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Preliminary Investigation of Whole Versus Sliced (Cut) Potato (*Solanum tuberosum* L.) Tubers Performance in Pankshin, North Central, Nigeria

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Authors' contributions

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

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ABSTRACT

Potato is a highly perishable crop and storage facilities for the crop are also limited. Consequently, to keep planting materials (seed) from the end of one cropping season to the beginning of another pose a great challenge to growers. This study was conducted during the 2019 cropping season in Pankshin, Plateau state, Northern Guinea savanna zone, Nigeria to compare the performance of whole seed tubers (T_1) and slice seed tubers (T_2) of potato. The treatments were laid out in a randomized complete block design (RCBD), each replicated thrice. Individual plots have a dimension of 3 m x 5 m with distance of 1 m between blocks and 0.5m between plots. Parameters evaluated were rate of plant germination from cultivated tubers, plant height and fresh yield. The data were analysed using T – test. Results showed that there was no significant difference between whole seed potato and sliced tuber seed for all the parameters tested. This study suggests that in

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areas where seed tubers are scarce, growers should cut there potato seed tubers to enable them have more seeds for planting. Storage facilities should be provided to farmers by government and spirited individuals or groups in order to reduce the high costs of seeds for planting.

Keywords: Seed size; whole seed tuber; cut seed tuber; bud.

1. INTRODUCTION

Potato (*Solanum tuberosum* L.) commonly call Irish potato was first cultivated about 10,000 years ago by South American Indians [1]. Spanish explorers brought the potato to Europe in the 16th century. At beginning it was mainly used for livestock feeding [2]. It is generally believed that the crop entered Africa with colonists who consumed them as vegetables rather than for starch [3]. Okonkwo et al. [4] reported that irish potato was first introduced into Nigeria in the later part of the 19th century and early 20th century by Europeans tin miners in Jos Plateau state and the Garman in the Cameroon's.

Irish potato is the most fruitful and efficient tuber crops in the world in terms of tuber yield and days to maturity. It matures in about 60-90 days (2-3 months) as compared to 9 and 12 months of yam and cassava respectively [5,6]. It gives the highest yield per unit area among root and tuber crops in Nigeria and also more income to farmers.

The crop is widely demanded by the society for consumption as vegetables, stable, animal feeds and other uses. It can be processed into chips, crips, marsheel potato, starch etc. little processing is presently carried out in Nigeria [7].

Irish potato like any other crop plant needs better and quality seeds to give the maximum yield that farmers needs. Despite the fact that Irish potato seedlings can produce regardless of the size, bigger seedlings plants tend to give more yield(if all the necessary factors are ensured) than the small size seedlings as reported by Mosley et al. [8]. The same authors considered that potato yields are proportional to seed size up to a point where very small or extremely large seed tubers should not be used for planting. The recommended seed sizes are those between 35-50 mm or 30-60 mm. Also, 1.7 tons of seeds are required per hectare depending on the size [6].

The whole tuber of Irish potato is formed from stolon of the plant; each bears several buds (the eye of the potato) that sprout and grow into new plant [9]. The whole seed tuber size develops a greater number of stems and tuber plant. To maximize marketable yield of potato from whole tubers, it is recommended that the seed must be between 28 g and 42 g in weight [10].

Stark and Love [11] recommended that if the tubers of potato are too small to medium in size, the whole tuber should be planted. But if they are larger, it can be sliced (cut) into half or equator them. Each section should have two to three "eyes". After slicing, the surface should be callus over night before planting. They further stressed that tubers that are larger than chicken egg should be sliced into pieces across. Each piece should have at least one 'eye' (the bud where stem will grow from) preferably two eyes.

Traditionally, sliced seeds are allowed to cure a few days to week before planting. The amount of seeds was reduced at about 50 % being a significant financial help to growers [12]. Pavlista [13] reported that slice potato tubers treated with fungicide (mancozeb) reduced decay and increase tuber yield. He reported that the performance of whole seed tubers is not significantly better than slice seed tubers.

Irish potato is a highly perishable crop and to compound this problem, storage facilities for the crop are unavailable. To keep planting materials (seeds) from the end of one planting season to the beginning of another planting season therefore pose a great challenge to growers. Potato tubers can be preserved at low temperature and using inhibitors existed on the market which inhibits sprout growth. This can be done in special depot. The solution to this problem falls on dry season farming which can provide fresh seeds for planting in the rainy season.

Unfortunately, the number of farmers involved in the dry season cultivation is so small as compared to those who work in the rainy season principally because of scarcity of water for irrigation. For this reason the price of seeds highly expensive.

Dimlong [9] reported that producers in the developing countries have to face with an inadequate supplying of certified seeds. Majority

of small holder farmers almost solely depend on an informal seed source (farm saved seeds, local market and neighbors).

Owing to the higher cost of seeds, 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). Kaguongo et al. [14] also reported that high cost of seeds, fertilizer and labour are the major challenge in potato industry in most developing African countries. Jwanya et al. [15] and Alabura further sustained the considerations of Kuguongo et al, (2008), when reported the average seed cost of potato per hectare as one hundred and forty thousand four hundred and eighty one naira seven kobo (N140,481.07).

This study is aimed at evaluation of the efficiency of the two king of culture from seed tuber of potato.

2. METHODOLOGY

2.1 Site, Weather and Climate

The research was conducted during the 2019 farming season at the Teaching and Research Farm of Federal College of Education, Pankshin located at Lat. 90^{o} N and 10^{o} N and Long. 9^{o} E and 26^{o} E. Pankshin is located within the Northern Guinea savanna agro-ecological zone of Nigeria. The site has a mean annual rainfall of 1028.9 mm and a temperature of 27^{o} C maximum and 10^{o} C minimum. It has an average height of 1829 above sea level.

2.2 Experimental Layout and Design

Two kinds of seed materials were tested; whole seed tubers (T_1) and sliced seed tubers (T_2) which were laid out in a Randomized Complete Block Design (RCBD) with each replicated three times. Individual plots had dimensions of 3 m X 5 m with a distance of 1 m between blocks and 0.5 m between plots. Each replication consisted of 9 plots and 15 seeds were planted per plot given a total of 135 seeds planted in each replication.

2.3 Land Preparation, Planting and Fertilizer Application

The vegetation was manually removed. The terrain was mechanically worked using a disc plough while ridges were done manually using big hoe. Plant material - Potato tuber seeds from a local source were hand sown at one seed per hole at a spacing of 1 m apart and 50 cm within rows which gave an approximately plant population of 300,000 plants per hectare.

Whole tubers with two or three eyes were sliced vertically and allowed to callus for 24 hours before planting. Planting was done on June, 19th 2019. Weed control was done manually at 3 weeks after the planting (WAP). Weed re-growth was also done manually using small hoe at 5 WAP.

Each experiment plot received a uniform application of fertilizer at 70 kg/ha of NPK 15.15.15 using broadcasting method. Top dressing was done with the same fertilizer at the rate of 50 kg/ha.

2.4 Data Collection

After 2 weeks after planting, the counting of the developed plants from tubers eyes was made. The rate of tuber germination per plot was expressed as the number of developed plants reported at of the number of tubers planted x 100 %.

The growth of plant wad measuring shoot height expressed in cm using a graduated measuring rule at 3, 5 and 7 weeks after planting.

An area of 2 m X 3 m on each plot was harvested manually using small hoe to determined fresh yield at maturity. Values registered for growth and yield (ware) parameters were subjected to t-test analysis.

3. RESULTS AND DISCUSSION

Treatment results on percentage germination of potato are presented in Table 1. The results in the two kinds of cultures showed that the rate of plant germination from potato seed in the case of whole tuber ranged from 87 % to 100 % while in case of sliced tubers ranged from 84.6 % to 95 %. The T - test analysis prove there was no significance difference between the two kinds of (whole and cut seed tubers) (estimated -T was 4.30 while T-calculated was 3.42). This result is in agreement with the report of Pavlista [13] about the performance of whole potato seed tubers which was not significantly higher than sliced seed tubers.

Concerning the height of plants generated from the two kinds of seed tubers, there was no significant between whole tubers and cut ones (Table 2). This means that as long as two to

Table 1. The rate of tuber seed germination (%)

Replicate (R)	Whole tuber T_1 (%)	Slice tuber T_2 (%)	D	d2	Df	T-cal	T-tab
R_1	87	9.5	7.5	56.25s	2	3.42	4.30
R_2	100	94.8	5.2	2702			
R_3	87	84.6	2.4	5.75			

$\sum D$ =15.1, $\sum D^2$ = 89.0

R –replicate, T_1 – whole seed tubers, T_2 - sliced seed tubers, d- difference, Df – degree of freedom, t – cal - calculated T, T – tab – estimated .T

Table 2. The growth of potato plants derived from seed tubers expressed as plant height (cm)

Replicate (R)	Whole tuber T_1	Slice tuber T_2	D	d2	Df	T-cal	T-tab
R_1	94.3	92.3	2	4	2	1.97	4.303
R_2	96.3	96.3	0	0			
R_3	95.3	93.7	1.6	2.25			

$\sum D$ =1.76, $\sum D^2$ = 2.37

Table 3. Potato yield (t/ha)

Replicate (R)	Whole tuber T_1	Slice tuber T_2	D	d2	Df	T-cal	T-tab
R_1	17.8	18.1	-0.3	0.09	1	2.32	4.30
R_2	19.7	18.2	1.5	2.25			
R_3	16.6	16.1	0.56	0.03			

$\sum D$ =1.76, $\sum D^2$ = 2.37

three eyes exist on the cut seed tubers similar performance to whole tubers were recorded. Nolte et al. [12] reported before that the growth rate (height) of the plants developed from whole tuber did not significantly differ from those grown from sliced tubers.

Concerning the yield ranged from 16.61 – 19.7 t/ha in case of potato whole tubers, while the highest yield for sliced seed potato tubers was 18.2 t/ha and the lowest yield was 16.1 t/ha. (Table 3).

The yield obtained was high compared to the average yield obtained in West Africa as reported by Dimlong [9]. In our experiment, the results concerning the yield showed there was no significance difference between the two kinds of planting materials T – test analysis revealed calculated was 2.3 compare to the estimated T(4.30). Nolte et al. [12] reported a similar result where they cultivated whole seed tubers versus slice seed tubers, the difference in yield or grade did not significantly vary.

4. CONCLUSION AND RECOMMENDATION

It is hereby concluded that it was not possible to disapprove the null hypothesis.

i. In areas where seed tubers are very scarce and expensive, farmers should use cut potato seed tubers to ensure more seed for planting.
ii. Agronomic research entities have to support and advise the farmers with the help of local and central authorities for storage and culture practices to help and improve production of potato

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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