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Comparative Analysis of *Manihot esculenta* (Cassava) Species Growth in Liberia Agro-ecological Zone

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

Manihot esculenta varieties were experimented in the tropical rain forest ecological zone of Liberia at Central Agricultural Research Institute with latitude 7°14"N and longitude 3°26"E to compare the growth indicators. The research was conducted from May 2019 to April 2020 with temperature mean of 33.47°C and mean relative humidity of 77.38 %. The data were analyzed using SPSS version 17. Two local varieties of cassava known as Butter cassava and Bentenlay while the four exotic varieties coded as 91/0430, 92/0057, 01/0040 and 01.1206 where grown to compare the growth indicators. The Randomized Complete Block Design (RCBD) was used as the research design. The null hypothesis stated that the introduction of exotic breeds of cassava into the Liberia agro-ecological zone will not grow. At 9 months after planting, Bentenlay and Butter Cassava had no significant difference in their plant height means with 227.55 cm and 230.55 cm respectively. Even at 6 and 9 months after planting, there were no significant difference in the leave width means for all varieties. At the 9 months after planting the mean leave length showed no significant

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difference as same superscripts was ranked for all varieties. At 9 months after planting, the mean number of leaves showed no significant difference. At 9 months after planting, Bentenlay had the maximum mean of 39.62 for the number of petioles. At 9 months after planting, there were no significant difference in the mean number of branches. The conclusions reached here are based on the data findings gathered from the analysis, Bentenlay and Butter Cassava (local varieties) had the maximum plant height means. The other growth parameters mean like leave width, leave length, number of leaves results showed no significant difference. The six varieties of cassava did well in the sandy loam soil.

Keywords: Cassava; growth and indicators; agro-ecological zone; relative humidity.

1. INTRODUCTION

Cassava scientifically known as *Manihot esculenta* belongs to the woody shrub of spurge family. It is native to South America mainly Brazil and is widely consumed for its starchy root which is a major source of carbohydrates. Cassava is an annual crop growing in the tropical and subtropical regions [1].

Cassava ranked the third largest source of carbohydrates after rice and maize in the world (FA), [2,3,4]. Cassava is a staple food in developing countries providing a major diet for over millions of people daily. The world production of cassava for 2020 reported by FAOSTAT, [5] is 303 million tons with Nigeria being the highest producer followed by Democratic Republic of Congo with 60 million tons and 41 million tons respectively. The production ranking for others African countries is very low accept for Ghana which was ranked fourth with 21.8 million tons.

Cassava is classified into two major clusters as sweet and bitter cassavas. Both clusters contain anti-nutritional factors and toxins with the bitter cassava having copious. The sweet cassava been the most favorable one for consumption purposes, there have been many varieties to outfit the appetites of many consumers [6,7,8]. It is one of the most drought tolerant crops which grows on marginal soils according to Soto-Blanco, B; Gorniak, S.l., [9].

2. MATERIALS AND METHODS

The research was conducted at the Central Agricultural Research Institute (CAR), Bong County, Liberia from 2019 to 2020 in the tropical rainforest zone of Liberia with longitude 3°26"E and Latitude 7°14"N. The temperature mean was 33.47◦C with a mean relative humidity of 77.38%. Two local varieties of cassava known as Butter cassava and Bentenlay were collected from the research station while the four exotic varieties coded as 91/0430, 92/0057, 01/0040 and 01.1206 were foreign varieties used for this research purpose. The general objective was to compare the growth parameters of the exotic varieties with the local varieties. The research was done using the split plot design and the varieties were assigned to subplot by Randomized Complete Block Design (RCBD). The cuttings obtained were cut into 25 cm length by using a sterilized cutter. The field was ploughed and harrowed mechanically. Ridges were constructed manually with traditional hoes in the experiments. Data were collected on the following characterization indicators as plant height (cm), leave width (cm), leave length (cm), number of leaves, number of petioles and number of branches.

2.1 Data Analysis

Data collected were subjected to IBM-SPSS (International Business Machine – Statistical Products for Service Solutions) version 17. The statistical tool used to separate means was the Duncan's Multiple Range Test (DMRT).

3. RESULTS

Table 1 depicts the DMRT result for the Mean plant heights measured in centimeter for six varieties of cassava. The analysis showed that the maximum plant height mean was recorded for Butter Cassava variety at 9 months after planting with 230.55 cm, followed by Bentenlay at the same 9 months after planting with 227.55 cm while 91/0430 variety had the minimum plant height mean of 31.98 cm at 3 months after planting.

Table 2 shows the detailed result for the mean leave widths measure in centimeter. At 9 months after planting, 01/1206 had the widest leave mean of 7.09 cm, followed by 92/0057 variety with a mean of 6.72 cm while the smallest leave

width mean was recorded for Bentenlay variety at 3months after planting with 3.58 cm.

Table 3 revealed the result for mean leave length measure in centimeter. The leave length parameter indicated that the longest leave length was captured for variety 01/0040 as 23.93 cm at 9 months after planting followed by the Butter Cassava variety at the same 9 months after planting with 20.47 cm while the shortest leave length mean was 12.69 cm recorded for 91/0430 variety at 3 months after planting.

Table 1, Mean Plant Heights (cm) analysis for six varieties of cassava using DMRT(Duncan's multiple range test)

Varieties	3 MaP	6 MaP	9 MaP
91/0430	31.98^{f}	119.75^{d}	154.04^{d}
Bentenlay	95.62^{a}	154.50^{a}	227.55^{a}
92/0057	53.35^{d}	133.15^{c}	184.52^{c}
Butter Cassava	74.45^{b}	151.67^{a}	230.55^{a}
01/0040	47.69^{e}	103.33^{e}	197.20^{b}
01/1206	70.00^{c}	141.27^{b}	201.83^{b}

MaP = Month after Planting and mean with same letter in a column showed no significantdifference with p – value @ 0.05

Table 2. Mean leave widths (cm) analysis for six varieties of cassava using DMRT(Duncan's multiple range test)

Varieties	3 MaP	6 MaP	9 MaP
91/0430	4.31^{a}	4.33^{a}	4.99^{a}
Bentenlay	3.58^{a}	5.24^{a}	5.99^{a}
92/0057	4.52^{a}	6.34^{a}	6.72^{a}
Butter Cassava	3.78^{a}	4.98^{a}	5.77^{a}
01/0040	3.60^{a}	5.70^{a}	6.15^{a}
01/1206	4.44^{a}	5.98^{a}	7.09^{a}

MaP = Month after Planting and mean with same letter in a column showed no significantdifference with p – value @ 0.05

Table 3. Mean leaves' lengths (cm) analysis for six varieties of cassava using DMRT(Duncan's multiple range test)

Varieties	3 MaP	6 MaP	9 MaP
91/0430	12.69^{c}	15.63^{b}	17.79^{a}
Bentenlay	12.75^{c}	14.25^{b}	17.33^{a}
92/0057	16.73^{a}	18.63^{a}	21.93^{a}
Butter Cassava	13.83^{bc}	16.09^{ab}	20.47^{a}
01/0040	13.71^{bc}	17.16^{ab}	23.93^{a}
01/1206	15.17^{ab}	16.98^{ab}	19.57^{a}

MaP = Month after Planting and mean with same letter in a column showed no significantdifference with p – value @ 0.05

Table 4. Mean number of leaves' analysis for six varieties of cassava using DMRT(Duncan's multiple range test)

Varieties	3 MaP	6 MaP	9 MaP
91/0430	22.77^{a}	37.50^{a}	37.53^{a}
Bentenlay	24.08^{a}	39.2^{a}	38.22^{a}
92/0057	25.23^{a}	33.03^{a}	34.36^{a}
Butter Cassava	19.06^{a}	35.43^{a}	31.10^{a}
01/0040	21.63^{a}	30.18^{a}	32.17^{a}
01/1206	24.54^{a}	31.45^{a}	31.57^{a}

MaP = Month after Planting and mean with same letter in a column showed no significantdifference with p – value @ 0.05

Table 5. Mean number of petioles' analysis for six varieties of cassava using DMRT(Duncan's multiple range test)

Varieties	3 MaP	6 MaP	9 MaP
91/0430	27.8^{b}	29.85^{b}	31.78^{bc}
Bentenlay	32.68^{a}	36.60^{a}	39.62^{a}
92/0057	25.17^{c}	28.72^{bc}	33.12^{b}
Butter Cassava	19.07^{f}	21.62^{e}	24.07^{d}
01/0040	21.36^{e}	24.02^{de}	25.75^{cd}
01/1206	24.53^{d}	26.20^{cd}	27.17^{bcd}

MaP = Month after Planting and mean with same letter in a column showed no significantdifference with p – value @ 0.05

Table 6. Mean number of branches' analysis for six varieties of cassava using DMRT(Duncan's multiple range test)

Varieties	3 MaP	6 MaP	9 MaP
91/0430	1.32^{c}	2.32^{a}	2.56^{a}
Bentenlay	1.78^{ab}	2.22^{a}	2.52^{a}
92/0057	1.80^{ab}	2.20^{a}	2.34^{a}
Butter Cassava	1.55^{bc}	2.30^{a}	2.61^{a}
01/0040	1.55^{bc}	1.87^{a}	2.01^{a}
01/1206	1.94^{a}	2.18^{a}	2.37^{a}

MaP = Month after Planting and mean with same letter in a column showed no significantdifference with p – value @ 0.05

Table 4 gives the mean number of leaves results at the three data collection dates as 3, 6 and 9 months after planting the cassava varieties. Bentenlay variety had the most plenteous number of leaves mean as 39.2 and 38.22 at 6 and 9 months after planting respectively, followed by variety 91/0430 at 9 months after planting with a mean of 37.53 while the minimum number of leave mean was recorded for Butter Cassava variety as 19.06 at 3 months after planting.

Table 5 depicts the data analysis for the number of petioles recorded for 6 varieties of cassava in an experimental trial. The results revealed that Bentenlay variety had the maximum number of petioles mean as 39.62 at 9 months after planting, followed by variety 92/0057 with 33.12 mean at 9 months after planting while the minimum number of petiole mean was recorded for Butter cassava as 19.07 at 3 months after planting.

Table 6 revealed the mean number of branches for the six varieties of cassava. It is recorded that Butter Cassava had the maximum mean as 2.61 at 9 months after planting followed by Bentenlay with a mean of 2.52 at same 9 months after planting while the minimum mean was recorded for variety 91/0430 as 1.32 at 3 months after planting.

4. DISCUSSION

It was observed that at 3 months after planting, Bentenlay variety had the maximum plant height mean of 95.63 cm. The results for 3 months after planting showed significant differences between the six varieties as all means had different superscript letters. Variety 91/0430 had the least mean value of 31.98 cm. At 6 months after planting, Bentenlay and Butter Cassava means had no significant difference. The others 4 varieties had significant differences because of different superscript letters. At 9 months after planting, Bentenlay and Butter Cassava had no significant difference in their plant height means. Varieties 01/0040 and 01/1206 means had no significant difference at the same 9 months after planting. The 2 varieties with different superscript letters showed significant difference. The mean leave width results at 3 months after planting depicts no significant difference as all varieties has same superscripts letter. Even at 6 and 9 months after planting, there were no significant difference in the leave width means for all varieties. The mean leave length results at 3 months after planting indicated that variety 92/0057 had the highest mean score of 16.73 cm while varieties 91/0430 and Bentenlay results had no significant difference. At 6 months for leave length, variety 92/0057 had the highest mean of 18.63 cm, Butter Cassava, 01/0040 and 01/1206 means had no significant difference while Bentenlay and 91/0430 means had no significant difference. At the 9 months after planting the mean leave length showed no significant difference as same superscripts was ranked for all varieties. The mean number of leaves at 3 months after planting showed no significant difference. At 6 months after planting, the mean number of leaves for the cassava varieties showed no significant different. At 9 months after planting, the mean number of leaves showed no significant difference. The mean number of petioles at 3 months after planting showed that all varieties means were significantly difference as superscript letters differs. At 6 months after planting, the means number of petioles for Bentenlay showed the highest, 92/0057 showing superscript ^{bc} revealed no significant difference with 91/0430 variety. Likewise, variety 01/0040 mean had no significant difference with Butter Cassava mean. At 9 months after planting, Bentenlay had the maximum mean of 39.62 for the number of petioles. Variety 01/1206 mean showed no significant difference with 01/0040 and 91/0430 since the superscript letters are found for each variety can be seen in any one of the varieties. The mean number of branches at 3 months after planting showed that variety 01/1206 had the maximum mean of 1.94. Bentenlay and 92/0057 varieties had no significant difference while Butter Cassava and 01/0040 varieties had no significant difference. The minimum mean was recorded for 91/0430 as 1.32. At 6 months after planting, there were no significant difference in the mean number of branches. At 9 months after planting, there were no significant difference in the mean number of branches.

5. CONCLUSIONS

The conclusions reached here are based on the data findings gathered from the analysis. Bentenlay and Butter Cassava (local varieties) had the maximum plant height means. The other growth parameters mean like leave width, leave length, number of leaves results showed no significant difference. The six varieties of cassava did well in the sandy loam soil. This research is subject to testing in different agro-

ecological zones and with inclusion of more exotic varieties.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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