Sub-Sahara African Academic Research Publications
September, 2020, Editions

JPAS
Journal of Pure and Applied Science
Vol..16, No.9, ISSN 2318-9315

THE EFFECT OF SOME SELECTED FERTILIZES AND SPACING ON THE YIELD OF MILLET (UNDER DIFFERENT FIVE SPECIES) A CASE STUDY OF DR. JAMILA BAKO BALARABE FARM

AMINU HARUNA; USMAN HASSAN; SALISU LUKUNTI; & USAMATU USMAN
Department of maths and Statistics, Federal Polytechnic Bauchi.

Abstract
This study was conducted to determine the effect of some selected fertilizer and spacing on five different varieties of millet (Foxtil. Little, Pearl, Finger and Proso Millets). Some related literatures were reviewed and secondary method of data collection was used. Data on the 5 varieties of millet were collected from Dr. Jamila Bako's farm for the period of 10 years (2009 – 2018). The data obtained from the study area were analyze using ANOVA/factorial (SPSS version 20.0) from the farm yield, little produced more quantity (184.54) followed by Pearl, Finger, Foxtail and Proso using 25cm spacing at inter-row and 75cm at intra-raw spacing. 2 different fertilizers were applied (NPK & Urea) and their combination (interaction). The analyzed result shows the significant effect of millet type, fertilizer type and their interaction at alpha level of 0.05 It is recommended that little millet should be planted when there is no any fertilizer application, while pearl millet should have planted too when there is fertilizer application.

Keywords: *Effect, Selected, Fertilizes, Spacing, Yield.*

Introduction:

Millets are one of the cereals asides the major wheat, rice, and maize. Millets are major food sources for millions of people, especially those who live in hot, dry areas of the world. They are grown mostly in marginal areas under agricultural conditions in which major cereals fail to give substantial yields (Adekunle, 2015). It is a drought resistant crop and can be stored for a long time without insect damage (Adekunle, 2015); hence, it can be important during famine. Discrepancies exist concerning classification of family millet, with some references giving the family name ***Gramineae***, and others classifying it in the family ***Poaceae***. Millets are classified with maize, sorghum, and Coix (Job's tears) in the grass sub-family Panicoideae (Yang et al., 2016). Millets are important foods in many underdeveloped countries because of their ability to grow under adverse weather conditions like limited rainfall. In contrast, millet is the major source of energy and protein for millions of people in Africa. It has been reported that millet has many nutritious and medical functions (Yang et al., 2016; Obilana and Manyasa, 2017). There are many varieties of millets. The four major types are Pearl millet (Pennisetum glaucum), which comprises 40% of the world production, Foxtail millet (Setariaitalica) (Yang et al., 2016), Proso millet or white millet (Panicum miliaceum), and Finger Millet (Eleusinecoracana). Pearl millet produces the largest seeds and it is the variety most commonly used for human consumption (Mariac et al., 2016; ICRISAT, 2017). Minor millets include: Barnyard millet (Echinochloa spp.), Kodo millet (Paspalumscrobiculatum), Little millet (Panicum sumatrense), Guinea millet (Brachiariadeflexa = Urochloadeflexa), Browntop millet (Urochloaramosa = Brachiariaramosa = Panicum ramosum),

Statement of the Problem

Even though there are different inventions of fertilizers, species and rainfall availability, the lands for cultivation are infertile. This warrant the close monitoring of the yield of crop produced based on the type of fertilizer applied and the species used. Therefore, this study will be of great importance in determining the appropriate fertilizer to be applied and the species to be used.

Research Questions

i. Which among the species yield more grains irrespective of the type fertilizer applied and spacing used?

ii. Do nature of soil or land affect the cultivation of millets in the study areas?

Objectives of the Research

This study aimed at analyzing the effect of some selected fertilizer under five (5) different species on the yield of millet in Dr. Jamila Bako Balarabe farm for the period of 10 years (2009-2018)

The proposed objectives of carrying out the study research are:

1. To determine whether the selected fertilizers has effect on the yield of millet for the period under review.
2. To test and analyze the effect of spacing on the yield of millet
3. To find out if there is interaction effect between the factors considered in this project
4. To recommend based on the results of the analysis

Statement of Hypothesis

i. **H_0**: the selected species have no difference in yields over the study period

ii. **H_1**: There is significance difference on yields over the study period between the selected species

Significance of the Study

The information gathered in this study will provide useful feedback to farmers and extension agents on fertilizer application under different five (5) species. For instance, factors found to be positively influencing adoption of water harvesting structures if targeted would be important at enhancing high agricultural production. It is also expected that the results will be useful to extension service providers in planning, designing and evaluating effective and efficient agricultural policies, programs and projects at local, regional and national scales for the small holder farmers in Nigeria and the sub-humid and semi-arid tropics in the Sub Saharan Africa. The findings will give insight to small holder farmers in choosing appropriate technologies for soil fertility improvement, water harvesting, yields increment and economic efficiency as a strategy for food security mitigation as well as alleviation of poverty.

Data Analysis

There are various statistical techniques that can be used in analyzing the data collected for this study, but it has to go in line with the objectives stated for the study. Therefore, 3^k factorial experiment was used. When several factors are of interest in an experiment with or without replicates, a factorial experimental design is used. In this experiment factors are varied together for the purpose of this research work, the two and three way classifications for the ANOVA models are employed.

1.7.2 3^k Factorial Model

The factorial Model is as below:

$$Y_{ijk} = \mu + \tau_i + \beta_i + (\tau\beta)_{ij} + \varepsilon_{ijk} \begin{cases} i = 1,2,\dots a \\ j = 1,2,\dots b \\ k = 1,2,\dots n \end{cases} \quad (1)$$

$$Y_{ijk} = \mu + \tau_i + \beta_i + Y_k + (\tau\beta)_{ik} + (\tau\gamma)_{ik} + (\beta\gamma)_{jk} + (\beta\tau\gamma)_{ijk} + \varepsilon_{ijkl}$$
$$\begin{cases} i = 1,2,\dots a \\ j = 1,2,\dots b \\ k = 1,2,\dots c \\ l = 1,2,\dots n \end{cases} \quad (2)$$

where in (1)and (2), μ is the overall mean effect, τ is the effect of the i^{th} level of factor A , β_j is the effect of thej^{th} level of factor B,$(\tau\beta)_{ik}$is the interaction between A and B ;while in the three factor model , $(\tau\gamma)_{ik}, (\beta\gamma)_{jk}, (\beta\tau\gamma)_{ijk}$represents the effect of the k^{th} level of factor C, the interaction between A-C;B-C and A-B-C respectively and $\varepsilon_{ijkl}/\varepsilon_{ijkl}$ is a random error component having normal distribution with mean zero and variance . We are interested in testing the hypothesis of no main effect for factor A, no main effect for B, no main effect for C, no AC interaction effect, no BC interaction and no ABC interaction effect. As with the single factor, the analysis of variance (ANOVA) will be used to test these hypotheses. To present he ANOVA, let Y_j.. denote the total of the observations taken at the

i^{th}level of factor A, Y_j denote the total of observations taken at the j^{th} level of factor B, Y_{ij} denote the total of the observations in the ij^{th} cell, and y… denote the grand total of all the observations .define ȳ…,ȳ…, $\bar{Y}_j$… as thecorresponding row, column, cell, and grand averages; that is

$$\bar{y}_{\dots} = {}^{y}/_{bn}\, y_{..} = \sum\sum Y_{ijk}$$

$$\bar{y}_{\dots} = {}^{y_{.j.}}/_{an}\, y_{.j.} = \sum\sum Y_{ijk}$$

$$\bar{y}_{\dots} = {}^{y_{\dots}}/_{abn}\, y_{\dots} = \sum\sum\sum Y_{ijk}$$

As before, the ANOVA tests these by decomposing the total variability in the data into component parts and then comparing the various elements in this decomposition.

Total variability is measured by the total sum of squares of the observations

$$SS_T = \sum\sum\sum(Y_{ijk} - \bar{Y}_{..})^2$$

And sum of squares decompositions is defined below symbolically

$SS_T = SS_A + SS_B + SS_{AB} + SS_E$ Implies that the total sum of squares SS_T is partitioned into the sum of squares for the row factor A ,SS_A, a sum of squares for the Colum factor B (SS_B), a sum of squares for the interaction between A and B (SS_{AB}) and an error sum of squares (SS_E).There are $(abn - 1$)total degree of freedom. Then the main effect A and B have $(a - 1)$ and $(b - 1)$ degrees of freedom respectively, while the interaction effect AB has $(a - 1)(b - 1)$ degrees of freedom. Observations in the cell can differ only because of random error. If we divide the various sums of squares by their corresponding degrees of freedom result in their mean squares while the various means squares by the error, mean square result in F-test statistic having g a degree of freedom as earlier stated. This is used in taken decisions regarding our hypothesis. The null hypotheses are rejected if the calculated F statistics at the level of significance $F_0 > F_{\alpha..}df_i, df_{e,}$ ($F_{\alpha..}df_i, df_{e,}$ has an F-distribution while df_i and df_e represent the degree of freedom for the factor and degree of error respectively). It is usually best to conduct the test for interaction first and then to evaluate the main effects. If interaction is not significant then interpretation of the test on the main effect is straight forward. However, when interaction is significant the main effect of factors involved in interaction may not have much practical interactive value. Knowledge of interaction is usually more important than knowledge about the main effects.

3KFactorial ANOVA Table

The analysis of variance, factorial experiment is summarized below:

Sources of variation (sv)	Degree of freedom (df)	Sum of squares (ss)	Mean square (ms)	F
Factor A	p-1	SSA	SSA/p-1 = MSA	MSA/MSE
Factor B	q-1	SSB	SSB/q-1 = MSB	MSB/MSE
Interaction AB	(p-1)(q-1)	SSAB	SSAB/(p-1)(q-1) = MSAB	MSAB/MSE
Error	(r-1)(pq-1)	SSE	SSE/(r-1)(pq-1)	-
Total	**pqr-1**	**SST**	**-**	**-**

Assumptions of ANOVA

i. Each population from which sample is assumed to be normal.
ii. Each sample is randomly selected and independent.
iii. The populations are to have equal standard deviations / variances.

Hypothesis for ANOVA

The Null hypothesis that all the group populations mean is the same. The alternate is that at least one pair of mean is different.

$H_0: \mu_1 = \mu_2$

vs

$H_0: \mu_1 \neq \mu_2$

RESULTS AND DISCUSSION

Analysis of Results:

Table 1: the table below shows the grain-weight of different millet species without fertilizer application.

YEAR	GRAIN-WIEGHT (MILLET SPECIES)/PLOT				
	Foxtail	**Little**	**Pearl**	**Finger**	**Proso**
2009	18.36	17.18	12.89	21.1	13.92
2010	12.89	19.86	17.5	19.3	17.47
2011	17.5	18.75	13.4	14.52	12.89
2012	13.4	21.1	9.67	18.36	17.5
2013	9.67	19.3	15.6	12.89	13.4
2014	15.6	12.85	14.8	17.5	9.67
2015	14.8	20.4	18.75	13.4	15.6
2016	13.92	17.6	21.1	9.67	14.8
2017	17.47	19.3	19.3	15.6	12.7
2018	15.55	18.2	14.75	14.8	18.5
Total	**149.16**	**184.54**	**157.76**	**157.14**	**146.45**

From the above table, little millet produced more grain yield than the others.

Table 2: the table below shows the result of ANOVA analysis using SPSS version 20.0

ANOVA[a]

Model		**Sum of Squares**	**Df**	**Mean Square**	**F**	**Sig.**
1	Regression	10.772	1	10.772	1.112	0.297[b]
	Residual	465.041	48	9.688		
	Total	475.813	49			

a. Dependent Variable: Yield

b. Predictors: (Constant), Millet

From the above table it is clearly seen that the significant value is greater than the alpha value of 0.05. This indicates rejecting the null hypothesis since ***0.297 > 0.05***. And this means that there is different in the yield of millet as per five (5) varieties.

Table 3: the table below shows the least significant difference in the mean grain yield of the five different species.

Multiple Comparisons

Dependent Variable: Yield

	(I) Millet	(J) Millet	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
						Lower Bound	Upper Bound
LSD	Foxtail	Little	-3.5380*	1.30750	0.010	-6.1714	-0.9046
		Pearl	-0.8600	1.30750	0.514	-3.4934	1.7734
		Finger	-0.7980	1.30750	0.545	-3.4314	1.8354
		Proso	0.2710	1.30750	0.837	-2.3624	2.9044
	Little	Foxtail	3.5380*	1.30750	0.010	0.9046	6.1714
		Pearl	2.6780*	1.30750	0.046	0.0446	5.3114
		Finger	2.7400*	1.30750	0.042	0.1066	5.3734
		Proso	3.8090*	1.30750	0.006	1.1756	6.4424
	Pearl	Foxtail	0.8600	1.30750	0.514	-1.7734	3.4934
		Little	-2.6780*	1.30750	0.046	-5.3114	-0.0446
		Finger	0.0620	1.30750	0.962	-2.5714	2.6954
		Proso	1.1310	1.30750	0.392	-1.5024	3.7644
	Finger	Foxtail	0.7980	1.30750	0.545	-1.8354	3.4314
		Little	-2.7400*	1.30750	0.042	-5.3734	-0.1066
		Pearl	-0.0620	1.30750	0.962	-2.6954	2.5714
		Proso	1.0690	1.30750	0.418	-1.5644	3.7024
	Proso	Foxtail	-0.2710	1.30750	0.837	-2.9044	2.3624
		Little	-3.8090*	1.30750	0.006	-6.4424	-1.1756
		Pearl	-1.1310	1.30750	0.392	-3.7644	1.5024
		Finger	-1.0690	1.30750	0.418	-3.7024	1.5644

Based on observed means.

The error term is Mean Square (Error) = 8.548.

The mean difference is significant at the 0.05 level.

From the above table there is no much difference in grain yield mean among the five species of millet. But based on the LSD result Little, Foxtail, Pearl and Prose shows little difference (<0.05). Therefore, the nature of the soil does not affect planting the species.

Table 4: the table below shows grain yield of millet with fertilizer applied

GRAIN-WIEGHT (MILLET SPECIES)/PLOT

YEAR	Foxtail	Little	Pearl	Finge	Proso
2009	35	46	74	55	56
2010	40	45	66	57	47
2011	45	84	56	66	67
2012	48.1	56	48	67	78
2013	62.5	47	78	84	69
2014	55.6	67	61	56	67
2015	64	78	79	47	40
2016	58	69	72	67	45
2017	63	67	55	78	48.1
2018	69	79	75	65	62.5
Total	**540.2**	**638**	**664**	**642**	**579.6**

From the table above, Pearl produced more grain yield when fertilizer is applied. Therefore, it is recommended that farmers should go for pearl planting with fertilizer application.

Table 5: the below shows ANOVA with fertilizer application results using SPSS version 20.0.

ANOVA

Dependent Variable: Yield

Source	Type II Sum of Squares	Df	Mean Square	F	Sig.
Corrected Model	1161.991	9	129.110	0.790	0.627
Intercept	187737.409	1	187737.409	1148.122	0.000
Millet	1048.211	4	262.053	1.603	0.192
Fertilizer	10.951	1	10.951	0.067	0.797

*Millet * Fertilizer*	102.829	4	25.707	0.157	0.959
Error	6540.680	40	163.517		
Total	195440.080	50			
Corrected Total	7702.671	49			

From the above table, the significance values of our factors: Millet Type, Fertilizer type and their interaction are greater than our alpha level i.e. **0.192, 0.797 and 0.959 > 0.05**, we accept the alternative hypothesis claiming significance difference on grain yield among our factors.

Table 6: Least Significance Difference in grain yield with fertilizer application.

Multiple Comparisons

Dependent Variable: Yield

	(I) Millet	(J) Millet	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
						Lower Bound	Upper Bound
LSD	Foxtail	Little	-9.78	5.719	0.095	-21.34	1.78
		Pearl	12.38*	5.719	0.036	-23.94	-0.82
		Finger	-10.18	5.719	0.083	-21.74	1.38
		Proso	-3.94	5.719	0.495	-15.50	7.62
	Little	Foxtail	9.78	5.719	0.095	-1.78	21.34
		Pearl	-2.60	5.719	0.652	-14.16	8.96
		Finger	-0.40	5.719	0.945	-11.96	11.16
		Proso	5.84	5.719	0.313	-5.72	17.40
	Pearl	Foxtail	12.38*	5.719	0.036	0.82	23.94
		Little	2.60	5.719	0.652	-8.96	14.16
		Finger	2.20	5.719	0.702	-9.36	13.76
		Proso	8.44	5.719	0.148	-3.12	20.00
	Finger	Foxtail	10.18	5.719	0.083	-1.38	21.74
		Little	0.40	5.719	0.945	-11.16	11.96
		Pearl	-2.20	5.719	0.702	-13.76	9.36
		Proso	6.24	5.719	0.282	-5.32	17.80
	Proso	Foxtail	3.94	5.719	0.495	-7.62	15.50
		Little	-5.84	5.719	0.313	-17.40	5.72
		Pearl	-8.44	5.719	0.148	-20.00	3.12
		Finger	-6.24	5.719	0.282	-17.80	5.32

Based on observed means.
The error term is Mean Square (Error) = 163.517.

**. The mean difference is significant at the .05 level.*

SUMMARY

This study is purposely carried to to determine the correct variety of millet to be planted and also to determine effect of planting the varieties with and without fertilizer application.

CONCLUSION

Based on the analysis, the little millet has more grain of yield than others if fertilizer is not applied. On the other hand, Pearl Millet has more grain yield than others when fertilizer is applied.

Similarly, the nature of soil or land does affect the cultivation of varieties of millet even though our LSD is almost the same.

It will be concluded that fertilizer application has great influence on the cultivation of millet.

RECOMMMENDATION

Based on the previous chapter results, the researcher recommends the following:

- The authority concern or farmers should consider planting of millet with fertilizer application
- Farmers should consider pearl millet than others
- Future research on same topic should be carry out for validating the finding of this work

REFERENCES

Adekunle, E. 2015. *The correct name for pearl millet and yellow foxtail*. Tax25: 297 - 304.

Amadou, B., G. Giordani, G., M. Corbellini, P. Vaccino, M. Guermandi, and G. Toderi. (2011). *Influence of crop rotation, manure and fertilizers on bread making quality of wheat (Triticum aestivum L.)*. Eur. J. Agron. 4:37-45.

Brunken et al., 2016 and Jauhar, 2015), *this dissertation will utilize the latest published scientific name which is Pennisetum glaucum*.

Brunken, J. N.2016.*The morphology and domestication of pearl millet*.Economy Botany Vol. 31: 163 - 174.

Burton, G. W. 2014*. Quantitative inheritance in pearl millet.* Agron. J. 43: 409 - 417.

Chase, A. 2015. *The Linnaean concept of pearl millet*. Ann. J. Bot. 8: 41 - 49.

Hanna, W. W. and G. W. Burton (2016). *Morphological characteristics and genetics of two mutations for early maturity of pearl millet.* Crop Science Vol. 25: 79 - 8I.

Marriac, P (2016), ICRISAT (2017). *Inheritance of plant height, days to heading, spike length, peduncle length and spike lets per spike in spring wheat cross*. Ind. J. Gen. 44: 522 - 527.

Obilana, K. 2013. *The use of selection indices in the improvement of pearl millet population*. Ind. Jour. Gen. Plant Breed 23: 30 - 34.

Obilana, K. and Manyasa 2014.*Evaluation of components of slow rusting in wheat varieties of yellow rust*. Ind. Phytop. 39: 221 - 224.

Singh, B. B. and S. S. Sokhi. 2011. *Effect of rust of pearl millet on yield components*. Ind. Phytop. 36: 89 - 91.