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FIELD EVALUATION OF FIRST GENERATION SEED TUBERS PRODUCED FROM TRUE POTATO SEED (TPS) FOR YIELD AND BIOTIC STRESS

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ABSTRACT

Studies were carried out in 1997 and 1998 at Kuru, Jos Plateau to evaluate the first generation seed tubers produced from TPS of six potato genotypes for yield and biotic stress. Tubers with odd shapes and off-colours were visually sorted out before planting.

The results showed that visual removal of seed tubers with odd shapes and off colours from the first generation seed lot before planting increased the uniformity of tuber skin colour and shape of the second-generation tubers by 8.4 and 17.6 percent, respectively. Difficulties in visual separation of the small size and immature seed tubers produced from TPS contributed to the incomplete uniformity in colour and shape of the second-generation tubers. Incidence of diseases and pests in the study was low. Disease scores ranged from 1 to 2 on a scale of 1 to 5. No genotype was resistant to all the disease and pests studied. Four out of six TPS genotypes out-yielded the local best potato variety. The tuber number, size, dry matter and tuber fresh weight yields of TPS of selected genotypes indicated that the TPS genotypes were not inferior to Nicola, the local best potato variety.

This study shows that normal potato seed tubers can be produced from first generation TPS tubers. Although the seed lot is a mixture of clones, it provides a short-term solution to farmers' seed demand for ware potato production.

INTRODUCTION

Inadequate supply of good quality seed potatoes to farmers is a major hindrance to the expansion of potato production in Nigeria. Okonkwo et al. (1995a) reported that seed demand by potato farmers each year is between 60,000 and 100,000 tonnes. Farmers produce 20-30% of this requirement and lose 30-40% of the quantity produced during storage (Okonkwo et al, 1988).

Most potato varieties grown in Nigeria today were imported over 15 years ago and their yields have declined by over 40% of the initial yield. Beukema and Zang (1979) reported that seed degeneration under tropical conditions is generally high. Because of the present restrictions in the importation of seed potato, there is need to seek other alternatives of supplying seed potato to farmers if the present level of production is to be sustained. Studies have shown that seed potato can be produced from true potato seed (botanical seed). True potato seed is widely used for seed and ware potato production in china, India and Peru (Malagamba and Monares, 1988). Among the several advantages of using TPS for potato production, the production and storage costs of potato tubers are drastically reduced. About 2 tonnes of seed tubers are required to plant one hectare of farmland while only 150 grammes of viable TPS are needed to plant the same area (Malagamba and Monares, 1988). Booth and Shew (1981) also reported that under tropical conditions, it is difficult to store seed tubers for more than 6 months outside refrigerated conditions, but true potato seed remain viable after storage for a period of 5 years (Burton, 1989). Use of TPS for potato production could also eliminate tuber borne diseases such as bacterial wilt and leaf roll virus (Burton, 1989).

Studies carried out at Kuru,

Table 1: Average Rainfall, Temperature, Relative humidity and Sunshine of Kuru (1997 and 1998)

Month	Rainfall (mm)	Temperature (°C)		Relative Humility	Sunshine (Hours)
		Max	Min	(%)	
January	0	19.3	10.9	48	9
February	0	21.0	11.8	55	9
March	0	26.5	13.8	68	8
April	55	27.4	16.8	76	8
May	216	24.8	16.9	78	7
June	245	24.8	16.5	80	6
July	329	26.5	15.8	86	6
August	378	23.6	15.6	90	5
Septem-	289	24.2	14.1	93	4
October	68	24.8	13.3	86	4
Novem-	0	22.1	12.2	69	7
Decem-	0	21.8	10.7	55	9
Mean	**131.7**	**23.9**	**14.0**	**73.7**	**6.8**

Nigeria showed that about 24 potato varieties which flower and fruit under Jos Plateau conditions are presently being grown by farmers, (Amadi and Okonkwo, 1995). Methods of TPS production, seed extraction, drying, breaking of dormancy and establishment of TPS seedling nursery have been developed and extended to farmers (Okonkwo and Amadi, 1995; Okonkwo, 1999 and Okonkwo et al., 1998). Tuber yields of 5-8 tonnes/ha have been reported in TPS studies under Jos Plateau conditions. (Okonkwo and Lang, 1998).

It has also been shown that potato tubers produced from TPS are generally small. The tuber skin colour and tuber shape are not uniform (Okonkwo and Lang, 1998).

This study evaluated the field performance of seed tubers produced from true potato seed (first generation tubers) under Jos Plateau, Nigeria conditions.

MATERIALS AND METHODS

This study was carried out in 1997 and 1998 at Kuru, Jos Plateau, 1450 meters above the sea level, and latitude 9.8°N and longitude 8.7°. The soil is ferrallitic combisol developed from volcanic rocks (Enwezor et al 1990). Analysis of soil sample taken from the experimental site showed 0.14% total N, 1.7% organic matters, 3.3 ppm available P and 95 ppm exchangeable K. The rainfall and temperature data for the location are shown on Table 1.

First generation seed tubers of six potato genotypes RC 767-2, RC 777-2, Clone 800946-AL-624, Kondor, VC 801-4 and CIP 384300-8 were evaluated to determine their field performance under Jos Plateau conditions. Nicola produced from seed tuber was also planted as the control. Visual removal of seed tubers with odd shapes and off-colour from each genotype was carried out. Only tubers with the predominant colour and shape of each potato genotype were planted. Intra-raw plant spacing was 30cm apart on rows spaced 1 meter apart. Plot size was $24m^2$ and plant population was 33,333 plants/ha. Fertilizers were applied at the rate of 100kg each of N and P_2O_5/ha and 40kg K_2O/ha at 2 weeks after planting. Weeding was done manually at 4 and 8

weeks after planting.

Seed germination and plant establishment counts were taken at 4 and 8 weeks after planting (WAP). Number of above ground stems per stand and final stand count before harvest were also recorded. Scores for early and late

Table 2: Characteristics of First Generation Tubers Produced from True Potato Seed (TPS)

Potato Genotye	Tuber Skin Colour	Tuber Shape	Tuber Yield (t/ha)	Tuber Number/H (x1000)	Tuber Size >50m
RC 767-2	100% Cream White	80% Oval	2.9e	199.00	11.0c
RC 777-2	100% Cream White	85% Oval	3.9d	166.6d	12.0c
Clone 800946-Al-624	80% Red	75% Oval	6.8 cd	233.3b	8.0c
kondor	86% Red	71% Ob-long	7.3c	230.3b	18.0b
VC 801-4	85% Red	76% Oval	9.3b	366.6a	20.0b
CIP38430-8	100% Cream White	85% Oval	5.6 cd	233.4b	11.c
Nicola (control)	100% Oblong	100% Cream White	17.8a	210.0 bc	46.0a
Average	90.8	78.7	5.9	238.2	13.3

In each column, figures followed by similar letter are not significantly different (DMRT. P=0.05).

blights attacks were taken at 10 and 8 WAP. Bacterial wilt, land roll virus, aphid and common scab scores were also taken at 8 WAP, while common scab scores were taken at 12 WAP. Scores were taken on a scale of 1-5: where 1: no attack of plant by disease or pest; 1:1- 25% of plant attacked; 3:26-50% of plant attacked; 51-75% of plant attacked; and 5: 76 – 100% of plant attacked.

At harvest, tuber number and yield were determined. Tubers were graded to determine tuber size. Skin colour and shape were recorded, while tuber dry matter was also determined.

RESULTS

The soil analysis showed a low soil organic matter, N, and

Table 3: Average Percentage Germination Field Establishment and Stem Number Per Stand of First Generation Seed Tubers Produced from True Potato Seed. (TPS)

Potato Genotype	% Germination	% Field Establishment (4 WAP)	Stems per Stand (8WAP)	Final Stand Count/Ha (X1000)
Rc 767-2	100a	100a	3.3c	32.4a
RC 777-2	96a	96a	1.1e	29.5ab
Clone 800946-AL-624	98a	90a	2.4d	33.1a
Kondor	100a	96a	3.1c	25.4c
VC 804-4	100a	100a	3.0c	28.3b
CIP 384300-8	100a	100a	4.0b	30.1a
Nicola	96a	96a	5.0a	31.6a
Average	99	97	2.8	29.8

In each column figures followed by similar letter are not significantly Different (DMRT P=0.05) WAP = WAP Week After Planting.

P. Lowest minimum temperature was obtained between the months of November and March. This period also had the highest sunshine hours (Tables 1).

Uniformity in tuber shape ranged from 71% to 100% while the uniformity in tuber skin colour of the three potato genotypes: RC 767-2, RC 777-2 and CIP 384300-8 was 100% as compared to the mother plants from where the TPS was produced. Skin colour of the remaining 3 TPS genotypes ranged from 80% to 85% (Table 2).

Seed germination and seedling establishment of the first gen-

Table 4: Reaction of Potato Plants from First Generation TPS Seed Tubers to Field Diseases and Pest.

Potato Genotype	Late Blight (8 WAP)	Early Blight (10 WAP)	Bacterial Wilt (8 WAP)	Leaf Roll Virus (8 WAP)	Aphid (8 WAP)	Common Scab (12 WAP)
RC 767-2	2.0a	2.0a1.0b	1.0a	2.0a	2.0a	1.0b
RC 777-2	2.0a	1.0n	1.0b	2.0a	1.0b	2.0a
Clone 800946-AL-624	1.0b	2.0a	1.0b	1.0b	2.0b	1.0b
Kondor	1.0b	2.0a	2.0a	1.0b	1.0b	1.0b
VC 801-4	1.0b	2.0a	1.0a	1.0b	1.0b	1.0b
CIP 384300-8	1.0b	1.0b	2.0a	1.0b	2.0a	1.0b
Nicola	2.0a	2.0a	2.0a	2.0a	1.0b	1.0b
Mean	1.3	1.6	1.3	1.1	1.5	1.2

In each column figures followed by similar letter are not significantly Different (DMRT P=0.05).

eration seed tubers were high and similar to the seed tuber of the control variety (Table 3).

The above ground stems of the 4 genotypes were generally lower than that of Nicola by 43% (Table 3). Diseases and pests attacks on the potato seedlings were generally low, the scores ranging between 1 and 2 on a scale of 1 to 5 (Table 4). There were 8.4 and 17.6% improvements in the uniformity of tuber skin colour

Table 5: Characterisitics of Second Generation Seed Tubers

Potato Genotype	Tuber Skin Colour	Tuber Shape	Tuber Number/Ha (‘000)	Tuber Yield (T/Ha)	Tuber Size 50mm (%)	% Dry Matter
Rc 767-2	100% Cream White	98% Oval	210.0c	20.7bc	40.6b	21.6a
RC 777-2	100% Cream	99% Oval	150.0a	19.9cd	39.6b	20.4a
Clone 800946-AI-624	97% Red	98% Oval	240.0b	23.3a	25.7d	19.6a
Kondos	98% Red	90% Oblong	186.0cd	16.3a	36.4c	20.7a
VC 801-4	98% Red	95% Oval	17?.0d	21.4b	21.3e	17.6b
CIP 384300-8	100% Cream	98% Oval	284.0a	24.8a	58.3a	19.9a
Nicola (Local Best)	100% Cream	100% Oblong	180.0d	18.3d	41.4b	17.7b
Mean	99.2	96.3	208	21.1	36.9	19.9

In each column figures followed by similar letter are not significantly Different (DMRT P=0.05).

and shape, respectively, due to the visual sorting out of odd-shaped and off-coloured tubers before planting the first generation TPS tubers (Table 5).

The second generation TPS tubers were 38% larger in size than the first generation TPS tubers (Table 2 and 5). Four out of the six TPS genotypes out-yielded Nicola, but only CIP 384300-8 produced larger size tubers than the local best variety (Table 5). Tuber number per hectare of three of the 6 TPS genotypes were significantly (P=0.05) higher than those produced by Nicola. With the exception of VC 801-4 which had low tuber dry matter tuber dry matter of the other genotypes were similar to that of Nicola.

DISCUSSION

The 99.2% and 96.3% uniformity in tuber skin colour and shape, respectively achieved by visual sorting-out of odd-shaped and off-coloured seed tubers before planting was an improvement over the 90.8 and 78.7% uniformity in tuber skin colour and shape obtained from the first generation TPS tubers. The result is consistent with that of Janick et al. (1974) showing that uniformity of tubers are maintained by vegetative propagation. Difficulty in the seperation of the tiny and immature tubers from TPS before planting may be responsible for the mixture in colour and shape found in the second generation TPS seed tubers. It is likely that sorting out of the odd-shaped and off-coloured seed tubers from the second generation TPS tubers before planting may bring the tuber characteristics to uniformity.

Potato plants grown from first generation TPS tubers showed higher vigour in the field than plants grown from normal seed tubers. The low diseases attack of the TPS genotypes recorded may be responsible for this. The results agree with these of Burton (1989) which showed that potato plants grown from TPS are free from tuber borne diseases such as bacterial wilt and leaf roll virus. Like many potato varieties some of the TPS genotypes were susceptible to late and early blight diseases of potato. Beukema and Zaag (1979) indicated that susceptibility to a disease is not considered a major problem where such disease can be economically controlled by chemical or cultural methods. Bintje, a popular po-

tato variety in the Dutch processing industry is highly susceptible to late blight, but farmers continued to produce it because its good processing qualities.

Fewer number of above ground stems produced by the TPS genotypes than Nicola was due to the smaller tuber size of the first generation TPS tubers. Burton (1989) indicated that large size tubers. The high tuber number per hectare obtained for some of the TPS genotypes indicate potentials for the genotypes to yield higher if the growing conditions are favourable for all the tubers to develop. The tuber yield and size also showed that the TPS genotypes were not inferior to the local best, Nicola.

The study shows that TPS can provide a short-term solution to farmers' seed demand in Nigeria. Seed tubers from TPS can be multiplied twice or thrice for ware potato production. Prolonged usage of the seed may require cloning to obtain pure varieties with desirable characteristics.

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