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A STUDY ON THE EFFECT OF FERTILIZER LEVELS ON SWEET POTATO VARIETIES

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ABSTRACT

This is research was carried out to establish how different fertilizer levels releases the nutrient and its influence on the crop. A variety of sweet potato (sheba) was studied for its vegetative growth, yield and growth uptake under the influence of two fertilizer (urea and Npk) which was used, under randomised complete block design (RCBD) with three replications. The objective of this research work is to evaluate the performance of fertilizer on sweet potato with thirteen varieties at two levels using two-way analysis of variance. Findings from the result shows that variety has p- value of (0.001) which is less than (0.05), we therefore reject the null hypothesis, and conclude that there is significance difference between the effect of fertilizer on the sweet potato varieties (subject effect). Also the null hypothesis is rejected on the two levels of fertilizer as it has p-value of (0.003) which is less than (0.05), and conclude that there is significant difference in the two levels of fertilizer. On the interaction effect between fertilizer and variety it shows that we fail to reject the null hypothesis, since its p-value (0.145) is greater than (0.05), so we conclude that there is no interaction effect between variety and fertilizer used in the experiment. For the Duncan multiple range test, we test for the significant difference. So therefore it shows that there is varietal differences in the performance of sweet potato.

***Keywords**: Level, Fertilizer, Plot, Analysis of Variance, Interaction, Replicate.*

1. INTRODUCTION

Sweet potato (ipomoeabatatas) which belong to the family Convolvulaceae is becoming the most widely distributed root crop in most developing countries. Sweet potato (ipomoeabatatas) is a foremost tuber crops in respect of calorific value and is grown in almost all soil types in most parts of the tropics and warm temperate regions. Globally, it is among the important food crops such as wheat, rice, maize, irish potato, and barley it ranks second among the world's production of root and tuber crops and third in consumption in several parts of tropical Africa. It has been established that sweet potato is more nutritious and flavorful. Therefore, it should be grown in greater quantities. It is also an excellent source of complex carbohydrate, high antioxidant, vitamin (A and C), phosphorus, potassium, magnesium, calcium, sulfur, iron, manganese, copper, boron, zinc, iodine, folic acid, cystine fiber, starch, protein, niacin, tryptophan and tyrosine. The starch in sweet potato easily convert to sugar and provide quick energy. So, it is actually a super food. The consumption of sweet potato is in different forms. It can be consumed as vegetable, boiled, fried as chips, baked, roasted or often fermented into food and beverages.

2. LITERATURE REVIEW

Randomised Complete Block Design (RCBD) is the standard design for agricultural experiment where similar experiments units are grouped into blocks or replicates. It used to control variation in an experiment by accounting for spatial effect in field or greenhouse. The purpose of grouping experimental units is to have unit in a block as uniform as possible so that the observed differences between treatments will be largely due to 'true' differences between treatments.

2.1 Review of Related Materials

Sweet potato (Ipomoea batatas L. Lam) is a dicotyledonous angiosperm plant which belongs to the Convolvulaceae family and its capable of producing nutritious tuberous roots eaten worldwide. Its origin, as well as the circumstances related to its worldwide dispersion, are pertinent questions and intrigue researchers till nowadays. China is the main sweet potato producing country, and the Asian continent has the largest share of world production. In Brazil, sweet potatoes are specially grown by small farmers and used to domestic market supply. The sweet potato arouses huge interest when considering its nutritional qualities, mainly because it is rich in fibers, micronutrients, and an excellent source of energy for the consumer. The colored pulp cultivars such as yellow, orange, and purple sweet potatoes have in their composition several bioactive compounds such as polyphenols, carotenoids, and anthocyanins. In this regard, the work presents a review of the main aspects related to taxonomy, morphology, history, world production, and Brazilian production, highlighting the nutritional potential and the social relevance of sweet potatoes as a crop. Sweet potato (ipomoea batatas L lam) is a tuber root bearing vegetable species grown in tropical areas for either domestic or industrial uses. Root of sweet potato is rich in vitamin A, B6, C, riboflavin, copper, pantothenic and folic acid (Abd El-Baky*et al*., 2009). According to Berberich*et al.*,(2005), The tuber have a great food quality and an excellent source of anti-oxidants and carotenes, sweet potato has several industrial uses including medicinal purposes, used for treating diabetes, hookworms, ulcer and internal bleeding.

According to isiaka kareem (2014) he states that Significant effect of phosphorus fertilizer on sweet potato root yield comfirmed that phosphorus is an important nutrient element for sweet potato production. This was in line with Isiaka*et al.*, (2014) who reported a significant reduction in both tuber and vine production of sweet potato when p was omitted in a missing nutrients experiment, stressing the importance of p for sweet potato growth and yield.

MacDonald (1963) and FAO (2005) however stated that p does not seem to be important for sweet potato even though it is normally included in the fertilizer mixture, but if eliminated the yield of the crop will not be affected, this suggest that a significant response of sweet potato to p fertilizer could be attributed to low level of native phosphorus in an experimental site, thus indicating the need for phosphorus application.

According to obigbesan*et al*. (1976), soil with less than 10 mg/kg are considered phosphorus deficient and may show positive response to phosphorus application. Significant effect of p fertilizer on sweet potato components of yield have also been reported by Hassan *et al*.,(2005).

Sweet potato (Ipomeabatatas L) is a dicotyledonous plant that belongs to the familyconovulacea (Miller, 2008).The crop is grown in many countries globally butproduction primarily occurs in tropical and subtropical areaswhere it is important staple food in the diet of many people(Hijamas, 2001). Sweet potato is one of the most importantroot and tuber crops in sub-saharan Africa with bothdomestic and industrial uses and its nutritional value farexceed that of yam, cocoyam and cassava (Onwueme,1997).

Potatoes are used for varieties of purposesand not asvegetable for cooking at home it is likely that less than 50%of potatoes grown worldwide are consumed fresh and therest processed into potato.(Adamu, 2002 and Abdulrazak, 2004).

In Nigeria Itis prepared into potato chips. More so, the starch frompotato is widely used by pharmaceutical textile, wood andpaper industries as adhesive agent. Sweet potatoes yield per hectare in Nigeria hasdeclined. This however yield low could be attributed topoor field management by the farmer.The application of fertilizer whether inorganic or organic resulted in an increase in petiole length, an increase in number of tubers and an increase in weight of sweet potato tubers. The longest petiole was recorded in plants receiving 120g of organic fertilizer. (Gravel &Ojiako, 1999 &2009)

3. RESEARCH METHODOLOGY

The general procedure for a randomized complete block design consists of selecting block running a complete replicate of the experiment in each block, the data that result from running a randomized complete block design for investigating a single factor with a levels and blocks are shown in Fig. 3.1. There will be an observation (one per factor level) in each block, and the order in which these observation are run is randomly assigned within the block.

We will now describe the statistical analysis for a randomized complete block design. Suppose that a single factor with levels is of interest and that the experiment is run in b blocks. The observation may be represent by the linear statistical model.

3.2 RANDOMISED COMPLETE BLOCK DESIGN (RCBD):

Randomize complete block design as the most used and useful of experimental designs. It takes advantage of grouping similar experimental units into blocks or replicates the blocks of the experimental units should be as uniform as possible. The purpose of grouping experimental units is to have the units in a block as uniform as possible so that the observed differences between treatments will be largely due to 'true' differences between treatments. Randomization procedure is that each replicate is randomized separately and each treatment has the same probability of being assigned to a given experimental unit within a replicate which treatment must appear at least once per replicate. The experiment consist of two factors laid out in a randomized complete block design (RCBD) replicated three times. Two different levels of fertilizer (Urea and Npk), which make up the first factor, were applied after fourth week of planting. Thirteen varieties of sweet patato are what comprises the second factor. All in all, there are 26 treatment combinations. This study does not reveal the exact amount or quantity of (Urea and Npk) fertilizer used, mainly because it is statistical rather than agronomic. The main interest lies in applying statistical techniques to data in order to obtain reliable results. The layout for this particular experiment is as follows;

REP 1	REP 2	REP 3
F1V1	F1V10	F2V1

F2V3	F2V3	F1V8
F1V13	F2V11	F2V7
F2V7	F1V7	F1V12
F1V11	F2V12	F2V3
F2V8	F1V4	F1V10
F1V3	F1V13	F2V4
F2V5	F1V1	F1V9
F2V6	F2V8	F2V5
F1V6	F1V9	F1V11
F2V2	F2V6	F2V6
F2V11	F1V2	F1V13
F1V12	F2V5	F2V13
F2V10	F1V11	F1V2
F1V9	F2V9	F2V2
F1V7	F2V10	F1V7
F2V4	F2V2	F2V8
F1V2	F1V12	F1V6
F1V4	F2V4	F2V10
F2V12	F1V8	F1V5
F1V10	F2V7	F2V12
F2V1	F2V13	F1V3

F1V5	F1V3	F2V11
F2V9	F1V5	F2V9
F2V13	F2V1	F1V4
F1V2	F1V5	F2V4

Fig. 3.3 layout of RCBD on sweet potato

Source: field survey 2019 at Ahmadu Bello University, Zaria.

The field or space was divided into uniform units to account for any variation so that observed differences are largely due to true differences between treatments. Treatment combinations were then assigned at random to the subject in the blocks once in each block. Each replicate was randomized separately and each treatment had the same probability of being assigned to a given experiment unit within a replicate. Note that any treatment combination can be adjacent to any other treatment, but not to the same treatment within the block.

The defining feature of the randomized complete block design is that each block sees each treatment exactly once

3.4 STUDY VARIABLES

3.4.1 Independent variables: which are

Replicate (block), variety, and fertilizer

Replicate: as used in this context, it is the blocking factor. Its use mainly for the purpose of increasing the efficiency of the experimental design by reducing the magnitude of the error term

Variety: taken as the second factor in this experiment. Thirteen varieties of sweet potato were considered.

Fertilizer: two fertilizer levels were used.

3.4.2 Dependent variables

Growth components

Root size; measured in kilograms (kg)

Root weight; measured in kilograms (kg)

Vine weight; measured in kilograms (kg)

Root per plot; measured in kilograms (kg)

Root yield; measured in kilogram (kg)

3.5 MODEL FOR RANDOMIZED COMPLETE BLOCK DESIGN

We have two factors,A(fertilizer) and B(variety). Factor A has 2 levels, and factor B has 13 levels. The number of experimental units for each A x B combinations is 26. There is a total of 3 x 2 x 13 = 78 experimental units divided into 2 x 13 = 26 combination of A and B. The set of treatments consist of 26 possible combinations of factor levels.

The model can be stated as follows:

$Y_{ijk} = \mu + (Block)_k + Ai + B_j + (AB)_{ij} + £_{ijk}$ *I = 1,…2; j=1,…3; k=1,…3*

Where:

μ = The grand mean

$(Block)_k$ = the effect of kth of the block

A_i = main effect for factor A

Bj= Main effect for factor B

$(AB)_{ij}$ = The interaction effect

$£_{ijk}$= random error

Hypothesis :

H_o: $\mu_1 = \mu_2$

H_1:at least one μ_i

Ho: β1=β2=………β=0

Hi= β1±β2 at least out one i

3.6 ASSUMPTIONS OF THE RCBD

1) Sampling:
   a. The blocks are independently sampled
   b. The treatment are randomly assigned to the experimental units within a block
2) Homogeneous variance: The treatment all has the same variability, i.e. they all have the same variance.
3) Approximate normality: Each population is normally distributed.

3.7 ANOVA Table for RCBD

Source	**Sum of Squares**	**Degree of Freedom**	**Mean Square**	**F-Statistic**
Block	ssblock	b-1	Ssblock/b-1	MSB/MSE
Factor A(Fertilizer)	SSA	a-1	SSA/a-1	MSA/MSE

Factor B(variety)	SSB	b-1	SSB/b-1	MSB/MSE
AxB (Fertilizer*Variety)	SSAB	(a-1)(b-1)	SSAB/df	MSAB/MSE
Error	SSE	ab(r-1)	SSE/df	
Total	SST	N-1		

Where:

SSA= $ar\sum(\bar{y}_{.b.} - \bar{y}_{...})^2$

SSB= $br\sum(\bar{y}_{a..} - \bar{y}_{...})^2$

SSAB= $r\sum\sum\sum(\bar{y}_{ab.} - \bar{y}_{a..} - \bar{y}_{.b.} + \bar{y}_{...})^2$

SSE = $\sum(y_{abr} - \bar{y}_{ab.})^2$

SST = $\sum\sum\sum(y_{abr} - \bar{y}_{...})^2$

a= 1,2

b= 1,2,3,……..,13.

This chapter present statistical analysis on the effect of some part of sweet potato (i.e stem length, root per plot, root yield etc) seedling, of the two fertilizer level and thirteen varieties used in the experiment. A randomized complete block design analysis was carried out as illustrated in chapter three on data of sweet potato production under two levels of fertilizer application. Therefore the analysis is to test the hypothesis of no effect of varying fertilizer levels as well as that of sweet potato varieties.

4. DATA ANALYSIS

4.1 RESULT AND INTERPRETATION

4.1.1 Statement of the hypothesis

There are two hypothesis for this experiment; (one on the response of sweet potato to fertilizer at two levels, second on the interaction of fertilizer and variety).

H_{01}; There is no significant difference between the effect of fertilizer levels on the performance of sweet potato.

H_{11}; There is significant difference between the effects of fertilizer levels on the performance of sweet potato.

H_{02}; There is no interaction effect between variety and fertilizer used in the experiment.

H_{12}; There is interaction effect between variety and fertilizer used in the experiment.

4.2.2 Level of significance

The level of significance was set at α=0.05

Table 4.9

Dependent variable: Root weight

Tests of Between-Subjects Effects

Dependent Variable:Root weight

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.
Rep	12.347	2	6.173	0.436	.649
Intercept	7100.431	1	7100.431	513.037	.000
Variety	1424.612	12	118.718	8.578	.000
Fertilizer	347.348	1	347.348	25.097	.000
Variety * Fertilizer	149.328	12	12.444	.899	.554
Error	719.680	52	13.840		
Total	9741.400	78			
Corrected Total	2640.969	77			

a. R Squared = .727 (Adjusted R Squared = .596)

Hypothesis:

H_{01}: There is no significant difference between the effect of fertilizer levels on the performance of sweet potato.

H_{11}: There is significant difference between the effect of fertilizer levels on the performance of sweet potato.

H_{02}: There is no interaction effect between variety and fertilizer used in the experiment.

H_{12}: There is interaction effect between variety and fertilizer used in the experiment.

Interpretation :

In table (4.9), variety has a p- value of (0.000) which is less than the significance level (0.05), therefore we reject the null hypothesis, and conclude that there is significance difference in the varieties of the sweet potato.

The fertilizer also has a p-value of (0.000) which is less than the sig. level (0.05), therefore we also reject the null hypothesis and conclude that there is significance difference in the two levels of fertilizer.

The interaction effect it also has p-value of (0.554) which is greater than the significance level of (0.05) so we therefore do not reject the null hypothesis, and conclude that there is no interaction between the varieties and fertilizer under (root weight).

Table 4.9.1
Dependent variable: Root yield

Tests of Between-Subjects Effects

Dependent Variable: Root yield

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.
Rep	16.592	2	8.296	.437	.648
Intercept	9506.323	1	9506.323	512.382	.000
Variety	1901.815	12	158.485	8.542	.000
Fertilizer	466.237	1	466.237	25.130	.000
Variety * Fertilizer	200.988	12	16.749	.903	.550
Error	964.767	52	18.553		
Total	13040.130	78			
Corrected Total	3533.807	77			

a. R Squared = .727 (Adjusted R Squared = .596)

Hypothesis:

H_{01}: There is no significant difference between the effect of fertilizer levels on the performance of sweet potato.

H_{11}: There is significant difference between the effect of fertilizer levels on the performance of sweet potato.

H_{02}: There is no interaction effect between variety and fertilizer used in the experiment.

H_{12}: There is interaction effect between variety and fertilizer used in the experiment.

Interpretation:

In table (4.9.1), variety has a p- value of (0.001) which is less than the significance level (0.05), therefore we reject the null hypothesis, and conclude that there is significance difference in the varieties of the sweet potato.

The fertilizer also has a p-value of (0.001) which is less than the sig. level (0.05), therefore we also reject the null hypothesis and conclude that there is significance difference in the two levels of fertilizer.

The interaction effect it also has p-value of (0.550) which is greater than the significance level of (0.05) so we therefore do not reject the null hypothesis, and conclude that there is no interaction between the varieties and fertilizer under (root yield).

5. SUMMARY

This research was carried out to establish how different fertilizer levels releases the nutrient and its influence on the crop. Two fertilizer (urea and Npk) which was used, under randomized complete block design (RCBD) with three replications. Also the aim of this research work is to evaluate the performance of fertilizer on sweet potato with thirteen varieties at two levels using two way analysis of variance. Findings from the result shows that variety has a p- value of (0.001) which is less than (0.05), we therefore reject the null hypothesis, and conclude that there is significance difference between the effect of fertilizer on the sweet potato varieties (subject effect).

6. CONCLUSION

In conclusion the treatment were studied in a randomized complete block design RCBD in the field experiment with three replicate each. The result were analyzed by the data and were used to separate the means. The analysis showed there were increase in root weight, root yield, root per plot, root size and vine weight of the sweet potato and from the result obtained, the ANOVA table showed that there is significant difference between the effect of fertilizer on sweet potato varieties, while the null hypothesis is rejected on the two levels of fertilizer and conclude that there is significant difference in the two levels of fertilizer. On the interaction also it show that there is no interaction effect between variety and fertilizer. For the Duncan it was concluded that there is varietal differences in the performance of sweet potato.

7. RECOMMENDATION

The federal government should increase its effort in promoting and transforming agricultural sector as it is the second after petroleum resources sector contributing in the rapid growth of the national GDP and among all reduces the level of poverty and hunger too. Also, Government should provide all essential information in using fertilizer to improve the yield of agriculture production. This includes the analysis that will clearly show the different constraints of soil nutrients and periodic analysis to check the efficiency of both old and new varieties of fertilizer substance.

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