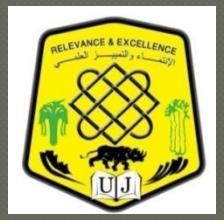

University of Juba
College of Natural Resources & Environ. Studies

Comparative Yield and Growth Performance of three Okra Genotypes under Organic (Poultry Manure) and Inorganic (NPK) Fertilizers under local Field Conditions.

Student Name	**:**	**Duluma Maker Dhalbeny**
Index Number	:	10-CN-013
Supervisor	:	Prof. Philip Wani Marchelo, PhD.
Specialization	:	BSc. (Hons) Degree in Agricultural Sciences
Year of Completion	:	October, 2018

A Dissertation Presentation for the Award of BSc. (Hons) Degree in Agricultural Sciences

Presentation Outline

1. Introduction
2. Problem Statement and Hypothesis
3. Objectives
4. Literature Review
5. Materials and Methods
6. Result and Discussions
7. Conclusion and Recommendations
8. Appendix
9. Q & A

Introduction

- Okra (*Abelmoschus esculentus*), locally known as Amilaak or Guom in Dinka Bahr el Ghazal, Bamia (when fresh) and Weka (when dried) in Juba Arabic, belongs to Malvaceae family. The popular genotypes grown in South Sudan includes Amilaak baar (Beledi), Khartoumia, Pusa sawani and Clemson spineless.
- It is an important leading vegetable crop grown for its pods and leaves and is consumed by almost all South Sudanese people either as green immature pods cooked as soup or stews and, or Sundried and ground into powdery form known as weka; an ingredient vital for making favorable mulah at times when fresh okra is out of stock.

Problem Statement and Hypothesis

- The research was intended to determine yield performance of three okra genotypes under Organic (Poultry Manure) and Inorganic (NPK) fertilizers under the local field conditions in the Hills and Mountainous Agro-ecological zone of South Sudan. The study was to prove whether the soils in this Agro-ecological zone need application of fertilizers in the production of okra crop or not. This is because there is local perception that the soils in six Agro-ecological zones of the Country especially the volcanic soils of Equatoria region have more nutrients load, therefore, there is no need to apply fertilizers.
- Is there any relationship between okra genotypes and fertilizers on the yield and growth attributes or not?

Objectives

a)General Objectives

- To determine the yield performance of three okra genotypes growing under Organic (Poultry Manure) and Inorganic (NPK) fertilizers in the local field conditions.
- To determine which one of okra genotypes growing under the Organic (Poultry Manure) or Inorganic fertilizers (NPK) is susceptible or resistant to pests and disease infestation.

b) Specific Objective

- To determine yield performance of three okra genotypes growing under Poultry Manure and NPK fertilizers in the local field conditions.

Literature Review

Origin and Geographical Distribution

- The origin of okra is disputed, some people believe that Okra originated from Abyssinian Centre of origin of cultivated plants, an area that includes the present-day Ethiopia, the Mountainous or Plateau area of Eritrea and the eastern higher part of the Anglo-Egyptian Sudan while other authors argued that it is native to Uttar Pradesh in northern India. Other group argued that Okra is found in its wild state on the alluvial banks of the Nile and the Egyptian were the first to cultivate it in the basin of the Nile (12th Century BC) where it was then propagated through North Africa, to the Mediterranean, the Balkans and India.

Literature Review (con'td)

❑ Botanical Features and Climatic Requirements

- Okra is an upright annual, herbaceous 3 to 8 feet tall plant. It has a deep taproot system, semi woody stem, leaves are cordate, with hibiscus-like flowers and an elongated, conical fruit.
- Okra is sensitive to frost and develops poorly below low temperature of about 15℃. Reports by Katung and Kashina (2005) indicated that okra requires high temperature of about 32℃ and long day length for optimum growth and development.
- A well – drained sandy loam soil with a pH of 6 - 6.8 is preferred. Although okra is a drought tolerant plant, the availability of water has significant impact on okra production, for high yields, an adequate water supply and relatively during actual growth period is required.

Materials & Methods

Experimental Site

- These studies were conducted at the New Base Farm of Global CST and Green Horizon Co. Ltd located at Surrea area of Nyarkenyi county, (behind the SPLA Military HQs – Bilpam) North-east of Juba International Airport, Jubek State, South Sudan. It is approximately at latitude $4^{0}86'$ North and longitude $31^{0}60'$ East and at an elevation of 518 m (1699 ft) above Sea level and falls within the Hills and Mountainous Agro-ecological zone of the country.
- The experiment was conducted from the month of April to July 2018 with the mean temperature of 27.5^{0} C, mean monthly rainfall of 79.6 mm. The climate was tropical and summer was a bit less hot but humid and rainy.

Materials & Methods (con'td)

❑ Design Details, Sources and Materials Used

- Name of crop: Okra.
- Date of planting: 20/04/2018.
- Type of experiment: Factorial experiment (3x3x3).
- Design: Group Balanced Block using RCBD.
- Subplot size: 4.5 × 1 = 4.5 Sq.M, Total area = 192 Sq. M.
- Total no. of subplots = 27.
- Spacing: 50 × 40 cm between row to row & plant to plant respectively.
- Furrow: 75 × 50 cm between replicate to replicate & subplot to subplot respectively.
- Sources of materials include Jambo seed centre, Global CST & Green Horizon Co. Ltd stores.
- Materials used: seeds, fertilizers, irrigation & spraying facilities, tape measure, weighing scale, knife, ropes, sacks, bamboos, digging tools & plant tags.

Result and Discussions

- This chapter focuses on the okra yield attributes such as number of fruits, fruit length in centimeter, fruit weight in grams, number of marketable fruits and number of unmarketable fruits per plot respectively. It also consider growth parameters such as number of leaves to 50% flowering and plant height in feet at final harvest per plot.
- The results recorded during the processes of experiment were statistically analyzed using the analysis of variance (ANOVA) technique in line with Statistical Procedures for Agricultural Research, 2nd edition by Gomez, K.A. and Gomez, A.A. (1984). The two-factor experiments, pp. 84-97. John Wiley and Sons Inc. New York.

Table I. Mean number of fruits per plot.

	Fertilizer levels			
Genotype	**Fo (No fertilizers)**	**F1 (Poultry manure)**	**F2 (NPK)**	**Mean**
Go (Khartoumia)	60.25	29.50	52.00	47.25
G1 (Pusa sawani)	103.00	132.50	110.75	115.42
G2 (Clemson spineless)	40.25	60.50	69.75	56.83
Mean	67.83	74.17	77.5	

Table II. Mean fruit length in cm per plot.

	Fertilizer levels			
Genotype	**Fo (No fertilizers)**	**F1 (Poultry manure)**	**F2 (NPK)**	**Mean**
Go (Khartoumia)	15.04	15.92	13.84	14.93
G1 (Pusa sawani)	16.08	18.25	20.42	18.25
G2 (Clemson spineless)	14.21	16.83	16.25	15.76
Mean	15.11	17.00	16.83	

Table III. Mean fruit weight in grams per plot.

	Fertilizer levels			
Genotype	**Fo (No Fertilizers)**	**F1 (Poultry Manure)**	**F2 (NPK)**	**Mean**
Go (Khartoumia)	1009.98	544.39	1011.71	855.36
G1 (Pusa sawani)	1162.88	1763.48	1334.26	1420.21
G2 (Clemson spineless)	552.88	1009.88	1158.38	907.05
Mean	908.58	1105.92	1168.12	

Table IV. Mean number of marketable fruits per plot.

	Fertilizer levels			
Genotype	**Fo (No fertilizers)**	**F1 (Poultry manure)**	**F2 (NPK)**	**Mean**
Go (Khartoumia)	44.75	21.75	39.25	35.25
G1 (Pusa sawani)	79.50	94.00	74.75	82.75
G2 (Clemson spineless)	29.25	44.50	49.50	41.08
Mean	51.17	53.42	54.50	

Table V. Mean No. of unmarketable fruits per plot.

	Fertilizer levels			
Genotype	**Fo (No fertilizers)**	**F1 (Poultry manure)**	**F2 (NPK)**	**Mean**
Go (Khartoumia)	15.50	8.00	12.75	12.08
G1 (Pusa sawani)	23.75	38.50	36.00	32.75
G2 (Clemson spineless)	11.00	16.00	20.25	15.75
Mean	16.75	20.83	23.00	

Table VI. Mean No. of leaves to 50% flowering per plot.

	Fertilizer levels			
Genotype	**Fo (No fertilizers)**	**F1 (Poultry manure)**	**F2 (NPK)**	**Mean**
Go (Khartoumia)	22.00	21.00	21.00	21.33
G1 (Pusa sawani)	19.00	22.00	25.00	22.00
G2 (Clemson spineless)	20.00	23.00	25.00	22.67
Mean	20.33	22.00	23.67	

Table VII. Mean plant height in Ft at final harvest per plot.

	Fertilizer levels			
Genotype	**Fo** (No fertilizers)	**F1** (Poultry manure)	**F2** (NPK)	**Mean**
Go (Khartoumia)	13.30	11.00	11.71	12.00
G1 (Pusa sawani)	8.40	10.10	12.70	10.40
G2 (Clemson spineless)	8.80	12.20	11.70	10.90
Mean	10.17	11.10	12.04	

ANOVA Table I. Number of fruits per plot.

SoV	DF	SS	MSS	Fcal.	F tab. 5%	F tab. 1%
Replication	2	103.153	51.577	0.741	3.63	6.23
Treatment	8	3200.084	400.010	5.744**	2.59	3.89
Genotype (A)	2	2723.514	1361.757	19.555**	3.63	6.23
Fertilizer (B)	2	48.223	24.112	0.346ns	3.63	6.23
A x B	4	428.347	107.087	1.538ns	3.01	4.77
Error	16	1114.18	69.636			
Total	26	4417.417				

Legend:	
SoV	Source of Variation
DF	Degree of Freedom
SS	Sum of Squares
MSS	Mean Sum of Squares
Fcal	Calculated F Value
Ftab	F Tabulated

LSD 0.01 = 31.31; SME± = 4.82; CV = 3.80%; ** = Highly Significant at P≤0.01; ns = Not Significant

ANOVA Table II. Fruit length in cm per plot.

SoV	DF	SS	MSS	Fcal.	F tab. 5%	F tab. 1%
Replicate	2	10.645	5.323	0.902	3.63	6.23
Treatment	8	99.833	12.479	2.115ns	2.59	3.89
Genotype (A)	2	53.696	26.848	4.551*	3.63	6.23
Fertilizer (B)	2	19.696	9.848	1.669ns	3.63	6.23
A x B	4	26.441	6.610	1.120ns	3.01	4.77
Error	16	94.384	5.899			
Total	26	204.862				

Legend:	
SoV	Source of Variation
DF	Degree of Freedom
SS	Sum of Squares
MSS	Mean Sum of Squares
Fcal	Calculated F Value
Ftab	F Tabulated

LSD 0.01 = 9.14; SME± = 1.40; CV = 4.96%; * = Significant at P≤0.05; ns = Not Significant.

ANOVA Table III. Fruit weight in grams per plot.

SoV	DF	SS	MSS	Fcal.	Ftab. 5%	Ftab. 1%
Replication	2	30202.714	15101.357	0.799	3.63	6.23
Treatment	8	373576.351	46697.044	2.469ns	2.59	3.89
Genotype (A)	2	195018.818	97509.409	5.156*	3.63	6.23
Fertilizer (B)	2	36723.293	18361.647	0.971ns	3.63	6.23
A x B	4	141834.24	35458.56	1.875ns	3.01	4.77
Error	16	302588.711	18911.794			
Total	26	706367.776				

Legend:	
SoV	Source of Variation
DF	Degree of Freedom
SS	Sum of Squares
MSS	Mean Sum of Squares
Fcal	Calculated F Value
Ftab	F Tabulated

LSD 0.01 = 517.05; SME± = 79.39; CV = 4.32%; * = Significant at P≤ 0.05; ns = Not Significant.

ANOVA Table IV. No. of marketable fruits per plot.

SoV	DF	SS	MSS	Fcal.	Ftab. 5%	Ftab. 1%
Replication	2	75.199	37.5995	0.923	3.63	6.23
Treatment	8	1579.518	197.4398	4.846**	2.59	3.89
Genotype (A)	2	1342.129	67.0645	1.646ns	3.63	6.23
Fertilizer (B)	2	5.782	2.891	0.071ns	3.63	6.23
A x B	4	231.607	57.902	1.421ns	3.01	4.77
Error	16	651.885	40.743			
Total	26	2306.602				

Legend:	
SoV	Source of Variation
DF	Degree of Freedom
SS	Sum of Squares
MSS	Mean Sum of Squares
Fcal	Calculated F Value
Ftab	F Tabulated

LSD 0.01 = 24.00; SME± = 3.69; CV = 4.01%; ** = Highly Significant at P≤ 0.01; ns = Not Significant

ANOVA Table V. No. of unmarketable fruits per plot.

SoV	DF	SS	MSS	Fcal.	Ftab. 5%	Ftab. 1%
Replication	2	14.518	7.259	1.054	3.63	6.23
Treatment	8	308.616	38.577	5.599**	2.59	3.89
Genotype (A)	2	243.185	121.593	17.650**	3.63	6.23
Fertilizer (B)	2	20.143	10.072	1.462ns	3.63	6.23
A x B	4	45.288	11.322	1.643ns	3.01	4.77
Error	16	110.232	6.889			
Total	26	433.366				

Legend:	
SoV	Source of Variation
DF	Degree of Freedom
SS	Sum of Squares
MSS	Mean Sum of Squares
Fcal	Calculated F Value
Ftab	F Tabulated

LSD 0.01 = 9.89; SME± = 1.52; CV = 4.33%; ** = Highly Significant at P≤ 0.01; ns = Not Significant

ANOVA Table VI. Mean No. of leaves to 50% flowering per plot.

SoV	DF	SS	MSS	Fcal.	Ftab 5%	Ftab 1%
Replication	2	4.000	2.000	1.043	3.63	6.23
Treatment	8	11.333	1.417	0.739ns	2.59	3.89
Genotype (A)	2	0.889	0.445	0.232ns	3.63	6.23
Fertilizer (B)	2	5.556	2.778	1.449ns	3.63	6.23
A x B	4	4.888	1.222	0.638ns	3.01	4.77
Error	16	30.667	1.917			
Total	26	46.000				

Legend:	
SoV	Source of Variation
DF	Degree of Freedom
SS	Sum of Squares
MSS	Mean Sum of Squares
Fcal	Calculated F Value
Ftab	F Tabulated

LSD 0.01 = 5.23; SME± = 0.79; CV = 1.54%; ns = Not Significant

ANOVA Table VII. Mean Plant height in Ft at final harvest per plot.

SoV	DF	SS	MSS	Fcal.	Ftab. 5%	Ftab. 1%
Replication	2	1.604	0.802	0.776	3.63	6.23
Treatment	8	7.644	0.956	0.925ns	2.59	3.89
Genotype (A)	2	1.346	0.673	0.652ns	3.63	6.23
Fertilizer (B)	2	1.749	0.875	0.847ns	3.63	6.23
A x B	4	4.549	1.137	1.101ns	3.01	4.77
Error	16	16.520				
Total	26	25.768				

Legend:	
SoV	Source of Variation
DF	Degree of Freedom
SS	Sum of Squares
MSS	Mean Sum of Squares
Fcal	Calculated F Value
Ftab	F Tabulated

LSD 0.01 = 3.84; SME± = 0.59; CV = 4.16%; ns = Not Significant; Note: 1 Ft = 30 cm.

Discussions

- Yield parameters tested such as number of fruits, fruit length in (cm), fruit weight in (g), number of marketable fruits and number of unmarketable fruits showed highly significant effect of genotypes on the yield attributes whereas the fertilizer levels showed no significant effect.
- Mean number of fruits per plot or plant differed significantly among the genotypes which resemblance the findings of Adlan et al. (2016) who found that Pusa sawani produced higher yield than Clemson spineless and Khartoumia respectively. Similar results were reported by Damar (2017) who found that Okra variety 1 (Kashi Pragati) produced more fruits compared to variety 2 (Kashi Kranti). Fruit weight also differed significantly among varieties, similar to the findings reported by Damar (2017), Mal et al. (2014), Singh et al. (2013 & 2014) and Jamala et al. (2011).

Conclusion

- The results obtained from the experiment revealed that yield parameters of okra genotypes were highly significant while that of growth parameters had showed non-significant differences at $P \leq 0.01$ according to the least significant difference test.
- Genotype G1 (*Pusa sawani*) had demonstrated superior performances in all yield attributes compared to the genotypes of *Clemson spineless* and Khartoumia. All these yield attributes are highly significantly different at $P \leq 0.01$.
- Numerically, treatments under F2 (NPK fertilizers) had influenced the following yield parameters resulting to mean maximum number of fruits per plot as 77.5, fruit weight in g as 1168.12, number of marketable fruits as 54.50, and number of unmarketable fruits as 23.00 respectively compared to treatments under Fo (Fertilizer control) and F1(Poultry manure).

Conclusion (con'td)

- However, application of poultry manures had influenced okra fruit length with a mean longest fruit having 17 cm compared to genotypes under NPK and no fertilizer (fertilizer control) respectively. Comparatively, application of poultry manure had also influenced on other yield parameters per plot but slightly lower than plots in which NPK fertilizers had been applied in a ratio of mean number of fruits as (74.17 : 77.50), fruit weight in g (1105.92 : 116812), number of marketable fruits as (53.42 : 54.50) and number of unmarketable fruits as (20.83 : 23.00).
- The results from the experiment showed that, okra growth parameters such as number of leaves to 50% flowering and plant height in ft are not significantly different at $P \leq 0.01$. Genotype G2 (Clemson spineless) had outperformed G1 (Pusa sawani) and Go (Khartoumia) in all growth attributes.

Recommendations

- Farmers
  - Production of Pusa sawani on a large and small scale is advisable to large resourceful and smallholder farmers because it has showed superior performance in all yield attributes under our environment compared to Clemson spineless and Khartoumia.
  - Khartoumia genotype showed much resistance to pests and disease infestation compared to Pusa sawani and Clemson spineless genotypes hence, its production is advisable.
  - Pusa sawani genotypes are more susceptible to pests and disease infestation especially when NPK fertilizers were applied unlike under no fertilizer application and application of poultry manure; therefore, its production should be supplemented by the application of organic fertilizers (poultry manure).
  - Use of organic (poultry manure) fertilizer is recommended to smallholder farmers because it is cheaper, readily available and enhances soil nutrient status while influencing okra yield attributes.

Recommendation (con'td)

- **Future Research.**
  - This experiment should be repeated for the verification of these findings.
  - Different inorganic & organic fertilizer levels should be tested against the same genotypes to determine whether they would be significant or not.
- **NGOs and partners supporting Agriculture**
  - Vegetables smallholder farmers should be supported especially okra producers through the provision of farm inputs.
  - In collaboration with national and state ministries of Agriculture, establish demonstration farms and facilitate the trainings of smallholder farmers on the good agricultural practices to be adopted in the production of okra.
- **National and state ministries of Agriculture**
  - Encourage organic farming and protect local okra genotypes from extinction through preservation and distribution of its seeds to the farmers.
  - Establish a national research institution to undertake research related tasks.

Appendix

Land Preparation stage.

Ridges formation and setting up of Drip Irrigation system .

Incorporation of Organic (PM) and Inorganic (NPK) Fertilizers to the selected Subplots.

Experimental Field Layout stage.

Weeding stage.

A Researcher recording Okra Fruit Weight per plot.

A Researcher measuring Plant height in feet.

A Researcher recording Number of Leaves to 50% Flowering.

A Researcher Picking Pods of Okra.

Variety Pusa sawani Pods.

Variety Clemson spineless Pods.

Variety Khartoumia Pods.