.23 cm) (control) and at 90 DAT, the length of shoot was observed maximum in T_2 (131.33 cm) (50% sheep manure + 50% cow manure) and minimum shoot length was found in T_8 (115.75 cm) 9control).

There were not any branches arised in the plants at 30 DAT, At 60 DAT, the number of branches per plant was observed maximum in T_6 (1.10) (poultry manure) and minimum number of branches per plant was found in T_8, T_1, T_2 (0.00) (control) and at 90 DAT, the number of branches per plant was observed maximum in T_7 (4.363) (25% sheep manure + 50*%* cow manure + 25% poultry manure) and minimum number of branches per plant was found in T_8 (1.493) (control).

The maximum number of leaves per plant at 30 DAT was noted in treatment T_5(12.16)(50% poultry manure + 50% cow manure) and minimum in T_8(5.39) (control), at 60 DAT, the maximum number of leaves per plant was noted in treatment T_5(19.72) (50% poultry manure + 50% cow manure) and minimum in T_8(10.15) (control) and at 90 DAT, the number of leaves per plant was observed maximum in T_5(33.75) (50% poultry manure + 50% cow manure) and minimum number of branches per plant was found in T_8 (19.72) (control).

Table 1: Effect of organic manures and their combinations on vegetative growth of okra

Treatment	Treatment Combinations	Shoot Length (cm)			No of leaves per plant			No of branches/plant	
		30 DAT	60 DAT	90 DAT	30 DAT	60 DAT	90 DAT	60 DAT	90 DAT
T_1	cow manure	32.03	104.61	124.93	7.09	14.2	24.50	0.00	2.51
T_2	50% sheep manure + 50% cow manure	32.31	107.33	131.33	6.77	16.7	30.17	0.00	2.37
T_3	50% sheep manure + 50% poultry manure	34.56	117.03	125.31	9.79	18.81	32.56	1.06	3.30
T_4	sheep manure	32.36	105.51	124.93	6.18	16.27	24.29	1.04	4.01
T_5	50% poultry manure + 50% cow manure	32.42	126.64	125.48	12.16	19.72	33.75	1.07	4.51
T_6	poultry manure	25.59	117.64	125.33	7.15	17.08	27.38	1.10	4.17
T_7	25% sheep manure + 50% cow manure + 25% poultry manure	32.47	116.15	125.86	10.04	19.01	32.35	1.01	4.36
T_8	control	31.17	83.23	115.75	5.39	10.15	19.72	0.00	1.49
	CD	1.71	4.12	4.34	1.22	1.42	1.26	0.06	0.64
	SE(m)	0.46	1.10	1.16	0.33	0.38	0.34	0.02	0.17

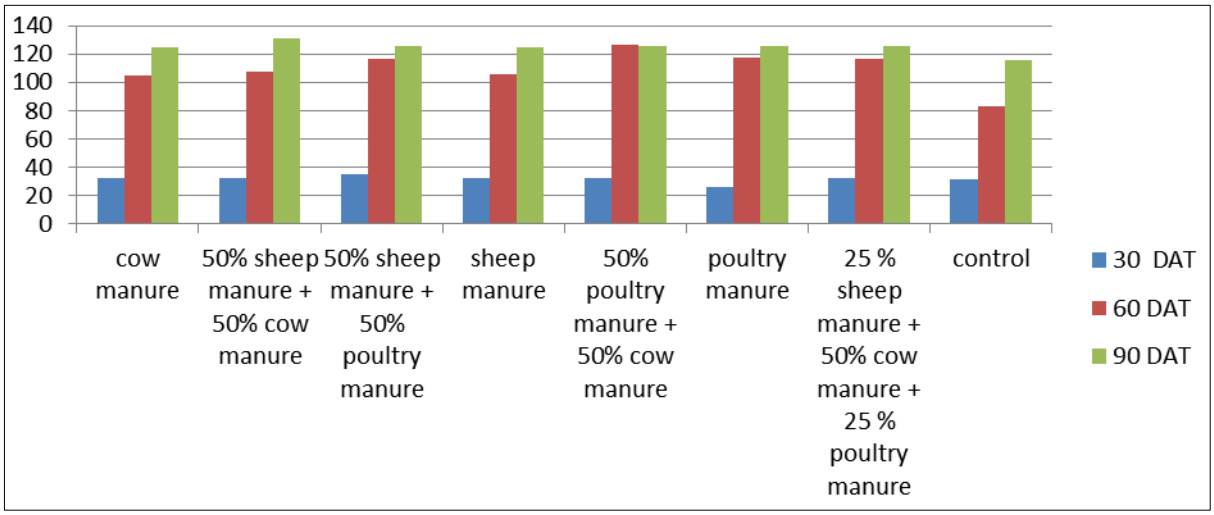

Fig 1: Effect of organic manures and their combinations on shoot length of okra

Effect of organic manures and their combinations on reproductive growth of okra

The number of fruits per plant was observed maximum in T_7(18.55) (25% sheep manure + 50% cow manure + 25% poultry manure) and minimum number of branches per plant was found in T_8 (9.42) (control). The length of fruits was observed maximum in T_7(9.90) (25% sheep manure + 50% cow manure + 25% poultry manure) and minimum fruit length was found in T_8 (7.41) (control).The diameter of fruit was observed maximum in T_7(1.82 cm)(25% sheep manure + 50% cow manure + 25% poultry manure) and minimum fruit diameter was found in T_8 (1.82 cm)(control). The number of seeds per fruit was observed maximum in T_7(90.23) (25% sheep manure + 50% cow manure + 25% poultry manure) and minimum was found in T_8 (72.00).(control). The weight of fruit was observed maximum in T_7(9.88 g) (25% sheep manure + 50% cow manure + 25% poultry manure) and minimum was found in T_8 (6.13 g) (control). The total yield of fruit was observed maximum in T_7(110.12 t/ha) (25% sheep manure + 50% cow manure + 25% poultry manure) and minimum was found in T_8 (76.77 t/ha)(control).

Table 2: Effect of organic manures and their combinations on reproductive growth of okra

Treatment	Treatment Combinations	No of fruit/plant	fruit length (cm)	fruit diameter (cm)	Number of seeds/fruit	Fruit weight (g)	Total yield (t/ha)
T_1	cow manure	10.21	7.73	1.11	73.39	6.81	84.67
T_2	50% sheep manure + 50% cow manure	13.65	8.76	1.45	83.08	8.95	101.78
T_3	50% sheep manure + 50% poultry manure	15.58	9.11	1.65	86.65	9.26	103.55
T_4	sheep manure	10.49	7.76	1.22	80.89	7.46	89.06
T_5	50% poultry manure + 50% cow manure	16.24	9.78	1.68	87.49	9.43	105.18
T_6	poultry manure	13.80	8.60	1.34	81.85	8.54	95.78
T_7	25% sheep manure + 50% cow manure + 25% poultry manure	18.55	9.90	1.82	90.23	9.88	110.12
T_8	control	9.42	7.41	1.04	72.00	6.13	76.77
	CD	1.18	1.21	0.28	3.52	1.06	5.13
	SE(m)	0.32	0.32	0.08	0.94	0.28	1.37

Effect of organic manures and their combinations on quality parameter of okra: The TSS was observed maximum in T_7(7.09ºbrix) (25% sheep manure + 50% cow manure + 25% poultry manure) and minimum was found in T_8 (5.26º brix) (control). The ascorbic acid was observed maximum in T_3 (12.45 mg/100g) (50% sheep manure + 50% poultry manure) and minimum was found in T_8 (10.15 mg/100g) (control)

Table 3: Effect of organic manures and their combinations on quality parameter of okra

Treatment	Treatment Combinations	TSS ºBRIX	Ascorbic acid (mg/100g)
T_1	Cow manure	5.95	11.41
T_2	50% sheep manure + 50% cow manure	6.53	11.89
T_3	50% sheep manure + 50% poultry manure	5.38	12.45
T_4	Sheep manure	6.30	12.02
T_5	50% poultry manure + 50% cow manure	6.75	11.69
T_6	Poultry manure	6.65	11.57
T_7	25% sheep manure + 50% cow manure + 25% poultry manure	7.09	12.15
T_8	Control	5.26	10.15
	CD	0.17	0.47
	SE(m)	0.04	0.13

Conclusion

The report showed that overall yield was maximum in treatment T_7 (25% sheep manure + 50% cow manure + 25% poultry manure). This result showed that the best combination for growing pusa makhmali variety of okra in Kanpur area of India is growing it with organic manures and their combinations. Only the single composition of organic fertilizer is not responsible for the higher yield but for the organic cultivation of the okra combinations of different organic manures is the best way for growing. For the commercial cultivation of okra, the combinations of different organic manures is more suitable for farmers.

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