Effects of different fertilizers on the growth and yield of Okra (*Abelmoschus esculentus* L.) in summer season in Chitwan, Nepal

*Sandesh Bhandari, Subodh Raj Pandey, Kushal Giri, Pratiksha Wagle, Suman Bhattarai, Ram Babu Neupane*

Agriculture and Forestry University, Rampur, Chitwan, Nepal  
*Corresponding email: bhandarisandesh2000@gmail.com*

---

**ARTICLE INFO**

*Original Research Article*

Received on March 11, 2019  
Revised on March 18, 2019  
Accepted on April 02, 2019  
Published on April 10, 2019

**Article Authors**  
Sandes Bhandari, Subodh Raj Pandey, Kushal Giri, Pratiksha Wagle, Suman Bhattarai, Ram Babu Neupane

**Corresponding Author Email**  
bhandarisandesh2000@gmail.com

**PUBLICATION INFO**

International Journal of Agricultural Invention (IJA)  
RNI: UPENG/2016/70091  
ISSN: 2456-1797 (P)  
Vol.: 4, Issue: 1, Pages: 1-9  
Journal Homepage URL  
http://agriinventionjournal.com/  
DOI: 10.46492/IJAI/2019.4.1.1

---

**ABSTRACT**

An experiment was conducted in the Horticulture Farm of Agriculture and Forestry University to demonstrate the effects of different fertilizers on the yield and yield parameters of okra (var. Arka Anamika). The experiment was laid out in Randomized Complete Block Design (RCBD) consisting of seven treatments and three replications. The various treatments used in the experiment were goat manure, sesame cake, mustard cake, synthetic fertilizer (NPK), poultry manure, vermicompost and untreated control. The required dose of nitrogen was fulfilled by the fertilizer itself whereas insufficient amount of phosphorous and potassium was fulfilled by addition of single super phosphate and muriate of potash respectively. The fertilizers were applied on the basis of recommendation given by the Nepal Agriculture Research Council (NARC). The effect of poultry manure on number of open flowers and number of fruits at 40 DAS was found superior. The effect of poultry manure on plant height, number of leaves, plant diameter was found superior at 50 DAS. Goat manure produced the superior result on number of open flowers at 50 DAS. Poultry manure on the number of leaves and plant height produced the significant result at 60 DAS. Synthetic fertilizer responded well to number of fruits at 60 DAS. Sesame cake produced the superior results at 70 DAS. Poultry manure responded well to all the parameters and produced the yield of 20 qt/ha with the BC ratio of 1.77. This experiment suggests the farmers to use the poultry manure to get the highest economic return. Vermicompost and mustard cake producing the superior and significant yield in this research are not recommended as they have low BC ratio unless effective measures are encouraged to reduce the cost of these fertilizers.

**KEYWORDS**

Okra, Fertilizers, Yield, Benefit-Cost Ratio, Organic, Income, Poultry

---

**HOW TO CITE THIS ARTICLE**

Bhandari, S. Pandey, S. R., Giri, K., Wagle, P., Bhattarai, S., Neupane, R. B. (2019) Effects of different fertilizers on the growth and yield of Okra (*Abelmoschus esculentus* L.) in summer season in Chitwan, Nepal, *International Journal of Agricultural Invention*, 4(1): 1-9. DOI: 10.46492/IJAI/2019.4.1.1

Okra (*Abelmoschus esculentus*) is an important summer vegetable of Nepal which belongs to family Malvaceae (Rajendra Prasad Maurya, 2013). It was originated from Africa and spread to tropics, subtropics and warmer part of temperate region (Farinde, 2007). Okra is the rich source of carbohydrate, amino acids, vitamin which have multipurpose use like fresh or cooked consumption, as fodder to animal, medicinal and industrial use (Farinde, 2007).

Okra response very well to fertilizer application and an effective fertilizer use is the key to its higher growth and yield. Inorganic fertilizers though helped farmers to get added yield but is deleterious to soil health causing soil acidification, plant burn, pollution and many more (Hunt). The continuous uses of these chemical fertilizers are toxic to human health over time and cause harm to us via direct and indirect way (Randeep Kumar, 2019).
Though, it supplies us with higher yield in short period of time but it end up with lower yield during long run (Buckler, 2017). Further, it hinders the world movement toward sustainable agriculture. So, an eco-friendly approach of using organic manure as an alternative to chemical fertilizer is the need of today. Organic fertilizers are derived exclusively from decomposed plants and animal remains (Buob, 2008). Different organic fertilizers include farm yard manures, animal manures, green manures, oil cakes, dried and decomposed plant and animal products etc.

Animal originated manures like poultry manure, goat manure and earthworm manure and plant originated mustard seed cake and sesame cake are used as the organic fertilizer in this study. Poultry manure in comparison to other supplies more nutrient to plant (Shripa Garg, 2008). Poultry manure increases plant height (Aniefiok Effiong Uko, 2013). Earthworm manures is known to restore the destructive effect of chemical fertilizers and improve soil properties and facilitates the growth of the crops (Sinha, 2009). Continuous use of vermicompost reclaims the soil and rejuvenates it. According to (Awodun, 2007) the growth, number of pods and yield of okra increased with increasing amount of goat manure. Various plant originated manures like mustard oil cakes, sesame oil cakes, peanut cakes, castor cakes helps in plant growth and increase yield by reducing the incidence of phytonematodes (Frederick Kankam, 2015, Aisha Sumbul, 2015). In this investigation, the effect of different organic and inorganic fertilizers on the growth and yield of okra is studied.

Materials and Methods

Experimental Site

It was carried out in the horticulture farm of Agriculture and Forestry University. The latitude and longitude of the research site is 27°37' and 84°37' respectively. The experiment was conducted from April 7, 2018 to July 2, 2018 and took 85 days from sowing to economic harvesting. It is located at an altitude of 250 meters above sea level. The soil status of the experimental site during field preparation was obtained by soil analysis report from Agriculture Technology Center, Lalitpur, Nepal. Brassica oleracea var. botrytis was grown last season in this research field. Arka Anamika is resistant to yellow vein mosaic virus.

Experimental Design

This experiment was carried out in randomized control block design (RCBD). It consists of 7 treatments and is replicated 3 times. The spacing of 50cm×30cm and wide spacing of 1m around the research plot was used. Spacing of 75 cm was used to separate the treatments and replications. The area of the plot is 2.5m×1.8m and thus covering 4.5 m². The research filed covers the entire area of 210.1 m².

Treatment and Trial Management

There are seven different treatments used in the experiment. They are: T₁: goat manure, T₂: sesame cake, T₃: mustard cake, T₄: synthetic fertilizers (NPK), T₅: poultry manure, T₆: control and T₇: vermicompost. The field was prepared 5 days before sowing and seed was sown after soaking for 24 hrs. Required dose of fertilizer application was given by Nepal Agriculture Research Council (NARC) i.e. 200:180:60 kg NPK/ha which accounts 90:81:27 g NPK/ 4.5 m². The NPK content different fertilizer determined by Animal Science Laboratory of AFU, Nepal is given below:

Table 1. Description of soil status of the research field

| S.N. | Description          | Properties     |
|------|----------------------|----------------|
| 1    | Soil texture         | Sandy loam     |
| 2    | Organic matter percentage | 3.5          |
| 3    | Soil pH              | 5.54           |
| 4    | Electrical Conductivity | (mmho/cm) at 25° | 0.13       |
| 5    | Nitrogen percentage  | 0.17           |
| 6    | P₂O₅ (Kg/ha)         | 55.09          |
| 7    | K₂O (Kg/ha)          | 342.58         |
| 8    | Sand percentage      | 76.4           |
| 9    | Silt percentage      | 18.67          |
| 10   | Clay percentage      | 6.04           |

The manures were applied to fulfill the required dose of nitrogen. Insufficient dose of phosphorous and potassium were applied through single super phosphate (SSP) and muriate of potash (MOP) respectively. The applied manures per plot are given in the table as follows:
Table 2. NPK content of different fertilizers

| S.N. | Manures          | N% | P% | K% |
|------|------------------|----|----|----|
| 1.   | Goat manure      | 3  | 1  | 2  |
| 2.   | Sesame cake      | 6.61 | 2.1 | 1.1 |
| 3.   | Mustard cake     | 4.52 | 1.78 | 1.4 |
| 4.   | Poultry manure   | 1.2  | 0.45 | 0.8 |
| 5.   | Vermicompost     | 2.35 | 1.6 | 1.5 |

The manures were applied to fulfill the required dose of nitrogen. Insufficient dose of phosphorous and potassium were applied through single super phosphate (SSP) and muriate of potash (MOP) respectively. The applied manures per plot are given in the table as follows:

Table 3. Amount of different fertilizer added in the research field

| S.N. | Manures          | Applied manures (for N) kg | SSP (g) | MOP (g) |
|------|------------------|---------------------------|---------|---------|
| 1.   | Goat manure      | 3.000                      | 318.75  | -       |
| 2.   | Sesame cake      | 1.361                      | 327.56  | 20.03   |
| 3.   | Mustard cake     | 1.991                      | 284.75  | -       |
| 4.   | Poultry manure   | 7.500                      | 295.31  | -       |
| 5.   | Vermicompost     | 3.829                      | 123.25  | -       |
| 6.   | Synthetic fertilizer(NPK) | 126.74g                  | 176.08g | 45      |
| 7.   | Control          | -                          | -       | -       |

Data Collection

There were altogether 30 plants in each plot. There were 18 border plants and 12 inner plants. Out of the 12 inner plants, 5 plants were sampled by using randomizer application and the data were collected on the following parameters:

Vegetative Parameters

Plant Height

The plant height was measured in 10 DAS, 20 DAS, 30 DAS, 40 DAS, 50 DAS and 60 DAS. It was measured using the measuring tape from the base to the tip of the plant.

Plant Diameter

The data for the plant diameter was measured in 20 DAS, 30 DAS, 40 DAS, 50 DAS and 60 DAS. The plant diameter was measured just below the 1st node from the ground.

Number of Leaves

The number of fully leaves was measured in 10 DAS, 20 DAS, 30 DAS, 40 DAS, 50 DAS and 60 DAS.

Reproductive Parameters

Number of Pods

The total number of pods was counted in 40 DAS, 50 DAS, 60 DAS and 70 DAS.

Number of Fruits

The total number of fruits was counted in 40 DAS, 50 DAS, 60 DAS and 70 DAS.

Number of Flowers

The total number of fully opened flowers was counted in 40 DAS, 50 DAS, 60 DAS and 70 DAS.

Yield

Okra fruits were collected in every 3 days by multiple harvesting from 45 DAS and they were picked 20 times up to economic production level.

Statistical Analysis

The data were collected and recorded in MS-Excel (Office Package, 2007) and subjected to statistical analysis according to one way ANOVA using R-stat (version: 3.4.2).

Economic Analysis

BC ratio of various treatments was calculated. The cost of various materials involved in the research was: goat manure: NRs 5/kg, sesame cake: NRs 25/kg, mustard cake: NRs 30/kg, poultry manure: NRs 5/kg, vermicompost: NRs 18/kg, urea: NRs 20/kg, DAP: NRs 45/kg, SSP: NRs 18/kg, okra seed: NRs 3500/kg, MOP: NRs 60/kg, labour: NRs 600/day, NRs 30/kg of the produce. It was calculated by adding all the cost except fertilizers to obtain the common cost (table 12). The common cost was added to the cost of manures to obtain the total cost (table 13). The yield was multiplied by the average value of the produce to obtain the benefit (table 14). Thus BC (table 14) ratio was calculated.
Meteorological Data (During the Investigation from April 7 to July 2)

National Maize Research Program (NMRP) under Nepal Agriculture Research Council (250 m far from the research site) provided required meteorological data of the entire cropping period. The maximum temperature ranges from 27.2°C to 38.01°C and the minimum temperature ranges from 27.02°C to 29.8°C. The research field received 385mm rainfall during the entire cropping period (fig 1).

Results

The effect of plant height and number of leaves at 10 DAS was found non-significant (table 4). Similarly, the effect of plant height, number of leaves and plant diameter at 20 DAS was found non-significant (table 5). Same result continues with the okra plant at 30 DAS (table 6). In 40 DAS, the effect of plant height, number of leaves, plant diameter and number of buds was found non-significant. But, the data for the number of open flowers and number of fruits was found significant at 1% and 5% level of significance respectively (table 7).

![Climatic Condition](image)

**Fig 1. Meteorological data during the investigation from April 7 to July 2**

**Table 4. Effect of different fertilizers on performance of okra at 10 DAS**

| Treatments          | 10 DAS | Number of leaves |
|---------------------|--------|-----------------|
| Plant height (cm)   |        |                 |
| Vermicompost        | 6.733333 | 3.066667 |
| Sesame cake         | 6.800000 | 3.000000 |
| Synthetic fertilizer| 6.400000 | 3.000000 |
| Goat manure         | 7.300000 | 2.933333 |
| Mustard cake        | 6.333333 | 2.933333 |
| Poultry manure      | 6.600000 | 2.933333 |
| Control             | 6.433333 | 2.866667 |
| SEM(±)              | 0.15    | 0.02            |
| LSD (0.05)          | 1.05    | 0.168           |
| CV (%)              | 8.86    | 3.18            |
| F-test              | NS      | NS              |

Note: Means with the same letter are non-significant at p=0.05 by DMRT, SEM: Standard error of mean, LSD: Least significant difference, CV: Coefficient of variation, NS: Non-significant
Table 5. Effect of different fertilizers on performance of okra at 20 DAS

| Treatments            | 20 DAS |                |                |                |
|-----------------------|--------|----------------|----------------|----------------|
|                       | Plant height (cm) | Number of leaves | Plant diameter (cm) |                |
| Goat manure           | 7.300000 | 5.466667       | 0.5400000       |                |
| Sesame cake           | 6.800000 | 5.266667       | 0.5500000       |                |
| Vermicompost          | 6.733333 | 5.600000       | 0.5133333       |                |
| Poultry manure        | 6.600000 | 5.866667       | 0.5666667       |                |
| Synthetic fertilizers | 6.400000 | 5.600000       | 0.6133333       |                |
| Mustard cake          | 6.333333 | 5.400000       | 0.5866667       |                |
| Control               | 6.300000 | 5.633333       | 0.5466667       |                |

SEM(±)                 | 0.15 | 0.1 | 0.01 |                |
LSD (0.05)             | 0.801 | 0.911 | 0.893 |                |
CV (%)                 | 6.78 | 9.23 | 8.97 |                |
F-test                 |     | NS | NS |                |

Note: Means with the same letter are non-significant at p=0.05 by DMRT, SEM: Standard error of mean, LSD: Least significant difference, CV: Coefficient of variation, NS: Non-significant

Table 6. Effects of different fertilizers on performance of okra at 30 DAS

| Treatments            | 30 DAS |                |                |
|-----------------------|--------|----------------|----------------|
|                       | Plant height | Number of leaves | Plant diameter |
| Mustard cake          | 26.93333 | 7.466667       | 0.7266667       |
| Synthetic fertilizers | 26.93333 | 8.333333       | 0.7066667       |
| Poultry manure        | 24.90000 | 8.666667       | 0.7000000       |
| Sesame cake           | 26.13333 | 8.666667       | 0.6800000       |
| Goat manure           | 26.26667 | 8.466667       | 0.6133333       |
| Vermicompost          | 25.13333 | 8.666667       | 0.6066667       |
| Control               | 23.46667 | 7.600000       | 0.5933333       |

SEM(±)                 | 0.44 | 0.2 | 0.02 |                |
LSD (0.05)             | 3.26 | 1.57 | 0.128 |                |
CV (%)                 | 7.15 | 10.9 | 10.9 |                |
F-test                 |     | NS | NS |                |

Note: Means with the same letter are non-significant at p=0.05 by DMRT, SEM: Standard error of mean, LSD: Least significant difference, CV: Coefficient of variation, NS: Non-significant

Table 7. Effects of different fertilizers on performance of okra at 40 DAS

| Treatments            | 40 DAS |                |                |                |                |                |                |
|-----------------------|--------|----------------|----------------|----------------|----------------|----------------|----------------|
|                       | Plant height | Number of leaves | Number of buds | Number of flowers | Number of open fruits | Number of fruits | of                |
| Vermicompost          | 53.66667 | 17.46667       | 1.19333        | 5.066667        | 0.3666667      | 0.8666667      | a                |
| Poultry manure        | 59.20000 | 17.13333       | 1.27333        | 5.866667        | 0.6333333      | 0.9666667      | a                |
| Mustard cake          | 55.33333 | 15.53333       | 1.26667        | 5.066667        | 0.3666667      | 0.9333333      | b                |
| Synthetic fertilizers | 60.86667 | 15.00000       | 1.28000        | 6.466667        | 0.3000000      | 0.6000000      | ab               |
| Sesame cake           | 61.40000 | 14.80000       | 1.28000        | 5.133333        | 0.3666667      | 0.6666667      | ab               |
| Goat manure           | 60.20000 | 14.20000       | 1.24000        | 4.466667        | 0.3000000      | 0.9333333      | a                |
| Control               | 51.76667 | 14.00000       | 1.20333        | 5.033333        | 0.2666667      | 0.4000000      | b                |

SEM(±)                 | 1.17 | 0.72 | 0.03 | 0.24 | 0.03 | 0.06 |                |
LSD (0.05)             | 8.96 | 5.47 | 0.21 | 2.07 | 0.154 | 0.38 |                |
CV (%)                 | 8.76 | 19.9 | 9.44 | 21.9 | 23.4 | 27.8 |                |
F-test                 |     | NS | NS | NS | ** | * |                |

Note: Means with the same letter are non-significant at p=0.05 by DMRT, SEM: Standard error of mean, LSD: Least significant difference, CV: Coefficient of variation, NS: Non-significant, *: 5% level of significance, 1% level of significance
### Table 8. Effects of different fertilizers in performance of okra at 50 DAS

| Treatments                  | Plant height | Number of leaves | Plant diameter | Number of buds | Number of open flowers | Number of fruits |
|-----------------------------|--------------|------------------|----------------|----------------|------------------------|-----------------|
| Poultry manure              | 88.73333     | 26.73333         | 1.960000       | 5.666667       | 0.6666667              | 2.066667        |
| Vermicompost                | 87.13333     | 24.93333         | 1.83333        | 6.800000       | 0.6666667              | 1.400000        |
| Sesame cake                 | 84.20000     | 19.73333         | 1.746667       | 8.200000       | 0.3333333              | 1.33333         |
| Goat manure                 | 54.66676     | 22.06667         | 1.586667       | 6.933333       | 0.8000000              | 1.466667        |
| Mustard cake                | 77.46667     | 18.80000         | 1.500000       | 6.600000       | 0.4666667              | 1.73333         |
| Synthetic fertilizers       | 75.20000     | 17.93333         | 1.343333       | 8.666667       | 0.4666667              | 1.666667        |

Control: 72.36667

**SEM(±)**: 1.65, **LSD (0.05)**: 9.11, **CV (%)**: 6.29

Note: Means with the same letter are non-significant at p=0.05 by DMRT, SEM: Standard error of mean, LSD: Least significant difference, CV: Coefficient of variation, NS: Non-significant, *: 5% level of significance

### Table 9. Effects of different fertilizers on performances of okra at 60 DAS

| Treatments                  | Plant height | Number of leaves | Plant diameter | Number of buds | Number of open flowers | Number of fruits |
|-----------------------------|--------------|------------------|----------------|----------------|------------------------|-----------------|
| Poultry manure              | 118.60000    | 44.60000         | 2.200000       | 10.566667      | 0.8                    | 3.666667        |
| Sesame cake                 | 117.73333    | 35.66667         | 1.773333       | 9.800000       | 0.8                    | 3.100000        |
| Vermicompost                | 111.6667     | 31.73333         | 1.846667       | 8.833333       | 0.9                    | 3.100000        |
| Synthetic fertilizers       | 111.2000     | 30.73333         | 1.676667       | 9.200000       | 0.6                    | 4.100000        |
| Goat manure                 | 109.3333     | 34.86667         | 1.936667       | 10.100000      | 0.6                    | 2.900000        |
| Mustard cake                | 107.1333     | 29.60000         | 1.740000       | 9.400000       | 0.5                    | 2.400000        |
| Control                     | 103.6667     | 25.06667         | 1.436667       | 8.933333       | 0.6                    | 2.333333        |

**SEM(±)**: 1.65, **LSD (0.05)**: 11.8, **CV (%)**: 5.96

Note: Means with the same letter are non-significant at p=0.05 by DMRT, SEM: Standard error of mean, LSD: Least significant difference, CV: Coefficient of variation, NS: Non-significant, *: 5% level of significance, **: 1% level of significance

### Table 10. Effect of different fertilizer on performance of okra at 70 DAS

| Treatments                  | Number of buds | Number of open flowers | Number of fruits |
|-----------------------------|----------------|------------------------|-----------------|
| Sesame cake                 | 15.03333       | 1.6000000              | 2.33333         |
| Poultry manure              | 14.40000       | 1.2000000              | 2.466667        |
| Synthetic fertilizers       | 12.20000       | 0.9333333              | 2.53333         |
| Goat manure                 | 11.26667       | 1.1333333              | 2.600000        |
| Mustard cake                | 10.93333       | 1.1333333              | 2.266667        |
| Vermicompost                | 10.13333       | 1.1333333              | 2.93333         |
| Control                     | 9.466667       | 1.0666667              | 2.266667        |

**SEM(±)**: 0.74, **LSD (0.05)**: 3.43, **CV (%)**: 16.2

Note: Means with the same letter are non-significant at p=0.05 by DMRT, SEM: Standard error of mean, LSD: Least significant difference, CV: Coefficient of variation, NS: Non-significant, *: 5% level of significance
Table 11. Effects of different fertilizers on yield

| Treatments           | Average Yield (qt/ha) | SEM(±)  | LSD (0.05) | CV (%) | F-test   |
|----------------------|-----------------------|---------|------------|--------|----------|
| Poultry manure       | 2000.000a             | 0.82    | 3.86       | 14.1   | **       |
| Vermicompost         | 1738.6667ab           |         |            |        |          |
| Goat manure          | 1672.8889ab           |         |            |        |          |
| Sesame cake          | 1662.2222ab           |         |            |        |          |
| Mustard cake         | 1464.4444bc           |         |            |        |          |
| Synthetic fertilizers| 1250.6667cd           |         |            |        |          |
| Control              | 961.3333d             |         |            |        |          |

Note: Means with the same letter are non-significant at p=0.05 by DMRT, SEM: Standard error of mean, LSD: Least significant difference, CV: Coefficient of variation, **: 1% level of significance

Table 12. Estimation of common-cost

| Particulars               | Amount (NRs/ha) |
|---------------------------|-----------------|
| Rental value of land      | 105,000         |
| Field preparation         | 6,000           |
| Seed cost                 | 23,089          |
| Irrigation cost           | 66,000          |
| Manuring (Labour)         | 1,800           |
| Weeding                   | 18,000          |
| Harvesting                | 24,000          |
| Total                     | 243,889         |

Note: NRs: Nepalese Rupees

Table 13. Estimation of cost

| Treatments          | Common cost(NRs/ha) | Cost of fertilizers (NRs/ha) | Total cost (NRs/ha) |
|---------------------|---------------------|-------------------------------|---------------------|
|                     |                     | Respective manures | Single Super Phosphate | Diammonium phosphate | Muriate of potash |
| Poultry manure      | 243,889             | 83,333             | 11,812                 | -                    | -                    | 339,034             |
| Vermicompost        | 243,889             | 153,160            | 4,390                  | -                    | -                    | 401,979             |
| Goat manure         | 243,889             | 33,333             | 12,750                 | -                    | -                    | 289,972             |
| Sesame cake         | 243,889             | 75,611             | 13,102                 | -                    | 2670                 | 335,272             |
| Mustard cake        | 243,889             | 132,733            | 113,90                 | -                    | -                    | 388,012             |
| Synthetic fertilizers| 243,889            | 5632               | -                      | 17,608               | 6,000                | 273,129             |
| Control             | 243,889             | -                  | -                      | -                    | -                    | 243,889             |

Note: NRs: Nepalese Rupees, ha: hectare

Table 14. Benefit-Cost (BC) ratio

| Treatments          | Benefit (NRS/ha) | Total cost (NRS/ha) | BC ratio |
|---------------------|------------------|---------------------|----------|
| Poultry manure      | 600,000          | 339,034             | 1.77     |
| Vermicompost        | 521,580          | 401,979             | 1.30     |
| Goat manure         | 501,840          | 289,972             | 1.73     |
| Sesame cake         | 498,660          | 335,272             | 1.49     |
| Mustard cake        | 439,320          | 388,012             | 1.13     |
| Synthetic fertilizers| 375,180        | 273,129             | 1.37     |
| Control             | 288,390          | 243,889             | 1.18     |

Note: BC: Benefit-cost, NRs: Nepalese Rupees, ha: hectare

Effects of different fertilizers on the growth and yield of Okra (Abelmoschus esculentus L.) in summer season in Chitwan, Nepal
Poultry manure and vermicompost was found superior in case of number of buds whereas poultry manure, goat manure, vermicompost and mustard cake were found superior in case of number of fruits. In 50 DAS, the vegetative parameters such as plant height, number of leaves and plant diameter was found significant at 5% probability level. The reproductive parameters such as number of buds and number of open flowers were found non-significant. The data for the number of fruits was found significant at 5% probability level (table 8).

In all the cases poultry manure was found superior except in the number of buds, where goat manure was found superior. In 60 DAS, the effect on plant height was found non-significant. Whereas, the data for the number of leaves and plant diameter was found significant at 5% and 1% probability level respectively. In both the cases, poultry manure was found superior. The effect on number of fruits was found significant at 5% probability level (table 9). Synthetic fertilizer was found superior followed by poultry manure, vermicompost, sesame cake, goat manure, mustard cake and control. The effect on the number of fruits was found non-significant (table 9). In 70 DAS, the effect on number of buds was found statically significant at 5% probability level. Sesame cake produced the superior number of buds followed by poultry manure, synthetic fertilizers, goat manure, mustard cake, vermicompost and untreated control. The effect on number of open flowers and number of fruits was found non-significant (table 10).

The effect of different fertilizer on the yield was found significant at 1% probability level. Poultry manure producing 20 mt/ha was found superior (table 11). It was followed by vermicompost, goat manure, sesame cake, mustard cake, synthetic fertilizers and untreated control. The BC ratio was highest in poultry manure followed by goat manure, sesame cake, synthetic fertilizers, vermicompost, untreated control and mustard cake (table 13). Vermicompost produced the comparatively superior yield but due to the high cost of the manure, the BC ratio seems to be quite low. In case of synthetic fertilizers, though they produced the fewer yields but due to the low cost of the fertilizers, they have quite superior BC ratio.

Discussion

Above result shows that Poultry manure was found to be superior in almost all parameters except the number of buds at 70 DAS (on significant cases). Here, organic manures was found to improve the yield and its attributing characters. The application of poultry manure would release the nutrient easily and improves the nutrient status of the soil by easy solubilization effect and high water holding capacity of it. Thus, increases the overall growth parameters of the crop. This results agree with the findings of (Sanwal, Lakminarayana, Yadav, Rai, Yadav, and Mousumi, 2007, Premsekh and Rajashree, 2009). Furthermore, the application of organic manure could ameliorate the acidic condition of soil to improve crop production (Akande, Oluwatoyinbo, Adediran and Buari, 2003).

Conclusion

From this experiment, it can be concluded that usage of poultry manure improves the performance of growth parameters and finally increases the yield and also have high BC ratio.

Recommendation

Further research should be carried out to suggest the most suitable dose of poultry manure to obtain the maximum profit. Vermicompost, producing the significant superior yield have less BC ratio, so suitable research should be carried out to prepare cost efficient vermicompost to obtain the better results.

Acknowledgement

We want to acknowledge the Department of Horticulture, Agriculture and Forestry University (AFU), Chitwan, Nepal for their continuous support and coordination during the entire research duration.

Authors Contribution

The various authors have respective roles in the entire research designing to execution. SB and SRP planned the experiment. KRG, SB, SRP was involved in the field preparation and layout of the research field. PW, KRG, SB and SRP were involved in the various field activities from weeding to irrigation on the daily basis.
SRP and SB involved in the data entry. Similarly, data analysis was analyzed by SRP and SB. SB interpreted the data. PW, KRG and SB was involved the designing of the table and figures. SB was involved in the final editing and the publication procedures. All the authors provided critical feedback in the entire process.

References

Aisha Sumbul, R. R. (2015) Oil-Cake Amendments: Useful Tools for the Management of Phytonematodes, *Asian Journal of Plant*, 3: 91-111.

Akande, M. O., Oluwatoyinbo, F. I., Adediran, J. A. and Buari, K. (2003) Soil amendments affect the release of P from rock phosphate and the development and yield of Okra, *Journal of Veg. crop Production*, 9(2): 3-9.

Aniefiok Effiong Uko, I. A. (2013) Effects of Poultry Manure and Plant Spacing on the Growth and Yield of Waterleaf (*Talinum fructicosum* (L.) Juss), *Journal of Agronomy*, pp: 146-152.

Awodun, M. (2007) Effect of Goat Manure and Urea Fertilizer on Soil, Growth and Yield of Okra (*Abelmoschus esculentus* (L.) Moench) *International Journal of Agricultural Research*, 2: 632-636.

Buckler, L. (2017) The Hidden Danger of Chemical Fertilizers.

Buob, T. (2008) Fertilizing the Organic Garden, *University of New Hampshire Cooperative Extension*, pp: 1-4.

Farinde, A. (2007) An overview of Production, Processing, Marketing and Utilisation of Okra, *Agricultural Engineering International: the CIGR Ejournal*.

Frederick Kankam, E. N. (2015) Management of root-knot nematode (*Meloidogyne spp.*) on okra (*Abelmoschus esculentus* (L.) Moench) with aqueous sesame seed extract, *International Journal of Agronomy and Agricultural Research (IJAAR)* 6: 24-31.

Hunt, J. (n.d.) Harmful Effect of Chemical Fertilizers.

Premsekhar, M. and Rajashree, V. (2009) Influence of organic manure on growth, yield and quality of okra, *American Eurasian Journal of Sustainable Agriculture*, 3(1): 6-8.

Rajendra Prasad Maurya, J. S. (2013) Impact of plant spacing and picking interval on the growth, fruit quality and yield of okra (*Abelmoschus esculentus*) *American Journal of Agriculture and Forestry*, pp: 48-54.

Randeep Kumar, R. K. (2019) The Impact of Chemical Fertilizers on our Environment and Ecosystem, *Research Trends in Environmental Sciences*, pp: 69-86.

Sanwal, S. K., Lakminarayana, K., Yadav, R. K., Rai, N., Yadav, D. S. and Mousumi, B. (2007) Effect of organic manures on soil fertility, growth, physiology, yield and quality of turmeric, *Journal of Horticulture*, 64 (4): 444-449.

Shripa Garg, G. B. (2008) Phosphorus availability to maize as influenced by organic manures and fertilizer P associated phosphatase activity in soils, *Bioresource technology*.

Sinha, R. H. (2009) Earthworms Vermicompost: A Powerful Crop Nutrient over the Conventional Compost and Protective Soil Conditioner against the Destructive Chemical Fertilizers for Food Safety and Security, *American-Eurasian Journal of Agricultural and Environmental Sciences*. 

Effects of different fertilizers on the growth and yield of Okra (*Abelmoschus esculentus* L.) in summer season in Chitwan, Nepal