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SEED GERMINATION AND EVALUATION OF THE ROOTS OF OPEN POLLINATED EXOTIC SWEETPOTATO SEEDLINGS FOR VARIATIONS IN ROOT FLESH COLOUR

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ABSTRACT: *Botanical seeds (from a polycross) of 21 families was raised in the screen house and then transplanted to a well-prepared ridge at the experimental field of National Roots Crops Research Institute Umudike, Southeastern Nigeria in an unreplicated block. This study was undertaken with the aim to determine the number of seeds germinated among the families, period of germination, percentage field survivability of the seedlings and variability in root flesh colour from various families. The seedlings root flesh colour were evaluated in the field on a single plant basis with a planting space of 1.0 x 1.0m per plant. Data rating were on number of germinated seeds, number of field survivability, number of flesh colour variability while the root fleshed characteristics were graded using Sweetpotato colour chart. Results obtained indicated that from the 21 sweetpotato families, 1,292 seedligs which accounted for 52.4% survived in the screen house. However, the family of Moza 1-3/v8 had the highest survivability percentage of 95.8% indicating its ability to survive the local environmental conditions. The highest germination rate of 47.0% was obtained two weeks after planting while the least percentage of 1.0% was at six weeks after planting which showed that within six weeks after planting, all viable seeds might had germinated. The 772 sweetpotato plants harvested produced nine different root fleshed colours. The 231 sweetpotato seedlings produced deep orange fleshed colour, 84 seedlings produced light orange fleshed colour, 114 seedlings had yellow root fleshed colour, 13 seedlings produced white fleshed root colour while 54 seedlings produced cream fleshed root colour. This indicated that there are many varieties of sweetpotatoes which could be put to various uses.*

KEYWORD: Seed Germination, Roots, Open Pollinated, Sweetpotato Seedlings, Root Flesh Colour, *Polycross, Nigeria*

INTRODUCTION

Sweetpotao (*Ipomoea batatas* (L) Lam) are commonly grown in every part of Nigeria and one of the major crops, used for animal feed and human foods (Kapinga et al., 1995) as well as means of economic empowerment to many poor resource farmers (Agbo and. Ene, 1994). More than 60% of the farmers engage in sweetpotato farming and it remain a prominent food crop to many rural dwellers especially in Northern parts of the country (Edebiri, et al., 2001). Sweetpoto crop grown in Nigeria is of a great importance for food availability due to its short maturity period (Freyre *et al*., 1991. The short lifespan has increased the production of sweetpotato round the year thereby making food available for the rapidly increasing population. In early breeding stages plants are raise from true seeds. The breeders use variety of techniques and methods such as recombination, modifications in chromosome number and

mutations in creating genetic variability that would have different traits to solve problem for various users. The high genetic variability offers the most effective condition for selection for a particular trait and to improve on it (Gibson *et al.,* 2008). Seeds could be generated through polycross and or controlled crosses and evaluated.

There are many varieties of this sweetpotato crop with variation in morphological growth pattern (erect, semi compact erect, spreading and extremely spreading) and according to Bernardo (2002), there are variations in root skin and root flesh colour (white, cream, yellow, orange and purple). Sweetpotato is a cheap source of beta carotene, carbohydrate, vitamins and other nutrients. The variation in the root flesh colour of different sweetpotato varieties (white, cream, orange yellow and purple) could be used to address numerous challenges of vitamin A deficiency in the country, Nigeria.

The sweetpotao purple and orange varieties are very important in fighting cancers; reduce incidence of blindness and incidence of malnutrition which is in high rate among children and pregnant woman. The purple sweetpotato root contained some antioxidant. That is why orange flesh colour is given priority for selection. The greatest problem of sweetpotato is the Virus Disease of sweetpotato (SPVD) complex. Gasura et al., (2008) observed that the high resistance sweetpotao genotypes to SPVD are needed in the breeding population for genetic improvement. Degree of resistance to SPVD is attributed to genetic variation (Mwanga et al., 2002). It is reported by Huamán *et al* (1999) that the important component of breeding is the selection of new varieties with desirable traits to create new and better population for future selection. This call for evaluation of sweetpotato seedlings raised from pollinated parent sweetpotato plants and selection of genotypes with good root flesh colour, and resistant to pathogens to complement the improvement of the crop. Sweetpotato foliar performance translates to higher or low root yield performance. However, the objectives of this work are: to determine the number of seeds germinated among the families, period of germination, percentage field survivability of the seedlings evaluated and variability in root flesh colour from various families.

MATERIALS AND METHODS

Seed germination: Botanical seeds (from a polycross) of 21 families totaled 2,791seeds received from Mozambique in 2016 were established in the Screen house of National Root Crops Research Institute, Umudike (NRCRI) in 2017. The seeds were raised and nurtured in perforated poly-bags which contained a mixture of sandy soil and poultry mature in the ratio of 1:1. This mixture was filled in the perforated poly-bag measuring 6cm x 4cm in size. Good and bad seeds were separated using floatation method which involved soaking the seeds in water for one hour. Bad seeds that floated on water surface were discarded while good ones settled at the bottom of the container. The good seeds were planted one per poly-bag. The planted seeds were watered and subsequence watering was applied as when needed. Weeding was done by hand pulling whenever necessary.

Data were collected as follows**:** Total number of seeds received, number of bad seeds, and number of good seeds planted. Also, number of seeds germinated and rate of germination at 2 weeks, 4 weeks and 6 weeks after planting were recorded. The data collected for rate of survivability were analyzed using the following formula:

$$\text{Survivability} = \frac{\text{Total Number of Seed Germinated}}{\text{Total Number of Seeds planted}} \times 100$$

The botanical seeds raised in the screen house were transplanted as seedlings to the field two months after planting in the screen house. A total of 1302 sweetpotato seedlings from 12 families were planted in an unreplicated block. The seedlings were evaluated using a single plant seedling evaluation trial. Each seedling was carefully removed from the polybag after loosening the soil around them, the single plants were planted at the crest of the ridge at a spacing of 1.0m x1.0m intra and inter row spacing to enable ease of observation of each seedling. Agronomy practices such as weeding and fertilizer application at 4 weeks after planting were carried out. Data were collected on percentage survivability. At harvest 16 weeks after planting, data were collected on root colour variation of the respective seedlings. Sweetpotato colour chart (Burgos *et al*., 2009) was used to grade the root flesh colour of the flesh roots of the sweetpotato seedlings. The field percentage survivability of the seedlings was calculated using the formula for percentage survivability:

$$\frac{\text{Total Number of Seedlings Survived}}{\text{Total Number of Seedlings Transplanted}} \times 100$$

RESULTS AND DISCUSSIONS

The results obtained from the sweetpotato botanical seeds planted are presented in Table 1.

Table 1: Number of Seeds Planted and Germinated Within the Sweetpotato Families and Percentage Survivability

Families name		Total number of seeds received/ family	Number of bad Seeds	Number of seeds planted	Number of seeds not germinated SNG	Total number of seeds germinated	% survivability
Moza9-/v.52	F/S	350	7	343	95	248	72.3
Moza2-51/v.39	F1	320	31	289	30	259	89.6
Moza1-3/v.8	F2	260	29	231	70	161	95.8
Tio Joe/p.5	F3	127	8	119	54	65	54.6
Moza 9-26/v.12	F4	90	1	89	32	57	65.5
Moza 12-26/v.10	F5	170	8	162	40	122	75.3
moza4-7/v.v1.	F6	75	4	71	46	25	35.2
moza 65-21/v.43	F7	110	88	102	54	48	47.1
moza 6-20/v.u8	F8	110	4	106	83	23	21.8
moza 121022-10/v.21	F9	80	6	74	44	30	40.5
moza 12-17/v.53	F10	80	10	70	52	18	1.43
moza11033-6/v.15	F11	37	0	37	29	8	21.6
AYT-16CO-15/T.11	F12	250	74	176	164	12	6.8
GP105413-4/T.16	F13	85	12	68	8	60	88.2
GP10703118/T.16	F14	80	17	68	49	19	27.9
AYT-16CN1448-428/T.6	F15	125	13	112	85	27	24.1

AYT16-EN49-37/T.7	F16	37	7	30	25	5	16.7
AUY-1613-ORCA350A-9/T.8	F17	120	0	120	65	55	45.8
GPC-15/T.25	F18	85	3	82	67	15	18.3
AYT-16GYL488-49-28/T.6	F19	100	34	66	45	21	31.8
GPC28 107038-31/T.21	F20	100	54	46	32	14	30.4
Total	**F21**	**2791**	**320**	**2461**	**1169**	**1292**	

The total number of seeds from all the families was 2,791. Out of this number, the total number of seeds planted was 2461. The number of seeds germinated was 1,292 representing 52.4% survivability. The result also indicated that the seeds from the family of Moza1-3/v.8 gave the highest survivability percentage of 95.8. This was followed by the seeds from the family of Moza 2-51/v.39. The family of AYT-16C0-15/T.11 gave the least survivability percentage of 6.8%. This result indicated that seeds from sweetpotato seeds that have the highest survival rate will do well under the local climate from where the seeds were raised.

The rate at which the seeds germinated (2, 4 and 6 weeks) after planting is presented in Table 2

Table 2: Seeds Germination Rate at 2, 4 and 6 Weeks After Planting

Families name	F/S	Number of seeds planted	Number germinated at 2 WAP	Number germinated at 4 WAP	Number germinated at 6 WAP
Moza9-/v.52	F1	343	238	8	6
Moza2-51/v.39	F2	289	234	24	1
Moza1-3/v.8	F3	231	168	0	2
Tio Joe/p.5	F4	119	64	0	1
Moza 9-26/v.12	F5	89	57	0	0
Moza 12-26/v.10	F6	162	109	4	9
Moza4-7/v.v1.	F7	71	23	1	1
Moza 65-21/v.43	F8	102	48	0	0
Moza 6-20/v.u8	F9	106	21	1	1
Moza 121022-10/v.21	F10	74	27	2	1
Moza 12-17/v.53	F11	70	15	1	2
Moza11033-6/v.15	F12	37	7	1	0
AYT-16CO-15/T.11	F13	176	9	3	0
GP105413-4/T.16	F14	68	55	5	0
GP10703118/T.16	F15	68	19	0	0
AYT-16CN1448-49-28/T.6	F16	112	21	4	2
AYT16-EN49-37/T.7	F17	30	5	0	0
AUY-1613-ORCA350A-9/T.8	F18	120	48	8	2
GPC-15/T.25	F19	82	14	1	0
AYT-16GYL488-49-28/T.6	F20	66	19	1	1
GPC28 107038-31/T.21	F21	46	13	1	0
Total	**21**	**2461**	**1166 (47.0%)**	**65 (2.0%)**	**28 (1.0%)**

The result showed that 2461 seeds from 21 families were planted. However, highest germination rate was obtained at the second week after planting representing 47.0%. The least germination rate was obtained at 6 weeks after planting which accounted for 1.0%. Although highest germination rate was obtained two weeks after planting, it also showed that viable seeds once planted could stay up to six weeks before germinating. Since the seeds planted were all good seeds, those that were yet to germinate may be as a result of hard seed coats. This has been the reason behind soaking sweetpotato seeds in sulphuric acids for one hour before planting or the use of abrasive paper to rub at the seed coat for water to enter it easily before planting for maximum seed germination (Mwanga et al., 2002). However, viable seeds of sweetpotato are supposed to germinate within 6 weeks after planting.

Field Evaluation: Total number of seedlings transplanted to the field was 1302. Number established one month after transplanted to the field was 981 which represented 75.5%. This high percentage of seedlings establishment was an indication that significant number of the exotic seedlings will do well under Umudike environment (figure 1).

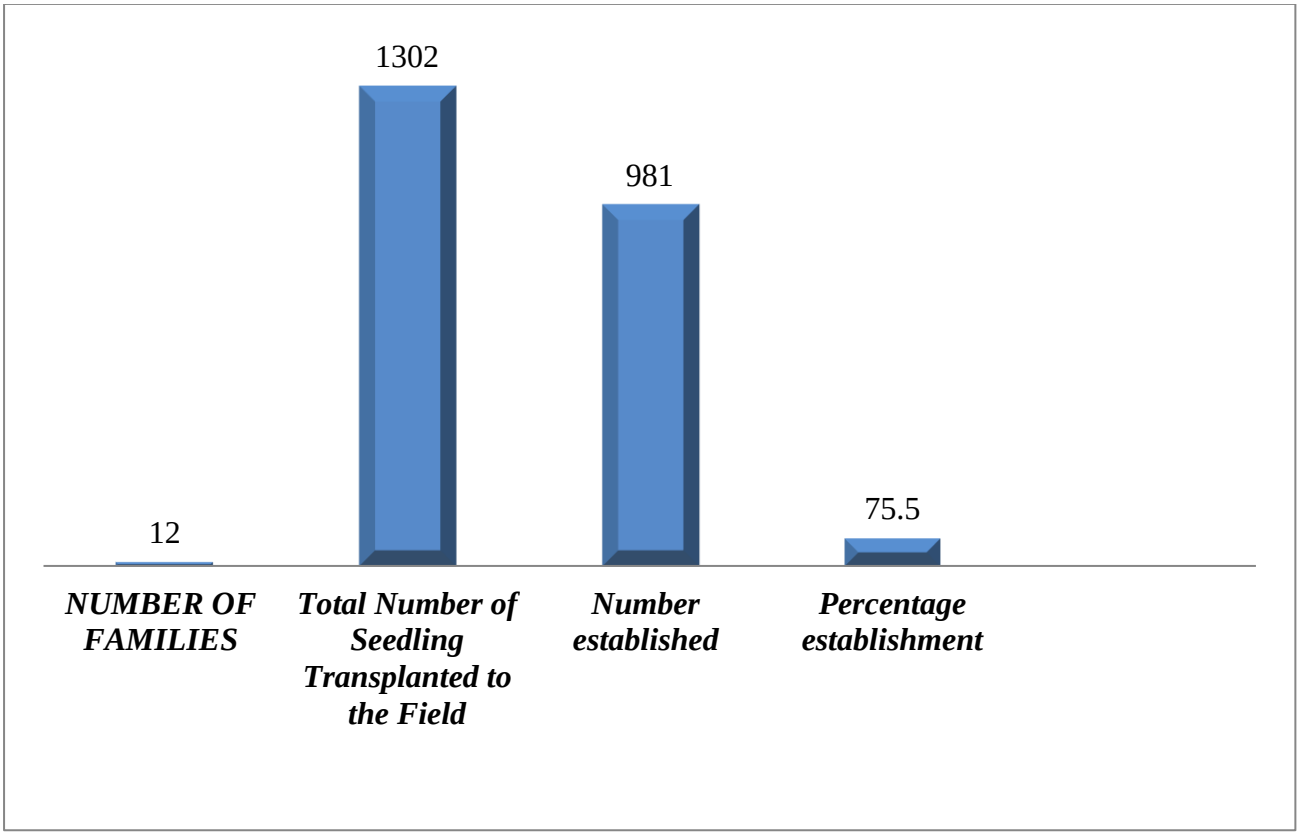

Fig :1 Number of Seedlings Planted and Percentage Establishment

The variations in root fleshed colour of sweetpotato seedling evaluated from 12 families are presented in Table 1.

Table 1: Variations in Root Fleshed Colour of Sweetpotato Seedling Evaluated from 12 Families

		Roots Flesh Colour								
Families Names	**Total**	**CR**	**WT**	**OR**	**DO**	**LO**	**YE**	**YxO**	**OxP**	**WxP**
Moza9-/v.52	109	22	1	15	23	17	22	7	1	1
Moza2-51/v.39	199	0	0	103	61	14	12	3	6	0
Moza1-3/v.8	73	5	2	6	27	13	6	13	1	0
Tio Joe/p.5	44	2	0	17	14	0	9	2	0	0
Moza 9-26/v.12	42	0	0	17	14	0	7	2	0	0
Moza 12-26/v.10	57	5	1	6	20	10	4	10	1	0
moza4-7/v.v1.	17	1	0	2	5	3	6	0	0	0
moza 65-21/v.43	28	1	1	2	7	6	10	1	0	0
moza 6-20/v.u8	14	0	1	4	3	0	6	0	0	0
moza 121022-10/v.21	16	0	0	5	2	3	6	0	0	0
moza 12-17/v.53	8	0	0	0	4	0	3	0	1	0
moza11033-6/v.15	3	0	0	3	0	0	0	0	0	0
AYT-16CO-15/T.11	12	4	4	0	0	4	0	0	0	0
GP105413-4/T.16	48	9	2	8	9	5	10	5	0	0
GP10703118/T.16	14	0	0	1	5	2	6	0	0	0
AYT-16CN1448-49-28/T.6	19	0	0	10	4	0	5	0	0	0
AYT16-EN49-37/T.7	3	0	0	0	2	1	0	0	0	0
AUY-1613-ORCA350A-9/T.8	24	3	1	3	12	5	0	0	0	0
GPC-15/T.25	15	3	0	5	6	0	1	0	0	0
AYT-16GYL488-49-28/T.6	20	0	0	8	10	1	1	0	0	0
Moza9-/v.52	8	0	0	5	3	0	0	0	0	0
TQTAL	**772**	**54**	**13**	**220**	**231**	**84**	**114**	**43**	**9**	**1**

NOTE CR-Cream, WT-White, OR-Orange, DO-Deep Orange, LO-Light Orange, YE- Yellow, YMO- Yell Mixed Orange, OMP-Orange Mixed Purple, WMP –White Mixed Purple

The result showed that nine different colours were observed from the sweetpotato seedlings from 12 families evaluated (Table1). The result indicated that out of 772 seedlings harvested, the highest number was 231 seedlings which was deep orange (DO). This represented 30.0%. This was followed by light orange flesh colour which was 220 which accounted for 28.4% while the least was seedlings which had white flesh colour mixed with purple. This gave 0.1%. The 114 seedlings were with yellow roots flesh colour while root flesh colour of 13 seedlings were white. The root flesh colour of 84 seedlings was light orange while the root flesh colour of 54 seedlings was cream. The root flesh colour of some seedlings was mixed (IBPGR (1999). For example, 43 seedlings have root flesh colour yellow mixed with orange, 9 seedlings had their root flesh colour orange mixed with purple while one seedling had its root flesh colour which is white mixed with purple. This showed that there are various varieties of sweetpotato genotypes with various range of colours.

The sweetpotato seedlings with orange deep orange and purple colour indicated presence of βeta carotene and anthocynine contents which are rich in boosting the immunity of children

under five years against blindness and have cancer fighting properties. Courtney *(*2007} reported that variability in root flesh colour indicated that the roots from these sweetpotato seedlings could be put to various uses such as for the use of vitamin A supplement due to the presence of βeta carotene (Cervantes-Flores *et al*., 2011) and anthocyanine which has cancer fighting properties, the purple flesh as antioxidant and white and cream fleshed could be used as carbohydrate food/flour for industrial uses (CIP, 2000)..

CONCLUSION

Two thousand, four hundred and sixty-one seeds from 21 sweetpotato families were planted, out of which 1,292 seedligs which accounted for 52.4% survived. The family of Moza 1-3/v8 had the highest survivability percentage of 95.8% indicating the ability of that family to survive under local environmental conditions. It was also observed that highest germination rate of 47.0% was obtained two weeks after planting while the least percentage of 1.0% was at six weeks after planting indicating that within six weeks all viable seeds might have germinated. Of the 1302 seedlings transplanted and evaluated in the field, only 981 seedlings or 76.0% survived. The 772 sweetpotato plants at harvested produced nine different root fleshed colours. The 231 sweetpotato seedlings produced deep orange fleshed colour, 84 seedlings produced light orange fleshed colour, 114 seedlings had yellow root fleshed colour, 13 seedlings produced white fleshed root colour while 54 seedlings produced cream fleshed root colour. This indicated that there are many varieties of sweetpotatoes.

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