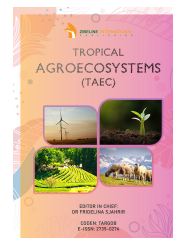




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RESEARCH ARTICLE

RESPONSES OF ORGANIC AND INORGANIC FERTILIZERS ON GROWTH AND YIELD OF OKRA (*ABELMOSCHUS ESCULENTUS* L. MOENCH CV. ARKA ANAMIKA)

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ABSTRACT

An experiment was carried out to determine the effects of different fertilizers on growth yield on Okra (var. Arka Anamika) at the summer season in mid-hills Khotang districts, Nepal. The treatment was carried out in the completely randomized block design (RCBD) with 5 treatments replicated 3 times. The different parameters such as plant height, leaf number, flower number, pod number, and yield were measured and analyzed. In the case of plant height, all the fertilizers showed the same response where the same case also found in leaf number. But in the case of flower pod and yield, we found different responses. In the case of flower number maximum response is shown by vermicompost followed by poultry manure whereas minimum response was observed in the recommended dose of fertilizers followed by control condition. In the case of pod number, maximum pod number was obtained in case of vermin-compost followed by poultry manure whereas the lowest response was shown by control followed by NPK. In the case of yield, maximum yield was obtained in poultry manure (2086.6kg/ha) followed by vermicompost (1680kg/ha) whereas the lowest yield was obtained in the control condition (430kg/ha). Experiments suggest that the use of poultry manure or vermin-compost will provide more economic return.

KEYWORDS

Vermi-compost; Blanket dose, Yield attributes, Mineral fertilizers, RCBD design; Diktel.

1. INTRODUCTION

Okra (*Abelmoschus esculentus* L. Moench), also known as Ladies Fingers is a member of the Malvaceae family (The Plant List, 2020). Locally it is known as 'Bhindi' or 'Chiplebhindi' (Singh and Bhandari, 2015). It is an important vegetable crop in the tropical and subtropical regions in the world. The okra is widely distributed throughout the different parts of the country. An average yield of 80 quintals of green fruits per hectare during spring-summer and 125 quintals in the rainy season is optimum (MOAD, 2018). Okra is a multipurpose crop. The tender okra pods are consumed fresh as well as canned and dried. Okra seeds are roasted, grounded, and used as a substitute for coffee in Turkey. It is a nutritious and delicious vegetable, fairly rich in vitamins and minerals (Gemed, 2016).

In the context of Nepal, it is cultivated in 9,619 ha of land with the average annual production of 109268 mt (Singh and Bhandari, 2015). The major producing district is Bara, Rautahat, Jhapa, Dhanusha, Kailali, Saptari, Chitwan, Morang, Mohattari (MOAD, 2018). Okra is valued for its edible green pods (fruits), a capsule that contains many seeds. However, its leaves are also eaten as a vegetable. Okra seeds are used as a non-caffeinated substitute for coffee and also as a source of seed oil (FAO, 2006). Okra is said to be of economic importance because of its nutritional value that has the potential to improve food security (FAO, 2006).

Okra requires heavy manuring for its potential production (Amjad and Muhammad, 1992). Fertilizer plays a major role in cultural practices for

increased crop production. However, the blanket application of inorganic fertilizer to farmland soils without adequate knowledge of the nutrient status, often leads to increased soil acidity, particularly when nitrogen fertilizers are applied (Akande et al., 2010). Inorganic fertilizers contain high concentrations of nutrients that are rapidly available and released for plant uptake, their use is limited due to scarcity, high cost, nutrient imbalance, and soil acidity (Akande et al., 2010). Nutritional imbalance in the soil causes instability in productivity and hidden hunger of nutrient besides results in poor nutritional quality of the vegetables.

Organic manures (especially with PGPR) not only balance the nutrient supply but also improve the physical and chemical properties of soil (Thapa et al., 2020). Mineral fertilizers only assure rapid and short-term growth and yield improvement but become unable to ensure the sustainability of agricultural production (Ware and Cullum, 1980; Titiloye et al., 1985). The application of organic manure could ameliorate the acidic condition of the soil to improve crop production (Ayodele, 2013). Thus, the study on the effects of organic and inorganic manures, and their effect over control was designed and studied in order to identify and report the nutrient management in Okra.

2. METHODOLOGY

2.1 Study area

The experiment was conducted in rupakot diktel which is at an altitude of 740 masl and the average temperature varies from 25- 34°C. Okra cultivar

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selected for study was *Arka Anamika*; the need for the study was to evaluate the performance of fertilizers so that it could aid for farmers to adopt the technology for optimal production. Okra being one of the important vegetables crop it has not been growing in properly with well managed practices. Our research aim was to addressed the problem of okra related to increase yield by proper and balanced use of organic fertilizer along inorganic keeping no any detrimental effects to environment. Many people of khotang localities were not using fertilizers in proper methods in balance ways due to which yields and quality of okra is not going good. So, hope our research will meet these condition for addressing such constraints related to okra productions.

2.2 Research design, field preparation, and data collection

The experiment was conducted in an RCBD design with 3 replications (R1, R2, and R3). Each replication has 5 plots each of 2.5*1.8m² area. And each plot was treated with different treatments (T1, T2, T3, T4, T5) (Table 1). Varying the treatments; the sowing time, dose of fertilizer, intercultural operation was kept constant. The spacing of 75cm was used to separate the treatments and replications. The area of the plot is 2.5m × 1.8m and thus covering 4.5m². The research filed covers the entire area of 210.1m². Plants were sown on the 27th of January 2019 and data collection was started from Feb 27 and so on.

The land was prepared by 2 times with soil turning, harrowing, and leveling. Plant stubbles and weed residues were removed from the plot and crisscross plowing was done. Pulverization of soil and each replication plot was leveled to make the fine structure of soil for sowing (Singh and Bhandari, 2015). Data collection was done by using standard scale and measuring tapes for plant height, a similar number of leaves, flowers, pods were recorded and yield was measured by using digital weighing balance. Data were collected on 30, 40, 50 and 60 DAS in plant height and leaf number, and flowers and pods were counted after they appeared as first count and second count.

Table 1: Details of the treatments used in the study.

| Treatment | Details of treatment | Dosage of application/block |
|-----------|-----------------------------------|-----------------------------|
| T1 | Recommended fertilizer dose (NPK) | 73.12:78.75:309 gm NPK |
| T2 | Farmyard manure (FYM) | 22.5 kg |
| T3 | Poultry manure () | 9 kg |
| T4 | Vermi-compost (VC) | 4 kg |
| T5 | Control | Not applied |

2.3 Statistical analysis

Data entry was done using ms-excel and R stat 4.0.1 was used for the analysis of collected data (Core Team, v 2017). The analysis includes Mean, F-test (1% and 5% level of significance), SE, coefficient of variation (CV), Least significant difference (LSD), and Duncan's multiple range test was done at 5% leave of significance (Shrestha, 2019; Gomez and Gomez, 1984).

3. RESULTS AND DISCUSSIONS

3.1 Plant height (cm) of okra in response to different treatments

The Plant height value for okra in response to different fertilizers was non-significant at 30, 40, 50, 60 DAS respectively (table 2). The highest plant height at 30 DAS was obtained in response to poultry manure (8.433) which is at par with vermin compost (8.433) whereas lowest height response was shown by the recommended dose of fertilizers (7.26) followed by control (7.32). Similarly, height in response to poultry manure was obtained highest (16.2) which was at par with vermin-compost (16.06) whereas lowest was found in response to the recommended dose of fertilizers (14.26) followed by control (14.4) at 40 DAS (figure 1). In 50 DAS, we found that poultry manure and the vermin-compost response showed the highest plant height (26.833) whereas the lowest was showed by the recommended dose of fertilizers and control (22.93).

In 60 DAS, we found that maximum plant height response was shown by vermin-compost and poultry manure (37.9 & 36.33) whereas the lowest was obtained in the recommended dose of fertilizers (33.2). Therefore, all DAS we found that in response to different fertilizers, maximum plant height was obtained in poultry manure and vermin-compost whereas the lowest was obtained in control followed by the recommended dose. The

plant list reported that plant height was non-significant to different doses of fertilizers (The Plant List, 2020). However, the highest plant height was reported in synthetic fertilizers which is contradictory to our finding but supported which suggests the highest plant height was observed in vermicompost and poultry manure (The Plant List, 2020; Singh and Bhandari, 2015).

Table 2: Plant height in response to different fertilizers(cm)

| | 30das | 40das | 50das | 60das |
|------------|-------|-----------------------|-------|--------|
| T1 | 7.26 | 14.26 | 22.93 | 33.2 |
| T2 | 7.77 | 15.26667 ^a | 24.76 | 36.933 |
| T3 | 8.43 | 16.2 | 26.83 | 36.33 |
| T4 | 8.43 | 16.067 | 26.83 | 37.9 |
| T5 | 7.323 | 14.46 | 23.5 | 32.56 |
| Grand mean | 7.829 | 15.10 | 24.97 | 34.72 |
| sem | 0.50 | 0.76 | 0.96 | 1.71 |
| F-test | NS | Ns | Ns | Ns |
| lsd | 4.31 | 6.68 | 7.78 | 12.24 |
| Cv% | 29.22 | 23.5 | 16.55 | 18.62 |

RDF = Recommended dose of fertilizers, FYM = Farm Yard manure, PM = poultry manure, VC = Vermi-compost, CV = Coefficient of variance, LSD = least significant difference SE = Standard error, *significant at 5 % level (Pr>f), ** significant at 1% level of significance, Ns= non-significant, Same letter in the means do not differ significantly at p= 0.05 by DMRT



Figure 1: Plant height in response to different fertilizers

3.2 Response of okra leaf number in relation with different fertilizers

The okra leaf in response to different fertilizers varied significantly at 30, 40, 50 DAS, and increased with time in all the responses (Table 3). But was non-significant at 60 DAS. In all the cases (30, 40, 50, 60 DAS) Maximum no of a leaf was found in response to poultry manure which at par with vermicompost whereas lowest no of a leaf was found in response to RDF and control (fig 2). A similar type of result was also reported where the highest number of leaves was observed in the application of organic fertilizers (The Plant List, 2020). MOAD reported the highest leaf area in response to poultry manure (MOAD, 2018).

Table 3: Response of different fertilizers in number of leaves.

| | 30das | 40das | 50das | 60das |
|------------|-------|---------|--------|-------|
| T1 | 4.8b | 9bc | 13.6b | 20.86 |
| T2 | 5.13b | 9.2bc | 13.6b | 19.6 |
| T3 | 4.86b | 8.66c | 12.8b | 20.8 |
| T4 | 7.13a | 12.2a | 15.73a | 20.73 |
| T5 | 4.86b | 10.66ab | 14ab | 20.8 |
| Grand mean | 5.05 | 8.53 | 13.89 | 19.33 |
| sem | 0.256 | 0.440 | 0.347 | 0.637 |
| F-test | ** | ** | * | Ns |
| lsd | 0.809 | 1.82 | 1.92 | 5.01 |
| Cv% | 8.02 | 9.8 | 7.32 | 13.37 |

RDF = Recommended dose of fertilizers, FYM = Farm Yard manure, PM = poultry manure, VC = Vermi-compost, CV = Coefficient of variance, LSD = least significant difference, SE = Standard error, *significant at 5 % level (Pr>f), ** significant at 1% level of significance, Ns= non-significant, Same letter in the means do not differ significantly at p= 0.05 by DMRT

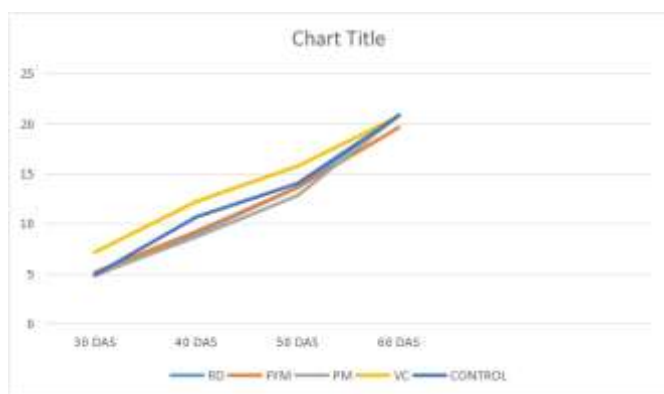


Figure 2: Leaf Number Under Different Treatment Responses

3.3 Response of flower and pods number to different fertilizers

In response to different fertilizers, we found that the maximum no of flowers in the 1st and 2nd count is observed in poultry manure and vermicompost whereas lowest was shown in control followed by the recommended dose of fertilizers (table). The number of flowers at first count and number of flowers at second count varied significantly at 1% level of significance. The Plant List reported the highest number of flowers in synthetic fertilizers but reported human urine can be adopted in exchange with inorganic fertilizers also improved yield significantly (The Plant List, 2020; Gemed, 2016).

3.4 Okra pod no. in response to different fertilizers

The okra pod no. in response to different fertilizers varied significantly at 1st count in 1% level of significance and non-significant at 2nd count. (Table 4). In 1st count maximum response was shown by vermicompost (4.06) followed by poultry manure whereas lowest pod no was obtained in response to control condition (1.533) (table 4). Similarly, in 2nd count maximum, no pod was obtained in response to vermicompost (5.20) followed by poultry manure whereas the lowest was obtained in response to control (2.1). A similar type of finding was reported by where the highest pod count was observed in poultry manure as no vermicompost was used in the study and lower was reported in NPK and control (MOAD, 2018).

Table 4: Responses of fertilizers to different growth parameters and yield

| | Yield | Number of pods1 | Number of pods 2 | Flower no 1 | Flower no 2 |
|------------|---------------------|-----------------|------------------|-------------|-------------|
| T1 | 1678.33B | 2.33B | 2.93 | 2.7b | 2.58b |
| T2 | 1058.33C | 2.4B | 3.4 | 2.8b | 3.26b |
| T3 | 1680B | 4.06A | 5.2 | 4.8a | 7.13a |
| T4 | 2086.6 ^A | 3.73A | 4.8 | 5.33a | 6a |
| T5 | 430D | 1.53B | 4 | 2.06b | 3.46b |
| Grand mean | 1386.66 | 2.81 | 3.65 | 3.54 | 4.66 |
| Sem | 155.644 | 0.285 | 0.376 | 0.394 | 0.540 |
| F-test | 0.001 | 0.01 | ns | 0.01 | 0.01 |
| LSD=0.05 | 104.42 | 1.291 | | 1.735 | 2.40 |
| CV% | 3.99 | 24.38 | 36.17 | 25.8 | 28.43 |

RDF = Recommended dose of fertilizers, FYM = Farm Yard manure, PM = poultry manure, VC = Vermi-compost, CV = Coefficient of variance, LSD = least significant difference, SE = Standard error, *significant at 5 % level (Pr>f), ** significant at 1% level of significance, Ns= non-significant, Same letter in the means do not differ significantly at p= 0.05 by DMRT

3.5 Yield of okra in response to different fertilizers

The Yield value for okra in response to different fertilizers varied significantly at harvest. In response to different doses of fertilizers, we found that maximum yield was obtained in poultry manure (2086.667)

followed by vermicompost whereas the lowest was in the control condition. Organic manure has a positive effect on the yield of okra and has been reported (Singh and Bhandari, 2015). Also, the findings have also been supported by the findings (The Plant List, 2020; FAO, 2006).

4. CONCLUSION

Okra is one of the heavy feeding crops and the nutrient requirement is generally high. This study conducted to identify the effect of different organic manures and inorganic fertilizers have a significant effect on growth, development, and yield. The highest plant height was reported in vermicompost followed by poultry manure. Similarly, a number of pods/plant, no. of flowers/plant and yield/plant highest response was recorded from vermicompost and poultry manure. The main reason for high yield in organic manure might be due to the high density of micro-organisms present in manures. To ensure and recommend the optimal doses multi-location research should be conducted in different agro-climatic conditions as results varied from one ecosystem to other.

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