Growth and Yield Performance of Banana (*Musa acuminate* L.) as Affected by Different Farm Manures

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Abstract - *This study was conducted at the Integrated Sustainable Agri-Techno Demo Farm (ISATDF) of the Pangasinan State University, Sta. Maria Campus, Sta. Maria, Pangasinan from October 15, 2013 to August 18, 2014 with a duration of 308 days. This study aimed to determine the growth and yield performance of banana (Musa acuminata L.) as affected by different farm manures. Specifically, it attempted to: (1) determine the effect of different farm manures on the growth and yield performance of banana; and to (2) determine the cost and return of the different farm manures. The experiment was laid out using the Randomized Complete Block Design (RCBD). The Analysis of Variance (ANOVA) was used to evaluate the differences between treatments using F-test at 5 and 1 percent levels of significance and the Duncan's Multiple Range Test (DMRT) was used to evaluate the differences among treatment means. The treatments used were the following: T_1 - chicken manure, T_2 - cow manure, T_3 - goat manure, and T_4 - hog manure. The results revealed that the application of chicken manure recorded the tallest plants (5.27 cm), most number of suckers (340). The application of chicken manure and goat manure significantly increased the mid-trunk diameter (25.63cm) and (25.62 cm); finger length (14.33 cm) and (13.13 cm); finger diameter (3.60 cm each); and weight of fruits (450kgs each). Net income and return on investment (ROI) were also influenced by chicken manure and goat manure. Application of chicken manure and goat manure significantly enhanced the yield quality attributes and income of banana compared to the other sources of organic manure.*

Keywords: *farm manures, mid-trunk, suckers, hands, fingers, bunch*

INTRODUCTION

Banana (*Musa acuminate* L.) is one of the important fruit crops of the tropics. The fruits are rich source of carbohydrate and energy. It is grown over 130 countries across the world in an area of 10.1mha and producing 121.85 mt of banana [1].

In order to reduce the environmental impacts of farming, research efforts and policies should be targeted to developing farming systems that produce high yields with low negative environmental impacts drawing on techniques from organic system [2].The International Federation of Organic Agriculture Movements' (IFOAM) Basic Standards are based on four principles [3]:i) health: organic agriculture is intended to produce high quality food without using mineral fertilizers, synthetic pesticides, animal drugs and food additives that may have adverse health effects; ii) ecology: organic agriculture should fit the cycles and balances in nature without exploiting it by using local resources, recycling, reuse and efficient management of materials and energy; iii) fairness: organic agriculture should provide good quality of life, contribute to food sovereignty, reduce poverty, enhance animal well-being and take future generations into account; iv) care: precaution and responsibility have to be applied before adopting new technologies for organic farming and significant risks should be prevented by rejecting unpredictable technologies

The importance of organic fertilizer has become increasingly popular. People have become more health conscious and do not want to expose their bodies in the environment to chemicals. These toxins cause numerous health problems and pollute the land.

In addition, increased public consciousness of environmental pollution has challenged the animal and agricultural scientists to expand and to improve the disposal system, recycling the waste nutrients effectively, wherever feasible [4].

The increasingly demand of livestock and poultry meat has prompted more animal raising with consequent effects on increased utilization of organic wastes (e.g. manure) as fertilizers. While the use of

organic wastes as manure has been in practice for centuries world-wide [5], there still exists a need to assess the potentials of farm manures on crop yield.

In organic farming, the main challenges are to improve the nutrient management and increase yields [6].

The quality attributes of banana fruit are mainly influenced by the genotype, the nutritional status of the soil also plays a significant role. It was found that early vegetative phase of growth of banana especially up to 3rd / 6th month after transplanting and bunch development stage are the critical stages of banana at which yield is affected [7].

Poor agricultural and field management practices, especially improper nutrition, lead to large losses in yield and fruit quality. Organic manures and amendments can enhance the yield, quality and post-harvest attributes of banana fruits [8].

One of the major factors influencing banana yields is crop management, particularly, plant nutrition. To sustain high production levels under low soil fertility and organic matter scenario, it becomes necessary, therefore, not only to meet the crop requirements but also improve soil fertility and organic matter levels. Banana which is a heavy feeder crop requires a large amount of nutrients. At this juncture, organic sources of nutrients form the basis for sustaining high banana yields and maintaining and improving the soil fertility at the same time.

The importance and value of farm manures cannot be understated. Thus, this study was conceived to determine the effect of different farm manures on important growth and yield quality attributes of banana.

OBJECTIVES OF THE STUDY

This study aimed to determine the growth and yield performance of banana (Latundan var.) as affected by different farm manures. Specifically, it attempted to find out the effect of the different farm manures on the growth and yield performance of banana; and to determine the cost and return of the different farm manures.

MATERIALS AND METHOD

Experimental Plants

The existing Latundan banana plantation at the Integrated Sustainable Agri-Techno Demo Farm (ISATDF) of the Pangasinan State University, Sta. Maria Campus, Sta. Maria, Pangasinan, Philippines was adapted for the study from October 15, 2013 to August 18, 2014 with a duration of 308 days.

Experimental Design and Treatments

The four (4) treatments replicated four (4) times were executed in randomized complete block design (RCBD). The treatments were: Treatment 1 – chicken manure, Treatment 2 – cow manure, Treatment 3 – goat manure and Treatment 4 – hog manure.

Table 1 shows the result of the nutrient analysis of the different farm manures from the Department of Agriculture, Bureau of Soils and Water Management, Diliman, Quezon City, Philippines.

Selection of Experimental Plants

The Latundan variety with two months old maiden suckers planted with 4 meters between rows and 3 meters between hills in a square system of planting were used as the experimental plants. Three sample plants per treatment were marked with a total of forty eight (48) sample plants were used in this study.

Soil Analysis

Soil sampling of the area was done by digging 12 randomly selected sites in a zigzag pattern at 40 cm deep, prior to the treatment application. From each site, a one inch thick column of soil was taken. All samples were mixed thoroughly then a one kilogram soil sample was obtained, air dried and submitted to the Bureau of Soils Laboratory for chemical analysis.

Rapid Composting of Manures

All manures were composted separately through rapid method by using Effective Microorganisms (EM) as decomposer. Compost materials were sprayed with EM solution and were watered to saturation point to facilitate decomposition. Compost heaps were provided with poles to promote aeration and a plastic cover to conserve heat and moisture. The compost heaps were turned-over weekly for four weeks and then the matured compost were harvested separately, packed and properly labeled in plastic lined sacks.

Fertilizer application

Before applying the different composted manures, dikes were constructed to enclose each treatment. Composted manures were applied at the base of each mat following the different treatments: Treatment 1 (Chicken manure), Treatment 2 (Cow manure), Treatment 3 (Goat manure) and Treatment 4 (Hog manure) at the rate of one bag (50kgs) per mat.

Table 1. Nutrient Analysis of the Different Farm Manures

Description Constituents (content)	Chicken Manure Oven-dry Basis	Hog Manure Oven-dry Basis	Cow Manure Oven-dry Basis	Goat Manure Oven-dry Basis
Total Nitrogen (N) %	3.07	0.81	1.65	1.66
Total Phosphorus (P_2O_5) %	9.92	1.83	1.83	2.71
Available Phosphorus (P_2O_5) %	-	-	-	-
Total Potassium (K_2O) %	1.33	0.25	0.61	1.48
Total Calcium (CaO) %	-	-	-	-
Total Magnesium (MgO) %	-	-	-	-
pH	-	-	-	-
% Calcium Carbonate Equivalent ($CaCO_3$)	-	-	-	-
Moisture content, %	-	-	-	-
Chloride (Cl) %	-	-	-	-
Sodium (Na) %	-	-	-	0.08
Sulfur (S) %	-	-	-	-
Zinc (Zn) ppm	-	-	-	-
Copper (Cu) ppm	-	-	-	-
Manganese (Mn) ppm	-	-	-	-
Iron (Fe) ppm	-	-	-	-
Organic Carbon Walkley Black Method) %	-	-		-

Remarks: To convert ppm to %: Starting from the decimal point count four (4) places to the left and affix the decimal point. Example: 10.50ppm = 0.00105%

Hilling-up

This was done using a shovel immediately after the application of the farm manures by covering it with a one-inch thick of soil.

Water Management

Water application was done seven times (2, 35, 55, 90, 150, 225, 275 days from the start of the study) per mat throughout the duration of the study with the used of water pump to make sure that the adequate soil moisture was available for further decomposition of the manures and for microorganism to break them down to release nutrients.

Weed Control

Hand weeding was done eight (8) times throughout the duration of the study to control weeds. This was done to minimize crop-weed competition and to maintain sanitation of the area.

De-blossoming

The blossom was removed immediately after the last hand has emerged and the fruits were starting to curve up.

Harvesting

Harvesting was done 8 weeks after de-blossoming by cutting the trunk slowly and partially 1/3 from the top to ensure the slow falling of the bunch and holding the tail end of the bunch before it touches the ground. The peduncle was cut leaving 30 cm of the stalk for easy handling. This was done with the used of a bolo.

Sampling and Data Gathering Procedure

Data were taken from test plants in a mat, (from the inner portion of the area) which also represented the replication.

Statistical Treatments of Data

All data in this study were subjected to the following statistical procedures: (1) all treatment means were derived from the raw data gathered; (2) the analysis of variance (ANOVA) for RCBD to determine the statistical significance among treatments means; and (3) the Duncan's Multiple Range Test (DMRT) to determine the degree of comparison among treatment means.

RESULT AND DISCUSSION

Table 2 shows that chicken manure registered a significant result in final height, mid-trunk diameter and number of suckers per mat. Likewise, a significant result is noted in goat manure in mid-trunk diameter.

Table 2.Effect of Different Farm Manures on Growth Parameters

Farm manures	Growth Parameters					
	Initial Height ns	Final Height **	Mid trunk Diameter **	No. of Suckers/Mat *	Initial No.of Leaves ns	Terminal No. of Leaves ns
Chicken manure	1.44	5.27 a	25.63 a	3.40 a	9.90	8.83
Cow manure	1.42	5.04 c	23.70 b	3.28 b	9.86	8.85
Goat manure	1.43	5.10 b	25.62 a	3.28 b	9.95	8.83
Hog manure	1.44	4.98 d	23.69 b	3.25 b	9.93	8.63

Table 3.Effect of Different Farm Manures on Yield Parameters

Farm manures	Yield Parameters				
	No. of Hands per Bunch Ns	No. of Fingers per Hands ns	Length of Fingers/Hand (cm) **	Diameter of Fingers per Hand(cm) **	Weight of Fruits (kg) **
Chicken manure	6.98	13.93	14.33 a	3.60 a	4.50 a
Cow manure	6.93	13.90	12.90 b	3.55 b	4.13 b
Goat manure	6.95	13.88	13.13 ab	3.60 a	4.50 a
Hog manure	6.90	13.88	12.33 b	3.28 c	3.99 c

These results corroborate with the findings that higher pseudo stem height and pseudo stem girth were recorded with application of various organic manures [9]. The result obtained was attributed to the mineral elements that were present on the different farm manures based on the nutrient analysis in Table 1 where chicken manure contained the highest N (3.07%), P_2O_5 (9.92%) and K_2O (1.33%) followed by goat manure with 1.66% (N), 2.71% (P_2O_5) and 0.62% (K_2O).The present findings are in agreements with the findings that poultry manure contains all the essential plant nutrients that are used by plants[4].

Table 3 indicates that chicken manure and goat manure revealed significant result in length and diameter of fingers as well as in weight of fruits. However, on the length of fingers per hand chicken manure and goat manure are comparable. Likewise, goat manure is comparable to cow manure and hog manure. Such effects have been attributed to the nutrient analysis of the different farm manures(Table 1). These findings are in accordance with the results that the increase in fruit volume was attributed to the corresponding increase in mineral elements content by the different farm manures [10]-[12].

Cost and Return Analysis

The cost and return analysis of one-hectare banana production treated with different farm manures (Table 4) shows that with the application of chicken manure and goat manure generated both the highest net income of Php 60,333.00 followed by cow manure with a net income of Php56,274.50 and hog manure with a net income of Php53,163.30, respectively.

Net income and Return on Investment (ROI) were also influenced by farm manures. A positive aspect of producing organically is the meaningful reduction of external inputs as well as organically produced products are of high economic value. These result lends support to the findings that any improvement in fruit quality garnered farmers a higher market price per unit [13],the organically produced products reflected higher sale price per kg [9], and high nutritive food items are of high economic value [14].

Table 4.Cost and Return Analysis

Farm manures	Items				
	Yield (Kg/ha)	Total Cost	Gross Income	Net Income	ROI (%)
Chicken manure	5,000.00	39,670.00	100,000.00	60,333.00	152.08
Cow manure	4,588.89	35,503.30	91,777.80	56,274.50	158.50
Goat manure	5,000.00	39,670.00	100,000.00	60,333.00	152.08
Hog manure	4,433.33	35,503.30	90,380.50	53,163.30	149.74

CONCLUSION AND RECOMMENDATION

Chicken manure and goat manure performed the better material followed by cow manure and hog manure in terms of yield and net income. Hence, these organic nutrient sources have been found to be an ideal option to improve yield and economics of banana. Studies may also be conducted on other farm manures as well as on the integrated use of various composts to determine their role in crop nutrition.

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