Effect of Different Organic Manure Rates on Yield and Post Harvest Storage of Okra (*Abelmoschus esculentus*)

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KEYWORDS

Deterioration,
Growth and yield parameters
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Post- harvest,
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ABSTRACT

The experiment was conducted at the Research Farm of the Department of Crop Science and Horticulture, Nnamdi Azikiwe University, Awka, Nigeria to study the effect of different organic manure rates on yield and okra. Different manure sources from poultry and pig and the rates were: 0 ton/ha, 5 tons/ha, 10 tons/ha, 15 tons/ha, and 20 tons/ha. The 2 x 5 factorial experiment was laid out in a Completely Randomized Design (CRD) and replicated three (3) times. Data were collected on growth and yield. For yield parameters, pig manure at15 t/ha rate gave the highest yield however, the interaction effects showed that 15t/ha poultry manure x yield produced the highest number and weight yield of pods, while 15 t/ha pig manure out performed in the length and width of okra pods. Hence, poultry manure at 15t/ha and 20t/ha pig manure were recommended. Considering the effect of postharvest storage materials on the physiological deterioration rates of okra pods, newspaper, and dried plantain leaves maintained better postharvest storage quality of okro than other storage materials.

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INTRODUCTION

Okra (*Abelmoschus esculentus* L. Moench) also known as Ladies Fingers is a member of the Malvaceae family (The Plant List, 2020). It is a vital fruit vegetable found in the tropical and subtropical regions of the world (Senjobi *et al*. 2013)..In Nigeria, okra is grown mainly for its green pods by peasant farmers, in-home gardens or in mix-cropping with cereals. The pods of Okra contain a mucilaginous substance used to thicken soups and stews, and as plasma replacement or blood volume expander (Onunkun, 2012). The young leaves and fruits are boiled or fried and eaten as a vegetable or in soup. It is a nutritious and delicious vegetable, rich in vitamins and minerals (Gemede, 2016). Okra seeds are used as a non - caffeinated substitute for coffee and as a source of seed oil (Olawuyi *et al.*, 2012). Industrially mature pods and stems contain fiber that can be used for the manufacture of paper, rope, jute etc. (Olawuyi *et al.*, 2012)..Among the relevant aspects of okra cultivation, its post-harvest management stands out as one of paramount interest to maintain optimum production and utilization. After harvesting, vegetables become quite perishable owing to their high-water

content (90%) and intense metabolism that is characterized by high respiratory rate (Mota *et al*., 2010). Okra pods can be kept at ambient temperatures for short periods of time (up to a week) if there is enough ventilation to prevent heat buildup from respiration. Persistent use of inorganic fertilizer has a lasting negative effect on soil properties and soil fertility status due to its effect on soil nutrient balance (Unagwu, 2019). Importantly, Organic manures not only balance the nutrient supply but also improve soil's physical and chemical properties. With the challenges associated with inorganic fertilizer application, the use of organic manure to replenish soil nutrients is a viable alternative. This is because organic manure improves plant nutrient use efficiency, and enhances soil conditions by improving the physical, chemical biological, and hydrological properties of the soil (Unagwu *et al.*,2019). . Hence, Organic manure stands as a beneficial and better alternative to inorganic fertilizers in crop production. This necessitates not just the use of organic manures in okra production but as well using the right application rate for optimum production.(Unagwu *et al.*,2019).

One notable challenge facing okra production in the tropics, especially in Nigeria is poor soil health. ~~T~~ This study in broad view therefore seeks to determine the most effective means of producing okra using different rates of organic manure from different sources (poultry manure and pig manure), the response of okra fruits to different organic manure, and storage materials that improve the shelf life of okra.

MATERIALS AND METHODS

Experimental Site: The study was carried out using polythene bags ~~pots~~ at the Department of Crop Science and Horticulture Nnamdi Azikiwe University, Awka, Anambra State. Awka is characterized by tropical rain forest with temperature of 27^0 -30^0. The area is located between latitude $06^0 15^1$ N and longitude 07^0 08^1 E.

Materials: Okra seeds was sourced from a reputable seed marketer; the organic manures (poultry manure and pig manure) were all obtained from the ~~d~~ Department of Animal Science and Technology, Nnamdi Azikiwe University, Awka and the bags/pots to be used were ~~was~~ sourced from Eke – Awka market in Awka, Anambra state.

Experimental Treatments: The treatments comprised of different manure sources at different rates which included poultry manure at 0 tons/ha, 5tons/ha,10 tons/ha,15tons/ha and 20tons/ha and pig manure at 0 tons/ha, 5tons/ha, 10 tons/ha,15tons/ha and 20tons/ha.

Data Collection: Growth Parameters included, Emergence, plant height, leaf area, leaf number etc. Yield parameters: The following were collected: Number of pods, Length of pods, Width of the pods:, Fresh weight of pods:,

Postharvest storage: Indicators of shelf life such as firmness, freshness of pod, appearance, texture and colour were observed and recorded to know which of these materials increased shelf life of okra as was observed between 3 – 7 days before the postharvest got terminated.

Statistical Analysis: All data collected were subjected to analysis of variance (ANOVA) using GenStat 2012 and significant differences among treatment means were separated using the least significant difference (LSD) at a 5% level of significance.

RESULTS

Effects of Manure Types and Rates on Fresh Weight of Pods of Okra

The result of the fresh pods weights as presented in Tables 1, there was no significant difference for the manure types however, pig manure gave higher fresh weight (12.16 g/fruit) of pods than poultry manure (11.18 g/fruit). On the rates 15t/ha gave the highest fresh weight of pod with mean value 13.98 and was statistically similar to 5, 10 and 20 t/ha which gave mean values 12.04, 13.45 and 12.67 g/fruit respectively. The least fresh weight was recorded from 0t/ha with mean value 6.20 g/fruit.

Interaction Effects of Manure Types and Rates on Fresh Weight of Pods of Okra

The result of fresh weight of pods in Table 2 shows that 15t/ha poultry manure gave the highest fresh weight of pods with mean value 14.32 g/fruit and was statistically similar to 10t/ha poultry manure, 15t/ha pig manure, 10t/ha pig manure and 5t/ha pig manure with mean values 12.83, 11.51, 10.67 and 11.49 g/fruit respectively which all gave significantly higher fresh weight of pods when compared with the control

treatment. The least fresh weight of pods was recorded at 0t/ha pig manure and poultry manure with 1.82 and 2.95 g/fruit respectively.

Table: 1 Effects of manure types and rates on fresh weight of pods of okra

Manure	Fresh Weight of Pods
PG	12.16
PM	11.18
LSD	NS
Manure rates	
0	6.20
5	12.04
10	13.45
15	13.98
20	12.67
$LSD_{0.05}$	4.261

***PG (Pig Manure), PM (Poultry Manure)

Table: 2 Interaction effects of manure types and rates on fresh weight of pods of okra

Manure Type	rates (ton/ha)	fresh weight of pods
Pig	0	1.82
5	11.49	
10	10.67	
15	11.51	
20	9.25	
Poultry	0	2.95
5	8.24	
10	12.83	
15	14.32	
20	3.95	
$LSD_{0.05}$	5.167	

***PG (Pig Manure), PM (Poultry Manure)

Interaction Effects of Manure Type and Rates on Number, Length and Width of Pods of Okra

From Table 3, 15t/ha poultry manure gave significantly ($P<0.05$) the highest number of pods and width of pods with mean values 3.80 and 7.25cm respectively. Also pig manure at rates 5,10,15,20 t/ha all were significantly different significantly ($P<0.05$) from the control treatment in number of pods and width of pods. Poultry manure *at al*l the rates of application gave significantly ($P<0.05$) higher number of pods and width of pods than the control treatment 0t/ha of poultry manure. On the length and width of pods at 5t/ha and 15 t/ha pig manure gave significantly the highest length of pods (8.76cm and 6.87cm respectively) and was statistically similar to all the other pig manure rates which significantly showed higher length of pods compared to the control treatment.

Table 3 Interaction effects of manure type and rates on number, length and width of pods of okra

Manure Type	Rates(ton/ha)	Number of pods	length of pods	width of pods
Pig	0	0.53	1.58	2.02
	5	3.13	8.76	6.14
	10	3.33	5.22	6.31
	15	3.67	5.41	6.87
	20	2.20	3.84	5.09
Poultry	0	1.00	2.52	3.13
	5	2.47	4.47	5.67
	10	3.73	6.16	7.07
	15	3.80	5.53	7.25
	20	0.87	2.38	2.76
$LSD_{0.05}$		1.533	3.628	1.979

***PG (Pig Manure), PM (Poultry Manure)

Effects of Storage Material on Post harvest Physiology of Okra Pods

Concerning the effects of storage materials on post-harvest storage, looking at level of deterioration, for white nylon the first day after harvest all the pods were still green, firm and fresh as well as the second day with droplets of moisture inside, but on the 3rd day deterioration started as the firmness reduced and dark spots seen on some of the pods. On the 4th day full discoloration was observed changing from green to yellowish coloration and the pods became slimy. On the 5th day over 50% of the pods had deteriorated and not good for consumption. The 6th day all the pods were completely deteriorated. For the black nylon as a storage material, on the first and 2nd day after harvest the pods still maintained their fresh green colour and firmness with presence of moisture observed on the 2nd day. On the 3rd day pale coloration was observed and reduction in firmness and deterioration seen. On the 4th day the pods were softer, and more pods started deteriorating up to 50% of the pods. On the 5th day deterioration continued and by the 6th day all the pods had deteriorated, and the presence of maggot observed. While fresh plantain leaves were used as storage material, the pods maintained their freshness, firm and greenish state only on the first day. Day 2 deterioration was observed as colour of pods became pale and by the 3rd day more than 50% of the pods were deteriorated, discoloured with dark spots all over. Day 4, most of the pods turned darkish and soft while all became slimy, discoloured entirely by day 5 and in day 6 maggots were observed.Using dry plantain leaves as storage material preserved the pods more compared to the other storage materials used in this study. The pods maintained their fresh, greenish and firm state day 1, 2 and 3 after harvest while at day 4 a few began to develop black spots but maintained their firmness and these spots spread a lot more by day 5 and pods began to soften. On the 6th day over 50% of the pods were shrinked and turned black but not slimy. All the fruits turned black, and presence of maggots observed at the 7th day.For newspaper, the first and second day all the pods were intact but started discolouration at day 3 yet maintained firmness. At day 4 more discoloration of pods while still firm. Day 5 discolouration to yellow started and most pods began to soften while the pods became pale and drying up at day 6. The presence of mold was observed at day 7 with over 50% of the pods turned black.

Table 4. Effects of storage material on postharvest physiology of okra pods

Storage material	Days to Deterioration	Days to 50% Deterioration
White nylon	3	5
Black nylon	3	4
Fresh plantain leaves	2	3
Dry plantain leaves	4	6
Newspaper	4	7

DISCUSSION

This study investigated the effect of different organic manure rates on vegetative growth and yield of okra and the effect of storage materials on post-harvest of okra. Application of manures generally improved the growth and yield parameters of okra. The positive effect of organic manure on growth and okra yield could be due to the contribution made by the soil amendments to the fertility status of the soil (Adekiya *et al.*,

2020). Also, the type of storage materials used for okra fruit storage had influence on the postharvest of the okra pods. Pig manure showed superior performance on the yield parameters (length and width of pods and the number and fresh weight of pods). This corroborates the finding of Oseni *et al.,* (2016), who reported that okra responded well to the application of pig manure. The application of pig manure improved soil organic matter and nutrient availability and gave high yield parameters such as the number of pods and weight of pods. Pig manure application also showed better performance in okra as reported by Iderawumi and Omogoye, (2019). Different rates of organic manure application had variable impacts on the yield parameters of okra which were better than the control~~,~~ This is similar to the findings of Adesina and Wiro, (2020) where organic manure at the higher rate significantly improved the yield performance of okra comparable to the increase in number of pods followed increase in pig manure rates except for 20t/h increased pod/fruit production with increase in manure rate is in consonant with the report of Olatunji and Oboh (2012) in okra (*Abelmoscus esculentum*) where pod yield was increased by 52% as a result of the application of pig waste. However, the interaction effect indicated that both the number and weight of okra pods had their peak performances when poultry manure was applied at the rate of 15 t/ha. Whereas the length and width of okra pods were highest at the application of pig manure at the rates of 5 and 15 t/ha respectively. Based on the finding of the study by Onwu, (2020), okra responded well to poultry manure compared to the control treatment and the effect of poultry manure at 15 t/ha performed better than other treatments. From the standpoint of days to deterioration and days to 50% deterioration, fresh plantain leaves stimulated the deterioration process compared to the two plastic bags (white and black nylon. Fresh fruits and vegetables tend to have a very high moisture content which facilitates the activities of spoilage organisms Iderawumi and Omogoye, (2019), and this high deterioration property explains why okra pods stored in fresh plantain leaves deteriorated fastest. Eziamaka *et al.,* (2021), reported that storage temperature has a better impact in slowing down the respiration rate, weight loss and decay, while maintaining the fruit firmness and overall quality in …….?. The higher the temperature ~~ranges~~ the faster the rate of spoilage, hence the ~~stimulated~~ deterioration rates of plastic bags used in storage as it ~~th~~e tend to generate more heat as the fruit respires aiding the activities of spoilage microbes. Also dried storage materials such as dried plantain leaves and newspaper were found to increase shelf life of stored produce (Olayinka *et al.,* 2016).

CONCLUSION

In conclusion a very positive influence of organic manure on the growth and yield of okra was seen in this experiment. The positive effect of organic manure on growth and okra yield could be due to the contribution made by amendments to fertility status of the soils.

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