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RESEARCH ARTICLE

EFFECT OF COMBINE USE OF UREA AND ORGANIC MANURES ON GROWTH AND SOIL NUTRIENT STATUS IN OKRA AT LAMJUNG

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ABSTRACT

Farmers in Nepal overuse or under use urea in okra production, which is a major cause of soil acidification and nutrient imbalance. A better approach is to apply organic and urea together, which can help to reduce soil acidity and nutrient imbalance problems in the mid- hills of Nepal. Therefore, a field experiment was carried out from April to July 2023 at Sundarbazar, Lamjung to evaluate the combined effect of urea and organic manures on growth and yield of okra. The experiment was carried out in a randomized complete block design with five treatments viz. control, cow manure + urea, buffalo manure + urea, goat manure + urea and goat manure + buffalo manure + urea, each replicated four times. Goat manure and urea fertilizer combination produced a significantly higher number of leaves (9.2) at 60 days after sowing (DAS), while the lowest number of leaves (4.93) was observed in the control treatment. Similarly, at 60 DAS, the goat manure and urea treatment produced a significantly higher number of pods (19.58), while the control plot had the lowest number of pods (7.48). The goat manure and urea treatment also produced a significantly higher number of primary branches (3.3), followed by cow manure and urea (2.33), while the control plot had a significantly lowest number of primary branches (1.3). Out of all the treatments, cow manure and urea resulted in the largest fruit diameter (17.24 mm), while the control treatment had the smallest fruit diameter (1.3 mm). Maximum organic matters (3.6%) and phosphorous (24.85%) content was obtained in combination of goat manure and urea after laboratory test. Least amount of organic matters content in control plot.

KEYWORDS

Okra, Integrated Nutrient Management, Organic manures, Urea.

1. INTRODUCTION

Okra (*Abelmoschus esculentus*) is one of the most popular and recommended vegetable crop among Nepali farmers and consumers especially due to its culinary features and has economic value. It is known as Bhindi or lady's finger which is cultivated mainly in summer season as Kharif crop, belonging to Malvaceous family. Okra was originated from Ethiopia which in turn propagated towards Africa followed by Asian sub continents by the end of 12th century (Fekadu Gemede, 2015). It is an upright, annual herbaceous plant with a height of 1-2 meters. The countries that grow the most of it on a global scale are India, Nigeria, Sudan, Pakistan, Ghana, Egypt, Benin, Saudi Arabia, Mexico, and Cameroon (Magar et al., 2023). From nutritional point of view, Okra is good source of Vitamin A and Vitamin C with trace amount of Vitamin B, it is also the factor to enhance essential and non-essential amino acids in our body and lysine is greatly induced by Okra consumption (Chikere Nwangburuka et al., 2012).

It provides healthy levels of vitamins, minerals, protein, lipids, and carbohydrates (Akintoye, 2011). For the best economic yields, which are essential for both the quality and quantity of okra production, okra is a heavy feeder of both macro and micronutrients. But indiscriminate use of inorganic fertilizers has resulted in limited nutrient uptake, poor produce quality, and diminished soil health (Otomoso and Johnson, 2015). According to the report, it is claimed that Okra is composed of various nutritional factors including carbohydrate, proteins, fats and fibrous minerals which is a major shortage in diet of developing countries. Successful okra production may contribute partially in solving vegetable scarcity in summer (Miah et al., 2020).

Okra is an economically important vegetable crop widely grown in tropical sub-tropical, and temperate region of the world. It is important for crop productivity and quality that organic manure and chemical fertilizer are utilized together in an integrated nutrient management (INM) system (Sachan et al., 2017). Agriculture occupies the huge area of economy of Nepal. Among total population of Nepal, 66% people engaged in agriculture sector for self-survival directly or indirectly (MoALD, 2021). The industrial sector's contribution has been essentially constant. Agriculture contributed 37.4% of total GDP (MOF, 2022). Vegetables were grown on 284,121 hectare of land in 2021 and production was 3,993,167 metric tons (MoALD, 2021).

Though, there exists a very high demand Okra in Nepalese market, only 9,584 hectare land is cultivated and the production was 110,565 metric tons. In Lamjung district 26 hectare land was cultivated and the production was 9.04 metric tons per hectare (MoALD, 2021). Vegetables are one of the prioritized crops of agriculture throughout the world. Lamjung is a district that possess a better climatic condition required for vegetables but the vegetable production in this passed fiscal year is about 20,449 Metric tons which is relatively lower than that of other mid hill areas (MoALD, 2021). This lower rate of vegetable production including Okra in our experimental area is predicted due to unavailability of all nutrient required for crop growth in soil around this particular site.

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The total Okra production in Lamjung district as recorded is about 236 Metric tons in an area of 26 hectare. This is relatively lower as per the increasing demand of Okra, this decreased production of Okra is estimated due to soil health degradation caused by excessive use of chemical fertilizers inadequately. High use of chemical fertilizers leads to soil acidification and nutrient loss. Organic matter alone fails to achieve desired yields due to slow nutrient release. Low okra production is also linked to slow nutrient release, inadequate irrigation, and traditional farming methods. To improve soil health, reduce acidity, and achieve optimal yields with controlled chemical fertilizer use, this experiment explores Integrated Nutrient Management (INM).To ensure greater productivity and enhanced soil health in a cost-effective manner, integrated nutrient management is a technique that combines the application of organic and inorganic fertilizers at the same time (Mageshen and Ammal, 2022). Therefore, the purpose of this experiment is to ensure desired amount of Okra production improving soil health reducing soil acidity and promoting the sustainable soil fertility status.

2. METHODOLOGY

The details of the materials used, and the methods adopted during the course of investigation with the objective of "Influence of Integrated Nutrient Management (INM) on Growth and Yield attributes of Okra at a Current Soil Status of Lamjung District, Nepal" is as discussed here under

2.1 Geographical location of experimental site

The experiment was conducted in horticultural farm of Institute of Agriculture and Animal Science, Lamjung Campus, Nepal during the period of Early February to Late May 2023. Geographically, it is located at 28.276^0 N latitude 84.3542^0 E longitude with an elevation of 625 meters above sea level.

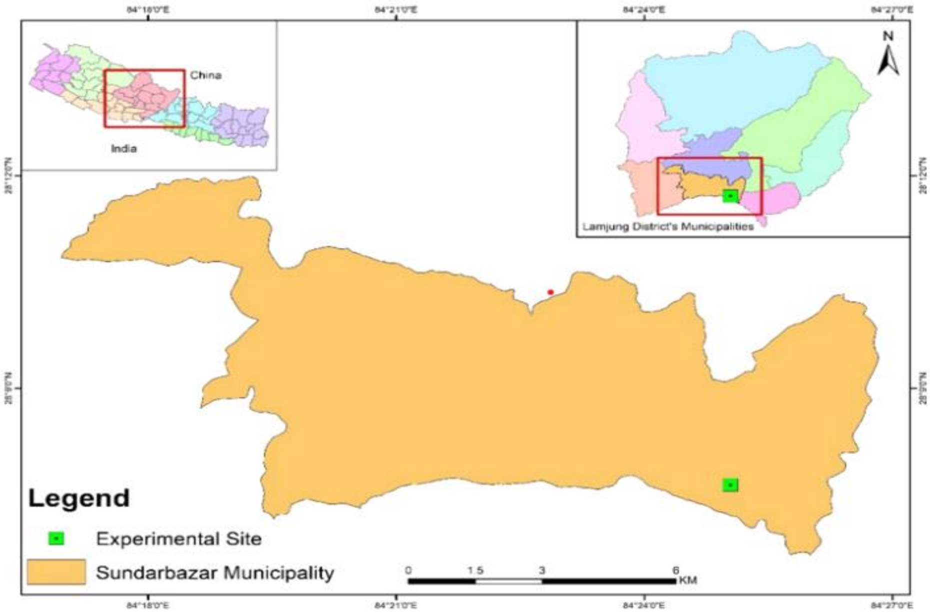

Figure 1: Geographical location of experimental site

2.2 Soil and Climatic condition of experimental area

Soil property estimation of a particular area is the key factor to determine abundant crop community of that location (Sigdel et al., 2015). Soil pH of different areas of Lamjung district is relatively lower. This means, the maximum area of land is moderately acidic followed by strongly acidic and very few parts of land have neutral soil status (Dahal et al., 2018). Soil fragments are the important elements required for increasing various soil parameters like bulk density, porosity, pore size distribution and saturated hydraulic conductivity (Chow et al., 2007). The average level of coarse fragment intensity in our experimental area is about 18.69%. the homogenous soil sample of our experimental plot before applying treatments was collected ant tested in Soil and Fertilizer Testing Laboratory, Gandaki province and it was found that the soil pH of our sample was 3.6 (Strongly acidic) and the soil nitrogen content was 0.06 (low).

According to the nearest meteorological station at kunchha village, the annual rainfall of our experimental area is about 2600 mm bearing 80% of the total rainfall in summer season with cold and dry winter. Also, as claimed by another meteorological station at Khudi, the average temperature of experimental site is 22.5^0 C with maximum of 28.64^0 C and minimum temperature of 16.39^0 C.

2.3 Seed collection and initial soil sampling

Seeds of Okra to be planted (variety: Arka-Anamika) was collected from nearby Argo-vet. The seed lot had Germination percentage and Purity percentage of 80% and 95%, respectively. Before applying the treatments into the field, a sample of soil was taken as initial homogenous soil sample from five pats of field with the help of Bucket agar from 15cm below the ground

2.4 Detail of the treatments

The experiment contained five treatments in which all of them were replicated four times. Out of which, the treatment T1 was control in which no any fertilizer or nutrient source was added and rest of the four treatments were made on the basis of "Integrated Nutrient Management" which is as follows:

Table 1: Detail of the treatments

Treatments	Symbol	Details
Control	T1	No any organic or in-organic fertilizers was applied
Cow manure + Urea	T2	50% N from organic manure as Cow dung + 50% N from inorganic fertilizer as Urea
Buffalo manure + Urea	T3	50% N from organic manure as Buffalo manure + 50% N from inorganic fertilizer as Urea
Goat manure + Urea	T4	50% N from organic manure as Goat manure + 50% N from inorganic fertilizer as Urea
Buffalo manure + Goat manure + Urea	T5	25% N from organic Goat manure +25% N from organic Buffalo manure + 50% N from inorganic fertilizer as Urea

The amount of both the organic manure and inorganic fertilizers were applied after calculation of required amount on the basis of fertilizer recommendation to Okra plant by Nepal Agricultural Research Council (ARC) which is N:P:K = 200:180:60 Kg/ha (Bhandari et al., 2019). Also, the nitrogen content on the organic manure applied by us is on the basis of the research conducted by which concludes the nitrogen content in different organic manures as follows (Sharma et al., 2022):

Table 2: Nitrogen content in different organic manures.

Organic manures	Nitrogen content (%)
Cow manure	0.830
Goat manure	1.667
Buffalo manure	0.665

During the experiment, the area per plot of our field is 3m^2, so the recommended NPK as per Nepal Agricultural Research Council becomes; (60:54:18) gm. Out of 60 gm of nitrogen per plot, 30 gm is allowed from Urea in each plot and remaining 30 gm from different organic manure sources. As per requirement, 30 gm nitrogen is provided by 65.2 gm of Urea. But, only32.6 gm of Urea was applied as basal dose and the remaining half dose of Urea was applied at 30 DAS. Full dose of all the organic manures were applied in the basal dose which are as listed below:

Since, cow manure contains 0.83% of nitrogen, per plot application of Cow manure was 3614.16 gm along with Urea.

Similarly, goat manure contains 1.667% of nitrogen so the per plot application of goat manure was 1799.64 gm along with Urea.

Similarly, buffalo manure contains 0.665% of nitrogen so per plot application of Buffalo manure was 4511.28 gm along with Urea.

In fifth treatment, calculated amount of goat manure and buffalo manure was applied as 899.82 gm and 2255.64 gm, respectively along with Urea.

Also, the per plot requirement of Phosphorous and Potassium was applied from 337.5 gm Single Super Phosphate (SSP) and 30 gm Muriate of Potash (MOP), respectively.

2.5 Experimental Design

The experiment was laid under single factor Randomized Complete Block Design (RCBD) in the field. Each of the five treatments were replicated four times creating 20 individual plots in the field.

2.6 Detail of the field Operation

2.6.1 Layout of the field

The field layout was carried out during early February in RCB design after a deep ploughing performed by cultivator followed by thoroughly levelling of land by rotavator provided by Campus administration. The total area of the field was 91.35 m^2 where the total length and breadth of the field were 14.5 m and 6.3m, respectively. There were altogether 20 plots in the field at which the length of each plot was 250cm and the breadth was 120 cm with an area of 3 m^2. The distance between plots and the distance between the replications was 50 cm. the layout of field was as shown in figure below:

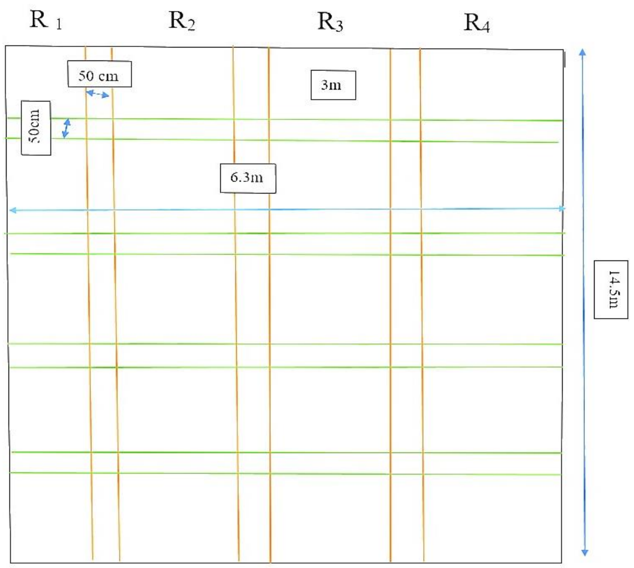

Figure 1: Layout of the field.

2.6.2 Treatment application details

Since, the experiment was conducted in RCB design, the treatments for each individual plot was selected in random through lottery method. After allocating treatments for each plot, the full dose of organic manure treatment was applied in the plots. Before incorporating into the soil, the organic manures were well rubbed manually into the simpler form. The goat manure was bind with the sticks to make it liable to apply in the field. After incorporating the manures, the land was well levelled and left for about a week. After a week, the half dose of Urea was applied at the time of seed sowing.

2.6.3 Sowing and thinning

After applying organic manures, the seeds were sown in a week. The seeds were sown at a distance of 30 cm maintaining the plant to plant and row to row spacing of (30×50) cm. two seeds were sown at each point and the thinning operation was carried out at 20 DAS.

2.6.4 Intercultural operations

Daily irrigation was provided through sprinkler method for a week and the irrigation was gradually reduced after a week. At 30 DAS, the remaining half dose of Urea was top dressed followed by the first manual hard weeding in the same day. First earthing up and hoeing was also done at 30 DAS. During the early stage of vegetative growth of the plant, the plants were highly damaged by Okra Cutworms which was controlled by application of insecticide "G-Sunami" at the rat of 2ml per liter of water with the help of Knapsack sprayer. Manual weeding operations were carried out frequently during data collecting periods.

2.6.5 Harvesting

The first harvest of Okra was conducted at 60 DAS and the repeated harvest of Okra was done at the interval of 3 days until 75 DAS.

2.7 Details of Observations

Both the vegetative and reproductive parameters were observed from the plants from 30 DAS to 75 DAS at the interval of 15 days.

2.7.1 Primary branch

At the time of final harvest, the number of primary branches was counted manually.

2.7.2 No of leaves

The number of leaves were counted manually from 30 DAS to 60 DAS at the interval of 15 days.

2.7.3 Number of pods

The fruit was counted from the sample plant which are likely to be harvested. The total number of fruits was counted in 45DAS, 60DAS, and 75 DAS.

2.7.4 Fruit diameter

The data for the fruit diameter was measured 60DAS.Measurement of diameter done at middle part of the fruit.

2.8 Final Soil Sampling

After completing all the required data collection of plant parameters, the soil sample was collected from individual plot creating 20 independent soil samples. Bucket agar was used again for final soil sampling and three samples were released out from the individual plots which was mixed to form one representative sample per plot. Each sample was released out from 15 cm below the ground. After collecting soil samples from the field, the soil was shade dried for 2 days and it was bitten to simpler pieces with the help of Mortar and Pestle.

Later on, the coarse fragment present on the sol was released out by using 2mm Mesh Soil Sieve and the final soil sample was ready for testing different soil parameters. Different soil parameters tested were pH, Nitrogen content and Organic Carbon from Soil and Fertilizer Testing Laboratory situated at Gandaki province, Kaski, Nepal.

2.9 Statistical analysis

Data collected from field was tabulated and processed from Microsoft Excel. After this, the significant differences between the treatments were determined from ANOVA. Finally, the mean separation between the treatments was done from LSD test at 5% level of significance using R-Studio version 4.2.0.

3. Result and Discussion

3.1 No of leaves and number of pods at different days

Table 3: Effect of integrated nutrient management on number of leaves and pods of okra.

Treatments	Number of leaves			Number of pods		
	NL30	NL45	NL60	NP45	NP60	NP75
T1	4.40[ab]	4.90[ab]	6.45[c]	4.93[c]	7.48[c]	4.28[c]
T2	4.60[ab]	5.10[ab]	8.30[ab]	7.95[b]	11.60[b]	8.25[b]
T3	3.95[b]	4.45[b]	6.70[bc]	7.10[b]	11.83[b]	14.38[a]
T4	4.75[ab]	5.25[ab]	9.20[a]	12.83[a]	19.58[a]	9.28[b]
T5	5.20[a]	5.70[a]	6.50[c]	8.73[b]	12.90[b]	4.9c
f- test	NS	NS	*	***	***	***
LSD	1.14	1.14	1.77	1.84	2.29	1.76
Sem	0.55	0.55	1.32	1.43	2.2	1.3
CV%	16.68	14.58	15.43	14.39	11.70	13.88
Grand Mean	4.58	5.08	7.43	8.305	12.68	8.21

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, Significant= *, **, ***.NL30=Number of leaves at 30days,NL45=Number of leaves at 45 days,NL60=Number of leaves at 60 days,NP45=Number of pods at 45 days,NP60= Number of pods at 60 days and NP75= Number of pods at 75 days.

3.2 Number of leaves

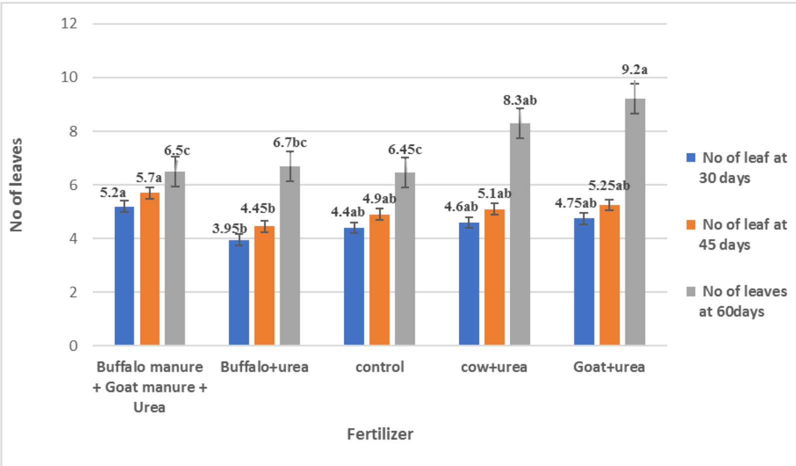

Figure 2: Bar graph showing the effect of combine use of urea and organic manures on number of leaves

The number of leaves of okra response to different treatment, we found that non-significant at first and second count. Significance difference was seen between the treatments for number of leaves at 60 DAS. The highest number of leaves (9.2) was recorded in T4: (goat manure + urea) which is statically at par with all other treatments and the lowest number of leaves (6.5) was recorded in control plot. Increase in the number of leaves with the application of nitrogen with different organic manures but significant increase shows between 6-8 DAS (Ogunlela et al., 2005).The number of leaves increase with the application of goat manure with urea. The results are in close conformity with the findings (America, 2009; Awodun, 2007).

3.2 Number of pods

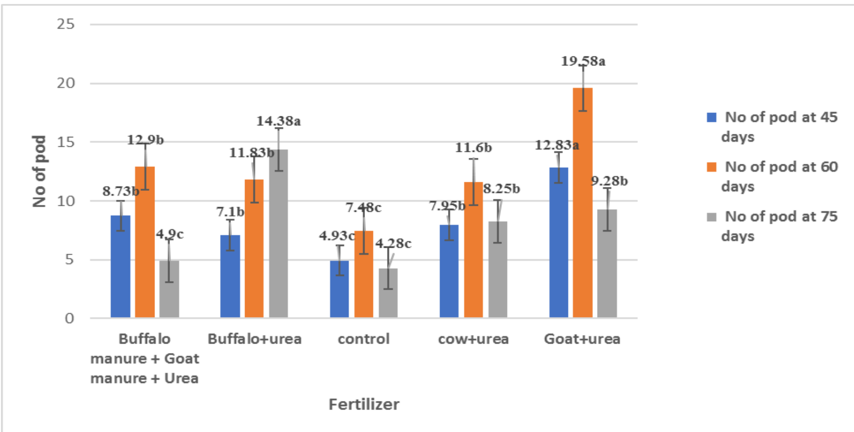

Figure 3: Bar graph showing the effect of combine use of urea and organic manures on Number of pods of okra at different days.

Among different treatments T4: (goat manure urea) gave maximum number of pods (12.83) and lowest number of pods obtained in control (4.93) at 45 DAS. Maximum number of pods (19.58) in second count obtained in T4: (goat manure urea) and minimum number of pods (7.48) seen in control. But in third count maximum number (14.38) of pods seen in T3 (buffalo manure urea) followed by T4 (goat manure urea) and minimum number of pods (4.28) seen in control, those second and third count are held at 60 and 75 DAS respectively.

3.3 Number of Primary branch and fruit diameter

Table 4: Effect of INM on number of branch and fruit diameter of okra.

Treatments	Number of Branch	Fruit diameter
T1	1.30^{c}	9.98^{c}
T2	2.33^{b}	17.24^{a}
T3	1.53^{c}	14.16^{b}
T4	3.30^{a}	16.64^{a}
T5	1.55^{c}	15.47^{ab}
f- test	***	***
LSD	0.57	1.93
SEm	0.14	1.57
CV%	18.38	8.53
Grand Mean	2.00	14.69

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, Significant= *, **, ***.

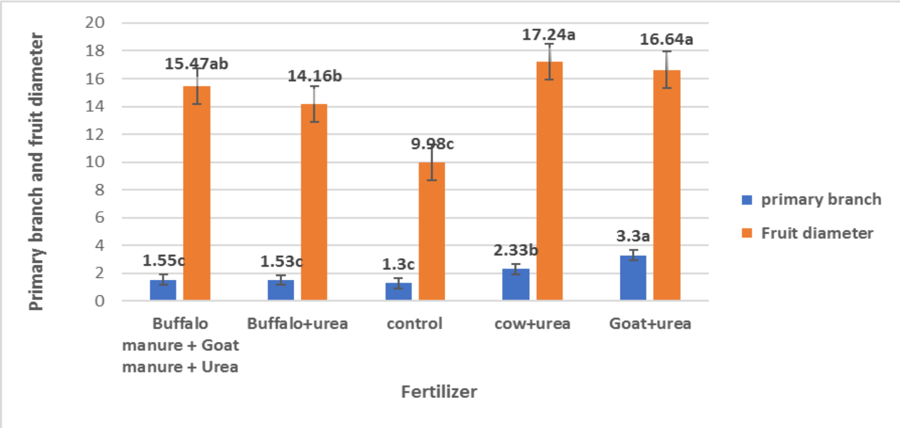

Figure 4: Bar graph showing the effect of combine use of urea and organic manures on primary branch and fruit diameter.

3.4 No of primary branch

Significant effect of different treatments was observed for number of primary branches. Maximum number (3.3) of primary branch was observed in T4 (goat manure urea) and followed by T2 (cow manure urea) having (2.33). Minimum number (1.3) of primary branch was observed in T1 (control) plot.

3.5 No of fruit diameter

Significant difference in fruit diameter was observed among the treatments. Observed data revealed maximum fruit diameter (17.24) was obtained in T2 (cow manure urea) which is statically at par with T4, T5, T3 whereas the lowest fruit diameter (1.3) was obtained in the control plot.

3.6 Organic matter

Table 5: Effect of combine use of organic and urea on organic matters

Treatments	Organic matters
T1	0.950^{c}
T2	2.420^{b}
T3	1.33^{c}
T4	3.61^{a}
T5	1.24^{c}
f- test	***
LSD	0.482
SEm	0.098
CV%	16.39
Grand Mean	1.91

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, Significant= *, **, ***.

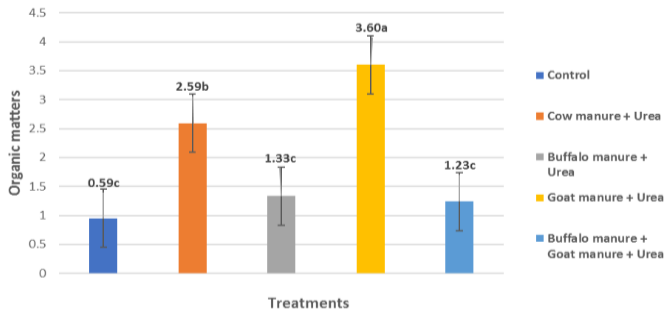

Figure 6: Bar graph showing the effect of combine use of organic manures and urea on organic matters content in soil.

After laboratory test, maximum organic matter content seen in soil where goat manure and urea applied and followed by cow manure + urea because goat manure has higher NPK (Gudugi, 2013). Least organic matters content seen in control plot.

3.7 Phosphorous

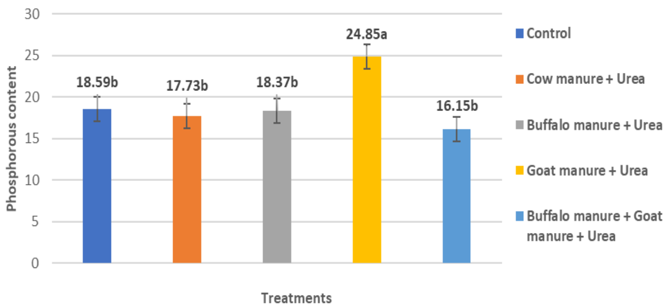

Figure 7: Bar graph showing the effect of combine use of organic manures and urea on phosphorous content in soil.

After laboratory test, maximum phosphorous content obtained in that plot where goat manure and urea applied. Because goat manure has highest NPK (Gudugi, 2013). Statically no significant difference between other treatments.

4. CONCLUSION

An assessment was done to find the response of Okra and to determine the status of different soil nutrients in different combination of organic manures and urea in IAAS, Lamjung. In this research chemical fertilizers and different organic manures were the treatments and the field were laid out on RCBD with five treatments and four replications. The observations were taken for number of primary branches, number of leaves, number of fruits, and fruit diameter in case of plant. Phosphorous content and organic matters content were taken in case of soil. Okra showed the greater response to the combine use of goat manure and urea. After goat manure and urea, the combine use of buffalo manure, goat manure and urea found to be better. Combine use of organic manures and urea can be a good option and cost effective to enhance production, as well as maintaining soil fertility. Therefore, it is advisable to use a combination of goat manure and urea as the source of nutrients to the production of Okra.

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Conflict of Interest

The authors proclaim that the publishing of this manuscript does not present any conflicts of interest for them.

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