EFFECT OF ORGANIC MANURES AND THEIR COMBINATIONS ON SOIL PROPERTIES AND YIELD OF OKRA (*Abelmoschus esculentus* L.)

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Abstract. A field experiment was conducted at Biratnagar-4, Morang of Nepal during April – July, 2019 to evaluate the effects of organic manures and their combinations on soil properties and yield of okra var parvati. The experiment was conducted in randomized complete block design with seven treatments and three replications. The treatments consisted of human urine, poultry manure, FYM, goat manure, FYM + human urine, goat manure + human urine and recommended fertilizer. All the treatments were based on fulfillment of required nitrogen by the crop. The result showed that the highest pod yield (24.303 Mg ha^{-1}) was obtained from the application of poultry manure. After okra harvest, the highest soil organic matter (0.4760 %), total soil nitrogen (0.243%), and available phosphorus (26.17 kg/ha) were determined from the soil of poultry manure treatments but the highest available potassium (109.2 kg/ha) was from FYM + human urine treatments. The highest N concentration in straw (5.280 %) and pod (2.253 %), P_2O_5 concentration in straw (0.2607 %) and pod (0.3447 %) was obtained from poultry manure treatment and the highest K_2O concentration in straw (1.320 %) and pod (2.757 %) was determined from FYM + human urine application. Uptake of N (286.7 kg/ha) and P (25.60 kg/ha) was significantly higher in poultry manure application followed by the application of FYM + human urine. Higher uptake of K (163.1 kg/ha) was obtained under FYM + human urine application followed by goat manure + human urine (148.1 kg/ha). The highest benefit cost ratio (2.99) was obtained from the application of poultry manure application and the lowest benefit cost ratio (2.22) was found under human urine application. This result suggest that poultry manure was important for increasing soil properties and performance of okra and can be used as an alternative to the chemical fertilizer.

Keywords: FYM, Human urine, Goat manure, Poultry manure, Soil quality

Abbreviations
FYM-Farm yard manure
PM-Poultry manure
HU-Human Urine
GM-Goat manure

INTRODUCTION

Conventional practices result on high yield crops, but there is concern regarding the negative biological and environmental consequences and long-term sustainability associated with these practices (Robertson et al., 2000). Realizing the facts, the importance of sustainable agriculture is increasing. Organic farming is one of the fastest growing sectors of agriculture worldwide which is sustainable. Organic manure can serve as an alternative practice to mineral fertilizers for improving soil

structure and microbial biomass. Therefore, utilization of locally produced manures for vegetable production may increase crop yields and improve quality of soil with less use of chemical fertilizer. Okra is one of the important fruit vegetable crops of the tropical and subtropical regions of the world (Vincet et al., 2005). Okra fruit is nutritionally very rich and contains carbohydrates (6.4%), proteins (1.9%), fats (0.2%), mineral (0.7%), β-carotene (53 mg), thiamine (0.07 mg), riboflavin (0.1 mg), vitamin C (13 mg), calcium (66 mg), magnesium (43 mg), oxalic acid (8 mg), phosphorus (56 mg), iron (1.5 mg), sodium (6.9 mg), potassium (103 mg), copper (0.19 mg) and sulphur (30 mg) per 100 gm edible portion (ICMR, 1980). In Nepal, Okra was cultivated in 9337 ha of land with a total production of 103353 MT and an average productivity of 11.07 MT/ha (MoALD, 2021). Okra covers 3.32% of total vegetable cultivating area in Nepal (MoALD, 2021). To meet the increasing demand, use of excessive inorganic fertilizers is becoming a common practice as a means of raising productivity. This has created a negative effect on human health and environment.

Long term studies indicated that the balanced use of NPK fertilizer could not maintain the higher yields over years because of emergence of secondary and micronutrient deficiencies and deterioration of soil properties. Ganry et al. (2001) reported that the use of organic manures either alone or with combination improve soil structure. Human urine is a natural resource, which is available in all human societies-even in the poorest ones (Sullivan and Grantham, 1982). The use of human urine in crop production is proved to be safe and used in different countries. Reuse of excreta on arable land secures valuable fertilizers for crop production and limits the negative impact on water bodies (WHO, 2006). The objective of the study was to assess the effects of organic manures and their combination on growth, yield and quality of okra.

MATERIALS AND METHODS

Location of the experimental site. The field experiment was conducted at famer's field in Biratnagar, Morang, Nepal. The altitude of the experimental site is 84 meter above sea level. It is situated at $26^0$20'- 53^0 North latitude and $87^0$16'-$87^0$41' East longitude.

Weather data of the experimental sites. The meteorological information's like maximum and minimum temperature, rainfall and relative humidity were collected from metereological station of Biratnagar. Data were received from the Regional Department of Hydrology and Meteorology, Dharan, Sunsari. The weekly means of maximum and minimum temperature, weekly total rainfall and weekly mean relative humidity during the crop growing season are presented in Figure 1.

Physico-chemical properties of soil. The experiment was conducted in sandy loam textured soil of Biratnagar. Ten random samples were collected from the experimental blocks from 15 cm depth and prepared composite samples before the start of experiment. Soil samples were analysed for Organic matter, total nitrogen, available phosphorus, available potassium and pH in the Regional Agriculture Laboratory, Jhumka. It contained low level of plant nutrients and organic matter. It was chemically neutral soil.

Experimental design. The experiment was conducted from April to July, 2019 in a randomized complete block design with seven treatments and three replications. Treatment consisted of various amount of manure, Human urine and chemical fertilizer are presented in the table (2). Their amount of various combinations was so fixed as to supply 100 kg N/ha for the crop, viz. 100kg/ha of N supplied from chemical fertilizers only, Human urine, Poultry manure, Goat manure, FYM only, 50% of N from Human urine and 50% from FYM, 50% of N from Human urine and 50% from Goat manure. Each treatment was randomly allocated. The area of each plot was 10.5 m^2 (3.5 x 3m) and net area was 220 m^2 (10.5m x 21 plot). There was 50 cm space between the plots. Similarly, blocks were separated by 1m space. The test crop was okra. There were seven rows in each plot and ten plants in each row. A distance of 50 cm between rows and 30 cm plant to plant within rows was maintained.

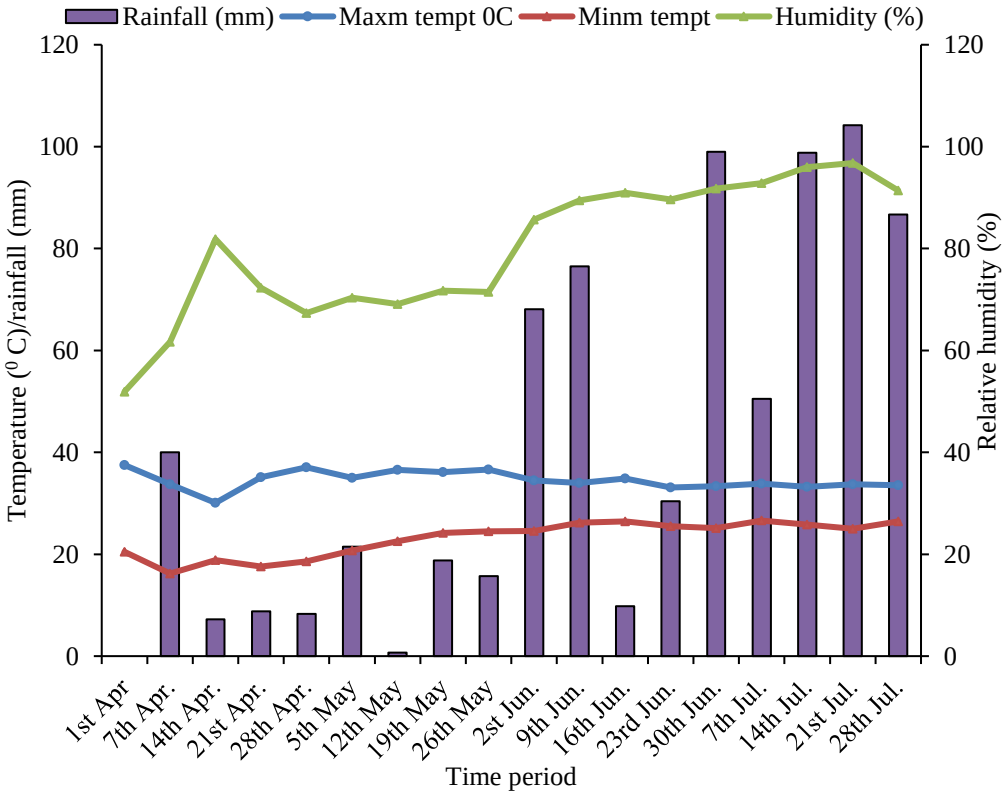

Figure 1. Weather conditions during the crop growing season at the study site, Biratnagar, Morang, Nepal, 2019

Table 1

Physio-chemical properties of soil of the experimental sites

Details/block	Mean
Ph	6.5 (neutral)
Organic matter (%)	0.18 (low)
Available nitrogen (%)	0.3 (low)

Available phosphorus (kg ha^{-1})	23 (low)
Available potassium (kg ha^{-1})	95 (low)
Soil texture	Sandy loam

Treatments details. Treatments were based on the fulfillment of the required nitrogen by the crop. The quantity of organic manures was calculated based on nitrogen content of the organic manures tested in the laboratory (Table 2). The amount of organic manures to fulfill the required nitrogen was doubled assuming that only 50% of N would be available to the plants in the first season (Baldwin et al., 2006 and Bary et al., 2004).

Table 2

Description of the treatments of the experiments

Treatments	Symbols	Descriptions	Quantity of manure t/ ha or chemical fertilizers kg/ha
1	$HU_{100\%}$	Full dose of N through HU	20407.6 lit
2	$PM_{100\%}$	Full dose of N through PM	7.5 4t/ha
3	$FYM_{100\%}$	Full dose of N through FYM	15.38 t/ha
4	$GM_{100\%}$	Full dose of N through Goat manure	17.85 t/ha
5	$FYM_{50\%}$+ $HU_{50)\%}$	1/2 dose of N through FYM + 1/2 dose of N through HU	7.69 t/ha +10203.8 lit
6	$GM_{50\%}$+$HU_{50\%}$	1/2 dose of N through Goat manure +1/2 dose of N through Human urine	8.92t/ha+ 10203.8 lit
7	$NPK_{chemicals}$	100:60:30 NPK kg/ha- recommended dose of fertilizer.	166.35 kg urea

Nutrient analysis of the manures. Heap of each type of organic manure was thoroughly stirred separately with hand and 1 kg manure was sampled from each manure heap and sent for testing. They were analyzed in Soil Laboratory of Soil Directorate, Government of Nepal, Hariharbhawan, Lalitpur to find out N, P and K contents. The nutrient content of manures are presented in the Table 3.

Test variety. The variety used under the experiment was Parvani Kranti. It is YVM resistant variety developed at Marathawada Agricultural University, Parvani Maharastra (Ram, 1997). Plants are tall and single stemmed with dark green foliage. Leaves are deeply lobed with narrow leaflets in the top 1/3rd portion. Peduncle is funnel shaped. First fruit is borne on 5-6th node. Marketable fruit is attained in 7-8 days after anthesis. The fruits are extremely dark-green, smooth, tender, slender, 5-ridged with long and narrow tip. The average green fruit yield of this cultivar is 8.5-9 t/ha during summer and 11.5 t/ha during rainy season. It is commercial variety, renamed as Parvati by National Seed Board, Nepal and widely cultivated in Nepal.

Land preparation. The experimental field was thoroughly ploughed on first week of April, 2019. Second ploughing was done after two weeks, followed by

planking to make pulverized tilth. The weeds, stubbles and other unwanted materials were removed from the experimental plots. The field was leveled; plot was separated and laid out with individual plot size of 10.5 m^2 according to experimental design.

Manure management and application. Well decomposed FYM, Goat manure and poultry manure were obtained from farmer's shed and nearby locality. Human urine was collected from the mobile toilet and stored for one month in plastic drum. All the organic manures with their full dose, one third dose of mineral nitrogen and Human urine, total dose of phosphorus and total dose of potash were applied according to treatment requirement at final land preparation. One third of urea and Human urine were top dressed 15 days after sowing and remaining one third 35 days after sowing. Mineral NPK was applied through urea, Diammonium phosphate (DAP) and Murate of potash (MOP). The amount of Human urine, compost and urea was calculated based on nitrogen content of the manures. Since, organic manures releases only 50 percent nutrients for plant absorption in the first season of application (Brady and Weil, 2002) hence to fulfill the nitrogen requirement of the crop, the quantity of each manure was doubled for the experimental plots. The amount of organic manures to fulfill the required nitrogen was doubled assuming that only 50% of N would be available in the first season (Baldwin *et al.*, 2006 and Bary *et al.*, 2004).

Table 3

Nutrient contents of FYM, goat manure, poultry manure, and human urine used in the experiment

Parameter	Instrument Used	FYM	Human Urine	Goat Manure	Poultry Manure
Total Nitrogen (%)	Kjeldhal digestion	1.3	0.94	1.12	2.65
Available phosphorous (%)	Spectrophotometer	0.65	0.35	0.92	1.48
Available potassium (%)	Atomic absorption Spectrophotometer	1.12	1.2	0.95	1.75

Seed sowing. Before sowing, seeds were soaked in water for 12 hours to enhance germination. Seed sowing was performed on April 29, 2012 using row to row spacing of 50 cm and plant to plant spacing of 30 cm. Seed sowing was done at a depth of 2-3 cm and four to five seeds were placed in each hill (Acharya, 2004). One seedling per hill was maintained thinning 15 days after germination (Hossain et al., 2003).

Intercultural operation and harvesting. Light irrigation was provided just after seed sowing with watering canes. Crop was irrigated daily until plant stand was established. Then the plots were irrigated at 5 days interval until rain started. First manual weeding was done 15 DAS and second done at 30 DAS and Third at 55 DAS.All capsules did not mature at a time. Harvesting was done manually. Harvested capsules from each plot were separated and required measurements were taken.

Soil sampling and preparation. Soil was sampled from the field before sowing okra seeds and after the harvest of the crop. Soil samples were collected at random points in the middle from each plot (to avoid the border effect) from the top soil (0 to 20 cm depth) with the help of bucket auger and composited. Composite Soil

samples were air dried at room temperature, ground with the mortar and pestle and passed through 2 mm sieve for analysis.

Soil analysis. Soil texture, pH, organic matter, N, P, and K were analyzed at soil laboratory of NARC, Khumaltar. The physical and chemical properties of soil before and after the experiment were analyzed by the following methods.

Table 4

Methods of analysis of physico-chemical properties of soil before and after the experiment

Parameter	Analysis
Soil texture	Hydrometer method (Gee and Bauder, 1986)
Soil pH	Beckman electrode pH meter (Cottenie *et al.*, 1982)
Organic matter content	Graham's colorimetric method (Graham, 1948)
Nitrogen	Kjeldahls distillation (Bremner, 1982)
Phosphorus content	Modified olsen's (Olsen *et al.*,1954)
Potassium content	Ammonium acetate extraction method (Pratt, 1965)

Nutrient content of the plant. Plant and fruits were washed to remove soil particles using distilled water. Washed samples were oven dried at 70 ^{0}C for 72 hours and ground to pass 1 mm sieve. Nitrogen, phosphorus and potassium of fruits and plant biomass were analyzed at soil laboratory of National Agriculture Research Council (NARC), Khumaltar, Kathmandu.

Table 5

Method of analysis of nutrient content of the plant

Parameter	Analysis method
Total nitrogen	Kjeldahl distillation (Bremner, 1982)
Phosphorus	Vandomolybdo-phosphoric yellow color method (Jackson, 1973)
Potassium	Ammonium acetate extraction method (Pratt, 1965)

Statistical analysis. The mean value of data of different parameters recorded in the study were analyzed by MSTAT-C package. Data were subjected to analysis of variance (ANOVA) to evaluate the significance of treatment effect. Means of the treatments were compared by Duncan's Multiple Range Test (DMRT) at 5% level of significance. Microsoft excel (2007) was used for tabulation of the data.

RESULTS AND DISCUSSIONS

Effect on vegetative characters. At earlier stage of growth, there were no significant effects of the treatments. But at 60 DAS, the highest plant height (151.9 cm) , leaf number (30.58 cm), leaf area (550.6 cm^2) and stem diameter (3.467 cm) was obtained with 100 % N supplied through poultry manure (Table 6). Application of only human urine resulted into significantly lower vegetative growth at later stage of crop growth. Olayinka (1990) reported faster decomposition and release of nutrients by PM due to its low C:N ratio. Manure when decomposed increases both macro and micro nutrients as well as enhances the physico-chemical properties of the soil. This could have led to its high vegetative growth. More availability of nutrients

from the mineralization of poultry manure in the soil for okra uptake led to the increased leaf number, leaf area and plant height. Agele (2001) observed increased tomato leaf area from the poultry manure application.

Fruit yield. Fruit yield was obtained highest with the application of poultry manure (24.303 mg ha^{-1}) and lowest from only human urine application (18.417 mg ha^{-1}). The application of PM, which contained appreciable quantity of magnesium, might have helped in chlorophyll synthesis which in turn increased the rate of photosynthesis. Thus, with the application of poultry manure increased leaf area and rate of photosynthesis eventually led to increased yield. Several researchers (Agbede and Ojeniyi, 2009; Mbah, 2006, Akanni and ojeniyi, 2007) that use of poultry manure enhanced the yield of okra.

Table 6

Effect of organic manures and their combination on leaf number, leaf area, plant height and stem diameter of Okra var. Parvati at 60 days after sowing along with the fruit yield

Treatments	Leaf number (cm)	Leaf area (cm)	Plant height(cm)	Stem diameter(cm)	Fruit yield (mg ha^{-1})
Human $urine_{100\%}$	25.90^{c}	60DAS	135.9^{c}	2.770^{c}	18.417^{d}
Poultry $manure_{100\%}$	30.58^{a}	550.6^{cd}	151.9^{a}	3.467^{a}	24.303^{a}
$FYM_{100\%}$	27.67^{bc}	650.5^{a}	142.6^{bc}	2.980^{bc}	21.493^{abc}
Goat $manure_{100\%}$	27.00^{bc}	594.6^{bc}	142.4^{bc}	2.953^{c}	20.567^{bcd}
$FYM_{50\%}$ + Human $urine_{50\%}$	28.500^{abc}	580.5^{bcd}	147.4^{ab}	3.343^{ab}	22.690^{ab}
Goat $manure_{50\%}$ + Human $urine_{50\%}$	28.17^{ab}	607.2^{ab}	146.6^{ab}	3.287^{ab}	22.480^{abc}
$RDF_{100\%}$	27.08^{ab}	604.8^{ab}	141.4^{c}	2.943^{c}	19.703^{cd}
CV%	7.75	532.2^{d}	3.38	7.95	7.59
LSD	3.619*	5.11	8.655*	0.4394*	2.886*
SEM±	0.1746	53.47**	2.8090	0.1425	0.9367

Human $urine_{100\%}$ = total N through human urine
Poultry $manure_{100\%}$ = total N through poultry manure
$FYM_{100\%}$ = total N through FYM
Goat $manure_{100\%}$ = total N through goat manure
$FYM_{50\%}$ + Human $urine_{50\%}$ = 1/2 N through FYM + 1/2 N through human urine
Goat $manure_{50\%}$ + Human $urine_{50\%}$ = 1/2 N through goat manure + 1/2 N through human urine
$NPK_{chemicals}$ = Recommended dose of chemical fertilizers (100:60:30 NPK kg ha^{-1})

Effect on Soil properties. The effects of organic manures differed significantly for organic matter content, soil P_2O_5 and soil K_2O. However, the treatments were non-significant for the residual soil N. The highest soil organic matter (4.760 %) and soil P_2O_5 (26.17 kg ha^{-1}) was obtained from the application of poultry manure. The highest residual soil K_2O (109.2 kg ha^{-1}) was obtained from the combination of FYM + human urine and lowest was from the application of chemical fertilizer (88.17 kg/ha). Organic manures enhanced the promotion of biological activity which in turn increased the organic matter content of soil (Bauer & Black, 1992). Similarly, Eghball et al. (2002) reported significantly greater soil organic

matter level in soil treated with organic manure. Agbede and Adekiya, (2012) reported that the highest soil organic carbon with the application of poultry manure alone or with the combination with other organic manures. Several researchers (Adekiya and Agbede, 2012; Akanni and Ojeniyi, 2008) also reported higher residual soil nitrogen by the application of poultry manure at the rate of 10 t/ha than the use of other organic sources and recommended chemical fertilizer. The available phosphorous content of soil from the application of organic manures were higher than the application of chemical fertilizer as the organic acid produced during decomposition of organic fertilizer, preventing the conversion of soluble form of phosphorus to insoluble form of phosphorus and enhanced the solubilization of native phosphorus in the soil (Gopalkrishnan, 2007). Human urine is the better source of K as it maintains higher level of this nutrient in soil. Addition of potassium through organic manure and also minimized potassium loss due to leaching by retaining potassium at exchange site and thereby increased the availability of K (Devaraja 2005). The level of residual K^+ was greater from urine fertilized soil, which may be due to the plants might absorbed Na^+ instead of K^+

Table 7

Effect of organic manures and their combination on Organic matter (%), Soil N (%), Soil P_2O_5 (kg ha^{-1}) and Soil K_2O (kg ha^{-1})

Treatments	Organic matter (%)	Soil N (%)	Soil P_2O_5 (kg ha^{-1})	Soil K_2O (kg ha^{-1})
Human $urine_{100\%}$	3.943^{b}	0.193^{a}	15.33^{e}	95.10^{bc}
Poultry $manure_{100\%}$	4.760^{a}	0.243^{a}	26.17^{a}	105.5^{a}
$FYM_{100\%}$	4.073^{b}	0.220^{a}	19.50^{cd}	102.3^{ab}
Goat $manure_{100\%}$	4.067^{b}	0.210^{a}	22.40^{bc}	90.37^{c}
$FYM_{50\%}$ + Human $urine_{50\%}$	4.300^{ab}	0.237^{a}	22.17^{bc}	109.2^{a}
Goat $manure_{50\%}$ + Human $urine_{50\%}$	4.2800^{ab}	0.227^{a}	24.30^{ab}	107.2^{a}
$RDF_{100\%}$	3.780^{b}	0.190^{a}	18.43^{de}	88.17^{c}
CV%	7.09	16.52	9.64	5.02
LSD	0.5277*	0.05626 NS	3.632**	8.897**
SEM±	0.170	0.0207	0.1787	2.8875

Primary nutrients concentration of straw and pod of Okra. The effect of organic manures differed significantly for the primary nutrient concentration on straw and fruit of okra. Straw (5.280 %) and fruit (2.253 %) N, straw (0.2607 %) and fruit (0.3447 %) P was significantly higher from the application of poultry manure. The highest straw K_2O (1.320 %) and fruit K_2O (2.757 %) was obtained from the application of FYM + human urine application.

Table 8

Effect of organic manures and their combination on straw N (%), fruit N (%), straw P_2O_5 (%), fruit P_2O_5 (%), straw K_2O (%) & fruit K_2O (%) of Okra

Treatments	Straw N (%)	Fruit N (%)	Straw P_2O_5(%)	Fruit P_2O_5 (%)	Straw K_2O (%)	Fruit K_2O (%)
Human $urine_{100\%}$	1.760^{e}	0.7167^{e}	0.1527^{c}	0.1743^{d}	0.870^{e}	1.610^{e}
Poultry	5.280^{a}	2.253^{a}	0.2607^{a}	0.3447^{a}	1.170^{bc}	1.923^{c}

manure$_{100\%}$							
FYM$_{100\%}$		3.483^{c}	0.900^{d}	0.1627^{c}	0.2230^{bcd}	1.047^{Cd}	1.770^{d}
Goat manure$_{100\%}$		3.343^{c}	0.8000^{e}	0.1590^{c}	0.2197^{cd}	0.9733^{de}	1.720^{de}
FYM$_{50\%}$	+	5.187^{a}	1.910^{b}	0.2010^{bc}	0.2437^{bc}	1.320^{a}	2.757^{a}
Human urine$_{50\%}$							
Goat manure$_{50\%}$	+	4.833^{b}	1.553^{c}	0.2247^{ab}	0.2777^{b}	1.270^{ab}	2.433^{b}
Human urine$_{50\%}$							
RDF$_{100\%}$		2.623^{d}	1.820^{b}	0.1520^{c}	0.2090^{cd}	0.9400^{de}	1.677^{de}
CV%		3.11	3.31	14.79	11.80	6.53	3.83
LSD		0.2105**	0.09774**	0.05626**	0.05626**	0.1258**	0.1378**
SEM±		0.0679	0.0304	0.0160	0.0165	0.0409	0.0439

The increased N concentration in plant tissues might be due to the increase in soil N from the mineralization of various organic manures. Ayeni *et al.* 2008 reported the highest N and P concentrations in maize from the application of poultry manure at the rate of 10t/ha. Higher N concentration in Okra from the application of poultry manure than others was due to the higher N and P contents in the poultry manure. Poultry manure application to tomato crops registered significantly higher phosphorus content among all the organic manures applied. Similar higher phosphorus content was reported from organically grown beetroot, spinach, tomato, turnip, cabbage, lettuce, spinach, carrots, apples pears than others (Worthington, 2001). The application of organic manures increased the proportion of soil CEC occupied by K (Johnston, 2001). Organic manures reduced the leaching losses of K due to absorption of K by exchangeable complex increased its concentration in plants. The potassium content was higher in pod than in straw. This might be due to the mobile nature of potassium which was diverted to reproductive parts of plants. Similar results were also reported by Warman and Termeer (2005).

Nutrients uptake by the plants. The highest N and P uptake was obtained with the application of poultry manure and the highest K uptake was obtained with the application of combination of FYM + human urine. Omotosu and Shittu (2008) also reported higher N uptake (1.38 %) from poultry manure application than recommended fertilizer. Application of poultry manure significantly resulted into the highest phosphorus uptake by okra plant than other treatments. Humic acid contained in the organic manure enhanced the nutrient uptake by the plants increasing the permeability of root cell membrane, stimulating root growth and increasing proliferation of root hairs (Pramanik et al., 2007). Nwachukwu, and Ikeadigh (2012) also reported higher uptake of P in maize compared to the urea.

Table 9

Showing nutrient uptake (kg ha^{-1}) pattern in different treatment combinations

Treatments	Uptake (kg ha^{-1})		
	N	P_2O_5	K_2O
Human urine$_{100\%}$	102.4^{e}	13.07^{d}	98.80^{e}
Poultry manure$_{100\%}$	286.7^{a}	25.60^{a}	123.7^{c}
FYM$_{100\%}$	175.3^{cd}	16.67^{bcd}	112.1^{d}

Goat manure$_{100\%}$	165.9 ^{d}	14.27 ^{bcd}	107.7 ^{de}
FYM$_{50\%}$ + human urine$_{50\%}$	283.9 ^{a}	19.67 ^{b}	163.1^{a}
Goat manure$_{50\%}$ + human urine$_{50\%}$	256.1^{b}	18.87 ^{bc}	148.1^{b}
RDF$_{100\%}$	177.7^{c}	13.37 ^{cd}	104.5 ^{de}
CV%	3.18	18.16	4.28
LSD	11.70**	5.607*	9.349**
SEM±	3.7960	1.8196	3.0341

Nitrogen budgeting. N from various sources was applied in the same amount (100 kg ha^{-1}). The unaccountable Nitrogen ranged from 3251.6 N kg ha^{-1} from human urine application to 1967.3 N kg ha^{-1} from the application of poultry manure. Very low amount of unaccountable Nitrogen was present in the poultry manure treatment. Very large amount of Nitrogen was lost from human urine application because the biomass production was very low and so was the Nitrogen uptake by plants. This may be mainly due to N losses from volatilization, denitrification, leaching etc.

Table 10

Showing nitrogen budgeting in different treatment combinations

Treatments	N input (kg ha^{-1})	Residual N (kg ha^{-1})	N uptake (kg ha^{-1})	Unaccountable Nitrogen (kg ha^{-1})
Human urine$_{100\%}$	7600	4246	102.4	3251.6
Poultry manure$_{100\%}$	7600	5346	285.7	1967.3
FYM$_{100\%}$	7600	4840	175.3	2584.7
Goat manure$_{100\%}$	7600	4620	165.9	2814.1
FYM$_{50\%}$ + Human urine$_{50\%}$	7600	5214	283.9	2102.1
Goat manure$_{50\%}$ + Human urine$_{50\%}$	7600	4994	256.1	2349.9
RDF$_{100\%}$	7600	4180	177.7	3242.3

Effect on economics of production. The highest net return (NRs. 242505) and B: C ratio (2.99) was recorded with 100% of N supplied through poultry manure followed by the application of FYM + human urine treatments. It seems mainly due to comparatively higher fruit yield and moderate cost of production in the treatment having poultry manure.

Table 11

Benefit cost ratio of okra var. Parvati production under the regime of different types of fertilizers at Biratnagar, Morang, Nepal, 2019

Treatments	Total cost of production (NRs)	Fruit yield (kg/ha)	Gross income (Rs/ha)	Net return (Rs/ha)	B/C ratio
T1	124703	18417	276255	151552	2.22
T2	122040	24303	364545	242505	2.99
T3	129880	21493	322395	192515	2.48
T4	132350	20567	308505	176155	2.33
T5	127291.5	22690	340350	213058.5	2.67
T6	128526.5	22480	337200	208673.5	2.62
T7	119157	19703	295545	176388	2.48

Note: T1- N $_{100\%\ Human\ urine}$, T2- N$_{100\%\ poultry\ manure}$, T3- N$_{100\%\ FYM}$, T4- N$_{100\%\ Goat\ manure}$, T5- N$_{50\%\ FYM}$+ N$_{50\%\ Human\ urine}$, T6- N$_{50\%\ Goat\ manure}$ + N $_{50\%\ Human\ urine}$, T7- RDF

CONCLUSIONS

The present study showed that the application of poultry manure resulted into the highest vegetative growth, yield and B: C ratio. N and P percentage in straw and fruit of okra was obtained highest from the application of poultry manure and K percentage in straw and fruit from the application of FYM + human urine treatments. Among the primary nutrients N and P uptake were high from the application of poultry manure and K uptake in FYM + human urine treatments. Thus, from this study it can be concluded that the small farmers who have less convenience to chemical fertilizers can replace chemical fertilizer by to fulfill half dose of nitrogen for obtaining better yield of sweet pepper and higher net profit as well.

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