Effect of Different Sources of Nutrient on Growth and Yield of Okra (Abelmoschus esculentus L. Monech)

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Abstract**—** *The experiment was carried out at Nepal Polytechnic Institute field, Bharatpur, Chitwan, Nepal to study the effect of different nutrient sources on growth and yield of okra (Abelmoschus esculentus L Monech). Five different treatments; poultry manure, FYM, goat manure, chemical (as per N equivalent) and no fertilizer (control) were replicated four times. The experiment was arranged in Randomize Complete Block Design (RCBD). The okra variety ArkaAnamika was used for experiment. The data were collected on the growth and yield parameters including plant height (cm), canopy (cm), numbers of leaves per plant, numbers of branches per plant, fruit length, diameter and yield. Results indicated that different nutrient sources had significant (P<0.05) affected on plant height, canopy, leaf number, branches and also in yield parameters. Based on the findings of the experiments, it can be concluded that application of poultry manure significantly increased the growth and yield performances on Abelmoschus esculentus L. Monech (okra) compared to other types of fertilizers. As the study reflected the use of no fertilizer results in the lowest vegetative growth and yield performances which indicates to use some nutrient sources for better growth and production of okra.*

Keywords**—** ***fertilizer, okra, growth, yield.***

I. INTRODUCTION

Okra, *Abelmoschusesculentus* L. Monech is a popular vegetable in tropic and countries of the world grown for its pod (Folorunso & Ojeniyi, 2003). It is a member of the hibiscus family, Malvaceae and has the typical floral characteristics of that family. It is originated from tropical Africa and was first cultivated in Egypt in 12thcentury (Maurya et al., 2013). The okra plant requires warm temperatures and is unable to withstand low temperature for long or tolerate any threat of frost. Optimum temperature is in the range of 21 to 30 degrees Celsius, with minimum and maximum temperatures of 18 degrees Celsius and maximum 35 degrees Celsius respectively.

Vegetables and vegetables based cropping systems show those vegetable crops are well responsive to nutrient supply through organic manures and chemical fertilizers (Kale et al., 1991) . Soil nutrient level gets decreased over time when crop plants get harvested, and these nutrients get replenished either through natural decomposition process or by adding fertilizers. Hence fertilization is an essential component of modern agriculture. Fertilizers provide different nutrients, one of them are the main macronutrients i.e. nitrogen (N), phosphorus (P), potassium (K), second are three secondary macronutrients i.e. calcium (Ca), magnesium (Mg) and sulfur (S), others are micronutrients. Today fertilizer has become essential to modern agriculture to feed the growing population. Use of fertilizers, especially, the chemical fertilizers has brought in blessings to humanity, which helped contain hunger and death in different corners of the world. However, the use of inorganic fertilizers alone may cause problems for human health and the environment (Arisha & Bradisi, 1999).

In recent year use of organic manures like FYM, poultry manure, goat manure is gaining prominence. The organic manuring has positive effect on soil texture and water holding capacity (Kale et al., 1991).It also provides food for soil micro-organisms. This increases the activity of microbes which in turn helps to convert unavailable plant nutrient to available form. Organic manure generally ameliorates the entire soil physical, chemical and biological properties of the soil as it energies the activities of soil microbes, which help in the liberation of plant nutrients and the healthy growth of the plants. Organic manure has also been found to sustain yield under continuous cropping and improve the fertility of a degraded soil (Eghareyba & Ogbe, 2002).

II. MATERIALS AND METHODS

2.1 Experimental site

The experiment was carried out at Nepal Polytechnic Institute field, Bharatpur-11, Bhojad, Chitwan, Nepal from April to June, 2019.The climate of the experiment site is sub-tropical. During summer the temperature may go as high as 40^0C while in winter, it may fall as low as 6-10^0C. Rainy season start from June and continue up to September, June-July receives highest rainfall (up to 150mm).

2.2 Experimental design

The experiment was arranged in Randomized Complete Block Design (RCBD) of five treatment replicate four times. Seeds were planted at a spacing of 50cm (R × R) and 30cm (P × P) and two seeds were put per hole and later were thinned to one seedling after their germination. There were four rows with six plants per row and a total of 24plants were accommodated in each plot. The area of each plot is 1.8m × 2m whereas the experimental area was 10.2m × 13m. Similarly, spacing of 50cm was maintained between the plots and also 50cm in between blocks was maintained.

2.3 Agronomic practices

The land was ploughed and harrowed to bring to fine tilth and leveling was done at Nepal Polytechnic Institute field. The test crop was ArkaAnamika which was obtained from Sahayogiagrovet. The seeds were soaked a night before planting to aid quick germination. Seeds were sown at the recommended spacing of 30cm apart on a row at a depth of 2cm with two seed per hole which was later thinned to one at the first weeding done after 15 days of sowing. Weeding was conducted manually at 15DAS and 35DAS in order to reduce weed competition. Harvesting was carried out after two months from sowing by hand picking of the fresh pods.

TABLE 1
TREATMENTS USED FOR EXPERIMENT

S.N	Treatments	Notations	Manure applied (kg/plot)
1	Poultry Manure	T1	10
2	Farm Yard Manure	T2	28.8
3	Urea + SSP + MOP	T3	0.15652 + 0.4065 + 0.036
4	Control	T4	
5	Goat Manure	T5	10

2.4 Measurement of data

To measure growth parameters, four plants were selected, one from each row to study the different parameters. Plant height was measured from base of the plant to its tip. It was measured from 25DAS to 55DAS.Plant canopy was measured by using meter scale and measured by taking diameter of canopy across two axes, after which mean was taken. The number of leaves was measured by counting fully opened leaves. Numbers of branches per plant were counted from 40 days from sowing till 55DAS at 15days interval.

To measure yield parameters plants from the middle rows were selected. Fruit diameter was measured from six plant selected randomly. It was measured with vernier caliper. The fruit length was measured by the help of measuring scale at harvesting. Fruit yield was recorded from the middle rows at three days interval. The obtained fruits were weighed with the help of weighing balance. The recorded data were then summed and expressed in tons/ha.

2.5 Statistical analysis

The recorded data was systematically arranged in Microsoft excel, which was used for simple statistical analysis, constructing graph and tables. The compiled data were subjected to Analysis of Variance (ANOVA) using Gen-Stat 15th edition. ANOVA was constructed and significant data were subjected to Duncan Multiple Range Test (DMRT) for mean separation with reference to Gomez and Gomez (1984).

III. RESULTS AND DISCUSSION

3.1 Effect of different nutrient sources on plant height:

The results obtained from the experiment are analyzed and presented in this section. The height of the plant was significantly influenced by the different nutrient sources at 25, 40 and 55 DAS. At 55 DAS the highest plant height was found in poultry manure (76.44 cm) which was significantly at par with the chemical (68.5cm) and goat manure (65.5cm). The significantly lowest height was found in controlled (36.9 cm). Okra grown on poultry manure performed better in terms of height of the plant. This shows that poultry manure was readily available and in the best form for easy absorption by the plant roots, hence there was a boost in morphological growth of the plant. The result corroborated with the findings of (Ajari et al., 2003) in okra production in which they reported that organic manures especially poultry manure could increase plant height of crops when compared with other source of manure.

TABLE 2
EFFECT OF DIFFERENT NUTRIENT SOURCES ON PLANT HEIGHT

Treatment	Plant height		
	25 DAS	40 DAS	55 DAS
Poultry manure	18.38[a]	46.8[a]	76.44[a]
Chemical	17.50[a]	41.4[ab]	68.5[ab]
Goat manure	15.06[b]	38.6[b]	65.50[ab]
FYM	14.25[b]	33.8[c]	56.94[ab]
Control	12.50[b]	24.5[c]	36.94[c]
SEM(±)	0.548	2.39	3.82
LSD(0.05)	1.688	7.36	11.76
CV%	7.1	12.9	12.5
Grand mean	15.54	37	60.9
Significance level	**	**	**

3.2 Effect of different nutrient sources on plant canopy

The plant canopy was significantly influenced by different nutrient sources at 25, 40 and 55DAS. At 55DAS the maximum mean canopy was found in poultry (79.2cm) which was statistically at par with chemical (69cm). The significantly minimum leaf canopy was found in controlled (43.4cm). The leaf canopy of goat manure was intermediate (67.4cm) which was statistically at par with FYM (60.9cm). The finding was supported by the results of (Ufera et al., 2013) who stated that the maximum leaf canopy was produced by the application of poultry manure. The effect of poultry manure enhanced the vegetative growth of okra (Alphonse & Saad, 2000) which might be due to having more nutrient content, rapid mineralization, optimum C/N ratio, growth promoting substances leading to better growth. These results are agreement with findings of (Makindae & Ayoola, 2012).

TABLE 3
EFFECT OF DIFFERENT NUTRIENT SOURCES ON PLANT CANOPY

Treatments	Canopy		
	25DAS	40DAS	55DAS
Poultry manure	21.50[a]	51.44[a]	79.2[a]
FYM	19.50[ab]	47.38[a]	69[ab]
Chemical	16.62[bc]	37.50[b]	67.4[b]
Control	14.94[c]	30.62[c]	60.9[b]
Goat manure	17.50[bc]	45.38[a]	43.4[c]
SEM(±)	0.905	2.217	3.33
LSD(0.05)	2.789	6.832	10.25
CV%	10.1	10.4	10.4
Grand mean	18.01	42.46	64
Significance level	**	**	**

3.3 Effect of different nutrient sources on number of leaves

Number of leaves was significantly influenced by different nutrient sources at 25, 40 and 55DAS. At 55DAS the maximum number of leaves per plant was found in poultry manure (40.62). The significantly minimum number of leaves per plant was recorded in control (17.1). The number of leaves per plant for chemical was intermediate (35) which was statistically at par with goat manure (33.94) and FYM (30).Reports from (Akanbi et al., 2000) stated that nutrient availability especially nitrogen determine plant vegetative growth. The increase of number of leaves per plant with organic fertilizer application stressed its importance during growth of plant (Tindall, 1992).

TABLE 4
EFFECT OF DIFFERENT NUTRIENT SOURCES ON NUMBER OF LEAVES

Treatments	Number of leaves		
	25DAS	40DAS	55DAS
Poultry manure	7.44[a]	19.75[a]	40.62[ab]
Chemical	7.00[a]	17.06[b]	35[b]
Goat manure	6.87[a]	16.00[b]	33.94[b]
FYM	6.68[ab]	15.44[b]	30[b]
Control	6.06[b]	9.56[c]	17.1[c]
SEM(±)	0.261	0.821	1.707
LSD(0.05)	0.804	2.530	5.260
CV%	7.6	10.6	10.8
Grand mean	6.86	15.56	31.49
Significance level	*	**	**

3.4 Effect of different sources of nutrient on number of branches

The numbers of branches were significantly influenced by different nutrient sources at40 and 55 DAS. At 55 DAS the maximum numbers of branches were found in poultry manure (4.06) which was statistically at par with chemical (3.44), goat manure (3.31) and FYM (3.19). The lowest numbers of branches were recorded in control (1.81). The application of poultry manure recorded the highest number of branches (Onwu et al., 2014). Similar results had been found by Nweke et al. (2013) who showed that poultry manure recorded the highest value in number of branches per plant i.e. 4.67 in okra and was significantly different from other treatments viz. goat manure, pig manure and control treatment.

TABLE 5
EFFECT OF DIFFERENT SOURCES OF NUTRIENT ON NUMBER OF BRANCHES

Treatments	Number of branches	
	40DAS	55DAS
Poultry manure	3.31[a]	4.06[a]
FYM	3.00[a]	3.25[a]
Chemical	3.12[a]	3.38[a]
Control	1.19[b]	1.62[b]
Goat manure	3.56[a]	3.75[a]
SEM(±)	**0.344**	**0.368**
LSD(0.05)	**1.059**	**1.133**
CV%	**24.2**	**22.9**
Grand mean	**2.84**	**3.21**
Significance level	**	**

3.5 Effect of different nutrient sources on fruit length

The fruit length was significantly influenced by the application of different nutrient sources. The highest fruit length was found in poultry manure (19.94cm) which was statistically at par with chemical (19.23) and goat manure (18.81). The lowest fruit length was observed in control (14.64). This agrees with the study of (John et al., 2004) who reported that PM contains essential nutrients which are associated with higher photosynthesis activities that promotes root and vegetable growth. Poultry outperformed NPK for all the reproductive traits measured. This agrees with the work of (Dauda et al., 2008).

TABLE 6
EFFECT OF DIFFERENT NUTRIENT SOURCES ON FRUIT LENGTH

Treatment	Fruit Length
Poultry manure	19.94[a]
Chemical	19.23[a]
Goat manure	18.81[a]
FYM	17.224[b]
Control	14.64[c]
SEM(±)	0.493
LSD(0.05)	1.520
CV%	5.5
Grand mean	17.97
Significance level	**

3.6 Effect of different nutrient sources on fruit diameter

The fruit diameter was significantly influenced by different sources of nutrient. The maximum fruit diameter was found in poultry manure (2.13). The significantly minimum fruit diameter was recorded in control (1.97cm). This agrees with the study of (John et al., 2004) who reported that PM contains essential nutrients which are associated with higher photosynthesis activities that promotes root and vegetable growth. Poultry outperformed NPK for all the reproductive traits measured. This agrees with the work of (Dauda et al., 2008).

TABLE 7
EFFECT OF DIFFERENT NUTRIENT SOURCES ON FRUIT DIAMETER

Treatment	Fruit Diameter
Poultry manure	2.13[a]
Chemical	2.00[b]
Goat manure	1.99[b]
FYM	1.94[b]
Control	1.79[c]
SEM(±)	0.0387
LSD(0.05)	0.1193
CV%	3.9
Grand mean	1.97
Significance level	**

3.7 Effect of different nutrient sources on fruit yield

The maximum yield was recorded in poultry manure (14.91 tn/ha) which was statistically at par with chemical (12.78 tn/ha) and goat manure (12.74 tn/ha) whereas the significantly minimum yield was recorded in control (7.03 tn/ha). The results obtain were in with the findings of (Premshekar & Rajashree, 2009) in which they reported that higher yield response of crops due to organic manure application could be attributed to improved physical and biological properties of the soil resulting in better supply of nutrients to the plants.

TABLE 8
EFFECT OF DIFFERENT NUTRIENT SOURCES ON FRUIT YIELD

Treatment	Fruit yield (tn/ha)
Poultry manure	14.91[a]
Chemical	12.78[ab]
Goat manure	12.74[ab]
FYM	10.44[b]
Control	7.03[c]
SEM(±)	1.408
LSD(0.05)	3.068
CV%	17.2
Grand mean	11.58
Significance level	**

IV. CONCLUSION

The research was carried out to evaluate the effect of different sources of nutrient on growth and yield of okra. The application of poultry manure, FYM, chemical and goat manure had a significant effect on growth and yield of ArkaAnamika variety of okra. Poultry manure produced maximum plant height (76.4cm), fruit length (19.94cm), fruit diameter (2.13cm) as well as fruit yield (14.91 tn/ha) in okra among all other nutrient sources. The results obtained revealed that okra responded well to the application of poultry manure compared to other different fertilizers and control treatment in the study. Therefore poultry manure could be used as the good organic nutrient source for increasing the productivity of the okra among different fertilizers.

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