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Effect of Goat Manure and Urea Fertilizer on Soil, Growth and Yield of Okra (*Abelmoschus esculentus* (L.) Moench)

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Abstract: In order to investigate the effect of goat dung manure on okra, field experiments were carried out at Ado-Ekiti and Akure in Southwest, Nigeria. In a preliminary study carried out at Ado-Ekiti the effects of 0, 2, 4, 6 and 8 t ha^{-1} goat manure (GM) on okra (var. v35) were studied. Goat manure applied at 4, 6 and 8 t ha^{-1} increased number of pods by 25, 31 and 44%, respectively. At Akure the relative effects of 160 kg ha^{-1} urea (72 kg ha^{-1} N), 8 t ha^{-1} GM, 6 t ha^{-1} GM+40 kg ha^{-1} urea (U), 4 t ha^{-1} GM +80 kg ha^{-1} U, 22 t ha^{-1} GM + 120 kg ha^{-1} U and no treatment on soil chemical composition and growth and yield of okra (var. NHAE-47-4) were studied. The 8 t ha^{-1} GM was more effective than 160 kg ha^{-1} U in increasing number and weight of pods. Addition of GM to urea increased pod weight, Soil Organic Matter (SOM), N and pH. GM increased soil, N, P, K and mg contents. The 2 t ha^{-1} GM+120 kg ha^{-1} gave the highest okra yield.

Key words: Okra, goat dung, urea, pod weight, soil organic matter and okra yield

INTRODUCTION

Due to decreasing land area, vegetable cultivation in Africa and particularly in Nigeria is continuously done in the same piece of land in the home gardens or in the fields with other food crops and especially near urban settlements (Grubben *et al*., 2004). This situation aggravates loss of soil fertility and inadequate supply of plant nutrients, nutrients deficiency symptoms especially those of Nitrogen (N) and low yield.

Okra (*Abelmoschus esculentus* (L.) moench). It is an important vegetable in tropical and subtropical area. It is one of the most important vegetables in India and in Nigeria alone it occupies 1.5 million hectares (IFA, 1992). The uptake of minerals by okra is rather high. Indicative figures for total nutrient uptake per ha of a crop with a fruit yield of about 10 t ha^{-1} are 100 kg N, 10 kg P, 60 kg K, 80 kg CA and 40 kg GM (Grubben *et al*., 2004). But scarcity and high cost of fertilizer hamper its adequate use (Adediran *et al*., 2003; Louise, 2003), Also further intensification of fertilizer use may also add to widespread problem of soil acidification (Scherr, 1999; Vanlauwe *et al*., 2002a) or eutroplication of coaster water.

To alleviate those problems, the resource poor farmers combine urea and locally sourced organic manure such as goat dung. The goat dung manure is expected to add other nutrients apart from N to the soil and it will also help to reduce soil bulk density which may reduce nutrient uptake, growth and yield of celesia (Ojeniyi and Adegboyega, 2003). The combine use of organic and inorganic fertilizer is consistent with the Integrated Soil Fertility Navaqenuily (ISFM) framework (CIAT, TSBF, ICRAT, 2002; Vanlanwe *et al*., 2002b). Although, many studies have been carried out on the effect of poultry and cattle manures on soil properties and crops, studies are quite scare on the effects of combined use of goat manure (GM) and urea fertilizer in okra. In Southwest Nigeria, GM applied at 10 t ha^{-1} increased soil pH and N and yield of plantain by 33% (Samuel *et al*., 2003). In Tanzania, Macrere *et al*. (2001) applied GM as source of N and found an increase in soil N and P, root growth,

fresh and dry matter yields of *Amaranthus viridis*. The objective of the present, research was to study the effect of different levels of GM and urea on some soil physical and chemical properties and nutrient status, growth and yield of okra grown in Southwest Nigeria.

MATERIALS AND METHODS

A preliminary experiment was concluded at Ado-Ekiti (7°31'N, 7°49'E). In Southwest Nigeria in year 2002, on a sandy loam soil in which 0, 2, 4, 6 and 8 t ha^{-1} goat manure were tried on v-35 extra variety. The treatments were replicated three times using a randomized complete block design. Okra was planted 5 seeds per stand at 60×60 cm in July 2002 in each of the 15 plots, each plot bearing 9 m^2. Thinning to one plant per stand was done a week after planting.

Ungrounded goat manure was applied three weeks after thinning by ring method (Tisdale *et al*., 1985). Green pods harvested from 5 plants per plot at 4 days interval were counted until the 10th harvested. The plant height, girth, leaf length and taproot length were determined after harvest.

Main Experiments

Field experiments were conducted at Akure (7°16'N longitude 5°12'E latitude) in Southwest Nigeria in 2003 and 2004. Six manual treatments were applied to okra (var. NHAE-47-4) and in each experiment the treatments were replicated three times using a randomized complete block design. The treatments were:

- Control (no fertilizer/manure)
- 160 kg ha^{-1} urea (72 kg ha^{-n}).
- 2 t ha^{-1} goat manure (GM) + 120 kg ha^{-1} urea.
- 4 t ha^{-1} GM kg ha^{-1} urea.
- G t ha^{-1} GM+40 kg ha^{-1} urea.
- 8 t ha^{-1} GM.

The site of experiments were manually cleared and five okra seeds were planted per hole on 30/6/2003 and 16/4/2004 respectively in case of the first (E1) and second (E2) experiments. Thinning to one plant per stand was done and the plant was spaced 60×60 cm each of the 18 plots was 6 in 2 with 72 plants per plot. Ground goat manure that was collected from the Federal University of Technology, School farm Akure and urea produced by NAFCON (Nigeria National Fertilizer Company of Nigeria) were applied by ring method (Tisdale *et al*., 1985) on the soil surface below each plant two weeks after planting. The two materials were separately applied.

Six plants were selected per plot for the determination of growth and yield parameters. The plant height and stem girth and number of leaves were determined weekly and for four times as from 4 weeks after application of treatments. Harvest of pods was done at 5 days interval as from 50 days after planting. The number and weight of pods and pod length were determined. After harvest, the plants were excavated for the determination of root length.

Soil Analysis

Surface (0-15 cm) soil samples were collected over each site before commencement of trials. Also, samples were collected in treatment plots 12 weeks after treatment application in 2003 and 2004 (i.e., after field experiment). Samples were air dried and passed through 2 mm sieve. Particle size analysis was done using hydrometer method, soil organic matter (som) was determined by wet dichromate oxidation method, total N by micro-Kjeldahl approach and available P by molybdenum blue colorimetry after bray-1 extraction.

Exchangeable caltims were extracted with ammoniums acetate; K was determined on flame pletometer and Ca and Mg by EDTA titration. Soil pH in 1.1 soil water suspension was determined (Tel and Hagarty, 1984).

Goat Dung Analysis

Samples of air-dried goat dung used was analyzed. Oven-dried at 70°C for 24 h and milled. Nitrogen was determined using micro-Kjeldahl method. Samples were dry ashed using metric-perchloric suphuric acid mixture for determination of P, K, Ca and Mg. Phosphorous was determined using vanado molybdate colorimetry, K by flame photometer and Ca and Mg by EDTA titration (Tel and Hagarty, 1984).

Statistical Analysis

Data on soil analysis and growth and yield parameters were subjected to analysis of variance and the names compared using the least significant difference (LSD) at 5% level of probability.

RESULTS AND DISCUSSION

Initial soil and goat dung analysis data shown in Table 1. The sandy loam soils were low in organic matter (om) available P, marginal in exchangeable K, adequate in total N, exchangeable Ca and Mg and slightly acidic (Akinrinde and Obigbesan, 2000).

The growth and yield of okra were enhanced by goat manure applied at 2, 4, 6 and 8 t ha^{-1} (Table 2). The 6 and 8 t ha^{-1} manure increased leaf length and root length significantly. The numbers of pods increase with amount of goat manure and the 4, 6 and 8 t ha^{-1} manure increased number of pods significantly. The increases were 25, 31 and 44%, respectively.

Table 3 shows that application of urea fertilizer, goat manure and combine application of reduced quantities of urea and goat manure increased plant height, number of leaves, pod length, pod weight and number of pods relative to no treatment. The effects of 8 t ha^{-1} manure and combine application of manure and urea on pod with 160 kg ha^{-1} urea, 8 t ha^{-1} goat manure gave higher values of pod weight, number of pods recorded for 8 t ha^{-1} manure were significantly higher ($p = 0.005$). Compared with no treatment the 160 kg ha^{-1} urea and 8 t ha^{-1} manure increased pod weight by 77 and 204%, respectively. The equipment values for number of pods were 100 and 200%.

Table 1: Analysis of soils at experimental sites and goat manure

Property	Site 1 (Ado-Ekiti)	Site 2 (Akure)	Goat manure (%)
Om (%)	2.40	2.30	68.2
Total N (%)	0.30	0.31	4.8
P (mg kg^{-1})	7.10	7.00	4.1
K (Cmol kg^{-1})	0.21	0.15	1.9 (total)
Ca, (Cmol kg^{-1})	1.70	1.50	1.0 (total)
Mg (Cmol kg^{-1})	1.40	1.20	0.9 (total)
pH	6.50	6.60	
Sand	66.50	69.20	
Silt	14.40	14.40	
Clay	19.00	16.40	

Table 2: Effect of goat manure on okra at ADO-EKITI

Goat manure (t ha^{-1})	Plant height (cm)	Plant girth (cm)	Leaf length (cm)	Tap root length (cm)	No. of pods
0	40.0	2.3	13.2	7.6	16
2	44.4	2.9	16.7	8.4	18
4	41.9	2.7	16.3	10.7	20
6	44.9	2.5	18.2	14.2	21
8	47.1	2.8	17.6	16.3	23
LSD (0.05)	NS	NS	4.3	3.9	2.2

NS: Non Significant

Table 3: Effect of goat manure (GM) and urea (U) fertilization on okra-experiments 1 (E1) and 2 (E2)

	Pod weight (g)		No. of pods*		Pod length (cm)		Plant height (cm)		No. of leaves*	
Treatments	E1	E2	E1	E2	E1	E2	E1	E2	E1	E2
No treatment	4.3	6.2	8.0	8.0	3.7	3.7	35.2	38.9	3.4	3.0
160 kg ha^{-1} U	8.0	10.8	16.8	15.2	5.1	5.0	43.2	45.6	8.8	8.9
8 t ha^{-1} GM	14.7	17.5	21.6	26.4	5.0	5.7	46.4	48.6	7.2	7.6
8 t ha^{-1} GM + 40 kg ha^{-1} U	12.8	12.6	14.8	16.0	5.3	6.3	51.7	52.3	7.8	8.8
4 t ha^{-1} GM + 80 kg ha^{-1} U	13.5	12.6	12.8	15.6	5.2	5.2	48.9	49.7	8.2	8.7
2 t ha^{-1} GM + 120 kg ha^{-1} U	21.5	20.1	23.2	24.0	6.0	6.6	54.3	55.4	8.5	8.7
LSD (0.05)	4.1	6.4	2.2	3.6	0.2	0.2	4.8	4.4	0.9	0.8

*Per plant basis

Table 4: Effect of goat manure (GM) and urea (U) fertilizer on soilchemical properties experiment 1 (E1) and 2 (E2)

	OM (%)		N (%)		P (mg kg^{-1})		K (mmol kg^{-1})		Ca (mmol kg^{-1})		Mg (mmol kg^{-1})		pH	
Treatments	E1	E2	E1	E2	E1	E2	E1	E2	E1	E2	E1	E2	E1	E2
No treatment	1.8	0.8	0.20	0.12	1.8	1.4	0.36	0.20	0.48	0.20	0.24	0.20	7.1	7.2
160 kg ha^{-1} U	2.0	1.8	0.22	0.14	8.2	10.4	0.47	0.92	0.50	0.49	0.33	0.40	6.2	6.1
8 t ha^{-1} GM	5.2	4.2	0.36	0.30	3.0	3.6	0.38	0.70	0.49	0.65	0.34	0.42	7.4	7.6
6 t ha^{-1} GM + 40 kg ha^{-1} U	4.3	2.8	0.26	0.16	2.9	3.2	0.43	0.82	0.60	0.52	0.30	0.36	7.1	7.2
4 t ha^{-1} GM + 80 kg ha^{-1} U	3.2	2.4	0.34	0.20	4.9	5.8	0.39	0.74	0.52	0.50	0.24	0.32	7.1	7.1
2 t ha^{-1} GM + 120 kg ha^{-1} U	2.4	2.5	0.38	0.32	9.4	10.3	0.40	0.88	0.40	0.56	0.26	0.30	7.3	7.3

Compared with 160 kg ha^{-1} urea, combine application of reduced quantities of urea (40, 80 and 120 kg ha^{-1}) and of manure gave higher values of okra pod weight, pod length and plant height. The calculated pod weight per plant for no treatment, 160 kg ha^{-1} urea, 8 t ha^{-1} goat manure + 40 kg ha^{-1} urea, 4 t ha^{-1} goat manure + 80 kg ha^{-1} urea and 2 t ha^{-1} manure + 120 kg ha^{-1} urea were 42.0, 150.4, 386.4, 195.6, 184.6 and 490.0 g, respectively. Therefore application of goat manure with urea increased okra yield compared with urea alone. The 2 t ha^{-1} of manure + 120 kg ha^{-1} urea gave the highest values of pod weight, number of pods, plant height and pod length.

Urea fertilizer, goat manure and urea plus goat manure treatments increased Soil Organic Matter (SOM), N, P, K, Ca and Mg contents compared with no treatment (Table 4). Compared with urea, goat manure tended to increase SOM, N and PH. Also addition of goat manure to urea increase SOM, N and PH. Application of 2 t ha^{-1} soil manure plus 120 kg ha^{-1} urea gave the highest soil N and P values.

The increased growth and yield of okra adduced to application of urea fertilizer and goat manure is attributed to increased availability of organic matter and nutrients in soil. Urea might have also increased microbial activities. The observation that goat manure used alone or combined with urea increased okra yield compared with urea alone might be due to the acidic nature of soil under urea fertilizer. The increased soil acidity under urea should have reduced micro-nutrients contents ad yield of okra (Owolabi *et al*., 2003). Application of goat manure tended to increase soil pH and reduce soil acidity. Also the goat manure tended to increase SOM and N status, whereas N is the nutrient most required by okra (Grubben *et al*., 2004). The highest okra yield recorded for 2 t ha^{-1} manure + 120 kg ha^{-1} urea is consistent with the highest soil N and P status recorded for the treatment.

CONCLUSION

It is concluded that goat manure increases soil nutrient contents and okra yield. Addition of goat manure to urea fertilizer enhanced soil organic matter and N status. Goat manure can be used to reduce the amount of urea fertilizer required by okra.

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