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ADAPTABILITY RESEARCH OF FOUR VARIETIES OF IRISH POTATOES (SOLANUM TUBEROSUM) IMPORTED FROM CZECH REPUBLIC AT KWAJA, MUBI ADAMAWA STATE, NIGERIA.

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Abstract

This research was conducted to assess the adaptability of the four varieties of Potatoes imported from the Czech Republic by Nigerian Experts on agricultural educational mission at Kwaja, Mubi Adamawa State Nigeria. The researcher aim is to apply the knowledge gained in the course of their mission to Czech Republic by embarking on the adaptability research on the new varieties which was given to them at no cost by the management staff of Potato Research Institute of Czech Republic in consultation with Czech University of Life Sciences, Prague. This will add value to potato production in Nigeria which is in dare need, increase yield, early maturing, disease resistance and improve income, food security and livelihood of small scale farmers and their households. Study area is Kwaja, locally called the Mubi Plateau due to the altitude and low temperature of the area in Mubi South local government area, Adamawa state. The temperature of the regime of the research area is warm to hot throughout the year, because of the high radiation Although, there has been a gradual increase in temperature from January to April with seasonal maximum in April, temperature drops slightly at the onset of rains due to the effects of cloudiness. It increases a bit after the cessation of rains in October to November. Four commercially released varieties of potato named as Dali, Careira, Redsonia and Connect (controlled) imported from the Potato Research Institute of Czech Republic with the exception of Connect which is under cultivation in the country. The field was laid out in a Randomized Complete Black Design (RCBD) with three replications. The unit plot size was 9 m^2 (3 m×3), having four rows (ridges) consisting of ten hills with intra and inter raw spacing of 0.3 and 0.75 m, respectively. Plant heights responded well to the environment. Data collected were plant heights, leaf area, stem girth, number of branches, weight of seed tubers per stand, weight of tubers per stand and yield (tons/ha). Results revealed that all the varieties tested performed well under the environmental condition of Kwaja plateau, Mubi Adamawa State.

It is recommended that all the varieties are here by recommended for potato growers on Kwaja Plateau and any other locations with similar environmental characteristics.

Key words: Adaptability, Redsonia, Careira, Dali, Connect, Environment, Temperature.

Introduction

Potato is the most abundant and efficient tuber crop in the world in terms of tuber yield and days to maturity. It matured in about 2-3 months (60 – 90 days) as compared to 9 and 12 months of yam and cassava respectively (Kudi.,*et al* 2008). The crop is now a Worldwide crop grown under many climate conditions. The highest average yields are obtained in region with moderate climate such as Northern United States and North Western Europe, where potato is grown under long days, moderate temperatures and modern cultivation methods (Levy and Veilleux, 2007). In Nigeria it becomes one of the most economically important crops as a source of food and cash especially on the Plateau and even other parts of the country such as southern Zaria in Kaduna and mambilla Plateau etc. (Dayok et al., 2019).

Potato is regarded as high potential food security crop because it produces large quantity of dietary energy (30 to 35 tons/ha starch based produce in 3 to 4 months) and has relatively stable yield under condition in which other crops may fail (Gebremedhin et al., 2008; FAO 2010). There is an increasing demand for potato as ingredient in other fast food that entail salad and process product

such as French fries and crisp, as a result of dietary diversification among urban dwellers, emerging fast food restaurants and small scale road side fryers (Tesfaye; Lemaga ; Mwakas endo; Ortiz; Criss - man and Thiele 2010).geria is the fourth biggest producer of potato in the sub-Saharan Africa. It has almost much land under potato production as Germany (Giz 2016). The main potato growing area is Jos Plateau state, where altitudes ranging from 1200 to 1400 m and a temperature that rarely exceed 35 °C makes the climate well suited for potato production. However, productivity is constrained by diseases and lack of suitable varieties among other factors .Average potato yield in Nigeria is a little over 3.1 tons/ha (Giz 2016), a far below, from the global average yield of 40 tons/ha.

The researcher aim is to apply the knowledge gained in the course of their mission to Czech Republic by embarking on the adaptability research on the new varieties which was given to them at no cost by the management staff of Potato Research Institute of Czech Republic in consultation with Czech University of Life Sciences, Prague. This will add value to potato production in Nigeria which is in dare need, increase yield, early maturing, disease resistance and improve income, food security and livelihood of small scale farmers and their households. In this way, the mission to Czech Republic would have achieved one of its many objectives. Therefore, it is essential to evaluate the imported varieties which have high yield potential to assess their suitability and adaptability to the local environmental conditions.

Problem Statement

1. Low yield /ha of potato
2. High susceptibility of potato variety to diseases
3. Inadequate improved variety of potato seed
4. High cost of seed potato
5. Late maturity of potato

Research Objectives

1. Improved variety with high yield that mature early
2. Early maturing and disease tolerant varieties to reduce high risk in potato farming
3. Improved varieties is made available to farmers at relatively low cost.

History and Distribution of potato

Potato is native to Peruvian – Bolivian Andes. It was cultivated in Southern America by the Inca (Inka Empire) was the largest as early as 1,800 years ago. The Spaniards who colonized South America introduced potato into Europe during second half of the 16th century ((Jeff, 2010). Potatoes were introduced outside Andes region four centuries ago, and have become an integral part of world food supply. It is world fourth largest food crop supply following Mize, wheat and rice (Bowl., William and Johnson, 2010). World potatoes species occur throughout from South America to Chile. The potato was believed to have been domesticated independently in multi locations, but later genetic test of the wild varieties of cultivars and species proved a single origin for the potatoes grown in the area of present Southern Peru and extreme Northern Bolivia from (species in *Solanum brevicaul* complex), where they were domesticated 7,000 – 10,000 years ago (Theissen, 2007). Other authors like Reader (2008) gave an account of the origin of potato that, its originated some 8,000 years ago in high altitude tropical area of Peru where a staggering 5,500 cultivated varieties have been developed by generation of century. The tuber quickly adopted to Northern growing conditions and soon became a stable food at a time of rapid population growth. From Europe, it spread across the globe. Today, potato is grown on an estimated 180,000 Sq. km of farm land ranging from China's Yunnan plateau and the Steppes of Ukraine (FAO, 2008). FAO (2008) says the increase in the production areas dedicated to potatoes in the commodities show that by 2002 the demand for potato is expected to double that of 1993.

The English word potato comes from Spanish patata. The Spanish Royal Academy says the Spanish word is a compound of the Taino batata (sweet potato). Originally referred to a type of sweet potato rather than the other way around although there is actually no close relationship between the two plants. the English confused the two plants one for another. In many of the chronicle detailing agriculture and plants, no distinction is made between the two as reported by Kudi et al. (2008).

The staple crop was subsequently conveyed by European Mariners and ports throughout the world. The potato was slow to adopt by distrustful Europeans farmers but soon enough, it became an important food stable and field crop that played a major role in the European 19th century population boom (Kohli, 2009)

Potatoes were introduced into Nigeria during the 1920s, probably by way of German living in the Cameroon and by Europeans involved in Tin mining in the Jos plateau (Obigbessan, 1976). Production was limited to a small garden plots until the second world war where the British Colonial Government encourage potato farming to help feed the service men in West Africa (Obigssan, 1976). Hijams and Spooner (20005) reported that an increase annual production from a mere 180 tons in 1940 – 1,732 in 1944 was reported.

Formal research on potatoes in Nigeria dates from 1940 with the establishment of the government farm in Riyom near Jos. In 1961 a seed multiplication project was established by the ministry of agriculture (Hijams and spooner, 2005). A potato producing program was established in 1964 with experimental sites at Gana wuri, Tatyos and Vom on the Plateau. The project was operated with funding and technical assistance from the United State Government program (USAID) and the department of agriculture (USDA). The institute of agricultural research at Samaru Zaria assumed responsibility for the program in 1972 (Hijams and Spooner 2005).

The crop is now an important delicacy in many households in Nigeria. it is cultivated in many parts of plateau state and exported to other neighboring countries (Abimaje, and paul, 2014). Plateau state could simply be tagged as the home of Potatoes because of the chilled and favourable weather. The crop is grown in commercial quantity in Mangu and Bokkos LGAs. These two area councils of the state along can feed the entire country and beyond with potatoes if the righst environment is created for its production including good quality seed (Abimaje and Paul 2014). The crop is also grown in some part of Plateau North Senatorial District including Barkin Ladi, Riyom and Bassa and Jos East LGAs.

The crop is Exported from Plateau state to neighboring States of Ghana, Ivory
Coast, Cotonou, Niger Republic Etc. According to a 2009 World Bank report on Potato in Africa, Nigeria has a harvested area of 27,000 hectare of farm land with 3.1 tons yield per hectare amounting to 843,000 tons annually. This is a far cry below Egypt; 105,000 ha, 24.8tons/ha and 2.6m tons annually (Abimaje and Paul, 2014).

In 2021, FAO data estimated that 376 million metric tons of potato were produced worldwide. China is the leading producer worldwide. The country accounted for approximately 94 million metric tons of potato that year. India ranked as second leading worldwide producer of potato. India accounted for approximately 54 million metric tons of potato in the same year (Kudi et al. 2008). Czech Republic has reported a per hectare yield of 29.3 tons /ha (Jeff 2010)

Environmental requirements of Potato

Klenpt and Olsen (2003) reported that potato requires a well-drained loamy soil that is rich in humus with a temperature range of 34 -40 °C and rainfall of 1,400 mm with minimum sunshine. Waterlogged soils are not suitable for the growth of the crop. The crop need a soil pH of less than 5 and hence, liming is not necessary unless the pH is very low. Potato requires night temperature as low as 9.4 °C – 15 °C which is essential for satisfactory result. Klenpt and Olsen (2003) also pointed out that potato is a crop of low climates, therefore, optimum growth and productivity is achieved when soil and other climatic conditions such as rainfall, temperature and relative humidity and day length are significantly satisfactory.

Claudhary (2004) showed that potato is a cool season crop. Low temperature and humidity favour foliage but dry condition results in dropping of flowers and leaves. The plant required low light intensity for it influences the ascorbic acid content of the tubers. If the light is high ascorbic acid content of tubers will be low. Reported experimental result indicates that water stress conditions at different growth stages cause different adverse effects on crops yield. For example, in southern Italy, when the October to December period was dry but the following January to May period was rather wet, one irrigation immediately after sowing resulted in tuber yield of 132 tons per/ha (from 2.03 t/ha – 4.71 t/ha). However, irrigation only at the booting stage increase yield by just 23 % (from 2.03 t/ha – 2.5 t/ha) as reported by Caliandro and Boari (1992). Studies in several growing areas have shown that daily water need increase rapidly from emergence until about two weeks after row closure. From this time, potato daily water requirement remains nearly constant until the vine begin to mature at which time water requirement decline rapidly (William and Johnson 2010; Dayok; Gusup; Gowok and Marroh 2019).

Botany of Potato

Potato plant are herbaceous perennial that grow about 60 cm high depending on variety the culm dying back after flowering. They bear white, pink, red, blue or purple flowering with yellow stamina. In general, the tuber with varieties with white to cream colour skin which may be mottled with black fleck or marks (Jeff, 2010).

Potato is classified as wax which means that they are clearly suited to boiling as they will hold their shape well. Potatoes are cross-pollinated mostly by insects including humble bee which carries pollen from one potato to the other but the substantial amount of self-fertilizing occurs as well (Jeff, 2010).

Seed Size of Potato

Potato can be planted whole or slice (cuts). Arsenault and Christic (2004) reported that for potato seed to be planted whole the seed must be between 28 - 34 grams in size. Stark and Canet-Love (2003) reported that if the tubers of potatoes are small to medium in size, the whole potato should be planted. if they are large in size, they can be cut (sliced) in half or equator. Each section '2-3' growing 'eyes' after cutting the surface should be callus before planting. Stark and Canel-love (2003) further stress that tubers larger than local chicken egg or slightly larger should be cut into two pieces across. Each piece should have at least one "eye" (the bud where they will grow from) preferably two "eyes". Traditionally, cuts seeds potatoes allowed to cure for some few days to week before planting. This will go a long way to reduce the amount of seed required to about 50 % which could be of great financial help to growers (Nolte; Batema; and Randal, 2002). Palvista (2005) claimed that cut potato tubers treated with fungicide Mancozeb decrease decay and increase tuber yields. He further said the performance of whole seed and cut seed is not significantly different. Nolte *et al* (2002) studied the performance of whole seed tubers versus cut seed tubers and reported that there is no yield difference between them.

Varieties of Potatoes

Farmers usually select seeds at harvest from their own farms and periodically go outside their farms to bring "new" or "fresh" seed (seed renewal). There are now well over 5000 varieties of potato (MANR 2016).

Potato is a versatile commodity adapted to a wide range of agro – ecologies and their indication of its potential for further expansion in various eco – systems (Burke 2017; CIP 2017). Potato can grow from sea level up to 4,700 meters above sea level, from the southern Chile to Greenland (CIP 2017). The hilly fertile terrain of East, Central, West and Southern Africa from Ethiopia to the North down to Mozambique on the Coastal South, from volcanic highland regions of the Democratic Republic of Congo, Burundi and Rwanda, the highland of West Africa of plateau of West Africa in Cameroon, and Nigeria. These are all home to more than seven million small holder potato farmer households (Abdulwahap; Griffin' Sculz and Struiuk 2016).

Plant breeding programs primarily focus on improving a crop adaptability and tolerance to biotic stress in order to increase yield. Crop improvement made since the 1950s couple with inexpensive organic inputs, such as fertilizer, fungicide and water have allowed agricultural production to keep pace with human population growth (Brummer; Wesley; Sarah; Thomas; Johnson and Seth (2011). In Ethiopia, a number of improved potato varieties have been released by different research institutes with major emphasis to wide adaptability, high tuber yield and late blight resistance (Asefa; Wassu and Tesfaya 2016). Since the registration of the first variety (AL-624) in 1987, more than 36 potato variety were released by the research center high learning institutions and private companies (Gebremedhi 2013, MANR, 2016). However, the performance of these varieties under a common set of environment was not studied and documented (CIP 2017). Since they were released by different institution and also recommended for different agro-ecologies. Thus it is crucial to evaluate these varieties under the same set of environment and identify high yielding varieties under central Ethiopia's environmental conditions.

The most common varieties of potato in Nigeria are red and the white skin, but the red variety stayed longer than the white. Potato is a stable food classified under vegetable. In recent years' potato has witness a growing demand (CIP 2017; Tilhun 2018).). This carries mainly consumers who have come to realize its health benefits.

There are several varieties of potatoes in Nigeria, some of which includes Rosetta, Diamond, Nicola etc. In Nigeria most of the potato varieties are imported due to limited availability of improved varieties that can withstand biotic stress in the country (NRCRI, 2005). Some few improved varieties, their yield potential and days to maturity are presented in Table 1. Since no single variety can satisfy all farmers' needs because of varying production, processing needs. The varieties of potato from research institute of Czech Republic brought by Nigerian Experts who went for educational mission in Agricultural Technology Transfer September – December 2022

MATERIALS AND METHOD

Site Description and Characteristics.

The Study Area.

Study area is Kwaja, locally called the Mubi Plateau due to the altitude and low temperature of the area in Mubi South local government area, Adamawa state. The region has a characterized tropical wet and dry season type of climate as coded by Koppeans classification. Data on major climate elements in the study area are not readily available as there is no standard weather station in the area under study. The department of Agricultural and Bio- Environmental Engineering of the Federal Polytechnic Mubi established a digital Meteorological station in January, 2002, to generate climate data of the region.

The temperature of the regime of the research area is warm to hot throughout the year, because of the high radiation (*Adebayo et al,* 2019). Although, there has been a gradual increase in temperature from January to April with seasonal maximum in April, temperature drops slightly at the onset of rains due to the effects of cloudiness. It increases a bit after the cessation of rains in October to November.

Elevation (altitude) is a local factor which affects temperature and encourage the production of Irish, Sweet potato and other temperate crops in the region intended for the research, as reported by *Jerry et al, 2023.* That Altitude is a local factor which affects the temperature regime in the tropics. The effects of elevation is noted in Kwaja- Nduku area, situated on the hills. Thus, temperature lowers as the altitude increases. In that regard settlements such as Kwaja, Bwade,Dirbishi and Julvu of both Mubi North and South local government. The highiest altitude in the region is most peculiar with the area is the production of Irish Potato in Kwaja and Bwade in Mubi south local government area,(*Adebayo et al, 2019).*

MATERIALS AND METHODS

Four commercially released varieties of potato named as Dali, Careira, Redsonia and Connect (controlled) imported from the Potato Research Institute of Czech Republic with the exception of Connect which is under cultivation in the country. The field will be laid out in a Randomized Complete Black Design (RCBD) with three replications. The unit plot size was 9 m^2 (3 m×3), having four rows (ridges) consisting of ten hills (40 hills per plot) with intra and inter raw spacing of 0.3 and 0.75 m, respectively. A distance of 0.5 m by 1 m will be maintained between unit plot and block respectively. Seed tuber of each variety was planted by hands in farrows at a depth of about 15 cm. Rabbitary dung will be applied through broadcasting as a base fertilizer. N.P.K 15-15-15 fertilizer will applied 4 WAP as per recommendation of Camps and Camps (2019) accordingly, 110 kgN and 90 kg of P_2O_5 ha^{-1}, Nitrogen will be applied in the form of Urea (46 %N) 165 kg/ha (split half of planting and the rest during flowering and P_2O_5 in the form of DAP (46 % P_2O_5 and 18 %N) 195 kg/ha site dressing at the time of planting (FAOSTAT 2011). Management practice such as weeding, cultivation and ridging will be practiced as per the recommendation of (Gebremedhin et al. 2008). Harvest will be undertaken by hand when the leaves 50% of the plants in the plot turned yellowish and the same process will be applied during the irrigation season.

Data Collection and Analysis

Data on growth and yield performance comprise of days to 50% emergence, days to 50% flowering, days to maturity plants height, stem number per hill, disease incidence, tuber number per plant, tuber weight, yield per plant marketability (ware tubers) yield, unmarketable (seed tuber) yield and total yield will be recorded for individual response variable from the two harvestable middle raw of each plot. The raw data will be subjected to ANOVA following the standard procedure given by SAS Institute Inc. (2008). After fitting ANOVA model for significant response variables, a mean separation was carried out using LSD method at 5 % level of significance. All the statistical analysis will carried out using SAS-9.2 statistical package (SAS Institute Inc., 2008

RESULTS AND DISCUSSION

Adaptability Study on Plant Height (cm) and Leaf Area (cm^2) of Potato

Adaptability effect on plant height and leaf area of potato are presented on Table 1. Result showed significant ($p < 0.05$) effect of adaptability on plant height at 6 WAP and 10 WAP but there was no effect at 8 WAP. Treatment D (Careira) gave higher plant heights (30.16 cm) followed by treatments B (Dali) and treatment C (Redsonia) with 20.8 cm each while treatment A gave the least plant height (20.2 cm) at 6 WAP. At 10 WAP the highest plant heights were obtained in treatment C (58.13 cm) followed by treatments A and B with 57.10 cm each while treatment D gave the least plant height of 8.03 cm.

There was significant ($p < 0.05$) effect of adaptability on leaf (cm^2) of potato throughout the duration of data collection. At 6 WAP, treatments C and D had 10.21 cm^2 each while treatments A and B gave lower leaf areas of 10.20 cm^2 each.

At 8 WAP, treatment B gave the highest leaf area of 40.16 cm^2 followed by treatments C and D with 40.13 cm^2 each while treatment A produced less leaf area. At 10 WAP, treatments A, C and D produced the same leaf area of 60.53 cm^2 each while treatment B had the lowest leaf area 60 48 $cm.^2$

Table 1: Adaptability effect on plant height and leaf area of potato

	Plant height (cm)			Leaf area (cm^2)		
Treatments	**6WAP**	**8WAP**	**10WAP**	**6WAP**	**8WAP**	**10WAP**
A	20.2	50.10	57.10	10.20	40.10	60.53
B	20.8	50.10	57.10	10.20	40.16	60.48

C	20.8	50.16	58.13	10.21	40.13	60.53
D	30.16	50.20	53.03	10.21	40.13	60.53
LSD	1.14	0.94	3.26	0.36	0.68	1.95
f-pv	<0.029	<1.070	<0.0002	<0.00003	<0.00026	<0.000005

Key: LSD (0.05): fisher's least significant; F-pv = probability value; WAP = Week after planting; A = variety Connect (control); B = Variety Dali; C = Variety Redsonia; D = Variety Cariera.

Adaptability study on Stem girth (cm) and Number of Branches of Potato

The result on the adaptability study on stem girth (cm) and number of branches of potato are presented in Table 2. Results revealed significant ($p < 0.05$) effect of adaptability on stem girth of potato throughout the time of data collection. A 6 WAP, treatment D gave more plant vigour (stem girth) (3.20 cm) followed by treatment B while treatments A and C gave the same stem girth of 3.13 each. At 8 and 10 WAP the result followed the same pattern.

The number of branches showed significant ($p < 0.05$) effect on response to the environment. At 6 WAP, treatments A, B and D responded to the environment equally with 2.66 branches each while fewer number of branches were obtained under treatment C. At 8 WAP, treatment B gave more number of branches (3.66) while treatments A, B and D maintained 3.33 number of branches each (Table 2). At 10 WAP, treatment B gave more number of branches followed by treatment D while the least number branches were obtained in treatment A.

Table 2
Adaptability effect on stem girth (cm) and number of branches of potato

	Stem girth (cm)			Number of branches		
Treatment	**6WAP (cm)**	**8WAP (cm)**	**10WAP (cm)**	**6WAP**	**8WAP**	**10WAP**
A	3.13	5.23	9.26	2.66	3.33	3.01
B	3.16	5.16	9.26	2.66	3.66	4.00
C	3.13	5.23	9.23	2.33	3.33	3.30
D	3.20	5.20	9.30	2.66	3.33	3.66
LSD	1.18	1.52	2.0.	1.07	3.98	1.24
f-pv	<0.0004	<0.0013	<0.0001	<0.012	<0.009	<0.002

Key
LSD (0.05): fisher's least significant; F-pv = probability value; WAP = Week after planting; A = variety Connect (control); B = Variety Dali; C = Variety Redsonia; D = Variety Cariera

4.3 Adaptability Effect on Weight (kg) of Seed Tubers, Weight (kg) of Ware Tubers and Yield (t/ha) of potato

Adaptability effect on weight of seed tubers per plant, weight of ware tubers per plant and yield (t/ha) of potato are presented in Table 3. Result on weight of seed tubers per plant and were not significant. However, there was significant ($p < 0.05$) effect of adaptability on weight of ware tubers

per plant and yield of potato at harvest. Treatments A, C and D had the same yield of 17.23 t/ha each while treatment B had the least yield of 17.06 t/ha.

Table 3

Adaptability effect on weight of seed tubers per plant, weight of ware tubers per plant and yield tons/ha of potato

Treatment	Weight of seed tubers/stand (kg)	Weight of ware tubers/stand (kg)	Yield (tons/ha)
A	12.00	15.33	17.23
B	12.66	16.66	17.06
C	13.00	17.00	17.23
D	13.00	15.00	17.23
LSD	2.29	2.58	2.39
f-pv	<0.0197	<0.063	<0.0003

Key

LSD (0.05): fisher's least significant; F-pv = probability value; A = variety Connect (control); B = Variety Dali; C = Variety Redsonia; D = Variety Cariera

DISCUSSION

Plant Heights and Leaf Area of Potato

Plant heights responded well to the environment. The heights were comparable to the findings of Jeff 2010. Jeff (2010) had reported that potato plant is a herbaceous plant that grow up to 60 cm. Abimale and Paul (2014) had reported that Plateau can simply be regarded as home of potato because of its chilled and favourable weather. In this study the findings revealed that all the varieties tested had a favorable and adaptability thus the heights are comparable to the one reported by other researchers.

The leaf areas also showed that the Czech Republic varieties (Dali, Redsonia and Carier) did well under the Plateau environment. They performed comparable to the connect (control) which has been tested and adapted to the ecosystem. The growth parameters are a pointer to yield production of the crop. Kudi et al (2008) had reported that potato crop is now a Worldwide crop grown under many climate conditions.

Stem Girth and Number of Branches of potato

The varieties tested produced high vigour plants which gave the plant capacity to withstand adverse environmental factors such as strong wind which could cause lodging and falling down of plants. Klenpt and Olsen (2003) noted that optimum growth and productivity of potato is achieved under soil and other climatic conditions such as rainfall, temperatures and relative humidity and day length are significantly satisfactory. Claudary (2004) said that low temperatures and relative humidity favours foliage but dry conditions result in dropping of flower and leaves.

Number of branches of potato were satisfactory. Thus made it possible for the crop to roots enough to ramify through the soil to obtained sufficient nutrients for the development of the crop. It also guaranteed the translocation of manufactured food from the leaves to plant roots. Burke (2017) and CIP (2017) posited that potato is a versatile commodity adapted to wide range of agro – ecologies and their indication of its potential for further expansion in various eco – systems.

Yield Parameters and Yield of Potato

The yield parameters (weight of seed tuber and weight of ware tubers) are a clear indications of the yield of potato. This study showed that the yield parameters were some good indicators of a favourable yield of potato. All the varieties tested gave favourable seed tubers and ware tubers. This is an indication that farmers who may not afford "new" seed varieties can get sufficient seed from their own farms for next farming season. And also have enough market size potato for sell to make profit.

SUMMARY AND CONCLUSION

The yield average (17.23t/ha) obtained for all varieties in this research were far higher the average national average of potato yield in Nigeria. Giz (2016) had reported that average potato yield in Nigeria is 3.1 tons/ha. Although the yield obtained is still a far cry from the global average yield of potato which is put at 40 tons /ha and the of the national average of the Czech Republic put at 29 tons/ha (Giz 2016; Jeff 2010), it is still a very encouraging result. The lower yield compared to the global average including that of the Czech Republic to loss in seed viable. The seeds were harvested in Czech Republic in September, 2022 and brought to Nigeria in December 2022 but were planted in May, 2024 at Kwaja Plateau, Mubi Adamawa State.

The research was carried out to determine the adaptability of improved potato varieties of potato in Plateau State. The potato varieties (Dali. Redsonia and Careira) were brought from Czech Republic in December, 2022. Variety Connect which is already an adapted variety was also planted to serve as a control

The land was cleared and ridges were made using big hoe. All agronomic and cultural practices were diligently followed. The experiment was laid out in a Randomized Complete Block Design (RCBD) with four treatments A= Connect (control), B = Dali, C = Redsonnia and D = Caareira each replicated three times.

Data collected were plant heights, leaf area, stem girth, number of branches, weight of seed tubers per stand, weight of tubers per stand and yield (tons/ha). Results revealed that all the varieties tested performed well under the environmental condition of Kwaja plateau, Mubi Adamawa State.

RECOMMENDATION

All the varieties are here by recommended for potato growers on the Plateau state and any other locations with similar environmental characteristics.

REFERENCES

Abdulwahap, A; Griffin, D; Sculz, S. and Striuk, C. (2016). The Ethiopian highlands; fertile ground for seed potato production; 2016, (accessed on May 2019).

Abimaje, A. and Paul, A. A. (2014). The hub of Irish potato farming in Plateau State. Nigeria.

Amadi, C. O., Okonkwo, J.C., Lenka, D.M., ASumugra, G. N. and Nirosu, K. L. (2009). A Guide to Potato Production in Nigeria. Extension Service Programmed. Natural Root Crops Research Institute Umudike.

Amadi, C. O; Kum, D. L and Okonkwo, J.C. (2000). Potato germplasm evaluation, characterization and conservation. Annual Report National Root crops Research Institute, Umudike,

Arsenault, W.J. and Christic, B.R. (2004). Effect of whole seed tuber size and pre plant storage condition on yield and tuber size distribution of Russet

Asefa, G; Wassu; M. and Tesfaye, A. (2016). Evaluation of potato (*Solanum tuberosu* L) for resistance to late blight at Sinna South eastern Ethiopia. Int. *J.*Agric.Res. Innov. Technol. 2016; 6(1): 21 – 25.

Balali, G.R., Hadi, M.R., Yavari, P., Bidram, H., Nadari, A.G. and Eslami, H. (2008). Effect of pot size, planting date and genotype of mini tubers production on yield of *Maritona* potato cultivar. *African Journal of Biotechology* 7 (9): 1265-1270.

Bowl, A. William, H. and Johnson, S. B. (2010). Commercial potato production in Northern America, the potato Association of America Handbook.

Bruke, J. J. (2017). The potato crop, vita. Equity House, Upper Ormond Quay, Dublin 7 Ireland, 2017.

Brummer, E.C; Wesley, J. B. Sarah, M. C; Thomas, S.C; Johnson, R. and Seth, C. M. (2016). Plant breeding for harmony between agriculture and environment. Front ecol. Environ. 2011. 9(10): 1 – 10.

Caliandro, A. and Boari, F. (1992). Supplementary irrigation in arid and semi-arid regions. In: International conference on supplementary irrigation and drought water management, volume-1, Sept 27-oct 2. Bari, Italy: C.I.H.E.A.M.

Camps, C. and Camps, Z. N. (2019). Optimizing production of reducing sugars dry matter of potato frying by TNIR spectroscopy on peel tubers. Molecules 2019: 24(5): 967 https://doi.org/10:3390/molecules 240967.

CIP (International Potato Center) (2007). Procedure for standard evaluation of trials of advance potato clones. An International Cooperations'Guide. Lima, Peru.

Claudhary, R. C (2004). Introduction to plant breeding. Oxford Publishing and IBIT C.O. PVTLTD. New Edition.

Daggash, H. (2018). Nigeria and climate change: Global Trends and Challenges. (online) Available at **www.CLIMATE/Nigeria** and climate change. The Republic. htm(Accessed 26 – 09 2018).

Darabi, A. (2002). Effects of planting on the yield of potato cultivars in Autum cultivation *seed plant*. 18(2): 242-254.

Dayok, S.T; Gosup, G. B; Gowok. H. and Marroh, Y. (2019). Supplemental irrigation for improved potato productivity and water use efficiency of potato in dry areas A review. Belt *Journal* of Education in Nigeria Vol. 3 No. 69 – 73 pp.

Dimlong, S.Y. (2012). Best practices on potato production and storage. Pro-poor Growth and Promotion of Employment in Nigeria Programme (SEDIN). Asokoro, Abuja, Nigeria.

FAO (2010). Strengthening potato value chains. The International Year of Potato. Rome, Italy. Internet Document, www.potato2010.org/en/world/africa.html.

FAO (2011). Production year book. Rome, Italy. 2011.197pp.

FAO, (2008). International year of the potato diffusion (Hidden Treasure). Food and Agriculture Organization of the United Nations. Retrieved 17th October, 2008 from http.www.potato2008.org.on potato.

FAOSTAT (2011). Food and Agricultural Organization of the United Nations. Available on line. https://www:fao.org/faostat/fr/Afdata/QC (accessed on January,2019).

Gebremedehin, W; Endale, G. and Lemaga, B. (2008). Potato Agronomy. In: Gebremedhin, W; Endale, G and Lemaga, B. (eds.). Roota and Tuber Crops: The untapped Resources. Pp 33 – 36. Ethiopia Institute of Agricultural Research.

Gebremedhin, W. (2013). Potato variety development strategies and methodologies in Ethiopia. In: Gebremedhin, W; Schulz, C and Baye, B, (eds.).

Proceedings of the National Workshops on Seed Potato Production Dissemination Experiences and Prospects. Ethiopian Institute of Agricultural Research and Amihara Regional Agricultural Research Institute, 12 – 14, Bahir, Dar, Ethiopaia 2013, pp 45 – 59.

GIZ (2016). Farmers Bussiness School – Production of potato, maize and soyabeans. Training Note book and Workshope. German Cooperation, 1st edition 2016, pp78.

Harris, H. C. (2001). Implications of climatic variability. In: S*oil and crop management for improved water use efficiency in rain-fed areas,* eds. H. C. Harris, P. J. M. Cooper, and M. Pala. Proceedings of an International Workshop 1989, Ankara, Turkey. Aleppo, Syria: International Centre for Agricultural Research in the Dry Areas.

Hijams, R, J; Forbes, C. G. and Walker, T.S. (2000). Estimating the global serenity of potato late blight with GIS linked disease forecast models. Plant Pathology 49: 697 – 705.

Hijmans, R.J. and Spooner, D.M. (2005). Lay summary "a single domestication for potato based on multilocus implied fragment length polymorphism Genotyping". PNAS 102(4). 14694-99. Doi.10.37/pnas0507400102.

Jeff, S. (2010). Growing Irish potato. Association of Agent Agricultural of Natural Resources University of Arizona, Co-operative Education. Yivapa Country.

Kawa-Kami, J., Iwena, K. and Jitsuyama, Y. (2005). Effect of planting date on the growth and yield of two potato cultivars grown from micro tubers and conventional seed tubers. *Plant product science* 8(1): 74-78.

Klenpf, G.E. and Olsen, N. (2003). Storage management in potato production. In: J.C. Stark ad S. L. Love (eds.) university of Idaho Agricultural Communications, 363-381.

Kudi, I.M., Akpoko, I.G. and Yada, p. (2008). Resource Productivity and Profitability. Analysis of Irish Potato Production in plateau State, Nigeria. *Savanna Journal of Agriculture* (3):47-52. Retrieved 27th August 2011 from http.www.savanna journal.comvo113html.

Levy, D. and Veilleux, R. E. (2007). Adaptation of potato to high temperature and salinity – A review. America *Journal* of Agriculture 36 (4): 25 – 30 PP.

Lukden, D.W., Zak, N.T. and Datom, D.D. (2004). Agricultural Science. A Practical Guide for Fields Crops. Pp 65.

Ministry of Agriculture and Natural Resources (MANR) (2016). Crop variety released. Protection and Seed Quality Control Directorate, Issue number 19, Addis Ababa Ethiopia, 2016.

National Root Crops Research Institute (NRCRI), (2005). Research Highlights of the National Root Crops Research Institute, Umudike, Accounts Division, Retrieved 20th October, 2009 from www.nrcri.org.

Ndor, D.C. (2013). A survey of Diseases of irrigated potato *(Selenium tuber sum L.)* in the Fadama areas of Kuru as Kerang. Plateau State. Maiden National Conference, Proceedings of Academic staff Union of Colleges of Agriculture and allied Institutions, College of Agriculture, Garkawa, Plateau State, Nigeria

Nolte, P; Batema, M. and Randal, J. (2002). Seed decay and performance of cut Obigbesan, G. O. (1976). Report on potato production in Nigeria. International potato course: production. Storage and seed technology. Report of participants. International Agriculture center, Wagenining, the Netherlands.

Nworgu, F.C. (2006). Prospect and pitfalls of agricultural production in Nigeria. Federal College of Animal Health and Production Technology, Institute of Agricultural Research and Training. Ibadan press. New age encyclopedia.14.

Obigbesan, G. O. (1976). Report on potato production in Nigeria. International potato course: production. Storage and seed technology. Report of participants. International Agriculture center, Wagenining, the Netherlands.

Okonkwo, J.C., Okoli, O.O. and Ene, S.O. (1995). A guide to Potato production from the true seeds in Nigeria. National Root Crops Research Institute, Umudike, Umuahia, Abia State, Nigeria.

Opeku-Ameyaw, K. and Harris, P.M. (2001). Intercropping early spring potato in a temperate climate. The influence of planting date, row and width and temperature change on the potential for intercropping potato. *Potato Research*.44:25-85.

Palvista, A.D. (2005). Cutting whole Potato seed tuber for planting. The Mebraska Potato, 17:14.

Rady, A. M. and Guyer, D.E. (2015). Evaluation of sugar content in potato using NIR reflective and wavelength selection technique postharvest. Biotech. 2015, (103) 17 – 26.

Reader, J. (2008). Propitious Esculent: Potato in world History. 66 (1): 315 – 320. Published by Random House London.

SAS Institute INC. (2008). SAS/STAT; 9 – 2 Users GUIDE. Cary, N. C. SAS Institute Inc. USA.

Stark, J. Canel- Love, S.L.(Editors) (2003). Potato production system, University of Idoho Agricultural Communication, Moscow, Idoho.

Tesfaye, A. B.; Lemag, J. A; Mwakasendo, Z. O; Ortiz, C.; Crissman and Thiele,

G. (2010). Market for fresh and frozen potato chips in the ASARECA Region and the potential of Regional Trade; Ethiopia; Rwanda; Burundi and Uganda. Working Paper International Center (CIP). Lima, Peru. 2010. 44pp.

Theissen, L. (2008). History and overview of world potato Atlas, Peru, International potato center.

Tilhun, B. (2018). Adaptability study of improved potato (*Solanum tuberosum* L.) varieties of Shebench District, South – Western Ethiopia. Academia *Journal* of Agricultural Research. 6(10)333 – 339, October 2018 Doi.1015413/ajar; 2018,0147 ISSN; Academia 2315 – 7739 @ 218 Academia Publishing.

William, H.B. and Johnson, S.B. (2010). The Potato Association of America Handbook. Commercial Potato Production in North America. Second Revision of American Potato Journal Supplement Volume 57 and USDA Handbook 267 by the Extension Section of the Potato Association of America. P. 54.