



Varietal effects on Productivity of Potato (*Solanum tuberosum* L.) in Kuru, Northern Guinea Savanna, Nigeria

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Authors' contributions

This work was carried out in collaboration among all authors. Authors STD and ATG designed the study, performed the statistical analysis, wrote the protocol and wrote the first draft of the manuscript. Authors STD and AA managed the analyses of the study. Authors AA and ATG managed the literature searches. All authors read and approved the final manuscript.

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ABSTRACT

A study on varietal effects on the productivity of potato (*Solanum tuberosum* L.) was conducted during the 2017 and 2018 cropping seasons at the Research Farm of the National Root Crops Research Institute (NRCRI) Kuru, Jos in Plateau State, Nigeria. The study was aimed at assessing the effect of variety on productivity of potato. The treatments consisted of two varieties of potato (improved variety: Daimat, local variety). The experiment consisted of 4 that were laid out in a 2x2 split plot arrangement in a randomized complete block design (RCBD) and replicated three times. Crop data collected were percent germination, plant height, leaf area, number of leaves, number of branches, number of stems, stem girth, number of tubers per plant, number of seed tubers per plant, number of ware tubers per plant, weight of seed tubers per plant, weight of ware tubers per

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plant and total yield of potato (tons/ha). Although there was no significant effect of variety on the growth parameters of potato but the improved variety performed better than the local variety. The improved variety is here by recommended for adoption in the study area.

Keywords: Potato; variety; productivity; yield tuber.

1. INTRODUCTION

Potato is fairly new to Sub-Saharan Africa (SSA) where it was introduced in the 19th centuries through the activities of European Missionaries [1]. It was introduced in Nigeria during the 1920s by way of Germans living in the Cameroons and by other Europeans involved in Missionary and Tin mining activities on the Jos Plateau, where production was limited to small garden plots [2].

Potato is grown in commercial quantity in Mangu and Bokokos Local Government Areas of Central Senatorial Zone of Plateau state. These two area councils of the state alone can feed the entire country and beyond with potato as reported by Abimaje and Paul [3]; Jwanya et al. [4]. The crop is also grown in some parts of Plateau Northern Senatorial Zone including Barkin Ladi, Riyom, Jos South, Jos East Local Government Areas.

The crop is exported from Plateau State to neighbouring countries of Ghana, Ivory Coast, Cotonou, and Niger Republic. According to a 2009 World Bank report on potatoes in Africa, Nigeria has a harvested area of 27,000 hectares of farm land with 3.1 tons yield per hectare amounting to 843,000 tons annually. This is a far distance below Egypt's 105,000 hectares, 24.8 tons per hectare and 2.6 m tons annually [4,5].

There are now over a thousand different types of potatoes worldwide descended from varieties that originated from the low lands of South Central Chile which displaced formally popular varieties from the Indian high lands [6].

Since no single variety can satisfy all farmers' needs because of varying production and processing needs, the following groups of selected clones are presently recommended [7].

- Medium yielding: varieties with tolerance/resistance to late blight and bacterial wilt, RC 767- 2 areta, Roslin Guacha, B9493-4-2 Rosline Ruaka.
- High yielding with fair resistance to late blight and bacterial wilt; Arka, Nicola, Mirka, Desiree B9462-1, Barka.

- Raining and dry season varieties; Rc767-2, Rc777-3, Ruaka and B9462-1 (varieties with short dormancy).
- Dry season varieties; Mirka, B9462-1, Estima, Arka, Desiree and Diamat.

Farmers usually select seeds at harvest from their own farms and periodically go outside their farms to bring in "new" or "fresh" seeds (seed renewal).

The aim of this study was to assess the effect of variety on productivity of potato in Kuru, Jos, Nigeria.

2. METHODOLOGY

2.1 Site Description and Characteristics

The field experiment was conducted at the Research Farm of the Potato Program, National Root Crops Research Institute, Kuru (09°44' N, 08°47' E, with elevation of 1,236.3 m a.m.s.l.). Mean rainfall is about 1500 mm received in 130-150 days from May to September [8]. Kuru has a maximum temperature of 27°C and a minimum temperature of 10°C. The dominant Vegetation at the site includes guinea grass (*Panicum maximun*), gamba grass (*Andropogon gayanus*) and elephant grass (*Penisetum pueperum*) [9].

The climate is characterized by two distinct wet and dry seasons. The wet season starts from late April and end in October while the dry season starts from November to mid-April. It is located within the northern guinea savanna agro-ecological zone of Nigeria [10].

2.2 Experimental Design and Treatment

The treatments consist of two (2) two varieties of potato: V₁ (Daimat; improved variety), and V₂ (Local variety). There were a total of 4 treatment combinations.

The treatments were laid out in a 2 x 2 split plot arrangement in a randomized complete block design (R C B D) and replicated three (3) times (in a 2 x 2 split plot arrangement) making a total of 12 plots. Each sub plots area had a dimension

of 2 m x 3 m (6 m²) separated by 1 m between block.

2.3 Land Preparation and Sowing

The vegetation was manually cleared. Ploughing, harrowing and ridging were done mechanically. Seeds were sourced from NRCRI Vom, Plateau State. Sowing was done at a spacing of 30 cm x 100 cm (33,333 plants per ha). Planting was done in 2nd week of April and 2nd week of May.

2.4 Fertilizer Application and Weed Control

NPK fertilizer was applied at 90 kg N ha⁻¹, 60 kg P₂O₅ ha⁻¹, 120 kg K₂O ha⁻¹ at 5 WAS. Weed control was done manually using small hoe at regular intervals to keep the field free of weed.

2.5 Data Collection

Seedlings count was done four (4) weeks after sowing (WAS). Five plants were selected randomly at the two centre rows of each plot and tagged for growth and yield data determination. Plant heights were measured using measuring rule, measuring the height of plant from the base to the tip of growing point. Number of branches, number of leaves, leaf area and stem girth were taken at 6, 8 and 10 WAP. Number of branches and number of leaves per plant were taken by counting. Stem girth was determined using thread and rule. Number of days to maturity was also noted.

Yield parameters taken include number of seed tubers per plant; number of ware tubers per plant (kg/plant), weight of seed tubers per plant, weight of ware tubers per plant (kg/plant) and total yield in t/ha.

2.6 Statistical Analysis

Data generated were subjected to analysis of variance (ANOVA) using GenStat. Means that were statistically significant were separated using Least Significant Difference (LSD) according to Steel and Torries [11].

3. RESULTS

3.1 Effects of Variety on Percent Germination and Plant Height of Potato

Results of effect of variety on percent germination and plant height of potato are presented in Table 1. Variety did not have

significant effect on percent germination in 2017 and 2018 planting seasons. However, local variety had higher germination percentage in both years. Similarly variety did not affect plant height both in 2017 and 2018; however, Daimat variety had higher heights in both years.

3.2 Effect of Variety on Number of Leaves and Leaf Area of Potato

Results of effect of variety on number of leaves and leaf area of potato are presented in Table 2. Variety had no significant effect on number of leaves of potato in 2017 and 2018 planting season. But the improved variety had more number of leaves and larger leaf areas.

3.3 Effect of Variety on Number of Branches, Number of Stems and Stem Girth of Potato

Results of effect of variety on number of branches, number of stems and stem girth of potato are presented in Table 3. Results showed that variety did not have significant effect on number of branches, number of stems and stem girth in both planting seasons. However, the improved variety had more number of branches, more number of stems and more vigorous stem girths.

3.4 Effect of Variety on Number of Tubers, Number of Seeds Tubers and Number of Ware Tubers/Plant of Potato

The results of effect of variety on number of tubers, number of seeds tubers and number of ware tubers are presented in Table 4. Number of tubers per plant was not affected by variety in 2017 but there was a significant ($p < 0.05$) effect of variety on number of tubers per plant in 2018. Diamat variety (V₁) gave more (4.04) number of tubers compared to local variety (V₂) which produced 3.26 number of tubers. Number of seed tubers per plant and number of ware tubers per plant were not affected by variety in 2017 and 2018.

3.5 Effect of Variety on Weight (Kg) of Seed Tubers Per Plant, Weight (Kg) of Ware Tubers Per Plant and Weight of Tubers (T/Ha) of Potato

Results of effect of variety on weight seed tubers per plant, weight of ware tubers per plant and weight tubers of potato is presented in Table 5.

Table 1. Effects of variety on germination count and plant height of potato

Variety	Germination count (%)			Plant Height(cm)					
	2017	2018	6WAP	8WAP	10WAP	6WAP	8WAP	10WAP	
Daimat	85.54	86.42	17.35	19.02	19.56	16.25	19.00	19.46	
Local Variety	87.96	88.25	16.21	18.31	19.02	16.21	18.31	19.02	
FLSD (0.05)	2.57	6.1	Ns	1.08	2.13	11.45	3.06	3.61	
F-pr	0.059	0.325	0.821	0.98	0.59	0.51	0.81	0.43	

KEY: FLSD (0.05) = Fisher's Least Significant Difference at 5% level of probability, F-pr = Probability value

Table 2. Effect of variety on number of leaves and leaf area of potato

Planting Date	Number of Leaves						Leaf Area (cm ²)					
	2017			2018			2017			2018		
	6WAP	8WAP	10WAP	6WAP	8WAP	10WAP	6WAP	8WAP	10WAP	6WAP	8WAP	10WAP
Variety												
Daimat	7.57	9.21	9.77	7.57	9.18	9.67	12.84	14.83	15.02	12.54	14.33	14.98
Local Variety	7.04	8.04	8.78	7.04	8.04	8.88	12.77	14.73	15.12	12.67	14.83	15.02
FLSD (0.05)	2.26	1.62	0.57	3.39	2.35	1.08	1.32	1.98	8.04	3.87	2.38	2.38
F-pr	0.92	0.79	1.00	0.81	0.89	1.00	<0.001	0.003	0.61	0.004	0.001	0.24

KEY: FLSD (0.05) = Fisher's Least Significant Difference at 5 % level of probability, F-pr = Probability value

Table 3. Effect of variety on number of branches, number of stems and stem girth of Potato

Variety	Number of Branches						Number of Stems						Stem girth (cm)					
	2017			2018			2017			2018			2017			2018		
	6WAP	8WAP	10WAP	6WAP	8WAP	10WAP	6WAP	8WAP	10WAP	6WAP	8WAP	10WAP	6WAP	8WAP	10WAP	6WAP	8WAP	10WAP
V1 (Daimat)	2.96	3.25	3.89	2.76	3.15	3.79	3.00	3.32	3.88	3.01	3.22	3.78	2.88	3.02	3.87	2.78	3.02	3.78
V2 (Local Variety)	2.95	3.42	3.69	2.85	3.12	3.69	3.08	3.23	3.71	3.08	3.13	3.71	2.91	3.15	3.76	2.80	3.14	3.74
FLSD (0.05)	0.83	0.46	0.82	0.82	1.82	1.24	0.16	0.16	0.57	0.36	0.36	0.9	1.34	2.49	2.1	0.46	0.53	0.75
F-pr	0.39	0.82	0.44	1.00	0.56	0.47	0.23	0.23	1.00	0.42	0.42	0.18	0.32	0.34	0.36	0.47	0.7	0.87

FLSD (0.05) = Fisher's Least Significant Difference at 5 % level of probability, F-pr = Probability value

Table 4. Effect of variety on number of tubers, number of seed tuber and number of ware tubers of potato

Variety	Number of tubers		Number of seed tubers		Number of ware tubers	
	2017	2018	2017	2018	2017	2018
Daimat	3.46	4.04	2.33	2.67	1.08	1.21
Local Variety	3.29	3.26	1.88	2.17	1.42	1.46
FLSD (0.05)	0.61	0.18	0.59	1.35	0.38	1.12
F-pr	0.49	0.01	0.10	0.25	0.70	0.43

KEY: FLSD (0.05) = Fisher's Least Significant Difference at 5 % level of probability, F-pr = Probability value

Table 5. Effects of variety on weight of seed tubers, weight of ware tubers and weight of tubers /plant of potato

Variety	Weight of seed tubers/ plant (kg)		Weight of ware tubers/plant (kg)		Weight of tubers (t/ha)	
	2017	2018	2017	2018	2017	2018
Daimat	0.12	0.16	0.13	0.17	8.99	9.32
Local Variety	0.09	0.2	0.12	0.13	6.84	7.12
FLSD (0.05)	0.05	0.88	0.016	0.12	1.31	2.61
F-pr	0.15	0.68	0.003	0.002	0.001	0.003

Key: FLSD (0.05) = Fisher's Least Significant Difference at 5 % level of probability, Ns = Not significant, F-pr = Probability value

Although variety did not significantly affected weight (kg) of seed tubers per plant and weight of ware tuber/plant, it had significant ($p < 0.05$) effect on weight of tubers (t/ha) in 2017. Daimat variety gave 8.99 t/ha while local variety recorded least weight of 6.84 t/ha of tuber. Significant ($p < 0.05$) interaction effect of planting date \times variety on the weight of tubers (t/ha) was observed in 2017 but the same effect was not significant in 2018 planting seasons. Results showed that early planting (April) \times Daimat variety yielded better (16.9 t/ha) while planting of local variety \times May gave least potato yield of 0.72 t/ha.

4. DISCUSSION

Varietal effect was less significant on growth parameters such as plant heights, number of branches, number of leaves and number of stem girths of potato. However, the improved variety (daimat) showed better performances of these parameters tested. There was significant effect of variety on leaf area of potato. The improved variety had more leaf area than the local variety. The wider leaf area in the improved variety implied that the improved variety enjoyed better photosynthetic activities compared to the local variety. This result agrees with the findings of Kamal et al. [12]. Dayok [13] also reported a similar result.

Yield parameters such as number of seed tubers per plant and number of ware tubers per plant

were not significantly affected by variety. However, the improved variety showed more number of both seed tubers per plant and ware tubers per plant than the local variety. The finding is in agreement with the findings of Cournac et al. [14]. The finding of this study also showed that there was significant effect of variety on productivity of potato. The improved variety gave higher ware tuber yield per hectare and the total yield per hectare. In 2017 the improved variety gave 8.99 t/ha. of potato compared to 6.84 t/ha. for the local variety. Similarly, in 2018, improved variety yielded 9.32 t/ha. of potato compared to 7.12 t/ha. for the local variety. The differences in yield between the improved variety and the local variety may be inferred from the variation in leaf area in which the improved variety had wider leaves compared to the local variety. Dayok et al. [15] had earlier reported a similar result in his study on assessment of planting and variety on water use efficiency of potato. Darabi [16] had reported that the improvement of variety is targeted at giving better yield to farmers.

5. CONCLUSION

The study concluded that although there was no significant effect of variety on growth parameters of potato but the improved variety performed better in all the parameters tested. The improve variety also had significant effect on the final yield of potato. It is here by recommended that

producers should adopt the use of improved variety in the study area.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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