Archives of Agriculture and Environmental Science 8(4): 585-589 (2023)
https://doi.org/10.26832/24566632.2023.0804019

e-ISSN: 2456-6632

This content is available online at AESA

Archives of Agriculture and Environmental Science

Journal homepage: journals.aesacademy.org/index.php/aaes

ORIGINAL RESEARCH ARTICLE

Effect of combined application of urea and organic manures on soil acidity along with the growth and yield attributes of okra at Lamjung, Nepal

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ARTICLE HISTORY

Received: 12 October 2023
Revised received: 27 November 2023
Accepted: 19 December 2023

Keywords

Cow manure
Goat manure
Okra
Soil pH
Yield

ABSTRACT

An experiment was conducted in horticulture farm of Institute of Agriculture and Animal Science, Lamjung Campus, Nepal to evaluate the effect of combined application of Urea and Organic manures on soil acidity along with the growth and yield attributes of Okra. The experiment was set up under Randomized Complete Block Design (RCBD) comprising five treatments replicated four times. The various treatments used in the experiment were Cow manure + Urea, Buffalo manure + Urea, Goat manure + Urea, Buffalo manure + Goat manure + Urea and the Untreated Control. The required doses of Nitrogen for the crop were applied through treatments and that of Phosphorous and Potassium was petitioned from Single Super Phosphate (SSP) and Muriate of Potash (MOP), respectively. The quantities of nutrients were put in as recommended by Nepal Agricultural Research Council (NARC) (i.e., 200:180:60 kg NPK per ha). The effect of Goat manure + Urea was found superior against plant height at 30 DAS (13.52 cm) and 45 DAS (32.15 cm), leaf area throughout the growth stage and in final mean fruit yield (12.33 t/ha). Meanwhile, the impact of Cow manure + Urea was found superior against plant height at 60 DAS (46.67 cm) and in case of reducing soil acidity (Soil pH = 6.75). Eventually, the experiment suggests the farmers to use Goat manure + Urea for desirable Okra production considering soil health and also with the application of Cow manure + Urea in the interval of (2-3) years ensuring the control over soil acidification.

Citation of this article: Basnet, S., & Khatri, K. B. (2023). Effect of combined application of urea and organic manures on soil acidity along with the growth and yield attributes of okra at Lamjung, Nepal. *Archives of Agriculture and Environmental Science*, *8*(4), 585-589, https://dx.doi.org/10.26832/24566632.2023.0804019

INTRODUCTION

Okra (*Abelmoschus esculentus*) is the widely popular vegetable crops among Nepali farmers and consumers especially due to its culinary features. Usually, it is known as Bhindi or Lady's finger and is particularly a tropical crop belonging to Malvaceous family (Maurya, 2013). Altogether, there exists about 2,283 species of Okra. Out of which, 1,769 species were collected from West Africa. Therefore, West Africa is referred to as center of origin for Okra (Hamon and Van, 2019). As claimed by USDA National Nutrient Database, the edible portion of Okra pod (100g) is composed of vitamin A (375 IU), vitamin C (21.1 mg), Calcium (81mg), Phosphorus (63mg) and Potassium (303mg). From medicinal point of view, the high amount of iodine in fruit is essential to control goiter and is also helpful to cure certain acute diseases like Genito-urinary disorders, Hemorrhoids, Spermatorrhea, Dysentery and so on (Adams, 2015). Okra is highly responsive towards chemical fertilizers (Kumar *et al*., 2017). As per the report of MoALD (2021), more than 1,54,314 metric tons of chemical fertilizers were sold around Gandaki province of Nepal in the year 2021/22. The application of chemical fertilizers has shown a better growth and yield performance of Okra. However, it has become one of the major reasons behind soil acidification. Soil acidity causes reduction in primary nutrients (largely Phosphorous), secondary nutrients (Ca, Mg) and micro nutrients (Mo, B and Zn). Besides, soil acidity also results in iron and aluminum toxicity (Dadarwal *et al*., 2009).

Liming can be one of the solutions against soil acidity but it is not advocated among farmers due to difficulty in application, higher prices and its soil specific rates. Also, the application organic manures is another alternative to reduce soil acidity which converts the instability of nutrients due to acidification into stable form by the activation of microbes (Manohar and Bahadur, 2001). But, due to slow and low nutrient releasing pattern of organic manures, the desirable yield of Okra cannot be obtained (Morgan *et al*., 2009).

Thus, to get the desired yield of Okra without any disturbance to soil health, we conducted an experiment in horticulture farm of Institute of Agriculture and Animal Science, Lamjung, Nepal with the concept of combined utilization of chemical fertilizers and organic manures. From this experiment, we actually wanted to evaluate the influence of combined application of Urea and organic manures on soil acidity along with the growth and yield attributes of Okra. This research can be claimed as one of the best and cost-effective idea to neutralize soil acidity, sustain soil health and to ensure maximum production of Okra as desired by farmers with the limited application of chemical fertilizer into the soil.

MATERIALS AND METHODS

Experimental site and climatic situation of the area

The experiment was conducted in horticultural farm of Institute of Agriculture and Animal Science, Lamjung Campus, Nepal (28.276^0 N latitude & 84.3542^o E longitude) during the period of Early February to Late May, 2023. According to the report of nearest meteorological station, the annual rainfall of our experimental area is about 2600 mm and the average temperature is 22.5^0 C with maximum of 28.64^0 C and minimum of 16.39^0 C.

Seed collection and initial soil testing

Seeds of Okra (variety-Arka-Anamika) was collected from local Agrovet. The seed lot had Germination percentage and Purity percentage of 80% and 95%, respectively. Initial soil sample was taken from different portions of the field at about 15 cm below the ground using Bucket auger. Those samples were mixed homogenously, shade dried and made ready for initial soil test. As per the test report of Soil and Fertilizer Testing Laboratory, Gandaki Province, Nepal, the soil condition of the field was moderately acidic (pH = 5.4).

Experimental design and detail of the treatments

The experiment was laid out under single factor Randomized Complete Block Design (RCBD). Altogether, there were five treatments, each of which were replicated four times creating 20 individual plots in the field. Out of five treatments, the treatment T1 was control in which no any fertilizer was added and rest of the four treatments were made as shown in Table 1. Actual amount of treatments were applied after calculating the amount of nutrients required for Okra on the basis of fertilizer recommendation by Nepal Agricultural Research Council (NARC) i.e., 200:180:60 kg NPK per hectare (Bhandari *et al*., 2019). Similarly, the nitrogen content in different organic manures were calculated according to the organic manure test report published by Sharma *et al*. (2022). Meanwhile, the Potassium and Phosphorous was applied from Muriate of Potash (MOP) and Single Super Phosphate (SSP), respectively.

Horticultural practices

Since, the experiment was conducted in RCB design, the treatments for each individual plot was selected randomly. After allocating treatments for each plot, the full dose of organic manures and the half dose of Urea was applied at the time of seed sowing. The seeds were sown (1-2) cm deep maintaining the plant to plant and row to row spacing of 30 cm and 50 cm, respectively. A couple of seeds were sown initially and the thinning operation was carried out at 20 Days After Sowing (DAS). Daily irrigation was provided through sprinkler method for a week and the irrigation was reduced gradually. At 30 DAS, the remaining half dose of Urea was top dressed followed by first manual hard weeding. During the early stage of vegetative growth, the plants were highly damaged by Okra Cutworms which was controlled by foliar application of insecticide "G-Sunami" at the rate of 2 ml per liter of water with the help of Knapsack sprayer. The first harvest was conducted at 60 DAS and the repeated successive harvest was performed at the interval of 3 days until 75 DAS.

Data collection and final soil sampling

Data required for plant height were recorded at 30, 45 and 60 DAS. Similarly, the data for canopy diameter was taken at 45, 60 and 75 DAS. The collected data of canopy diameter was converted to leaf area as follows:

Leaf Area = $\pi d^2/4$

Where, d = recorded average canopy diameter.

Table 1. Detail of the treatments.

S. No.	Treatments	Symbol	Details
1	Control	T1	No any organic manure or Urea.
2	Cow manure + Urea	T2	50% N from Cow dung + 50% N from Urea
3	Buffalo manure + Urea	T3	50% N from Buffalo manure + 50% N from Urea
4	Goat manure + Urea	T4	50% N from Goat manure + 50% N from Urea
5	Buffalo manure + Goat manure + Urea	T5	25% N from Goat manure +25% N from Buffalo manure + 50% N from Urea.

Fruits were harvested five times at the interval of 3 days from 60 DAS to 75 DAS. The final mean fruit weight per plot was calculated as kilogram and the final mean fruit yield was expressed in terms of tones per hectare. The data required for soil pH was recorded as per the soil test report of Soil and Fertilizer Testing Laboratory, Gandaki Province, Nepal. Bucket augers were used for final soil sampling and three samples were released out from each plot which were mixed uniformly developing 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 fragments present on the soil samples were removed by using 2 mm Mesh Soil Sieve and the final soil sample was made ready for the test.

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.

RESULTS AND DISCUSSION

Effect of the treatments on Plant height at different days after sowing

At 30 DAS, the highest plant height (13.52 cm) was obtained from Goat manure + Urea which was especially due to increased amount of N, P, K and Ca in soil by the combined action of Urea and Goat manure whereas the minimum plant height (5.29 cm) was obtained from Control. Similarly, at 45 DAS, highest plant height (32.15 cm) was seen on Goat manure + Urea and the lowest plant height (15.88 cm) was seen on control. This was because, Urea increased the activity of Urease synthesizing microorganisms and Goat manure reduced soil acidity creating favorable environment for vegetative growth (Abdulraheem *et al*., 2021). Similar result was also found by (Thakur *et al*., 2020). But, at 60 DAS, the highest plant height (46.67 cm) was found in Cow manure + Urea which was statistically at par with the treatment Goat manure + Urea and the minimum intensity of plant height (31.59 cm) was obtained in the Control that was statistically similar with rest of all other treatments. This happened due to slow decomposition of Cow manure at later stage releasing required amount of micro and macro nutrients for plant. Further, the nitrogen released from Urea is volatile in nature which was balanced by Cow manure at later stages resulting higher intensity of plant height (Ibrahim *et al*., 2020). This situation is fully supported by (Roy and Kashem, 2014)

Effect of the treatments on Leaf Area at different days after sowing

At 45 DAS, the leaf area was found maximum (464.01 cm^2) on Goat manure + urea and minimum (82.85 cm^2) on the Control which was statistically at par with all other treatments. Similarly, at 60 DAS, the maximum leaf area (1103.01 cm^2) was found from Goat manure + Urea and the minimum (314.63 cm^2) from the Control which was statistically at par with the treatment Buffalo manure +Urea. This was because, the Goat manure was applied after converting into the simpler forms so that it released nitrogen from the initial vegetative growth along with Urea. Also at 75 DAS, the leaf area was again found maximum (3936.93 cm^2) in Goat manure + Urea and minimum (1084.98 cm^2) in the Control which was statistically at par with all other treatments. This occurred due to higher nitrogen content (0.895%) in Goat manure than other organic treatments which continued the vegetative growth for longer period of time. On the other hand, Nitrogen is the basic requirement for vegetative growth of Okra which was supported abundantly by Urea and Goat manure without increasing soil acidity (Shiyam *et al*., 2016).

Table 2. Means separation of plant height at different days after sowing using LSD test.

Treatments	Plant height (cm)		
	30 DAS	45 DAS	60 DAS
Control	5.29^{c}	15.88^{c}	31.59^{b}
Cow manure + Urea	10.91^{b}	25.89^{b}	46.67^{a}
Buffalo manure + Urea	6.87^{c}	17.67^{c}	31.86^{b}
Goat manure + Urea	13.52^{a}	32.15^{a}	43.94^{a}
Goat manure + Buffalo manure + Urea	10.76^{b}	16.82^{c}	35.92^{b}
CV (%)	14.32	18.73	8.72
SEM ±	1.66	3.54	3.47
LSD Value	2.08	6.26	5.10
Grand mean	9.47	21.69	37.99

Note: Means with same letters are not significantly different, LSD = Least Significant Difference, CV=Coefficient of Variation and SEM = Standard Error of Mean.

Table 3. Means separation of leaf area at different days after sowing using LSD test.

Treatments	Leaf area (cm^2)		
	45 DAS	60 DAS	75 DAS
Control	82.85^{C}	314.63^{d}	1084.98^{d}
Cow manure + Urea	219.26^{b}	804.78^{b}	2721.74^{b}
Buffalo manure + Urea	105.88^{c}	346.80^{d}	1771.38^{c}
Goat manure + Urea	464.01^{a}	1103.01^{a}	3936.93^{a}
Goat manure + Buffalo manure + Urea	97.25^{c}	669.91^{c}	1339.61^{cd}
CV (%)	13.83	12.51	15.91
SEM ±	80.24	164.68	583.74
LSD Value	41.31	124.926	532.44
Grand mean	193.83	647.82	2170.93

Note: Means with same letters are not significantly different, LSD = Least Significant Difference, CV=Coefficient of Variation and SEM = Standard Error of Mean.

Table 4. Mean separation of final soil pH using LSD test.

Treatment	Final soil pH
Control	4.65^{bc}
Cow manure + Urea	6.75^{a}
Buffalo manure + Urea	4.40^{bc}
Goat manure + Urea	5.78^{ab}
Goat manure + Buffalo manure + Urea	4.00^{c}
CV (%)	17.70
SEM ±	0.56
LSD Value	1.39
Grand mean	5.11

Note: Means with same letters are not significantly different, LSD = Least Significant Difference, CV=Coefficient of Variation and SEM = Standard Error of Mean.

Table 5. Mean separation of final mean fruit yield using LSD test.

Treatment	Final Mean Fruit Yield (t/ha)
Control	4.04^{d}
Cow manure + Urea	9.54^{ab}
Buffalo manure + Urea	6.97^{bc}
Goat manure + Urea	12.33^{a}
Goat manure + Buffalo manure + Urea	5.10^{cd}
CV (%)	24.39
SEM ±	1.69
LSD Value	2.85
Grand mean	7.60

Note: Means with same letters are not significantly different, LSD = Least Significant Difference, CV=Coefficient of Variation and SEM = Standard Error of Mean.

Effect of the treatments on final mean fruit yield

The final mean fruit yield was found maximum (12.33 t/ha) from Goat manure+ Urea which was especially due to increased photosynthesis by vigorous vegetative growth. The minimum (4.04 t/ha) fruit yield was found in the Control which was statistically at par with all other treatments. High amount of nitrogen and organic carbon present in Goat manure + Urea significantly increased the rate of photosynthesis followed by the higher amount of food storage and flowering resulting higher yield (Meena *et al.*, 2019).

Effect of the treatments on final soil pH

After testing the final soil sample, the final soil pH was found maximum (pH = 6.75) from Cow manure + Urea whereas soil pH was found minimum (pH = 4.00) from Goat manure + Buffalo manure + Urea. This means that the soil pH was significantly improved by Cow manure + Urea due to activation of ammonia oxidizing bacteria such as *Nitrosomonas* that converted active ammonium ion into nitrates reducing soil acidity. Furthermore, Cow manure + Urea improved physio-chemical properties of soil, nitrogen cycle and bacterial enzymatic activities. Similar result was also found by (Wu *et al.*, 2022).

Conclusion

From this experiment, we observed that maximum crop yield was obtained from Goat manure + Urea because of relatively higher (0.895%) nitrogen content in Goat manure than that of other organic treatments. On the other hand, we noticed that Cow manure + Urea was effective for reducing soil acidity by activation of ammonia oxidizing bacteria (*Nitrosomonas*) and by balancing nitrogen cycle. Ultimately, we would like to recommend the farmers of Nepal to cultivate Okra with combined application of Goat manure and Urea in equal proportion and

also to use Cow manure + Urea at the interval of (2-3) years ensuring control over soil acidification. However, the multi seasonal and multi locational trials of the experiment is necessary for worldwide advocation of combined application of Urea and Organic manures.

ACKNOWLEDGEMENT

The authors would like to acknowledge the Soil Science laboratory of Institute of Agriculture and Animal Science. Also, we are grateful to all the administration committee of Lamjung Campus, Nepal.

Conflict of interest

The authors state that there are no any conflicts of interest.

REFERENCES

Abdulraheem, M. I., Charles, E. F., & Fudzagbo, J. (2021). Amaranthus performance as influence by integrated application of goat manure and urea fertilizer. *Journal of Soil Science and Plant Physiology*, *3*(1), 1–4.

Adams, C. F. (2015). *Nutritive value of American foods in common units* (No. 456). Agricultural Research Service, US Departy,ment of Agriculture.

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. *Archives of Agriculture and Environmental Science*, *4*(4), 396–403, https://doi.org/10.26832/24566632.2019.040405

Dadarwal, R. S., Jain, N. K., & Singh, D. (2009). Integrated nutrient management in baby corn (Zea mays). *Indian Journal of Agricultural Sciences*, *79*(12), 1023–1025, https://doi.org/10.23910/ijbsm/2018.9.1.1855

Hamon, S, & Van Sloten, D. H. (2019). Characterisation and evaluation of okra. *The Use of Genetic Resources*, 173–196.

Ibrahim, H., Aniyikaye, R., Adewoyin, D. T. E., Osunde, A. O., & Bala, A. (2020). Effect of different combinations of organic and inorganic nitrogen sources on growth and pod yield of Okra (*Abelmoschus esculentus*) in Minna , Niger State. 44th Annual Conference proceeding of soil science society of Nigeria.

Kumar, V., Chopra, A. K., Srivastava, S., Singh, J., & Thakur, R. K. (2017). Irrigating okra with secondary treated municipal wastewater: Observations regarding plant growth and soil characteristics. *International Journal of Phytoremediation*, *19*(5), 490–499, https://doi.org/10.1080/15226514.2016.1244169

Manohar, R. K., & Bahadur, A. (2001). Response of okra to biofertilizers. *Vegetable Science*.

Maurya, R. P. (2013). Impact of Plant Spacing and Picking Interval on the Growth, Fruit Quality and Yield of Okra (*Abelmoschus esculentus* (L.) Moench). *American Journal of Agriculture and Forestry*, *1*(4), 48-54, https://doi.org/10.11648/j.ajaf.20130104.11

Meena, R. K., Vashisth, A., Singh, R., Singh, B., & Manjaih, K. M. (2019). Study on change in microenvironment under different colour shade nets and its impact on yield of spinach (*Spinacia oleracea* l.). *Journal of Agrometeorology*, *16* (1), 104–111.

MoALD, (2021). Statistical Information On Nepalese Agriculture (2077/78). *Publicatons of the Nepal in Data Portal*, *73*, 274. https://nepalindata.com/resource/statistical-information-nepalese-agriculture-207374-201617/

Morgan, K. T., Cushman, K. E., & Sato, S. (2009). Release mechanisms for slow- and controlled release fertilizers and strategies for their use in vegetable production. *HortTechnology*, *19*(1), 10–12, https://doi.org/10.21273/hortsci.19.1.10

Roy, S., & Kashem, M. A. (2014). Effects of Organic Manures in Changes of Some Soil Properties at Different Incubation Periods. *Open Journal of Soil Science*, *04*(03), 81–86, https://doi.org/10.4236/ojss.2014.43011

Sharma, R., Kandel, S., Khadka, S., & Chaudhary, S. (2022). Nutrient contents in different sources of organic manures used in different farms of Bhaktapur district, Nepal. *Journal of Agriculture and Natural Resources*, *5*(1), 150–156. https://doi.org/10.3126/janr.v5i1.50705

Shiyam, J. O., Binang, W. B., & Stephen. (2016). Effect of animal manure on soil nutrients replishment and performance of okra (*abelmoschus esculentus* l.) grown on degraded sandy soil in calabar, Nigeria. *1* (October), 20–31. http://www.scirea.org/journal/Environmental

Thakur, S., Cahuhan, R. P., & Singh, O. P. (2020). Effect of Different Mulching Materials on Growth and Yield of Okra [*Abelmoschus esculentus* (L.)]. *Journal of the Institute of Agriculture and Animal Science*, *1*, 197–205, https://doi.org/10.3126/jiaas.v36i1.48419

Wu, W., Lin, Z., Zhu, X., Li, G., Zhang, W., Chen, Y., Ren, L., Luo, S., Lin, H., & Zhou, H. (2022). Improved tomato yield and quality by altering soil physicochemical properties and nitrification processes in the combined use of organic-inorganic fertilizers. *European Journal of Soil Biology*, *109*, 103384.