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Statistical Appraisal of the Yield Performance of Watermelon (*Citrullus Lanatus*) in Kazaure Hinterland in Response to Crop Variety and Fertilization Nature

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Abstract: *The study was aimed at identifying the ideal water melon crop variety to grow and the treatment combination to adopt for a bumper harvest in Kazaure hinterland. To achieve this, ten different watermelon crop varieties were planted and treated with five different fertilizers on a farmland specifically prepared for the study. The preparation was done in such a way that fifty experimental units were replicated fifty times in each of the fifty pots prepared based on factorial design scheme. The factors of interest were crop variety and fertilizer type. The experimental units were allowed to germinate for eight weeks. Number of leaves, vine length and chlorophyll content were measured from the germinated units. The data was analysed using two-way MANOVA, one-way ANOVA and other relevant statistical techniques. The results from the analysis revealed that the yield parameters significantly differ from one crop variety to another as well as from one type of fertilizer to another. Further investigations using separate one-way ANOVA son vine length, chlorophyll content, and number of leaves revealed that the ten-crop type have significant different effect on these parameters. The same technique revealed a significant different in impact between the types of fertilizer on the same parameters when considered separately. Differentiating the level of the factors, post-hoc test indicated that Sweet Polly, Traveler, and Captivation significantly increased the yield parameters than Bijou, King Man, SV0258WAT, Cut Above, Citation, Harvest Moon, and Triple Treat, while the rest did not differ significantly between themselves. The test also showed that Farmyard Manure, Poultry Drop, and Cow Dung performed significantly better than Urea and NPK 15 15 15 as levels of fertilizer-type experimental factor. The study thus encourages growing Sweet Polly, Traveler, and Captivation and be treated with Farmyard Manure, Poultry Drop, and Cow Dung for a bumper harvest in this part of the world.*

Keywords: Watermelon, MANOVA, Crop, Fertilizer and Performance

I. INTRODUCTION

According to Adeoye *et al*., (2007), and Oguntola (2006), Watermelon is unarguably a popular fruit in tropical and subtropical countries of the world. Its global consumption is greater than that of any other cucurbits as per Beckman (1973). Egypt was the first country to grow Watermelon in Africa, about 4000 years ago. China, Turkey, the United States of America, Iran, and the Republicsof Korea are the five leading nations in Watermelon production (Mujaju, 2009).About 1,200 varieties of the fruit are available worldwide, many of which are grown in Africa (Zohary and Hopf, 2000). From these numbers, the dominating varieties in the continent of Africa are those from America and Asia with the ones from Africa almost abandoned completely. Watermelon farming has been practiced inNigerian communities for decades. Ever since it started in these regions, few if no programs by the relevant authorities were meant to promote it through any means in Jigawa state, particularly Kazaure local government area. Nigeria, like many other nations, suffers from crashing crude oil prices in the world market. This is a result of the country's over-dependence on crude oil products, necessitating the need for a diversified economy. Agriculture will not only solve the problem of a non-

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diversified economy in Nigeria but also creates millions of job opportunities for its citizens. Watermelon production is such an agricultural movement that will go a long way in making such a move realizable, particularly since it is a very good commercial crop. However, farmers in Nigeria experience more loss than profit because of a lack of know-how about the appropriate approach to the cultivation of this crop as well as many others, Kazaure local government is not an exception. Coupled with this, the farmers in this part of the country need to understand the suitable crops for their farmlands as not all varieties of a particular crop are viable in the region, profit-wise. Kalahari Desert originated (Schippers, 2000) and desert-friendly Cucurbitaceae plants family member (Jarret *et al*., 1996) crop will be a good choice to Kazaure community farmers. Yet the growing need for organic and inorganic fertilizers in farming is something to be monitored if we are to ensure bumper harvests. According to Beckman (1973), manure treatment improves soil productivity, and hence the output. Dauda *et al*., (2005b) and Aliyu, (2000) both claimed that chicken waste and farmyard waste are also positively connected to higher eggplant fruit output. On the other hand, the large quantity application of inorganic fertilizer affects many crops' output. In contrast to the positive impact of nitrogenous inorganic fertilizers on making the crop greener and healthier when used optimally, as reported by John *et al*., (2004), the negative impact of their non-optimal use on the crop includes a reduction in the number of fruits produced and in the fruit setting (John *et al*., 2004). If food production in the country remains stagnant, the government's campaign for food self-sufficiency will be impossible to achieve This study will then take place in Kazaure, to study the impact of fertilizer type and crop variety on crop yield. The study is as well focused on finding the best watermelon crop variety for Kazaure local government, as well as the best treatment combination to boost its production in the area. The study thus aimedat investigating the effect of crop variety and fertilization nature on the yield performance of watermelon (*Citrulluslanatus*) in Kazaure hinterland.

II. LITERATURE REVIEW

According to Dube *et al*., (2021), choosing the best watermelon cultivar to cultivate in a given community based on the yield and market needs is critical for watermelon farmers everywhere. It's worth noting that watermelon has numerous health benefits. For example, Collins *et al*., (2007) found that consuming citrulline from watermelon lowers plasma arginine concentrations. Watermelon extract is a hyperinsulinemia and hypoglycemic duct used to manage diabetes, according to Ahn*et al*., (2011).Wang *et al.,* (2006) found a link between watermelon-component-induced-dietary-lycopene and insulin levels in diabetic individuals as a result of better body metabolism in their body (Huh *et al*., 2008). Similar study indicated that the fruit also has phenolics that are equivalent to those found in other fruits (Kaur and Kapoor, 2001; Jaskani*et al*., 2005). It has also been shown by Edwards *et al.,* (2003) and Naz*et al.,* (2014)to be effective in the treatment of cancer, cardiovascular problems, diabetes, blood pressure, and obesity.

However, identifying the generally grown and non-often grown cultivars in the region is essential for enhancing the health and economic importance of watermelon in Nigeria. In Africa, cultivars such as Sugar Baby, Florida Sweet, Carolina Cross, and Crimson Sweet are prevalent (Mrema and Maerere, 2018). Nonetheless, the farmers used various treatment combinations for various varieties. Some crops respond better to certain treatments than others. That is, the debate over which treatment should be used on which watermelon crop variety remains valid.

According to a study by Enujeke, (2013), a high rate of manure predicted a good yield. Sugar baby, a popular watermelon variety found in northern Nigeria, responded to the chicken manure treatment substantially better than the other varieties evaluated by Olaiya, (2020). Sabo *et al.,* (2013) discovered that NPK fertilizer improves watermelon growth and yield significantly. According to Eifediyi*et al.,* (2017), watermelon production is 20 times higher with manure treatment than with NPK.Ibrahim*et al*., (2015)reported that the use of organic waste in Watermelon production in Zaria gave a better yield as per their research findings. In a research to study the effect of different levels of Cow dung and NPK on the growth and yield of watermelon in Gombe State, Sabo*et al*., (2015) recommended that the application of Cow dung in combination with NPK gave a better output.

Okunlola*et al.,* (2011) conducted a study at the teaching hospital research farm of federal university of technology, Akure, to compare the growth and yield performance of watermelon fruits grown under sub-optimal rates of application of different types of manure in southwestern Nigeria. The study considered poultry manure at the rates of 4t/ha, 6t/ha, 8t/ha and 10t//ha, organic manure at the rates of 4t/ha, 6t/ha, 8t/ha and 10t//ha, organomineral fertilizer at the rates of 2.5t/ha, 3.0t/ha, 3.5t/ha, 3.5t/ha and 4.0t/ha and control. Their findings revealed that higher rates of fertilization were

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associated with increased yield and growth of the crop in the study area. The control treatment was significantly inferior to all the other treatments considered in the study.

In a similar study, Enujeke, (2013) applied ANOVA technique to compare the effect of five different rates of poultry manure on watermelon production in the teaching and research farm of Delta state university, Asaba. He employed a randomized completely block design to achieve his goals, where he considered the five rates of the poultry manure at 0t/ha, 5t/h, 10t/ha, 15t/ha and 20t/ha each replicated three times. His findings revealed that20t/ha treatment level contributed significantly better to the yield of the crop than the other rates of treatment considered. The parameters considered were vine length, number of leaves per plant, number of branches per plant and fruit weight.

Also, do Nascimento *et al*., (2017) indicated that the average per plant fruit production of watermelon did not significantly change even as the manure and potassium levels were improved in the study area. However, the study revealed that the yield parameters were significantly better under the potassium and manure treatment levels as compared to control.

Egbuchua&Enujeje, (2021) investigated the yield response of watermelon crop in a coastal plain soil under variable fertilization rates in Delta North ecological zone of Nigeria. The fertilization rates they considered were (0:0:0), (50:25:25), (80:40:40) and (120:60:60) kg N, P205 and K20/ha. Using the randomized complete block experimental design to generate the data and the analysis of variance to analyze it, the study revealed that an improvement in the crop's yield components owing to an increased fertilization rate from (0:0:0), (50:25:25) kg/ha to (80:40:40)kg/ha and a depression in the components when the treatment rate was increased from (80:40:40)kg/ha to (120:60:60)kg/ha.

In the Ilorin Southern Guinea savanna zone of Nigeria, Ojo*et al.,* (2014**)** investigated the effects of organomineral fertilizer and un-amended compost on the growth and yield of watermelon. The research was conducted at Kwara State University's teaching and research farm. According to the findings, NPK at a rate of 200 kg/ha had a larger significant contribution to vine length, number of leaves, average fruit weight, and crop yield. The study went on to show that all of the treatments contributed much more than the control.The yield metrics were significantly improved using an organomineral fertilizer grade A at a rate of 2.5t/ha and an unamended compost grade B at rates of 1.5t/ha, 2.0t/ha, and 2.5t/ha. Overall, the best fruit yield was obtained with organomineral fertilizer grade A at a rate of 2.5kg/ha.

The preceding discussions revealed the difficulties of selecting an appropriate fertilization type and rate for watermelon cultivation in Nigeria. The issue is not only about choosing the proper fertilizer type and rate, but also about choosing the right watermelon crop variety for that fertilizer. Nigerian farmers are frequently obliged to use traditional farming practices due to a lack of access to modern inputs, which reduces productivity. Watermelon cultivation in Africa has not undergone substantial technological improvement in compared to other crops, such as the adoption of novel hybrids, fertilizer, and processing (Kahan, 2013).Munisse*et al.*, (2013) backed this up by pointing out that most African farmers rely on self-saved seed that is stored without special treatment for the following cropping season, a condition that reduces productivity. As a result, as evidenced by the literatures below, the competitive yield advantage between the several different watermelon crop varieties in Nigeria and the rest of the world is contested.

Anikwe*et al.,* (2016) conducted research in two communities in Enugu state, Nigeria, to evaluate the agronomic performance of five selected watermelon varieties, namely New dragon, Empire, Dark Balle, Koloss, and Kaolack (control) (Agbani and Iwollo). The scientists found that Dark Balle was the best of the five types in both locations, using randomized block experimental design and analysis of variance.

Narine*et al.,* (2019) examined the performance of five hybrid watermelon varieties: Bonta, Sugar Doll, Santa Matilde, Delta, and Sentinel in coastal Guyana, South America. Sugar Doll was discovered to be the least performing variety in the area, while the others performed admirably.

Gichimu*et al.,* (2010) compared the performance of three native Kenyan watermelon varieties to a newly introduced US cultivar, Sugar Baby, Crimson Sweet, and Charleston Gray. Based on the yield components tested, Crimson Sweet surpassed all other cultivars.

The yield indices of six watermelon varieties were studied by Enujeke, (2015). Among the varieties tested were Crimson Sweet, Sugar Baby, Charleston Gray, Green Gold, Jubilee, and Ice Box. Sugar Baby had the best vine length, number of leaves, number of branches, and fruit weight after two and a half years of testing.

Dangora*et al*., (2020) used a split-plot experimental design in Bunkure, Kano state, to conduct a study to determine which watermelon variety produces the best yield and brix when cultivated at a proper planting season in the location.

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The kinds that were compared were Crimson sweet, Sugar baby, Congo, Grey bell, and a native land race. According to the findings, Grey bell produced the highest yields of 30.3t/ha in 2015 and 25.7t/ha in 2016, followed by Crimson sweet with 30t/ha in 2015 and 22.2t/ha in 2016, and the local land race with 26.9t/ha in 2015 and 21.2t/ha in 2016.

Enujeke, (2013) conducted field trials at Delta State University's teaching and research farm in Asaba, Nigeria, during the 2011 and 2012 cropping seasons to examine some yield metrics of six watermelon cultivars (Sugar baby, Charleston gray, Crimson sweet, Green gold, Jubilee, and Ice box). A three-replicate randomized complete block design was utilized in the investigation. Sugar baby had significantly higher mean vine length (63.4cm, 133.1cm, and 181.1cm) at 4, 6, and 8 weeks, mean number of leaves per plant (30.5, 33.5, and 40.4) at 4, 6, and 8 weeks, mean number of branches per plant (5.0, 6.0, and 7.0) at 4, 6, and 8 weeks, and mean weight of fruit (1315.43tha(-1) at 75 days, according to the findings.

Oraegbuna*et al*., (2016) conducted research at the faculty of agriculture university of Nigeria, Nsuka's teaching and research farm. The study's goal was to evaluate the agronomic performance and adaptability of three watermelon cultivars (Lagone, Koloss, and Charleston gray (local)) in derived savanna sandy loam soil. According to the research, Koloss is the best variety for the area.

In light of the foregoing disputes, it is clear that only a few of the above-mentioned literatures investigated the effects of various fertilizer types on watermelon growth, yield, and quality in Nigeria. Above all, the publications that explored the principles lacked a comparison of all the supposedly enhanced kinds with the local land race. Against these odds, the study is being conducted to examine the effects of various fertilizer kinds and watermelon varieties on the crop productivity.

III. MATERIAL ANDMETHOD

3.1 Study area

The study took place at Dambo Dam in Kazaure, Jigawa State, Nigeria. Kazaure,is a town in northwest Nigeria. It covers an area of around 770 km^2 and is located between latitudes 12^o 30’ 00” N and 12^o 45’ 00” N and longitudes 8^o 15’ 00” E and 8^o 30’ 00” E.

3.2 Statistical techniques

The study multivariate two-way MANOVA to analyse the main and interaction effect of the factors in the study. Separate one-way ANOVA as also utilized to evaluate effect of crop type and type of fertilizer on each parameter of interest separately. Least significant difference (LDS) was used all the factor levels. The factors in the study are two viz: crop type and type of fertilizer. Crop type has ten treatment levels and they are Sweet Polly, Traveller, Captivation, Bijou, Kingman, SV0258WAT, Cut Above, Citation, Harvest Moonand Triple Treat. The type of fertilizer factor also has five levels viz Farm yard manure, Poultry drop, Cow dung, NPKK, and UREA.

3.3 Design

A factorial design was used to lay down the experiment in which there were fifty pots. In each post there were fifty replications of the treatment combination. The seedlings were allowed togerminate for eight weeks after which three parameters were measured and recorded. The parameters were number of leaves, chlorophyll content and vine length.

IV. RESULTS AND DISCUSSION

4.1 Initial Soil Properties

Table 1 provides information on the initial physico-chemical characteristics of the soils that were utilized in the investigation. Particle size fracture revealed low fertility and a sandy loam texture in the soils, which was supported by the low levels of total nitrogen (0.88 g kg -1) and organic matter (14.9 g kg -1). Strongly acidic soil has a mean pH of 5.30. According to the FMANR (1996) assessments for the ecological zone, the available phosphorus (P) and water-soluble potassium (K), with mean values of 5.5 mg kg^{-1} and 0.16Cmol kg-1, respectively, appeared to be poor. The majority of ultisols in humid environments are extensively weathered, with low activity clay mineralogy and high acidity from excessive precipitation and the resulting erosion and leaching in the environment. This is reflected in the low fertility condition of the soils.

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Table 1. Initial phyisco-chemical properties of the soils used for the study

Parameters	Values (%)
Salt	87.00
Silt	9.7
Clay	4.9
Textural structure	Sandyloamy
pH (H2O)	5.5
Organic Matter g kg^{-1}	14.9
Total Nitrogen g kg^{-1}	0.88
Available P (mg g kg^{-1})	5.30
Exchangeable K (Cmol kg^{-1})	0.16
CFC (Cmol kg^{-1})	10.2

4.2 Discussion and Discussion

Two-way MANOVA results were presented in Table 2. The results revealed that the yield parameters differ significantly from one crop variety to another. This agrees with the findings ofDangora*et al*., (2020) who revealed a significant difference in effect between five watermelon crop variety they considered in their study.

Table 2. Multivariate Tests

Effect		Value	F	Hypothesis df	Error df	Sig.	Partial Eta Squared
Crop	Pillai's Trace	31.231		27	7350	0.000	0.932
	Wilks' Lambda	27.444	0.432	27	7150.065	0.000	0.723
	Hotelling's Trace	36.925	0.432	27	7340	0.000	0.785
	Roy's Largest Root	28.900	0.766	9	2450	0.000	0.855
Fertilizer	Pillai's Trace	19.223	0.823	12	7350	0.000	0.356
	Wilks' Lambda	16.230	0.822	12	6477.091	0.000	0.770
	Hotelling's Trace	25.365	0.822	12	7340	0.000	0.783
	Roy's Largest Root	23.667	1.492	4	2450	0.000	0.921
Crop * Fertilizer	Pillai's Trace	38.992	1.025	108	7350	0.000	0.657
	Wilks' Lambda	36.872	1.025	108	7332.343	0.000	0.723
	Hotelling's Trace	31.002	1.025	108	7340	0.000	0.654
	Roy's Largest Root	29.800	1.423	36	2450	0.000	0.734

Design: Intercept + CROP + FERTILIZER + CROP * FERTILIZER

The resultsalso showed that that the yield parameters are also significantly different fromone type of fertilizer to another. This means that the five type of fertilizers considered in this study contributed significantly differently to the yield parameters measured. This result is in tandem with the findings ofOkunlola*et al.*,(2011)who revealed a significant difference in effect between five watermelon crop variety is considered.

Table 3. Tests of Between-Subjects Effects

Source	Dependent Variable	Sum of Squares	Df	Mean Square	F-Value	P-Value	Partial Eta Squared
Crop	Chlorophyll Content	406.432	9	45.159	42.03407	0.002	0.932
	Vine Length	8736.428	9	970.714	36.27153	0.001	0.723

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	Number of Leaves	61.3	9	6.811	49.57796	0.002	0.785
Fertilizer	Chlorophyll Content	360.162	4	90.041	83.8103	0.001	0.855
	Vine Length	4314.694	4	1078.673	40.3055	0.041	0.356
	Number of Leaves	67.038	4	16.759	121.9905	0.000	0.77
Crop * Fertilizer	Chlorophyll Content	3492.43	36	97.012	90.29892	0.013	0.783
	Vine Length	121911.962	36	3386.443	126.5372	0.018	0.921
	Number of Leaves	435.69	36	12.103	88.09897	0.013	0.657
Error	Chlorophyll Content	2632.14	2450	1.07434286			
	Vine Length	65567.94	2450	26.7624245			
	Number of Leaves	336.58	2450	0.13737959			
Total	Chlorophyll Content	6891.164	2500				
	Vine Length	200531.024	2500				
	Number of Leaves	900.608	2500				

Separateone-way ANOVA results on vine length, chlorophyll content, and number of leaves revealed that the ten-crop type have significant different effect on these parameters as presented in Table 3. This means that the crop varieties were revealed to have differ significantly in the manner they impact the vine lengths plants. It also means that they differ significantly in the way they affect the number of leaves of the plants. Finally, this also means that the crop varieties are significantly different in their effect on the chlorophyll contents of the plans. In contrary, the findings of Enujeke, (2013)revealed that Sugar baby variety was superior in growth and yield of watermelonto the Charlestongray, Crimson sweet, Green gold, Jubilee, and ice box that were compared.

From the same Table 3, it was equally revealed that the impact of the types of fertilizer on vine length, number of leaves and chlorophyll contents of the plant were separately considered. The results then showed that the type of fertilizers considered have significant different effect on vine lengths, number of leaves and chlorophyll contents. Eifediyi,*et al.*,(2017) identified in his study entitled "performance of watermelon (Citrullus lanatus L.) in response to organic and NPK fertilizers"thatthe organic amendments were environmentally more friendly compared to the inorganic amendment (NPK fertilizer) in terms of positive effects on soil structural properties.Also, a study by Aitbayeva, et al., (2021) aimed at comparing different types of fertilizers on growth, yield and quality properties of watermelon (Citrullus lanatus) in the Southeast of Kazakhstan revealed that there were significant differences among the treatments in relation to fruit yield of watermelon, growth parameters and quality properties (dry matter, total sugar, Vitamin C and NO3-N). The study thud recommendedthat fertilizer dose (N90, P60, K60) had the highest fruit yield of watermelon and growth parameters followed by manure applied at 40 t ha-1. The final conclusion by the authors was that all the fertilizer treatments had higher yield of watermelon than control indicating that one has higher effect on the yield parameters than another as seen in this study.

Post-hoc test was also conducted to determine the pair of treatment that differ significantly and the direction of the difference. The results though not presented here because of the size of the table for the results indicated that Sweet Polly, Traveller, and Captivation significantly increased the parameters than Bijou, King Man, SV0258WAT, Cut Above, Citation, Harvest Moon, and Triple Treat, while the rest did not differ significantly between themselves. The test also showed that FarmyardManure, PoultryDrop, and Cow Dung performed significantly better than Urea and NPK 15 15 15 as levels of fertilizer-type experimental factor.

V. CONCLUSION

Finally, ideal crop and fertilizer type work together to increase agricultural produce yield. The result of this study demonstrated that the application of Sweet Polly, Traveller, Captivation, farmyard manure, poultry drop, and cow dung positively affected the growth and yield characteristics of watermelon; for this reason, these treatment combinations are recommended in Kazaure and its environs.

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