

Farmers' Variety Assessment Of Advanced Sweetpotato to Genotypes Evaluated On-Farm

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Abstract: Breeding programs involve farmers in variety selection. This is done through on-farm trial by formalizing farmer involvement in the variety testing process. In view of this fact, a systematic investigation into the on farm testing was carried out in seven states in Nigeria to address this problem. The objectives were to investigate the effect of the new varieties on the farmers, to introduce the varieties to end- users (farmers), to test performance of promising varieties under farmer growing conditions and researcher-farmer management, to test farmers' acceptance and ranked preference of the varieties for yield and quality attributes including Consumer/culinary acceptability assessment, and to obtain feedback (in terms of what farmers like in a variety) to breeders. The performance of each variety was assessed by each farmer individually by assigning and putting one card only in the bag. The farmers gave their opinions using the cards provided to assess the crops' attributes in terms of field performance and culinary attributes. Four farmers were selected per state, and seven states were involved. Total of 28 farmers were used. The plot size was 5 x 6m² per plot. Six varieties, three orange-fleshed (NRSP/05/022, CIP 440293 and CIP 199004.2) and three white-fleshed (NRSP/05/1B, NRSP/05/3D and NRSP/05/10D) were distributed to the 28 selected farmers. The result of the Combined Mean percentage of participatory field and culinary evaluation showed that three varieties NRSP/05/10D, NRSP/05/022, and CIP440293 plus the national Check (TIS87/0087) had high rate of acceptance between 70 to 100%. These three varieties were nominated for release as the farmers' choice in terms of field performances and culinary attributes while the high acceptance of the Check variety is an indication that the farmers still appreciates its good qualities which Breeders could use in future breeding programme.

Key word: on-farm, farmer-participatory, variety testing, farmers' preference, nomination for release.

I. Introduction

Sweetpotato constitute a primary food source in a number of households in Nigeria particularly amongst populations of rural communities and selected few rich households in urban centres where it is used as fried food for breakfast (Cristina *et al*, 1999). The cultivation of sweetpotato is becoming more and more important with each passing day, and the crop has great potential as food product (FAO,2009). The crop need few inputs and has potentially high yields which made it an inexpensive food (Bovell-Benjamin, 2007). Sweetpotato roots are well suited for processing into food products for people and animals. Research objectives are to increase the yield of sweetpotato and area under cultivation. As a result of this, on-farm trials are carefully conducted for careful selection of new varieties which show greater adaptability and stability as well as excellent agronomic characteristics (Cristina *et al*, 1999). Varieties which met these requirements are selected by farmers and consumers as varieties they will adopt for cultivation and promoted for consumption and will be produced within the reach of everyone within the community. One of the easiest ways to do this, is through development of technology in the form of evaluation and selection of improved or native clones through a research methodology based on farmer participatory evaluation (Egesi *et al* 2011). It is a method in which farmers are actively involved in the cultivation and selection of sweetpotato varieties which they could guarantee the rapid transfer and adoption of the variety and any new technology that will be used to promote it (Agboola, 1979). The release of the new varieties that display the characteristics required by the farmers will be of benefit to farmers.

In Nigeria, the sweetpotato is grown for its enlarged roots which can be boiled, baked, fried or processed into chips. The stems and tips may be boiled or fried for use in soups and salads (James, 1994). Both roots and foliage can be grown as feed. It is presently planted and harvested year-round throughout the states in Nigeria, with production hectares on the increase yearly primarily in Sweetpotato States like Benue, Ebonyi, Kwara, Kaduna and Nassarawa. Sweetpotato has a wide adaptability to Nigerian environments and has a high content of vitamins, beta carotene, and ascorbic acid. The young leaves, common in some oriental and Filipino dishes, have 25 to 33 percent protein content on a dry weight basis (Maziya-Dixon Busie 2006). Sweetpotato is a highly nutritious root crop. It is richer in vitamins and minerals than cassava and yam, the more consumed root and tuber crops. The orange-fleshed types typically have a higher vitamin A and lower dry matter content. It is

good source of beta-carotene (vitamin A precursor), thiamine (vitamin B1), riboflavin (B2), folic acid and ascorbic acid (Woolfe, 1992).

New bred sweetpotato varieties need to be tested on-farm. On-farm trials are an effective way to improve client-orientation of breeding programs by formalizing farmer involvement in the variety testing process (Tanaka, 1976). They can also be an important first step in variety dissemination, since data from on-farm trials are usually required for official varietal release, and farmers will be keen to obtain planting materials of varieties that perform well in trials (Tewe *et al*, 2003). Standardization of procedures is important for easy and meaningful analysis and presentation of results. However, circumstances, including population density, the presence of organized farmer groups, their previous experience with sweetpotato, and budgets can dictate varying approaches to on-farm variety testing. Often there is a mismatch of what the researchers and farmers (end users) consider as the best variety. This probably explains the low adoption rates for some of the research generated varieties and the dominance of farmer varieties in some areas. There are also cases of varieties adopted by farmers having previously been rejected by the breeding programs. On-farm variety testing is aimed to bridge the gap during the variety development (Tsou and Hong, 1992). In view of this fact, a systematic investigation into the on farm testing was carried out to address those problems, the study was initiated with the objectives of investigating the effect of the new varieties on the farmers, to introduce the varieties to users (farmers) – initial step for variety/technology transfer, to test performance of promising varieties under farmer growing conditions and researcher-farmer management, to test farmers' acceptance and ranked preference of the varieties for yield and quality attributes (including taste tests), To obtain feedback (in terms of what farmers like in a variety) to breeders and to build farmers' capacity on variety assessment (experimentation)

II. Materials and Methods

Four farmers were selected per state, and seven states were involved. Total of 28 farmers. The plot size was 5 x 6m² per plot. Six varieties, three orange-fleshed (NRSP/05/022, CIP 440293 and CIP 199004.2) and three white-fleshed (NRSP/05/1B, NRSP/05/3D and NRSP/05/10D) were distributed to selected farmers.

The ADPs were used to coordinate and supervise the farmers. Each farmer was considered a replicate in each state while the state constituted a trial site. The varieties were evaluated along with the local best and a national check in each location for fresh root yield and farmers' preferences.

Sweetpotato farmers participatory field evaluation: This was done with the farmers using cards to indicate their observation on different attributes of each of the test varieties. Three types of cards were used: Green, Yellow and Red. Green means very acceptable, Yellow means moderately acceptable/ manage, Red means reject/ not acceptable. Each batch of card was divided into two M –cards for males while F-cards for female. Pre-labeled bags bearing variety name and attributes being assessed were placed on each plot. The performance of each variety was assessed by each farmer individually by assigning and putting one card only in the bag. When the exercise was completed per individual varieties, the bags were collected and bundled by attributes. The farmers give their opinion using the cards provided on the following attributes: 1. Ability to produce enough planting material (foliage production), 2. Ability to tolerate diseases (especially SPVD), 3. Ability to tolerate pest damage (mainly weevil), 4. Yielding ability (number and size of mature roots). 5. Attractiveness of the root skin colour and why accepted or rejected, 6. Attractiveness of the root flesh colour and why the preference, 7. The overall opinion on the acceptability of the variety. The cards in each bag were separated and counted by colour and sex. The information was then recorded in the data sheet.

Consumer/culinary acceptability assessment: Roots from each variety were served fresh, boiled, and small pieces served on plates for blind assessment using A, B, C, D, E and F to code each variety. The consumer acceptability exercise is done in similar way as that for field evaluation. Each individual voted how the individual feel about the particular variety using the card provided. The farmers gave their opinion on, 1. Attractiveness of the appearance of the root flesh colour , Taste of the root when chewed (assessment of sweetness), Flavour/aroma in the mouth, Flouriness/starchiness, Consistency of the root texture (fibrousness), Overall opinion on the acceptability of the variety under test.

III. Results and Discussion

The yield performances in farmers' fields are presented in Table 1, while their preferences are presented in Table 2 to 3. The overall farmers' acceptances are presented in Table 4 and the distinguishing characteristics of the varieties selected by farmers are presented in Table 5.

The performance of the varieties in Table 1 indicated that across the States, the variety CIP 440293 gave mean yield of 45.65t/ha and was ranked number 1. This was followed by NRSP/05/022 which had mean

yield of 42.94t/ha and was ranked 2nd, while the least yield was obtained from CIP 440163 which had mean yield of 18.83t/ha across the States.

The highest yield was obtained from Nassarawa State in the North Central of Nigeria Savanna agro-ecology where the Local best produced 95.89t/ha. This was followed by CIP 440293 which produced 85.45t/ha. The State that gave the least yield was Abia State in the Southeastern Nigeria Forest agro-ecological zone. The variety NRSP/05/022 produced 7.10t/ha.

From the result, it showed that the yield potential of the local varieties could be as high as 95.89t/ha while the yield potential from some Introduced varieties could be as high as 85.45t/ha (CIP440293). This indicated that local best varieties that have been acclimatized could be used as maternal parents in crosses when it comes to the incorporation of desirable traits to the local varieties.

Yield performance across varieties indicated that Nassarawa State had the highest mean yield of 55.28t/ha, while Cross River had the least mean yield of 14.74t/ha. The soil of Cross River State in the South humid rainforest of Nigeria is hydromorphic. Swampy/ hydromorphic soils are not suitable for sweetpotato cultivation. For commercial farmers, they should choose areas with suitable soil and climatic conditions for growing crops such as sweetpotato which are of economic value.

The result in Table 2 showed the participatory field assessment of the sweetpotato varieties in terms of planting materials, yielding ability, skin colour, and flesh colour. The result indicated that 20% (red) of both men and female sweetpotato farmers rejected the variety CIP440293, because the vine production was not much and that the orange colour was new to them. Fourteen percent (14.0%) (Yellow), said they could manage the variety in terms of the factors mentioned while 66.4% (green) indicated that they accepted the variety especially the root colour which was attractive.

Men and female sweetpotato farmers did not reject (red, 0.0 %) the variety NRSP/05/022.. Twenty percent (20%, yellow) of the farmers said they could manage the variety to give it a trial since it is a new variety, while 79.0 % (green) accepted the cultivation of the variety because it produces vigorous vines which are greenish and would be good as vegetable and that the root yield and colour is equally attractive and a variety that yielded highly, the vine production was vigorous and could give enough planting material and excellent ground cover against weeds.

For the variety NRSP/05/10D, none of the sweetpotato farmers rejected the variety (Red, 0.0%), 15.0% said they could manage the variety because it produces white fleshed roots, while 85.0% accepted the variety because the root flesh colour was very white and attractive, the vine production for planting material and ground coverage was also good.

Acceptance levels of other varieties were less than 55.0%. Any variety with high percentage acceptance is an indication that such variety would be adopted and cultivated by the farmers. Three varieties including the Check varieties received high level of acceptance that fall between 60 to 90%.

The result of the Sweetpotato farmers participatory evaluation of culinary quality of boiled Sweetpotato roots in terms of taste, starchiness, fibrousness and tenderness indicated that 76.8% (green) of both men and female sweetpotato farmers accepted the variety CIP440293, because the colour of the boiled roots were very attractive. A little above fourteen percent (14.8% yellow) said they could manage the variety because the colour of the roots added to the variation of what they already have, while 9.4% (red) rejected the boiled root of the variety because the roots were soft and should be given to children developing teeth. Also the boiled orange colour scares them.

For the variety NRSP/05/022, 97.5% (green) sweetpotato farmers accepted the variety because the taste was good and had a starchy feel in the mouth, 1.25% (yellow), said they could manage the variety while 1.25% (red), rejected it because the boiled root is not very attractive to them. The variety NRSP/05/10D was accepted (100%, green) by the entire farmers because it has white fleshed colour roots that were very attractive after boiled.

The acceptance levels of other varieties were less than 65.0%.

The variety 440293 is a deep orange fleshed variety, the variety NRSP/05/022 is light orange fleshed while NRSP/05/10D is white fleshed variety. The high percentage acceptance of the culinary attributes of these varieties fall between 90 to 100% which was an indication of acceptance of the food quality of these varieties.

The Combined Mean percentage of participatory field and culinary evaluation showed that the variety NRSP/05/10D had the highest rate of acceptability of 93.0%, followed by the variety NRSP/05/022 which had 88.3%, the Check variety (TIS87/0087) with 73.2% while CIP440293 was 72.0%.

The characteristics of the varieties as additional reasons for acceptance of the varieties by the farmers are presented in Table 5. White flesh colour was ranked more acceptable than orange flesh colour because generally the orange fleshed varieties have low dry matter content which makes them less acceptable by farmers and end users. To meet the quality needs, there is a need to take into account the farmers and consumers preferences when developing and selecting sweetpotato varieties and in most cases this can be addressed

through participatory variety selection (Rees *et al.*,2003). Fortunately, the attributes considered most important by farmers and consumers were already identified and ranked by the farmers.

IV. Conclusion:

The Combined Mean percentage of participatory field and culinary evaluation showed that three varieties NRSP/05/10D, NRSP/05/022, and CIP440293 plus the national Check (TIS87/0087) had high rate of acceptance between 70 to 100%.

These three varieties are nominated for release as the farmers' choice in terms of field performances and culinary attributes. The high acceptance of the Check variety is an indication that the farmers still appreciates its good qualities. Breeders can continue to make use of the Check variety in future breeding programme.

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Table 1. Root yield (t/ha) of Sweetpotato varieties under on-farm pre-release trial in some states of Nigeria during 2011 and 2012 cropping season

| State | 440293 | NRSP/05/022 | 440163 | NRSP/05/10D | NRSP/05/3D | 199004-2 | 87/0087 | Ex-Igbariam | Local best | Yield Performance across varieties |
|----------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|------------------------------------|
| Kwara | 43.70 | 62.46 | NA | 36.46 | NA | 36.46 | NA | 33.76 | 42.91 | 42.63 |
| Benue | 77.40 | 52.05 | NA | 24.41 | NA | 24.41 | NA | 22.74 | 44.07 | 40.84 |
| Nassarawa | 85.45 | 79.07 | NA | 19.17 | NA | 19.17 | NA | 32.94 | 95.89 | 55.28 |
| Abia | 24.8 | 8.00 | 15.10 | 7.10 | 10.70 | 7.10 | 20.02 | 16.50 | NA | 24.5 |
| Cross River | 15.9 | 22.60 | 18.30 | 9.60 | 21.70 | 9.60 | 18.00 | 7.80 | 9.20 | 14.74 |
| Kaduna | 26.8 | 33.45 | 23.10 | 31.40 | 18.90 | 27.90 | 22.90 | 15.90 | 20.90 | 24.58 |
| Mean | 45.68 | 42.94 | 18.83 | 21.36 | 17.10 | 20.77 | 20.31 | 21.61 | 32.01 | |
| Ranking | 1 | 2 | 8 | 4 | 9 | 6 | 7 | 5 | 3 | |

Table 2 Sweetpotato farmers participatory field evaluation

| Genotypes | Gender | Assessment Of Planting Material | | | Assessment Of Yielding Ability | | | Assessment Of Skin Colour | | | Assessment Of Flesh Colour | | | Overall Acceptability % | | |
|-----------------|--------|---------------------------------|--------|-------|--------------------------------|--------|-------|---------------------------|--------|-------|----------------------------|--------|-------|-------------------------|--------|-------|
| | | Red | Yellow | Green | Red | Yellow | Green | Red | Yellow | Green | Red | Yellow | Green | Red | Yellow | Green |
| 440293 | Male | 10 | - | 2 | - | - | 12 | - | 10 | 2 | - | - | 12 | 20.0% | 14.0% | 66.4% |
| | Female | 15 | 3 | 2 | - | - | 20 | - | 5 | 15 | -- | - | 20 | | | |
| NRSP/05/022 | Male | - | - | 12 | - | 2 | 10 | - | 4 | 8 | - | 4 | 8 | 0.0% | 20.0% | 79.0% |
| | Female | - | - | 20 | - | 3 | 17 | - | 5 | 15 | -- | 7 | 13 | | | |
| NRSP/05/10D | Male | - | 1 | 11 | - | 5 | 7 | - | 4 | 8 | - | - | 12 | 0.0% | 15.0% | 85.0% |
| | Female | - | 2 | 18 | - | 3 | 17 | - | 4 | 16 | - | - | 20 | | | |
| 440163 | Male | - | 6 | 6 | - | 7 | 5 | 3 | 6 | 3 | 2 | 7 | 3 | 9.4% | 63.3% | 27.3% |
| | Female | - | 17 | 3 | - | 13 | 7 | 7 | 10 | 3 | - | 15 | 5 | | | |
| 199004-2 | Male | - | 6 | 6 | - | 7 | 5 | - | 8 | 4 | - | 3 | 3 | 0.0% | 50.9% | 49.1% |
| | Female | - | 6 | 14 | - | 7 | 13 | - | 16 | 4 | - | 5 | 15 | | | |
| NRSP/05/3D | Male | - | 10 | 2 | - | 9 | 3 | - | 7 | 5 | - | 6 | 6 | 1.6% | 60.2% | 39.8% |
| | Female | 2 | 12 | 8 | - | 12 | 8 | - | 8 | 12 | - | 13 | 7 | | | |
| 87/0087 | Male | - | - | 12 | - | 2 | 10 | - | 1 | 11 | - | 6 | 6 | 0.0% | 11.7% | 88.3% |
| | Female | - | 2 | 18 | - | 1 | 19 | - | 2 | 18 | - | 1 | 19 | | | |
| Ex-Igbariam | Male | 5 | 2 | 5 | 1 | 5 | 6 | - | - | 12 | - | 2 | 10 | 17.2% | 28.9% | 53.9% |
| | Female | 10 | 5 | 5 | 6 | 12 | 2 | - | - | 20 | - | 11 | 9 | | | |
| Local Varieties | Male | 2 | 3 | 7 | 10 | | 2 | - | 7 | 5 | - | 9 | 3 | 13.3% | 43.0% | 43.7% |
| | Female | 5 | 10 | 5 | 10 | 2 | 8 | - | 12 | 8 | - | 10 | 10 | | | |

Table3 Farmers participatory evaluation of culinary quality

| Genotypes | Gender | Assessment Of Cooked Appearance | | | Assessment Of Cooked Taste | | | Assessment Of Starchiness | | | Assessment Of Fibrousness | | | Assessment Of Cooked Tenderness | | | Overall Acceptability | | |
|-------------|--------|---------------------------------|--------|-------|----------------------------|--------|-------|---------------------------|--------|-------|---------------------------|--------|-------|---------------------------------|--------|-------|-----------------------|--------|-------|
| | | Red | Yellow | Green | Red | Yellow | Green | Red | Yellow | Green | Red | Yellow | Green | Red | Yellow | Green | Red | Yellow | Green |
| 440293 | Male | - | - | 12 | 2 | 6 | 4 | 3 | 1 | 8 | - | 2 | 10 | 5 | 3 | 4 | 9.4% | 14.8% | 76.8% |
| | Female | - | - | 20 | 1 | 2 | 17 | 2 | 3 | 15 | - | 1 | 19 | 2 | 4 | 14 | | | |
| NRSP/05/022 | Male | - | - | 12 | 1 | 1 | 10 | - | - | 12 | - | - | 12 | - | - | 12 | 1.25% | 1.25% | 97.5% |
| | Female | - | - | 20 | 1 | 1 | 18 | - | - | 20 | - | - | 20 | - | - | 20 | | | |

Farmers' Variety Assessment Of Advanced Sweetpotato Genotypes Evaluated On-Farm

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|---------------|--------|---|----|----|---|----|----|---|----|----|----|----|----|----|----|----|------|-------|-------|
| NR SP/05/10D | Male | - | - | 12 | - | - | 12 | - | - | 12 | - | - | 12 | -- | - | 12 | 0.0% | 0.0% | 100% |
| | Female | - | - | 20 | - | - | 20 | - | - | 20 | - | - | 20 | - | - | 20 | | | |
| 440163 | Male | - | 7 | 5 | - | 4 | 8 | - | 3 | 9 | - | 5 | 7 | - | 5 | 8 | 0.0% | 44.4% | 55.6% |
| | Female | - | 12 | 8 | - | 5 | 15 | - | 13 | 16 | - | 9 | 11 | - | 8 | 12 | | | |
| 199004-2 | Male | - | 8 | 4 | - | 4 | 8 | - | 6 | 6 | - | 1 | 11 | - | 2 | 10 | 0.0% | 40.6% | 59.4% |
| | Female | - | 11 | 9 | - | 5 | 15 | - | 10 | 10 | - | 13 | 7 | - | 5 | 15 | | | |
| NR SP/05/3D | Male | - | 7 | 5 | - | 4 | 8 | - | 3 | 9 | -- | 6 | 6 | - | 3 | 9 | 0.0% | 45% | 55% |
| | Female | - | 13 | 7 | - | 11 | 9 | - | 4 | 16 | - | 15 | 5 | - | 6 | 14 | | | |
| 87/0087 | Male | - | 6 | 6 | - | 5 | 7 | - | 2 | 10 | - | 1 | 11 | - | 3 | 9 | 0.0% | 40.6% | 58.1% |
| | Female | - | 16 | 4 | - | 9 | 11 | - | 7 | 13 | - | 6 | 14 | - | 10 | 10 | | | |
| Ex-Igbariam | Male | - | 4 | 8 | - | 5 | 7 | - | 4 | 8 | - | 1 | 11 | - | 1 | 11 | 0.0% | 38.8% | 61.3% |
| | Female | - | 12 | 8 | - | 9 | 11 | - | 9 | 11 | - | 7 | 13 | - | 10 | 10 | | | |
| Local Variety | Male | - | 4 | 8 | - | 2 | 10 | - | 6 | 6 | - | 5 | 7 | - | 5 | 7 | 0.0% | 41.9% | 58.1% |
| | Female | - | 8 | 12 | - | 7 | 13 | - | 10 | 10 | - | 8 | 12 | - | 12 | 8 | | | |

Table 4: Combined Mean percentage of participatory field and culinary evaluation

| Genotypes | Overall participatory field Acceptability % | | | Overall participatory culinary Acceptability % | | | Combined Mean percentage of participatory field and culinary evaluation | | |
|-----------------|---|--------|-------|--|-------------|--------------|---|--------|-------------|
| | Red | Yellow | Green | Red | Yellow | Green | Red | Yellow | Green |
| CIP440293 | 20.0 | 14.0 | 66.4 | 9.4 | 14.8% | 76.8 | 14.70 | 14.40 | 72.0 |
| NRSP/05/022 | 0.0 | 20.0 | 79.0 | 1.25 | 1.25 | 97.5 | 0.63 | 10.63 | 88.3 |
| NRSP/05/10D | 0.0 | 15.0 | 85.0 | 0.0 | 0.0% | 100.0 | 0.00 | 7.5 | 93.0 |
| 440163 | 9.4 | 63.3 | 27.3 | 0.0 | 44.4% | 55.6 | 4.70 | 53.85 | 41.5 |
| 199004-2 | 0.0 | 50.9 | 49.1 | 0.0 | 40.6% | 59.4 | 0.00 | 45.75 | 54.3 |
| NRSP/05/3D | 1.6 | 60.2 | 39.8 | 0.0 | 45% | 55.0 | 0.80 | 52.60 | 47.4 |
| 87/0087 | 0.0 | | 88.3 | 0.0 | 40.6% | 58.1 | 0.00 | 26.15 | 73.2 |
| Ex-Igbariam | 17.2 | 28.9 | 53.9 | 0.0 | 38.8% | 61.3 | 8.60 | 33.85 | 58.0 |
| Local Varieties | 13.3% | 43.0% | 43.7% | 0.0% | 41.9% | 58.1% | 6.70 | 42.5 | 51.0 |

Table 5: Distinguishing characteristics of the three Sweetpotato varieties selected by farmers

| CIP 440293 | NRSP/05/022 | NRSP/05/10D |
|---------------------------------|--------------------------------------|--------------------------------------|
| Very high beta-carotene content | Sweetpotato virus disease resistance | High yielding |
| Very high yielding | Very high yielding | Sweetpotato virus disease resistance |
| Good for fries and flour | Good for fries and chips | High dry matter |
| High dry matter | Broadly adapted | Good for white sweetpotato flour |
| | High dry matter | |
| | Good for orange flower | |